MANUAL FOR TRANSPLANT COORDINATORS

Editors

Dr. G Swarnalatha

Dr. Manisha Sahay

Organising Secretary ISOT 2018, Hyderabad

Dr. Sree Bhushan Raju

President ISOT 2018

Dr. K L Gupta

First Edition

Manual for Transplant Coordinators

Editors:
Dr. G. Swarnalatha, Dr. Manisha Sahay

Value of the book: Complementary – ISOTCON 2018

The content, research results, conclusions and opinions expressed are of the authors, not of editors.

The authors and the editors make no representation, express or implied, that the drug dosages in this book are correct. Readers must therefore always check the product information with the most up-to-date published product information and data sheets provided by the manufacturers. The authors and the editors do not accept responsibility or legal liability for any error in the text or for the misuse or misapplication of material of this work. Except where otherwise stated the drug dosages are for non-pregnant adult who is not breast feeding.

Concept & Design by **Envizon Design Studio**
e: envizondesigns@gmail.com | www.envizondesigns.com

"Life is not worth living until you have someone to die for. And life is not worth dying once you have someone to live for."

This book is dedicated to all the organ donors and their families.

ADVISORY COMMITTEE

Dr. T. Gangadhar, MD DM FISN (Harvard)
Professor, Nephrology
Nizam's Institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9494940008
Mail: gangadhar3@yahoo.com

Dr. Kiran Mayee Ismal, MD DM
Professor, Nephrology
Osmania General Hospital
Hyderabad, Telangana
Mobile: 9849073438
Mail: kiranmaiismal@yahoo.com

Dr. Uttara Das, MD DNB
Additional Professor, Nephrology
Nizam's institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9849551704
Mail: uttaradas806@gmail.com

Dr. Y. Manjusha, MD DM
Professor & HOD, Nephrology
Gandhi General Hospital
Hyderabad, Telangana
Mobile: 9848185044
Mail: manjuyadla@gmail.com

Dr. P. S. Vali, MD DM
Associate Professor, Nephrology
Osmania General Hospital
Hyderabad, Telangana
Mobile: 9397399953
Mail: nephron365@gmail.com

Dr. K. Raja Karthik, MD DM
Associate Professor, Nephrology
Nizam's Institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9397399953
Mail: nephron365@gmail.com

Dr. B. Vijay Kiran, MD DM
Assistant Professor, Nephrology
Nizam's Institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9247701326
Mail: bharadwaj16@gmail.com

SUPPORTING TEAM

Dr. D. Keerti Reddy MD
Senior Resident, Nephrology
Nizam's institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9494222568
Mail: keerthisiddhu@gmail.com

Dr. T. Ramchander MD
Senior Resident, Nephrology
Nizam's institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9032548075
Mail: chanduxlnt@gmail.com

Dr. Sarang Vijayan MD
Senior Resident, Nephrology
Nizam's institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9745937464
Mail:drsarangvijayan@gmail.com

Dr. J. Neeharika MD
Senior Resident, Nephrology
Nizam's institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9160942500
Mail:neeharika117@gmail.com

Dr. G. N. Ravi Patel MD
Senior Resident, Nephrology
Nizam's institute of Medical Sciences
Hyderabad, Telangana
Mail: gnrpatel@gmail.com

Dr. S. Aashish Nayak MD
Senior Resident, Nephrology
Nizam's institute of Medical Sciences
Hyderabad, Telangana
Mobile: 7895488953
Mail: sanayak89@gmail.com

CONTRIBUTORS

Dr. Aashish Nayak, MD
Senior Resident, Nephrology
Nizam's Institute of Medical Sciences
Hyderabad, Telangana
Mobile: 7983325138
Mail:sanayak89@gmail.com

Dr. Alla Gopala Krishna Gokhale, MS Mch
DNB, SMP (IIM-C)
Senior Consultant, CT Surgeon
Apollo hospital, Jubilee hills
Hyderabad, Telangana
Mobile: 9848045810
Mail: drgokhale@drgokhale.com

Dr. Ayanavelli Deepthi, MD DM
Mobile: 8125922282
Mail: deepthi0909@gmail.com

Dr. Bhanu Chandra Dharani Pal.S
Senior Transplant coordinator
Osmania General Hospital
Hyderabad, Telangana
Mobile: 9966658979
Mail: bcd.sreevari@gmail.com

Dr. B. Sukanya, MD DM
Associate Professor, Medical Gastroenterology
Nizam's Institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9959547697
Mail: sukanyab92@gmail.com

Dr. B. Vijay Kiran, MD DM
Assistant Professor, Nephrology
Nizam's Institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9247701326
Mail: bharadwaj16@gmail.com

Dr. CH. Madhusudhan, MS Mch
I/C. Professor & HOD Surgical
Gastroenterology
Osmania General Hospital
Hyderabad, Telangana
Mobile: 9959182606
Mail: madhuchinthakindhi@rediffmail.com

Dr. Chinmaye Sapre, MD
Senior Resident Nephrology
Narayana Medical College
Nellore, Andhra Pradesh

Dr. Dashetwar Abhijeet, MS Mch FIACS
Senior Consultant CTVS
Virinchi Hospital
Hyderabad, Telangana
Mobile: 9866010604
Mail: drabhijeet@icloud.ccom

Dr. G. Swarnalatha, MD DM
Additional Professor, Nephrology
Nizam's Institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9908662448
Mail:Swarnamalli@hotmail.com

Dr. G. Srikanth, MD DM
Consultant Nephrologist
Care Hospital
Hyderabad, Telangana
Mobile: 9703185959
Mail: srikanthnephro@gmail.com

Dr. Girish Vasudev Kumthekar, MD DNB
Consultant Nephrologist
Care Hospital
Hyderabad, Telangana
Mobile: 7032295272
Mail: drgirishkumthekar@gmail.com

Mr. Girish Shetty
Senior Transplant Coordinator
Apollo Hospital, Jubliee Hills
Hyderabad, Telangana
Mobile: 9652222655
Mail: shettygirish171@gmail.com

Dr. G. Surya Ramachandra Varma, MS Mch
Associate Professor, Surgical Gastroenterology
Nizam's Institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9848107891
Mail: drsurya777@gmail.com

Mr. K. Shiva Krishna, M.Sc.
Senior Research
Dept. of Clinical Pharmacology and therapeutics
Nizam's Institute of Medical Sciences
Mobile: 9010952172

Dr. Krishna Mohan Lalukota MRCP (UK, London)
Consultant Cardiologist
Virinchi hospital
Hyderabad, Telangana
Mobile: 9100058486
Krishna.lalukota@gmail.com

Dr. Kutala Vijay Kumar
Additional Professor, Pharmacology & Therapeutics
Nizam's Institute of Medical Sciences.
Mobile: 9395532288
Mail: vijaykutala@gmail.com

Dr. Koteshwar Rao, MS Mch
Associate Professor, Plastic Surgery
Nizam's institute of Medical sciences
Hyderabad, Telangana
Mobile: 9885042400
Mail: rayidi@hotmail.com

Dr. K. Bharathi, MD DM
Consultant Nephrologist
Arun Kidney Center
Vijayawada, Andhra Pradesh
Mobile: 9701804137
Mail: bharathi.ndl@gmail.com

Dr. Kamal Kiran, MD DNB
Senior Consultant Nephrologist
Century Hospital
Hyderabad, Telangana
Mobile: 9492755309
Mail: kamal2s@yahoo.com

Dr. Kolla Praveen Kumar, MD DM
Professor & HOD Nephrology
Narayana Medical College
Nellore, Andhra Pradesh
Mobile: 9948171072

Dr. K. S. Nayak, MD DNB FISN
Chief Nephrologist & HOD, Renal Sciences
Deccan hospital
Hyderabad, Telangana
Mobile: 9848014555
Mail:drksnayak@gmail.com

Dr. Manish Patni, MD
Senior Resident, Neurology
Care Hospital
Hyderabad, Telangana
Mobile: 9764508335
Mail:patnimanish0811@gmail.com

Dr. Manisha Sahay, MD DM
Professor & HOD, Nephrology
Osmania General Hospital
Hyderabad, Telangana
Mobile: 98490097507
Mail: drmanishasahay@gmail.com

Dr. Nobel Gracious, MD DM
Associate Professor, Nephrology
Government Medical College
Trivandrum, Kerala
Mobile:9446390313
Mail:Nobelgracious@hotmail.com

Mr. Nelvin Nelson
Transplant Coordinator
Yenepoya medical college & Hospitals
Mangalore, Karnataka
Mobile: 812018855
Mail: nelvin@yenepoya.edu.in

Dr. N. Pavan Kumar Rao, MD DM
Consultant Nephrologist
Deccan Hospital
Hyderabad, Telangana
Mobile: 9849206433
Mail:pavannavva@gmail.com

Dr. Padmaja Durga, MD
Professor Dept. of Anaesthesia
Nizam's Institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9440387299
Mail: padmajanims@yahoo.co.in

Dr. P. Sandhya, MD
Consultant anaesthesiologist
Apollo Cradle Hospital
Hyderabad, Telangana
Mobile: 9440715000
Mail:sandhyaw3@gmail.com

Dr. P. Vikranth Reddy, MD DNB MNAMS
Senior Consultant (Nephrology)
Care Hospital, Banjarahills
Hyderabad, Telangana

Dr. Praveen Kumar Etta, MD DM
Consultant Nephrologist,
Asian Institute of Nephrology & Urology
Hyderabad, Telangana
Mobile: 9454035398
Mail: drpraveen85@gmail.com

Dr. Pingali Sri Lakshmi, MD Psychiatry
Associate Professor, Psychiatry
Gandhi General Hospital
Hyderabad, Telangana
Mobile:93090048686
Mail:drpingali@gmail.com

Dr. P.S. Vali, MD DM
Associate Professor, Nephrology
Osmania General Hospital
Hyderabad, Telangana
Mobile: 9397399953
Mail: nephron365@gmail.com

Dr. Siva Parvathi, MD DM
Mobile: 8125922282
Mail: mrs.raviprakash@gmail.com

Dr. Sadineni Raghavendra, MD DM
Consultant Nephrologist
Nellore Medical College
Nellore, Andhra Pradesh
Mobile: 7382678768
Mail: raghavendrasadineni@gmail.com

Dr. Santhosh Pai B.H, MD DNB
Associate professor and HOD, Nephrology
Yenepoya medical college & Hospitals
Mangalore, Karnataka
Mobile: 9449471243
Mail: drbhspai22@yahoo.co.in

Mr. Sai Gopal
News Editor
Telangana Today
Hyderabad, Telangana
Mobile: 9849743102
Mail: saigopal.m@gmail.com

Mr. Sagayam Francis
Transplant coordinator
MIOT Hospital, Tamilnadu
Mobile: 9791793333
Mail:Sagayam.iatc@gmail.com

Dr. Subramanyam, MD MISN
Senior Consultant
Deccan Hospital
Hyderabad, Telangna
Mobile: 9885356897
Mail:sreepada11@gmail.com

Dr. Shailesh R Singi, MD
Consultant Hematologist
Century Hospital
Hyderabad, Telangana
Mobile: 9849010021
Mail: drsrs74@yahoo.com

Dr. Srinivas Prasad
Eye Bank Chairman
HOD & Professor, Dept. of Cornea
Sarojini Devi Eye Hospital
Hyderabad, Telangana
Mobile: 9848019856
Mail:drkillani@gmail.com

Dr. Superna Mahendra, MS Ophthalmology
Civil Assistant Surgeon
Sarojini Devi Eye Hospital
Hyderabad, Telangana
Mobile: 9849298339
Mail: drsuperna95@gmail.com

Dr. T. Venu Madhav, MS Mch
Associate Professor, Surgical Gastroenterology
Nizam's Institute of Medical Sciences
Hyderabad, Telangana
Mobile: 9849253304
Mail: thummavenumadhav@gmail.com

Ms. Trilly Rachel Mathews
Senior Transplant coordinator
Fortis memorial research Institute
Gurgaon, Haryana
Mobile: 8800466476
Mail: trillymathew@gmail.com

Dr. Urmila Anandh, MD, DM, DNB (Med, Nephro), FRCP FISN FASN
Senior Consultant & HOD, Nephrology
Yashoda hospital
Secunderabad, Telangana
Mobile: 7093505100
Mail: uanandh@gmail.com

Dr. Y. Manjusha, MD DM
Professor & HOD, Nephrology
Gandhi General Hospital
Hyderabad, Telangana
Mobile: 9848185044
Mail: manjuyadla@gmail.com

Dr. Y. Muralidhar Reddy, DNB DM
Consultant Neurologist
Care Hospital
Hyderabad, Telangana
Mobile: 9912329342
Mail:Muralidharnims@gmail.com

PREFACE

The role of a transplant coordinator in organ transplant programme is well-recognized in developed countries and is being increasingly recognized in India. This manual is intended to be a comprehensive guide for transplant coordinators in the process of organ transplantation. This endeavour is First-of-its kind in India. The authors have tried to cover all aspects of the process of organ transplantation, ranging from the anatomy and physiology of the organs, legal aspects, and the process of declaration of brain death to organ perfusion techniques, and future trends in the field of organ transplantation. This manual also includes a section on the experience of the coordinators themselves.

Government of Telangana has initiated deceased donor programme in 2010 by GO 184 under which administrative wing is with Nizam's Institute of Medical Sciences, awareness programme is with Gandhi Hospital and training of transplant coordinators is with Osmania General Hospital. Before the initiation of this programme there was no formal training of transplant coordinators. Since inception, about 100 coordinators are being trained every year. The course consists of 60 lectures which are held monthly in different hospitals and it is mandatory for the coordinators to attend all these lectures by concerned specialists. Syllabus covers all aspects of organ transplantation including legal, psychosocial, medical and surgical aspects with which a coordinator should be familiar. The training involves workshops on basic and advanced life support, brain death declaration forms, case scenario discussion, role play, grief counseling, organ packing and transplant etc. Trainees are required to maintain a log book of their practical experiences and procedures done which is checked and reviewed monthly. At the end of the course, certificates are awarded by Jeevandan and Osmania. The programme is the first of its kind in the country and is running successfully since 3 years.

In addition to the transplant coordinators, this manual would also help the transplant nurse, post graduates and the young faculty in understating the practical and legal aspects of organ donation. The human organ transplantation act, rules and amendment have been included at the end of the manual for quick reference. The directory of transplant coordinators has also been included in the end for easy networking.

Every effort was spent to make it an exhaustive resource. Despite the best efforts of the authors to keep this manual error-free, errors, if any, may have crept in inadvertently.

Dr. G. Swarnalatha
In charge
Jeevandan Programme

Dr. Manisha Sahay
Convener
Transplant Coordinator
Training Programme

Dr. B. Nagendra
Chairman
Transplant Coordinator
Training Programme

FOREWORD

For a transplant programme, especially the deceased donor transplant programme, to be successful the transplant coordinator is the pivotal person to coordinate with the transplant team, the recipient and his family, the team which is responsible for the brain death declaration, the treating medical team of the potential donor, and above all ,the kith and kin of the potential organ donor.

The editors have done a commendable job, in bringing out the manual for the training and reference of the transplant coordinators, in identifying the key areas for the training, and in bringing together authors who are lucid in their knowledge and expression. The individual authors have spared no effort in putting their thoughts in a clear perspective.

The book started with an exposition of the current scenario of organ transplantation.

The chapter on scope of transplant coordinator in transplantation programme shows the various facets of the work of a transplant coordinator.

The chapter on legal policies of organ transplantation- basics and beyond, explains the legal aspects involved and the acts enunciated to bring a semblance of the order in the transplantation programme.

The chapters on the anatomy and physiology of organs are simple and clear enough, for the nonmedical persons also to understand the human body.

The chapter on grief counseling deals with the role transplant coordinator and the medical team play in assisting the family of the deceased individual to come to terms with the loss of a loved one and take wise decisions.

The chapter on journey from potential donor to actual donor outlines the procedure in coordinating the actual nuts and bolts in getting a transplantation done.

The chapter on brain death declaration clearly elucidates the basis and the steps in brain death declaration along with the case scenarios.

The chapter on evaluation and management of potential donor, deals with the optimal medical management of the potential donor in achieving improved quality as well as number of successful organ transplantations.

The chapter on documentation in organ transplantation, explains the importance of documentation of every detail in organ donation and transplantation to make it safe and transparent, and to avoid any legal hassles that arise in the process.

The chapter on perfusion fluids deals with the components of various types of perfusion fluids, their function and the techniques of efficient perfusion of the donor organs to maximize the survival of transplanted organ.

The chapter on organ packaging, labeling and transportation, puts across the standard operating procedures involved.

The chapter on organ sharing and networking deals with the rules and regulations of organ allocation, sharing and networking within various groups so as to enable efficient and just allocation of organs , and preventing wastage of organs available for transplantation.

The chapter on tissue matching explains, in a clear and simple way, the basics of tissue matching in organ donation.

The chapter on evaluation and preparation for kidney and liver transplantation, elucidates the principal points involved in the evaluation, accepting and preparation of a recipient for renal or liver transplantation.

In the chapter on Post-transplant management - Immediate post-operative care and long term follow up, the authors teach, what are the precautions to be taken during the immediate post transplantation period , and the long term monitoring and care of the transplant recipient in case of different organs.

The chapter on role of transplant coordinator in heart and lung transplantation emphasizes the special aspects in the heart and lung transplantation.

The ophthalmology team explained the process and the guidelines in corneal transplantation in a lucid way.

The chapter on bone marrow transplantation explains in a simple way what a bone marrow transplant means for a transplant coordinator.

The chapter on tissue banking explains with respect to skin grafting, the various aspects such as procurement, processing, storage and distribution.

The chapter on transplantation in unusual situations tried to create an understanding of the transplantation as well as donation in the scenarios involving individuals with HBV, HCV and HIV infections.

The chapter on standard and extended criteria donors explains the differences between the two and the need for both to be used in expanding the donor pool.

The chapter on paired or swap kidney donation, deals with the ways and means of organizing a swap kidney donation in a living donor transplantation situation.

The chapter on ABO incompatible transplantation has explored the hitherto inaccessible aspect of the transplantation in a way to stimulate interest.

The chapter on donation after cardiac death details the protocols, methods, precautions and regulations involved in non-heart beating organ donation scenario and how to use it in expanding the available donor pool.

The chapter on role of public and media in organ donation deals with effectiveness of the media in promoting organ donation, and also the pitfalls associated, as well as the precautions needed to be taken in using print, digital and social media.

The chapter on road block to deceased organ donation in India, outlines the challenges encountered in implementing a transplant programme in our country.

The chapter on psychosocial issues in organ donation and transplantation, explains the issues for the transplant recipient, the care givers as well as the organ donors.

The chapter on coordinators perspective of future research in organ transplantation explains the direction of the research in the field of transplantation, especially renal transplantation, and the need for the coordinators to understand these aspects in carrying out their work.

The chapter on future of transplant coordinator in India discusses the current position, activities and outlines the areas where the transplant coordinators can chip in with their expertise in promoting organ donation as well as organ transplantation.

The chapter on coordinators view explains the challenges involved in the job and the satisfaction derived out of the work, which itself is the reward well earned. The authors discussing the case scenarios of difficult situations have diligently detailed how to go about in each problem.

The effort of Prof. Dr. Guditi Swarnalata needs to be specially mentioned about the way she mentored the Jeevandan programme, as In-Charge of the programme, surmounting many difficulties and chartered a road map for the promotion of deceased donor transplant programme in the erstwhile unified state of Andhra Pradesh and later in the newly formed state of Telangana. She used her immense experience in bringing out this very useful manual for transplant coordinators which can also be a hand book on organ donation for transplant physicians. And Prof. Dr. Manisha Sahay has done an unenviable job of under taking the training programme of the Transplant coordinators in the Jeevandan Programme as the Convenor of the Transplant Coordinators programme as evident from the increased awareness and success of the organ donation as well as organ transplantation in the states of Andhra Pradesh and Telangana.

Prof. Dr. Kaligotla Venkata Dakshinamurty, MBBS MD DM DNB (neph) FISN

Senior Consulatant Nephrologist

Mahatma Sri Ramchandra Centenary Memorial Hospital
Vijayanagar colony, Apollo Hospitals, Hyderguda, Hyderabad.

INTRODUCTION

The Jeevandan programme was started in 2013 by the government of erstwhile unified Andhra Pradesh and now Telangana. The nodal center of Jeevandan is located in the Nizam's Institute of Medical Sciences, Hyderabad. This is a flagship programme of the state government for management of deceased-donor organ transplantations. The programme has grown by leaps and bounds ever since its inception and today, has one of the highest rates of organ donation and transplantation in the country. The programme has come a long way from 41 organ donations in its first year to 129 (and counting) in 2018, amounting to a total of 566 donations, which has benefited 2215 organ and tissue transplant recipients. Compared to the meagre national organ donation rate of 0.8 donations per million, Telangana has achieved 5.09 donations per million population. Jeevandan also conducts training programme for transplant coordinators, continuous medical education programme for medical professionals and awareness programme for the general public. Jeevandan, as its name suggests has literally become a "life-giver" for thousands of patients suffering from irreversible, end-stage organ damage and their families. Today, the number of patients registered under Jeevandan has crossed 5000. The selfless act of organ donation is the biggest source of inspiration and energy for all those involved with this programme. The waitlist of prospective recipients is increasing with each passing day and reminds us of the challenges that lie ahead.

"Excellence is a continuous process and not an accident"

— *APJ Abdul Kalam*

Dr. K. Manohar
Direct NIMS
Co Chairman AACT
Jeevandan Programme

Dr. K. Ramesh Reddy
DME, Telangana State
Chairman AACT
Jeevandan Programme

CONTENTS

CHAPTER 1

Current Scenario of Organ Donation in India

Dr. A Deepti | Dr. S Aashish Nayak | Dr. G Swarnalatha

Introduction

Organ transplantation is the only definite cure for end-stage organ damages of the liver, kidney, heart and lungs. In India, about 2.5 lakh people die each year on an average, due to non-availability of organs. About one lakh people in India are awaiting a liver transplant, about two lakh people are awaiting a kidney transplant and about 50,000 people need a heart transplant. [1] However, there is a wide gap between the number of transplants awaited, and the organs available. The depressing statistics convey the urgent need for more people to step and donate their organs; save the lives of people languishing due to organ failure.

The challenges

India's organ donation rate in 2016 stood at an abysmal 0.8 persons per million population compared to Spain's 36 per million, Croatia's 32 per million or US's 26 per million. Only a few states in India have an active donation and transplant programme. Many states with big populations such as Uttar Pradesh, Chhattisgarh etc. are yet to make any headway in this direction.

Various challenges faced in the Indian scenario are related to many cultural and religious beliefs that influence the decision making regarding deceased organ donation. Lack of awareness (80.1%) is the major factor for organ donation followed by religious beliefs and superstitions (63.4%), and lack of faith in the healthcare system (40.3%).[2] India has an Opt-in system (consent for donation is required) as opposed to Opt-out system (implied consent), which is present in Spain, France and several other European nations. The question of refusal of donation by the next of kin after brain death diagnosis is often the biggest hindrance in pushing this programme further. Severe lack of organs and poverty are the main reasons why illegal organ trading is thriving. Organ donation should not be an example of unethical business; its value must be restored.

Socio-cultural aspects

In Asian subcontinent, the concept of life after death is cross linked with the concepts of ethics, religion and spirituality. This is seen in major countries like India, China and Japan. The transplant coordinators find it very difficult to even start a conversation regarding organ donation in these regions of the world, especially in the case of a brain-dead donor. Religious concerns may also have an impact.

Superstitions and beliefs

Many superstitions prevalent in our society create a negative attitude towards organ donation. Superstitions such as being born with a missing organ (that has been donated); and, that tampering with the body will not free their dead relatives from the cycle of life-death-rebirth, are some of the prevalent superstitions.[3] The concept of 'brain death' and its legal implications are not familiar to the majority of the population in India. Lack of public awareness regarding organ donation is another detrimental factor for the concept of organ donation. There is a lack of awareness about these issues even among the medical professionals.

Lack of effective communication

An educated donor who is willing to donate his organs usually has a good knowledge about the concept of 'brain death' and the procedures related to organ donation. He is more likely to effectively communicate with the family members regarding his willingness to donate his organs. Many a times, people sign the donor card due to peer pressure and other factors without having a complete knowledge about the issues involved. These people are less likely to stick to their decision in the future and usually back out from their commitment prior to their death.

Lack of organizational support

Despite conduction of various awareness programmes in institutions and organizations, there is a lack of adequate number of transplant centers with staff, as well as transplant coordinators. Non availability of adequately educated transplant coordinators who are well-versed with the procedure required to conduct an organ donation programme is a major hurdle to the deceased organ donation programme. The other challenges are lack of good dialysis programmes, research, and effective national health insurance plans. Even major hospitals do not have a clear protocol for declaring brain death. Some of them also do not have effective transplant coordinators who could sympathetically approach the family members of the brain-dead, potential donor patients, and take consent from them regarding organ donation. The lack of enough enthusiasm in medical community is another factor to a great extent.

Efforts to improvise the prevailing conditions

In the recent years, organ procuring rates in India have immensely improved with the involvement of the state and the central government taking the active role. This is true mainly in the case of southern states of India (Tamil Nadu, Telangana, Kerala, Andhra Pradesh, Maharashtra and Pondicherry), where deceased organ donation and transplantation is much better established than in other

parts of the country. Several non- governmental organizations, are also promoting deceased organ donation by educating the public. In 2008, the Government of Tamil Nadu through a pioneering effort put together government orders laying down systems and procedures for deceased organ donation and transplantation in the state. In this way, the Cadaver Transplant Programme (CTP) came into being. The government orders also came at a time when the public was becoming more aware about organ donation. Jeevandan in both the telugu states, is a government funded organization which addresses the various issues relating to declaration of brain death, infrastructure, coordination and public awareness. It was first proposed in 2010.

Green corridor has created a lot of public and media attention in promoting the organ donation apart from the timely transporting the organ Green corridor refers to a special road route that facilitates the transportation of harvested organs meant for transplantation to the desired hospitals. The street signals are manually operated to avoid stoppage at red lights and to divert the traffic to ensure a rapid transportation of the desired organ. There are many recent instances in India where organs were transported in time using this facility.

Transplant coordinators have been made mandatory for a hospital to register a transplant center. Transplant coordinators are the employees of registered hospital and have knowledge related to medicine, social work or public health.[4] They help in counseling of families for taking consent for organ donation and coordinate the process of donation and transplantation.

NOTTO – National Organ and Tissue Transplant Organization

This is a national level organization set up under the Directorate General of Health Services, Ministry of Health and Family Welfare. The National Human Organ and Tissue Removal and Storage Network is a subdivision of this organization, which was formed as mandated by the Transplantation of Human Organ Act (THOA) amendment in 2011. This is established in Delhi and will gradually expand to involve other states and regions of the country. It functions as an apex center for conducting all India activities related to coordination and networking, for the procurement and distribution of organs and tissues, for maintaining the registry of organs, and for facilitating tissue donation and the transplantation of the harvested organs across the country.

Tissue banks

Tissue banking is the process in which biomedical tissue is stored under cryogenic conditions to be used later when the need arises. A number of tissue banks have been established in India in the recent times, which help in storing tissues such as the cornea, skin, heart valves, bones and tendons for later use. These centers help in preventing tissue wastage to a great extent.

Legislation

Transplantation of Human Organ Bill was introduced in the Lok Sabha on 20th August 1992. Transplantation of Human Organ Act (THOA) was passed in 1994. This is the primary legislation related to organ donation and transplantation in India. Before the introduction of this Act, the regulations for organ donation and transplantation in India were nonexistent and malpractices were rampant. The amendment to the Act was passed by the parliament in 2011, and the rules were notified in 2014 as the Transplantation of Human Organs and Tissue Rules – 2014.[4]

Jeevandan

Considering the large number of patients suffering on account of irreversible organ ailments involving heart, liver, pancreas and kidney who could have led healthy lives if they had the opportunity to have transplant surgery and the ethical issues surrounding live and deceased donor organ donation, a comprehensive scheme called "Jeevandan", was introduced , G.O.Ms.No 184 dated 16.8.2010,5 which addressed the various issues relating to declaration of brain death, infrastructure, coordination and public awareness. Jeevandan web portal" jeevandan.gov.in was designed by National Informatic Center (NIC) for effective functioning of Jeevandan scheme including online registration of recipient and online, dynamic and transparent allocation of organs as per the committee recommendation. Since 2013, there have been 539 donations from brain death individuals till July 2018 with steady increase in rate of donation every year. The present donation rate of state of Telangana is 4.96 pmp (Table-1). The age group, sex and the blood group distribution of the donor are shown in Table-2. There are 5645 recipients registered for various organs under Jeevandan scheme (Table 3). The government hospitals in Telangana; NIMS Hospital, Osmania General Hospital and Gandhi hospital are actively performing the decreased donor kidney, liver and heart transplantations, which is being supported by the Aarogya sree Health Insurance by the state government.

Year	2013	2014	2015	2016	2017	2018	Total
Brain dead donations	41	51	89	106	150	102	539
Kidney	76	90	150	182	221	155	874
Liver	35	51	92	100	137	95	510
Heart	2	1	11	15	33	13	75
Lungs	3		1	2	2	4	12
Pancreas	2	1		4	1	1	9
Total organs donated	118	143	254	303	394	268	1480

Table-1: Total brain deaths and organ donations under Jeevandan scheme till July2018

Year	2013	2014	2015	2016	2017	2018	Total
Donations	41	51	89	106	150	102	539
Mean Age (years)	38	43	43	40	42	43	41.5
Male : Female (%)	82.92 : 17.03	62.74: 37.25	76.40: 26.59	78.30: 21.69	78.66: 21.33	77.450: 22.54	76.80: 23.19
Blood group A	8	12	13	18	29	14	94
Blood group AB	3	3	4	2	7	7	26
Blood group B	16	14	29	25	42	28	153
Blood group O	14	22	43	61	72	53	266
Donation rate (pmp)	0.58	0.72	2.52	3.01	4.26	4.96	

Table-2: Age, sex and blood group distribution of the brain dead donors

Year	2013	2014	2015	2016	2017	2018	Total
Recipients	233	591	801	1215	1584	1221	
Mean Age	48 (+12.42)	49 (+12.99)	47 (+13.71)	46 (+13.430)	45 (+13.53)	43 (+13.49)	
Male : Female (%)	72.131 : 27.869	75.36 : 24.63	75.41 : 24.58	74.85 : 25.14	77.43 : 22.56	77.60 : 22.39	76.21 : 23.78
Kidney	147	296	372	614	844	732	3005
Liver	73	282	411	553	642	439	2401
Heart	6	10	16	34	83	35	184
Lungs	5	1	2	8	10	8	34
Pancreas	2	2		6	5	7	22

Table-3: Total registrations for various organs under Jeevandan Scheme

The future

The following steps can be taken to increase the number of organ donations in India:

1. Large-scale awareness creation
2. Setting up a national registry and a donor-recipient network
3. Making brain death declaration mandatory
4. Recognizing the role of transplant co-ordinator
5. Improve infrastructure in government hospitals to facilitate transplantation
6. Involvement of non-transplant hospitals in organ retrieval
7. Provision of more opportunities for donor pledges; e.g.: linking with Aadhar

Conclusion

There is inequity existing in the organ donation scenario of the country. NGOs working on this issue in India have also not yet caught up with this issue in a satisfactory manner except for few organizations. The government should address this issue with utmost importance to bring equity.

The stigmas and misconceptions surrounding this issue can be removed only through awareness programmes. Since the issue has a clear religious overtones, there should be a concerted effort to rope in organizations that have a say in such matters to address the issue. A simple fact is that almost all organs in a cadaver can be transplanted in a living body within prescribed conditions of time limit. Hence, there is also a need to further rationalize the process through innovative methods and techniques. Research in this regard is another frontier into which the country has not ventured into so far, vigorously. Hence, government should allocate funds for new medical researches in organ transplantation.

The concept of organ donation should reach the public, and the role of various stakeholders is pivotal in this process. The government, NGOs, medical fraternity, media, and youth organizations should join hands for this endeavor. The loopholes in the law should be rectified and administrative bottlenecks should be reduced from the government side.

The infrastructure in government and private hospitals to conduct transplantation should be strengthened. Various awareness programmes such as continuing medical education programmes among medical and paramedical personnel, transplant counselors, and coordinators should be done. The “standard operating procedures” established to identify and certify brain death, maintain and transport organs, and tackling medicolegal cases should be uniform and standardized in both government and private hospitals. Since lack of uniformity may pave way for malpractices.

To propagate organ transplantation in a big way, we have to enlist support from various stakeholders on priority basis. Doctors have their role in facilitating this. However, the medical students have the added responsibility to carry out the meaningful propagation of this noble mission. There should be a systematic evaluation of the doctors' knowledge and commitment to this concept. We should inculcate these ideas of life-giving and life-extending measures in the medical curriculum as well as in school curriculum to promote organ donation.

References

1. Singh Hashraj, Patient's kin hesitant of organ donation. Hindustan Times (print edition). August 03, 2013
2. Panwar R, Pal S, Dash NR, Sahni P, Vij A, Misra MC. Why are we poor organ donors: A survey focusing on attitudes of the lay public from northern India. J Clin Exp Hepatol 2016;6:81-6.
3. Singh P, Kumar A, Sharma RK. Factors influencing refusal by relatives of brain-dead patients to give consent for organ donation: Experience at a transplant centre. J Indian Med Assoc 2004;102:630, 632-43
4. Transplantation of Human Organs and Tissues Rules, 2014. The Gazette of India: Extraordinary Part II Section 3 Subsection (i) March 27, 2014.
5. G.O.Ms.No 184 HM&FW (M1) Department dated 16.8.2010

CHAPTER 2

Scope of a Transplant Coordinator in the Transplantation Programme

Dr. P S Vali

Introduction

The role of Transplant coordinators has been appreciated in the western world during the 1970s and was made an integral part of transplant team since then[1]. In India, the importance of transplant coordinators is being recognized for the past two decades but has gained momentum for the past few years. Transplantation of the Human Organs Act, 2011 and Transplantation of Human Organs and Tissues Rules, 2014 mandates that it is a prerequisite for the transplant center to have transplant coordinator. As per these acts, transplant coordinator is defined as a person who is appointed by the hospital and coordinates and over sees all the entities related to removal and transplantation of the organs/tissues or both and assists the authority in the same. In view of the ever-increasing recognition of the importance of transplant coordinator, it is worth reviewing the scope of work of the transplant coordinators.

The two essential responsibilities of transplant coordinator are to plan and coordinate all the elements of clinical care of the potential transplant recipients and organ retrieval process[2]. A transplant coordinator should serve as an expert link between the patients and the soctors[3]. The execution of responsibilities of transplant coordinator involves complex coordination between medical, paramedical and law enforcement authorities. The ultimate objective of this is to deliver quality and honest services to the recipients, donors and their families.

Such a process begins when a patient is referred to an organ transplantation center and covers the whole process of transplantation and even extends into post-transplant follow up care.

The four essential qualities which a transplant coordinator should acquire, uphold and refine are[4]:

1. The capability of coordination and networking
2. Dissemination of the communication
3. Empathetic approach
4. An inclination to be a continuous learner

The below mentioned are the broad responsibilities of a transplant coordinator.

1. Coordination and communication

The primary role of the recipient transplant co-ordinator is to facilitate guidance and the empathetic support to the potential transplant recipient and to orchestrate the organ retrieval process in accordance with the instructions of hospital administration and transplant physician and surgeon[4]. This requires close networking with medical, paramedical, and non-medical teams. Medical teams include transplant physicians, surgeons, anaesthetists. paramedical members include laboratory and imaging technicians, nursing professionals and hospital administrators. Further, transplant coordinators should actively coordinate with police and related law enforcement authorities. all this would result in not only quick but well-synchronized decisions. A transplant coordinator should collaborate with police and law enforcing authorities to complete the legal formalities and post mortem examination of the deceased. Such synchronized efforts will result in the abbreviation of the administrative and regulatory hurdles, and the mortal remains of the deceased will be handed to the bereaved family at the earliest.

2. Workup of the potential recipient

A clinical coordinator should take an active role in facilitating pre-transplant workup of recipients in both live related donation and during the process of work up of recipients for deceased donor transplantation[5] . This includes close liaison with various medical specialties, booking the appointments for various tests, coordinating with the Nephrologist and other care givers[6]. This applies to donor evaluation too. The transplant coordinator should present him / herself as a single point of contact pertaining to the issues related to all the stages of recipient evaluation[7]. Transplant coordinator should promptly update the concerned Nephrologist regarding all matters which can adversely impact the momentum of recipient and donor evaluation. Concerning deceased donor programme, a transplant coordinator should oversee the process of listing of patients on the recipient waiting list. Another critical entity is to monitor the patients who have been waitlisted and alert the Transplant team whenever a patient develops an intercurrent complication such as infection, cardiovascular event or a sudden drop in haemoglobin. Such monitoring and timely alerts can be rewarding as it changes the course of treatment and can lead to suspension of the patient from the waitlist till he recoups from the acute illness. This results in the proper utilization of organs and facilitates uninterrupted organ allocation to the recipients who are fit.

3. Role in organ orocurement

Once the brain death is imminent, and the family has consented for organ donation, transplant coordinator has to coordinate all the necessary events which enable the transplantation process to undergo at the earliest. This includes the onsite review of the available medical records of the potential brain dead individual, tracking of the brain death declaration process, to participate in the process of reviewing of the current medical fitness of the recipients in the next waiting list and to assist the medical team in preparing them for transplantation surgery[4]. Besides, a transplant coordinator should take a lead role in completing the mandatory legal formalities before the transplantation process, the filing of all the legal documents and formalities and ensure communication with the government regulatory authorities[8].

A transplant coordinator should solicit organ donation with their empathetic approach. In this process, they should develop the skill of listening with immense patience and to clarify all their apprehensions and doubts with a gentle admixture of empathy and professional knowledge[9].

4. Grief counselling

One of the key responsibilities of a transplant coordinator is to approach the family members of the brain dead individual once the brain death has been declared by the team of doctors and should discuss their willingness to donate organs. This could be a challenging task, and in this process, a transplant coordinator is expected to offer grief counselling to the bereaved family members who would be in a state of melancholy. A transplant coordinator is supposed to display impeccable professionalism and unshakable empathy during this vital process. Grief, in general, has got five stages, and these include Stage of denial, Stage of Anger, Stage of Bargaining, Stage of Depression and Stage of Acceptance. A transplant coordinator should clearly understand the fact that fact this is the phase wherein the family is enduring the worst possible grief in their lives and should be able to buffer their rapidly transforming emotions. Further, a transplant coordinator should be aware of the various religious beliefs of the bereaved family and tackle this sensitive issue tactfully[10]. This process demands integrity, patience, and empathy. This is one particular area where in the skills and the characteristics of a transplant coordinator would be, and this can only be accomplished with tolerance and humanity.

5. Participation in educational & public awareness programmes

It would be an integral part for any transplant coordinator to engage themselves in programmes to educate and support patients, families and general public[11]. The field of transplantation is ever expanding and innovating. Educating the public about the organ donation is worth regarding meeting the hitherto unmet need for organs. A transplant coordinator should identify oneself as an integral part of the transplant team and should always be at the forefront in spreading the awareness about the organ donation process and should get trained to enthusiastically clear the queries and apprehension about the organ donation pro-

cess. They should develop necessary educational materials and should deliver programmes tailored as per the target audience. This ultimately leads to increased esteem and credibility of each transplant coordinator.

6. Maintenance of data and documents

It is imperative on the part of the transplant coordinator to maintain various records and to digitalize them as needed. Such records include medical data, social records, cross consultations, lab data and various legal documents including consent forms and forms[12]. Proper record maintenance is the key to the periodic analysis of the transplant programme and aids in tracking of the outcomes of the programme at a center. Besides, the transplant coordinator should be able to present at the time of consent consultation. Further, basing on the analysis of the medical records and cross consultation summaries, as and when needed transplant coordinator should arrange for periodic reviews of the potential recipients with the transplant physician.

7. Post-transplant care

It is to be understood that the duty of a transplant coordinator does not end with the accomplishment of renal transplantation but extends even after renal transplantation. A transplant coordinator should continue to engage with the individuals who underwent renal transplantation. This should start with appropriate education of the transplant recipient before discharge and should continue subsequently in the form of telephonic advise after transplant. One should utilize this opportunity to educate the recipients regarding the need for drug adherence, need for regular follow up, measures to avoid opportunistic infections and to cope up with the side effects of immunosuppressive medications. Also, in the event of permanent graft failure, a transplant coordinator should specifically discuss with the transplant physician about the feasibility of second transplantation and should positively encourage ideal patients about the same and should aid in the appropriate workup of the recipients for repeat transplantation.

8. Willingness to be a continuous learner

One of the essential facets of the medical profession is the need to update one's knowledge. This is mandatory as the medical profession is an ever-innovating and transforming science. As a result, only the person who has a passion for learning forever commands respect from his peers and the society. This rule is equally applicable to all the strata of caregivers including transplant coordinators.

A transplant coordinator should continuously update their knowledge regarding the below mentioned broad categories:

A. Legal & Ethical Issues: This is of primordial importance given the complex legal and delicate ethical intricacies involved in the process of organ donation, organ retrieval and transplantation[13]. What is interpreted as a correct decision can be argued as a controversial entity from another perspective[14]. To circumvent such controversies, a transplant coordinator should have sound knowledge about the transplantation laws of a particular country and state.

B. Changing Clinical Practises: Understandably, it would be worth noting to update oneself with the recent practices and evolving trends. Further, a transplant coordinator should have a balanced inclination to accept new trends and should practice discretion in counselling the patients and families about a newly introduced but yet unvalidated tool. This is possible by participating in the continuous medical education programmes usually organized by the consortium of transplant centers and non-government organizations.

Conclusion

The essential responsibilities of a transplant coordinator is to plan, execute and coordinate all the facets of recipient workup and the organ procurement process. It is worth mentioning that the scope of the transplant coordinator need not be restricted to the above mentioned broad categories. Like any other offshoots of the healthcare profession, transplant coordinator should be prepared to deliver their duties at any time point as per the patient need and clinical circumstance. A transplant coordinator should model himself as a self-propelled individual and galvanize themselves to set a new benchmark in every task they undertake.

References

1. Falvey S. The Role of the Transplant Coordinator. J R Soc Med. 1996;89(29):18.
2. Cogliano J. Transplant coordinator--racing the clock. Nurs Spectr (Wash D C). 1998;8(15):8-9.
3. Puschel VA. Brazilian nurses play pivotal role in organ transplant. Int Nurs Rev. 1998;45(6):168.
4. Matesanz R, Miranda B, Felipe C. Organ procurement in Spain: impact of transplant coordination. Clin Transplant. 1994;8(3 Pt 1):281—286.
5. Miranda B, Vilardell J, Grinyó JM. Optimizing cadaveric organ procurement: the catalan and Spanish experience. Am J Transplant. 2003;3(10):1189—1196.
6. Aguilar Mendez C, Suarez Vazquez MG, Pinson Guerra AG. [Nursing participation in the coordination of organ transplants]. Arch Cardiol Mex. 2002;72 Suppl 1:S241-6.
7. Fournier C, Lerrat L. [Transplant nurse coordinator, a key mission]. Rev Infirm. 2016;65(226):28-30.

8. Woderska A, Milecka A, Czerwinski J. [The post of transplant coordinator in Polish law regulations]. Wiad Lek. 2009;62(4):275-280.

9. Fontaine M. [Kidney transplant coordinator, a collaborative nursing practice]. Rev Infirm. 2014;(201):29-30.

10. Hvidt NC, Mayr B, Paal P, Frick E, Forsberg A, Bussing A. For and against Organ Donation and Transplantation: Intricate Facilitators and Barriers in Organ Donation Perceived by German Nurses and Doctors. J Transplant. 2016;2016:3454601.

11. Martin RK. The role of the transplant advanced practice nurse: a professional and personal evolution. Crit Care Nurs Q. 1999;21(4):69-76;

12. Nanni Costa A, Pugliese MR, Venturoli N, et al. [The transplant coordinator]. Ann Ist Super Sanita. 2000;36(2):247-251.

13. Levi BH, Green MJ. Ethical concerns for organ transplant coordinators. Prog Transplant. 2003;13(4):242-248.

14. Freeman RB, Bernat JL. Ethical issues in organ transplantation. Prog Cardiovasc Dis. 2012;55(3):282-289.

CHAPTER 3

Legal Policies of Organ Transplantation: Basics and Beyond

Dr. Manjusha Yadla

Introduction

Over the past three decades, Government of India has brought in various guidelines to be followed across the country for the uniformity of organ transplantation in order to maintain the ethical and legal values of the system.

Available guidelines are in the form of

1. Act
2. Amendments and
3. Rules

Definitions

1. Act: Act is a law passed by the legislature
2. Amendments: A minor change or addition designed to improve a piece of legislation.
3. Rules: As most laws are not complete code in themselves and certain provisions are deliberately left by the legislature, wherein rules can be laid to help govern the law.

The Acts, Rules, Amendments

Over last thirty years, organ transplantation act was published for the first time in 1994. Following this, many rules and amendments were made to the existing act in order to make much stronger ethically and legally. The timeline of evolution of the Transplantation of Human Organs and Tissues Act is shown in Table-1.

Date Year	Title of the framework	Issuing Authority	Sections and subsections/Rules
Date Year	Title of the framework	Issuing Authority	Sections and Subsections/Rules
11th July 1994	The Transplantation of Human Organs No.42 of 1994	President assent Approved by Parliament	Sections and Subsections
4th February 1995	Transplantation of Human Organ Rules -1995	Ministry of Health and Family welfare	Notification of Rules Introduction of Forms
31st July 2008	Transplantation of Human Organs(Amendment) Rules, 2008	Ministry of Health and Family welfare	Notification of Rules Forms(1-10) were modified
28th September 2011	The Transplantation of Human Organs Act, 2011	Presidents assent Approved by Parliament Ministry of Law, Justice and Company Affairs	Sections and Subsections
27th March 2014	Transplantation of Human Organs and Tissues Rules, 2014	Ministry of Health and Family welfare	Notification and Rules

Table-1: Time line of evolution of the Transplantation of Human Organs and Tissues Act

Transplantation of Human Organs Act, 1994 (THOA 1994)

An Act to provide for the regulation, removal, storage and transplantation of human organs for therapeutic purpose and prevention of commercial dealings in human organs. This Act is called Transplantation of Human Organs Act, 1994.

There are 7 Chapters and 25 sections in the Act. Each sections deals with different aspect involved in donation, retrieval and legal procedures (vv -2)

Section	Title of the Section	Clauses and explanations
CHAPTER I: PRELIMINARY		
1	Short Title, Application and Commencement	Mentions the date of commencement of Act and the states which adopted
2	Definition	Deals with definitions of terms of importance
CHAPTER II : AUTHORITY FOR REMOVAL OF ORGANS		
3	Authority of removal of organs	1-7 subsection States who should remove the organs Mentions regarding Board of Medical Experts

4	Removal of organs not to be authorized in certain cases	1&2 subsections mentions about conditions or situations where the removal of organs should not be done
5	Authority of removal of human organs in case of unclaimed bodies in hospital or in prison	
6	Authority for removal of human organs from bodies sent for post-mortem examination for medico-legal or pathological cases	
7	Preservation of human organs	
8	Savings	
9	Restrictions on removal of organs	Subsections 1-6 Restrictions of Authorities for removal are mentioned Authorization committee at Central and State Government need to apply to Authorization committee in case of other than near relative
CHAPTER III : REGULATION OF HOSPITALS		
10	Regulation of Hospitals conducting removal, storage or transplantation of human organs	Subsections 1&2
11	Prohibition of removal or transplantation of Human Organs for any purpose other than therapeutic purpose	
12	Explaining effects etc to donor and recipient	
CHAPTER 1V : APPROPRIATE AUTHORITY		
13	Appropriate Authority	Sub sections 1-3
CHAPTER V : REGISTRATION OF HOSPITALS		
14	Registration of hospitals engaged in removal, storage or transplantation of Human organs	Subsections 1-3
15	Certificate of Registration	Subsections 1-3
16	Suspension or cancellation of registration	Subsections 1&2
17	Appeals	Sub section 1
CHAPTER VI : OFFENCES AND PENALTIES		
18	Punishment for removal of human organs without authority	Subsections 1&2

19	Punishment for commercial dealings in Human Organs	
20	Punishment for contravention of any other provision of this Act	
21	Offences by companies	Subsections 1&2
22	Cognizance of Offence	Subsections 1-3
CHAPTER VII : MISCELLANEOUS		
23	Protection of action taken in Good faith	Subsections 1&2
24	Power to make Rules	Subsections 1&2
25	Repeal and Saving	Subsections 1&2

Table-2: Chapters and sections of THOA 1994

In the year 1995, certain rules were added to THOA 1994, addition of these rules further defined duties of medical practitioner, specific tests in immunology to establish the relationship. In addition, the pre requisites for grant of permission or renewal of permission were further defined. Salient points of Transplantation of Human Organs Act, Rules, 1995 (Table-3)

1	Defined duties of a medical practitioner
2	Introduction of specific forms of donor authorization, tests for HLA, DNA probe, form 8 for brain death declaration
3	Joint application by donor and recipient in live renal transplantation in Form 10
4	Payment details of Registration and Renewal of Hospitals
5	Conditions for grant of permission : General requirement, Infrastructure, Personnel
6	Details of appeal in case of Authorization committee rejection.

Table 3: THOA Rules 1995

Though the Act and Rules were introduced in 1994 and 1995 respectively, the State of Andhra Pradesh could adopt the Act in 1995 only, under the name of AP THOA, 1995 (The Andhra Pradesh Transplantation of Human Organs Act, 1995). In this Act, certain changes were made to suit the State Government. However, 1995 Rules were not adopted by the erstwhile Andhra Pradesh Government.

After a gap of thirteen years, in 2008, notification was issued mentioning the Rules, now on called, Transplantation of Human Organs (Amendment) Rules 2008. (Table-4)

1.	Definition of NABL accredited labs,
2.	Replacement of Form 1 with Form 1A, Form 1B, form 1C,
3.	Composition of Authorization committee ,
4.	Addition of Hospital based Authorization committee,
5.	The documents for evaluation by the Authorization committee in case of other than Near relative transplant,
6.	Check list document evaluation by competent authority in case of Near Relatives transplant,
7.	Introduction of process of senior Embassy Official certification of Relationship in case of Foreigners,
8.	Videographing the procedure of interviewing,
9.	Mandatory transplant coordinator in hospitals performing organ transplant
10.	24 hour availability of infrastructure and petsonnel in the hospitals applying for Registration.
11.	Qualifications of the skilled expertise of doctors involved in organ transplantation

Table-4: Amendment of Transplantation of Human Organs Rules 2008

Following this, certain Amendments were made to the Act, 1994 in the year 2011. As the utility of tissues was increasing, the Act was made as tissue and Organ Act, 2011. Introduction of Swap transplantation, increase in the quantum of punishment and definition of near relative were included in the Act, 2011 (Table-5).

1	Inclusion of tissues along with organs in the Act
2.	Expansion of near relative category: Inclusion of grandchildren, grand parents
3	Concept of Tissue Bank, prerequisites of the same
4	Defining the scope of work and role of transplant coordinator
5	Prerequisites of infrastructure in hospitals which can declare potential Brain deaths.
6	Expansion of team of brain DEATH DECLARATION: Inclusion of Physician, Anaesthetist and Surgeon, Intensivist in brain death declaration team.
7	Scope of work and limits of authorization committee.
8	Composition of Authorization committee.
9	Introduction of Advisory committee for guidance to Authorization committee
10	Concept of maintenance National Registry
11	Registration of Tissue Bank

Table-5: Amendment of Transplantation of Human Organs and Tissues Act 2011

With the inclusion of above features, it is called Transplantation of Human Organs and Tissues (Amendments) Act, 2011 (THOTA), which was approved the Parliament and had assent of the then President of India. Three years later , with increase in number of deceased donor organ transplantation programme and an increase in number of centers performing organ transplant, Rules were published which are THOTA – Rules, 2014. In these Rules, there is further definition of certain terminologies, introduction of twenty one forms which are mandatory for Live / Deceased donor/ Submission to Authorization committee. Procedure for near relatives and for other than near relatives, qualifications for transplant coordinator, details and process of establishment and maintenance of organ registry have been defined in these rules. Scope of the Regulatory bodies such as Appropriate Authority and Advisory Committee have also been defined.

Functions of Appropriate Authority

1. Grant, renew, suspend or cancel the registration of hospitals, and to enforce standards that have been prescribed for hospitals undertaking transplantation activities and tissue banks which test, store or distribute tissues
2. Investigate any complaint of breach of any of the provisions of the Act and take appropriate action
3. Inspect tissue banks and hospitals periodically to ensure compliance
4. Powers of a civil court
5. Summon any person in relation to a violation of any provisions of the Act, order the discovery or production of any document or material object and issue a search warrant for any place where it is suspected that unauthorised or illegal organ transplants are taking place

Functions of Advisory Committee

1. To assist Appropriate Authority in the discharge of its functions
2. Constituted for a period of two years
3. A Representative from NGO working in the field of organ or tissue donation.

What are the other Guidelines and Policies at International Level regarding Organ Transplantation?

DOI: Declaration of Istanbul:

The Declaration of Istanbul expresses the determination of donation and transplant professionals and their colleagues in related fields that the benefits of transplantation be maximized and shared equitably with those in need, without reliance on unethical and exploitative practices that have harmed poor and powerless persons around the world.

It aims to provide ethical guidance for professionals and policymakers who share this goal. The Declaration thus complements efforts by professional societies, national health authorities, and

inter-governmental organizations to support the development of ethical programmes for organ donation and transplantation, and to prevent organ trafficking and transplant tourism. These efforts have contributed to the considerable progress made in countries around the world since 2008.

Declaration of Istanbul Custodian Group (DICG) has further defined certain activities such as

1. Organ trafficking
2. Trafficking in persons for purpose of organ removal
3. Definition of resident and non resident with respect to organ transplantation tourism
4. Travel for transplantation
5. Self sufficiency in organ transplantation and donation
6. Financial neutrality in organ donation.

For further details please check website: www.declarationofistanbul.org.

Latest edition of 2018 is available in English, Hindi and Urdu.

The forms required in live and deceased donor transplantation as per THOTA 2014 are shown in Table 6.

<table>
<tr><th colspan="2">Live donor transplantation</th><th>Deceased donor transplantation</th></tr>
<tr><td>Near Relative</td><td>Form 1, Form 2
Form 4, Form 5
Form 11</td><td rowspan="6">Form 8
Form 9
Form 10</td></tr>
<tr><td>Other than Near Relative</td><td>Form 3 Form 11</td></tr>
<tr><td>Foreign National</td><td>Form11 Form 21</td></tr>
<tr><td>Approval from Authorization Committee for Near Relative</td><td>Form 18</td></tr>
<tr><td>Approval from Authorization Committee for other than Near Relative</td><td>Form 19</td></tr>
<tr><td>Approval from Authorization Committee for spouse (Indian)</td><td>Form 6</td></tr>
<tr><td>Voluntary donation before death</td><td colspan="2">Form 7</td></tr>
<tr><td>Application for Registration / Renewal by Hospitals</td><td colspan="2">Form 12-17</td></tr>
</table>

Table 6: The forms required in live and deceased donor transplantation as per THOTA 2014

Suggested reading

1. Transplantation of Human Organs Act 1994
2. Transplantation of Human Organs Act Rules 1995
3. Transplantation of Human Organs Amendment Rules 2008
4. Transplantation of Human Organs and Tissues Amendment Act 2011
5. Transplantation of Human Organs and Tissues Amendments Rules 2014

CHAPTER 4

Anatomy & Physiology of Kidney

Dr. A Deepthi

Introduction

The kidneys are the waste filtering and disposal system of the body. As much as 1/3 of all blood leaving the heart passes into the kidneys to be filtered before flowing to the rest of the body's tissues. While a person could live with only one functioning kidney, our kidneys are vital organs; the loss of both kidneys would lead to a rapid accumulation of wastes and death within a few days time.

Structure

The kidneys are bean-shaped, pair of organs found along the posterior muscular wall of the abdominal cavity. The indentation on the concave side of the kidney, known as the renal hilus, provides a space for the renal artery, renal vein, and ureter to enter the kidney.

The renal capsule provides a stiff outer shell to maintain the shape of the soft inner tissues. Deep to the renal capsule is the soft, dense, vascular renal cortex. Seven cone-shaped renal pyramids form the renal medulla deep to the renal cortex. The renal pelvis exits the kidney at the renal hilus, where urine drains into the ureter (Figure-1).

The specific components of the kidney are the nephrons, the collecting ducts (CDs), and a unique microvasculature.[1]

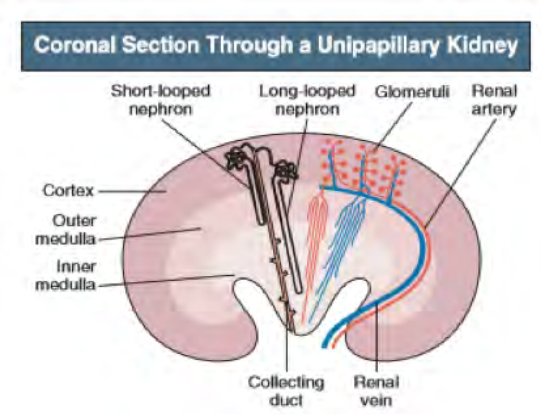


Figure 1: Coronal section through a unipapillary kidney

The nephron

Each kidney contains around 1 million individual nephrons, the kidneys' microscopic functional units that filter blood to produce urine. Responsible for filtering the blood, renal corpuscle is formed by the capillaries of the glomerulus and the glomerular capsule (also known as Bowman's capsule).

A series of tubes called the renal tubule concentrate urine and recover non-waste solutes from the urine. The renal tubule carries urine from the glomerular capsule to the renal pelvis (Figure-2).

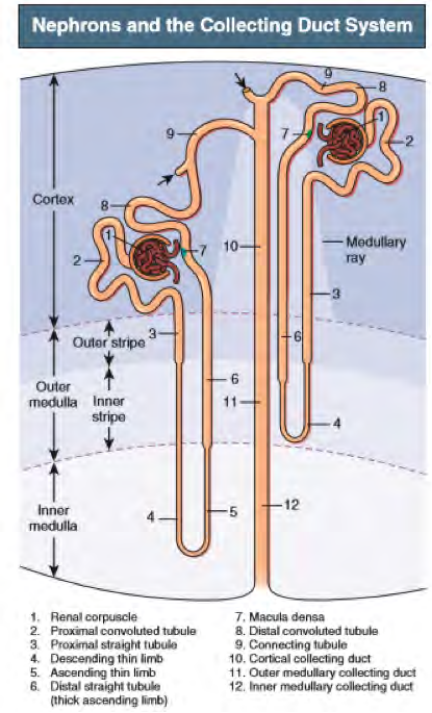


Figure 2: Nephrons and the collecting duct system

Blood supply (Figure 3)

1. The renal arteries branch directly from the abdominal aorta and enter the kidneys through the renal hilus.
2. Inside kidneys, the renal arteries diverge into the smaller afferent arterioles of the kidneys.
3. The peritubular capillaries merge to form veins that merge again to form the large renal vein.
4. Finally, the renal vein exits the kidney and joins with the inferior vena cava, which carries blood back to the heart.

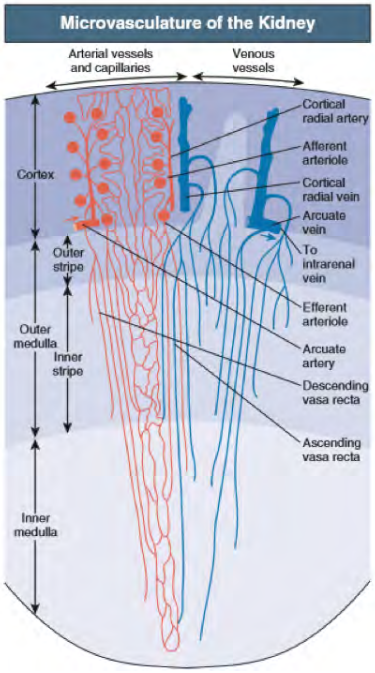


Figure 3: Microvasculature of the kidney

Physiology of the kidneys

Excretion of wastes

The primary function of the kidneys is the excretion of waste products resulting from protein metabolism and muscle contraction. The muscles of body use creatine as an energy source and, in the process, produce the waste product creatinine. Ammonia, uric acid, urea, and creatinine all accumulate in the body over time and need to be removed from circulation to maintain homeostasis. The glomerulus in the kidneys filter all four of these waste products out of the bloodstream, allowing body to excrete them out in urine.

Filtration, reabsorption, and secretion

1. The kidneys filter blood as it passes through the capillaries that form the glomerulus. The filtered plasma, now known as tubular fluid, begins to flow out of the glomerular capsule and into the proximal convoluted tubule.
2. At the same time, Epithelial cells lining the tubule actively reabsorb valuable molecules of glucose, amino acids, and ions from the filtrate and deposit them back into the blood. These cells also absorb any waste products remaining in the blood (such as ammonia and creatinine) and secrete these chemicals into the filtrate.
3. When filtrate reaches the end of the collecting duct, almost all of the valuable nutrients, ions, and water have been returned to the blood supply while waste products and a small amount of water are left to form urine. The urine exits the collecting duct and joins with urine from other collecting ducts in the renal pelvis.

Water homeostasis

The kidneys are able to control the volume of water in the body by changing the reabsorption of water by the tubules of the nephron. Under normal conditions, the tubule cells of the nephron tubules reabsorb (via osmosis) nearly all of the water that is filtered into urine by the glomerulus. Water reabsorption leads to very concentrated urine and the conservation of water in the body. The hormones antidiuretic hormone (ADH) and aldosterone both increase the reabsorption of water until almost 100% of the water filtered by the nephron is returned to the blood. Aldosterone functions by increasing the reabsorption of Na^+ and Cl^- ions, causing more water to move into the blood via osmosis.

Acid/Base homeostasis

The kidneys regulate the pH level of the blood by controlling the excretion of hydrogen ions (H+) and bicarbonate ions ($HCO3^-$).

Electrolyte homeostasis

The kidneys maintain the homeostasis of important electrolytes by controlling their excretion into urine.

1. **Sodium (Na^+):** Over 99% of the sodium ions passing through the kidneys are reabsorbed into the blood from tubular filtrate.
2. **Potassium (K^+):** Unlike sodium, however, only about 60 to 80% of the potassium ions passing through the kidneys are reabsorbed. Most of the reabsorption of potassium occurs in the proximal convoluted tubule and ascending loop of Henle.
3. **Chloride (Cl^-):** The proximal convoluted tubule and ascending loop of Henle reabsorb about 90% of the chloride ions filtered by the kidneys.

4. **Calcium (Ca^{2+}):** The proximal convoluted tubule and the ascending loop of Henle reabsorb most of the calcium in tubular filtrate into the blood. Parathyroid hormone increases the reabsorption of calcium in the kidneys when blood calcium levels become too low.
5. **Magnesium (Mg^{2+}):** The proximal convoluted tubule and loop of Henle reabsorb most of the magnesium that passes through the kidney.

Blood pressure homeostasis

The kidneys help to control blood pressure in the body by regulating the excretion of sodium ions and water and by producing the enzyme renin. Renin starts a complex process that results in the release of the hormone aldosterone by the adrenal glands. Aldosterone stimulates the cells of the kidney to increase their reabsorption of sodium and water to maintain blood volume and pressure.

Hormones

The kidneys maintain a small but important endocrine function by producing the hormones calcitriol and erythropoietin.

1. **Calcitriol** is the active form of vitamin D in the body, it increases the absorption of calcium from food in the intestinal lumen.
2. **Erythropoietin (EPO)** is a hormone produced by cells of the peritubular capillaries in response to hypoxia (a low level of oxygen in the blood). EPO stimulates the cells of red bone marrow to increase their output of red blood cells.

Renal failure

Kidney failure can be divided into two categories: acute kidney injury or chronic kidney disease.

Acute Kidney Injury (AKI), previously called acute renal failure (ARF),[1,2] is a rapidly progressive loss of renal function, generally characterized by oliguria (decreased urine production, quantified as less than 400 mL per day in adults,[3] less than 0.5 mL/kg/h in children or less than 1 mL/kg/h in infants); and fluid and electrolyte imbalance.

Chronic Kidney Disease (CKD) can also develop slowly and, initially, show few symptoms.[4] CKD can be the long term consequence of irreversible acute disease or part of a disease progression. Chronic kidney disease (CKD) is recognized as a major health problem. When kidneys fail to filter properly, waste accumulates in the blood and the body, a condition called azotemia. Patients with chronic kidney disease (CKD) stages 1-3 (glomerular filtration rate [GFR] >30 mL/min/1.73 m^2) are frequently asymptomatic. clinically evident disturbances in water or electrolyte balance or endocrine/metabolic derangements become manifest with CKD stages 4-5 (GFR < 30 mL/min/1.73 m^2). Uremic manifestations in patients with CKD stage 5 are believed to be primarily secondary to an accumulation of multiple toxins.

Symptoms of kidney failure include the following:

1. High levels of urea in the blood, which can result in vomiting or diarrhea (or both) which may lead to dehydration, nausea, weight loss, nocturnal urination, more frequent urination, or in greater amounts than usual, with pale urine, less frequent urination, or in smaller amounts than usual, with dark coloured urine, pressure, or difficulty urinating.
2. A buildup of phosphates in the blood that diseased kidneys cannot filter out may cause itching, bone damage, nonunion in broken bones, muscle cramps (caused by low levels of calcium which can be associated with hyperphosphatemia).
3. A buildup of potassium in the blood that diseased kidneys cannot filter out (called hyperkalemia) may cause abnormal heart rhythms, muscle paralysis
4. Failure of kidneys to remove excess fluid may cause swelling of the legs, ankles, feet, face, or hands, shortness of breath due to extra fluid in the lungs.

Delaying or halting progression of chronic kidney disease

Measures indicated to delay or halt the progression of chronic kidney disease (CKD) are as follows:

1. Treatment of the underlying condition if possible
2. Aggressive blood pressure control to target values
3. Treatment of hyperlipidemia to target levels
4. Aggressive glycemic control per the American Diabetes Association (ADA) recommendations (target hemoglobin A1c [HbA1C] < 7%)
5. Avoidance of nephrotoxins, including intravenous (IV) radiocontrast media, nonsteroidal anti-inflammatory agents (NSAIDs), and aminoglycosides
6. Use of renin-angiotensin system (RAS) blockers among patients with diabetic kidney disease (DKD) and proteinuria
7. Use of angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin-receptor blockers (ARBs) in patients with proteinuria

Renal replacement therapy

Indications for renal replacement therapy in patients with chronic kidney disease (CKD) include the following:

1. Severe metabolic acidosis
2. Hyperkalemia
3. Pericarditis
4. Encephalopathy
5. Intractable volume overload

6. Failure to thrive and malnutrition
7. Peripheral neuropathy
8. Intractable gastrointestinal symptoms
9. In asymptomatic adult patients, a glomerular filtration rate (GFR) of 5-9 mL/min/1.73 m^2, irrespective of the cause of the CKD or the presence or absence of other comorbidities

Timely planning for long-term renal replacement therapy

1. Early patient education regarding natural disease progression, different dialytic modalities, renal transplantation, and option to refuse or discontinue chronic dialysis
2. Timely placement of permanent vascular access (arrange for surgical creation of primary arteriovenous fistula, if possible, and preferably at least 6 months in advance of the anticipated date of dialysis for patients in whom transplantation is not imminent)
3. Timely elective peritoneal dialysis catheter insertion
4. Timely referral for renal transplantation

Dialysis replaces some of these functions when kidneys no longer work. There are two different types of dialysis - hemodialysis and peritoneal dialysis.

Hemodialysis

It is a process of purifying the blood when kidneys are not working normally. This type of dialysis achieves the extracorporeal removal of waste products such as creatinine and urea and free water from the blood when the kidneys are in a state of kidney failure. Hemodialysis can be an outpatient or inpatient therapy. It involves diffusion of solutes across a semipermeable membrane. Hemodialysis utilizes counter current flow, where the dialysate is flowing in the opposite direction to blood flow in the extracorporeal circuit. Counter-current flow maintains the concentration gradient across the membrane at a maximum and increases the efficiency of the dialysis. Fluid removal (ultrafiltration) is achieved by altering the hydrostatic pressure of the dialysate compartment, causing free water and some dissolved solutes to move across the membrane along a created pressure gradient.

Conventional hemodialysis is usually done three times per week, for about three to four hours for each treatment (Sometimes five hours for larger patients), during which the patient's blood is drawn out through a tube at a rate of 200–400 mL/min. The tube is connected to a 15, 16, or 17 gauge needle inserted in the dialysis fistula or graft, or connected to one port of a dialysis catheter. The blood is then pumped through the dialyzer, and then the processed blood is pumped back into the patient's bloodstream through another tube (connected to a second needle or port) (Figure-4)

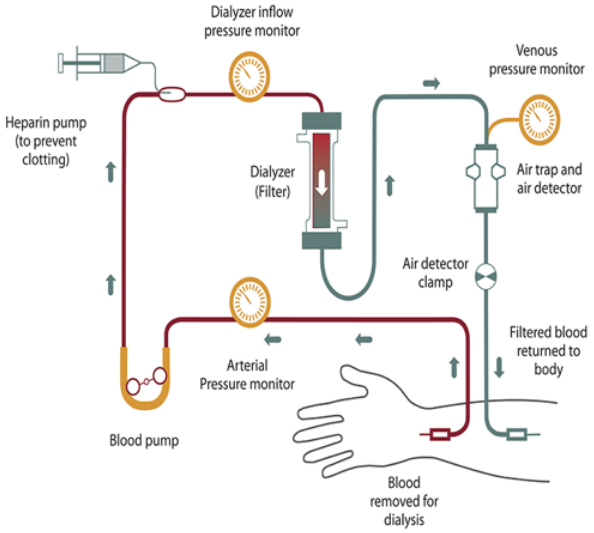


Figure 4:
Hemodialysis circuit

Complications: Side effects caused by removing too much fluid and/or removing fluid too rapidly include low blood pressure, fatigue, chest pains, leg-cramps, nausea and headaches. patients undergoing hemodialysis may expose their circulatory system to microbes, which can lead to bacteremia, an infection affecting the heart valves (endocarditis) or an infection affecting the bones (osteomyelitis). Heparin allergy can infrequently be a problem and can cause a low platelet count. First-use syndrome is a rare but severe anaphylactic reaction to the artificial kidney. Its symptoms include sneezing, wheezing, shortness of breath, back pain, chest pain, or sudden death. It can be caused by residual sterilant in the artificial kidney or the material of the membrane itself. Long term complications of hemodialysis include hemodialysis-associated amyloidosis, neuropathy and cardiovascular disease.

Peritoneal dialysis

Peritoneal dialysis (PD) is a type of dialysis which uses the peritoneum in a person's abdomen as the membrane through which fluid and dissolved substances are exchanged with the blood. It is used to remove excess fluid, correct electrolyte problems, and remove toxins in those with kidney failure. Peritoneal dialysis has better outcomes than hemodialysis during the first couple of years.

Technique: The abdomen is cleaned in preparation for surgery and a catheter is surgically inserted with one end in the abdomen and the other protruding from the skin. Before each infusion the catheter must be cleaned, and flow into and out of the abdomen tested. 2-3 liters of dialysis fluid is introduced into the abdomen over the next ten to fifteen minutes. The total volume is referred to as a dwell[8] while the fluid itself is referred to as dialysate. The dwell can be as much as 3 liters,

and medication can also be added to the fluid immediately before infusion. The dwell remains in the abdomen and waste products diffuse across the peritoneum from the underlying blood vessels. After a variable period of time depending on the treatment (usually 4–6 hours), the fluid is removed and replaced with fresh fluid (Figure-5). This can occur automatically while the patient is sleeping (automated peritoneal dialysis, APD), or during the day by keeping two litres of fluid in the abdomen at all times, exchanging the fluids four to six times per day (continuous ambulatory peritoneal dialysis, CAPD).

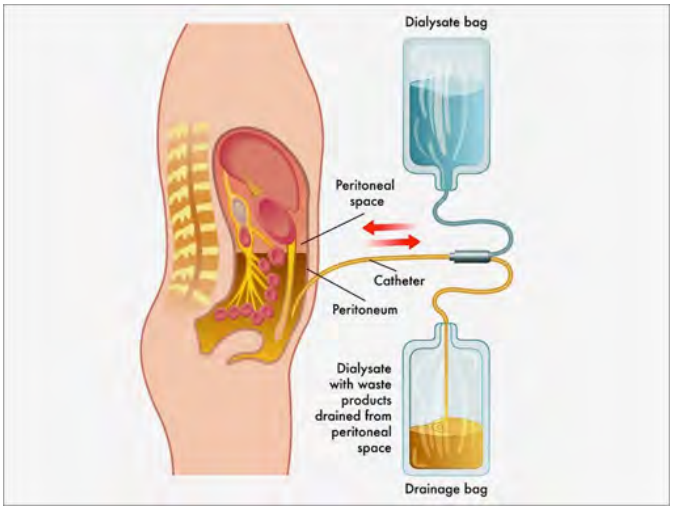


Figure 5:
Peritoneal dialysis

Complications: Excessive loss of fluid can result in hypovolemic shock or hypotension while excessive fluid retention can result in hypertension and edema. Also monitored is the color of the fluid removed: normally it is pink-tinged for the initial four cycles and clear or pale yellow afterward. The presence of pink or bloody effluent suggests bleeding inside the abdomen while feces indicates a perforated bowel and cloudy fluid suggests infection. The patient may also experience pain or discomfort if the dialysate is too acidic, too cold or introduced too quickly, while diffuse pain with cloudy discharge may indicate an infection. Severe pain in the rectum or perineum can be the result of an improperly placed catheter. The dwell can also increase pressure on the diaphragm causing impaired breathing, and constipation can interfere with the ability of fluid to flow through the catheter. A potentially fatal complication estimated to occur in roughly 2.5% of patients is encapsulating peritoneal sclerosis, in which the bowels become obstructed.

Renal transplantation

The living kidney transplantation programme in India has evolved in the past 45 years and is currently the second largest programme in numbers after the USA. Transplantation from deceased donation where neurological criteria are used for determination of death has been possible since 1995 after the Indian parliament passed the law related to transplantation.[5] As per the Indian law and amendments to it in 2011, there is a provision of "required request" available to the intensive care doctors to ask for organ donation in the event of brain death. It also makes it mandatory to have

a national registry to look at outcomes and appointment of a trained transplant coordinator for the purpose of counseling relatives for organ donation. This has been done with the idea of improving the deceased donation rate in India.[5]

Kidney transplantation is the best treatment for end-stage renal disease (ESRD). Kidney transplantation or renal transplantation is the organ transplant of a kidney into a patient with end-stage renal disease. Kidney transplantation is typically classified as deceased-donor (formerly known as cadaveric) or living-donor transplantation depending on the source of the donor organ.

Deceased donation can be of two types:

1. Donation after Brain Death (DBD)
2. Donation after Cardiac Death (DCD)

Although brain-dead (or 'heart beating') donors are considered dead, the donor's heart continues to pump and maintain the circulation. This makes it possible for surgeons to start operating while the organs are still being perfused (supplied blood). During the operation, the aorta will be cannulated, after which the donor's blood will be replaced by an ice-cold storage solution, such as University of Wisconsin (UW), Histidine Tryptophan Ketoglutarate (HTK).

Donation after Cardiac Death' donors are patients who do not meet the brain-dead criteria but, due to the unlikely chance of recovery, have elected via a living will or through family to have support withdrawn. In this procedure, treatment is discontinued (mechanical ventilation is shut off). After a time of death has been pronounced, the patient is rushed to the operating room where the organs are recovered. Storage solution is flushed through the organs. Since the blood is no longer being circulated, coagulation must be prevented with large amounts of anti-coagulation agents such as heparin. Several ethical and procedural guidelines must be followed.

In general, the donor and recipient should be ABO blood group and crossmatch (human leukocyte antigen — HLA) compatible. If a potential living donor is incompatible with their recipient, the donor could be exchanged for a compatible kidney. Kidney exchange, also known as "kidney paired donation" or "chains" have recently gained popularity.

Technique: In most cases the barely functioning existing kidneys are not removed, as removal has been shown to increase the rates of surgical morbidity. Therefore, the kidney is usually placed in a location different from the original kidney. Often this is in the iliac fossa so it is often necessary to use a different blood supply:

1. The renal artery of the new kidney, previously branching from the abdominal aorta in the donor, is often connected to the internal iliac artery in the recipient.
2. The renal vein of the new kidney, previously draining to the inferior vena cava in the donor, is often connected to the external iliac vein in the recipient.
3. The donor ureter is anastomosed with the recipient bladder. The kidney will soon start producing urine.

Living donor kidneys normally require 3–5 days to reach normal functioning levels, while cadav-

eric donations stretch that interval to 7–15 days. Hospital stay is typically for 4–10 days. Immunosuppressant drugs are used to suppress the immune system from rejecting the donor kidney. These medicines must be taken for the rest of the recipient's life. The most common medication regimen today is a mixture of tacrolimus, mycophenolate, and prednisolone. Some recipients may instead take ciclosporin, sirolimus, or azathioprine. Post operatively, kidneys are periodically assessed by ultrasound to assess for the imaging and physiologic changes that accompany transplant rejection. Imaging also allows evaluation of supportive structures such as the anastomosed transplant artery, vein, and ureter, to ensure they are stable in appearance.

Problems after a transplant may include: Post operative complication, bleeding, infection, vascular thrombosis and urinary complications

1. Transplant rejection (hyperacute, acute or chronic)
2. Infections and sepsis due to the immunosuppressant drugs that are required to decrease risk of rejection
3. Post-transplant lymphoproliferative disorder (a form of lymphoma due to the immune suppressants)
4. Imbalances in electrolytes including calcium and phosphate which can lead to bone problems
5. Proteinuria
6. Hypertension
7. Other side effects of medications including gastrointestinal inflammation and ulceration of the stomach and esophagus, hirsutism(excessive hair growth in a male-pattern distribution) with ciclosporin, hair loss with tacrolimus, obesity, acne, diabetes mellitus type 2, hypercholesterolemia, and osteoporosis.

References

1. Moore, EM; Bellomo, R; Nichol, AD . "The meaning of acute kidney injury and its relevance to intensive care and anaesthesia". Anaesthesia and intensive care. 2012;40 (6): 929–48.
2. Ricci, Zaccaria; Ronco, Claudio. "New insights in acute kidney failure in the critically ill". Swiss Medical Weekly. 2012;142: w13662.
3. Klahr, Saulo; Miller, Steven B. "Acute Oliguria". New England Journal of Medicine.1998; 338 (10): 671–75.
4. "Chronic kidney disease". A.D.A.M. Medical Encyclopedia. National Institutes of Health. Retrieved 1 January 2013.
5. Shroff S. Current trends in kidney transplantation in India. Indian Journal of Urology : IJU : Journal of the Urological Society of India. 2016;32(3):173-174.

CHAPTER 5

Anatomy & Physiology of Liver

Dr. Venu Madhav Thumma |
Dr. Surya Ramachandra Varma Gunturi

Introduction

The liver is considered a vital organ. It has multiple important functions in the body. It is an organ which can regenerate, which means after injury or resection, liver has the ability to increase its size and fuction. In this review anatomy and physiology of the liver contributing to the liver functions will be discussed. Also, a brief overview of acute liver failure and cirrhosis will be discussed.

Anatomy

The liver is the largest solid organ of the body. It accounts for 2 to 3% of total body weight (nearly 1500 gms in adult). The liver is situated below the right diaphragm and under the rib cage (Figure 1).

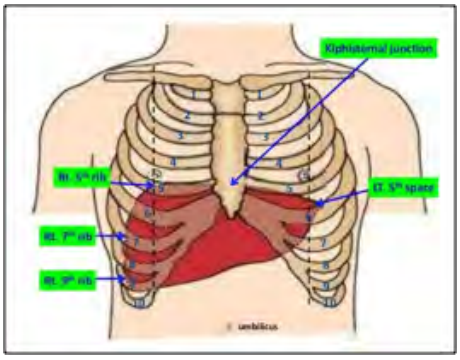


Figure 1: Surface anatomy of liver

External anatomy

The liver is divided externally into right and left lobe by the falciform ligament (Figure 2). Posteriorly the caudate and quadrate lobes can be identified. The posterior surface of liver is closely related to inferior vena cava.

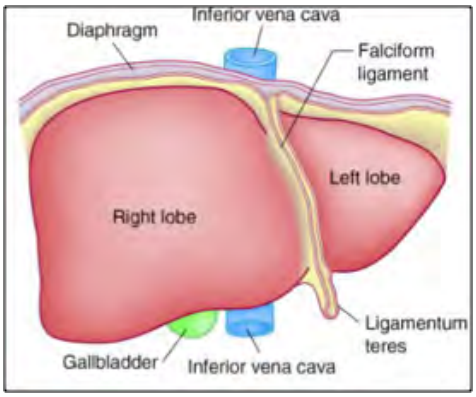


Figure 2: Lobes of the liver

Functional anatomy

The liver contains 8 segments (Figure 3). Each segment is supplied by a branch of portal vein, hepatic artery and bile duct. The right hemi liver contains segment V, VI VII and VIII.The left hemiliver contains segment II, III and IV. The segment 1 is called caudate lobe which is present on the back side of liver in close relation to inferior vena cava. The importance of this anatomy is that in a normal liver 80 percent of liver can be removed if we preserve the blood supply to atleast 2 segments. This has applicability in split liver transplantation.

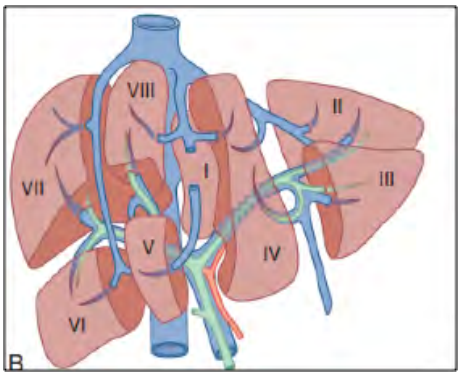


Figure 3: Segments of the liver

Blood supply (Figure 4)

The liver is a unique organ in the body as it is supplied by 2 blood vessels. Hepatic artery supplies 25% of blood supply. The remaining is supplied by the portal vein which drains blood from the intestine and spleen. The venous drainage is by right, middle and left hepatic veins which drain into the inferior vena cava. There is huge variation in the origin and branching of these blood vessels. An accurate preoperative imaging to know these variations preoperatively is very important in planning liver resections and split liver transplantation.

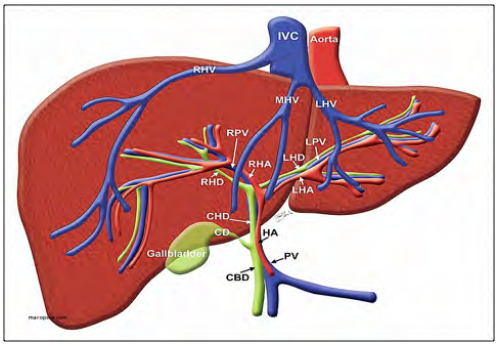


Figure 4: Blood supply of the liver

(RED HA hepatic artery, RHA Right hepatic artery, LHA Left hepatic artery. BLUE PV portal vein, RPV right portal vein, LPV left portal vein, RHV right hepatic vein, MHV middle hepatic vein, LHV left hepatic vein, IVC inferior vena cava. RHD Right hepatic duct, LHD Left hepatic duct, CHD Common hepatic duct, CBD Common bile duct)

Functions of liver

The liver contains nearly 1,00,000 lobules. The blood enters the lobule via portal triad (Figure 5). The nutrients absorbed in the gut are drained into the lobule via portal vein branch where it mixes with arterial blood from hepatic artery as it enters sinusoids. As blood flows through the sinusoids it comes into contact with hepatocytes which then absorb nutrients and secrete synthesised molecules. If there is an excess of nutrients these are removed and stored and if there is a deficiency of nutrients these are released or synthesised by the hepatocytes. From sinusoids blood then flows into the central vein, hepatic vein and then into the vena cava.

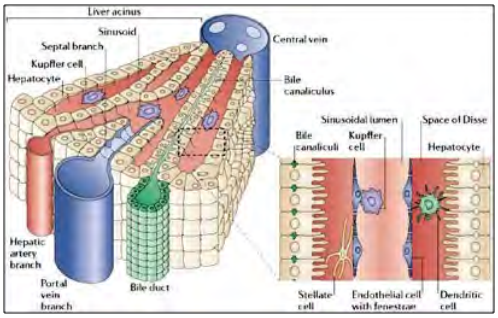


Figure 5: Functional unit of liver (hepatic lobule and portal triad)

Formation and functions of bile

Hepatocytes produce a juice called bile which contains water, electrolytes, bile acids, cholesterol, phospholipids and bilirubin. Bile plays a key role in the digestion of fats within the small intestine. Bile is secreted by hepatocytes and later transported to right and left hepatic ducts which join up to form the common hepatic duct. From the common hepatic duct bile is stored in gallbladder and later transported into small intestine via the common bile duct in response to fatty meals.

Bile performs two key functions. It contains bile salts which are vital for the digestion and absorption of fats and fat-soluble vitamins. Bile also removes waste products such as bilirubin from the body as a component of faeces. Bile salts make up one of the most important constituents of bile. They are water-soluble derivatives of cholesterol. Bile acids perform two important functions. First, they help to break down, or emulsify (not digest), fat globules to smaller fat droplets. This helps to increase the surface area across which the enzyme lipase can work to digest fats. When bile salts have completed their function, they are released back into the lumen of the small intestine and are transported with chyme to the terminal ileum.

Bile secretion is very important for removing waste products of metabolism like bilirubin. The old RBC are broken down and recycled by phagocytic cells in the body which is then converted to bilirubin. The bilirubin binds with albumin in plasma and later transported to liver where free bilirubin is absorbed by hepatocytes. In hepatocytes it undergoes a process called conjugation. This conjugation makes bilirubin into soluble form so that it can be secreted into the bile duct. It then reaches small intestine where the bacteria act on bilirubin and later excreted in faeces.

The inability of the liver to remove bilirubin from the body can lead to a yellow discolouration of the skin. The clinical term for this is jaundice.

The following are the functions of liver

1. **Excretory function**

   The liver is useful in excretion of bile acids, cholesterol, bilirubin.

2. **Synthetic function**

   a. The liver produces coagulation factors I (fibrinogen), II (prothrombin), V, VII, IX, X and XI, as well as protein C, protein S and antithrombin.

   b. Almost all proteins except immunoglobulins and hemoglobin are synthesized by the liver

3. **Metabolic function**

4. **Carbohydrate metabolism**

   Liver is a major player in maintaining stable glucose concentration due to glycogenesis, glycogenolysis and gluconeogenesis

   a. Uses glucose for its own cellular energy

   b. Circulates glucose to peripheral tissue

   c. Stores glucose as glycogen

5. **Lipid metabolism**

   a. Liver gathers free fatty acids from diet and breaks them down to Acetyl- CoA to form triglycerides, phospholipids or cholesterol.

   b. It converts insoluble lipids to soluble forms.

   c. The liver produces 70% of cholesterol.

6. **Detoxification**

   Liver serves as a gatekeeper between the circulation and absorbed substances. It acts as a first pass. Every substance absorbed in GI tract passes through liver. Detoxification includes drugs and poisons, and metabolic products like ammonia, alcohol, and bilirubin.

   The mechanisms by which liver performs detoxification are

   a. It facilitates to bind material reversibly to inactivate.

   b. It chemically modifies compound for excretion.

   c. It acts as a drug metabolizer to detoxify drugs and poisons.

   d. It acts as a storage organ for glycogen, vitamins and Iron.

   e. It also has immunologic functions. It aids in phagocytosis of bacteria.

   f. It also aids in IgA secretion

Liver function tests

The most common tests used to asses liver function include the serum aminotransferases, bilirubin, alkaline phosphatase, albumin, and prothrombin time. However abnormal values can be caused by diseases unrelated to the liver. In addition, these tests may be normal in patients who have advanced liver disease.

Serum aminotransferases

They are sensitive indicators of hepatocyte injury. The most commonly measured are ALT (alanine aminotransferase) also called SGPT (Serum glutamic-pyruvic transaminase) AST (aspartate aminotransferase) also called SGOT (Serum glutamic-oxaloacetic transaminase) Serum aminotransferases are elevated in most liver diseases, various infections, drug toxicity, acute heart failure, and metastatic carcinoma.

In disorders associated with extensive hepatocellular injury, such as acute viral hepatitis, ischemic hepatitis (hypoxic hepatitis, shock liver), and acute drug- or toxin-induced liver injury (e.g., acetaminophen toxicity) highest elevations in value are seen .In patients with cholestasis or biliary obstruction alkaline phosphatase is raised

The synthetic function is assessed by prothrombin time (acute marker) and albumin (chronic marker)

Liver failure which requires liver transplantation can be acute or chronic.

Acute liver failure

Acute liver failure (ALF) is an uncommon but dramatic clinical syndrome that is associated with a high risk of mortality. The defining features of ALF reflect mental status changes (i.e., hepatic encephalopathy) and coagulopathy in patients without preexisting liver disease. Viral and drug-induced hepatitis are the most common causes of acute liver failure in adults.

Treatment strategies for ALF include early transfer to a liver transplant center, disease-specific therapies in selected patients, and aggressive treatment of complications, including infection, renal failure, metabolic disorders, and cerebral edema, in an intensive care unit setting.

The etiology of ALF is the strongest predictor of spontaneous recovery. There are prognostic Criteria like Kings college which are important in identifying patients with a low probability of survival without liver transplantation. LT is associated with a significant survival benefit in patients with ALF with a low probability of spontaneous recovery.

Cirrhosis

Cirrhosis represents a late stage of progressive hepatic fibrosis characterized by distortion of the hepatic architecture and the formation of regenerative nodules. It is generally considered to be irreversible in its advanced stages, at which point the only treatment option may be liver transplantation.

Etiology - The common causes are Chronic viral hepatitis (hepatitis B, C), Alcoholic liver disease and Nonalcoholic fatty liver disease. A specific etiology can be determined in 85 to 90 percent of patients with cirrhosis.

The clinical manifestations of cirrhosis may include nonspecific symptoms (e.g., anorexia, weight loss, weakness, fatigue) or signs and symptoms of hepatic decompensation (jaundice, pruritus, signs of upper gastrointestinal bleeding, abdominal distension from ascites, confusion due to he-

patic encephalopathy). Physical examination findings may include jaundice, spider angiomata, gynecomastia, ascites, splenomegaly, palmar erythema, digital clubbing, and asterixis. Laboratory abnormalities may include elevated serum bilirubin, abnormal aminotransferases, elevated alkaline phosphatase/gamma-glutamyl transpeptidase, a prolonged prothrombin time/elevated international normalized ratio (INR), hyponatremia, and thrombocytopenia.

Conclusions

The advances in the knowledge of anatomy has made it possible to do living donor liver transplantation and complex liver resections. The liver performs vital function of the body. Accurate understanding of pathophysiology of liver diseases is important in planning treatment.

Suggested reading

1. Gastrointestinal Nursing. First ed. Taylor & Francis Group; 2018.
2. Handbook of liver diseases.Fourth ed. Elsevier; 2018.
3. Vikas Dudeja YF. The Liver. Sabiston Text Book of Surgery The biologic basis of modern surgical practice. 20th ed. 2017. p. 1418-81.

CHAPTER 6

Anatomy & Physiology of Pancreas

Dr. B Sukanya

Introduction

Pancreas is a glandular organ which is an essential component of both the digestive and endocrine systems. It is located in the abdominal cavity behind the stomach and was in middle ages considered as a bed for the stomach. The pancreas may be considered as a 'J'shaped organ. The right end of the pancreas is wide and called the head. From the head, the organ tapers to the left. The middle sections are called the neck and body, while the narrow end on the left side of the body is called the tail. A portion of the pancreas called the uncinate process bends backward from the head and underneath the body.

Microscopic structure of pancreas shows the pancreatic cells being arranged in clusters which are known as acini. The pancreatic juice produced in the acini reaches the duodenum via a complex ductal system.

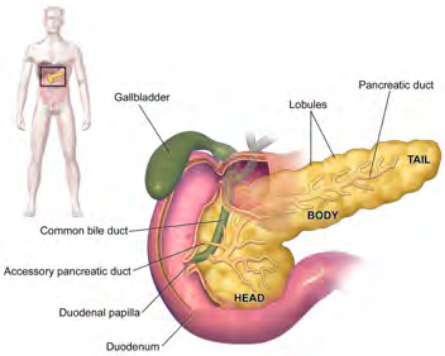


Fig 1. Structure of pancreas.

Pancreas has 2 functional components. 1. Exocrine and 2. Endocrine. Exocrine function consists of production of several important enzymes which are essential for digestion of food. The endocrine function consists of production of hormones in the islet cells of the pancreatic acini which are essential mainly for regulation of blood sugars.

Role in digestion

The pancreas plays a vital role in the digestive system. It secretes a fluid called 'pancreatic juice' which contains numerous enzymes into the duodenum. These enzymes help to break down carbohydrates, proteins and lipids (fats). This role is called the "exocrine" role of the pancreas. These enzymes are produced in the pancreatic acinar cells and secreted into the middle of the acinus from where they drain into the intralobular ducts, which in turn drain to the main pancreatic duct, which opens directly into the duodenum. They are produced in inactive form known as 'zymogens or proenzymes' and upon reaching the duodenum the proenzyme is activated by an enzyme present in duodenal mucosa called enteropeptidase into active enzymes. This sets off a cascade of enzyme activation. The first proenzyme that gets activated is trypsinogen into trypsin. The trypsin then further activates chymotrypsinogen to chymotrypsin. The enzymes which aid in digestion of proteins are known as proteases; trypsin and chymotrypsin are the chief peptidases. Lipases are the enzymes involved in breakdown of fats and amylase is the enzyme which helps in digestion of carbohydrates or starchs. This apart the pancreas also secretes phospholipase A2, lysophospholipase, and cholesterol esterase.

Blood glucose regulation

This is the endocrine function of the pancreas. Within the islets are four main types of cells which are involved in the regulation of blood glucose levels. Each type of cell secretes a different type of hormone: α alpha cells secrete glucagon, β beta cells secrete insulin, δ delta cells secrete somatostatin and γ gamma cells secrete pancreatic polypeptide. These hormones act to control blood glucose by secreting glucagon to increase the levels of blood glucose when patient is hypoglycemic. Insulin decreases the glucose levels and is released in response to ingestion of meals. Insulin also allows glucose to enter muscle and other tissue, works with the liver to store glucose and synthesize fatty acids and stimulates the uptake of amino acids Somatostatin controls the regulation/ deregulation of α and β cells

The islets are crisscrossed by a dense network of capillaries. The capillaries of the islets are lined by layers of islet cells, and most endocrine cells are in direct contact with blood vessels, either by cytoplasmic processes or by direct apposition. The hormones are directly released into the blood vessels thereby bypassing the pancreatic ductal system.

The 3 major disorders of the pancreas are

1. Pancreatitis
2. Diabetes Mellitus
3. Pancreatic Cancer

Pancreatitis

Inflammation of the pancreas is known as pancreatitis. Pancreatitis is most often associated with recurrent gallstones or chronic alcohol use, although a variety of other causes, including anatomic variations, infections like measles, mumps, some medications like beta blockers which are commonly used for control of Hypertension, congenital conditions like alpha-1 antitrypsin deficiency and even scorpion sting may cause pancreatitis. Pancreatitis may have acute presentation like causing intense pain in the central abdomen, typically radiating to the back, fever and obstipation. Pancreatitis may also have a chronic presentation where patients typically present with signs and symptoms of fat malabsorption in form of oily, fowl smelling stools, weight loss etc. They also can have severe abdominal pain especially after meals causing in patients a fear of eating 'sitophobia' resulting in weight loss.

Diabetes mellitus

Type 1 diabetes

Diabetes mellitus type 1 is a chronic autoimmune disorder in which the immune system attacks the insulin-secreting cells of the pancreas. Lack of insulin leads to high blood sugar. As an untreated chronic condition, diabetic neuropathy can result. Type 1 diabetes can develop at any age but is most often diagnosed before adulthood. For people with type 1 diabetes, insulin injections are critical for survival.

Type 2 diabetes

Diabetes mellitus type 2 is the most common form of diabetes. Here the causes for high blood sugar is a combination of peripheral insulin resistance and impaired insulin secretion. Here the peripheral tissues like muscles, liver do not respond to insulin stimulation resulting in pancreas producing more and more insulin and once the insulin requirement reaches a threshold pancreas can no longer meet the demands necessitating exogenous insulin replacement in form of insulin injections. The management of type 2 diabetes relies on a series of changes in diet, increased physical activity to reduce blood sugar levels to normal ranges and also to increase insulin sensitivity. Oral hypoglycemic drugs and insulin are added to above mentioned life style changes to maintain euglycemic status.

Pancreatic cancer

Patients with chronic pancreatitis have higher predeliction to develop pancreatitis. That apart smoking, genetic causes, certain carcinogens predispose a patient to develop carcinoma of the pancreas. Carcinoma pancreas is a very aggressive disease and often presents in advanced stage. The classical presentation is severe pain abdomen, jaundice, weight loss and sudden worsening of diabetes or new onset diabetes.

Apart from these three other uncommon disorders of pancreas are cystic lesions of pancreas, neuroendocrine tumours of pancreas, infections, cystic fibrosis.

Pancreatic transplantation

Pancreatic transplantation involves removal of diseased pancreas from the patient and replacing it with pancreas from a deceased donor. Usually it is done in conjunction with renal transplantation. The common indications are Type II diabetes with complications, Type 1 diabetes with severe disturbances in sugar control/ hypoglycemia unawareness. A not so commonly accepted indication for pancreatic transplant is chronic pancreatitis.

Suggested reading

1. Harrison's Textbook of Medicine
2. Sleisenger and Fortran's Textbook of Gastroenterology

CHAPTER 7

Anatomy & Physiology of Heart

Dr. Abhijit Dashetwar | Dr. Krishna Mohan Lalukota

Anatomy

The heart and circulatory system together make up cardiovascular system. The anatomy of heart is shown in Figure -1. The heart is a muscular organ that weighs between 200 to 425 grams and is a little larger than the size of one's fist that functions as the body's circulatory pump that pushes blood to the organs, tissues, and cells of body. Blood delivers oxygen and nutrients to every cell and removes the carbon dioxide and waste products made by those cells. Blood is carried from heart to the rest of the body through a complex network of arteries, arterioles, and capillaries. Blood is returned to the heart through venules and veins. Twenty major arteries make a path through tissues, where they branch into smaller vessels called arterioles. Arterioles further branch into capillaries, the true deliverers of oxygen and nutrients to the cells. Most capillaries are thinner than a hair. In fact, many are so tiny only one blood cell can move through them at a time. Once the capillaries deliver oxygen and nutrients and pick up carbon dioxide and other waste, they move the blood back through wider vessels called venules. Venules eventually join to form veins, which deliver the blood back to the heart to pick up oxygen.

The heart together with the arterial and venous system is called the Cardiovascular system. The one-way system carries blood to all parts of body. This process of blood flow within the body is called circulation.

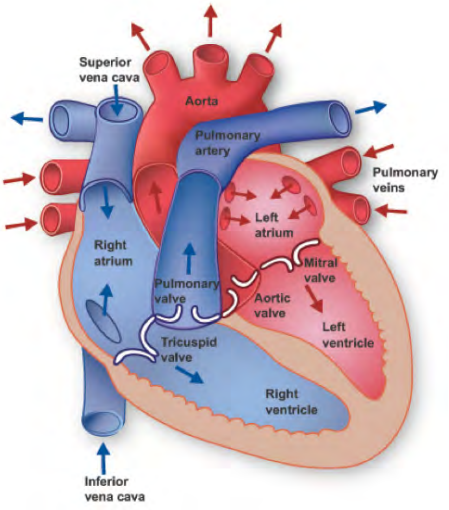


Figure -1: Anatomy of cross-section of heart

In pulmonary circulation, though, the roles are switched. It is the pulmonary artery that brings oxygen-poor blood into your lungs and the pulmonary vein that brings oxygen-rich blood back to your heart.

If all the vessels of this network were laid end to end, they would extend for about 60,000 miles (more than 96,500 kilometers), which is far enough to circle the planet Earth more than twice!

Location: (Figure-2) The heart is located underneath the sternum in a thoracic compartment called the mediastinum, which occupies the space between the lungs, behind and slightly to the left of breastbone (sternum). The narrow end of the heart is called the apex. It is directed downward and to the left and lie just above the arch of the diaphragm at the approximate level of the fifth or sixth rib. The broad end of the heart is called the base and gives rise to the major blood vessels, which is directed upwards and to the right and lies at the approximate level of the second rib.

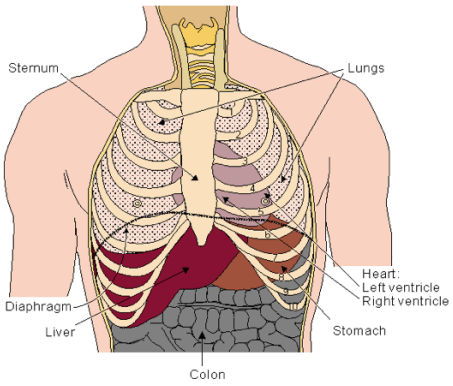


Figure-2: Position of the heart in mediastinum

Pericardium: The heart sits within a fluid-filled cavity called the pericardial cavity comprising of double-layered membrane called the pericardium which surrounds heart like a sac. The outer layer of the pericardium surrounds the roots of heart's major blood vessels and is attached by ligaments to the spinal column, diaphragm, and other parts of the body. Pericardium is a type of serous membrane that produces serous fluid to lubricate the heart and prevent friction between the ever beating heart and its surrounding organs. Besides lubrication, the pericardium serves to hold the heart in position and maintain a hollow space for the heart to expand into when it is full.

The inner layer of the pericardium is attached to the heart muscle. A coating of fluid separates the two layers of 4membrane, letting the heart move as it beats.

Chambers of the heart: Heart has 4 chambers. The upper chambers are called the left and right atria, and the lower chambers are called the left and right ventricles (Figure-1). The atria act as receiving chambers for blood, so they are connected to the veins that carry blood to the heart. A wall of muscle called the septum separates the left and right atria (Interatrial septum) and the left and right ventricles (Interventricular septum).

The heart valves: Valves that separate the atria from the ventricles are called the atrioventricular valves.There are two: the tricuspid on the right and the mitral on the left. Valves at the ventricular outlets are called semilunar valves. The two semilunar valves are the pulmonary and the aortic.

Four valves regulate blood flow through your heart (Figure-1):

1. The tricuspid valve regulates blood flow between the right atrium and right ventricle.
2. The pulmonary valve controls blood flow from the right ventricle into the pulmonary arteries, which carry blood to your lungs to pick up oxygen.
3. The mitral valve lets oxygen-rich blood from your lungs pass from the left atrium into the left ventricle.
4. The aortic valve opens the way for oxygen-rich blood to pass from the left ventricle into the aorta, your body's largest artery.

Structure of the heart wall

The heart wall is made of 3 layers: epicardium, myocardium and endocardium.

1. Epicardium. The epicardium is the outermost layer of the heart wall and is just another name for the visceral layer of the pericardium. Below the epicardium is the second, thicker layer of the heart wall: the myocardium.
2. Myocardium. The myocardium is the muscular middle layer of the heart wall that contains the cardiac muscle tissue. Myocardium makes up the majority of the thickness and mass of the heart wall and is the part of the heart responsible for pumping blood. Below the myocardium is the thin endocardium layer.

3. Endocardium. Endocardium is the simple squamous endothelium layer that lines the inside of the heart. The endocardium is very smooth and is responsible for keeping blood from sticking to the inside of the heart and forming potentially deadly blood clots.

The thickness of the heart wall varies in different parts of the heart. The atria of the heart have a very thin myocardium because they do not need to pump blood very far—only to the nearby ventricles. The ventricles, on the other hand, have a very thick myocardium to pump blood to the lung or throughout the entire body. The right side of the heart has less myocardium in its walls than the left side because the left side has to pump blood through the entire body while the right side only has to pump to the lungs.

The conduction system

Heart is able to create it's own electrical impulses and control the route the impulses take via a specialised conduction pathway.

This pathway is made up of 5 elements (Figure-3):

1. The sino-atrial (SA) node
2. The atrio-ventricular (AV) node
3. The bundle of His
4. The left and right bundle branches
5. The Purkinje fibres

This electrical signal begins in the sinoatrial (SA) node, located at the top of the right atrium. The SA node is sometimes called the heart's "natural pacemaker." The SA node releases electrical stimuli at a regular rate, the rate is dictated by the needs of the body. Each stimulus passes through the myocardial cells of the atria creating a wave of contraction which spreads rapidly through both atria.

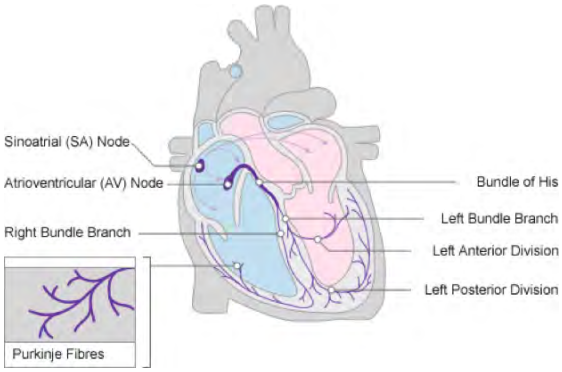


Figure-3: Conduction system of the heart

and eventually passes through the AV node and and Bundle of His into the Bundle branches and Purkinje fibres in the ventricles.

As the ventricles contract, the right ventricle pumps blood to the lungs where carbon dioxide is released and oxygen is absorbed, whilst the left ventricle pumps blood into the aorta from where it passes into the coronary and arterial circulation.

Coronary arteries & veins

The heart receives nutrients and gases from set of arteries, veins and capillaries called the coronary circulatory system.

There are two main coronary arteries (Figure-4):

1. The Left main coronary artery which divides into Left anterior descending (LAD) and Left circumflex (LCX). The LAD further gives branches and they are called Diagonals (D). The LCX branches are called obtuse marginal (OM). The number of D and OM varies patient to patient.

2. The right coronary artery on the posterior surface of the heart divides into posrterior interventricular artery (PIV) or posterior descending artery (PDA) called right dominant system. The PIV and PDA in some patients arises from LCX when it is called left dominant system.

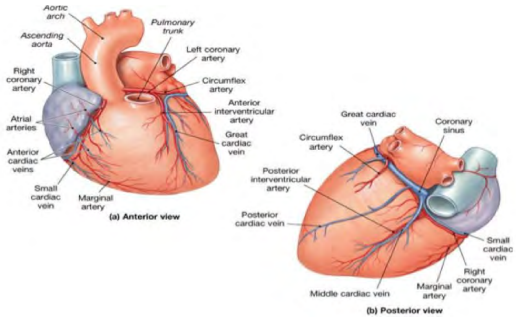


Figure-4: Anatomy of coronary circulation

After flowing through the myocardium, most (80%) of the oxygen-depleted blood is returned to the right atrium by several prominent veins that run along the surface of the heart, like great cardiac vein, one or more left marginal veins and small anterior cardiac veins.

On the posterior side of the heart, the great and small cardiac veins merge with the coronary sinus, which empties into the right atrium. The coronary sinuses also receives blood from the middle cardiac vein that ascends along the posterior interventricular groove and the posterior vein of the left ventricle.

Physiology of cardiovascular system

The events that take place in the heart between successive heartbeats constitute the cardiac cycle. The cardiac cycle is split into two phases: systole (contraction/ejection phase) and diastole (relaxation/filling phase). During systole, the ventricles contract and push blood into the arteries. During diastole, the ventricles relax and receive blood from the atria.

The pumping action of the heart usually maintains a balance between cardiac output and venous return. Cardiac output (CO) is the amount of blood pumped out by each ventricle in one minute. The normal adult blood volume is 5 liters (a little over 1 gallon) and it usually passes through the heart once a minute. Note that cardiac output varies with the demands of the body.

The heart sounds transmitted are due to closing of heart valves, and abnormal heart sounds, called murmurs, usually represent valve incompetency or abnormalities.

Systemic circulation

The systemic circuit originates in the left side of the heart and functions by receiving oxygen-laden blood into the left atrium from the lungs and flows one way down into the left ventricle via the mitral valve. From the left ventricle, oxygen rich blood is pumped to all organs of the human body through the aortic semilunar valve (Figure-5).

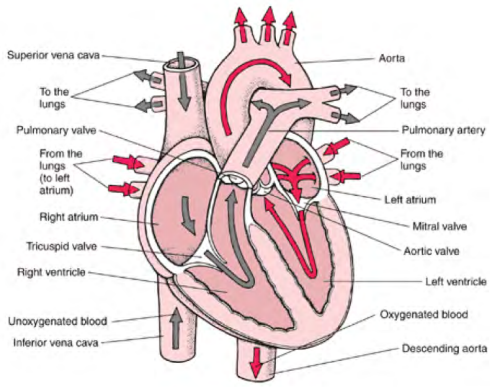


Figure 5: Overvirw of cardiac cycle

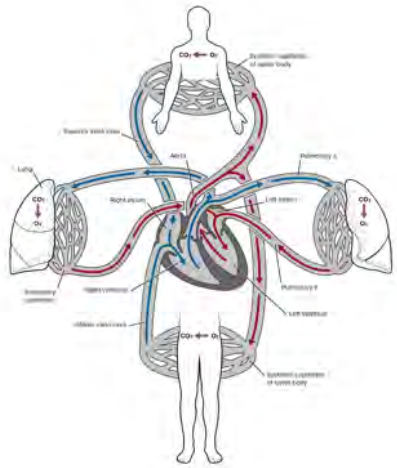


Figure-6: Systemic and pulmonary circulation.

Pulmonary circulation

The pulmonary circuit is on the right side of the heart and serves the function of gas exchange. Oxygen-poor systemic blood reaches the right atrium via 3 major venous structures: the superior vena cava, inferior vena cava, and coronary sinus. This blood is pumped down to the right ventricle via the tricuspid valve and eventually through the pulmonic valve, leading to the pulmonary trunk that takes the oxygen deprived blood to the lungs for gas exchange. Once gas exchange occurs in the lung tissue, the oxygen-laden blood is carried to the left atrium via the pulmonary veins, hence completing the pulmonary circuit (Figure-6).

By the end of a long life, a person's heart may have beat (expanded and contracted) more than 3.5 billion times. In fact, each day, the average heart beats 100,000 times, pumping about 2,000 gallons (7,571 liters) of blood.

Heart failure

With the advances in the therapy of heart attacks, all patients who have survived are at risk of developing heart failure. Advances in treatment are increasing the survival of people longer than ever albeit with the lesser preserved function of the heart. In next two or three decades the incidence and burden of heart failure will increase steeply. The costs of heart failure therapy exceeds most of the other diseases, and the survival is worse than most of the cancers. Moreover the awareness is very little in general population at the current time in India.

Heart failure is not only a physically disabling condition to the person affected, it also causes tremendous financial and emotional stress to both patient and their families. Based on the currently available information the cost of treatment of the heart failure exceeds most ailments including a heart attack, and many cancers.

Nearly 50% of the people who are diagnosed with heart failure die within five years despite several advances in the current day therapy. Hence it is important we increase awareness about heart failure to deal with it in a better and more effective manner.

Definition and epidemiology

Definition of heart failure is "a complex clinical syndrome that can result from any structural or functional cardiac disorder that impairs the ability of the ventricle to fill with or eject blood". In simple language it is a condition when your heart is not able to pump or relax as well as it should do. It is still working but at very low level and may fail to meet your body requirements, especially during stressful circumstances, such as physical or emotional exertion.

Heart failure affects about 1- 2% population worldwide, and the number of people affected increases to about 10% in people over the age of 70 years. Out of these an estimated 50% have problem with contraction of the left ventricle of the heart causing Systolic heart failure, HFrEF (Heart Failure with Reduced Ejection Fraction), and the rest of the 50% have problem with relaxation of the left ventricle, HFpEF (Heart Failure with Preserved Ejection Fraction).

The current European Society of Cardiology guidelines classify heart failure into three categories (Table 1)

Aetiology

There are several known causes for heart failure. Common causes are having blocked arteries (Coronary Artery Disease) causing heart attack, which leads to permanent damage to heart muscle leading to scarring and weakness of the heart. Other causes include chronic alcoholism (Dilated Cardio myopathy), valvular heart diseases, which may be congenital or developed later in the life, high blood pressure, diabetes, congenital (diseases present by birth) and infections especially viral infections. There are some other unusual causes like women with pregnancy (Peri Partum Cardiomyopathy), heart rate abnormalities like too slow or too rapid rates over a period of time, and some rare causes which are beyond the scope of this chapter. In small number of people cause is never known, when it is known as idiopathic.

Symptoms and diagnosis

Unfortunately it is a serious condition. One in 5-6 people who develop heart failure will either require admission or die within a year. However if diagnosed early and with modern day treatment your quality of life can be maintained. The cost of treatment goes higher in people with advanced disease, if in doubt it is always better to investigate sooner than later.

It makes one feel breathless on activity, and sometimes even while resting. Other common symptoms are feeling tired or lethargic, swelling of legs and feet. Some people may have cough at night and on lying flat. There are other non-specific symptoms such as feeling bloated, tired, dizzy etc.

Fortunately it is relatively simple to diagnose the heart failure. An Electrocardiogram (ECG), Echocardiogram and some blood tests will be sufficient in majority of patients to see whether or not heart failure is present. Nowadays, testing blood natriuretic peptide levels has become popular and is widely available, which helps confirm the heart failure in most cases. Some specialised tests may be necessary in few people with suspected heart failure, but it is uncommon. The heart failure is best managed by a Cardiologist and preferably by a heart failure Specialist.

Management

Over the last three decades many trials have been done to develop medication and other therapies for effective treatment of heart failure. For treatment in early stages only tablets may be sufficient. There are several groups of medication currently available. Diuretics form mainstay of treatment for symptom control (Table 2). However as a result of extensive research several groups of medication (Table 3) have proven to be beneficial in management of heart failure patients

In several cases like Dilated Cardiomyopathy, early recognition and treatment might reverse the heart failure altogether. If presented or diagnosed late, or in advanced stages of disease, medical therapy is followed by additional treatment with Artificial Implantable Defibrillators (AICD) especially in high risk groups to prevent Sudden Cardiac Death (SCD) may be necessary. In one third

of the patients heart may lose synchronised beating due to electrical abnormalities associated with heart failure. In these patients a special and advanced Pacemaker called Cardiac Resynchronisation Therapy with Pacing (CRT-P) may be of help not only to improve function, but also to improve their life span. Few patients will benefit most with a combination of CRT-P and ICD called CRT-D (Cardiac Resynchronisation Therapy with Defibrillator). These devices are however very expensive, and many patients in India are unable to afford this therapy.

Advanced and end stage heart failure

Many patients deteriorate despite the best possible therapy they could afford and few due to late presentation and develop "Advanced heart failure" (Table 4). Patients in Advanced heart failure are considered for specialised therapies like Ventricular Assist Devices (VADs) or Cardiac transplantation.

However not all patients are suitable for Cardiac Transplantation. Indications and contra indications are listed in Table 5. Cardiac transplant requires a full work up pre operatively to establish suitability of the candidates. After careful assessment all candidates who fit the criteria will enter a transplant list. In the interim these patients need to be under intensive monitoring to avoid any further deterioration or new problems.

Post Cardiac transplant all patients will be prescribed Immuno suppressive regime to prevent graft rejection. In majority they start feeling better soon and will be able to lead a near normal life with a new heart. However, they are prone for graft rejection, and opportunistic infections in view of immuno suppression. The one year survival is 80%, and ten year survival is about 50% as per the current data.

Much progress has been made in the management of heart failure, but still a lot can be achieved with ongoing and continued efforts of the medical research.

Type	EF & Symptoms	Other Criteria
HFrEF	EF<40% Symptoms +/- Signs	-
HFmEF	EF -40 - 49% Symptoms +/- Signs	Elevated levels of Natriuretic peptides And 1) Relevant Structural heart disease (or) 2) Diastolic dysfunction
HFpEF	EF>50% or more Symptoms +/- Signs	Elevated levels of Natriuretic peptides And 1) Relevant Structural heart disease (or) 2) Diastolic dysfunction

Table 1: Classification of heart failure

Class	Examples
Loop Diuretics	Furosemide Bumetanide Torasemide
Thiazide Diuretics	Bendroflumethiazide Hydrochlorothiazide Metolazone Indapamide
Potassium Sparing Diuretics	Spironolactone/Eplerenone Amiloride Triamterene

Table 2: Types of diuretics used in heart failure

Group of Drugs	Examples
ACEI Angiotensin Converting Enzyme inhibitors	Captopril Enalapril Lisinopril Ramipril Trandalopril
Beta Blockers	Bisoprolol Carvedilol Metoprolol Succinate Nebivolol
ARBs Angiotensin Receptor Blockers	Candesartan Valsartan Losartan
MRAs Mineralocorticoid Receptor Antagonists	Eplerinone Spironolactone
ARNI Angiotensin Receptor and Neprilysin Inhibition	Sacubitril/ Valsartan
If-Channel blocker	Ivabradine

Table 3: Guideline directed medical therapy for heart failure

Criteria for Advanced heart Failure	
1.	Repeated (2 or more) hospitalizations or ED visits for HF in the past year
2.	Progressive deterioration in renal function
3.	Weight loss without other cause (Cardiac cachexia)
4.	Intolerance to ACE inhibitors due to hypotension/or worsening renal function
5.	Intolerance to Beta blockers due to worsening HF or hypotension

6.	Frequent systolic BP <90mmHg
7.	Persistent dyspnoea with dressing or bathing requiring rest
8.	Inability to walk 1 block on the level ground due to dyspnoea or fatigue
9.	Increase in diuretic dose, daily Furosemide dose >160mg and or supplemental Metolazone therapy
10.	Progressive decline in serum sodium, usually to <133mEq/L
11.	Frequent ICD shocks

Table 4: Criteria for advanced heart failure

Indications for Cardiac Transplantation	End stage HF with Severe symptoms, Poor prognosis, with no remaining alternative options Well motivated, well informed, emotionally stable Capable of complying with intensive treatment post operatively
Contra-indications for Cardiac Transplantation	Active infection, Severe peripheral or cerebro vascular disease Irreversible and severe Pulmonary hypertension Active Cancer, Irreversible Renal Dysfunction Other severe co morbid disorders with poor prognosis Severe multi system disorders Current Alcohol or drug dependency Pre transplant BMI >35 Kg/m2 (reduce pre op where possible) Poor social support deemed insufficient to achieve compliant care

Table 5: Indications and contra indications for cardiac transplant.

Suggested reading

1. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine 11th edition.
2. Russell SD, et al. Advanced heart failure; Congest heart Fail. 2008;14:316-21.
3. The heart failure guidelines of ESC (European Society of Cardiology).

CHAPTER 8

Grief Counseling in Deceased Organ Donation

Dr. Bhanu Chandra Dharani Pal.S

Introduction

Majority of the population is not aware of Brain death and have difficulty in accepting the concept of brain death, and this is one of the major reasons that is associated with family refusals. It is vital to spend time ensuring a full understanding of the concept of brain death before discussing organ donation. The key is to give the family as much time as they need and to use language that leaves no room for any doubt whatsoever that brain-stem death is death – not its likelihood, not its inevitability but death itself.

Utilizing diagrams, press releases and useful scans or inviting one or two members of the family to witness brain-stem death tests are all ways in which donor coordinator along with a senior medical professional explain the situation and support the family through the uncertainty.

Despite impressive improvements in some elements of the pathway, there is one crucial outcome that has proven stubbornly resistant to change, namely the proportion of families who give their consent for organ retrieval to take place. Our study in the state of Telangana reveals that the consent rates for donation after brain-stem death (DBD) are gradually improving especially in district areas and in urban regions have become static. Donation after Cardiac death (DCD) has to still begin. Family refusal among some religious and communities represents the biggest 'step down' in loss of potential donors in the whole of the donation pathway and lack of the infrastructure and personnel contribute to non-identification of the potential donors.

"Grief is intense sorrow of a person especially caused by someone's death"

Grief has five stages

1. **Denial:** The relatives refuse to believe the death of their loved one. They feel that the heart is still beating, body is warm or "this cannot be true".
2. **Anger:** The relatives show anger on themselves or some other family member and hospital staff including doctors, nurses, security etc.
3. **Bargain:** The common questions asked by the relatives in this stage are "

   a. Are you sure death has occurred?

   b. Do we need to take a second opinion?

   c. Can we shift the patient to other bigger hospital? etc.

   Thus, family bargains with the counselor demonstrating that they have not yet accepted death
4. **Depression:** The relatives are in a depressed mood and silently recollect the relation with the patient.
5. **Acceptance,** This is the last stage of grief, where the relatives start consulting other family members and approach the counselor for available options. In this stage only, a counselor can make a request for organ donation.

Grief Counseling

Approaching the Family Members

There are three key stages to approaching the families of potential organ donors:

1. Planning,
2. Confirming, a family have understood and accepted their loss (breaking bad news)
3. Discussing, about organ donation

Donation should not be raised until it is clear that a family have understood and accepted their loss. If this is not the case the discussion in which donation is raised should be delayed. Donation should be presented in a way that emphasizes its benefits and should never be described in a negative and apologetic fashion

There is considerable evidence that approaching families in certain ways arbitrarily prompts a premature refusal and avoiding such pitfalls can result in a positive outcome. Approaching the family, convincing them to the inevitability of their loss of a loved one, time of requesting for organ donation have a considerable impact on the outcome and even the type of language used can make a difference to the outcome.

The standard best practice followed worldwide is the counseling is handled by specially trained Donor Coordinator or experienced counselor outside the hospitals and it should be a collaborative effort between the senior medical professional and donor coordinator. Counseling should be in the way to support the family members to deal with their problems and take wise decisions but not be criticizing and demoralizing in nature.

Conclusion

The major goal of grief counselor is to balance the emotions of the family members and make positive behavioral changes in them at the time of grief. The counselor must be a good listener with good communication skills and have control over multiple languages and should have a knowledge in medical, ethical, legal and social aspects. Decoupling method is the best practicing method worldwide where the counselor should never ever mix the grief counselling either with "Brain death" or "organ donation" concepts.

Reference

1. International practices of organ donation. C. Rudge R. Matesanz F. L. Delmonico J. Chapman BJA: British Journal of Anaesthesia, Volume 108, Issue suppl_1, 1 January 2012, Pages i48–i55, https://doi.org/10.1093/bja/aer399, published on 1st January 2012.
2. http://www.grieflink.asn.au/TopicOrganDonation.aspx
3. Lifesharing Community Organ & Tissue Donation, San Diego, CA 92108, USA. dstouder@ucds.edu.
4. Grief Counseling and Grief Therapy, Fourth Edition A Handbook for the Mental Health Practitioner: J. William Worden PhD, ABPP.

CHAPTER 9

Journey from Potential Donor to Actual Donor

Mr. Girish Shetty

Background

"Help A Generation With Organ Donation."[1]

Organ donation is giving an organ to someone else who needs a transplant. Organ donation is an amazingly generous act and saves thousands of lives, every year.[2] Organ donation is when a person allows an organ of theirs to be removed, legally, either by consent while the donor is alive or after death with the assent of the next of kin. Donation may be for research, or, more commonly, healthy transplantable organs and tissues may be donated to be transplanted into another person, but most donations occur after the donor has died.

As of 2 February, 2018, there were 115,085 people waiting for life-saving organ transplants in the US. Of these, 74,897 people were active candidates waiting for donor. While views of organ donation are positive there is a large gap between the numbers of registered donors compared to those awaiting organ donations on a global level.[3] Organ transplantation is one of the greatest medical marvels of the twentieth century, which has prolonged and improved the lives of hundreds of thousands of patients, worldwide. Countless acts of generosity by organ donors and their families have made transplantation not only a live saving treatment but also a shining symbol of human solidarity.

The disparity between the huge demand for organs and their poor supply is the main issue of concern. Organ shortage is a global issue and deceased organ donation is the major sustainable solution.

This article attempts to look at the existing challenges and ongoing efforts being implemented to circumvent the problems that interfere with Identification of potential donor for successful running of the organ donation programme.[4]

Potential deceased donor identification

Organ donation after brain death has gained momentum in India in last few years. Telengana State is leading the programme in active organ transplantation across the country. The greatest problem in the transplant world is lack of donors and, consequently, insufficient organs for the current number of existing recipients.

Brain death is the total and irreversible loss of all brain function and the circumstance under which the donation of vital organs most commonly takes place.

The concept of brain death is often difficult for families to come to terms with when dealing with a tragic loss. Their loved one who has suffered from an injury to the brain is in a hospital intensive care unit. Doctors are doing everything possible to help the patient including supporting blood pressure and heart rate with medications, breathing for the patient with a ventilator, and constantly monitoring the patient's condition. Often, for the patient with a non-traumatic brain injury like a stroke, there is no outward sign that their loved one has suffered a devastating and non-survivable injury to the brain. The patient looks to be asleep, is warm to touch and appears to breath, albeit with the help of a machine.

It is under these circumstances that families are asked to understand that their loved one has died. It is also under the same scenario that organ donation is presented as an option in order to give life to others.[5]

Organization of the identification, referral and consent processes

1. Each hospital should have a policy and protocol that is consistent with these recommendations for identifying patients who are potential donors and managing the consent process.
2. Each hospital should identify a clinical team to ensure the development, implementation and regular review of their policies.
3. If it is Intensive Care Unit (ICU) doctor who decide on possible donors and who conduct the family meet. If the ICU doctor informs the transplant coordinator of a possible brain death situation, and it is the latter who evaluates the patient as a possible donor and who conducts the family interview, this is the best way to ensure that a potential donor is properly evaluated using the most current criteria.
4. That the interview is conducted by a professional.
5. The skills and competencies required of the individual members of the team will depend on their role in the process.

However, all healthcare professionals involved in identification, specially Transplant coordinators should have following qualities

1. Knowledge of the basic principles and the relative benefits of, donation after circulatory death (DCD) versus donation after brainstem death (DBD).
2. Understand the principles of the diagnosis of brain death.

3. Be able to explain brain death clearly to families.
4. Understand the use of clinical triggers to identify patients who may be potential organ donors
5. Understand the processes, policies and protocols relating to donor management.
6. Adhere to relevant professional standards of practice regarding organ donation and end-of-life care.
7. Referral to a transplant coordinator for organ donation, and consent processes

The term donor detection may lead to confusion and error as it certainly has different meanings in the various transplant coordination systems. It would be correct to use the term "potential donor detection." This is because it is important to detect patients who, due to their neurological status, are nearing a situation of brain death or may possibly become brain dead. The "Glasgow Coma Scale" is an excellent marker for the neurological status and on occasions may be used as a predictive value of brain death, particularly with scores of 5 or below. Evidently this type of patient would be found in the different critical care units which are the units that the transplant coordinator should prioritize.

Who is responsible for donor detection and how is it conducted?

The relations between the transplant coordinator and critical care units are fundamental to ensure that all patients in brain death situations or those nearing it are evaluated for the possibility of organ and/or tissue donation.

The collaboration of the transplant coordinators is important because of the many changes in both donor profiles and acceptance criteria, which requires the professionalization's of this task.

The most difficult question to answer is how donor detection should be conducted. Relations between different structures and healthcare professionals within health systems vary and at times are not very flexible, and this is what defines where the transplant coordinator may operate.

The ideal would be that all patients in situations close to brain death or who is brain dead be referred to the transplant coordinator irrespective of their underlying disease or medical history. In reality this does not happen, and therefore the coordinator must seek alternative methods of finding out about this pool of patients.

- The administrative route, where the coordinator has a list of all the patients admitted on the previous day to ICU and their diagnosis. The coordinator may then monitor their progress and be prepared for possible cases of brain death.
- The most commonly used process is the visiting process, where the transplant coordinator "visits" the units that may produce donors to obtain first-hand knowledge of the status of patients in neurocritical care.

Brain death occurs when a person has an irreversible, catastrophic brain injury, which causes total cessation of all brain functions (the upper brain structure and brain stem). It is important to be informed about all the possible donors or better still about all cases of suspected brain death.

The diagnosis of brain death is primarily clinical.

1. No other tests are required if the full clinical examination, including each of two assessments of brain stem reflexes and a single apnea test, are conclusively performed.
2. In the absence of either complete clinical findings consistent with brain death, or confirmatory tests demonstrating brain death, brain death cannot be diagnosed.
3. What is the legal time of death for a brain dead patient?
4. The legal time of death is the date and time that doctors determine that all brain activity has ceased. This is the time that is noted on the patient's death certificate.

Consent for organ donation

Organ transplantation has a major role in the management of organ failure –that is, of a single organ system of the kidneys, small bowel, liver, pancreas, heart, or lung, and of combined organ failure of the heart and lung, the kidney and pancreas, the liver and kidney, or liver and small bowel. Transplants may be needed because of primary organ disease, such as chronic inflammatory disease of the kidneys or cardiomyopathy, or because of secondary effects of a disease – for example, people with diabetes needing kidney, islet cell and/or pancreas transplants, and people with cystic fibrosis needing lung transplants.

There is a shortage of organs for transplant resulting in long waits for transplantation and a significant number of deaths among those awaiting transplantation, and among those not considered for transplantation because of organ scarcity.

Many reviews of organ donation have been done, but all failed to resolve the problems that result from the lack of a structured and systematic approach to organ donation. This guideline focuses on identifying potential donors and obtaining consent for solid organ donation under current legislation. It aims to help address the burden of disease by increasing the availability of organs for transplant.

Approach to those close to the patient

The Organ Donor Register now allows anyone to register a decision to donate, not to donate or to nominate a representative to make a decision after their death.

The approach should be through multidisciplinary team (MDT) and MDT should include the medical, transplant coordinator, medical social worker, nursing staff involved in the care of the patient, the specialist nurse for organ donation and should be led throughout the process by an identifiable consultant

Whenever possible, continuity of care should be provided by team members who have been directly involved in care of the patient. The MDT involved in the initial approach should have the necessary skills and knowledge to provide to those close to the patient appropriate support and accurate information about organ donation.

Points to be discussed with the family members

A. Before approaching those close to the patient:

1. Identify a patient's potential for donation in consultation with the specialist nurse for organ donation/ transplant coordinator.
2. Check the state organ donor register and any advance statements or Lasting Power of Attorney for health and welfare
3. Clarify coronial, legal and safeguarding issues.

B. Before approaching those close to the patient, try to seek information on all of the following:

1. knowledge of the clinical history of the patient who is a potential donor
2. identification of key family members
3. assessment of whether family support is required – for example faith representative, family liaison officer, bereavement service, trained interpreter, advocate
4. Identification of other key family issues
5. Identification of cultural and religious issues that may have an impact on consent.
6. Approach those close to the patient in a setting suitable for private and compassionate discussion.
7. Every approach to those close to the patient should be planned with the MDT and at a time that suits the family's circumstances.
8. In all cases those close to the patient should be approached in a professional, compassionate and caring manner and given sufficient time to consider the information.
9. Discussions about organ donation with those close to the patient should only take place when it has been clearly established that they understand that death is inevitable or has occurred.

C. When approaching those close to the patient:

1. Discuss with them that donation is a usual part of the end-of-life care
2. Use open-ended questions – for example 'how do you think your relative would feel about organ donation?

3. Use positive ways to describe organ donation, especially when patients are on the expressed a wish to donate during their lifetime – for example 'by becoming a donor your relative has a chance to save and transform the lives of many others'

4. Avoid the use of apologetic or negative language (for example 'I am asking you because it is policy' or 'I am sorry to have to ask you').

D. The healthcare team providing care for the patient should provide those close to the patient who is a potential donor with the following, as appropriate:

1. assurance that the primary focus is on the care and dignity of the patient (whether the donation occurs or not)

2. explicit confirmation and reassurance that the standard of care received will be the same whether they consider giving consent for organ donation or not

3. the rationale behind the decision to withdraw or withhold life sustaining treatment and how the timing will be coordinated to support organ donation a clear explanation of, and information on:

4. the process of organ donation and retrieval, including post-retrieval arrangements

5. what interventions may be required between consent and organ retrieval

6. where and when organ retrieval is likely to occur how current legislation applies to their situation

7. consent documentation

8. Reasons why organ donation may not take place, even if consent is granted.

E. Allow sufficient time for those close to the patient to understand the inevitability of the death or anticipated death and to spend time with the patient.

F. Discuss withdrawal of life-sustaining treatment or neurological death before, and at a different time from, discussing organ donation unless those close to the patient initiate these discussions in the same conversation.

G. For discussions where circulatory death is anticipated, provide a clear explanation on:

1. What end-of-life care involves and where it will take place – for example, theatre, critical care department

2. How death is confirmed and what happens next

3. What happens if death does not occur within a defined time period.

H. For discussions where neurological death is anticipated, provide a clear explanation on:

1. How death is diagnosed using neurological criteria

2. How this is confirmed and what happens next.

Conclusion

Transplant coordinator has a list of all the patients admitted on the previous day to ICU and their diagnosis. The coordinator may then monitor their progress and be prepared for possible cases of brain death. The most commonly used process is the visiting process, where the transplant coordinator visits the units that may produce donors to obtain first-hand knowledge of the status of patients in neurocritical care. The relations between the transplant coordinator and critical care units are fundamental to ensure that all patients in brain death situations or those nearing it are evaluated for the possibility of organ and/or tissue donation.

References

1. https://www.thereshquotes.com/donate-organs-save-lives-slogans-quotes/
2. https://www.organdonation.nhs.uk/about-donation/what-is-organ-donation/
3. https://en.m.wikipedia.org/wiki/organ_donation
4. http://www.neurologyindia.com/text.asp?2018/66/2/316/2275259 (Deceased organ donation and Transplantation in India: Promises and challenges)
5. http://www.donorrecovery.org/learn/understanding-brain-death/
6. shttps://www.nice.org.uk/guidance/cg135/evidence/organ-donation-full-guideline-1s84994893

CHAPTER 10

Brain Death Certification

Dr. Muralidhar Reddy Y | Dr. Manish Patni

Introduction

Brain death is a state of permanent cessation of all functions of the brain including consciousness, cardiac and respiratory drive but with preserved cardiopulmonary function maintained on mechanical ventilation. This is an ideal state to harvest viable organs from an individual for organ transplantation. India enacted a law in 1994 to legalize brain-stem death.[1] However, due to limited awareness and misconceptions over the certification procedure, brain death is not promptly declared. In this chapter, we attempt to review the concept of brain death and certification procedure.

Concept of brain death

Before 1960, death declaration was done when complete and irreversible cessation of spontaneous cardio-respiratory functions occurred.[2,3] By latter half of twentieth century, with the advent of mechanical ventilators which enabled temporary support of cardiopulmonary function in patients with irreversible brain damage, cardiopulmonary definition of death lost relevance and concept of brain stem death has evolved. It is a state where patient is dead (brain dead) while heart is still beating.

Two French physicians, Mollart and Goulon were the first to describe brain death and termed it 'coma depasse' (a state beyond coma).[4] In 1968, the Ad Hoc Committee of the Harvard Medical School defined brain death as a state of irreversible coma, with absent reflexes and no spontaneous respiratory effort during a 3-minute period of disconnection from the ventilator.[5] In 1995, the American Academy of Neurology (AAN) published the practice parameters for the diagnosis of brain death.[6] Indian parliament enacted Transplantation of Human Organs Act (THOA) in 1994 and subsequently amended in 1995, 2008, 2009, 2011, 2013 and 2014.[7-9]

Brain death determination

Brain death determination is done in a step wise manner. It consists of four steps as shown in flow chart (Figure 1).[10] Each step is discussed in detail below.

Step 1	PREREQUISITES
Step 2	NEUROLOGICAL EXAMINATION
Step 3	ANCILLARY TESTS
Step 4	DOCUMENTATION

Figure 1: Flow chart showing steps in brain death confirmation

STEP I: Prerequisites

1. Establish the irreversible cause of coma: Exclude intoxication due to alcohol or central nervous system (CNS) depressing drugs, muscle relaxants, severe electrolyte and acid base disturbances. It can be done by history, clinical examination, neuroimaging or appropriate laboratory tests.
2. Achieve normal body temperature. Warming blankets and cold sponging may be used depending on the situation.
3. Achieve normal systolic blood pressure (≥ 100 mmHg). Inotropes (Noradrenaline or Vasopressin) may be used judiciously.

STEP II: Neurological examination

v It includes establishment of absent brain stem mediated reflexes and absent respiratory drive on apnea test. These are outlined in Table 1 & 2.

Test	Technique	Result consistent with brain stem death	Comments
Motor response to pain	Apply thumb pressure over supraorbital groove or temporomandibular joints or pressure over sternum	Absence of facial grimacing or any movement. Spinal mediated reflex movements are acceptable (Lazarus sign)	Peripheral nerve stimulator is used to stimulate if NM blockers are administered recently
Pupillary response to light	Observe both pupils for a minute and later with bright light shone into both eyes	Widely dilated (4-9mm) pupils with no response to bright light	Pupils should be examined for a minimum of one minute to avoid missing slow responses

Corneal Reflex	Briskly turn the head horizontally and vertically keeping eyelids retracted watching for ocular movements	Absence of any ocular movement	Best avoided in subjects of cervical spine injuries
Oculovestibular Reflex	Keeping subject's head elevated to 30 degrees and in the center; a soft catheter is introduced into the external auditory canal and irrigated slowly with at least 50 ml of ice-cold water. Eyes are held open by an assistant and observed for one minute after the irrigation is completed. It is repeated later on the other side (use different catheters for both ears)	Absence of any deviation of eye towards opposite side (eyes remain fixed with no movement)	Best avoided in subjects with cervical spine injuries and skull fractures with ear bleed; cold air may be used if eardrum is perforated
Gag Reflex	Stimulate both side of oropharynx with tongue depressor or suction catheter	Absence of any palatal or tongue movement	Best avoided in intubated patients
Cough Reflex	Pass a suction catheter into endotracheal tube or tracheostomy tube to deliberately stimulate carina	Absence of any cough response or chest or diaphragm movements	-

Table 1: Table showing examination technique and results of brain stem reflexes

Apnea testing is essential for confirmation of brain stem death.

When to be carried out? - All prerequisites have been met and all other brain stem reflexes are absent.

What are the prerequisites? - core temperature of ≥ 36.5 degree Celsius; systolic blood pressure (SBP) of ≥ 90 mm Hg; presence of euvolaemia (preferably a positive fluid balance in the previous 6 hours; normocapnea (arterial pCO2 ≥40 mm Hg).

What are the brain stem reflexes? - All the tests described in Table 1.

How to perform the test?

Step 1: Preoxygenate for at least 10 minutes with 100% oxygen, reduce ventilation frequency to 10 breaths per minute, reduce Positive End Expiratory Pressure (PEEP) to 5 cm H2O to maintain oxygen saturation (SpO2) ≥ 95
Step 2: Draw an ABG (Pre test) and note the arterial oxygen (pO2) and carbon-dioxide (pCO2)
Step 3: Disconnect the ventilator and pass an insufflations catheter till the level of carina and deliver 100% oxygen at 6 L/min for 8-10 minutes observing for spontaneous respiratory movements keeping a watch on arterial blood pressure and SpO2 on the monitor
Step 4: Draw an ABG (Post test) and reconnect the ventilator.

When to abandon the test?

Abandon before step 1 & 2: If all prerequisites are not met and one or more brain stem reflexes are present.

Abandon before step 3: If pCO2 in the pre test ABG is < 40 mmHg and pH < 7.2.

Abandon before step 4: If respiratory movements enough to generate tidal volumes are present; SBP falls to ≤ 90 mmHg, Sp02 < 85 for more than 30 seconds and cardiac arrhythmias.

How to interpret the result?

Positive: If the respiratory movements are absent and the arterial pCO2 is ≥60 mmHg (or a 20mm Hg increase in the pCO2 over the baseline value).

Table .2: Technique and interpretation of Apnea test

STEP III: Ancillary tests

One or more ancillary tests should be done if apnea test could not be done or the results are inconclusive. These include Electroencehalography (EEG), Cerebral angiography, Transcranial Doppler Ultrasonography (TCD), Tc 99 isotope scan and Somatosensory evoked potentials (SSEPs).

Electro-cerebral silence on EEG is a reliable confirmatory test for the diagnosis of brain death (Figure 2).[11] EEG recording protocol for brain death confirmation requires recording by 16 or 18-channels for minimum of 30 minutes and measured at sensitivity of 2 microvolts.[12] However, EEG can be fallacious due to many non biological artefacts in intensive care units (ICUs). Moreover, it can be affected by hypothermia, metabolic derangements and CNS depressant drugs. Despite these shortcomings, it continues to be most commonly used ancillary test.

Demonstration of absent arterial flow in intracranial vessels by four-vessel cerebral angiography is a gold standard ancillary test for establishing brain death. However, this technique is invasive and not feasible all times. MR angiography or CT angiography (Figure 3) can be used alternatively.[11,13-14] However, these tests are not validated.

Small systolic peaks or reverberating flow (Figure 4) on Transcranial Doppler (TCD) is accepted as reliable test for confirmation of brain death by AAN.[15] TCD is an easy, convenient and repeatable bed side test to assess the flow in the major intracranial arteries.[16] TCD recording protocol for brain death confirmation requires assessment of flow in bilateral middle cerebral arteries and basilar artery for at least 30 minutes.[17]

No uptake of isotope in the brain parenchyma (hollow skull phenomenon) by radionuclide imaging techniques, like the technetium 99 m scan is also a reliable ancillary test to confirm brain death.[18]

Demonstration of absent P14 trace by nasopharyngeal SSEP recording is a valuable confirmatory test for brain death.[19] However, the test is technically demanding and not validated.[20]

Figure.2: 16 channel EEG showing electro cerebral silence with ECG artefacts

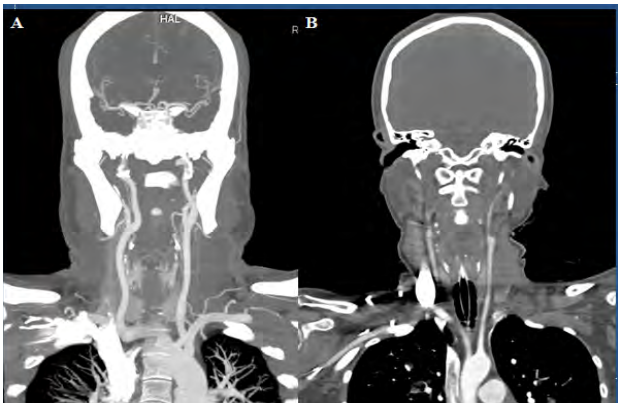


Figure. 3: CT angiography showing normal opacification of extracranial and intracranial vessels (A) and non visualisation of intracranial circulation in a brain dead patient (B)

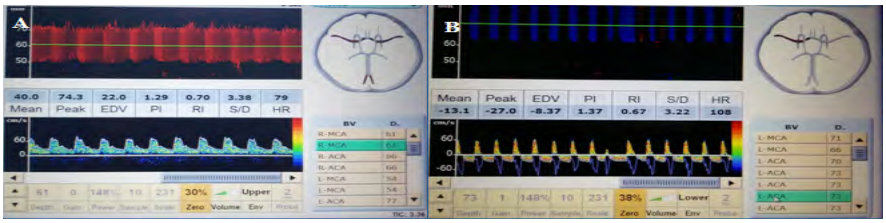


Figure.4 (A-B): TCD traces of a normal middle cerebral artery flow (A) and a brain dead patient showing reverberatory flow in anterior cerebral artery (B)

STEP IV: Documentation

In India, according to the Transplantation of Human Organs (THO) Act, 1994 (Sub section 6 of Section 3) brain stem death has to be certified by a board of medical experts consisting of (1) The medical superintendent (MS) / In-Charge of the hospital (2) a specialist, (3) a neurologist or a neurosurgeon nominated by the MS, from a panel approved by the appropriate authority, and the doctor under whose care the brain- stem death has occurred.[7] Amendments in the THO Act 2011 have allowed selection of a surgeon/physician and an anaesthetist, if an approved neurosurgeon or neurologist is unavailable.[8] Time of death is the time the arterial PCO2 reached the target value. In patients with an aborted apnea test, the time of death is when the ancillary test has been officially interpreted. The details are documented in the format shown in Figure 5.

BRAIN-STEM DEATH CERTIFICATE

(A) Patient Details:

1. Name of the patient — Shri / Smt. / Km. _____

   S/o, D/o, W/o Shri _____

   Sex _____ Age _____

2. Home Address _____

   _____

   _____

3. Hospital Number _____

4. Name and Address of next of kin or person responsible for the patient (if none exists, this must be specified) _____

   _____

   _____

   _____

5. Has the patient or next of Kin agreed to any transplant? _____

   _____

   _____

6. Is this a Police Case? Yes _____ No _____

(B) Pre-Conditions:

1. Diagnosis: Did the patient suffer from any illness or accident that led to irreversible brain Damage? Specify details _____

   _____

   Date and time accident/onset of illness _____

   Date and onset of non-responsible coma _____

2. Findings of Board of Medical Experts:

   (1) The following reversible causes of coma have been excluded:-

   Intoxication (Alcohol)

   Depression Drugs

   Relaxants (Neuromuscular blocking agents)

	First Medical Examination		Second Medical Examination	
	1st	2nd	1st	2nd

Primary hypothermia

Hypovolaemic shock

Metabolic or endocrine disorders

Tests for absence of brain-stem functions

(2) Coma

(3) Cessation of spontaneous breathing

(4) Pupillary size

(5) Pupillary light reflexes

(6) Doll's head eye movements

(7) Corneal reflexes (Both sizes)

(8) Motor response in any cranial nerve distribution, any responses to stimulation of face, limb, or trunk

(9) Gag reflex

(10) Cough (Tracheal)

(11) Eye movements on coloric testing bilaterally

(12) Apnoea tests as specified

(13) Were any respiratory movements seen?

Date and time of first testing

Date and time of second testing

This is to certify that the patient has been carefully examined twice after an interval of about six hours and on the basis of findings recorded above, Shri. / Smt. / Km. _____ is declared brain-stem dead.

Signature _____

1. Medical Administrator Incharge of the hospital.
2. Authorized Specialist.
3. Neurologist/Neurosurgeon.
4. Medical Officer treating the patient.

NB: I. The minimum time interval betw-een the first testing and second testing will be six hours.

II. No.2 and No.3 will be co-opted by the Administrator Incharge of the hospital from the Panel of experts by the appropriate authority.

Brain Death Declaration Form

We, the following members of the Board of medical experts after careful personal examination, hereby certify, hereby certify that Shri. / Smt. / Km. _____ aged about _____ S/o, D/o, W/o, Shri. _____ resident of __ _____ _____ is dead on account of permanent and irreversible cessation of all functions of the brain-stem. The tests carried out by us and the findings therein are recorded in the Brain-Stem Death Certificate annexed here to.

Dated _____ Signature _____

1. Medical Superintended of the hospital
2. An independent Medical Practitioner Nominated by the Medical Superintendent of the Hospital /AACT
3. A Neurologist or Neurosurgeon nominated By the Medical Superintendent of the Hospital/AACT
4. The doctor on-duty treating the patient

Figure. 5: Brain death certificate and Declaration form

Case scenario -1

Ms. S, A 26-yr-old female sustained right parietal and temporal bone fracture, left sided multiple rib fractures (1 -11) and hemothorax, multiple vertebral fractures and right scapular fracture in a road traffic accident. She was intubated in view of GCS (Glasgow Coma Scale) [3]. She developed hypovolemic shock and haemoglobin was 2.5 gm/dL. She was transfused with two units of packed cells and started on vasopressor support. Intercostal tube drainage tube was placed in left pleural cavity and referred to our hospital 24 hours later. At admission, she was deeply comatose with no motor response to pain, dilated and fixed pupils, absent vestibuloocular, vestibulocaloric, gag and cough reflexes. She was maintaining blood pressure on high dose of noradrenaline and vasopressin. Twelve hours later, her condition was same with all absent brain stem reflexes. Apnea test could not be done in view of severe metabolic acidosis and hypocapnia despite correction with rebreathing mask (pH 7.20 & PaCO2 21.6 mmHg). Ancillary tests were done. EEG showed electro cerebral silence. TCD showed reverberating flow in bilateral middle cerebral arteries and basilar artery. She was certified brain dead.

Case scenario-2

Mr. G.M, A 25-yr-old male sustained polytrauma in a road traffic accident and became unconscious immediately. He developed cardiac asystole and revived immediately and intubated. He sustained right odontoid fracture and developed miminal bilateral hemithorax. He was referred to our hospital 24 hours later. At admission he was deeply comatose with no motor response to pain, bilateral pupils 2 x 2 mm and reacting to light and trigger on ventilator. He was maintaining blood pressure on noradrenaline. One day later he developed another cardiac arrest, revived and started on fentanyl infusion which was stopped one day later. 24 hours after stopping sedation, she was deeply comatose with no motor response to pain, dilated and fixed pupils, absent vestibuloocular, vestibulocaloric, gag and cough reflexes. Apnea test was positive (Pre test ABG: pH 7.42; PaCO2 39.4mmHg; Post test ABG- pH 7.20; PCO2 72.2 mm Hg). Apnea test was positive. He was certified brain dead.

Conclusion

Human organs are natural resources. There is a large unmet need for these resources. With the increasing availability of ICUs in towns and small cities, many critically ill patients are revived. However, despite the best medical care, a fraction of them may end up being brain dead. It is the need of the hour to sensitise the medical and paramedical staff at all ICUs about the concept of brain death and procedure of certification so that families are explained about the condition if need arises.

Acknowledgments

My mother: Mrs. Anuradha Y; my wife: Dr. Vijayamadhuri S; my mentor: Dr. JMK Murthy.

References

1. Transplantation of Human Organs Act, 1994. Act no. 44 of 1994. Govt. of India with Appendix
2. Camps FE, editor. Gradwhol's Legal Medicine. 2nd ed. Bristol: John Wright and Sons Ltd; 1968. p. 80.
3. Sharma BR, Harish D. Organ transplantation programme - An overview of the present scenario. J Med Sci Law 2004;44:245-51
4. Mollart P, Goulon M. Le coma dépassé. Rev Neurol 1959; 101:3-15.
5. A definition of irreversible coma. Report of the AdHoc Committee of the Harvard Medical School to examine the definition of brain death. JAMA 1968; 205:337-40.
6. American Academy of Neurology Practice parameters for determining brain death in adults (summary statement). The Quality Standards Subcommittee of the American Academy of Neurology. Neurology 1995;45:1012-4
7. The Transplantation of Human Organs (Amendment) Act, 2008.
8. The Transplantation of Human Organs (Amendment) Act, 2011.

9. The Transplantation of Human Organs (Amendment) Act, 2014

10. Wijdicks EF, Varelas PN, Gronseth GS, Greer DM, American Academy of Neurology. Evidence-based guideline update: Determining brain death in adults: Report of the quality standards subcommittee of the American academy of neurology. Neurology 2010; 74:1911-8.

11. Wijdicks EFM. The diagnosis of brain death. N Engl J Med 2001;344:1215-21

12. Guideline three. Minimum technical standards for EEG recording in suspected cerebral death. J Clin Neurophysiol 1994;11:10-13

13. Ishii K, Onuma T, Kinoshita T, Shiina G, Kameyama M, Shimosegawa Y. Brain death: MR and MR angiography. AJNR Am J Neuroradiol 1996; 17: 731-5.

14. Dupas B, Gayet-Delacroix M, Villers D, Antonioli D, Veccherini MF, Soulillou JP. Diagnosis of brain death using twophase spiral CT. Am J Neuroradiol 1998;19:641– 647

15. American Academy of Neurology, Therapeutics and Technology Assessment Subcommittee. Assessment: Trans-cranial Doppler. Neurology 1990; 40: 680-1.

16. Li, Y., Liu, S., Xun, F., Liu, Z., & Huang, X. (2016). Use of Transcranial Doppler Ultrasound for Diagnosis of Brain Death in Patients with Severe Cerebral Injury. Medical Science Monitor : International Medical Journal of Experimental and Clinical Research, 22, 1910–1915.

17. Segura T, Calleja S, Irimia P, Tembl JI; Spanish Society of Neurosonology. Recommendations for the use of transcranial Doppler ultrasonography to determine the existence of cerebral circulatory arrest as diagnostic support for brain death. Rev Neurosci. 2009; 20(3-4):251-9.

18. Facco E, Zucchetta P, Munari M, Baratto F, Behr AU, Gregianin M, et al. 99mTc-HMPAO SPECT in the diagnosis of brain death. Intensive Care Med 1998;24:911-7

19. Ying Z, Schmid UD, Schmid J, Hess CW. Motor and somatosensory evoked potentials in coma: Analysis and relation to clinical status and outcome. J Neurol Neurosurg Psychiatry 1992;55:470-4

20. Wagner W. Scalp, earlobe and nasopharyngeal recordings of the median nerve somatosensory evoked P14 potential in coma and brain death. Brain 1996; 119:1507–1521.

CHAPTER 11

Evaluation and Management of Potential Donor

Dr. Padmaja Durga

Introduction

The deceased donor organ donation rate in India is only 0.8 per million as compared to Spain (32 per million), USA (25.6 per million) or UK(18.3 per million). Optimal management is essential to improve the donor pool and the graft survival after donation. Once the futility of neurological recovery is determined, the decision to stop or remove specific brain-related intensive treatments needs to be taken but the extra-cranial physiological support may be continued till the determination of brain death or very severe irreversible brain damage. Guidelines for management of patients with severe neurological injuries may improve outcomes neurologically devastating injuries. The same practices may also improve perfusion and function of the remaining organs if these patients regress to neurological death and subsequently and become donors as well. The widespread physiological changes and generalized inflammatory and hormonal changes associated with brain death adversely affect donor organ function and propensity to rejection. The quality of donor management is a major determinant of the outcome of donation after brain death (DBD). Focused critical care management of potential donor improves the number of organs retrieved and also the outcomes of transplantation. The potential donor optimization and aggressive management should begin long before the declaration of a neurological determination of death (brain death) and continue till organ recovery. A multispeciality involvement and critical care is important to maximize potential organ retrieval.

General care of potential organ donors in ICU

General measures of infection control in the ICU should be applied

1. Hand hygiene
2. Frequent turning of patient for decubitus ulcer prophylaxis
3. Urinary and intravascular catheter care must be meticulous
4. Bronchial toilet - Improves elimination of secretions and therefore improves chances of lung donation
5. Eye care
6. Insert nasogastric tube must be inserted for gastric decompression and prevention of aspiration
7. Arterial and central venous lines should be inserted preferably into the upper extremities

The pathophysiological changes that follow severe cerebral injury and brain death have implications for management of the potential donor in the ICU (Table-1)

Pathophysiological Change	Consequence	Implication
Cardiovascular		
Negative feed back through carotid and aortic sinuses. Vagal activation. Entire cerebrum ischemic Compression of brain stem Vagal cardiomotor nucleus became ischemic	Cushing phenomenon Activation of Cardioaccelaratory Fibres Sympathetic nervous outflow Unopposed sympathetic stimulation High blood levels of catecholamine (i.e., autonomic storm) Results in Hypertension/ Bradycardia or Tachycardia and Hypertension	Brief and attempts to reduce blood pressure may not be necessary or even not be recommended
Tonsillar herniation. Outflow of the cardioaccelerating and vasomotor neurons to the spinal cord suddenly ceases	Loss of sympathetic tone, Myocardial dysfunction, Decreased systemic vascular resistance Results in Decrease in heart rate Mean arterial pressure, and cardiac output	Adequate volume replacement with balanced salt solution or colloid solution and, in some cases, blood transfusion is required. Inotropic agents, such as dopamine, epinephrine, and norepinephrine to maintain an adequate blood pressure. Hypotension, if untreated, leads to hypoperfusion of all organs, including the heart, and may contribute to rapid donor loss

The vasomotor and cardioaccelerating neurons of the spinal cord obtain automaticity	Arterial blood pressure returns to normal	
Respiratory		
Dysfunction of medullary respiratory neuron	Spontaneous respiration does not occur in patients even when PaCO2 reaches 55 to 60 mm Hg	
Raised pulmonary hydrostatic pressure Capillary endothelial damage triggered by endogenous norepinephrine.	Neurogenic pulmonary oedema	Diminished oxygenation
Regulation of Body Temperature		
Neural connection between the temperature-regulating center and peripheral body tissues is lost. Reduction in metabolic rate and muscle activity and peripheral vasodilatation	Patient becomes poikilothermic tends to be hypothermic	Hypothermia even with vigorous application of external heat Even if infection occurs, fever does not develop
Hypothalamic-Pituitary Endocrine Functions		
Hypothalamic and anterior pituitary functions are preserved to a certain degree because of preserved pituitary blood flow. Level of vasopressin decreased sharply after brain death	Hypernatremia and hypokalemia Plasma levels of the thyroid hormones triiodothyronine (T3) and thyroxin (T4) decreased markedly 'euthyroid sick syndrome' Insulin concentrations decreases	Hypernatraemia and dehydration Hyperglycaemia and insulin resistance common Hormonal therapy for hemodynamic stabilization of brain-dead organ donors recommended. Hormonal treatment of brain-dead donors (T3/T4, methylprednisolone, and arginine vasopressin) revealed significant increases in organs transplanted and in 1-year survival of kidneys and hearts
Immune System		
CNS exerts significant influence over the immune system	Increased levels of inflammatory mediators, such as cytokines (IL-1β, IL-6, TNF-α) [49] [50] and adhesion molecules (E-selectin, ICAM-1, VCAM-1) in blood and in organs	Cytokines are responsible for some of the endocrine and acute-phase reactant abnormalities found in these patients and for the low success rates after organ transplantation.
Coagulation		
Release of tissue thromboplastin from necrotic brain in brain death	Disseminated intravascular coagulation in donors	Coagulopathy is present in up to 34%

Table-1: Pathophysiological changes in severe cerebral injury and brain death and their implications

Monitoring

Monitoring is a crucial part of the medical management of potential organ donor. The following monitoring and investigations are required.

A. Routine monitoring

1. ECG, BP, pulse oximetry
2. Core temperature
3. Hourly urine output
4. Central venous pressure

B. Advanced

1. Bedside echocardiography- Assessment of fluid deficit, cardiac dysfunction
2. Swan-Ganz catheter/cardiac output monitors -For unstable donors, who have persistent acidosis with the evidence of tissue hypoperfusion

Investigations

1. Arterial blood gas, lactate, electrolytes, and blood sugar levels - every 2-4 hourly
2. Hemoglobin, hematocrit, complete blood count
3. Urine analysis
4. Blood urea nitrogen, serum creatinine
5. Liver function tests
6. Coagulation profile
7. Microbiological screening for hepatitis B, C, hepatitis B core antigen, HIV
8. IgM and IgG for cytomegalovirus
9. Cultures of blood and urine -if there is evidence of infection or if the patient is hospitalized for more than 72 h
10. Additional tests
    a. Echocardiography for heart donor
    b. Bronchoscopy for lung transplantation

Management

Specific management for organ donors depends on the existing compromises and the organs are being considered for transplantation.

Management goals

Standard goals – Simple way to remember- the 'rule of 100'

1. Systolic arterial pressure 100 mm Hg,
2. Urine output .100 ml /h
3. PaO2.100 mm Hg
4. Hemoglobin concentration 100 g/ litre
5. Blood sugar 100mg/dl

The medical management of organ donor should include management of respiratory parameters hemodynamics, metabolic derangement, temperature management, respiration and hematological parameters and nutrition management.

A. Ventilation

The donor lungs must be able to achieve a PaO2 of 50 kPa with an FiO2 of 1.0 and a PEEP of 5 cm.

Ventilatory strategies aim to protect the lung whilst optimizing oxygenation.

1. Tidal volumes of 6–8 ml/ kg
2. Ideal 5–10 cm H2O (treatment of pulmonary oedema and preventing alveolar collapse)
3. PEEP >10 cm H2O may be associated with lung damage or induce hypotension.

If the lungs are considered for transplantation

1. FiO2 should be as low as necessary to achieve a PaO2>10 kPa
2. PEEP should be limited to 5–10 cm H2O.
3. Fluid loading to a CVP greater than 6 mm Hg (in absence of PEEP) avoided.
4. Avoiding high inspired oxygen concentrations may limit bronchiolitis obliterans syndrome in lung recipients

B. Circulation

The aim of treatment is to protect the heart itself from ischaemic or other damage while maximizing its ability to perfuse other organs. Goals for management of hemodynamic status of the donor are shown in flowchart (Figure-1)

1. Maintain normovolemia and BP
2. Optimize cardiac output so as to maintain perfusion pressure of all organs with the use of the least amount of vasoactive support.

Common hemodynamic disturbances

Hypertension: Usually transient in nature due to autonomic storm, antihypertensives are usually not required. If needed, short-acting antihypertensives such as esmolol, sodium nitroprusside, hydralazine, labetalol, or nitroglycerine should be used. Antihypertensive is not required for a long time.

Hypotension

Causes of Hypotension

1. Hypovolemia- because of either increased losses (mannitol, other diuretic therapy or diabetes insipidus)
2. Profound vasodilatation
3. Cardiac dysfunction

Management of hypotension

Fluid resuscitation is usually necessary but fluid overload should be avoided. CVP monitoring is mandatory and Transoesophageal echocardiography or pulmonary artery occlusion pressure (PAOP) measurement and cardiac output measurement may be required. There is no evidence that any specific fluid has particular advantages for resuscitation in donors. If large volumes of crystalloid solution are given, balanced salt solutions may help avoid hyperchloraemic acidosis, and avoid confusion if base excess is being used as an index of the adequacy of resuscitation. Artificial colloids have few advantages in general ICU practice. Concerns that starch-based colloids are associated with delayed graft function may have been related to older formulations, but high doses of starch-based colloids should be avoided. For lung and pancreas transplant retrieval, colloids are preferred over crystalloids.

Suggested targets:

1. CVP or pulmonary artery occlusion pressure (PAOP) - 10–12 mm Hg (if the lungs are not being considered for transplantation)
2. Cardiac index 2.2–2.5 litre/ min/ m2
3. Mean arterial pressure 70 mm Hg

To achieve these goals, the standard monitors, measurement of urine output and invasive measurements of arterial pressure and CVP (frequently with a pulmonary artery catheter) should be used.

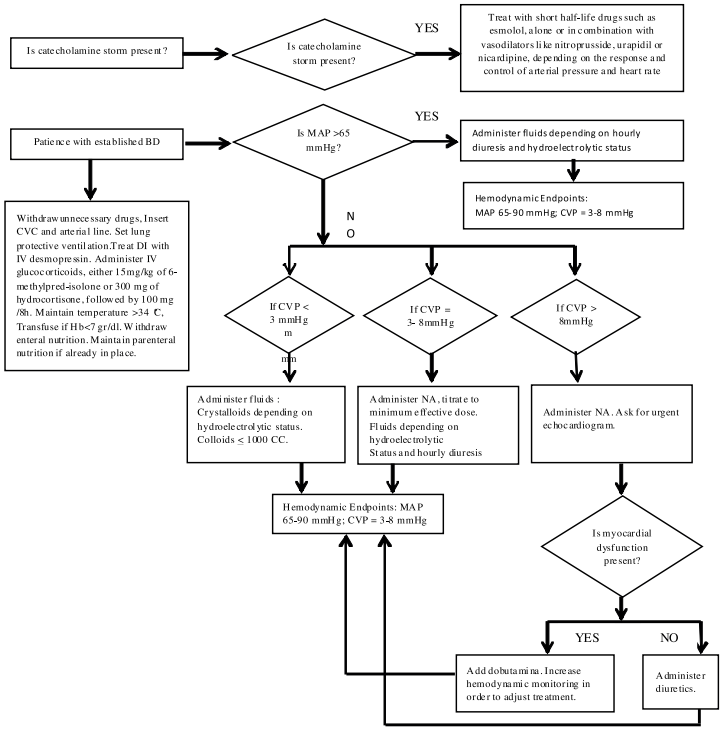


Figure -1: Algorithm for haemodynamic management

Assessment for heart donation

ECG, echocardiogram, coronary angiogram may be indicated for potential heart donors. Causes for ventricular dysfunction associated with BD may be stunned myocardium which are potentially reversible. If cardiac dysfunction is detected with the first echocardiogram it should be repeated after hemodynamic stabilization of the donor has been achieved, with at least 65mmHg of mean arterial pressure and adequate intravascular volume replacement hours later. Ventricular function reversibility is seen in 75% of patients.

Endocrine replacement

Replacement of hormones essential for maintenance of homeostasis and organ function

1. DDAVP –Treats Diabetes insipidus
2. I.V. triiodothyronine (T3) – Improves cardiovascular stability in the donor. It has been shown to improve function of the donor heart in the recipient.
3. High dose methylprednisolone - Attenuates the effects of pro-inflammatory cytokines, improving oxygenation and increasing lung donor recovery; it may be indicated if lung transplantation is planned or 'hormone resuscitation' considered.
4. Insulin- Controls hyperglycemia

Three-drug 'hormone resuscitation' is included in the standardized management protocol of the United Network for Organ Sharing (UNOS), which led to a 22% increase in numbers of organs recovered

Hyperglycaemia

Poor glucose control adversely affects donor renal function. Insulin concentrations decline after brainstem death and insulin infusion with standard ICU protocols is required to maintain glucose. Hyperglycemia is exacerbated by steroid administration.

Temperature control

Normothermia (35.8C) is achieved by using fluid warmers, forced air warming blankets and active inspired gas humidification before and during the retrieval operation.

Hematology

Coagulopathy should be managed with clotting factors and platelets, as necessary. Blood transfusion may be required. Four units of blood should be available before organ procurement in theatre, as surgery may involve significant blood loss.

Renal and pancreatic function

Kidneys are vulnerable to catecholamine-induced ischaemia at the time of brain death, and subsequent hypoperfusion if donor management is inadequate. Dopamine has no significant renal protective effect on renal function in the critically ill

Fluid and electrolyte disturbances

Electrolyte disturbances may be related to polyuria from diabetes insipidus, osmotic diuresis, or acute renal impairment. Untreated diabetes insipidus leads to marked hypernatraemia. Increased recipient mortality was seen when donor sodium concentrations were <130 or >170 mmol /litre

Inflammatory response

Methylprednisolone is given as a component of 'HR'. It is frequently given alone in a dose of 15 mg/kg to attenuate the inflammatory response. Methylprednisolone use is associated with increased organ retrieval. The use of methylprednisolone is associated with improved oxygenation, reduced increases in extravascular lung water, and increased lung yield. Inflammation in the liver, heart, and kidney is also reduced after transplantation, but does not reduce incidence or duration of primary graft failure. Active removal of cytokines by haemoadsorption is also feasible.

Duration of donor management

Timing of retrieval can be planned if donors are stable. Unstable donors may require earlier retrieval operations or else suffer cardiac arrest. If the quality donor management is good, transplantation

can be delayed to improve donor condition. A 'relax and repair' may be better than a 'rush and retrieve' approach. Early Institution of management in the ICU is also associated with increased numbers of transplantable organs.

General care	Manage in ICU. Support for relatives. Infection control measures Actively identify and treat any current infections. Stop unnecessary drugs, e.g. sedatives.
Respiratory	Nurse with the head of the bed elevated to reduce the risk of aspiration. Avoid the administration of excessive i.v. fluids. Consider diuretics if marked fluid overload May require bronchoalveolar lavage (lung recruitment after) Use 'lung protective' ventilation Tidal volume 6–8 ml kg−1with optimal PEEP to allow minimum FiO2 . Recruitment manoeuvres initially, and repeated after apnoea testing or tracheal suction. Maintain tracheal cuff pressure at 25 cm H2O
Cardiovascular	Review fluid balance and correct hypovolaemia Titrate fluids and inotropic or pressor drugs to intended goals If vasopressor drugs required vasopressin 0–2.4 units h−1* may reduce catecholamine requirements. High doses of catecholamines (e.g. norepinephrine >0.05 μg kg−1 min−1) should be avoided if possible. Consider triiodothyronine bolus and infusion* Use cardiac output monitoring if possible
Fluids and nutrition	Avoid positive balance and hypernatraemia Monitor urine output and maintain at 0.5–2.5 ml kg−1 h−1. Consider diagnosis of diabetes insipidus -If urine output is >4 ml kg−1 h−1 Treat with vasopressin infusion or DDAVP Maintain feeding or glucose source. Blood glucose target concentrations 4–8 mmol litre−1. Insulin infusion (1 unit h−1 minimum). Correct electrolyte abnormalities to normal values
Temperature	Reduce heat loss and actively warm if necessary to maintain core temperature >35°C.
Blood and coagulation	Correct coagulation if evidence of active bleeding; consider need for coagulation support during retrieval. Consider need for transfusion Maintain thromboprophylaxis as there is a high incidence of pulmonary emboli found at retrieval
Systemic effects	Methylprednisolone 15 mg kg−1 bolus immediately after brain death confirmed. Triiodothyronine*

Table-2: Summary of management of beating heart brain dead organ donor

Parameter	Target
Heart rate	60–120 beats / min
Arterial pressure	Systolic pressure >100 mm Hg
	Mean pressure ≥70 mm Hg
Central venous pressure	6–10 mm Hg
Urine output	0.5–3 ml / kg / h
Electrolytes	Serum sodium 130–150 mmol / litre
	Normal potassium, calcium, magnesium, phosphate
Blood glucose	Glucose 4–8 mmol / litre
Blood gases	pH: 7.35–7.45
	: 4.7–6 kPa
	: ≥10.7 kPa
	saturation ≥95%
If pulmonary artery catheter inserted	
Pulmonary capillary wedge pressure	6–10 mm Hg
Cardiac index	2.4 litre / min / msq
Systemic vascular resistance	800–1200 dyn s cm–5

Table-3: Summary of donor management goals

Conclusion

The best results with heart beating brain dead donor management are obtained with high-quality ICU management and early attention to management of complex cardiovascular changes and maintenance of other management goals.

Suggested reading

1. R A Pandit et al Management of potential organ donor. Indian Journal of Critical Care Medicine. 2017:21(5);303-316
2. Management of the Potential Organ Donor in the ICU: Society of Critical Care Medicine/ American College of Chest Physicians/Association of Organ Procurement Organizations Consensus Statement Crit Care Med. 2015 Jun;43(6):1291-325.

CHAPTER 12

Documentation in Organ Transplantation

Dr. Sivaparvathi

Overview

The idea of putting this chapter is to enable the readers, (transplant coordinators) about the various legal aspects of transplantation and the importance of documentation in the present era. We will cover the topic under the following headings.

1. Introduction
2. Documentation in relation to living donor transplantation.
3. Documentation in relation to deceased donor transplantation.
4. Documentation in special situations.
5. Working examples

Introduction

The dictionary meaning of donation is “something which someone gives to a charity or organization” so it is an act of philanthropy and there should not be any monetory or financial benefits to the donor.

The main purposes of documentation and legal justification in any transplant setting is to

1. Avoid commercial dealings during the process of transplantation.
2. Confirm no unethical practices are done during the process.
3. Provide the evidence at a later date, if something otherwise is proven.

Documentation in living related renal transplant

Living related renal transplant as per the THOA 1994, is allowed between parents, siblings and children and emotionally related (spouse) but now extended to include grand parents and grand children as per THOT Rules 2014, (but not yet adapted by state of Telangana). During the process of evaluation for living related transplantation, the transplant team should confirm that recipient and donor are related as stated above.

The documents to be verified and secured include

1. Relationship certificate.
2. Family member certificate issued by the RMO / Tahsildar of the residential place of both donor and recipient.

If both recipient and donors are not related to each other as stated above, then the approval for transplant is to be given by Authorisation committee of the state. Hence the transplant coordinator has to take care of all the required documents.

Another important thing to consider is that both the donor and recipient should belong to the same state where transplant is being performed. If either or both of them belong to other states, then it has to be notified to the state of their origin before performing transplant.

These are the forms that are issued by the central and state government to be filled and signed appropriately (as per THOTA 2014) in living related renal transplant.

Forms for living related renal transplant

Form 1- For organ or tissue donation from identified living near related donor (to be completed by him or her)

Form 2 - For organ or tissue donation by living spousal donor (To be completed by him/her)

Form 3 - Consent for donation by other than near relative living donor.

Form 4 - For certification of medical fitness of living donor (to be given by registered medical practiotioner).

Form 5 - For certification of genetic relationship of living donor with recipient (To be filled by the head of Pathology Laboratory certifying relationship).

Form 6 - For spousal living donor (to be filled by competent authority* and Authorisation Committee, of the hospital or district or state in case of foreigners)

Form 11 - Application for approval of transplantation from living donor (To be completed by the proposed recipient and the proposed living donor)

Form 18 - Certificate by the Authorisation Committee of Hospital (If Hospital Authorisation committee is not available then the Authorisation Committee of the district/State) where the transplantation has to take place (To be issued on the letter head) for transplantation from living donor, other

than near relative/ swap donation cases/ all foreigner under the Transplantation of Human Organs Act, 1994 (42 of 1994)

Form 19 - Certificate by competent authority [as defined at rule 2(c)] For Indian near relative, other than spouse, cases.

Form 20 Verification certificate in respect of domicile status of recipient or donor [To be issued by tehsildar or any other authorised officer for the purpose (required only for the donor - other than near relative or recipient if they do not belong to the state where transplant hospital identified for operation is located)]

Form 21 Certificate of relationship between donor and recipient in case of foreigners (To be issued by the Embassy concerned)

Documentation in relation to deceased donor transplantation.

Deceased donor transplantation is coordinated and authorized by both state and central government and it becomes very important to make it as transparent as possible for several reasons which include

a. To ensure the donors, that all the organs donated are utilized and distributed appropriately to the needful in a lawful and acceptable manner. This encourages them to promote the act of donation among the society. This requires a proper and effective documentation of the entire process starting from brain stem declaration to donation to allocation and transplantation.

b. In view of the dependency of post transplant outcomes on the various donor factors like the cause of death, requirement of inotropes, presence of infection at the time of donation (chance of spread of infections through organs), serological status (HIV, HBsAg, HCV), associated comorbities and the other factors regarding storage and transport of organs like warm and cold ischemia time along with the recipient factors , a detailed documentation of all these is very crucial to the successful outcome.

c. Documentation during registration for deceased donor transplantation. This varies across different organisations and the whole process is centered on establishing the presence as well as the severity of disease in the recipient in order to have a proper allocation.

Example: Let us go through the documentations required for registering for renal transplant in Jeevandan programme of state of Telangana (Figure-1 &Table 1).

Kidney Registration & Medical Factors

Jeevandan *Cadaver Transplantation Programme*
Govt. of Telangana
Donating Life

Name		Blood Group		Age	
Native Kidney Disease		Infections			
* Date of Starting Hemodialysis		Place of Dialysis			
If Female-Number of pregnancies		*Previous Kidney Donor (Yes/No)			
* No of Transfusions		*No of AV Fistula Vessel Failed			
* Failure of synthetic graft after multiple vascular access failure(yes/No)		*Previous Primary Graft Failure (Yes/No)			
Cytotoxic Anti bodies (%)		Renal biopsy			
HBs Ag		HCV		HIV	
CMV	Ig G		Ig M		
Hb (gm %)		PCV (vol %)		TLC(/cumm)	
DLC	P		L		M
	E		%		
ESR (mm/1st hr)		Pl.count (lakh/cumm)		P/S	

BI Urea- mg% S. Creatinine - mg% S. Na + S.K + S. Cl - meq/L

S. Ca ++ mg% Phos - mg % SUA - mg% FBS - mg%

TSP - & Albumin - g% T Bilirubin - mg% SGOT - & SGPT - u/l ALP - u/l

T. Chol - HDL - LDL- VLDL - TGL - mg%

CUE : pH Spgr - Albumin - Sugar - Ketones - M/S –

24 hrs. Urinary protein - mg/gm, CCR - ml/min, Volume - ml.

Anti GBM-Ab ANA - ds DNA - C_3 - C_4 - C- ANCA - P-ANCA-

CAD - CAV - Urine c/s - US Abdomen - RK- LK-

MCU - ECG - 2D ECHO –

Clearance :

Cardiology - Chest –

MGE - Urology -

This patient is fit for kidney transplantation

Treating Doctor:	**Transplant Surgeon:**
Name:	Name:
Designation:	Designation:
Signature:	Signature:

* **Supporting documents to be enclosed**

Figure 1. Form for registration to Jeevandan for deceased donor kidney

Criteria	Score
Age score: 3-10 years 11-20 years 21-40 years	 3 2 1
Period on dialysis	0.1 per month
Period of Registration	0.1 per each month
primary graft failure for (Live & Cadaver)	2
Identical Age group(+10)	2
Previous Kidney Donor	3
Synthetic Graft Failure	3
Fistula Failure	0.5 per Fistula failure

Table-1: Relevance of the documentation for organ allocation score criteria.

As a transplant coordinator, one should explain patients, the importance of documenting AV failure scans and providing the proof of start of dialysis which do carry points in allocation. The patients also should notify the recent illness and major surgeries or infections which will help the registration database to segregate the waiting list in to active and inactive. It is the duty of the transplant coordinator to provide all the necessary documentation as and when required.

Forms to be filled during deceased donor transplantation as per the ACT.

Form 7 - For organ or tissue pledging (To be filled by individual of age 18 year or above)

Form 8 - For Declaration cum consent (To be filled by near relative or lawful possessor of brain-stem dead person)

Form 9 - For unclaimed body in a hospital or prison (To be completed by person in lawful possession of the unclaimed body)

Form 10 - For certification of brain stem death (To be filled by the board of medical experts certifying brain-stem death)

Documents for hospital administration for registering in to state deceased donor programme

Form 12 - Application for registration of hospital to carry out organ or tissue transplantation other than cornea.

Form 13 - Application for registration of hospital to carry out organ/ tissue retrieval other than eye or cornea retrieval. (To be filled by head of the institution)

Form 14 - Application for registration of tissue banks other than eye banks. (To be filled by head of the institution)

Form 15 - Application for registration of eye bank, corneal transplantation center, eye retrieval center under transplantation of human organs act .

Form 16 - Certificate of registration for performing organ/ tissue transplantation/ retrieval and or tissue banking.

Form 17 - Certificate of Renewal of Registration (To be given by the appropriated authority on the letter head)

All these forms are made available at the end of this manual, one can refer to them.

Documentation in special situations

Living related renal transplant in ABO incompatible transplants.

ABO incompatible transplantation is defined as transplantation across incompatible blood groups. Here the process of documentation should include all that is done in living related transplant along with the entire family tree exploring all family members, members blood groups are screened and establish the fact that no compatible donor is missed. This is very important because ABO incompatible transplant is associated with requirement of higher immunosuppression and associated risk of infections, as well as increased risk of rejection and surgical complications and higher economical burden.

These risks and benefits should be explained to the donor and recipient along with the family and proper consent to be taken.

Living related renal transplant in swap transplantation.

The swap transplantation is said to be done between pairs who has an incompatible donor and recipients but matching with the other donor and recipient (Figure 2).

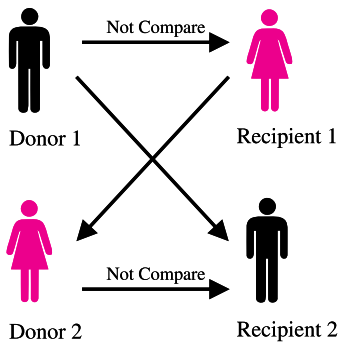


Figure 2. A 2x2 swap transplantation.

There are several geographical differences in the policies involved in swap transplantation. Legal restrictions on living organ donation have played a significant role in the evolution of kidney pared donation (KPD) in many countries. In 2005, in the United States, the term "kidney paired donation" rather than "kidney exchange" was adopted to emphasize that these arrangements should not be seen as violating the National Organ Transplantation Act's (NOTA's) prohibition on selling living donor organs (phrased as "exchanging for valuable consideration"). In December 2007, the United States enacted a new law – HR 710, the Charlie W. Norwood Living Donation Act – clarifying that KPD was not illegal under NOTA. This law made possible the efforts of the United Network for Organ Sharing in building a national KPD registry funded and overseen by the US government. In the United Kingdom, only relatives and those with strong emotional ties to the candidate were permitted to be living organ donors, until legislation allowing kidney exchange was enacted in 2006. In India, every paired exchange performed must be individually approved by the Authorization Committee of the particular state, effectively discouraging intrastate arrangements. Swap transplants are accepTable under THOT RULES 2014, but this is not adopted by the state of Telangana, so as of now permission has to be taken on case by case basis until the state adopts the 2014 act.

Anonymity (Revealing the identity of both pairs to each other)

The conventional practice in the United States is to maintain strict anonymity among the KPD participants before surgery, with meetings possible after surgery if desired by all parties. In the Netherlands, patients in a pilot study expressed a strong preference for anonymity, and so that country's exchange programme maintains anonymity throughout the process. In Germany, anonymous KPD is prohibited, so exchanges can only proceed after incompatible pairs meet and socialize. In Romania, a single center programme transplanted 56 pairs between 2001 and 2005 and this group felt that maintaining anonymity among pairs involved in KPD was unnecessary and would be too logistically difficult, so they encouraged open interaction before and after the transplants. In India majority of swap transplants are done in IKDRC Ahmedabad.

Procedure in case of foreigners.

When the proposed donor or the recipient are foreigners;

A. A senior Embassy official of the country of origin has to certify the relationship between the donor and the recipient as per Form 21 and in case a country does not have an Embassy in India, the certificate of relationship, in the same format, shall be issued by the Government of that country;

B. The Authorization Committee shall examine the cases of all Indian donors consenting to donate organs to a foreign national (who is a near relative), including a foreign national of Indian origin, with greater caution and such cases should be considered rarely on case to case basis, provided that the Indian living donors wanting to donate to a foreigner other than near relative shall not be considered.

Documentation in deceased transplants in special situations

A. Donation in case of medicolegal cases.

B. Donation in case of minor.

A. Donation in case of medicolegal cases.

1. After certification of brain death in medicolegal cases and the consent to donate organs from a brain-stem dead donor are obtained, the registered medical practitioner of the hospital shall make a request to the Station House Officer or Superintendent of Police or deputy Inspector General of the area either directly or through the police post located in the hospital to facilitate timely retrieval of organs or tissue from the donor and a copy of such a request should also be sent to the designated post mortem doctor of area simultaneously.
2. It shall be ensured that, by retrieving organs, the determination of the cause of death is not jeopardized.
3. The medical report in respect of the organs or tissues being retrieved shall be prepared at the time of retrieval by retrieving doctor (s) and shall be taken on record in postmortem notes by the registered medical practitioner doing postmortem.
4. Wherever it is possible, attempt should be made to request the designated postmortem registered medical practitioner, even beyond office timing, to be present at the time of organ or tissue retrieval.
5. In case a private retrieval hospital is not doing post mortem, they shall arrange transportation of body along with medical records, after organ or tissue retrieval, to the designated postmortem centre and the post mortem centre shall undertake the postmortem of such cases on priority, even beyond office timing, so that the body is handed over to the relatives with least inconvenience.

B. Donation in case of minor.

In the case of brain-stem death of a person of less than eighteen years of age, a certificate specified in Form 10 has been signed by all the members of the Board of Medical Experts and an authority as specified in Form 8 has been signed by either of the parents of such person or any near relative authorized by the parent.

Working example

Case 1. A 25 year old patient A wants to get transplanted with his brother, (fathers brothers son) write down the legal procedure to be followed and the forms to be filled during the process of transplantation.

Let us start working this by stating the relationship, as per the act living related transplant includes father, mother, daughter and sons, (though grandson, daughter, grand father and mother are accepted as per THOA 2014) , the donor becomes a near relative, the proposed donation has been approved by the competent authority. The forms 5, 9, 11 has to be verified by the competent authority along with other forms for living related transplantation.

Practice questions

Case 2. A 35 male wanted to get transplant from his mother in Hyderabad, both of them belong to pune, what is the procedure to be followed and forms to be filled.

Case 3. A 21 year old lady was declared brain dead, of suspected dowry death what are the legal proceedings and required documentation to be done in this case.

Suggested reading

1. The transplantation of human organs and tissues rules, 2014. Ministry of health and family welfare notification New Delhi, the 27th march, 2014.
2. Peter J Morris & Stuart J Knechtle. Kidney transplantation: principles and practice 2014. Seventh edition

CHAPTER 13

Perfusion Fluids & Techniques

Dr. Srikanth Gundlapalli | Dr. P Sandhya

Introduction

Perfusion fluids are used to perfuse the transplantable organs retrieved from the donor. The main aim of perfusion fluids is to minimise the damage to the organs when they are without the supply of nutrients and oxygen (ischemic) in the outer environment by reducing cellular metabolism and oxygen demand. Development of various fluids and techniques of dynamic perfusion enabled excellent transplant outcomes. The aim of the following chapter is to make clear the concepts of different types of perfusion fluids, their functions and techniques of organ perfusion.

History

By the time, organ transplantation started in the early 1960s, there was understanding regarding the viability of tissues outside the human body and the need for acellular cold perfusion fluids mimicking intracellular fluid for prevention of cell death and degeneration. The pioneering work by Collins et al[1] led to the development of Collins solution which was used for almost two decades. Many modifications of this followed over the next few decades leading to better organ preservation.

Functions of the perfusion fluids

The Table 1 illustrates the main mechanisms of organ damage and the properties of different perfusion fluids which help in mitigating the effects.

	Problem	Perfusion fluid property mitigating the effect
1	Metabolic demands higher in warm organ	Organ is cooled to lower temperatures during perfusion
2.	Intracellular phosphate with calcium and sodium: increased osmolality	High osmolar fluid to prevent cellular swelling and damage
3.	Intracellular calcium	Calcium chelation with citrate
4.	Free radical damage	Use of anti-oxidants
5.	Lack of nutrition	Tryptophan and Alpha ketoglutarate as nutrients

Table 1 : Mechanisms of organ damage and the properties of different perfusion fluids.

1. Role of 'Cooling'

The idea has been derived from hibernating animals like polar bears which have an extreme ability to lower their oxygen and metabolic demand in extreme cold environments. The exact mechanisms underlying the advantages of cooling are still not understood, but the involvement of intracellular calcium has been proposed.[2] Tolerated periods of cold ischaemia vary depending on the organ: 24 h for the kidney, 12–15 h for the liver, a maximum of 8 h for the lung, and 6 h for the heart. Prolonged cold ischaemia is an independent risk factor for the non-functioning or dysfunction of the transplant.

2. Role of osmotic agents

With ischemia, intracellular osmolality increases due to release of calcium and other osmoles from intracellular organelle. Perfusion fluids with high content of sodium or calcium and sometimes potassium have been developed primarily to match the intracellular fluid during ischemia and prevent cellular swelling and death. With advanced understanding, glucose and then mannitol/raffinose and lactobionate have been developed as newer osmotic agents for preservation of cellular structure.

3. Role of citrate and anti oxidants

Calcium inflicts significant damage to ischemic cells by enhancing apoptosis. Calcium chelation with citrate reduces these effects. Dynamic equilibrium between oxidised and reduced forms of enzymes is called redox potential. Redox potential is lost in organs when they are ischemic leading to organ damage. Use of reduced glutathione mitigates the free radical damage to cells.

4. Role of nutrients

Glucose enhances the formation of lactic acid and worsens the acidosis. Use of tryptophan and alpha ketoglutarate provides adequate substrate for anaerobic metabolism and prevents cellular starving.

Types of perfusion fluids

Now that we learnt the basics of perfusion fluid function, we will further discuss the common perfusion fluids and their key advantages in the order of their evolution

1. Collins Solution - This is the earliest preservation solution. The predominant strategies adopted in this solution for organ preservation are cold perfusion (to minimise metabolic demand) and osmotic barrier reduction (glucose/ potassium as substrates).
2. Euro Collins - This was developed as modification of the original Collins solution. Two changes predominantly followed. Mannitol replaced glucose, reducing the accumulation of lactate and associated acidosis. Omitting Magnesium phosphate reduced chances of crystal formation.[3]
3. Citrate Solutions (Marshall/Ross) - This is based on clear understanding about damage that Calcium inflicts the ischemic cells. Citrate helps helps prevent detrimental accumulation of calcium in the cytosol. This paved the way for safe preservation of kidney for 24-30 hrs facilitating international sharing of organs.
4. University of Wisconsin Solution - This marked a quantum leap in the evolution of perfusion solutions. The important features are
    a. Combination of metabolically inert osmotic substances, lactobionate and raffinose enabled better physiological function and prevented cellular edema.
    b. Supplementation with precursor of ATP (adenosine), the energy store house.
    c. Defense against the oxidative damage by the antioxidants (allopurinol, reduced glutathione).

By the 1990s, UW solution clearly showed superiority over the earlier solutions in preservation of pancreas, heart, kidney and lung.

5. Bretschneider's (Custodiol) Solution.[4] This is also called as the HTK (Histidine-tryptophan-ketoglutarate) solution. Lower costs facilitated the emergence of HTK as preferred solution in developing countries.[5] The salient features included
    a. Low sodium and calcium provided for a safe transfer of fluid into the recipient during reperfusion.
    b. Buffer (Histidine) prevented intracellular acidosis
    c. Mannitol was used as the osmotic barrier.
    d. Low permeable aminoacids (tryptophan and alpha-ketoglutarate) acted as substrates for anaerobic metabolism.
    e. This solution differed form UW in being less viscous facilitating rapid perfusion and wash out from the organs.

6. Ringer's Lactate solution - In live transplants a simple cold 'Ringer's Lactate solution' with heparin for anticoagulation and papaverine for vasodilatation has also been successfully used in certain centres. However this provides no significant protection against cellular swelling and damage and is based solely on benefits of cooling the organ.

Techniques of perfusion

There are three ways in which these fluids are used for perfusion

1. Insitu- This is perfusion when the organs are in the donor's body prior to retrieval. Chilled solutions of 4-6 litres is infused into the major vascular channels. Moderate cooling is achieved prior, which makes the retrieval process nearly blood less.[6]
2. Organ retrieval followed by static flush cooling and ice storage (Static Cold Storage- SCS) relies on cooling as the predominant method of organ preservation assisted by solutions which influence the metabolic pathways.[7]
3. Organ is retrieved and immediately cold perfused by using pump assisted pulsatile perfusion (Dynamic), also called Hypothermic Machine Perfusion (HMP).

We will discuss a little more detail about the Static and Dynamic organ perfusions.

Static Organ perfusion is the most widely used preservation method. This method is approved for kidneys, liver, lung, pancreas and heart. a cold perfusion solution is kept ready prior to the organ retrieval. Once the organ is retrieved, it is immediately collected in an iced tray and perfusion fluid is infused into the artery of the organ. Perfusion is continued till the following parameters are noted.

1. Organ is pink and turgid
2. Venous outflow is clear of residual blood

Turgid and cold organ marks the onset of "cold ischemia time". Each organ is then surrounded with the perfusing solution and placed in sterile plastic bags. This is further stored in ice and transported in insulated containers.

Dynamic organ perfusion with machine on the other hand, is based on pulsatile supply of perfusion fluid with nutrients, and provides for tissue oxygenation ensuring activation of residual metabolism. This method of organ preservation is well studied and approved for renal transplantation alone.[8]

Clinical preservation of individual organs at the present time

In general, hypothermic static cold storage is the most common method of organ preservation. The type of solution is usually influenced by the contemplated ischemia time in the most commonly transplanted organs of liver and kidney.

a. Long preservation times- UW solution
b. Less than 24 hrs- Marshall's Citrate or Celsior solution
c. Short preservation Intervals and Living Donor- HTK Solution

Cardiac preservation is unique and involves cardioplegia (stopping of function) with high potassium based solution followed by topical cooling and sterile transport. The tolerated ischemia period is short 4-6 hrs.

Conclusion

Use of perfusion fluids has significantly changed both short-term and long-term graft outcomes. Type of organ and cold ischemia time influences the choice of preservation solution. These slow down the cellular hypoxic damage and can cause primary graft dysfunction. Search for ideal perfusion solution with universal applicability and long storage times is still under way.

References

1. Collins GM, Bravo-Shugarman M, Terasaki PI. Kidney preservation for transportation. Initial perfusion and 30 hours' ice storage. Lancet Lond Engl. 1969 Dec 6;2(7632):1219–22.
2. Elimadi A, Haddad PS. Cold preservation-warm reoxygenation increases hepatocyte steady-state Ca(2+) and response to Ca(2+)-mobilizing agonist. Am J Physiol Gastrointest Liver Physiol. 2001 Sep;281(3):G809-815.
3. Andrews PM, Bates SB. Improving Euro-Collins flushing solution's ability to protect kidneys from normothermic ischemia. Miner Electrolyte Metab. 1985;11(5):309–13.
4. Rayya F, Harms J, Martin AP, Bartels M, Hauss J, Fangmann J. Comparison of histidine-tryptophan-ketoglutarate solution and University of Wisconsin solution in adult liver transplantation. Transplant Proc. 2008 May;40(4):891–4.
5. Bellamy CA, Nicely B, Mattice BJ, Teaster R. Comparative analysis of clinical efficacy and cost between University of Wisconsin solution and histidine-tryptophan-ketoglutarate. Prog Transplant Aliso Viejo Calif. 2008 Sep;18(3):166–71
6. Starzl TE, Hakala TR, Shaw BWJ, Hardesty RL, Rosenthal TJ, Griffith BP, et al. A flexible procedure for multiple cadaveric organ procurement. Surg Gynecol Obstet. 1984 Mar;158(3):223–30.
7. McAnulty JF. Hypothermic organ preservation by static storage methods: Current status and a view to the future. Cryobiology. 2010 Jul;60(3 Suppl):S13-19.
8. Fuller BJ, Lee CY. Hypothermic perfusion preservation: the future of organ preservation revisited? Cryobiology. 2007 Apr;54(2):129–45.

CHAPTER 14

Organ Packaging, Labelling and Transportation

Dr. Vijay Kiran

Introduction

The following terminologies need to be incorporated into the system of organ package and labelling and transportation. These are not exclusive duties and some times a single person can take up additional responsibilities.

- Transplant Coordinator (LDC and DDC)
- Organ Preservation Practitioner
- Recipient Centre Point of Contact (RPoC)
- Retrieving surgeon
- Implanting surgeon
- Nephrologist/ Transplant physician
- Scrub Practitioner

Definitions

Living Donor Coordinator (LDC) - Specialist Nurse/trainee with the relevant knowledge, skills and training in all aspects of living donation and transplantation (In our setting they go by the name-'transplant coordinators')

Deceased donor coordinator (DDC) - Specialist Nurse/trainee with the relevant knowledge, skills and training in all aspects of cadaver/deceased donation and transplantation (In our setting they go by the name-'transplant coordinators')

Organ Preservation Practitioner - Healthcare professional who facilitates the perfusion and preservation of organs as per local team practice.

Recipient Centre Point of Contact (RPoC) - Healthcare professional responsible for communicating information to the implanting surgeon/center for a final decision to be made on accepting an organ for transplant.

Retrieving surgeon - The lead retrieval surgeon.

Implanting surgeon - Usually a Urologist or a transplant vascular surgeon.

Nephrologist/ Transplant physician - The main point of care deciding the immunosuppressive protocol and assessment of immunological risk.

Scrub Practitioner/nurse – Healthcare professional who assists the surgeons and facilitates the organ retrieval.

Standard operating procedure

1. Packaging an organ for transport

1.1. Packaging an organ in preparation for transport is defined as a medical activity. This means that the activity must be performed under the advice and guidance of a qualified doctor.

1.2. The doctor undertaking responsibility for preparing and packaging an organ for transport must be appropriately trained and experienced in the role. He/She must be present in theatre, and advice must be sought immediately in the event of a problem being identified.

1.3. Organs must be prepared for packaging in THREE bags in line with international guidelines. All organs should be prepared for packaging as follows

a. Each organ is submerged in sufficient cold preservation solution in the first bag

b. The second bag is filled with a least 250 cold saline (without any ice)

c. A small amount of fluid (sufficient to ensure there is no air in the bag) shall be placed between the second and third bags

Important: Each bag is firmly tied after adequate de –airing

1.4. The organ may be transported in an organ box or transportable perfusion system.

Simple static cold storage (SCS) can reliably provide good early function in the majority of grafts where storage times over 36 h have not been required within modern integrated transplant networks.

1.5. The person responsible for packing the organ in the transport box for transport should check the organ transport box to ensure that

a. It is structurally intact

b. It can be fastened securely, where possible, to prevent unauthorised or accidental opening

c. It contains sufficient melting water ice to maintain the temperature and position of the organ during transit

d. Any previous documentation, not related to the current donor or donated organ is removed.

1.6. For organ transport boxes cable ties must be used to seal both sides of the transport box

1.7. Before an organ is packed in the organ transport box, the following must be confirmed

a. Which organ is being handed over by the scrub practitioner/surgeon e.g. right kidney, left kidney, liver lobe.

b. That the organ has been surrounded by perfusion/preservation fluid and bagged according to the agreed procedure.

1.8. The prepared and packaged organ must be packed immediately inside the organ transport box.

1.9. The following actions should be taken for all organs

a. The organ must be contained and covered by melting water ice

b. The box should be closed but not sealed until all required blood, tissue samples and documentation have been placed inside and are ready for transportation

c. Before transportation, and where applicable, the box must be sealed on both sides with tie wrap straps/cable ties (where possible) and a note made of the ID number of the box.

2. Labelling and packaging of tissue/blood samples to accompany an organ in deceased donation

2.1. All tissues and blood samples required to support transplantation of a donor organ must be labelled with the patient's name and 3 points of identification

a. In Patient Department (IPD) number

b. Date of birth/date of admission

c. Hospital name and place

2.2. Tissue samples must be placed into tissue sample containers filled with sterile saline

In addition to identification labelling; each container will also be labelled with details of the specific tissue contained within it. Once all required tissue samples have been received, the containers should be stored within a sealable sample pouch and placed into the relevant organ transport box

2.3. Blood vessels, if required, must be placed into appropriately labelled sterile blood vessel containers filled with preservation/perfusion fluid. The containers must be kept sterile at all times. The blood vessels container should be placed into a sealable sample pouch and stored in the relevant organ transport box.

3. Identification and labelling of an organ transport box

3.1. The organ transport box must be clearly labelled to show than an organ is being transported. The following must be visible on the box

a. "Handle With Care"

b. "Organ in Transit"

c. The name of hospital where the retrieval took place

d. Identification of which organ is inside the organ transport box

e. Identification of the destination recipient centre, including the address.

f. Specific instructions on the required transport conditions e.g. keep upright.

3.2. The transport box must be labelled using the either a plasticised luggage label/marker or the Organ Box Sticker.

4. Documentation to accompany an organ

4.1. The following documentation must accompany an organ, and be placed inside the organ box. It must be separate from the organ and protected by an appropriate waterproof bag or pouch.Organ Specific Form completed by the retrieval surgeon.

4.2. Information on donor characterisation (deceased donor), will be available online. This information should also be communicated in a written format directly to the implanting surgeon/ nephrologist.

5. Sealing the organ transport box

5.1. The organ transport box must be secured. Where applicable, cable ties should be used to ensure that the box remains closed on both sides (where possible). Box ID/tag for each organ must be relayed to both Jeevandaan office and implanting surgeon/nephrologist to maintain traceability from the donating hospital to the recipient centre.

6. Arranging transport of an organ

6.1. The transport of organs must only be arranged through locally agreed transport provider organisations/ambulance services

6.2. Transport provider organisations/ambulance services must be able to demonstrate their ability to meet service requirements. This should include the ability to

a. Ensure a professional code of conduct

b. Provide a timely response to transport requests

c. Maintain appropriate conditions of transit

d. Ensure timely delivery of organs to their destination

e. Manage/report adverse events during transport

f. Monitor the progress of a journey

g. Provide vehicles fitted with mobile communication devices, and with routeing/GPS tracking facilities

h. Ensure the relevant licences for all vehicles and drivers

6.3. There must be an identified person responsible for arranging transport of an organ.

6.4. The person arranging transport must agree transport timings with the RPoC, taking into account the acceptable cold ischaemic time of the specific organ. This information must be communicated to the transport company/ambulance services.

7. Releasing an organ for transport

7.1. The person releasing an organ for transport must

a. Confirm the identity of the person collecting the organ. This should be done through proof of identification via a badge of the transport company, with photographic evidence of the transport personnel.

b. Confirm the type of organ that is being dispatched, the intended destination and the required time of arrival.

c. Check that the organ transport box is structurally intact and fastened securely.

d. The person releasing an organ for transport must record the date and time of handover to transport personnel, and sign, print and date the record.

8. Receipt of the donor organ at the recipient centre

8.1. The person receiving the organ must

a. Confirm the identity of the person delivering the organ. This should be done through proof of identification via a badge of the transport company, with photographic evidence of the transport personnel.

b. Confirm the type of organ that is being delivered and its point of origin, and ensure that these details are consistent.

c. Check that the organ transport box is structurally intact and fastened securely

d. Socially clean the exterior of the organ transport box with universal surface disinfection wipes.

8.2. In the case of cold organ storage the level of ice in the organ transport box must be checked, and more ice added, if required, to ensure that the organ is completely covered.

8.3. The organ must remain in the transport box in a secure location at the recipient centre until it is transferred into the operative field for implantation.

8.4. After removing the organ from the transport box, the ice should be emptied out and the box cleaned with a sterile wipe (or with warm water and 5.25% sodium hypochlorite to remove any stains). The box must be left to air dry before re- sealing.

8.5. Check the box inside and out for any damage, particularly any damage to the seal inside the lid.

Conclusions

A well designed integrated approach is necessary for the safety of the organ being transplanted. If we follow this standard operating procedure (SOP) more and more organs will be available for transplantation across the country.

Suggested reading

1. National health services(NHS), UK.

CHAPTER 15

Organ Sharing and Networking

Dr. Manisha Sahay

Introduction

Organ transplantation is one of the greatest medical marvels of the twentieth century, which has prolonged and improved the lives of hundreds of patients, worldwide. Countless acts of generosity by organ donors and their families have made transplantation not only a life-saving treatment but also a symbol of humanity.[1]

However, the shortage of organs is a universal problem. Asia lags behind much of the rest of the world. Even in Asia, India lags far behind other countries. An estimated around 1.8 lakh persons suffer from renal failure every year, however the number of renal transplants done is around 6000 only. An estimated 2 lakh patients die of liver failure annually in India, about 10-15% of which can be saved with a liver transplant. Hence about 25-30 thousand liver transplants are needed annually in India but only about one thousand five hundred are being performed. Similarly about 50000 persons suffer from Heart failures annually but only about 10 to 15 heart transplants are performed every year in India. In case of Cornea, about 25000 transplants are done every year against a requirement of 1 lakh.

The total number of road accident deaths in 2013 in India was 1,37,572, contributing to almost 1.1% of the world's total deaths.[2] In 40 to 50% of road accident casualties, the cause of death was head injury. The numbers of victims of head injury from road traffic accidents are enough to meet the demand of potential donors of organs in the country. The total organ donation shortage of the country can be met with if even 5 to 10% of these persons involved in fatal accidents serve as organ donors. There are however, a number of barriers and challenges to the dream of completely meeting the demands for organ donation.[1]

Cause of low organ donation rate

There are three main causes for low donation rates which are highlighted below.

1. Illegal practices
    a. Organ trading- commercialization of organ donation which demotivates the potential donor families to donate organs and Non Regulation of Non- Govt. Sector
2. Poor organ donation from deceased donors
    a. Lack of infrastructure especially in Govt. sector hospitals
    b. Lack of awareness of concept of brain stem death among stakeholders
    c. Poor rate of brain stem death certification by hospitals
    d. Lack of organized systems for organ procurement from deceased donor
    e. Lack of defined standards in transplantation, retrieval and tissue banking
3. Poor organ sharing and networking

It is perhaps one of the most important causes of poor organ retrieval rates and is the key issue for discussion in this chapter. Health is a State subject. Present organ donation programmes are mostly happening inside the state. However, all harvestable organs are not being retrieved and used, owing to lack of networking. [3,4] A state may not be able to utilize certain organs like heart, lungs and liver due to non availability of a competent transplanting team for these organs. Sometimes heart may be available in one state however there may be no recipient waiting for the heart in that state. Hence these organs may get wasted unless there is an interstate network or a country wide network for organ sharing. Organs are national resources and should not be wasted. Organs wasted are equal to lives lost. Hence networking is important to avoid wastage.

Solutions

The Government has taken a series of steps to promote organ donation especially in case of brain stem death and also to augment capacity for organ retrieval and transplantation in the country. The possible solution to the above 3 problems-

1. Establishing guidelines-Legal aspects
    a. Before the year 1994 the process of organ donation and transplantation was unregulated. Government of India passed the Human Organ Transplantation Act in 1994 which gave guidelines about organ allocation. State of united Andhra Pradesh adopted this act in 1995 called THOA or Transplantation of human organ act. Subsequently the act was amended in 2011 and was expanded to include deceased donor transplantation. New rules came in 2014 which broadened the criteria for live donation from near relatives by including grand parents and also defined 21 forms related to various aspects of organ donation.[5-7] Swap transplantation was legalized.

2. Efforts to promote organ donation from brain stem death patients

    a. by augmenting capacity for organ retrieval and transplantation in the country by providing personnel and infrastructure

    b. THOTA includes detailed description of brain death.

3. Another way forward is to organize organ sharing and networking all across India and is discussed in detail below.

Organ sharing and networking

Initial efforts in organ sharing

MOHAN Foundation (NGO) had started an 'Initiative for Organ Sharing' (INOS) group in Tamil Nadu. INOS was started as a pilot project by the Foundation in November 1999 between a group of five hospitals in Tamil Nadu. Hospitals included Apollo Hospital, Sri Ramachandra Hospital, Sundaram Medical Foundation and Madras Medical Mission – all from Chennai and Christian Medical College, Vellore. The essence of forming the group was so that "organ could be shared between different hospitals and not wasted".[8]

Organ sharing and network in few States

Subsequenlty some states started their own organ harvesting and transplantation network eg Tamil Nadu, Telangana, Rajasthan etc. [9] The national organ donation rate in these states is above the national average.

National organ sharing and networking- future

A three-tier system with National Organ and Tissue Transplant Organization (NOTTO) at centre, Regional Organ and Tissue Transplant Organization (ROTTO) at regional level and State Organ and Tissue Transplant Organization (SOTTO) at state level are being set up.

NOTTO

It is a National level organization set up under Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India located at 4th and 5th Floor of Institute of Pathology, ICMR Building in Safdarjung Hospital New Delhi. In the future all the states and their websites would be linked to NOTTO. It has following two divisions:

National human organ and tissue removal and storage network

This has been mandated as per the Transplantation of Human Organs (Amendment) Act 2011. The network is being established initially for Delhi and gradually expanded to include other States and Regions of the country. Other states have already existing programmes which will be linked to NOTTO. National Network division of NOTTO would function as apex centre for all india activities of coordination and networking for procurement and distribution of organs and tissues and registry of organs and tissues donation and transplantation in the country.

National Biomaterial Centre (National Tissue Bank)

The Transplantation of Human Organs (Amendment) Act 2011 has included of tissue donation. Hence National level Tissue Bank and State and Regional levels tissue bank are being established. The centre will take care of the following Tissue allografts:-Bone and bone products, skin graft, cornea, heart valves and vessels. Other tissues shall be gradually included.

ROTTO

Under NOTTO we can have ROTTO (Regional organ transplantation and tissue organization and SOTTO (State organ transplantation and tissue organization) ROTTO will be responsible for similar functions as NOTTO at the state level and will work under NOTTO and contribute regional information to NOTTO.

Name of ROTTO	States covered
Seth GS medical college and KEM Hospital, Mumbai (Maharashtra)	Maharashtra, Gujarat, Goa, UTs of DNH, Daman, Diu, M.P., Chhattisgarh
Govt. Multispecialty Hospital, Omnadurar, Chennai (Tamil Nadu)	TN, Kerala, Telangana, Seem Andhra, Karnataka, Pondicherry, A & N Islands, Lakshadweep
Institute of PG Medical Education and Research, Kolkata (West Bengal)	West Bengal, Jharkhand,Sikkim, Bihar and Orissa
PGIMER Chandigarh(UT of Chandigarh)	Punjab, Haryana, HP, J &K , Chandigarh , Rajasthan, Uttar Pradesh and Uttarakhand
Guwahati Medical College (Assam)	Assam, Meghalaya, Arunachal Pradesh, Manipur, Nagaland, Mizoram, Tripura.

SOTTO

It is envisaged to make SOTTOs in new AIIMS like institutions. SOTTO will be responsible for similar functions as NOTTO but at the state level and will work under NOTTO and contribute state information to NOTTO.

Activities of organ and tissue transplant organization

NOTTO will function at national level, ROTTO and SOTTO will function at regional and state level respectively.

1. Policy making

   Lay down policy guidelines and protocols for various functions. Bringing together members to develop policies that make the best use of the limited supply of organs and give all patients a fair chance at receiving the organ they need, regardless of age, sex, ethnicity, religion, lifestyle, or financial/social status.

2. Monitoring

   Monitoring every organ match to ensure organ allocation policies are followed. Monitoring of transplantation activities in the Regions and States

3. Data management

   Maintaining data-bank. The software is already available for data management and can be further developed by taking inputs from all states. A website by the name www.notto.nic.in has been hosted for NOTTO and similar websites would be made for states and regions. An online system through website is being developed for establishing network for Removal and Storage of Organs and Tissues from deceased donors and their allocation and distribution in a transparent manner

4. Assistance; Providing assistance to patients, family members and friends.

5. Networking: Network with similar regional and state level organizations.

6. Awareness: Creating awareness, promotion of organ donation and transplantation activities.

7. Coordination: Coordination from procurement of organs and tissues to transplantation when organ is allocated outside the region.

8. Information: Dissemination of information to all concerned organizations, hospitals and individuals.

9. Registries

   a. Organ donor registry.

   b. Recipient registry- Maintaining the waiting list of ill patients requiring transplants. The recipient's details can be incorporated in the NOTTO website along with HLA. This would enable the patient to get the best matched organ from anywhere in India. The allotment system will allocate organs based on a score.

   c. Organ transplant registry- Maintaining the database that contains all organ transplant data for every transplant event that occurs in India. All registry data from States and Regions would be compiled and published.

10. Legal powers

    Consultancy support on the legal and non-legal aspects of donation and transplantation.

11. Training, awareness and advocacy workshops

    a. Coordinate and organize trainings for various cadre of workers.

    b. Educating transplant professionals about their important role in the donation and transplant processes.

    c. Educating the public about the importance of organ donation.

12. Post-transplant patients & living donor follow-up for assessment of graft rejection, survival rates etc.

13. Allocation, transportation, storage and distribution of organs and tissues –as an example allocation process in jeevandan is discussed

Activities of tissue banks under NOTTO, SOTTO and ROTTO

1. Coordination for tissue procurement and distribution
2. Donor tissue screening
3. Removal of tissues and storage
4. Preservation of tissues
5. Laboratory screening of tissues
6. Tissue tracking
7. Sterilization
8. Records maintenance, data protection and confidentiality
9. Quality management in tissues
10. Patient information on tissues
11. Development of guidelines, protocols and standard operating procedures
12. Training
13. Assisting as per requirement in registration of other tissue banks
14. Managing the India organ transplant system by bringing together transplant and organ procurement professionals and volunteers in order to make life-saving organ transplants possible.

Existing state programmes

Many states have their own organ transplantation and harvesting networks. These include Jeevandan in Telangana, Mrithasanjeevani in Kerala, TRANSTAN in Tamilnadu, 8 Rajasthan Network for organ sharing (RNOS) in Rajasthan, Jeevasarthakathe Transplant Authority of Karnataka (Previously Zonal Coordination Committee of Karnataka (ZCCK) in Karnataka. Others include MOHAN (Multi Organ Harvesting Aid Network), ZTCC- Maharastra, ORBO in Delhi, FORTE in Bangalore and SORT in Cochin.

These networks can be linked to central agency NOTTO

Organ sharing and networking in Telangana – Our experinence

The Jeevandan programme in Telangana was started by the government by passing a GO 184 in

2010. It has given a boost to organ donation in the state. The website has been developed by National informatics centre (Figure-1).

Figure- 1: Jeevandan web portal

The administrative wing is with Nizam's Institute of Medical Sciences (NIMS), transplant coordinator training is under Osmania General Hospital (Figure 2) and awareness programme is under Gandhi Hospital.

Figure 2- Transplant coordinator programme

The criteria for organ allocation should be objective so that there is no bias and everyone has a fair chance to receive the organs. Some of these criteria used in Jeevandan Telangana programme are described under Jeevandan web portal "jeevandan.gov.in".The organ allocation system is very transparent and is based on objective criteria for organ allocation as mentioned above. Example of organ allocation and sharing is given below. Organ is allotted to the patient with maximum score. Generally organs are allotted to same blood group recipients.

The score for kidney allocation

1. Cytotoxic antibodies 1-point for each 10% more than 50%
2. Age scoring:
   - 3-10 Years 3 points
   - 11-20 years 2 points
   - 21-40 years 1 point
3. Period on dialysis 0.1 per month of including all days of temporary suspension from the list.
4. Period of Registration 0.1 per each month from the date of registration
5. Scoring for previous graft failure is as follows

   Live donor graft failure within 3 months - 3 points

   3 months to - 1 year - 2 points

   After 1 year - 1 point

   Deceased donor graft failure at any time - 1 point
6. HLA Match 1 point per antigen
7. Identical Age group (+ 10 years) 2 points
8. Previous kidney donor 3 points
9. AV fistula failures get 0.5 score for each failed access and 1 for a failed AV graft

Cytotoxic antibodies and HLA matching are currently not included but may be considered in future.

The individual criteria may vary from one organ type to another. For example, with liver, candidate recipients may be listed as superurgent as liver failure patients cannot be maintained long term unlike kidney failure patients who can be maintained on dialysis till they get an organ.

Multi organ transplantation

1. Multi-organ transplantation shall be considered for Kidney–liver and, Simultaneous Kidney pancreas transplantation
2. The Organ transplanting centre(OTC) pool Liver and Kidney shall only be allocated for Multi-organ transplantation on priority basis
3. If there are many multi-organ recipients registered in an OTC, then the OTC shall allocate liver – kidney to the recipient according to liver priority.
4. General pool Liver and kidney shall not be allocated to multi-organ recipient on priority basis, however if general pool kidney has been allocated to Hospital which has multi-organ recipient the hospital can consider multi-organ recipient dragging general pool, kidney.

5. General pool kidney, if utilized by the Hospital for multi-organ recipient as mentioned in 2D above, that hospital shall pay back either OTC or general pool kidney

State is divided into zones for allocation- North, south, east and west. If kidney harvested from OTC 1 kidney goes to OTC and the other to combined government and private hospital list of that zone. If organ is retrieved from government hospital first kidney goes to that hospital and for the second kidney priority is given to the government hospitals. Each hospital maintains its own list. If the donor hospital is non transplanting organ harvesting centre (NTOHC) the both kidneys go to common pool. An organ retrieved in the state is generally used within the state.

Regional networking

If for some reason the organ can't be used by the state ie if blood group not matching or if competent transplant team for that organ not available, it is allotted to the states that fall within the region. Many centres are doing kidney transplants. Liver transplants have also started happening in a good number of cities however cardiac, lung, pancreas and intestinal transplants have been performed in lesser number of centres. Hence if a centre is not able to utilize these organs due to non availability of a competent transplanting team the organ can be shifted to another centre or state so that none of the organs are wasted.

National networking

If the waiting list in the region is exhausted then the NOTTO looks at country wide possibility and if no one in the country needs it then NRIs and foreigners are given preference.

Green corridors

Organs may need to be shifted from one state to the other and this may sometimes involve long distance travel. To reduce the travel time and avoid traffic congestions and delays the green corridor concept is being utilized where the ambulance carrying the organs is given priority passage by traffic police so that organs can reach the destination in the shortest possible time. Similarly facilities to airlift the organs are also being provided in the form of air ambulance so that organs can be transported between far off places in a short time when matching recipients are not present in the state or the region (Figure-3).

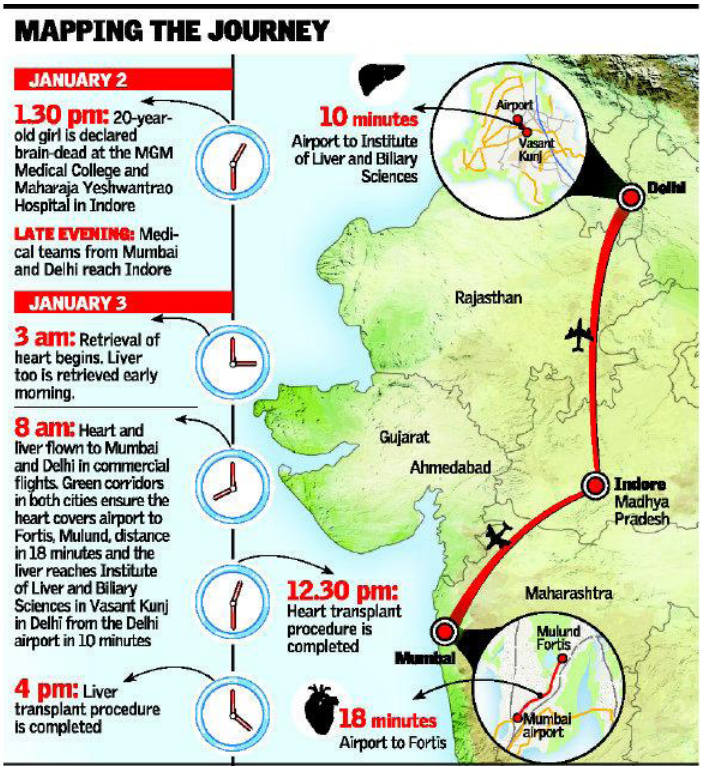


Figure 3: Green corridor

Conclusion

India is a great country with many different religions, languages, cultures and festivals. Each state is a mini country in itself. No other country has this unique distinction. We are sometimes divided by our different cultures etc. Our strength is unity in diversity. We should all remember that we are all Indians first and later on only Punjabis or Gujaratis or Marwaris. Let us all unite and contribute to our state and national registry, our own Indian registry so that we generate authentic Indian data which can be projected to the world. Let each state have its own registry and let all registries and websites be linked with the national registry. This will facilitate organ sharing between different parts of our country to provide the best matched organ to the patient.

References

1. Srivastava A, Mani A. Deceased organ donation and transplantation in India: Promises and challenges. Neurol India 2018;66:316-22
2. WHO global safety report on road safety 2015. Availablefrom:http://www.who.int/violence_injury_prevention/road_safety_status/2015/en. [Last accessed on 2018 Mar 02].
3. Panwar R, Pal S, Dash NR, Sahni P, Vij A, Misra MC. Why are we poor organ donors: A survey focusing on attitudes of the lay public from northern India. J Clin Exp Hepatol 2016;6:81-6.
4. Singh P, Kumar A, Sharma RK. Factors influencing refusal by relatives of brain-dead patients to give consent for organ donation: Experience at a transplant centre. J Indian Med Assoc 2004;102:630, 632-43.
5. Transplantation of Human Organs and Tissues Rules, 2014. The Gazette of India: Extraordinary Part II Section 3 Subsection (i) March 27,2014.
6. Shroff S. Legal and ethical aspects of organ donation and transplantation. Indian J Urol 2009;25:348-55.
7. Sahay M. Transplantation of human organs and tissues Act-"Simplified". Indian J Transplant 2018;12:84-9
8. Dr. Sumana Navin, Dr. Sunil Shroff. INOS and the essence of organ sharing. Indian Transplant Newsletter Vol. III Issue NO.: 10 (October 2001)
9. Abraham G, Vijayan M, Gopalakrishnan N, Shroff S, Amalorpavanathan J, Yuvaraj A, et al. State of deceased donor transplantation in India: A model for developing countries around the world. World J Transplant 2016;6:331-5.

CHAPTER 16

Tissue Matching in Organ Transplantation

Mr. Shiva Krishna Katkam | Dr. Vijay Kumar Kutala

Introduction

The human major histocompatibility complex is a family of genes that encodes HLA molecules, which have crucial role in organ transplantation. Humans have three class I HLAs namely A, B, C that are mainly present on all nucleated cells and six class II HLAs DPA1, DPB1, DQA1, DQB1, DRA1, DRB1 that are present only on antigen-presenting cells and lymphocytes. The basic function of these MHC molecules is to differentiate self-antigens from non-self. Class I HLA presents intracellular antigens (such as virus particles) while class II HLA present extracellular antigens (bacteria and fungi).

The human MHC molecules exhibit diversity and heterogeneity, which allows the human immune system to protect against various group of foreign pathogens and ability to recognize self and non-self molecules. Among various class I and class II alleles three of alleles HLA-A, -B, and -DRB1 contribute to the majority of the immunogenicity of mismatched antigens and that is mainly due to highly polymorphic nature. Hence, traditional HLA-typing methods have primarily focused matching of these alleles prior to the organ transplantation. In recent years, un-matched HLA donors (spouses or cadaver) are becoming more common and very successful due to strong immunosuppressive regimen.

The presence of pre-formed donor specific allogeneic HLA antibodies in patients are mainly due to multiple blood transfusions, multiple pregnancies, and prior transplantation and that may result in the rapid rejection of transplanted organ. Thus, detection of donor specific anti- HLA antibodies is essential to prevent antibody-mediated acute rejection.

Remarkable advancement in the field of immunogenetics has developed a DNA-based high resolution technique for HLA-typing to identify the HLA antigens in both donor and recipients and anti-HLA antibodies in recipient serum may considerably enhanced the safety of transplantation. Therefore, antibody characterization is necessary to determine the clinical importance of a cross-match test result.

Basic approaches for immune compatibility

1. High resolution DNA based HLA-Typing of both donor and recipient prior to the organ transplantation.
2. Identification of pre-formed donor specific HLA antibodies in potential recipient by Cell-based crossmatch assays.
3. Cell- based crossmatch assays provide us a direct assessment of the reactivity of antibodies from potential recipient with the cells of a potential donor. The following techniques are used to detect and characterize the anti-HLA antibodies.

Cross match test must be performed within 48 hrs before the transplantation. Basic requirement are recipient's serum and donor (cadaver) WBCs. Test must be performed immediately after the sample collection. The various methods to detect preformed antibodies are:

1. Complement dependent cytotoxicity cross match (CDCXM) (Figure-1a):

The underlying principle of CDC cross-match is to detect clinically relevant donor-specific anti-HLA antibodies, in which donor lymphocytes (T and B cells) are incubated with recipient's sera and complement. If donor-specific anti-HLA antibodies are present, these will bind to donor lymphocytes and initiate the complement cascade resulting in nonviable (dead) donor lymphocytes. The percentage of dead cells will be quantified under Invert phase microscope and that forms the basis to reject or accept the suitability for transplantation. Many laboratories perform CDC assays in the presence of anti-human globulin which enhances the sensitivity of assay by enhancing the number of Fc receptors available to bind with complements and/or dithiothreitol (breaks down the disulfide bonds in IgM antibodies which are of no clinical significance) to improve the accuracy and reduce the false negative rates associated with these assays.

CDC can be falsely negative due to low titer of antibody, low expression of antigen on the cell surface and non-complement fixing antibodies. Falsely positive CDC tests are seen in the presence of IgM auto antibodies.

2. Flow cytometry cross match (FCXM) (Figure-1b):

The flow cytometric crossmatch test involves the separation of lymphocytes from donor and incubated with the transplant recipient serum, followed by the addition of fluorescently labeled anti-human immunoglobulin reagents which is specific for Fc part of IgG, usually conjugated with FITC (Fluorescein). Along with the anti-IgG antibodies, the markers specific for B-cells and T cells, which usually include CD19, CD20 or CD22 labeled with phycoerythrin (PE) for B-cells and CD3 labeled with peridinin chlorophyll protein (PerCP) for T-cells are used to separate and identify the

positive signals. The anti-HLA antibodies against Class I antigens will bind to both B-cells and T-cells; while those against Class II antigens will bind only to B-cells. The test also contains positive and negative control serums which are commercially available to analyze and validate the test result. A positive test indicates the presence of HLA class I or/and II antibodies.

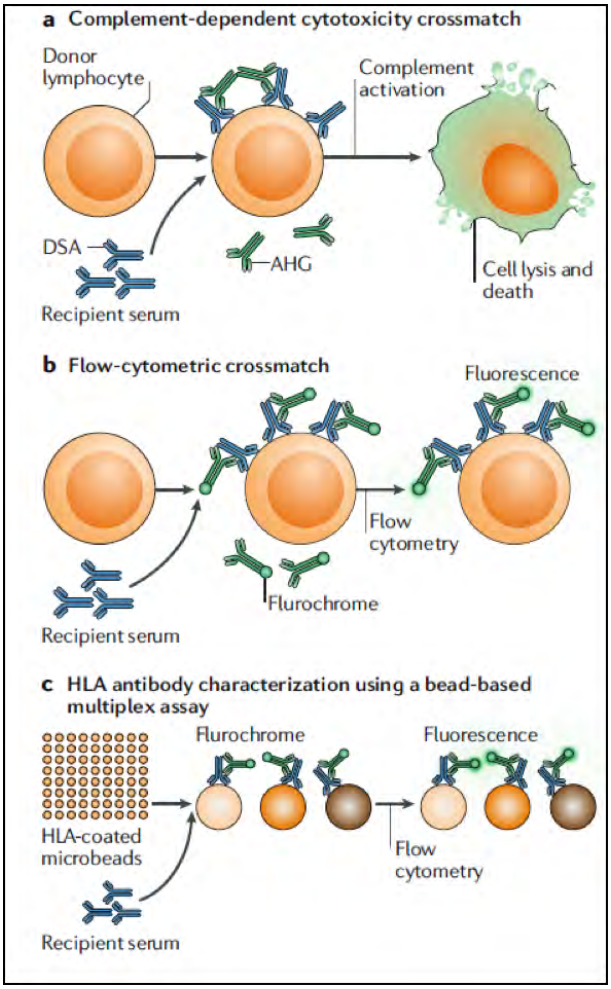


Figure-1. Principle of (a) CDC cross match test (b) Flow cytometry

(c) HLA antibodies detection

3. Solid-phase assays (e.g. enzyme-linked immunosorbent assay [ELISA] or Luminex) (Figure-1c):

The Luminex platform is a solid-phase assay that utilizes polystyrene microspheres (beads), each embedded with fluorochromes of differing intensity attached to one (single-antigen beads) or several HLA molecules (screening beads) to determine anti-HLA antibody specificity. The recipient's sera containing anti-HLA antibodies are added to the bead mix and these antibodies bind to the appropriate beads expressing specific antigen(s). Next, a second phycoerytherin-labelled anti-human IgG is added to this mixture and these antibodies bind to the primary anti-HLA antibody already attached to the beads. The sample is then passed through lasers, which would independently excite the beads and the phycoerytherin therefore allowing the laser detector to define antibody specificity. Unlike the CDC assays, Luminex assay can detect both complement-fixing and non-complement fixing anti-HLA antibodies but does not detect IgM autoantibodies or non-HLA antibodies.

Suggested reading

1. Montgomery RA, Tatapudi VS, Leffell MS, Zachary AA. HLA in transplantation. Nat Rev Nephrol. 2018 Sep;14(9):558-570.
2. Hung Do Nguyen, Rebecca Lucy Williams, Germaine Wong and Wai Hon Lim (February 13th 2013). The Evolution of HLA-Matching in Kidney Transplantation, Current Issues and Future Direction in Kidney Transplantation Thomas Rath, Intech Open, DOI: 10.5772/54747.
3. Chughtai SA, Ajay SK, Halawa A Interpretation of Crossmatch reports in a patient with Lupus Nephritis. Arch Organ Transplant 2017; 2(1): 023-029.
4. Mohanka et al. "Careful Interpretation of HLA Typing and Cross-Match Tests in Kidney Transplant." (2017).

CHAPTER 17

Evaluation and Preparation for Kidney Transplant

Dr. Raghavenda Sadineni

Introduction

Kidney transplantation is the treatment of choice for suitable patients with end-stage kidney disease and must be discussed with patients with advanced chronic kidney disease (CKD) preparing for, or on renal replacement therapy.

Evaluation of kidney transplant candidates includes medical, surgical, immunologic, and psychosocial evaluations. The workup should be tailored according to patient specific conditions. The patient's individual risks and benefits of transplantation are discussed so that he or she can make an informed decision about whether to proceed with transplantation. After candidates are placed on the deceased donor list, a periodic reevaluation is necessary to address new issues that may impact on transplant suitability.

Transplantation workup

The purpose of the evaluation is to identify contraindications for kidney transplantation and address and correct medical and psychological conditions that may affect transplant outcomes.

1. Comprehensive history and physical examination with emphasis on the following:

    a. Document the cause of renal disease and assess the risk of recurrence in the transplanted kidney; this includes review of the native kidney biopsy report, if available.

    b. Financial evaluation to assess ability to afford transplant medications

    c. Psychosocial evaluation in conjunction with a transplant social worker to assess support network, determine suitability, and develop a plan to avoid adverse post transplantation psychosocial outcomes

2. Contraindications for kidney transplantation

a. Severe uncorrectable systemic conditions with short expected life expectancy

b. Reversible renal failure

c. Recent or untreatable malignancy

d. Uncontrolled psychiatric disorders and active substance abuse

e. Ongoing noncompliance

f. Chronic or ongoing active infection

g. Primary oxalosis (evaluate for combined liver-kidney transplantation)

h. Limited irreversible rehabilitative potential

3. Required laboratory tests

a. Blood type (need confirmatory test by 2laboratories)

b. Complete blood count and comprehensive metabolic panel

c. Prothrombin time (PT), partial thromboplastin time (PTT)

d. Hepatitis serological tests

e. Venereal disease research laboratory (VDRL) serological test

f. Cytomegalovirus serological test

g. Tissue typing for HLA and panel-reactive antibody (PRA)

h. Identification of specific HLA antibody should be performed in patients with positive PRA

i. Electrocardiogram (ECG)

j. Chest X-ray

k. Renal ultrasound for those on dialysis therapy for more than 5 years in patients without recent imaging

Tests to be considered in special clinical situations

1. Purified protein derivative (PPD) test in those with a history of exposure to tuberculosis, prior residence in an endemic area, or chest X-ray suspicious of tuberculosis
2. Colonoscopy in patients older than 50 years
3. Gynecological evaluation, including Papanicolaou smear in women of childbearing age
4. Mammogram in women older than 40 years
5. Prostate-specific antigen (PSA) in men older than 45 years
6. Serum immunoelectrophoresis in patients older than 60 years and those with unexplained renal failure and anemia.
7. Stress test, echocardiogram, and cardiac angiogram (see cardiac section)
8. Vascular study (see vascular section)

9. Detailed coagulation study in those with history of deep venous thrombosis, spontaneous abortion, recurrent clotting of a dialysis fistula or graft, or bleeding tendency
10. Toxoplasmosis, coccidioidomycosis, and histoplasmosis titres in residents of endemic areas

Cardiac evaluation

1. Patients with CKD have a high prevalence of CVD, left ventricular hypertrophy, and congestive heart failure and therefore are at high risk of cardiovascular events perioperatively and post-transplantation
2. History and physical examination to assess cardiovascular symptoms and signs, risk factors, and physical status
3. ECG for all patients; abnormal results warrant additional cardiac evaluation
4. Non-invasive screening to rule out occult CVD should be performed in patients with symptoms or clinical signs; given the high prevalence of occult CVD, those with significant CVD risk factors, including diabetes, age older than 50 years, severe peripheral vascular disease, cigarette smoking history, or long-term CKD should undergo a stress test.
5. Patients with diabetes may benefit from a stress test with imaging due to the low sensitivity of exercise ECG stress test; type of imaging test should take into account the transplant centre's experience
6. Although data are lacking, there is a general consensus to support repeated screening for cardiac disease; those with a normal coronary angiogram may not need re-evaluation for 3 years; new cardiac symptoms warrant immediate evaluation
7. Echocardiogram should be obtained in those with suspected valvular disease or congestive heart failure
8. Those with inducible ischemia should be referred for cardiology consultation and coronary angiography should be considered; if CVD is detected and amenable to revascularization, the procedure should be performed before transplantation
9. Smoking cessation is recommended in all patients, especially those with significant CVD; referral to smoking cessation programme is recommended

Peripheral vascular evaluation

1. Vascular disease is common in patients with end-stage renal disease (ESRD), and kidney transplantation involves major vascular surgery
2. Physical examination should focus on femoral and peripheral vascular arteries; Doppler studies of iliac and lower-extremity vessels or other imaging study may be performed in patients with symptoms and signs suggestive of peripheral vascular disease to evaluate the feasibility of allograft placement.

Pulmonary evaluation

1. Evaluation should include assessment of general anesthetic risk.
2. A pulmonary function test is indicated in patients with a significant smoking history and those with symptoms and signs of chronic lung disease, unexplained shortness of breath, or exercise limitation
3. Isoniazid (INH) prophylaxis should be considered in patients with a positive tuberculin skin test result or chest X-ray suggestive of tuberculosis
4. Smoking cessation is recommended in all patients before transplantation

Urological evaluation

1. Indications for a voiding cystourethrogram may include recurrent urinary tract infections, pyelonephritis, history of vesicoureteral reflux, history of urinary retention, or other abnormal voiding patterns
2. Renal ultrasound or other imaging studies should have been performed in all patients undergoing evaluation for renal transplantation and should be available for review; specific pathological conditions for which renal ultrasound is indicated include acquired cystic kidney disease, suspected kidney stones, unexplained hematuria, suspected renal mass, evaluation of hydronephrosis in children presenting with CKD, and those with a significant history of urinary tract infection.
3. Urodynamic studies should be considered in patients with a suspected neurogenic bladder and may be indicated in young patients with unexplained CKD
4. Patients with abnormal prostate examination findings and those with high PSA levels should be referred for a possible prostate biopsy
5. Patients with a history of obstructive voiding symptoms and benign prostatic hyperplasia should have an assessment for postvoid residual volume; those with high residual volume may need urological referral and further workup

Indications for pretransplantation native nephrectomy:

Chronic pyelonephritis, infected stone, heavy proteinuria, intractable hypertension, polycystic kidney disease with severely enlarged kidneys, recurrent bleeding or infection, or renal mass suspicious for renal cell carcinoma

Assessment for immunologic risk

Screening tests to detect preformed HLA antibodies include an enzyme-linked immuno- sorbent assay (ELISA), flow cytometry and cytotoxicity test to assess PRA; positive PRA results should be followed by specific HLA antibody tests

1. An ELISA is inexpensive and is used to detect antibody against purified class I and class II antigens
2. Flow cytometry is more sensitive and allows sera to be tested against whole lymphocytes, purified HLA antigens, or single antigen beads; without desensitizing treatment, antibodies to a specific antigen identify those antigens as unaccepTable for transplant

Highly sensitized patients

Sensitization is defined as the presence of preformed antibodies against HLA in the blood and is a major barrier to successful transplantation. Available options include kidney paired donation, kidney list donation, and desensitization treatment

1. Kidney paired donation involves 2 or more pairs of incompatible living donors and recipients; the mutual exchange results in 2 or more compatible transplants
2. Kidney list donation involves a pair of an incompatible potential living donor and recipient and a waiting list recipient; a waiting list recipient receives the organ from the living donor; the donor's intended recipient is given priority to receive a deceased donor organ
3. Patients with a cross-match–positive living donor or those on the top of the waiting list should be referred to a transplant centre with expertise in desensitization protocols and/or a donor exchange programme

Evaluation of comorbid conditions

1. Diabetes

a. In patients with type 1 diabetes with ESRD, early transplantation with a living donor followed by pancreas-after kidney transplantation usually is regarded as the best option

b. Due to the superior outcomes of simultaneous kidney-pancreas transplantation compared with deceased donor kidney transplantation, this option should be discussed with patients with type 1 diabetes, especially those without potential living donors; the additional risk and benefits should be discussed thoroughly with patients.

2. Obesity

a. Because morbid obesity is associated with increased risk of graft loss, delayed graft function, wound complications, prolonged hospitalization, and new-onset diabetes after transplantation, weight loss often is recommended before transplantation, although the benefit of this intervention is unclear; there is no specific guideline on body mass index (BMI) cut-off value, although most centres will decline candidates when BMI is greater than 40 kg/m2

3. Patients with history of cancer

a. Most, but not all, patients will benefit from waiting 2 to 5 years before transplantation;

b. The exception may include cancer in situ, localized non-melanoma skin cancer, and limited incidental renal cell cancer. The optimal waiting time varies depending on type, stage, and localization of tumour, as well as response to therapy; data for exact risk of cancer recurrence are lacking; additional information can be obtained from the Israel Penn International Tumour Registry; oncology consultation may be beneficial

4. Hypercoagulable state

a. Patients with a history of spontaneous abortion or thrombosis, including recurrent clotting of a dialysis fistula and graft, should be screened

b. Hypercoagulable states exist in up to 15% to 20% of patients with ESRD; common causes include activated protein C resistance, factor V Leiden gene mutation, prothrombin gene mutation,and antiphospholipid antibody

c. A hypercoagulable state is rarely a contraindication for transplantation; patients need to be managed with anticoagulation therapy during and after transplantation; anticoagulation is associated with an increased risk of bleeding.

5. Hepatitis C infection

a. Liver biopsy should be performed to evaluate the extent of liver damage because clinical findings and biochemical markers may underestimate the degree of advanced liver disease in patients with ESRD

b. Cirrhosis is a contraindication for kidney transplantation due to increased mortality in this group; instead, liver kidney transplantation should be considered

c. Consideration should be given to treatment of patients with hepatitis before transplantation,especially those with a treatmentsensitive genotype (non–type 1)

d. The option of hepatitis C–positive donor transplantation should be discussed with patients with active hepatitis C given the shorter waiting time for hepatitis C deceased donor kidney and accepTable outcome

e. Patients who are hepatitis B naïve should be vaccinated against hepatitis B

6. Hepatitis B infection

a. With the introduction of effective antiviral therapy, hepatitis B infection is no longer considered an absolute contraindication for transplantation

b. Patients with past natural infection with detecTable antibody to hepatitis B surface antigen (HBsAb) and negative hepatitis B surface antigen (HBsAg) are at low risk of hepatitis B resurgence; antiviral prophylaxis may be beneficial

c. Liver biopsy should be performed in patients with active hepatitis B; if advanced liver disease is detected, patients should be referred for combined liver-kidney transplantation

d. Antiviral treatment should be initiated in patients with active viral replication (positive hepatitis B e antigen [HBeAg] or hepatitis B virus DNA)

7. Human immunodeficiency virus (HIV) - Infected patients

a. HIV infection is no longer considered an absolute contraindication for transplantation

b. Potential candidates should have no active acquired immunodeficiency syndrome (AIDS)-defining illness and have sustained CD4 counts greater than 200 cells/mL with undetecTable serum HIV RNA on sTable antiretroviral therapy

8. Systemic lupus erythematosus and vasculitis

a. Transplantation should be delayed until patients have no clinically active disease and are on minimal immunosuppression; the duration of dialysis therapy before transplantation and serological status in the absence of clinically active disease do not predict recurrenc

b. Previous treatment with steroids increases the risk of bone disease

c. Exposure to cytotoxic agents increases the risk of bone marrow toxicity and posttransplantation malignancy

9. Polycystic kidney disease

a. Pretransplantation nephrectomy may be indicated in patients with recurrent urinary tract infections, bleeding, or large kidneys extending into the pelvis to make room for placement of an allograft

b. Extrarenal manifestations, such as aneurysm, valvular heart disease, and diverticulosis, may complicate the transplantation course, and screening should be performed in suspected cases

10. Primary oxalosis

Primary oxalosis is a contraindication for single-organ kidney transplantation, and patients should be referred for combined liver-kidney transplantation

11. Blood dyscrasias

a. In the presence of paraproteinemia, a workup for myeloma is warranted; benign monoclonal gammopathy is a diagnosis of exclusion and serial monitoring for 12 months to rule out myeloma is recommended before transplantation; patients should be counselled about the long-term risk of developing frank myeloma

b. Patients with treated myeloma may be cautiously considered for transplantation; these patients remain at high risk of posttransplantation infections

c. Amyloidosis is associated with poorer prognosis after transplantation; however, patients with amyloidosis with limited extrarenal manifestations can be considered for kidney transplantation

12. Advanced age

a. Patients older than 60 years are at a greater risk of posttransplantation infection and are more susceptible to medication side effects

b. Appropriately evaluated and educated patients in their 70s may benefit in terms of life expectancy from transplantation and may be considered as transplant candidates

c. There are limited data on outcomes for patients in their late 70s and early 80s; most of these patients are better served by remaining on dialysis therapy

d. Counseling should emphasize the benefit of timely transplantation given the high mortality rate of elderly patients on the waiting list; living donor transplantation should be encouraged, and the option of expanded criteria donor (ECD) listing should be discussed.

e. ECD is particularly advisable for older patients without a living donor in whom a prolonged wait for standard criteria donor (SCD) is anticipated

f. Age-appropriate screening for malignancy should be maintained

13. Primary glomerular disease

a. Most, but not all, glomerular disease may recur after transplantation; recurrence of disease may result in graft loss; the rate of recurrence and risk of graft loss vary according to primary disease

b. Primary focal sclerosis may recur in 20% to 50% after kidney transplantation and lead to graft failure in up to 20% of patients after transplantation; risk factors include younger age and rapid progression in native kidneys; detailed counseling should be performed

c. Risk of graft loss is similar in living versus deceased donor transplantation and a living donor should be considered in the first transplantation ; however, if the first graft is lost rapidly due to recurrent disease, the chance of recurrence in subsequent transplants is more than 80% and a living donor transplant should generally be avoided

14. Patients with a previously failed graft

a. Referral should be made as patients approach stage 4 CKD

b. Patients with a failed graft are at risk of developing donor-specific antibodies, especially those with early graft loss due to severe rejection; screening followed by confirmation of donor-specific antibodies should be performed.

c. Allograft nephrectomy generally is not indicated except in those with ongoing uncontrolled rejection, severe hematuria, and/or malignancy; allograft nephrectomy may be associated with a resurgence of donor-specific antibodies

d. Patients with early failed grafts due to recurrent glomerulonephritis are at very high risk of subsequent recurrence; patients with recurrent focal segmental glomerulosclerosis (FSGS) should be considered for pretransplantation plasmapheresis

e. Patients with graft failure due to BK nephropathy can successfully undergo retransplantation; allograft nephrectomy may not be necessary, especially in those who showed clearance of viremia; vigorous monitoring of BKviremia and adjustment of immunosuppression posttransplantation are important

f. A hypercoagulable workup should be performed in patients with graft failure due to unexplained graft thrombosis

g. In patients approaching CKD stage 5 with a potential living donor, consideration should be given to maintain adequate immunosuppression, promptly followed by retransplantation to avoid immune activation

Re-evaluation of patients awaiting deceased donor kidney transplants

1. Primary nephrologists and/or transplant candidates on the waiting list are expected to inform the transplant programme of intercurrent illnesses that may affect their transplant candidacy
2. Due to the prolonged wait time for a deceased donor transplant and the high incidence of morbidity in dialysis patients, transplant candidacy needs to be reassessed periodically
3. The timing, frequency, and type of testing depend on comorbid conditions. The local allocation algorithm may predict the timing of transplantation and impact on the schedule of wait-list follow-up; centers that rely primarily on dialysis time may see patients when accrued time approaches expected wait time
4. Proper vaccination, cancer screening, and other health maintenance should be continue
5. During the follow-up visit, reassessment of cardiovascular status is of utmost importance; routine cardiac rescreening is recommended in moderate- to high-risk patients; new symptoms and signs suggestive of coronary disease should be thoroughly evaluated
6. Patients with correcTable conditions should be made temporarily unavailable until the condition is successfully corrected; those with uncorrecTable contraindication should be removed from the waiting list.

Suggested readings

1. Abbud-Filho M, Adams PL, Alberu J, et al:Areport of the Lisbon conference on the care of the kidney transplant recipient. Transplantation 2007; 83:S1-S22.
2. Arndorfer JA, Meier-Kriesche HU, Ojo AO, et al: Time to first graft loss as a risk factor for second renal allograft loss. Transplant Proc. 2001; 33:1188-1199.
3. Choy BY, Chan TM, Lai KN: Recurrent glomerulonephritis after kidney transplantation. Am J Transplant2006; 6:2535- 2542.
4. Cibrik DM, Kaplan B, Arndorfer JA, Meier-Kriesch HU: Renal allograft survival in patients with oxalosis. Transplantation .2002;74:707-710.

5. Danovitch GM, Hariharan S, Pirsch JD, et al: Management of the waiting list for cadaveric kidney transplants: Report of a survey and recommendations by the Clinical Practice Guidelines Committee of the American Society of Transplantation. JAm Soc Nephrol.2001; 13:528-535.

6. Fabrizi F, Martin P, Dixit V, Bunnapradist S, Dulai G: Hepatitis C virus antibody status and survival after renal transplantation: Meta-analysis of observational studies. Am J Transplant.2005; 5:1452-1461.

7. Friedman GS, Meier-Kriesche HU, Kaplan B, et al: Hypercoagulable states in renal transplant candidates: Impact of anticoagulation upon incidence of renal allograft thrombosis. Transplantation.2001; 72:1073-1078.

8. Gaston RS, Danovitch GM, Adams PL, et al: The report of a national conference on the wait list for kidney transplantation. Am J Transplant.2003; 3:775-785.

9. Gore JL, Pham PT, Danovitch GM, et al: Obesity and outcome following renal transplantation. Am J Transplant,2006; 6:357-363.

10. Jordan SC, Tyan D, STablein D, et al: Evaluation ofintravenous immunoglobulin as an agent to lower allosensitization and improve transplantation in highly sensitized adult patients with end-stage renal disease: Report of the NIH IG02 trial. JAm Soc Nephrol 2004;15:3256-3262.

11. Marcen R: Cardiovascular risk factors in renal transplantation—Current controversies. Nephrol Dial Transplant.2006;21:Siii3-Siii8.

12. Meier-Kriesche H, Port FK, Ojo AO, et al: Deleterious effect of waiting time on renal transplant outcome. Transplant Proc.2001; 33:1204-1206.

13. Meier-Kriesche HU, Arndorfer JA, Kaplan B: The impact of body mass index on renal transplant outcomes: A significant independent risk factor for graft failure and patient death. Transplantation .2002;73:70-74.

14. Montgomery RA, Hardy MA, Jordan SC, et al: Consensus opinion from the antibody working group on the diagnosis, reporting, and risk assessment for antibodymediated rejection and desensitization protocols. Transplantation.2004; 78:181-185.

15. Ojo A, Meier-Kriesche HU, Friedman G, et al: Excellent outcome of renal transplantation in patients with Fabry's disease. Transplantation2000; 69:2337-2339.

16. Ramos E, Vincenti F, Lu WX, et al: Retransplantation in patients with graft loss caused by polyoma virus nephropathy. Transplantation.2004; 77:131-133.

17. Scandling JD: Kidney transplant candidate evaluation. Semin Dial.2005; 18:487-494.

CHAPTER 18

Evaluation and Preparation for Liver Transplantation

Dr. B. Sukanya

Introduction

Liver is the largest organ in the body and weighs approximately 1% of the total body weight. It carries out numerous functions like processing proteins, fats and carbohydrates, and breaking down toxic substances such as drugs and alcohol. The liver makes the chemical components that help your blood clot. When the liver fails irreversibly and medicines no longer help the patient, the condition is known as 'End Stage Liver Disease (ESLD)'. At this point the patient becomes eligible for a 'Liver Transplantation'.

Liver transplantation is one of the most complex surgeries ever performed. Hence before a patient can be taken up for surgery, one needs detailed assessment to make sure patient can survive the rigorous operation.

Five main factors to be determined while evaluating for liver transplant

1. Does the patient qualify for a liver transplant?
2. Is the patient fit for transplant?
3. Does the patient suffer from a condition which will recur in the new liver
4. Is the patient and family psychologically prepared for such a major surgery and the changes in lifestyle and discipline it entails for the rest of their lives?
5. Does the patient have the necessary finances for pre operative, intra operative and postoperative care?

Does the patient qualify for a liver transplant?

The first thing that needs to be determined is does the patient have a condition which warrants liver transplant

Conditions that are considered for transplantation

1. Acute liver failure
2. Chronic liver disease; any cirrhosis which may be due to:
    a. Fatty liver disease: alcohol or non-alcohol related
    b. Chronic viral hepatitis B, C, D
    c. Autoimmune liver diseases: primary biliary cirrhosis, primary sclerosing cholangitis, chronic active liver disease and overlap syndromes
    d. Genetic haemochromatosis
    e. Wilson's disease
    f. α-1 antitrypsin deficiency
    g. Congenital hepatic fibrosis and other congenital or hereditary liver diseases
    h. Secondary biliary cirrhosis
    i. Hepatopulmonary syndrome
    j. Familial amyloidosis
    k. Primary hypercholesterolaemia
    l. Polycystic liver disease
    m. Hepatic epithelioid haemangioendothelioma
    n. Recurrent cholangitis
    o. Nodular regenerative hyperplasia
    p. Hereditary haemorrhagic telangiectasia
    q. Glycogen storage disease
    r. Ornithine transcarbamylase deficiency
    s. Primary hyperoxaluria
    t. Maple syrup urine disease
    u. Porphyria
    v. Amyloidosis
3. Tumours
    a. Hepatocellular carcinoma
    b. Benign UnresecTable hepatoblastoma (without active extrahepatic disease)
    c. UnresecTable benign liver tumours with disabling symptoms
4. Any aetiology leading to hepatopulmonary syndrome or portopulmonary hypertension

5. Variant syndrome
6. In Paediatric patients, the additional disorders are
    a. Biliary atresia
    b. Caroli's syndrome
    c. Cystic fibrosis
    d. Progressive familial intrahepatic cholestasis (all types)
    e. Alagille's syndrome
    f. Glycogen storage disease types 3 and 4
    g. Tyrosinaemia type 1
7. Metabolic liver disease with life-threatening extra-hepatic complications
    a. Crigler-Najjar syndrome
    b. Urea cycle defects
    c. Hypercholesterolaemia
    d. Organic acidaemias
    e. Primary hyperoxaluria
    f. Glycogen storage disease type 1
    g. Inherited disorders of complement causing atypical haemolytic uraemic syndrome
    h. Maple syrup urine disease
    i. Porphyria

For patients with chronic liver disease, selection for liver transplantation depends on their risk of dying from the liver disease weighed against their risk of dying from the transplantation, its attendant complications and medications. For this, various mortality risk scores have been formulated and based on these scores the timing of surgery is determined. The common scores used are MELD are UKELD. A MELD score of 15 or above, UKELD of 49 or above are the cut offs for listing for liver transplant unless the patient qualifies for MELD exception criteria where this pre requisite can be waived off.

Is the patient fit for transplantation?

Once it is ascertained that patient meets the criteria for liver transplant then the next step is to find whether the person is fit for liver transplant. The first step involves a series of blood investigations to assess the status of liver function, a detailed evaluation of the possible cause of liver disease in case it is not already known, to look for sub clinical infections both in the liver and outside the liver. There are tests to determine your lung capacity, cardiac function, renal function, anaesthesia risk eg. ECHO, Pulmonary function tests, etc. Imaging studies in the form of CT scans, X rays, MRIs are done to plan the surgery and to look for clots in the blood vessels of liver, tumours in liver. In case of patients with HCC, detailed imaging is done to rule out extrahepatic spread of the disease and to make sure that the tumour is within the transplantable criterion. Apart from the treating

hepatologist, other concerned specialists opinions are also taken for risk assessment and clearance. Nutritional evaluation and counselling is a very important and integral part of pre transplant assessment. Many a patients are found to be malnourished due to a combination of the disease itself and the prevailing cultural taboos and food avoidance. They need to be given individualised diet sheet to improve their nutritional status. Malnutrition can worsen post op outcomes and is entirely avoidable. In children if the dietary targets are not met nocturnal tube feeds may also be given. These patients need diet which is high in calories and proteins. Salt and free water restriction needs to be reinforced. Not all patients who are evaluated will be cleared for transplant. A proportion of them are found to be unfit either due to advanced non hepatic disorders which makes the surgery too morbid to carry out.

Does the patient suffer from a condition which will recur in the new liver?

There are disorders of the liver which may recur in the new transplanted organ. Auto immune diseases, non alcoholic fatty liver, Hepatitis B and C to name a few will recur in the new organ hence it is important that patient understands this risk and continues the medications that are needed to prevent them from recurring. For some of these diseases screening biopsies, colonoscopies may be needed on a protocol basis and the importance of these should be emphasised to them.

Is the patient and family psychologically prepared for such a major surgery and the changes in lifestyle and discipline it entails for the rest of their lives?

The role of clinical psychologist or social worker cannot be over emphasised. Liver transplant is a life changing surgery. For those patients with alcohol related liver disease a thorough psychological assessment is very important. One needs to be sure that patient is not actively taking alcohol, is not smoking nor indulging in any other substance abuse. Active alcoholism, smoking, substance abuse are absolute contra indication for liver transplant. One also has to ascertain that patient is well motivated to remain abstinent for the rest of their lives in the post transplant period. Also any transplant involves a certain commitment and discipline from patient and their families. Importance or hygiene and cleanliness should emphasised. Compliance to immunosuppressive agents, regular hospital visits and evaluations are mandatory. As patients are sick in the waiting period to transplant many of them have depressed moods due to never ending wait for the organ, poor quality of life, being away from work/ social life in few situations. They have to be physically and mentally prepared for post transplant complications The role of a supportive family is essential here. Make sure that someone is always there to take care of the patient. Family needs to ensure that patient is taking medicines regularly, eating well and exercising sufficiently. The endeavour should be to be fit and available for transplant whenever the call comes from the transplant coordinator.

Does the patient have the necessary finances for pre-operative, intra operative and post-operative care?

Last but not the least, in India where most of medical treatment is self financed, it is very important that patient and family understands the financial implications both direct and indirect, of liver transplant. The cost of evaluation, expense incurred in the lead up to transplant in the form of accommodation at a place close to hospital, nutritional supplements, loss of income due to unemployment of the patient and probably another family member needs to be informed. Patient also needs to be told that even after transplant even though the patient may go back to their usual occupation, the money incurred on immunosuppressive agents, investigations and regular visits to the doctor is considerable. It must be emphasised that if due to financial constrains drugs are stopped they stand the risk of losing the graft forever.

In summary, a through evaluation and counselling for taking care of patient's medical, nutritional and emotional well being is needed in preparation for a liver transplant

Checklist of things to be done prior to enlisting patient for liver transplantation:

Name: Age: Blood Group – (Subtyping of A as A1 or A2 is essential)

Co- morbidities:

Diagnosis : MELD Scores

MELD exception – Applicable/ Not applicable

Addictions: If yes – Is the patient abstinent and the duration of abstinence

HIV/HBsAg/ HCV: HBV DNA, HCV RNA:

Anti HBc (Total) :

CMV Serology :

EBV Serology :

Coagulation work up: Detailed Thrombophilia work up in cases of Budd Chiari Syndrome

Renal Function tests including 24 hour urine protein and creatinine clearance

Pulmonary function tests

Cardiac evaluation including Cardiac stress tests (TMT/ DSE/DST)

Cross consultations:

Psychological evaluation: Psychiatrist and counsellor

Nutritional consultation : For nutritional rehabilitation, for specific diets in Wilsons etc

Cardiac Consultation

Pulmonary Consultation

Nephrology Consultation

Urology/ Gynaecology Consultation: Very important in adolescent patients

Infectious Disease Consultation: Vaccinations as appropriate

Dental Consultation

Ophthalmology Consultation : Especially if patient is long standing diabetic

Neurological Evaluation : Especially in Wilsons Disease

Anaesthesia Clearance:

Suggested reading

1. www.transplant.hrsa.gov – Policy and Guidance, OPTN Policy 9: Allocation of livers and liver-intestine
2. www.odt.nhs.uk – Liver selection and allocation; Liver allocation policy
3. www.jeevandan.gov.in – Guidelines For Liver
4. www.notto.gov.in – Updated Allocation Criteria for Liver

CHAPTER 19

Evaluation and Post-Transplant Care for Heart and Lung

Dr. Alla Gopala Krishna Gokhale

Introduction

Transplant coordinator role in heart and lung transplants cannot be over emphasized. From donor side, they help in tracking donor calls and evaluation of fitness of donors for donation of heart and lungs. They help in evaluation of potential recipient and register the patient in the state transplant waiting list, coordinate with the logistics team and medical team during donor organ retrieval and transplant, track donor calls and collect reports, and blood tests and biopsy results, look after the exit site, the list is endless; they are the backbone of the programme.

Different roles

I. Donor assessment and maintenance

Unlike liver and kidneys, there are many limitations in choosing a donor for heart and lungs. If possible, better to inform the recipient team at the time of first brain death declaration, giving them enough time to organize the recipients.

Donor criteria for heart transplant

a. Less than 50 years of age
b. Absence of severe chest trauma
c. Absence of infection
d. Absence of prolonged cardiac arrest if young donor-discuss with surgeon if donor had cardiopulmonary resuscitation (CPR)
e. Not on high doses of ionotropes (Noradrenaline not more than 0.02 micrograms/kg/min, Dobutamine <10microgrmas/kg/min, Vasopressin <4 u/hr)

f. Negative screens for HIV, hepatitis C, and hepatitis B
g. Blood type (ABO) compatibility
h. Close match of size between donor and recipient (a difference of upto 25% is accepTable)
i. Echocardiography- good cardiac function and no anatomical abnormalities
j. Clear chest radiograph
k. No history of malignant neoplasms

Donor criteria for lungs transplant

a. Less than 55 years of age
b. Absence of severe chest trauma
c. Absence of infection
d. Absence of prolonged cardiac arrest (heart-lung only)
e. Minimal pulmonary secretions
f. Endotracheal tube (ET) secretions: Gram's stain should be negative for bacteria, fungi, AFB
g. Negative screens for HIV, hepatitis C and B
h. Blood type (ABO) compatibility
i. Close match of lung size between donor and recipient
j. PaO2 > 300 mm Hg on 100% fraction of inspired oxygen (FiO 2)
k. Clear chest radiograph
l. No history of malignant neoplasms
m. If smoker, less than 10 cigarettes/day

Donor assessment form

The following assessment form, if filled properly, can help the surgeon decide about the suitability of donor.

Name: Age: Sex:

Ht wt: BSA: Blood group:

Name of the doctor attending: DOA:

Diabetic: Y/N

Smoking history: yes/no If yes, describe:

Any other past history:

Time of first brain death declaration: 2ND brain declaration planned at:

Organ harvesting planned at:

Cause of death:

Details of CPR if any: Ventilation started on:

Any surgeries done:

Heart rate: Blood pressure:

CVP: Temperature:

Lungs: Inotropes:

Antibiotics:

Chest X ray:

ABG report: Ph PCO2 PaO2
FiO2

PaO2 on 100% oxygen: PEEP:

CBP report: Sr Cr:

HBsAg Hep C HIV

CMV report: Blood group& Rh typing:

ECG: Echo report:

ET Secretions: color, quantity

Culture sent: if yes- report of culture.

Gram's stain report

CT chest for harvesting lungs:

Bronchoscopy report if done:

Collect blood sample for viral profile, CMV(1 red top tube from donor) and lymphocyte cross-match.

For lymphocyte crossmatch: 2 EDTA tubes (unclotted) from donor and 1 red top tube from recipient (clotted).

II. Role in recipients

A working knowledge about the indications and evaluation protocols for heart and lung transplants is necessary.

Heart transplant indications

The ACC/AHA guidelines include the following indications for cardiac transplantation

a. Refractory cardiogenic shock requiring intra-aortic balloon pump counter pulsation or left ventricular assist device (LVAD)

b. Cardiogenic shock requiring continuous intravenous inotropic therapy

c. Peak VO2 (VO2max) less than 10 mL/kg per min

d. NYHA class of III or IV despite maximized medical and resynchronization therapy

e. Recurrent life-threatening left ventricular arrhythmias despite an implanTable cardiac defibrillator, antiarrhythmic therapy, or catheter-based ablation

f. End-stage congenital HF with no evidence of pulmonary hypertension

g. Refractory angina without potential medical or surgical therapeutic options.

The traditional classical indications constitute the indications in 95% patients, but in < 5% patients especially in those with HCM/RCM, the following may also to be considered as indications

a. Persistent haemodynamically compromising ventricular arrhythmias, refractory to all usual therapies.

b. Refractory angina, where there is clear objective evidence of recurrent significant myocardial ischemia that is not amenable to conventional treatment.

c. RCMP/HCM with persisting NYHA III or IV symptoms refractory to conventional treatment and/ or recurrent admissions with decompensated HF, irrespective of ejection fraction.

Heart transplant contraindications

a. Pulmonary Hypertension: Irreversible fixed pulmonary hypertension with maximal medical and mechanical therapy. In general, accepTable candidates will have demonstrable sPAP< 50, Trans Pulmonary Gradient ≤ 15 mmHg, and a pulmonary vascular resistance (PVR) < 3-4 wood units.

b. Irreversible End Organ Damage (liver, kidney, cerebrovascular): Considered an absolute contraindication unless multi-organ transplant is considered. The respective specialty doctors should be contacted.

c. Irreversible Pulmonary Disease: FVC < 50% of predicted will be considered an absolute contra indication. Forced expiratory volume in 1st sec (FEV1) / forced vital capacity (FVC) < 0.6 will be considered a relative contra indication after the pulmonologist has been consulted.

d. Peripheral Vascular Disease: Severe symptomatic disease irremediable to surgical intervention will be exclusionary.

e. Malignancy: A history of malignancy will be evaluated on the basis of likelihood of recurrence, likelihood of metastases, and overall survivability from the tumor.

f. Uncontrolled Major Affective Disorders or Schizophrenia: Likelihood to adversely affect compliance will be considered a relative contraindication.

g. Substance Abuse: Active alcoholism or active use of drugs of abuse/ nicotine is considered exclusionary unless behavioral change/treatment is documented.

h. Obesity: Obesity with a euvolemic BMI >35 is a relative contraindication.

i. Osteoporosis. Significant osteoporosis will be considered a relative contraindication

j. Noncompliance. History of documented significant medical noncompliance will be considered exclusionary unless behavioral change is documented.

k. Psychosocial Status. Psychosocial or financial issues that could result in inadequate post-transplant care are considered a relative contraindication.

l. HBsAg and Hepatitis C Antibodies positivity are relative contraindication and should be further evaluated for the level of active viremia and for liver cirrhosis.

m. HIV infection : Active HIV infection is an absolute contraindication, but some of the transplant centers in USA and Canada do transplants from HIV positive donors.

n. Old age - Once considered an absolute contraindication to transplantation, older recipient age is now seen as a relative contraindication.

Lung transplantation indications

Lung transplantation is indicated for patients with chronic, end-stage lung disease who are failing maximal medical therapy, or for whom no effective medical therapy exists. The goal of lung transplantation is to provide a survival benefit, along with improvement in quality of life. Lung transplantation confers significant survival benefit, particularly in patients with advanced cystic fibrosis, idiopathic pulmonary fibrosis (IPF), and primary pulmonary hypertension. The patients with chronic obstructive pulmonary disease (COPD) and Eisenmenger's syndrome may not have survival benefit but they clearly have quality of life improvement with lung transplantation. Lung transplantation for most patients is a palliative rather than curative treatment, and improvements in quality of life in addition to survival should be used to assess the effectiveness of the procedure . Lung transplantation should be offered to adults with an array of end stage respiratory disease wherein –

a. There is more than 50% risk of death from lung disease within 2 years.

b. More than 80% likelihood of surviving at least 3 months post lung transplantation.

c. More than 80% likelihood of 5-year post-transplant survival from a general medical perspective.

The situation in India is little different. Most of the referrals for lung transplantation are the patients with IPF. COPD constitutes a negligible subgroup referred for transplantation (as opposed to the western data).

Indications for heart and lung transplantation

a. Irreversible primary pulmonary hypertension with heart failure;
b. Eisenmenger complex.
c. Pulmonary fibrosis, with severe left ventricular dysfunction.
d. Cystic fibrosis with severe heart failure;
e. Chronic obstructive pulmonary disease with heart failure;
f. Emphysema with severe heart failure

Evaluation of recipients

Unless critically ill, all patient will have the following tests as the part of the evaluation for transplant

1. Routine laboratory studies (Metabolic profile, liver function tests, thyroid function tests, cholesterol profile, complete blood and differential count, erythrocyte sedimentation rate, prostate specific antigen, iron studies, PT/aPTT, hemoglobin
2. Serologies for hepatitis B, hepatitis C, EBV, CMV, HSV, VZV, toxoplasmosis
3. HIV testing
4. PPD skin testing with controls
5. Echocardiography and/or MUGA scan
6. Electrocardiogram
7. Cardiopulmonary stress testing with max VO2 measurement
8. Right heart catheterization with measurement of pulmonary vascular resistance. If the PA pressures (PA systolic > 50, PVR >3) are high along with a high transpulmonary gradient > 12, reversibility can be tested on Table or by decongestion and repeating the test after some time. Right heart pressures every six months.
9. Pulmonary function tests
10. Chest radiograph
11. 24 hour urine collection for creatinine clearance and total protein
12. Prostate specific antigen (men >45 yrs); mammogram and Pap smear (women > 40 years)
13. Panel reactive antibody (PRA) mandatory and HLA phenotype not mandatory. Send PRA before vaccination. Done every six months if on waiting list.

Additional test for patients more than 50 years or with diabetes

1. Abdominal ultrasound
2. Carotid and transcranial dopplers
3. Non-invasive arterial studies (for Ankle Brachial Index (ABI)
4. CT chest, head, abdomen is often done as a baseline
5. Carcino embryonic antigen (CEA) levels.

Consultations

1. Psychiatry
2. Social work
3. Other clinical services (eg, renal, pulmonary, Infectious diseases , Gastrointestinal etc)

Vaccinations

1. Hepatitis B
2. Pneumococcal
3. Human influenza
4. DPT, Mumps, Measles (Complete if incomplete)

III. Matching donor and recipient

This applies to lung too. Generally matching of organs is based on blood group ,size and complement dependent Cytotoxic assay when possible.

Immunological matching before heart transplant using cadaver donor : The Immunological Matching prior to Heart Transplant in Indian practice normally Involves the Following process:

1. ABO Blood group Match
2. Quantitative anti- HLA Pre formed antibodies or Panel reactive antibodies (PRA). Panel reactive antibody measurement is a preliminary test in which recipient serum is tested for percentage of positive antibody levels against a pre –determined panel of HLA antigens. Less than 10% PRA value is accepTable, if the value is 10-50% then a single antigen bead MFI should be done. The single antigen bead HLA antibody assay tests the exact antibody level to different HLA Class 1 or Class 2 antigens measured as per their MFI (Mean Flourescent Index) by Luminax technique or measure antibody levels using Flow cytometry. Very high level of PRA above 75 % or high levels of donor specific antibodies (more than 2000 MFI) would constitute a very high risk case for Heart Transplant and higher risk for both hyper acute rejection as well as higher risk for recurrent antibody mediated rejection and poorer one year outcomes after HTX. Such cases with high PRA's can be taken for heart transplant after desensitization protocols and if required pre or peri operative plasmapharesis.
3. Complement dependent cytotoxic assay (CDC assay) between donor serum and recipient lymphocytes which is routinely done as soon as donor serum becomes available.
4. Virtual Crossmatch: It is standard practice in USA and UK to collect donor serum in ACT vials (Temperature 0-4 degrees) and perform a HLA typing (for HLA class 1 and Class 2 antigens) as soon as the donor is ready for organ donation. This HLA profile is then uploaded in a nationwide internet database. This enables the recipient hospital to check donor specific antibodies in the recipient against these donor related antigens and also match against the recipient HLA profile. This process is called a "Virtual Cross match ". High levels of donor specific antibodies against multiple HLA sites would constitute a relative contraindication for transplant. Then donor serum is stored in minus zero temperatures for future use. Virtual cross match thus is different from prospective cross match using both donor and recipient HLA typing, as done for live solid prgan transplants.

5. In the Indian Context where donor serum is neither stored nor sent for HLA typing, there is always a small but not insignificant chance that many cases where PRA was low against the standard HLA panel, donor specific antibodies could have been present in recipient serum. Also later testing for donor specific antibodies (DSA's) becomes very important in case of suspicion of antibody mediated rejection.

IV. Role in post op followup

Transplant coordinator is the link between recipient and transplant surgeon/physician in keeping track of patient progress.

The process of transplantation mandates lifelong surveillance for health maintenance. After recovering from the lung transplant surgery, the recipients are at a risk for host of complications due to drug toxicity, immune suppression, rejection and infection. Put together they can contribute to significant morbidity, mortality and also adversely affect the long term outcome of the graft.

1. Drug toxicity and medical complication of transplant
2. Rejection
    a. Acute cellular rejection
    b. Acute antibody mediated rejection
    c. Bronchiolitis obliterans (BO)
    d. Chronic lung allograft dysfunction other than BO
3. Infections
    a. Tuberculosis
    b. CMV
    c. Viral Hepatitis
    d. Pneumocystis pneumonia
    e. Aspergillus
4. Malignancies
    a. Post-transplant lymph proliferative disorder (PTLD)
    b. Skin cancer

Follow up visits

The following is the general clinic visit pattern.

a. Once weekly for the first month
b. Biweekly for the 2nd month
c. Monthly until 6 months
d. Once in three months until 1 year
e. Subsequently the follow up can be half-yearly.

The assessment will be focused on symptom evaluation to check for tolerance of post transplant drugs, nutrition and progression of physical fitness. The importance of protective measures to prevent infections can be addressed along with the review of the screening blood works and imaging studies.

Clinical assessment: Daily monitoring of weight, blood pressure, heart rate, oxygen saturation, temperature and peak flow at home (for lung transplants).

Fasting capillary blood glucose – Once weekly unless indicated otherwise.

Laboratory testing: CBC with differential, sodium, potassium, magnesium, phosphorus, tacrolimus level, BUN and creatinine

The goal is to identify and treat renal, metabolic and marrow toxicity of tacrolimus, mycophenolate, valganciclovir and septran at an early stage and prevent adverse outcomes.

Chest X-ray

a. Once monthly for 3 months
b. Once every 3 months for next 9 months
c. Followed by once in 6 months.

The recipient is at the highest risk for infection and rejection in the first 6 months following transplantation. A regular chest x-ray screening at this stage is a valuable tool in surveillance.

Drug levels: Prevention of rejection using optimal drug dosage and serum levels: The cornerstone of rejection avoidance is administering immunosuppressent drugs at optimal dosages as dictated by blood levels. The recommended trough (C0) levels for common immunosuppressent drugs in adult patients are :

a. Tacrolimus: Early post operative period
   Upto 60 days : 10-15 ng/ml
   3- 6 months : 8-12 ng/ml
   After 6 months : 5-10 ng /ml
b. Everolimus : 3-8 ng/ml
c. Mycophenolate : 1.9 -4 mg/ L
d. Cyclosporine : First 3 months: 275-375 ng/ml
   After 3 months : 100-150 ng/ml

Biopsies

Heart transplant : Surveillance Endomyocardial (EM) biopsies : For early detection of rejection. In view of the costs involved in India, we recommend the first biopsy to be done before discharge at 2-4 weeks after the heart transplant, second biopsy within one month, then at three, six and twelve months. This is useful for monitoring and also for reducing immune suppression. After one year, endomyocardial biopsy is recommended every year The EM biopsy samples are sent for both cell

mediate rejection (CMR) analysis and antibody Mediated rejection (AMR) analysis.

Lung transplant: Transbronchial biopsy and Broncheo-alveolar lavage with microbiology in lung transplants– 1 month, 3 month, 6 month, 1 year.

After 1 year post transplant, the most common cause of mortality is chronic rejection. It is a progressive disease with very limited treatment options. There is some evidence showing that the identification and treatment of acute rejection may decrease or delay the development of chronic rejection. Surveillance biopsies to diagnose clinically imperceptible rejections may improve overall survival. In addition the bronchoscopic evaluation of the anastomosis and airway patency can be done to evaluate for aberrant healing of the graft airway. The broncheo-alveolar lavage can be used in conjunction with radiographic findings to identify colonization or infection of the graft.

Coronary angiogram in heart transplant recipients: In view of premature coronary atherosclerosis in these patients, coronary angiogram is recommended at one year and then every two years and earlier if required as per the clinical status of patient.

PFT and 6 minute walk test in lung transplant recipients– 1 month, 2 month, 3 month, 6 month and then every 6 months.

Liver function test, fasting lipid profile, urine analysis, HbA1C, fasting blood sugar– Once every 6 months

Annual surveillance - CT Chest plain study, Tuberculin skin testing, HIV, HBsAg, Hep C, DEXA scan, mammogram, PSA, PAP smear and Ophthalmology visit.

Conclusion

Transplant coordinator role is critical in preparation for transplantation, post-operative management and long term follow up for the success of any transplant programme, especially heart and lung transplantations.

CHAPTER 20

Renal Transplantation: Immediate Post-operative and Long Term Care

Dr. Praveen Kumar Etta

Introduction

Renal transplantation (RT) is the treatment of choice for end-stage renal disease (ESRD). A successful RT improves the quality of life and reduces the mortality risk for most patients when compared with dialysis. However, patients require close follow-up after RT since they are on complex immunosuppressive (IS) regimens that render them susceptible to various complications and to preserve graft function. This topic addresses the immediate post-RT care, long term follow-up and management of the RT recipient with emphasis on monitoring allograft function and minimizing the risk of complications.

An interdisciplinary approach that includes urologists, nephrologists, intensivists, infectious disease specialists and specialized nurses is required to provide close follow-up, and to prevent and treat the potential complications in a RT recipient.

The management can be divided into three phases (Table 1):

1. Peri- and immediate post-transplant period (up to one month after surgery): includes RT surgery, initiation of IS, post-operative care
2. Early post-transplant period (one to six months after surgery): includes optimization of IS and graft function, prevention of acute rejection, prevention of opportunistic infection
3. Late post-transplant period (after six months of surgery): includes preservation of graft function, prevention of long-term consequences of IS

Immediate post-transplant	Early post-transplant	Late post-transplant
Induction and maintenance IS	Optimized maintenance IS	Optimized maintenance IS
Fluid balance	Adequate hydration	Avoid dehydration
Electrolytes: Na, K, Cl, Mg, Ca, phosphate	Electrolyte disturbances	Hyperkalemia, mineral bone disease
Acid-base: pH, pCO2, pO2, bicarbonate	Metabolic acidosis	Acidosis, hyperuricemia
Hypertension	Hypertension, PTDM	Hypertension, Dyslipidemia, Obesity, CVD, PTDM
Graft perfusion/vascular thrombosis: USG, Doppler study	Close monitoring of CNI trough levels	Adverse effects of IS
Graft function: DGF/SGF	Close monitoring of graft function	Monitoring graft function
Causes of graft dysfunction: Acute tubular necrosis Hyperacute or accelerated rejection Urologic- obstruction/urine leak Vascular thrombosis- renal artery/ renal vein Volume contraction	Causes of graft dysfunction: Acute rejection CNI toxicity Volume contraction Urologic- obstruction Infection- pyelonephritis, viral infections Interstitial nephritis Recurrent disease	Causes of graft dysfunction: Acute rejection Volume contraction CNI toxicity Urologic- obstruction Infection- pyelonephritis, viral infections Chronic allograft nephropathy Recurrent disease Renal artery stenosis PTLD
Surgical: wound care, drains, DJ stent, foley catheter, abdominal collections	Surgical: ureteric stricture/ stenosis	Surgical: ureteric stricture/stenosis, renal artery stenosis
Infections: UTI, RTI, surgical site, Candida, donor-derived infection	Infections: Opportunistic	Infections: Opportunistic and community acquired
Prophylactic antibiotics and antivirals	Prophylactic antibiotics and antivirals	Vaccinations, malignancy

Table 1. Important points to consider in different phases of post-RT period. CVD: cardiovascular disease, PTDM: posttransplant diabetes mellitus, CNI: calcineurin inhibitor, DGF: delayed graft function, SGF: slow graft function, PTLD: posttransplant lymphoproliferative disorder, UTI: urinary tract infection, RTI: respiratory tract infection

Immediate and early post-transplant period

During the early post-RT period, the patient remains under close observation with monitoring of vitals and clinical status. Fluid and electrolyte replacement during the post-RT period aims to maintain an adequate intravascular volume to ensure renal perfusion so immediate graft function is optimized.

Initially, the urine output (U/O) is recorded hourly and replaced with the same volume of crystalloids. Large-volume administration of 0.9% saline (NS) may result in hyperchloremic metabolic acidosis. By contrast, balanced crystalloid solutions (BCS; Ringer's lactate or Isolyte) are relatively safe. The relative hypotonicity of BCS causes inhibition of anti-diuretic hormone and the water diuresis occurs earlier and more satisfactory than with NS.[1] Close monitoring of serum electrolytes (4-6 hourly initially) remains a cornerstone of care for guiding fluid therapy. Fluid replacement is also guided by hemodynamic parameters like central venous and mean arterial pressures, etc. Overzealous fluid administration should also be avoided. Because of high U/O volume in post-operative period calcium, magnesium, potassium and phosphate levels must be monitored and replaced.

The initial fluid management varies among centers; One of the commonly used protocol is as follows

1. 0.45% saline and Ringer's lactate alternately to match hourly U/O for initial 24-48 h
2. Isolyte-M depending on hourly U/O for initial 48-72 h: 100ml/h if U/O is >700ml/h; 75ml/h if U/O is 500-700ml/h; 50ml/h if U/O is <500ml/h
3. 10% Calcium gluconate 10ml and 25 meq Sodium bicarbonate are given iv for every 4 litres of U/O for initial 48-72 h
4. MgSO4 iv once a day for initial three days

Calcium channel blockers are safe and effective for blood pressure control, as they can reverse the vasoconstrictive effect of CNIs. Antibiotics are normally administered during the perioperative period to prevent wound infections. Antimicrobial and antiviral prophylaxis typically for the first six months to one year after RT is routinely administered. Co-trimoxazole is initiated to prevent Pneumocystis carinii and urinary infections. Anti- Cytomegalovirus (CMV) prophylaxis is recommended based on the donor and recipient CMV serological status and the IS regimen. Thrombotic prophylaxis with heparin is recommended in the immediate post-RT period for patients at risk of thrombosis.

Routine post-operative USG and doppler are required to identify urinary obstruction, pyelonephritis, fluid collections- urinoma, hematoma, lymphocele, or abscess and vascular thrombosis. The renal graft generally is placed in the right or left iliac fossa in an extraperitoneal position and is most often anastomosed to the internal or external iliac artery. Graft tenderness and swelling are often observed in cases of acute rejection, outflow obstruction, pyelonephritis, or renal vein occlusion. Allograft dysfunction and rejection may occur in this period. Hyperacute rejection of the renal allograft occurs within hours of the RT; nephrectomy is indicated. Acute rejection can occur at any time which can be cellular or humoral mediated.

In general, abdominal drains and bladder catheters are left in place for at least 3-7 days. An increase in the drain output can indicate urinary fistula, lymphorrhea or bleeding. The foley catheter ensures the bladder is well drained and reduces strain on the ureter anastomosis. The catheter normally stays in place for a minimum of 3-5 days. If inserted, DJ stent is removed after 2-4 weeks.

Immunosuppression (IS)

IS must begin before or at the time of the RT. It can be divided into induction and maintenance regimens. Induction therapy is administered at or around the time of RT typically consists of biologic antibodies. In patients with regular immunological risks, interleukin-2 receptor antagonist (basiliximab) is generally used for induction, whereas in patients with high immunological risks, T-cell depleting antibodies are recommended (rabbit antithymocyte globulin, ATG). The typical maintenance therapy consists of a CNI (tacrolimus or cyclosporine), an antimetabolic agent [mycophenolate mofetil (MMF) or azathioprine] and glucocorticoids. Mammalian (mechanistic) target of rapamycin (mTOR) inhibitors (sirolimus, everolimus) are used in few patients. CNI blood concentrations are monitored regularly.

Delayed graft function (DGF)

DGF is most commonly used to describe the failure of the allograft to function promptly, leading to dialysis within 1 week after RT. It occurs in up to 5% of living donor recipients and 20% of deceased donor recipients. Optimal fluid therapy has been shown to decrease DGF after RT. When the transplanted kidney is not functioning it is critical to exclude arterial or venous occlusion and urinary obstruction or leak. DGF immediately after RT is usually due to acute tubular necrosis (ATN).

Long-term management

Out-patient follow-up

Patients are followed very closely for at least first 3-6 months following RT. The frequency of follow-up varies among centers and depends upon the stability of the patient, but usually this involves twice weekly for the first two to four weeks, then weekly for one month, then every two weeks for another month, and then every 1-3 months for the first year after RT. IS therapy is gradually reduced during the first 3-6 months to avoid adverse medication effects while still preventing rejection. Patients continue to require close monitoring lifelong to ensure that the graft is functioning optimally and to assess for complications due to side effects of IS drugs.

Laboratory monitoring

Commonly followed protocol is shown here (Table 2).[2]

Serum creatinine, bicarbonate, and electrolytes (sodium, potassium, calcium, magnesium, and phosphorus)	Every visit
Complete blood count and differential	Every visit
Tacrolimus/cyclosporine/everolimus/sirolimus level	Every visit
Urinalysis	Every visit
Fasting blood glucose	Weekly for the first four weeks, then at three and six months, then every year

HbA1c	Every three months or every visit if less frequent
Fasting lipid profile	Every three months or every visit if less frequent
PTH and 25-hydroxyvitamin D	every 6 to 12 months
Surgical: wound care, drains, DJ stent, foley catheter, abdominal collections	Surgical: ureteric stricture/stenosis
Infections: UTI, RTI, surgical site, Candida, donor-derived infection	Infections: Opportunistic
Prophylactic antibiotics and antivirals	Prophylactic antibiotics and antivirals

Table 2. Laboratory monitoring of post-RT patient. HbA1c: hemoglobin A1c; PTH: parathyroid hormone

Allograft monitoring

This typically involves monitoring the serum creatinine level and screening for proteinuria. Few may require a renal biopsy to determine the cause of these abnormalities. Some centers perform surveillance biopsies on all RT patients at regular intervals, whereas others do surveillance biopsies on all high-risk recipients, such as those with a history of BK virus, those at higher risk for recurrent disease or rejection, or highly sensitized patients. The threshold for RT biopsy should be low since the procedure is relatively safe.

Maintenance immunosuppression (IS)

Maintenance IS initiated at the time of RT is continued long-term for the duration of the allograft. Target levels for CNIs/whole-blood trough concentrations of CNIs are routinely monitored among RT recipients to achieve proper dosing and to avoid drug toxicity (Table 3).

CNIs	Hirsutism and gingival hyperplasia (cyclosporine), alopecia (tacrolimus), neurologic disturbances, insomnia, hypertension, acute and chronic renal dysfunction, electrolyte abnormalities, PTDM, hyperlipidemia, malignancies, and anemia
MMF	Gastrointestinal disturbances, particularly diarrhea
mTOR inhibitors	Pulmonary edema, hypertension, poor wound healing, joint pain, anemia, edema, and hyperlipidemia
Azathioprine	Leukopenia, hepatitis, and anemia
Glucocorticoids	Hypertension, PTDM, hyperlipidemia, bone disease

Table 3. Toxicity associated with IS agents. CNIs: calcineurin inhibitors; MMF: mycophenolate mofetil; PTDM: posttransplant diabetes mellitus

Infections

Infections are a major cause of death following RT. The risk of a particular infection is related to several factors including the degree of IS of the recipient. UTIs are among the most common bacterial infections occurring in the RT recipient.[3] Opportunistic infections like CMV, Epstein-Barr virus (EBV), Polyomavirus (BK virus) and Pneumocystis jirovecii can also occur.

Vaccinations

Inactivated vaccines are generally considered to be safe following RT. However, patients should not be given any live or live attenuated vaccines after RT (Table 4). It is advisable to avoid direct contact with anyone who has received a live vaccine. Close contacts (such as family members) of RT recipients should also be fully immunized.

Recommended vaccines	Not recommended
Diphtheria-pertussis-tetanus Haemophilus influenzea B Hepatitis A (for travel or other risk) Hepatitis B (receive before RT) Pneumovax (single booster at 5 years) Inactivated polio Influenza types A and B (booster every year) Meningococcus (if at high risk) Typhoid Vi	Varicella zoster Bacillus Calmette-Guerin (BCG) Smallpox Intranasal influenza Live oral typhoid Ty21a and other newer vaccines Measles (except during an outbreak) Mumps Rubella Oral polio Live Japanese B encephalitis vaccine Yellow fever

Table 4. Vaccination in post-RT period

Cardiovascular disease (CVD)

CVD is the major cause of death and graft loss in RT recipients. CNIs and glucocorticoids contribute to hypertension. Hypertension among RT recipients is associated with worse long-term graft outcomes. Dyslipidemia is a major risk factor for both CVD and reduced renal allograft survival; it is associated with mTOR inhibitors, CNIs (particularly cyclosporine) and glucocorticoids. Obesity may be due to long-term glucocorticoids also contributes to CVD.

Post transplant diabetes mellitus (PTDM)

PTDM or new-onset diabetes after transplantation (NODAT) most commonly develops within the first few months post-RT.[4] IS medications such as glucocorticoids, CNIs, and mTOR inhibitors are diabetogenic. Other risk factors include increased age, obesity, African-American race, family history of diabetes or gestational diabetes, and hepatitis C virus infection.[5]

Mineral bone disease

Bone disease is common among patients with chronic kidney disease (CKD) and often persists following RT. Factors that contribute to post-RT bone disease include pretransplant renal osteodystrophy, glucocorticoids, CNIs, persistent hyperparathyroidism, and calcium and vitamin D deficiencies.

Osteoporosis

Bone loss occurs rapidly following RT. Risk factors for osteoporosis that are specific to RT recipients include the long-term use of glucocorticoids, CNIs, and persistent hyperparathyroidism. RT recipients should undergo bone mineral density assessment to screen for osteoporosis.

Hematologic problems

At the time of RT, nearly all patients have anemia due to reduced endogenous erythropoietin production and iron deficiency that is associated with CKD. Anemia typically resolves within 6 to 12 months after RT. However, anemia may redevelop late in the post-RT period in association with decreased allograft function, IS drugs, antiviral agents, infections, and the use of angiotensin-converting enzyme inhibitors (ACEI) or angiotensin receptor blockers (ARB). Posttransplant erythrocytosis (PTE) is defined as persistently elevated hemoglobin (>17 g/dL) and hematocrit (>51 percent) levels that occur after RT and persist for more than six months. Leukopenia is a common occurrence following RT and may be associated with lymphocytopenia, neutropenia, or both. It is frequently related to medications such as ATG, antimetabolic agents (MMF/azathioprine) and mTOR inhibitors. In addition, viral infections such as CMV, EBV, parvovirus B19 can also cause leucopenia.

Malignancy

RT recipients are approximately three times more likely to develop cancers than the general population. IS and viral infections play a key role. Skin cancers and PTLD are most common.

Electrolyte and acid-base disturbances

Hypomagnesemia thought to be due to CNIs; it may play a role in the development of PTDM and CNI nephrotoxicity. Hyperkalemia can result from impaired allograft function and the concomitant use of medications such as CNIs, ACEI/ARB, beta blockers, and co-trimoxazole. Hypercalcemia and hypophosphatemia are the result of persistent hyperparathyroidism. Metabolic acidosis is also common.

Hyperuricemia and gout

It can occur due to effect of CNIs (especially cyclosporine), loop/thiazide diuretics and renal impairment.

Pregnancy

Despite the return of fertility after RT, the rates of successful pregnancy remain far lower than in the general population. Modification of the maintenance IS regimen is frequently necessary prior to conception. The use of MMF and mTOR inhibitors should be avoided starting six weeks prior to conception as they are teratogenic.

RT recipient can safely proceed with pregnancy provided that the following conditions are met.[6]

1. It has been more than one year since RT
2. Graft function is optimal (serum creatinine of <1.5 mg/dL with urine protein excretion of <500 mg/24 hours)
3. There have been no episodes of rejection in the previous year
4. There are no concurrent fetotoxic infections, such as CMV
5. The patient is not on known teratogenic or fetotoxic medications
6. The IS regimen is sTable at maintenance levels

Conclusions

RT is the treatment of choice for patients with ESRD. Optimal fluid therapy immediately after RT has been shown to decrease DGF and its long term effects. Patients require close follow-up after RT since they are on IS regimens that render them susceptible to infection, malignancy, and CVD.

References

1. Gonzalez-Castro A, Ortiz-Lasa M, Penasco Y, Gonzalez C, Blanco C, Rodriguez-Borregan JC. Choice of fluids in the perioperative period of kidney transplantation. Nefrologia 2017;37:572-8.
2. Kidney Disease: Improving Global Outcomes (KDIGO) Transplant Work Group. KDIGO clinical practice guideline for the care of kidney transplant recipients. Am J Transplant 2009;9:S1(Suppl 3).
3. Etta PK, Rao MV. Emphysematous pyelonephritis in a renal allograft. Indian J Transplant 2018;12:59-61.
4. Etta PK. Posttransplantation diabetes mellitus in renal allograft recipients – Indian perspective. Indian J Transplant 2018;12:75-7.
5. Prasad N, Etta PK, Jaiswal A, Sharma RK, Bhadauria D, Saraswat V, et al. Long-term outcomes of hepatitis C virus infected renal allograft recipients. Indian J Transplant 2017;11:35-41.
6. McKay DB, Josephson MA, Armenti VT, August P, Coscia LA, Davis CL, et al. Reproduction and transplantation: report on the AST Consensus Conference on Reproductive Issues and Transplantation. Am J Transplant 2005;5:1592.

CHAPTER 21

Liver Transplantation: Immediate Post-operative and Long Term Care

Dr. CH Madhusudhan

Introduction

Deceased donor liver transplantation (DDLT) replaces the diseased liver with a transplanted allograft liver in the anatomically correct position and has become an increasingly used treatment for end-stage liver disease. Since the first successful Liver transplantation (LT), done by Thomas Starzl in 1967, the technique of LT has been refined to a relatively standardized procedure, but the operation remains a formidable surgical challenge.The postoperative course in LT patients ranges from straightforward to extremely complicated, and the outcome depends on the status of the recipient, donor organ, and technical issues in the operation. Complications after liver transplantation can have a significant impact on outcomes and costs of the procedure. Timely diagnosis of alterations in the normal postoperative course is the critical factor to minimize morbidity and mortality and to improve outcomes.

Post-transplant management

Immediate post-operative care

Immediately following LT, these patients are returned to the surgical intensive care unit (ICU). Following transfer to ICU these patients are closely followed by the surgical, intensive care and medical team, as well as by nurses, nutritionists, and physical therapists. In the ICU, they are maintained on a ventilator until fully conscious and able to breathe on their own while being able to protect their airway. During the ICU stay, there is a need for close attention to management of fluid and electrolytes which could be significantly abnormal as a result of the prolonged operation and massive fluid shifts. Patient needs to be closely monitored for bleeding and coagulation abnormalities which are very common due to liver dysfunction, platelet malfunction and portal hypertension.

Appropriate antibiotics needs to be given depending upon preoperative culture sensitivity reports and institutional protocols. The Ultrasound abdomen with doppler is done at bed side twice daily to know the status of portal vein, hepatic artery and hepatic veins

Immunosuppressive agents, based on specific protocols and on the patient's renal function, are started early after LT. Doses are adjusted according to blood levels and functional status of the transplanted liver and renal function. Most patients with an uncomplicated postoperative course and good liver function remain in the ICU for 2 or 5 days before being transferred to an inpatient transplantation room.

Fluid and electrolyte status and kidney and liver function need to be monitored at least daily. Dosages of immunosuppressive agents are adjusted according to blood levels and organ function during this period. The pattern of liver function test (LFT) results are monitored for early signs of dysfunction, which can require further study or intervention. Any major alteration in liver function should initiate a series of studies, which may include Doppler ultrasound to evaluate vascular patency of the new liver, bile duct studies (e.g., T-tube cholangiography, endoscopic retrograde cholangiopancreatography [ERCP], percutaneous transhepatic cholangiography) to evaluate any abnormality of the biliary system (e.g., stricture, bile leak, obstruction), and liver biopsy to rule out rejection. Necessary treatments are initiated based on these findings. Usually, in an uneventful recovery, the patient is discharged within 10 to 14 days after OLT and followed as an outpatient.

During the transition to an outpatient setting, the patient meets with the post-LT coordinator and goes through extensive teaching regarding his or her medications and immunosuppressive agents and their potential side effects. The patient receives instructions about the schedule for blood work and follow-up clinic visits. The patient receives a book containing after-discharge instructions, including when and how to notify the transplantation programme if he or she feels that there is something wrong, such as abnormal pain, fever, diarrhea, and headaches. The recipient is also instructed about physical activities, diet, and general health maintenance.

Long term follows up

Medications

The maintenance medications after discharge include immunosuppressive agents, prophylactic medications for prevention of opportunistic infections, such as for Pneumocystis carini infection (trimethoprim-sulfamethoxazole), viral infections (valgancyclovir), fungal infections (flucanazole), as well as other prophylactic medications, such as acid-reducing agents (proton pump inhibitors). In addition to these agents, the patient might also require antihypertensive medications, insulin or oral hypoglycemic agents, or mild analgesics. In addition, certain patients require additional medications depending on their original disease; for example, patients who received a transplant for hepatitis B or C require anti– hepatitis treatment (antivirals or Directly Acting Antivirals), and patients who received a transplant for Budd-Chiari syndrome might require anticoagulation. It is also emphasized that patients call the transplantation programme with any new medication started for them by other physicians for assessing compatibility with their immunosuppressive agents.

Laboratory investigations

Laboratory studies are usually done biweekly for the first 2 weeks, weekly for the next 8 weeks, every other week for 2 months, and then once monthly if laboratory test results are stable. Blood test can be done at the local laboratory. Outpatient laboratory work is reviewed by the post- transplantation coordinator in conjunction with the transplantation surgeon or physician.

Long-term problems during follow-up

Fever

Fever higher than 101° F or associated with chills should be taken seriously in immunosuppressed patients. The spectrum of potential infectious organisms is large in the immunosuppressed population and might also point to anatomic complications after LT. In addition, fever could be the primary sign of rejection. The fever workup includes cultures, blood and radiologic diagnostic tests and, if needed, endoscopies and biopsies. Patients might need to be hospitalized and kept on broad-spectrum antibiotics or antiviral agents until results are available. Identifying the cause of the fever allows targeted appropriate treatment.

Impaired liver function test

Any dramatic or persistent increase in the results of LFTs mandates a series of diagnostic tests to evaluate for possible causes, such as rejection, ischemic insult to the liver (hepatic artery problems), biliary complications, infections (viral hepatitis, bacterial sepsis), or drug toxicities or hypersensitivities. A thorough workup, including blood tests, computed tomography (CT) scanning and ultrasound of the abdomen, radiologic studies of the biliary system, viral studies, and liver biopsy, may be indicated for appropriate therapeutic response.

Immunosuppression

The commonly used immunosuppressive drugs to prevent rejection of the liver allograft are corticosteroids (prednisolone), calcineurin inhibitors (Tacrolimus) and mycophenolate mofetil (MMF).

Calcineurin Inhibitors. The routine application of CNIs to LT has dramatically reduced rejection. The dosage of TAC is based on blood levels and is tailored based on time after LT, presence or absence of renal dysfunction, or other side effects. The usual accepTable trough levels early post transplant are 8 to 12 ng/mL for TAC. The side effects of TAC include nephrotoxicity, neurotoxicity, diabetogenicity, increased susceptibility to opportunistic infections, and certain de novo malignancies.

Corticosteroids. The most commonly used non-CNI immunosuppressive agents in LT are corticosteroids. Corticosteroids have been shown to decrease transplant rejection when combined with other immunosuppressive agents. Whereas most post-transplantation protocols rapidly lower the dosage of corticosteroids to a minimum, some protocols also discontinue them shortly after OLT. These practices recognize that acute and chronic dosing of corticosteroids are associated with side effects that include hypertension, hyperglycemia, delayed wound healing, osteoporosis, glaucoma,

suppressed growth, hyperlipidemia, increased risk of gastrointestinal ulceration, risk of fungal infections, and suppression of the pituitary-adrenal axis.

Mycophenolate Mofetil (MMF) is anti-myeloproliferative drug appears to be a more effective immunosuppressive agent. When MMF is used in combination with TAC and steroids, the dose of TAC required is usually lowered. This can improve renal dysfunction that results from higher levels of CNI. The commonly observed complications with MMF are diarrhoea and bone marrow suppression.

Metabolic abnormalities

Diabetes: Main cause of hyperglycemia in liver transplant patients are corticosteroids and CNIs. Drug-induced hyperglycemia is usually transient and improves after discontinuation of steroids and reduction in dosage of CNIs. Less than 5% of these patients require long-term treatment.

The other long term metabolic complications are hypomagnesemia, osteoporosis hypertension and hypertriglyceridemia.

Renal dysfunction

Renal dysfunction (acute or chronic) occurs in 17% to 95% of patients after LT. The most common causative factors include acute tubular necrosis secondary to ischemic or toxic insult to the kidneys, preexisting hepatorenal syndrome (HRS) or renal insufficiency, diabetes mellitus, drug-induced interstitial nephritis, and CNI nephrotoxicity. CNIs are generally considered to be the main cause of post-transplantation nephropathy in liver transplant patients, estimated to be responsible for 70% of progressive end-stage renal failure after LT. In the presence of renal dysfunction after LT, as the first line of therapy, these agents are withdrawn from the immunosuppressive regimen or the dose is reduced to minimize their nephrotoxic effect.

Neurologic complications

CNI related neurotoxicity occurs in approximately 25% of liver transplant recipients. These could be dose-related and include impaired mentation or confusion, psychosis, dysphasia, mutism, cortical blindness, extrapyramidal syndromes, quadriplegia, encephalopathy, seizures, and coma. Treatment includes reducing or completely discontinuing the suspected offending agent. In some cases of suspected CNI toxicity, substitution of one CNI by another is all that is needed.

Malignancy

In liver transplantation, estimates of cancers approach 15% by 10 years after LT, with the rate for solid organ tumors being markedly higher in adults than in children. Post-transplantation lymphoproliferative disorders (PTLDs) are a heterogeneous group of hyperplasias and lymphomas that are serious post-transplantation complications for all organ recipients. Most cases of PTLD are believed to arise from Epstein-Barr virus (EBV)-infected B cells. The clinical signs and symptoms of PTLD are diverse and are similar to those seen during primary EBV infection, such as fever,

sweats, malaise, and lymphadenopathy. The incidence of PTLD varies with the transplanted organ, with the highest prevalence in the small bowel (approximately 20%) and a lower prevalence in other solid organs (1% to 10%). However, despite identification of EBV as the causative factor in 90% of patients with PTLD, the immunosuppressive drugs used to prevent graft rejection are largely responsible for the deficient immune response to EBV infection or reactivation. In contrast to solid organ cancers after LT, the preponderant risk of PTLD is high in pediatric population.

Disease recurrence

Hepatitis B

A total of 5% to 10% of patients undergoing LT have HBV- associated chronic or fulminant liver disease. Recurrent infection in the graft can lead to graft failure, retransplantation, or death. Hepatitis B anti-viral drugs such as lamivudine, adefovir, entecavir and tenafovir, which improves the outcomes of patients with decompensated cirrhosis awaiting transplantation as well can be used in transplant recipients who had recurrent HBV disease. Because of the increase in development of resistance to lamivudine, the American Association for the Study of Liver Diseases has recommended entecavir for preventing disease recurrence after LT.

Hepatitis C

Post-transplantation recurrence of HCV infection is a universal phenomenon, with a highly variable natural history. Recent introduction of DAA anti-viral drugs like Sofasbuvir therapy significantly decreased HCV after LT.

Cholestatic diseases

There is approximately a 10% to 20% long-term risk of recurrence for cholestatic liver disorders, such as primary sclerosing cholangitis and primary biliary cirrhosis. Diagnosis is made by appropriate histologic, biochemical, and radiologic tests.

Personal experience/ Institute statistics

Till now 38 liver transplantations were done in Osmania General Hospital and Maxcure Hospital with 7% mortality.22 were DDLTs and 16 were LDLTs

Conclusions

Liver transplantation has progressed to become an acceptable means for the treatment of end-stage liver disease, with excellent long-term outcomes. With increased understanding of organ donor management and better preservation solutions, graft survival at 1 year has increased from 72% to 82% and the 5-year survival has increased to 67%.

Immunosuppressive agents are the mainstay of rejection prevention in liver transplantation. To prevent their long-term toxicity, the patient must adhere to the prescribed regimen and compliance with close follow-up for medication adjustments.

Complications (e.g., infection, rejection, disease recurrence) are common after liver transplantation

and, if untreated, can lead to graft failure and increased morbidity and mortality. Close follow-up of the patients by the transplantation team is essential for prevention, early diagnosis, and treatment of these issues.

Suggested reading

1. Almusa O, Federle MP: Abdominal imaging and intervention in liver transplantation. Liver Transpl 2006;12:184-193.
2. Amesur NB, Zajko AB: Interventional radiology in liver transplantation. Liver Transpl 2006;12:330-351.
3. Charlton M: Recurrence of hepatitis C infection: Where are we now? Liver Transpl 2005;11:S57-S62.
4. Davis JE, Moss DJ: Treatment options for post-transplant lymphoproliferative disorder and other Epstein-Barr virus-associated malignancies. Tissue Antigens 2004;63:285-292.
5. De la Mora-Levy JG, Baron TH: Endoscopic management of liver transplant patients. Liver Transpl 2005;11:1007-1021.
6. Lok ASF, McMahon BJ: AASLD practice guideline. Chronic hepatitis B. Hepatology 2007;45:507-539.
7. Ojo AO, Held PJ, Port FK: Chronic renal failure after transplantation of nonrenal organ. N Engl J Med 2003;349:931-940.
8. Post DJ, Douglas DD, Mulligan DC: Immunosuppression in liver transplantation. Liver Transpl 2005;11:1307-1314.
9. Starzl TE, von Kaulla KN, Hermann G, et al: Homotransplantation of the liver in humans. Surg Gynecol Obstet 1963;117:659-676.
10. Terrault N, Roche B, Samuel D: Management of the hepatitis B virus in the liver transplantation setting: A European and an American perspective. Liver Transpl 2005;11:716-73.
11. Tzakis AG, Gordon RD, Shaw BW Jr, et al: Clinical presentation of hepatic artery thrombosis after liver transplantation in the cyclosporin era. Transplantation 1985;40:667-671.

CHAPTER 22

Corneal Transplantation

Dr. Superna Mahendra | Dr. Srinivas Prasad

Introduction

A brief history of corneal transplantation: From ancient to modern

Franz Reisinger initiated experimental animal corneal transplantation in 1818, coining the term "keratoplasty". Subsequently, Wilhelmus Thorne coined the term corneal transplant and 3 years later Samuel Bigger, 1837, reported successful corneal transplantation in a gazelle. Indeed, the first successful human corneal transplant was not performed by Eduard Zirm until 1905. Since that first successful corneal transplant, innumerable ophthalmologists have contributed to the development and refinement of corneal transplantation aided by the development of surgical microscopes, refined suture materials, the development of eye banks, and the introduction of corticosteroids. Recent developments, including the replacement of selected corneal layers rather than full-thickness keratoplasty, have the potential to improve or transform corneal transplant surgery in the future.

The Modern Era

In the modern era, corneal transplantation was the forerunner in developments of human organ transplantation. Indeed, the first successful human corneal transplant was performed in 1905, and there was an interval of 49 years before the first successful solid organ (kidney) transplant[1] an eon in the modern medical timeline. The year 1905 marked the first successful human allograft performed by Eduard Zirm (1887-1948) in Olmutz near Prague[2]

Definition: Corneal transplantation, also known as corneal grafting or keratoplasty is a procedure during which dysfunctional cornea is removed from a patient's eye and replaced with healthy clear cornea from a donor[3].

Indications for Corneal Transplantation

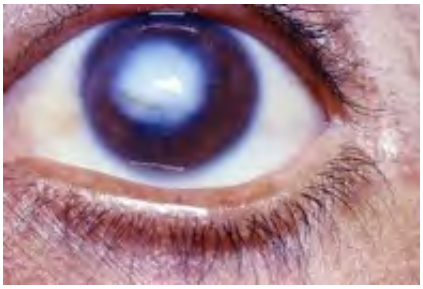


Figure 1: Corneal opacity

Optical/refractive: to improve visual acuity due to opacification of the cornea (Figure -1).

Tectonic/reconstructive: to maintain corneal anatomy and integrity.

Therapeutic: as treatment for infective keratitis that is refractory to antibiotics or antifungals.

Cosmetic: to improve the appearance of eyes with opaque corneal scarring.

The most common reason for a corneal transplant is keratoconus, followed by bullous keratopathy, failed previous transplant, Fuch's endothelial dystrophy, herpetic eye disease, corneal scarring and trauma.

Recent developments in corneal transplantation over the past decade

Instead of penetrating keratoplasty (Figure 2), lamellar keratoplasty (LK) or partial thickness corneal grafting has emerged as the principle alternative to full thickness corneal grafting. LK involves a targeted removal of diseased cornea and replacement with healthy donor cornea, whilst preserving the unaffected layers.

Partial thickness corneal grafting can involve replacing either the anterior stroma (anterior lamellar keratoplasty (ALK) (Figure 3,4) or the posterior stromal and endothelial layers (posterior lamellar keratoplasty (PLK) or endothelial keratoplasty (EK) . Having an intact recipient endothelial layer eliminates endothelial rejection and long term failure is unlikely. Being mostly a non-penetrating procedure, the incidence of intraocular complications is greatly reduced. The eye is tectonically stronger than following a penetrating keratoplasty as Descemet's membrane is not breached. There are a multitude of acronyms associated with PLK . The more common terminologies are:

Deep lamellar endothelial keratoplasty (DLEK) where the donor lamella and the host cornea are hand- dissected.

Descemet's stripping endothelial keratoplasty (DSEK) (Fig 5) where the host endothelium is peeled off and the hand cut donor lamella is attached.

Descemet's stripping automated endothelial keratoplasty (DSAEK) where the host endothelium is

peeled off and the automated keratome cuts the donor lamella graft. Endothelial keratoplasty has faster visual rehabilitation in terms of visual acuity, stability of refraction and less astigmatism compared to PK.

Rejection can occur at any time from two weeks, however is more common in the first two years. Patients may complain of decreased vision, redness, pain, irritation, discharge and/or photophobia. Fortunately, corneal graft rejection if recognised and treated aggressively with topical steroids can be reversed. Any corneal graft patient with the above symptoms lasting more than a few hours should be instructed to seek urgent ophthalmologic attention.

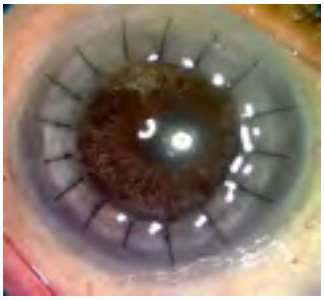


Figure 2: Penetrating keratoplasty

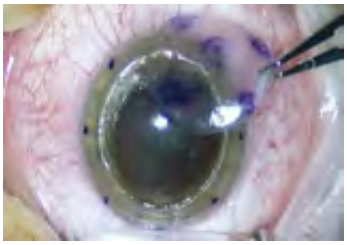


Figure 3 Lamellar Keratoplasty

Figure 4 : Lamellar keratoplasty

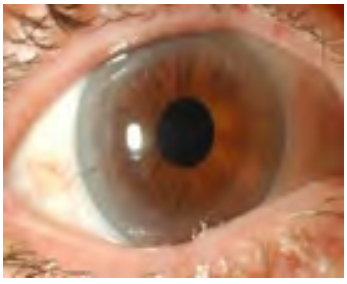


Figure 5: DSEK

The Future

The major limitations of modern day corneal transplantation surgery may be classified under the following headings; paucity of donor tissue, graft rejection and failure, and variable visual and tectonic outcomes. Evolution in the field of corneal transplantation is therefore targeted towards overcoming these obstacles. Recent developments with the potential to transform corneal transplant surgery include: A revival of anterior and posterior lamellar techniques, the artificial or bioengineered cornea, the manipulation of corneal endothelial cells as a substitute for transplantation, and the use of the surgical femtosecond laser[3].

Existing literature and Guidelines

More than 2.5 lakh blind people in India could regain eyesight if majority of the Indian hospitals start conducting eye transplants, showed statistics recently released by AIIMS [4]. Data from the Health Ministry has revealed that 51,354 eyes were donated in 2013-14, of which only 22,384 were used for transplant. The numbers have remained dismal over the past few years, with more than 50% of the donated eyes going to waste. Data from All India Institute of Medical Sciences (AIIMS) showed that the number of eye donations has increased from 680 in 2009 to 1,321 in 2013, and the proportion of unused eyes increased from 185 to 400 in the same period.

Current supply of donor corneas in India

According to Eye Bank Association of India (EBAI) data there were18641 tissues retrieved across the country in 2000 of which more than 50% were collected by Gujarat, Maharashtra, and Tamil Nadu, in the same year 4381 optical corneal transplants were done . This number has increased to 34520 in year 2008 and 9509 optical corneal transplants were done in year 2008. The EBAI data on corneal tissue retrieval from across the country along with total number of corneal transplants (total of optical, therapeutic, and lamellar grafts) done from 2000 to 2008 are shown in Table-1. It is very clear from this data that the trends are positive and corneal retrieval is increasing but not enough to meet the perceived need for harvesting 200,000 tissues annually to do 100,000 corneal transplants a year. More than 50% corneal tissue collection is done by Tamil Nadu, Gujarat, Maharashtra, Andhra Pradesh, and Karnataka[5].

Name of the State	Collection	Optical PKP	Therapeutic PKP	Lamellar Keratoplasty
Andhra Pradesh	4362	1316	763	154
Karnataka	2544	545	163	58
Kerala	868	223	8	2
Pondicherry	359	70	78	5
Tamil Nadu	8178	1404	866	249
Maharashtra	4685	1051	415	15

Gujarat	5611	2075	359	31
Punjab	751	324	249	0
Rajasthan	1190	522	50	5
Haryana	1134	413	48	17
Chandigarh	468	164	162	7
Delhi	1598	562	339	39
West Bengal	1688	301	63	125
Orissa	91	48	18	0
Andaman Nicobar	0	0	0	0
Assam	215	122	22	0
Bihar	34	32	0	0
Madhya Pradesh	399	91	33	0
Uttar Pradesh	345	246	33	2
Total	**34520**	**9509**	**3669**	**709**

Table 1: Total number of corneas collected across India in 2008 and their utilisation (EBAI data)[6,7]

	Collection	TKP	OKP	DALK	DSEK	PATCH GRAFT
Sarojini Devi Eye Hospital T.L. Kapadia Eye Bank	32	23	4	2	2	1

Table 2: Total number of corneas collected by T L Kapadia Eye Bank, Sarojini Devi Eye Hospital, Hyderabad and their utilisation for a period of 3 months (Apr to June 2018)

In our study over 3 months period from April to June 2018(Table 2), 32 corneal buttons were procured from donors of all ages. Maximum donors were between 61 to 70 years age group amounting to 31.25%. Male to female donor ratio was 21:11 and maximum utilization of donor cornea was done for therapuetic keratoplasty.

Conclusion

From mythological and allegorical tales to reality, corneal transplantation is now established as the most common and indeed the most successful form of human transplantation. Corneal transplantation continues to evolve and emerging techniques offer the potential of a truly customized personal transplant material within genetic profiling. It is important to have an understanding of the indications for surgery, techniques available, post-operative care and potential complications of corneal transplantation so that optimal outcomes are achieved for the patient. Modern techniques are associated with more rapid visual recovery, less risks of rejection and a tectonically stronger eye compared to penetrating keratoplasty .

References

1. Merrill JP, Murray JE, Harrison JH, Guild WR. Successful homotransplantation of the human kidney between identical twins. J Am Med Assoc. 1956;160:277–82.
2. Zirm E. Eine erfolgreiche totale keratoplastik. Arch Ophthalmol. 1906;64:580–93.
3. Kalevar V. Eye banking in India. Ind J ophthalmol. 1989; 37 (3): 110-111.
4. Dandona L, Dandona R, Naduvilath TJ, McCarty CA, Nanda A, Srinivas M, Mandal P, Rao GN. Is current eye-care-policy focus almost exclusively on cataract adequate to deal with blindness in India?. The Lancet. 1998 May 2;351(9112):1312-6.
5. Lancet 1998; 351: 1312-1316 5. Dandona R and Dandona L. Corneal blindness in a southern Indian population: need for health promotion strategies. Br J Ophtalmol 2003; 87: 133-141.
6. Medical Standards of Eye banking in India published by NPCB, Directorate General of Health Services, Min Of Health and Family Welfare, Govt. of India, New Delhi10011, 1999; pp 1-6.
7. Rao GN. Eye banking – are we really upto it in India? Ind J Ophthalmol. 2004; 52(3): 183-184.

CHAPTER 23

Bone Marrow Transplantation: General Perspective for Transplant Coordinators

Dr. Shailesh R Singi

Introduction

Bone marrow is the soft, spongy tissue in the center of bones that is responsible for formation of blood cells. Bone marrow does this through the use of immature cells called hematopoietic stem cells or simple "stem cells". These stem cells have special characteristics i.e. they can renew themselves, and have the capability to develop into any type of blood cells to keep our blood and ourselves healthy. For example, they can turn into bone marrow cells, red blood cells, white blood cells, or platelets.

A bone marrow transplant (BMT) is a treatment for some types of cancers and diseases that keep hematopoietic stem cells from developing normally. A bone marrow transplant provides new stem cells after old, damaged or cancerous cells have been removed using chemotherapy alone or in combination with radiation therapy. The transplanted stem cells can make new, healthy blood cells. This treatment is also called a stem cell transplant. Thus, "Hematopoietic stem cell transplantation" is now also referred to as "Bone marrow transplantation". Today, this is a viable option for several disorders and with continued research, success has improved markedly.

Types of BMT

There are two basic types of transplants, allogeneic and autologous, depending on who donates the bone marrow or stem cells.

Allogeneic BMT: Donor and Recipient are two separate individuals and transplant is done using the stem cells of donor. It may be:

1. Matched Related, where donor is HLA matched relative usually a sibling.
2. Matched Unrelated, where donor is not a relative of patient and usually found from one of the various national or international registries.
3. Partially Matched Related, where donor is from a patient's family but partially matched (haploidentical)

Autologous BMT: Donor and Recipient are same individuals, where transplant is done using patient's own stem cells.

Indications for BMT

There are certain conditions for which BMT is recommended.

Malignant conditions

1. Acute Lymphoblastic leukemia (ALL)
2. Acute Myeloid Leukemia (AML)
3. Chronic Myeloid Leukemia (CML)
4. Hodgkin Lymphoma
5. Non-Hodgkin Lymphoma
6. Myelodysplastic syndrome (MDS)
7. Multiple Myeloma
8. Neuroblastoma
9. Germ cell tumors
10. Other rare cancers of childhood

Nonmalignant conditions

1. Thalassemia
2. sickle cell anemia
3. Aplastic anemia
4. Fanconi anemia and other bone marrow failure syndromes
5. Inborn errors of metabolism
6. Congenital Immunodeficiency syndromes

Procedure of BMT

Autologous (AUTO) transplant

Patients receive own previously separated and stored stem cells. This type of stem cell transplant may also be called high-dose chemotherapy with autologous stem cell rescue. In this type of transplant, the first step is to collect and freeze stem cells from blood. Then patient undergoes chemotherapy with or without radiation therapy. Finally, thawed stem cells are put back into bloodstream using an intravenous injection into a vein. The stem cells find their way back into the marrow and begin to grow. After 10 to 14 days, the process is complete. This type of transplant has minimal complication and is preferred for diseases like multiple myeloma/lymphoma.

Allogeneic (ALLO) transplant

Patients receive stem cells from other donors. Before a person receives an ALLO transplant, a matching donor must be found using human leukocyte antigen (HLA) typing. This special blood test analyzes HLAs, which are specific proteins on the surface of white blood cells and other cells that make each person's tissue type unique. HLA-matched bone marrow is less likely to cause a possible side effect of transplantation called graft verses host disease (GVHD). GVHD is when immune cells in the transplanted tissue recognize the recipient's body as "foreign" and attack it. Only about 30% of people who need a transplant can find an HLA-matched donor in their immediate family. A brother or sister may be the best match. But another family member or volunteer might work as well. For the remaining 70% of people, doctors need to find HLA-matched bone marrow from other donors. HLA typing can be done from cells from donor cheek with a cotton swab or a small blood sample. The sample is analyzed to determine donor HLA type. Newer methods have greatly increased the number of potential donors for a transplant. With this type of transplant, the first step is to find a donor and coordinate when the transplant will happen. Next, the patient receives chemotherapy with or without radiation therapy. On the transplant day, fresh donor stem cells are given through a vein.

Are there any risks associated with BMT?

Yes, BMT is a complex procedure that carries significant risks and serious complications.

Many side effects of bone marrow transplantation result from the cancer treatment(s) received before the transplantation. The most noticeable side effects are hair loss and intestinal upset. However, the most serious side effect is a higher risk of infections, particularly during the first few weeks after transplantation. ALLO transplants have additional side effects, including an increased risk of infections for months to years, the need for anti-rejection drugs, and the risk of GVHD.

Is BMT a surgery like kidney transplant?

No, Bone Marrow Transplant is a medical procedure. Mostly, stem cells are collected via peripheral vein and the whole procedure is like donating blood or platelet. In some patients Bone marrow harvest is done which involves general anaesthesia to the donor.

Is there any risk to the donor?

No, there is no risk to the donor. Bone marrow donors are usually able to resume their duties the next day after collection of the stem cells. Nowadays, hematopoietic stem cells can also be obtained from peripheral blood after treatment with certain growth factors or from umbilical cord blood.

The bone marrow donation process

If donor agrees to donate bone marrow, donor undergoes peripheral blood stem cell (PBSC) collection. The procedure of collection of stem cell is as follows

For 5 days leading up to the donation, donor will get a daily injection of granulocyte colony-stimulating factor (G-CSF), a white blood cell growth hormone.

On day 5, a trained health care provider will place a needle in each of donor arms. One needle will remove blood and a machine circulates the blood and collects the stem cells. Donor blood is then, returned to donor body through the second needle. The process takes about 3 hours and may be repeated on a second donation day if needed. Side effects include headaches, bone soreness and discomfort from the needles during the process.

Although less common, some donors may be asked to undergo a bone marrow harvest, during which doctors take bone marrow (liquid blood) from the donor's hip bone under general anesthesia. Donors usually go home the same day of the procedure and can return to normal activity within 1 week. Common side effects include nausea, headache and fatigue which are due to anesthesia. Bruising or discomfort in the lower back is also common. The good news is that donating bone marrow can be as easy and painless as giving blood.

Suggested reading

1. Bone marrow transplantation in practice. Jenefer Treleaven
2. Hand Book of Bone Marow Trasnplantaion.. Jacob M Rowe

CHAPTER 24

Tissue Banking

Dr. R. V. Koteswara Rao

Introduction

Donor skin and dermal grafts are used in different clinical settings where there is extensive loss of substance. They can promote reepithelialisation, shorten healing time, reduce pain, and protect underlying structures. Even though large numbers of skin substitutes are available donor skin offers distinctive advantages.

Skin bank organisation is complex and require continuous updating. Careful donor selection to prevent transmission of pathogens to recipient is mandatory. Constant training and periodic checks are important for proper functioning. First skin bank was set up in USA during 1949[1]. The first skin bank in India was established in 2010[2]. Currently 9 functioning skin banks are there in India and many more are in plans. A skin bank can prevent many deaths in severe burn cases. Autologous skin grafting is gold standard in deep burns, but in severe burn injuries it may not be available where the next life saviour is donor skin.

Tissue banking mainly involves four stages; procurement, processing, storage and distribution.

Procurement

Procurement team should contain atleast two individuals. Skin can be harvested as a part of multi organ retrieval with utmost coordination not to contaminate it, or skin alone. Skin can be procured within 12 hours of death if body is not refrigerated, upto 24 hours if body is refrigerated within 6 hours of death[3]. Skin harvesting conditions should match live harvesting conditions to prevent contamination of donor skin. Live donor skin can be procured from abdominoplasty specimens after proper consent. Skin grafts will be harvested from back and lower limbs of donor. Different types of skin grafts based on their thickness can be harvested by using dermatomes.

Figure 1: Battery operated dermatome (A) and harvesting levels with thickness (B). STSG; split-thickness skin graft, FTSG; full-thickness skin graft

The procured skin has to be transported to skin banks in different conditions based on their future usage such as cryopreserved skin allograft or glycerol preserved allograft.

Processing

Procurement should always be based on comprehensive medical and social data, physical examination, serological and microbiological tests to reduce the risk of transmission diseases[4]. Minimum serological screening for HIV, hepatitis B and C and syphilis, and optional testing for human T-lymphotrophic virus, cytomegalovirus, ABO grouping and Rh typing are performed by most tissue banks.

To preserve live cells, cryopreservation using cryoprotectants[5] supplemented with various antibiotics is ideal. Processing with various concentrations of glycerol will produce glycerol preserved allograft in which cells are devitalised but structural integrity will be maintained. Deepidermised dermis will be obtained by removing epidermis manually. After processing and storage, processed samples have to be sent for microbiological laboratory for testing bacteriological and fungal contamination. Only after certification, they will be considered as fit for clinical usage.

Storage

Cryopreservation[6,7] is defined as a process in which the biological and structural functions of tissues or cells are preserved by cooling to sub-zero temperatures in a cryoprotectant such as dimethyl sulfoxide or glycerol. Temperatures vary from -90 degrees to -170 degrees Celsius. For longer period storage temperatures should be less and for shorter period temperatures can be towards -90 degrees Celsius. Cell viability depends on storage temperatures and longevity of storage.

Glycerol preservation fixes free water in intra and extra cellular spaces. Glycerol preserved allografts are stored at +2 to +10 degree Celsius in concentrated glycerol[8]. There will not be any viable cells in glycerol preserved allografts. They have advantages such as they can be stored easily at above said temperatures and can be easily distributed at refrigerated temperatures, they will have antibacterial and anti-viral properties, and their immunogenicity will be reduced.

Gamma irradiation and lyophilisation/freeze drying are other different methods for storage.

Clinical usage

The first report of skin grafting dates back to the second century BC, when the Indian surgeon Sushruta used auto-grafted skin for rhinoplasty. Skin allografting was first described by Reverdin[9].

The gold standard for permanent wound closure is autologous skin grafting, however it may not be possible in severe degree burns (100% burns) where homograft availability will not be there. In these patients allografting has many advantages. It acts as barrier and reduces the loss of water, electrolytes and protein. It prevents the colonisation of bacteria and reduces the pain by protecting the nerve ends. It prepares the wound bed for future definitive closure. It promotes the epithelialisation and provides dermal templates for epidermal grafts.

Considering the above facts, skin allografting can be used for coverage of extensive wounds where autologous tissue is not available, to cover widely meshed skin autografts[10], extensive partial thickness burns and in cases of extensive epidermal detachment. Dermal allografts help in wound healing as the less immunogenic dermal component takes to the wound bed. The preservation techniques of skin bank products and its clinical applications are shown in Table-1

Cryopreserved skin	Cryopreserved DED	Glycero-preserved Skin	Glycero-preserved/ dermis/DED	Lyophilized acellular dermis
Cell viability		Nonviable tissue		
Wound-bed preparation, skin regeneration Composite graft, temporary coverage, possible engraftment of the dermal component Extensive burns Nonhealing leg ulcers Epidermolytic diseases (Stevens-Jhonson syndrome) - Toxic epidermal necrolysis - Staphylococcal scalded skin syndrome Posttraumatic/surgical wound regeneration	Composite graft, temporary coverage Posttraumatic wounds Leg ulcers	(GPskin) antalgic effect, scaffold for skin regeneration Temporary coverage, Composite graft Extensive burns, cutaneous wounds, Lyell syndrome Extensive ulcers Donor area coverage	Composite graft, Possible engraftment of the dermal matrix Pressure/ posttraumatic wounds/ ulcers Full-thickness burns cutaneous wounds	Engraftment of the dermal matrix Cutaneous full-thickness wounds (venous ulcers, pressure ulcers, diabetic/trophic ulcers) Burns (hot, chemical), surgery (posttraumatic full-thickness wounds), orthopaedic surgery, ENT, oral and plastic surgery

Table 1: Indications of skin bank products, classification and clinical use. DED: de-epidermised dermis.

Allografts are usually removed when wound site is sufficiently healed for re-harvest or when autologous cultured skin is available for permanent wound closure. Allografts show delayed rejection in severe burns due to immunocompromised status and can last for several weeks before rejection.

Conclusion

Allografts are effective in the treatment of various conditions of skin loss and may be lifesaving. They have many clinical uses. By acting as physiological medication, they promote wound healing, shorten hospitalisation time, control pain and protect the dermis and subcutaneous structures such as bone, cartilage, tendons and nerves. They can be used as skin substitute that incorporate the dermal component into the wound bed and promote physiological wound healing. Even though great variety of skin substitutes are available, skin allografts remain a major therapeutic choice for extensive deep burns and chronic wounds.[11, 12]

There is a risk of transmission of pathogens even after rigorous quality control. So it is important to assess risk benefit ratio and to obtain full informed consent before taking up of these patients for these procedures. One has to keep in mind contraindications such as wound infection, non-debrided wounds, skin cancers and allergy to agents used in skin processing.

For the effective functioning of the tissue banks following the standard protocols, regular quality checks, continuous training and good supervision are essential. It requires a complex network between donor and recipient through various systems to facilitate smooth operation of tissue banks.

References

1. McCauley RL. The skin bank. Total burn care. 1st ed. Philadelphia, PA: Saunders; 1996:159–163.
2. Gore MA, De AS. Deceased donor skin allograft banking: response and utilization. Indian J Plast Surg. 2010;43 (Suppl):S114–S120.
3. Ireland L, McKelvie H. Tissue banking in Australia. Cell Tissue Bank. 2003;4(2–4):151–156.
4. Official Journal of the European Union. Directive 2004/23/EC of the European Parliament and Council on quality and safety standards for the donation, procurement, testing, processing, preservation, storage and distribution of human tissues and cells. Official Journal of the European Union; 2004.
5. Gaucher S, Elie C, Verola O, Jarraya M. Viability of cryopreserved human skin allografts: effects of transport media and cryoprotectants. Cell Tissue Bank. 2012;13(1):147–155.
6. Mericka P. Brief history of the tissue bank, Charles University Hospital, Hradec Kralove, Czech Republic. Cell Tissue Bank. 2000;1(1):17–25.
7. Freedlander E, Boyce S, Ghosh M, Ralston DR, MacNeil S. Skin banking in the UK: the need for proper organization. Burns. 1998;24(1):19–24.

8. Mackie DP. The Euro Skin Bank: development and application of glycerol-preserved allografts. J Burn Care Rehabil, 1997;18(1):S7–S9.

9. Hauben, DJ, Baruchin A, Mahler A. On the history of the free skin graft. Ann Plast Surg. 1982;9(3):242–245.

10. Alexander JW, MacMillan BG, Law E, et al. Treatment of severe burns with widely meshed skin autograft and widely meshed skin allograft overlay. J Trauma. 1981;21(6):433–438.

11. Debels H, Hamdi M, Abberton K, Morrison W. Dermal matrices and bioengineered skin substitutes: a critical review of current options. Plast Reconstr Surg Glob Open. 2015;3(1):e284.

12. Fimiani M, Pianigiani E, Di Simplicio FC, et al. Other uses of homologous skin grafts and skin bank bioproducts. Clin Dermatol. 2005;23(4):396–402.

CHAPTER 25

Transplantation in Unusual Situations : Infection with HIV, HCV, HBV

Dr.Vikranth Reddy P | Dr. Girish Vasudeo Kumthekar

Introduction

The reported prevalence of chronic kidney disease (CKD) in different regions ranges from <1% to 13%, and recently, data from the International Society of Nephrology's Kidney Disease Data Center Study reported a prevalence of 17%.[1] The etiology of CKD varies considerably throughout India. Parts of the states of Andhra Pradesh, Odisha, and Goa have high levels of CKD. The true burden of end stage renal disease (ESRD) in India is not known, with few dedicated centres for care, lack of universal access to renal replacement therapy (RRT), and absence of a registry. Even today, over 90% of patients requiring RRT in India die because of inability to afford care, and even in those who do start RRT, 60% stop for financial reasons. Among patients who undergo kidney transplantation, unexpected complications have the potential to impose serious financial hardships.

Haemodialysis (HD) was introduced in India in 1962, transplantation was introduced in 1971, and peritoneal dialysis (PD) was introduced in 1991. As of 2017, RRT is predominantly a private health care–driven initiative. There are over 130,000 patients receiving dialysis, and the number is increasing by about 232 per million populations, a reflection of increasing longevity in general. Transplantation practices are dependent on state welfare funding, brain death declaration practice, personal religious beliefs, and availability of technical expertise and expensive immunosuppressive medication. Living donor kidney transplantation far exceeds deceased donor transplantation in India. However, despite its cost-effectiveness, high initial costs and limited availability of living related donors are barriers.

These fact files tell us loud and clear how big is the gap between demand and supply of organs for those with end organ damage states. To overcome this scarcity of organs, transplantation community started looking beyond standard criteria donors and recipients alike. Almost gone are those days

when transplantation was a near taboo for those with seropositivity for HIV, HbsAg, HCV and also retriving organs from people with similar viral status.

Renal transplantation in HIV positive individuals showed excellent 1 and 3-year survival rates. But donation from HIV seropositive donors is not practiced as proven safety is not documented. Registry data also suggest good 5 and 10-year outcomes; with an improvement in survival compared with patients who remain on the wait-list. Studies in other settings have confirmed the safety of kidney transplantation in individuals with well-controlled HIV disease. [2, 3]

Immunosuppressant protocols for the general population can be applied to HIV-positive individuals. In view of the increased immunological risk, some centers prefer induction therapy with an interleukin-2 receptor antagonist, polyclonal antithymocyte globulin, or alemtuzumab. Tacrolimus is the calcineurin inhibitor of choice for maintenance immunosuppression.[4] KDIGO [5] also recommends kidney transplantation as preferred renal replacement for ESRD with HIV positivity over maintenance dialysis.

Selection criteria for potential HIV-positive kidney transplant recipients

In addition to the standard criteria for kidney transplant recipients, the following should be met 2,3

1. Effective HIV suppression for 6 months prior to transplantation
   a. UndetecTable plasma HIV-1 RNA
   b. CD4+ cell count > 200 cells/mm3
2. No active opportunistic infections
3. No history of:
   a. Progressive multifocal leukoencephalopathy
   b. Primary central nervous system lymphoma
   c. Pulmonary aspergillosis
   d. Visceral Kaposi's sarcoma
   e. CoccidiomycosisChronic intestinal cryptosporidiosis >1 month
4. Hepatology evaluation for patients co-infected with hepatitis B or Hepatitis C virus

British transplantation society guidelines

British Transplantation society guidelines recommend that all HBsAg positive patients undergoing transplant work up must have the following tests:

1. HBeAg, HBeAb and HDV Ab serology, and HBV DNA levels.
2. HDV RNA testing must be performed in potential transplant recipients where HDV serology is positive or equivocal.
3. Any potential transplant recipients found to be HBcAb positive but HBsAg negative (past infection) must have HBV DNA and HDV serology testing to exclude occult HBV or HDV infection.

4. All donors who are positive for HBcAb but HBsAg negative (past HBV exposure) must have HBV DNA testing to exclude the possibility of occult HBV infection. All HBsAg positive individuals being considered for liver transplantation should be treated with either tenofovir or entecavir before transplantation, aiming for an undetecTable HBV DNA level.
5. Individuals undergoing non-liver solid organ transplantation who are HBsAg positive must have liver disease staging and suppression of HBV DNA by either tenofovir or entecavir before transplantation if there is a standard clinical indication. All recipients of a liver from an HBsAg positive donor must be treated with entecavir or tenofovir from the time of transplantation.
6. Use of HBIg rarely achieves HBsAg negativity, and is not recommended. Individuals undergoing non-liver / liver solid organ transplantation who are HBsAg positive must have liver disease staging and suppression of HBV DNA by either tenofovir or entecavir before transplantation if there is a standard clinical indication.
7. The kidneys, heart and lungs from the HBcAb positive organ donor can be used for any recipient, and the risk of de novo HBV infection is low.
8. Lifelong antiviral therapy is recommended for all individuals with HBV recurrence or de novo hepatitis B post-liver transplantation.

KDIGO Guidelines

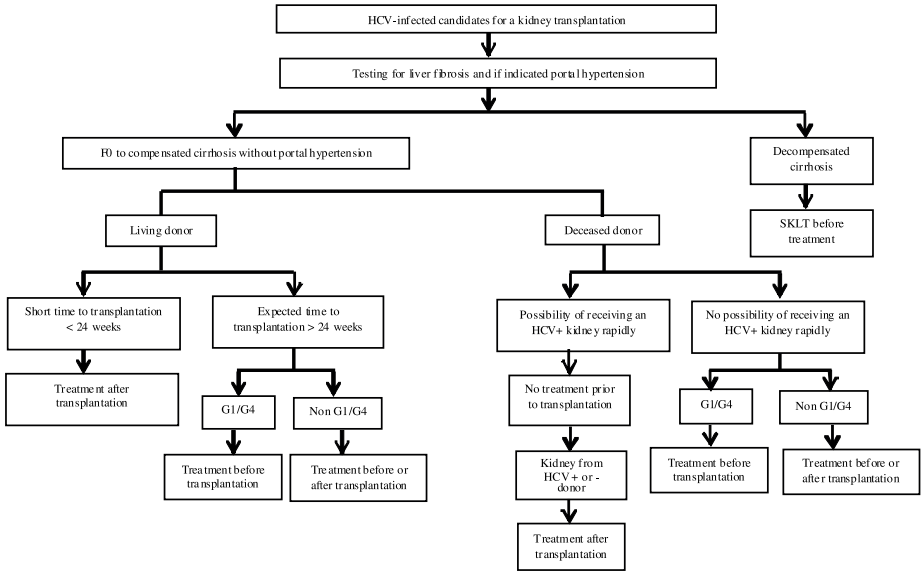
KDIGO [6] recommends kidney transplantation as the best therapeutic option for patients with end-stage renal disease (ESRD) irrespective of presence of HCV infection.

KDIGO guidelines also suggest that, if receiving a kidney from a HCV-positive donor improves the chances for transplantation, the HCV RNA-positive patient can undergo transplantation with a HCV-positive kidney and be treated for HCV infection after transplantation.

It is also suggested that all conventional current induction and maintenance immunosuppressive regimens can be considered for use in HCV-infected kidney transplant recipients.

Hence, renal and non-renal solid organ transplantations for HCV positive recipients have become feasible due to effective directly acting anti-viral (DAA) drugs. These drugs are safe post transplantation with minimal interactions with routinely used immunosuppressant's. Current issue may be timing of starting DAAs in relation to transplantation.

Algorithm 1, may help understand different options we have for treating HCV infection in relation to transplantation.



Algorithm 1. Proposed strategy in HCV infected kidney transplant candidate.

G1, genotype 1; G4, genotype 4; HCV, hepatitis C; SKLT,
Simultaneous kidney -liver transplantation

Personal experience/ Institute statistics

As a tertiary care centre Care Hospitals, Banjara Hills has performed more than 375 renal transplantations. Among these, 10 transplants were performed for HCV positive and 2 transplants for HbsAg positive patients. We could find 1 year graft survival at par with seronegative transplantations. These recipients required immunosuppression not different than other transplants. Post transplantation monitoring remains mandatory for recurrence or reactivation as well as for mixed infections. We could see only one case of post transplantation HIV positivity which responded well to Anti retroviral therpy (ART).

Conclusion

The need of the hour is to understand and practice considering HIV, HbsAg, and HCV seropositive individuals as potential donors as well as recipients in future. This may increase the pool of organs for donation as well as number of beneficiaries of these organs. But these practices need scientific understanding of virology, especially dealing with viral reactivation coupled with detailed counselling for patients and their families. The current understanding is that except for HIV positive organ donor, all other seropositive donors and recipients including HIV positive are accepted in current transplantation practice with due careful monitoring and timely treatment of reactivation, recurrence and mixed infections.

References

1. Ene-Iordache Bet al, Chronic kidney disease and cardiovascular risk in six regions of the world (ISN-KDDC): A cross-sectional study. Lancet Glob Health 4: e307–e319, 2016
2. Yoo J, Baumstein D, Kuppachi S, et al. Diffuse infiltrative lymphocytosis syndrome presenting as reversible acute kidney injury associated with Gram-negative bacterial infection in patients with newly diagnosed HIV infection. Am J Kidney Dis. 2011;57:752–755
3. Martin-Blondel G, Debard A, Laurent C, et al. Mycobacterial-immune reconstitution inflammatory syndrome: a cause of acute interstitial nephritis during HIV infection. Nephrol Dial Transplant. 2011;26: 2403–2406.
4. Xu GJ, Kula T, Xu Q, et al. Viral immunology. Comprehensive serological profiling of human populations using a synthetic human virome. Science. 2015; 348:0698.
5. CR Swanepoel et al.: Kidney disease and HIV: a KDIGO conference report Kidney International (2018) 93, 545–559
6. KDIGO 2017 Clinical Practice Guidelines on the Prevention, Diagnosis, Evaluation and Treatment of hepatitis C in CKD.

CHAPTER 26

Expanded and Standard Criteria Donor

Dr. Kolla Praveen Kumar | Dr. Chinmaye Sapre

Introduction

More than 90% of patients who had ESRD and underwent Deceased Donor kidney transplantation have had to wait for prolonged duration for 3 to 5 year before they received a kidney transplant .There is a current enduring critical shortage of organs. Also the substantial replacements of the deceased donor pool with decedents have kidneys damaged by systemic atherosclerosis which means that the donor pools of kidneys under offer have wide-ranging functional vitality and multiple pathologic features.[1–3] Hence the classification for donors whose kidneys can be used for renal transplant was made. Initially the classification included only standard criteria for donor (SCD). Due to the acute shortage of organs the American United Network for Organ Sharing (UNOS) in 2002 proposed to increase the pool of donor kidneys by including an Expanded Criteria Donor (ECD). The recipients getting a kidney from the expanded donor criteria patient had a relative risk of graft failure 1.7 fold higher than kidney transplant recipients from Standard Criteria Donor (SCD). [4]

Definitions

Standard criteria donor (SCD): An ideal standard donor is a 35 year old man who has no history of diabetes or hypertension and the death has resulted from a motor vehicle accident. In clinical practice though standard criteria donor is defined as all deceased donors not fitting expanded donor criteria and in whom donation occurred after brain death. [5]

Expanded criteria donor (ECD): An Expanded criteria donor is one who, at the time of death, is aged >60 or aged 50 to 59 years and has any two the following three criteria:

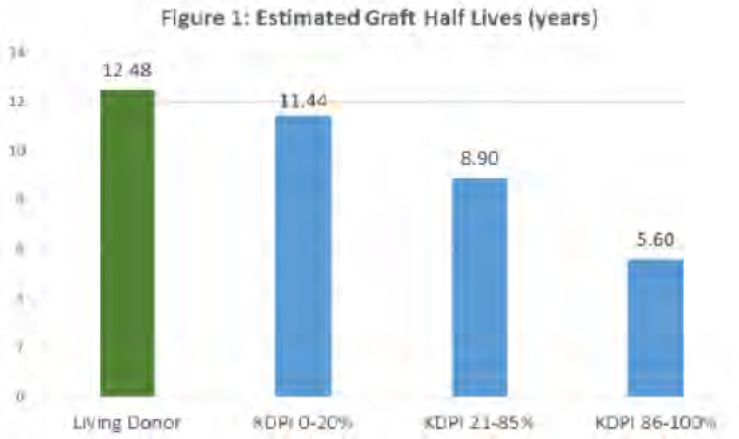
1. Cause of death is cerebrovascular accident
2. Pre-existing history of systemic hypertension
3. Terminal serum creatinine >1.5 mg/dl.

These criteria were based on the presence of variables that increased the risk for graft failure by 70%. 5

In 2009, Rao et al.[6] proposed a new risk quantification score known as the Kidney Donor Risk Index (KDRI). The KDRI combines 10 donor variables to express the quality of the donor kidneys relative to other donors. The KDRI tells you how long a deceased donor kidney is expected to function relative to all of the kidneys recovered in the U.S. during the last year. Lower KDRI scores are associated with longer estimated function, while higher KDRI scores are associated with shorter estimated function. The KDRI score can be calculated with a calculator available online.

Donor characteristic	Applies to which Donors	KDRI coefficient (β)	KDRI Xβ Component
Age (integer years)	All	0.0128	0.0128x (Age–40)
	<18 years	-0.0194	-0.0194x (Age–18)
	>50 years	0.0107	0.0107x (Age–50)
Height (cm)	All	-0.0464	-0.0464x (Hgt–170)/10
Weight (kg)	Weight < 80 kg	-0.0199	-0.0199x (Wgt–80)/5
Ethnicity	African American	0.1790	0.1790
History of Hypertension	Hypertensive	0.1260	0.1260
History of Diabetes	Diabetic	0.1300	0.1300
Cause of Death	CVA	0.0881	0.0881
Serum Creatinine (mg/dL)	All	0.2200	0.2200x (Creat–1)
	Creatinine > 1.5	-0.2090	-0.2090x (Creat–1.5)
HCV Status	Positive	0.2400	0.2400
DCD Status	DCD	0.1330	0.1330

Table 1: KDRI Donor Factors and Model Coefficients



ECD Vs SCD

In 2008, Pascual et al. [4] performed a systematic review and concluded that ECD recipients had worse long-term survival than SCD recipients. This review was not considered substantial as it contained a large group of studies which were just observational thus increasing the chances of confounding bias. Mezrich et al [7] studied 201 patients getting a transplant from ECD vs 358 patients receiving a transplant from SCD. There was an increased risk of death and graft failure in patients receiving kidneys from ECD (hazard ratio: 1.49). On sub analysis Mezrich et al [7] also found that the risk in ECD increased even more when the recipient was more than 60 years old (hazard ratio: 1.97). Various other studies were found to have similar outcomes. [8] A meta-analysis done on the studies in the USA in ECD vs SCD derived a few hypotheses. These included (i) a higher level of comorbidities in ECD recipients or a lower level in SCD recipients, (ii) a lower use of hypothermic machine perfusions before transplantation from ECD, or (iii) a more exhaustive old-to-old and young-to- young graft allocation policy. All these were named as possible factors. [9] On the other hand pascal et al [4] noted a beneficial use of ECD criteria, especially for old recipients who would most likely not survive long waiting periods.

Allocation process for ECD

In the USA ECD kidneys are allocated to patients on the kidney transplant waiting list in accordance with the allocation policy (United Network for Organ Sharing Policy, Allocation of Cadaveric Kidneys) put in place by the Organ Procurement Transplantation Network(OPTN) in October 2002, which states, "Kidneys procured from the ECD will be allocated to patients determined to be suiTable candidates: First, for zero antigen mismatched patients among this group of patients with time limitations; and next, for all other eligible patients locally, regionally, and nationally, based on time waiting and not the HLA matching".[10] Here are several common misconceptions about the ECD allocations policy. First, opting to receive an ECD kidney does not put the transplant candidate on a separate waiting list, as is commonly misconstrued. There is no separate waiting list for ECD kidneys. Second, a patient on the waiting list may change his or her desire to be considered for an ECD kidney at any time and may choose not to accept one particular ECD kidney when offered without jeopardizing his or her status on the waiting list or the chances of being offered another ECD kidney. Third, an ECD kidney is awarded only on the basis of the number of points accrued as a result of the time that the candidate has spent on the waiting list or since initiation of dialysis when applicable. This means that allocation points accrued for HLA DR match, panel-reactive antibody levels, and other factors in the SCD allocation process do not count toward the ranking for an ECD kidney offer. [11] These guidelines are not adhered to in India and no separate option for accepting ECD kidney exists. The recipients are counselled and with their willingness the renal transplant is carried out.

Conclusion

The scarcity of kidneys is an area of utmost concern. The use of SCD and ECD has increased the donor pool substantially. The use of ECD has higher probability of graft failure and worse patient survival chances when compared to SCD yet it is beneficial in comparison to patients on haemodialysis awaiting a renal transplant.

References

1. Smith RB, Fairchild R, Bradley JW, Cho SI: Cadaver kidney donors with hypertensive histories. Transplant Proc. 1988; 20: 741–742.
2. Alexander JW, Vaughn WK, Carey MA: The use of marginal donors for organ transplantation: The older and younger donors. Transplant Proc. 1991; 23: 905–909,
3. Alexander JW, Zola JC: Expanding the donor pool: Use of marginal donors for solid organ transplantation. Clin Transplant. 1996; 10: 1–19.
4. Pascual J, Zamora J, Pirsch JD. A systematic review of kidney transplantation from expanded criteria donors. Am J Kidney Dis 2008; 52: 553.
5. Metzger RA, Delmonico FL, Feng S, Port FK, Wynn JJ, Merion RM. Expanded criteria donors for kidney transplantation. Am J Transplant. 2003; 3(Suppl. 4): 114
6. Rao PS, Schaubel DE, Guidinger MK, et al. A comprehensive risk quantification score for deceased donor kidneys: the kidney donor risk index. Transplantation. 2009; 88: 231.
7. Mezrich JD, Pirsch JD, Fernandez LA, et al. Differential outcomes of expanded-criteria donor renal allografts according to recipient age. Clin J Am Soc Nephro.2012; 7: 1163.
8. Woodside KJ, Merion RM, Leichtman AB, et al. Utilization of kidneys with similar kidney donor risk index values from standard versus expanded criteria donors. Am J Transplant. 2012; 12: 2106.
9. Querard AH, Foucher Y, Combescure C, et al. Comparison of survival outcomes between expanded criteria donor and standard criteria donor kidney transplant recipients: A systematic review and meta-analysis. Transpl Int. 2016; 29: 403–415.
10. Rosengard BR, Feng S, Alfrey EJ, Zaroff JG, Emond JC, Henry ML, Garrity ER, Roberts JP, Wynn JJ, Metzger RA, Freeman RB, Port FK, Merion RM, Love RB, Busuttil RW, Delmonico FL: Report of the Crystal City meeting to maximize the use of organs recovered from the cadaver donor. Am J Transplant. 2002; 2: 701–711.
11. Rao PS, Ojo A. The alphabet soup of kidney transplantation: SCD, DCD, ECD – fundamentals for the practicing nephrologists. Clin J Am Soc Nephrol. 2009; 4(11):1827-1831.

CHAPTER 27

Paired Kidney Donation

Dr. Santhosh Pai B.H | Mr. Nelvin Nelson

Introduction

A paired kidney exchange or donation, also known as a "kidney swap" happens where a living kidney donor is not able to donate to the recipient, and exchanges kidneys with another donor/recipient pair due to HLA or blood group incompatibility. This kidney paired donation transplant helps two incompatible recipients to receive healthy, more compatible kidneys. All medically eligible donor/recipient pairs may participate in the paired kidney exchange programme (Figure-1)

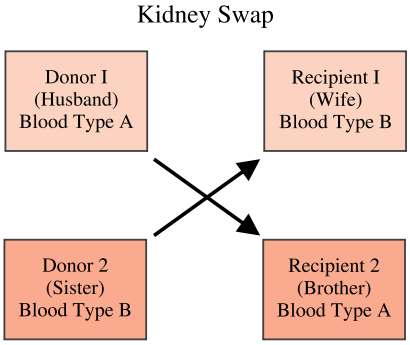


Figure-1: Two way paired kidney donation

In more complex cases, additional donor/recipient pairs may be used. Here is a diagram showing a three-way kidney exchange (Figure-2).

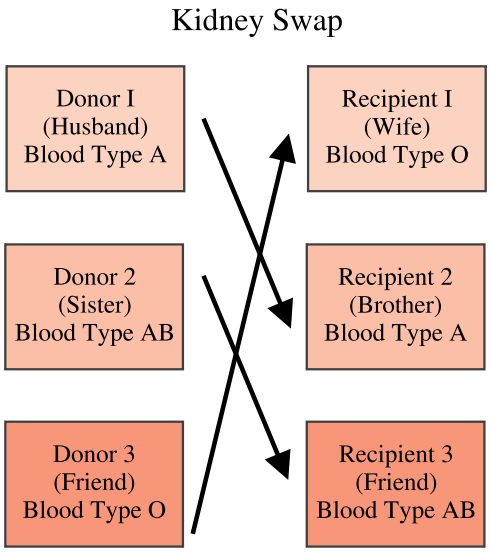


Figure-2: Three way paired kidney donation

Kidney paired donation initially started in Dutch programme as closed loop of 2-way kidney exchange. It can be arranged as 3-way, 4-way and n-way exchanges. Paired kidney exchange programme allows for a recipient to receive a better matched kidney, and helps other individuals who would otherwise continue to wait for a matched donor. It has greater long-term graft survival rate than deceased donor kidney transplantation.

Non-directed anonymous donors (Good Samaritan or altruistic donors) are donors who want to donate a kidney, but do not have an intended recipient. Non-directed anonymous donors from the general population can initiate the kidney paired donation chain to increase transplant rate for O group and sensitized patients in kidney paired donation [1 – 4]

Kidney exchange will increase the living donor kidney transplantation opportunity for sensitized and O group patients. Multi-centre domino kidney paired donation increases access to living donor kidney transplantation, with similar outcome to conventional kidney paired donation [5]

Institute of Kidney Diseases and Research Centre, Dr HL Trivedi Institute of Transplantation Sciences, Ahmedabad, India has used different forms of kidney exchanges including 2-way, 3-way, 4-way, 6-way kidney exchange, use of compatible patient donor pairs, kidney exchange with desensitization, non-simultaneous kidney exchange and international kidney exchange [6-12]

In a single center kidney paired donation the donor pool is less, donor transport and shipment is not required, cold ischemia time and cost is less. The hospital will be familiar with easy follow up compared to multicenter kidney paired donation where donor pool is more , donor transport and shipping of kidneys are required, cold ischemia time and cost is more and hospital is unfamiliar with difficult follow up.

Anonymity

Advantage of anonymity is that, it saves time in counseling and there is no psychological pressure. In Indian scenario, an authorization committee conducts the meeting of the 2 donor-recipient pair together and evaluates about the consent to participate in kidney paired donation. Anonymity is very difficult to maintain in case of simultaneous transplant surgery in single centre kidney paired donation programme.

Reciprocal match requirement

The kidney paired donation matches require reciprocal compatibility. It is standard practice to consider simultaneous donor nephrectomy and transplant surgery in kidney paired donation. Majority of Indian transplant centers perform simultaneous two way kidney exchanges and long chains are not preferred due to limited transplant team (operating rooms and surgical staff) and infrastructure.

More than 2-way exchanges and long chains can be performed with single centre non-simultaneous kidney paired donation or multi-centre simultaneous kidney paired donation. Multi-centre simultaneous kidney paired donation requires donor travel or transport of kidney. The long term graft survival is not significantly affected when cold ischemia time is short (< 8 h). In non-simultaneous kidney transplantation, the long chain can break if donor reneges or recipient become medically unfit

In India, Transplantation of Human Organs Act (Amendment) 2011 gives legal permission for kidney paired donation[13]. The altruistic donors are not allowed for organ donation in kidney paired donation in India.

Presently the kidney paired donation or swap is not accepted in Telangana as per the old TOHA but will soon be incorporated in the new THOTA. Hence though swap donations are being done in Telangana they are being done under special permission from the state assembly.

Recently national paired donation guidelines have been published in Indian journal of nephrology and Indian journal of transplant which can serve as guiding principles for swap donation.[14] In future the live donation registry can be linked to Jeevandan in the state to offer the best kidney to the patient.

Conclusions

1. An effective kidney paired donation programme should be tried in all transplant centers
2. Kidney paired donation has all advantages of living donor kidney transplantation (similar patient, graft survival, cost and outcome) without long waiting time for deceased donor kidney transplantation.
3. Solving legal barriers, ethical problems and proper couselling and communication by transplant team including coordinators is key to success in kidney paired donation

References

1. Matas AJ, Garvey CA, Jacobs CL, Kahn JP. Nondirected donation of kidneys from living donors. N Engl J Med. 2000;343:433–436

2. Bramstedt KA, Dave S. The silence of Good Samaritan kidney donation in Australia: a survey of hospital websites. Clin Transplant. 2013;27:E244–E248.

3. Rees MA, Kopke JE, Pelletier RP, Segev DL, Rutter ME, Fabrega AJ, Rogers J, Pankewycz OG, Hiller J, Roth AE, et al. A nonsimultaneous, extended, altruistic-donor chain. N Engl J Med. 2009;360:1096–1101.

4. Roodnat JI, Zuidema W, van de Wetering J, de Klerk M, Erdman RA, Massey EK, Hilhorst MT, Ijzermans JN, Weimar W. Altruistic donor triggered domino-paired kidney donation for unsuccessful couples from the kidney-exchange programme. Am J Transplant. 2010;10:821–827.

5. Lee YJ, Lee SU, Chung SY, Cho BH, Kwak JY, Kang CM, Park JT, Han DJ, Kim DJ. Clinical outcomes of multicenter domino kidney paired donation. Am J Transplant. 2009;9:2424–2428.

6. Kute VB, Gumber MR, Shah PR, Patel HV, Vanikar AV, Modi PR, Shah VR, Trivedi HL. Successful three-way kidney paired donation transplantation: The first Indian report. Indian J Nephrol. 2014;24:45–47

7. Kute VB, Patel HV, Shah PR, Modi PR, Shah VR, Rizvi SJ, Pal BC, Modi MP, Shah PS, Varyani UT, et al. Increasing access to kidney transplantation for sensitized recipient through three-way kidney paired donation with desensitization: The first Indian report. World J Clin Cases. 2016;4:351–355

8. Kute VB, Vanikar AV, Gumber MR, Shah PR, Patel HV, Engineer DP, Balwani MR, Gautam RS, Gera DN, Modi PR, et al. Successful three-way kidney paired donation with compatible pairs to increase donor pool. Ren Fail. 2014;36:447–450.

9. Kute VB, Patel HV, Shah PR, Vanikar AV, Trivedi HL. National kidney paired donation programme in India: Challenges, solution, future direction. Nephrology (Carlton) 2015;20:442.

10. Kute VB, Patel HV, Varyani UT, Shah PR, Modi PR, Shah VR, Rizvi SJ, Pal BC, Shah PS, Wakhare PS, et al. Six end-stage renal disease patients benefited from first non-simultaneous single center 6-way kidney exchange transplantation in India. World J Nephrol. 2016;5:531–537.

11. Kute VB, Patel HV, Shah PR, Modi PR, Shah VR, Rizvi SJ, Pal BC, Shah PS, Wakhare PS, Shinde SG, et al. International kidney paired donation transplantations to increase kidney transplant of o group and highly sensitized patient: First report from India. World J Transplant. 2016;7:64–69.

12. Kute VB, Vanikar AV Patel HV, Shah PR, Gumber MR, Engineer DP, Trivedi HL. Combining kidney paired donation with desensitization increases renal transplantation rate in highly sensitized patients. Indian J Transplant. 2013;7:109–111.

13. Agarwal SK, Srivastava RK, Gupta S, Tripathi S. Evolution of the Transplantation of Human Organ Act and law in India. Transplantation. 2012;94:110–113.

14. Kute VB, Agarwal SK, Sahay M, Kumar A, Rathi M, Prasad N, et al. Kidney-paired donation to increase living donor kidney transplantation in India: Guidelines of Indian Society of Organ Transplantation – 2017. Indian J Transplant 2018; 12:67-74.

CHAPTER 28

ABO Incompatible Kidney Transplantation

Dr. Kamal Kiran

Introduction

The burden of chronic kidney disease (CKD) is increasing all over the world.[1] End-stage renal disease (ESRD) ultimately needs renal replacement therapy (RRT). That kidney transplant (KT) is the best treatment for ERSD is well-known, but a severe donor shortage has significantly limited this treatment. To overcome this profound donor shortage, immunologic barriers historically considered as absolute contraindications to transplantation are being re-evaluated. One such barrier is the ABO blood group incompatibility.

ABO incompatibility (ABOi) was long considered to be an absolute contraindication for KT. Through better understanding of related immunologic mechanisms and effective various regimens for controlling it, ABO-incompatible kidney transplantation (ABOi KT) is being performed with increasing frequency. [2] Japan lead the way in performing the highest number of ABOi-KT.[3] Europe and America soon followed with excellent success rates. [4, 5] In India too, ABOi-KT is being performed regularly in few centres. [6]

Blood group antigens and antibodies

ABO blood group antigens

The most important blood antigens consist of A, B, and O group antigens. These antigens are found on many cells, including erythrocytes, platelets and endothelial cells of all vascular organs. ABO blood group incompatibility is a significant immunologic barrier because humans have natural antibodies against the A and/or B antigens that they do not have.

Blood group A carries A1 or A2 antigen, with expression of A2 antigen weaker than that of A1 antigen.

Anti-ABO antibodies are both immunoglobulin IgM or IgG type. Most centres use only IgG titres.

There are various methods to measure the anti-ABO antibody titre. The most common is the saline tube technique, although there is significant inter-centre variation in the titre determined by this method.[7] New techniques, such as gel card technique and flow cytometry, may be better than the saline tube test because, both show improved reproducibility. [7,8,9] Flow cytometry would be suiTable for an accurate measurement but is not available at all centres because of its high cost

Desensitization for ABOi KT

Current immunosuppressive strategies for ABOi KT have two main principles:

1. Pre-transplant anti-ABO antibodies removal
2. Preventing the reappearance of anti-ABO antibodies

Antibody depletion

Antibody-depleting treatment is the basis of desensitization for ABOi KT. Current methods for the removal of anti-ABO antibodies involve

A. Classical Plasmapheresis

B. Double-filtration plasmapheresis (DFPP)

C. Antigen-specific Immuno Adsorption (IA)

Classical plasmapheresis removes antibodies and plasma proteins from the circulation, and the recipient plasma is replaced by either albumin, fresh-frozen plasma (FFP), or a combination of both. Because of the removal of coagulation factors and other useful immunoglobulins, the risk of bleeding and infections is increased after plasmapheresis. To avoid these complications, many centres use FFP for the final sessions before transplantation. Other complications were hypocalcaemia, hypotension, and nausea or vomiting.[10] Plasmapheresis removes all antibodies, both good and bad and hence increase the risk of infections. Plasmapheresis removes about 20% antibodies per session.

In DFPP, plasma is separated by filtration and passed through a second filter where immunoglobulins are selectively filtered out and discarded. DFPP can minimize hemodynamic instability and the amount of replacement volume needed. DFPP also removes 60–70% of the antibodies per session. Although DFPP avoids the loss of coagulation factors and albumin, unlike classical plasmapheresis, albumin is almost always needed in the replacement fluid.

IA can remove antigen-specific antibodies, such as anti-ABO antibodies. Between the specific and nonspecific IA techniques, antigen-specific IA is used more commonly in ABOi KT, whereas antigen-nonspecific IA is suiTable for the depletion of anti-HLA antibodies. In ABO-specific IA, the plasma is processed through an ABO immunoadsorbent column that is coated with either blood type A or B antigens. This allows the selective removal of anti-A or anti-B antibodies, and the processed plasma is then re-infused into the recipients. Antigen-specific IA removes a two-fold to

four-fold titre per session. At least four preoperative IAs are usually needed to obtain an acceptable titre.[11] IA is normally preferred because of its safety and efficacy. However, the application of IA outside Europe and Australia is limited because of its high cost that is often not covered by health insurance.

Procedure

ABO incompatible transplants are performed by trying to remove antibodies from patient's plasma. As stated earlier, antibodies are measured in dilutions. So if a patient's antibodies have been found to be 1:128, using several sessions of plasmapheresis, DFPP or Immunoadsorption, the antibiotics are removed. The target is to bring down the antibodies as low as possible, that is 1:4 or 1:8. Once this is achieved the patient is then taken up for kidney transplantation.

Our regular protocol is to administer rituximab (anti-CD20), 3 to 4 weeks before transplantation. The next week triple immunosuppression (tacrolimus, mycophenolate and steroid) are started. A week later imunoabsorption or plasmapheresis sessions are started. We perform sessions on alternate days. Titres are estimated before every session. When target titres are reached, patient is posted for transplant. The patient is induced with thymoglobin or basiliximab and transplant proceeds like usual ABO compatible transplantation. Once transplantation is performed then titres are measured everyday for the first one week and on alternate days for the next one week, then monthly once for a period of 6 months. The plan is to keep the titres less than 1:16 in the first one week and less than 1:32 in the second week. Plasmapheresis or IA is performed if deemed necessary. The phenomenon of accommodation is unique in ABO incompatible kidney transplantation, wherein on a kidney biopsy C4d is positive but there are no signs of rejection, whereas in normal kidney transplant (ABO compatible transplant) C4d positive would mean antibody mediated rejection. This phenomenon is called accommodation. This is very desirable in ABOi kidney transplantation. It means the new ABO incompatible kidney has got accommodated into the host. Once successful transplantation has been performed and two to three weeks have passed with normal graft function and no features of rejection the incompatible kidney proceeds to perform just like a normal ABO compatible transplantation.

My personal experience: I have performed 54 ABOi KT since 2011 till date of which 45 have been successful. Of the remaining 9, seven were thrombotic microangiopathy and 2 had humoral rejection.

Risks and complications

Due to the higher level of immunosuppression (rituximab, antibody depletion) that ABOi KT involves infection rates are higher. Rejection rates are considered to be slightly higher. There is a higher rate of thrombotic microangiopathy for unknown reasons. Bleeding complications are higher when plasmapheresis is used.

Conclusions

ABOi KT is being performed more frequently these days even in our country. The risks and complications, the higher cost involved should be explained. Alternate options like cadaver transplant and swap transplant options should be offered to the patient. ABOi KT should be undertaken after a complete appraisal of the risks and benefits involved has been carried out and discussed with the patient and family.

References

1. Ojo A. Addressing the global burden of chronic kidney disease through clinical and translational research. Trans Am Clin Climatol Assoc. 2014;125(1):229-43.
2. C. C. Magee, Transplantation across previously incompatible immunological barriers, Transplant International, 2006; 19 (2): 87–97.
3. H. Ishida, K. Tanabe, H. Toma, and T. Akiba, "Therapeutic apheresis therapy for ABO-incompatible renal transplantations," Therapeutic Apheresis, 2003;7 (6): 520–528.
4. G. Tydén, G. Kumlien, H. Genberg, J. Sandberg, T. Lundgren, and I. Fehrman, "ABO incompatible kidney transplantations without splenectomy, using antigen-specific immunoadsorption and rituximab," American Journal of Transplantation. 2005;5 (1):145–148.
5. R. A. Montgomery, "Renal transplantation across HLA and ABO antibody barriers: integrating paired donation into desensitization protocols," American Journal of Transplantation, 2010;10 (3) :449–457.
6. Shroff S. Current trends in kidney transplantation in India. Indian J Urol. 2016;32(3):173-174
7. T Kobayashi, K Saito. A series of surveys on assay for anti-A/B antibody by Japanese ABO-incompatible Transplantation Committee. Xenotransplantation, 2006;13:136-140
8. G Stussi, K Huggel, HU Lutz, U Schanz, R Rieben, JD Seebach. Isotype-specific detection of ABO blood group antibodies using a novel flow cytometric method. Br J Haematol, 2005;130 :954-963
9. G Kumlien, J Wilpert, J Safwenberg, G Tyden. Comparing the tube and gel techniques for ABO antibody titration, as performed in three European centers. Transplantation, 2007; 84 :S17-S19
10. AA Tobian, RS Shirey, RA Montgomery, DJ Tisch, PM Ness, KE KingTherapeutic plasma exchange reduces ABO titers to permit ABO-incompatible renal transplantation. Transfusion, 2009;49 :1248-1254
11. G Tyden, G Kumlien, M Efvergren. Present techniques for antibody removal. Transplantation, 2007;84 : S27-S29

CHAPTER 29

Donation after Cardiac Death

Dr. K. Bharathi

Introduction

Organ transplantation improves the quality of life and increases the life expectancy of patients with end-stage organ failure. Donor scarcity and the increased need for organ transplantation has prompted the development of an alternative source of donors to the more conventional brain dead donor(DBD). This has prompted many countries to re-introduce DCD (Donation after Cardiac or Circulatory Death) schemes not only for kidney retrieval but increasingly for other organs with a lower tolerance for warm ischaemia such as the liver, pancreas, and lungs.[1,2]. Extracorporeal membrane oxygenation (ECMO) [3] is a technique that was developed as a bridge to support cardiorespiratory functions in patients with severe heart or lung dysfunction and later used in patients with refractory cardiac arrest and it is considered one of the technique potentially useful to expand the organ donation pool.[4] The challenge in the practice of DCD includes how to identify patients as suitable potential DCD donors, how to support and maintain the trust of bereaved families, and how to manage the consequences of warm ischaemia in a fashion that is professionally, ethically, and legally acceptable.

Donation after cardiac death

Donation after Circulatory Death (DCD) occurs when a patient donates organs following the determination of death by cardio-respiratory criteria. It is also known as Donation after Cardiac Death (DCD), Donation following the Circulatory Determination of Death (DCDD), or Non Heart Beating Organ Donation (NHBD). DCD was largely abandoned during the 1970's, the damaging effects of the "warm ischemic time" (WIT) cited as one major difficulty. WIT is the period of hypoperfusion that inevitably occurs following the withdrawal of life-sustaining therapies. The WIT begins when the SaO2 or Systolic BP fall below 70% or 50mmHg respectively and ends with cold perfusion of

the organs.[5] With advances in immunosupression, storage and perfusion of organs, outcome data now demonstrate almost equivalent renal, pancreatic and pulmonary graft survival[6].

Classification of DCD

The modified Maastricht classification[7] is widely used to categorize DCD (Table 1). Categories I, II, and V describe organ retrieval that follows unexpected and irreversible cardiac arrest (uncontrolled DCD) (UDCD), while categories III and IV refer to retrieval that follows death resulting from the planned withdrawal of life-sustaining cardiorespiratory support (controlled DCD)(CDCD). It follows that uncontrolled DCD can only occur in centres where facilities for organ perfusion and retrieval are at immediate hand (i.e. close to or within a transplantation centre), whereas almost any intensive care unit (ICU) or emergency department (ED) should be able to support controlled DCD. Differences between controlled and uncontrolled DCD are shown in Table 2.

Category	Description	Type of DCD	Location practiced
I	Dead on arrival	Uncontrolled	ED in a transplant centre
II	Unsuccessful resuscitation	uncontrolled	ED in a transplant centre
III	Anticipated cardiac arrest	controlled	ICUand ED
IV	Cardiac arrest in brain-dead donor	controlled	ICU and ED
V	Unexpected arrest in ICU patient	uncontrolled	ICU in a transplant centre

Table 1. Modified Maastricht classification[7] of DCD and the locations where mainly practiced. ICU: Intensive Care Unit, ED: Emergency Department

Process of DCD

Process of DCD is depicted in Figure 1 & 2. After the decision to withdraw life support has been made, the patient is evaluated to determine whether death most likely will occur within a predetermined period (generally 1 hour) after withdrawal of life support; this period is considered the maximum accepTable interval between withdrawal of support and recovery of organs for minimizing ischemic organ injury[8]. If cessation of cardiorespiratory effort most likely will occur within this period and the patient otherwise seems to be medically suitable as an organ donor, then the patient's family is counseled about the possibility of organ donation. In order to safeguard against conflicts of interest, the decision to withdraw life support must not be intertwined with the discussion of opportunities for organ donation. If the patient's legal next-of-kin agrees to donation, physiological support is continued through the evaluation-and-allocation phase, similar to the procedure in organ donation after brain death. Once the transplant teams arrive at the hospital, the patient is transferred to the operating room or a room close to the operating room for the withdrawal of life support. Life support is withdrawn in the presence of the caregiving team in the same fashion as it would be in the critical care unit. Once cardiorespiratory function has ceased, the patient is pronounced dead on the basis of cardiopulmonary criteria by the attending physician or the physician's designee.

Variable	Controlled	Uncontrolled
Case characteristics	Patient sustains nonrecoverable injury Family elects to withdraw support in collaboration with hospital care team If organ procurement organization (OPO) not previously notified, patient referral is made Overall stability of patient's condition is aggressively maintained	Patient sustains nonrecoverable injury Patient has sudden cardiac arrest or condition becomes profoundly unstable If OPO not previously notified, urgent patient referral is made Resuscitation measures, Including cardiopulmonary resuscitation, are aggressively continued.
Withdrawal decision / family approach	Once the family has communicated its decision to withdraw life support, the OPO Presents the opportunity for DCD in a supportive environment. Withdrawal typically occurs in a progressive, controlled fashion Time to discuss all aspects of the process may be unlimited	Once resuscitation efforts are determined to be futile or instability of patient's condition is determined to be irreversible, by the necessity the family may be presented with the opportunity to donate during a crisis situation. Opportunity to consider DCD must be presented to the family urgently and succinctly, emphasizing that extending resuscitation times may decrease the chance for successful transplantation of recovered organs
Withdrawal of Support/recovery process	All aspects of withdrawal and organ recovery are collaboratively planned among the family, caregiving team, and OPO Possibility for coordination of ideal circumstances exists Withdrawal is done in the operating room Caregiving staff are in attendance Recovery teams are present, and organ preservation process is ready Family has adequate time for closure and rituals	Collaboration between OPO and caregiving team must occur quickly, with minimal time for discussion No possibility exists for coordination of ideal circumstances; everyone is committed to working within the constraints of the situation. Formal withdrawal does not occur because the patient most often is undergoing cardiac massage up until time of organ recovery Operating suite is rapidly secured Recovery teams are emergently transported Organ preservation may be delayed

Table 2: Differentiation of controlled and uncontrolled donation after cardiac death (DCD)

Definition of death

This will be in accordance with the criteria defined by Academy of Medical Royal Colleges Criteria (2008) [9]. Death is certified after 5 minutes of asystole on a continuous ECG display or 5 minutes absence of pulsatile flow using direct intra-arterial pressure monitoring. This should be accompanied by apnoea, absent pupillary reactions, corneal reflexes and absent response to supraorbital pressure.

Period of non-interventon

This is a second 5-minute period after the diagnosis of death. In this time the patient continues to be monitored for evidence of autoresuscitation (defined as the unassisted Return of Spontaneous Circulation (ROSC) after a cardiac arrest). Autoresuscitation may be characterised by the resumption of breathing, a change in neurological status or the return of a pulse or an arterial waveform. Autoresuscitation has never been described in the context of controlled DCD[10]. Should this occur however, a further observation period of 5 minutes is mandatory after this activity has disappeared, before proceeding with organ donation. The period of non-intervention may be used to transfer the patient to the theatre where sterile preparation and draping may begin. No incision will be made until this 5-minute period has elapsed

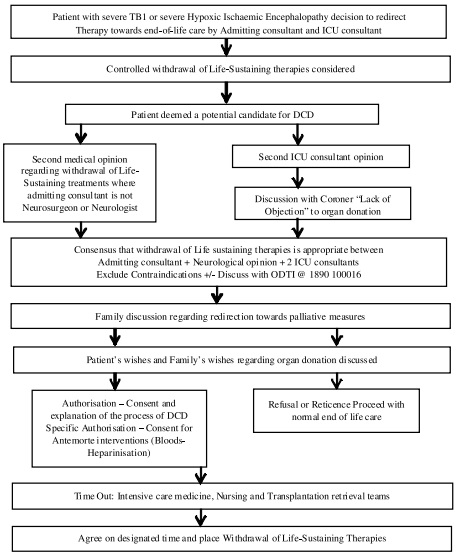


Figure-1 : Process of withdrawal of life sustaining therapies (WLST)

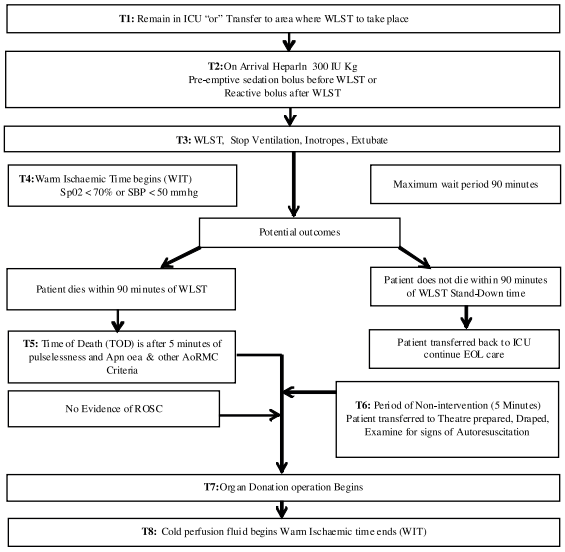


Figure 2: Process of DCD

The time from extubation to the start of perfusion of the organs with cold solution is also recorded as the warm ischemic time and is used to help guide the determination as to which organs are suiTable for transplantation. The organs recovered after cardiac death may be kidneys only or kidneys and other organs such as the liver, pancreas, and lungs. Patients 50 years and older are considered for kidney donation only; patients less than 50 years old are considered for both kidney and other organ donation. However, no absolute age cut-off exists, and extrarenal organs from patients more than 50 years old have been successfully transplanted. The recovery of extrarenal organs also depends on the time from withdrawal of support to the start of perfusion with cold solutions. If that time exceeds 30 minutes, the liver may not be recovered, and if it exceeds 45 minutes, the pancreas may not be recovered. In the majority of donors, this time does not exceed 1 hour8.

One of the problems with DCD is warm ischemia which interfere with quality of organs and thus their suitability for retrieval. Various perfusion techniques were developed to circumvent this.one such method is ECMO (Extra Corporeal Membrane Oxygenation).

Extracorporeal membrane oxygenation

Through a cannula inserted in the venous system, blood is directed by a pump into an extracorporeal circuit through which blood is oxygenated and carbon dioxide is removed. Blood is then returned to the patient's circulation through the veins (venovenous ECMO) or arteries (venoarterial ECMO)(Figure 3)

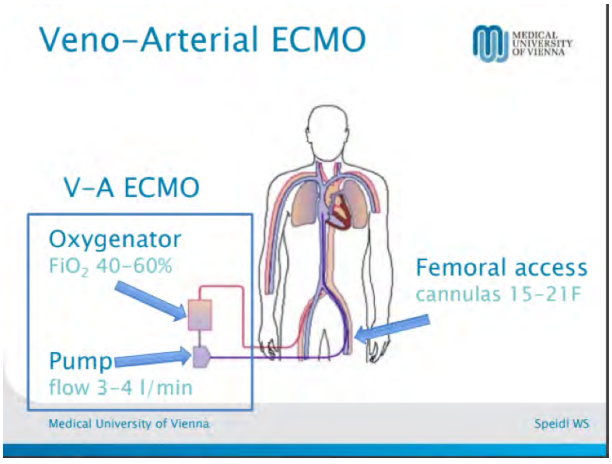


Figure 3: Principle of ECMO

Description of CDCDD protocols using ECMO and an aortic balloon

The University of Michigan protocol 11 provides that after family members and health professionals agree to W-LST, the option of CDCDD is offered to the family. With consent, ECMO cannulas are inserted with a deflated supradiaphragmatic aortic occlusion balloon. Life-sustaining therapy is then withdrawn. If death occurs within 60 min, the patient is deemed suiTable for CDCDD. A

no-touch period (also called a stand-off period) of 5 min is observed, defined as the time from circulatory arrest to death determination, after which the aortic balloon is inflated and ECMO is begun. After the family has said a last good-bye, the patient is transferred to the operating room (OR), where organs are removed. Because ECMO causes systemic recirculation, the aortic occlusion balloon is necessary to prevent brain and cardiac recirculation 12,13 and thus possible resuscitation of the brain and heart. Similarly, in the Henry Ford Health System 11 and at Wake Forest University13 , ECMO cannulas are inserted premortem, after informed consent. At National Taiwan University Hospital, the insertion of ECMO cannulas is conducted postmortem14, with no mention of the requirement for informed consent.

Description of CDCDD protocols using ECMO and an aortic clamp

In the United Kingdom, three centers (Cambridge, Birmingham, and Edinburgh) recently developed another procedure using ECMO, called normothermic regional perfusion (NRP) 15. After W-LST occurs either in the intensive care unit (ICU) or in the OR, death is determined after a notouch period of 5 min. In the Operatingroom(OR), laparotomy and sternotomy are performed, and ECMO cannulas are inserted. Before the initiation of ECMO, the descending aorta is clamped to prevent brain and cardiac recirculation. When the heart is to be transplanted, the clamp is positioned across the aortic arch vessels 16 to exclude only the brain circulation. ECMO catheters are inserted postmortem; specific informed consent is not required.

The ECMO team experience is crucial in this phase since “times should be the shortest “ (that is ECMO team call time and ECMO team implantation time). The time between cardiac arrest and “ECMO start” should not be longer that 150 minutes (that is pure warm ischemia time = 30-40 minutes + ACLS time=max 120 minutes). The “ECMO -time” (that is from implantation to organ explantation) varies but it should not exceed 4 hours. Whenever blood gas parameters and laboratory tests are sTable, an ECMO-time of 6 hours should be tolerated. ECMO-DCD algorithm shown in Figure 4.

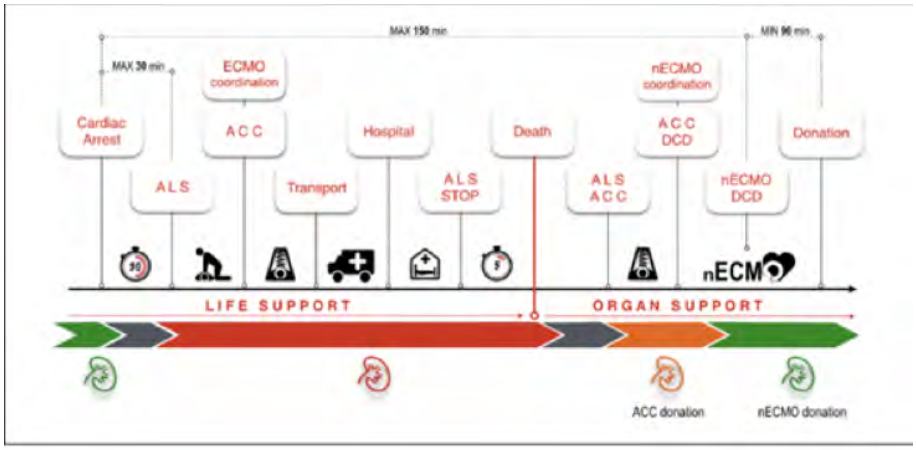


Figure 4: DCD ECMO Algorithm. ALS Advanced Life Support. ACC Automated Chest Compression.

ECMO support has to be stopped in presence of one of the following conditions:

1. Whenever an appropriate flow cannot be maintained i.e. because of massive flow loss;
2. After 4-6 hours of ECMO support if some necessary steps have not been successfully completed (i.e. incomplete history, legal authorization not on time...);
3. When harvesting of organs has been performed

Ethical analysis of ECMO:

Using ECMO in CDCDD programmes raises the following ethical issues, which are summarized in Table 3.

	Pros	Cons
Premortemcannulation of ISP or ECMO	Technically easier Less risk of damaging bodily integrity Decrease of WIT with possible improve in future graft outcome	More than minimal risk of harm Modify end-of-life care Invasive, painful Risks of complications Damage to bodily integrity Unnecessarily implemented if death does not happen soon enough to permit organ donation
ECMO	Decrease WIT Permit W-LST in the ICU	
Aortic balloon versus aortic clamp	Permits initiation of ECMO more rapidly than aortic clamp and thus decreases WIT	Risk of reviving the patient in case of aortic balloon dysfunction or misplacement Negates the previous declaration of death if based on cessation of circulatory function Risks invalidation the acronym DCDD if brain is reperfused Other cDCDD protocols that do not use ECMO perform W-LST in the ICU Interfere with body value after death Risk of confusing the understanding of professionals and family around death (as the body recirculates and looks alive) Higher risk of dysfunction or misplacement with the aortic balloon than with the aortic clamp Both: Deliberate exclusion of brain circulation, which raises the question of the complicity of physicians in the patient's death

Table 3: Ethical issues of ECMO in CDCDD

cDCDD, controlled donation after circulatory determination of death; DCDD, donation after circulatory determination of death; ECMO, extracorporeal membrane oxygenation; ICU, intensive care unit; ISP, in situ perfusion; WIT, warm ischemia time; W-LST, withdrawal of life-sustaining therapy.

ECMO and respect for the dead donor rule

The dead donor rule (DDR) provides that donors of vital organs must be declared dead prior to organ removal so the donor does not die as a result of organ donation[17]. Several authors have voiced concern that DCDD programmes may violate the DDR, claiming that the donor is not dead [18], a concern that may be exacerbated by the use of ECMO. After death declaration, the resumption of circulation by ECMO may revive the patient unless brain or heart perfusion is prevented..In DCDD protocols with ECMO that did not use an aortic occlusion balloon or an aortic clamp, lidocaine was administered to maintain cardiac arrest or phenobarbital was used to prevent brain stem activity.

Several authors echo the view of Manara et al [19], who stated, "No intervention that might potentially restore cerebral circulation at a time when nervous tissue might be responsive to such restoration should be allowed under any circumstances, given the timesensitive way in which death is diagnosed in the setting of DCDD ... [and] given the risk of negating the previous declaration of death."

Similarly, Shemie reported that "Canadian DCDD guidelines explicitly prohibit any post-mortem intervention that reestablishes brain blood flow" [20]. The American Thoracic Society chose not to rule on the use of ECMO in CDCDD programmes, stating that postmortem "interventions such as ECMO may stimulate physiologic function and require further analysis to determine their clinical usefulness and ethical merit"

Graft outcome from CDCDD programmes using ECMO

In theory, using ECMO with CDCDD may improve future graft function for three reasons:

1. It allows restoration of homeostatic function to the donor organs.
2. It allows the assessment of the suitability of the organs for transplantation.
3. It may reduce WIT.

The first application of normothermic reperfusion to humans was done in 1998 in the field of kidney transplantation from uncontrolled DCD [21] and in liver transplantation in 2002 by the group of Barcelona[22]. Sáchez-Fructuoso et al.[23] reported one and five year graft survival were 90.7 and 85.5% respectively in DCD kidneys less than 60 years; 79.8 and 73.3% respectively in DBD at least 60 years. Fondevila et al.[24] analyzed the results of transplanted livers from 2002 to 2010, preserved under normothermic ECMO perfusion. One-year recipient and graft survivals were 82% and 70%, respectively (median follow-up 24 months). Zych et al[25] (26 out of 157 lung transplantation [16.5%] were retrieved from DCD donors) who documented that medium-term results after lung transplantation with organs procured after circulatory death were comparable with those obtained after standard lung transplantation. In 2012 Yang et al.[26] presented five cases of brain-dead potential donors presenting with hemodynamic instability (despite maximal medical support), with an onset before the declaration of brain death or obtaining consent. The potential donors were supported using ECMO. All three heart recipients recovered uneventfully after one yr of follow-up.

Conclusion

The concept of extracorporeal support with oxygenation in DCD seems very promising since it has been reported to increase the available organ supply by approximately 20% to 25% by increasing the number of donors by approximately 33%. Centres with ECMO facilities should implement local programmes for donation after cardiac death (both in the emergency department and intensive care) using ECMO taking into account that this technique has been proven to increase donor pool.

References

1. Akoh JA, Dento MD, Bradshaw SB, Rana TA, Walker MB. Early results of a controlled non-heart beating kidney donor programme. Nephrol Dial Transplant 2009; 24: 1992–6 .
2. White SA, Prasad KR. Liver transplantation from non-heart beating donors. A promising way to increase the supply of organs. Br Med J 2006; 332: 376–7.
3. Thiagarajan RR, Brogan TV, Scheurer MA, Laussen PC, Rycus PT, Bratton SL. Extracorporeal membrane oxygenation to support cardiopulmonary resuscitation in adults. Ann Thorac Surg 2009;87:778-85.
4. Lazzeri C, Bernardo P, Sori A, Innocenti L, Stefano PL, Peris A et al. Venous-Arterial Extracorporeal membrane oxygenation for refractory cardiac arrest: a clinical challenge. Eur Heart J Acute Cardiovasc Care 2013;2:118-26.
5. Citerio G, Cypel M, Dobb G et al. Organ Donaton in Adults: A Critcal Care perspectve. Intensive Care Med. 2016; 42: 305-315.
6. White SA, Prasad KR. Liver transplantation from non-heart beating donors. A promising way to increase the supply of organs. Br Med J 2006; 332: 376–7.
7. Kootstra G, Daemen JH, Oomen AP. Categories of non-heart beating organ donors. Transplant Proc 1995; 27: 2893–4.
8. John Edwards etal.Maximizing Organ Donation Opportunities Through Donation After Cardiac Death. CriticalCareNurse Vol 26, No. 2, APRIL 2006:101-116.
9. A Code of Practce for the diagnosis and confrmaton of death. Academy of Medical Royal Colleges.2008. www.aomrc.org.uk/.../code-practice-diagnosis-confrmation-death
10. Hornby K, Hornby L, Shemie SD. A systematic review of autoresuscitation after cardiac arrest. Crit Care Med. 2010; 38: 1246-1253.
11. Rojas-Pena A, Sall LE, Gravel MT, et al. Donation after circula- tory determination of death: The University of Michigan Experience with extracorporeal support. Transplantation 2014; 98: 328–334.
12. Magliocca JF, Magee JC, Rowe SA, et al. Extracorporeal support for organ donation after cardiac death effectively expands the donor pool. J Trauma 2005; 58: 1095–1102.

13. Farney AC, Hines MH, al-Geizawi S, Rogers J, Stratta RJ. Lessons learned from a single center's experience with 134 donation after cardiac death donor kidney transplants. J Am Coll Surg 2011: 212: 440–451.

14. Lee C-Y, Tsai M-K, Ko W-J, et al. Expanding the donor pool: Use of renal transplants from non-heart-beating donors supported with extracorporeal membrane oxygenation. Clin Transplant 2005; 19: 383–390.

15. Oniscu GC, Randle LV, Muiesan P, et al. In situ normothermic regional perfusion for controlled donation after circulatory death– The United Kingdom Experience. Am J Transplant 2014; 14: 2846–2854.

16. Ali A, White P, Dhital K, Ryan M, Tsui S, Large S. Cardiac recovery in a human non-heart beating donor after extracorporeal perfusion: Source for human heart donation? J Heart Lung Transplant 2009; 28: 290–293.

17. Bernat JL, Capron AM, Bleck TP, et al. The circulatoryrespiratory determination of death in organ donation. Crit Care Med 2010; 38: 963–970.

18. Marquis D. Are DCD donors dead? Hastings Cent Rep 2010; 40: 24–31.

19. Manara AR, Murphy PG, O'Callaghan G. Donation after circulatory death. Br J Anaesth 2012; 108(Suppl 1): i108–i121.

20. Shemie SD. Clarifying the paradigm for the ethics of donation and transplantation: was 'dead' really so clear before organ donation? Commentary. Philosophy, ethics, and humanities in medicine 2007; 2: 18.

21. Valero R, Garcı´a-Valdecasas JC, Tabet J, Taurá P, Rull R, Beltran J et al. Hepatic blood flow and oxygen extraction ratio during normothermic recirculation and total body cooling as viability predictors in nonheart-beating donor pigs. Transplantation 1998;66:170-6.

22. Garcı´a-Valdecasas JC, Fondevila C. In-vivo normother- mic recirculation: an update. Curr Opin Organ Transplant 2010;15:173-6.

23. Sánchez-Fructuoso AI, Prats D, Torrente J, Perez-Contin MJ, Fernandez C, Alvarez J et al. Renal transplantation from nonheart beating donors: a promising alternative to enlarge the donor pool. J Am Soc Nephrol 2000;11:350-8.

24. Fondevila C, Hessheimer AJ, Flores E, Ruiz A, Mestres N, Calatayud D et al. Applicability and results of Maastricht type 2 donation after cardiac death liver transplantation. Am J Transplant 2012;12:162-70.

25. Zych B, Popov AF, Amrani M, Bahrami T, Redmond KC, Krueger H et al. Lungs from donation after circulatory death donors: an alternative source to brain-dead donors? Midterm results at a single institution. Eur J Cardiothorac Surg 2012;42:542-9.

26. Yang HY, Yang HY, Lin CY, Tsai YT, Lee CY, Tsai CS. Experience of heart transplantation from hemodynamically unsTable brain-dead donors with extracorporeal support Clin Transplant 2012:26:792-6.

CHAPTER 30

Media, as an Enabler in Organ Donations

Mr. Sai Gopal

Introduction

There is no denying the fact that the traditional print and television media and the relatively new social media platforms did play a significant role in the rise of organ donations in Telangana State and in general across other Indian States.

While it needs a lot of fact-based research to actually be able to quantify and correlate the jump in the number of organ donations to reports that have appeared in various media platforms, the undeniable fact, however, remains that media does play a crucial role in popularising organ donations.

This is not just an assertion but a first-hand experience that I had been personally, as a journalist, witness to. Fortunate enough to cover the novel initiative of Jeevandan since its planning stage to implementation, I would find it very difficult to ignore the unique symbiotic relationship that organ donation shares with various media outlets.

Media is like a double edged sword

Ensuring proactive and positive media engagement is crucial to improve knowledge and awareness about organ donations. The trick is to create a positive environment that will translate into better interaction with community, an improvement in pledges and organ donations. This is easier said than done because the act of donating someone's organs depends a lot on trust. The moment families lose confidence on the organ donation programme, which usually happens when exposed to frequent biased and cynical coverage across media platforms, the interest and faith towards the cause of donating organs and saving people's lives loses steam.

In this direction, a comparative study of print media on organ donation initiatives of Post Graduate Insti-

tute of Medical Education and Research (PGIMER), Chandigarh has shed some new light. The research, published in August, 2017 by A K Gupta et al,[1] made it clear that proactive and positive media coverage was vital to improve organ donations. Between April, 2015 and March, 2016, the study tracked organ donation stories and news reports in Chandigarh.

"A comprehensive media strategy was chalked out and on its basis, a proactive and positive media engagement was ensured by consistent information sharing regarding initiatives on organ donation by PGIMER. This resulted in over 600 stories in print tracked in a year, leading to almost ten times increase in frequency and space coverage".

"The cadaver organ donations at PGIMER, between the same time when the media study was taken up, dramatically rose from 27 to nearly 40. The approach further calls for comparative studies in other States to advance this research line by examining the association between organ donations initiatives related to media coverage and organ transplantation rates," the PGIMER study said.

Hyderabad experience

The role of scores of organ donation counsellors, volunteers and doctors in spreading awareness about donating organs in Hyderabad can't be ignored. In fact, the synergy between Jeevandan, corporate hospitals in Telangana, media and State-run hospital in holding multiple and frequent awareness sessions with stakeholders is quite noteworthy and remarkable.

Launched in 2013, like any other initiatives, the beginnings of Jeevandan in Hyderabad were quite humble. The understanding about the concept of organ donation among the media outlets, leave alone the general public, was limited and it took time to take ground. In fact, before Jeevandan was launched, organ donation was unfortunately had earned a bad reputation for itself. The mere mention of organ transplantation evoked images of gullible patients being taken advantage of by the 'scheming' hospitals and health care professionals.

Media reports on exploitation of the poor for donor organs and misuse of the then organ transplant regulations were quite rampant and frequent. Cadaver donation was not that big on the agenda and there was less talk about it and more stress on living-related organ donation, which actually limits availability of organs. This had made the organ donation and transplantation an exclusive club. As a result, media outlets struggled to form a coherent enabling argument towards the noble cause of organ donation.

The perception began to change with the advent of an established organ donation programme in the form of Jeevandan and the framing of regulations. Private transplant centres were brought into the umbrella of Jeevandan, which brought a lot of goodwill.

Year 2015 was the turning point for media and organ donation

Things started to change in a big way in 2015 when the entire media in Hyderabad was awestruck by what organ transplantations can do, in terms of saving lives, irrespective of boundaries. Thanks to a few enterprising doctors and Jeevandan officials, the trend of providing 'Green Channels', transporting donor organs across the State borders using flights and running against time to save lives, became a norm.

This caught the imagination of print and television outlets due to the exciting narrative of how donor organs can save lives sans boundaries. Organ donations since then, in Hyderabad and elsewhere in the two-Telugu speaking States have continued to flourish.

Social media and organ donation

Like the traditional print media outlets, the social media platforms too have the potential to create awareness about organ donations. Unlike traditional media platforms, social media outlets like Twitter, Facebook, Instagram and even dedicated websites have the potential to reach out to a larger multitude of people.

The rippling effect of the social media platforms like Twitter and Facebook are huge and provide a great opportunity to spread the word among a large cross-section of people. That being said, one also must acknowledge the fact that the potential of Facebook and Twitter has largely remained untapped.

Social media has immense potential to spread awareness and at the same time present us with unique pitfalls, as illustrated in a recent incident in the Facebook.

In 2012, Facebook announced that its 150 million users now had the option to indicate their organ donor statuses on their Timelines and share that life event with their extended friend networks. On selecting their status as an organ donor, users were given a link to their state organ registries (if possible) to officially sign up. Researchers found that on the first day of the new initiative, approximately 13,054 users updated their organ donor profile, representing a 20 fold increase in online donor registrations from the baseline rate. Although it slowly diminished over the next 12 days, the substantial increase in registrations from baseline was termed "the Facebook effect" by Cameron et al.[2]

In sharp contrast, organ registration rates while issuing driving licenses have not been as effective as the Facebook experiment. The Facebook study clearly indicated the powerful, immediate impact of social media on donor registration rates, especially on a social platform where the effect of one update can multiply across a vast social networking tree.

Moreover, the organ donor profile in Facebook and Twitter will have worldwide demographics, which will present fresh challenges. In countries that do not have organ donation registries, Facebook profile might be the only document that specifies an individual's interest to donate organs.

However, social media is largely unregulated and organisations involved in making people aware on the importance of organ donations do struggle on such platforms.

Moreover, organ donations and transplantation, especially in the background of cadaver organ donation, must respect the individual privacy of those who are involved. Since end-of-life treatment is involved, it becomes imperative for organisations to provide privacy to individuals involved, which becomes difficult in social media.

The identity of donors and recipients can't be revealed because in social media platforms that would encourage illegal sale of organs, intimidation and even peer pressure. While the social media has become the go-to platform to reach out to the generation next, there is also a definite need to be cautious due to issues like patient confidentiality and respecting the privacy of an individual. These are the inherent

challenges that the health care community and other stakeholders involved will have to learn to live and contend with, if one has to leverage social media for a greater cause i.e. creating an enabling environment in the community to donate organs.

Reference

1. Gupta AK, Kaoshal, Vipin Madra, Saryu Dinesh, Bagla, Milan Kumar. To evaluate the role of print media in gaining traction and promoting community engagement in organ donation by ROTTO. Transplantaion. 2017:101;S103
2. Cameron AM, Massie AB, Alaxnder CE, et al. Social media and orgn donor registration: the Facebook effect. American Journal of Transplantation 2013 Aug;13(8):2059-65.

CHAPTER 31

Road Blocks to Deceased Organ Donation in India

Dr. Urmila Anandh

Introduction

It is more than 50 years since the first cardiac transplant was done and over the same period more than 140,000 deceased donor transplantations have been carried out worldwide. India is also slowly picking up its deceased donor transplant rates. In the last 5 years, 700 deceased donor transplants have been done, led by Tamil Nadu, Telangana, Maharashtra and Kerala. The numbers are still woefully small and inadequate and is the single most important road block to a thriving deceased donor programme in India. Besides, there are many other challenges in successfully running a deceased donor programme in India as this case illustrates.

Case

A 61 year old gentle man with road traffic injury is admitted in hospital and is now clinically brain dead. The hospital authorities are not aware of organ donation and the hospital is not licensed to retrieve organs. Furthermore, as the hospital was not a recognised transplant centre, there were no protocols in establishing brain death.

Challenge 1

Even though the Human Organ Transplant Act was passed by Parliament in 1994, various states have not ratified the law including the amendments. The National Organ and Tissue Transplant Organization (NOTTO) was established as was mandated by the Transplantation of Human Organ Act (THOA) amendment 2011and the rules were notified in 2014. [1] It is the coordinating agency for procurement and distribution of human organs and tissues. Despite it's establishment, many states have not accepted the recommendations and there is no clarity on the protocols of retrieval of organs in non- transplant centres.

Because of this disparity in states, deceased organ donation is majorly restricted to South and West India (Figure 1)

Figure1: Deceased Donor Transplantation in India

Challenge 2

There is lack of awareness not only in the lay public, but also amongst medical professionals about organ donation. The concept of "brain death" is still alien to many medical professionals. [2]

The patient family wanted to shift the patient for better care and hence was shifted to a higher centre which was a recognized transplant centre. Here the patient was medically assessed by the neurosurgical team and was shifted to the intensive care unit. The patient did not show any clinical improvement and the issue of organ donation was discussed. The first meeting of the new transplant coordinator was not very fruitful as there were many questions from the family.

Challenge 3

Though the Government mandates the appointment of transplant coordinators in all transplant centres there are very few states which run regular training activities for them. Often the transplant coordinator is the first point of contact for organ donation. They meet the patient's relatives without any knowledge of the counselling done in the ICU. There are very few ICUs with dedicated grief counsellors and there is little communication between the ICU counsellors and transplant coordinators.

Challenge 4

Lack of public awareness, coupled with superstitions, multiple relatives and multiple opinions often hampers consent from the relatives.

After repeated counseling, 48 hours later, family members agreed to donate his organs. The coordinator asked for the next of kin to sign the consent form. At this point of time, the family members wanted to wait for some more time as his wife has to come from their home town and give consent. Upon her arrival, she was reluctant to give consent. Further 6 hours were needed when she finally agreed to donate her husband's organs. There was a request that the body be handed over as soon as possible as they didn't want to delay the funeral according to their faith.[3]

Challenge 5

The 2011 amendment of the THOA is not clear about the definition about the near relative who can give consent. It is also not clear whether the consent once given can be negated by another relative.

The brain death was declared and the process of organ donation was initiated. The pre -retrieval investigations showed deranged electrolytes, acidosis and high serum creatinine. The liver team wanted the hypernatremia to be corrected and doubts were raised by the renal team about the viability of the elderly kidneys. A donor kidney biopsy was asked for and the sample was sent to the coordinating centre.

Challenge 6

In a major transplant centre, the area which is often neglected is the donor maintenance. Usually an average of 2 days elapse before the family which is overcome with grief can make any rational decision about organ donation, hence maintaining the donor's hemodynamics, and laboratory parameters is an important prerequisite.[4]

Challenge 7

There is reluctance to accept expanded criteria donors and donors with high terminal creatinine. Often organs get discarded because of suspicions of non -viability. The discard rates of the Jeevandan programme is given in Figure 2.

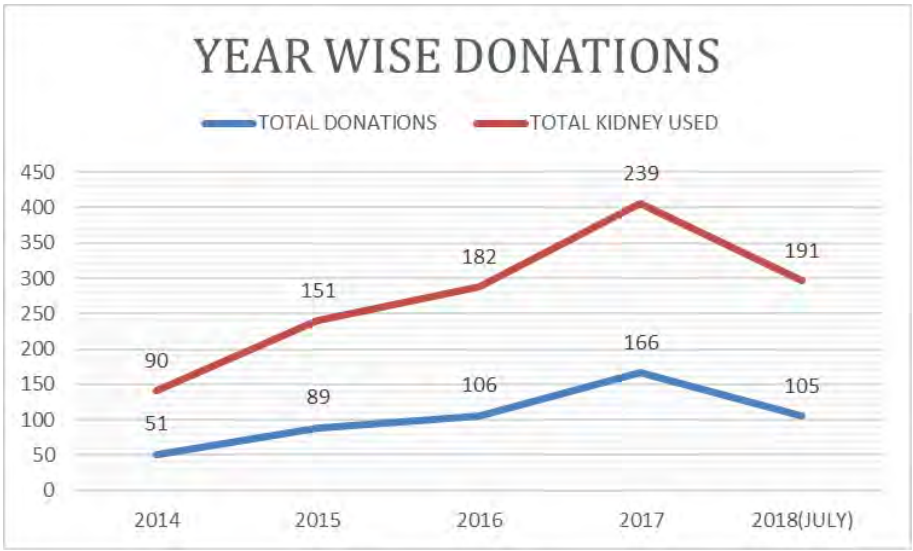


Figure 2: Discard rates in the Jeevandaan programme in the state of Telangana-inadequate donor maintenance and reluctance to accept Expanded Criteria Donors.

Challenge 8

Often specialised tests are required for detecting viability of the organ and many transplant programmes are unable to provide out of office hours services for these tests.

After appropriate donor maintenance measures the hospital authorities informed the authorised local police station about the organ donation. Also the forensic team of the nearest medical college was informed about the post mortem formalities. There were certain issues about the jurisdiction of the police station and as it was in the middle of the night considerable time was taken up for these activities. The forensic examiner was requested to attend the retrieval process and a transport was arranged for him.

Challenge 9

Considerable legwork and coordination is required by the hospital authorities and governmental organisations for organ donation. Careful training and sensitisation regarding the process to the non- medical authorities is required to streamline the legal issues of the transplant procedure.

Meanwhile the transplant coordinators started getting in touch with priority waitlisted recipients. The first in the list was not reachable and the second recipient has not followed up with his nephrologist and had not informed that he is admitted in a local hospital with a chest infection. It was after considerable delay that the third and fourth (stand by) recipient were called for the transplantation. The liver had to be airlifted to another city as there were no suiTable recipients locally at that time.

Challenge 10

Recipients in the waitlist are from remote areas and often don't follow up with the treating nephrologist. Often at the time of transplantation they are unfit. Regular communication and clinical monitoring of the waitlisted recipients is often inadequate.

Challenge 11

Interstate organ transplantation is still in its infancy in India. There are many stakeholders involved in this process with many coordination and logistics challenges (Figure -3).

Figure 3: Stakeholders in the interstate transfer of organs (The Green Corridor)-coordination between various stakeholders a big challenge.

Conclusions

Conducting a successful retrieval and a deceased donor transplantation is often a race against time with multiple hurdles and road blocks. The challenges can be overcome with efficient coordination between hospital doctors, surgeons, intensivists, retrieval team, transplant coordinators, governmental agencies and above all with the support of families of the donor and the recipient (Table 1). Throughout the process, high degree of ethics, awareness of legal issues related to transplantation and utmost sensitivity towards the feeling of the donor family is the need of the hour. Finally, even after we overcome existing challenges, an optimal quality control mechanism should be set up to audit the programme continuously and maintain high standards of transparency and work ethics.

Challenges	Possible Solutions
Very few deceased donor transplantation in India	Public awareness campaigns Voluntary organisational support Brain death declaration mandatory in all ICUs and a regular government supervised audit of all hospitals . Consideration for 'opt-out policies", required request law and donation after cardiac death . Streamlining unclaimed body donation.
Variability of various state deceased donor transplantation programme	Strict adherence of the transplant amendment act. Expeditious ratification of the act by various state. Development and support from the organ transplant organisation (NOTTO, ROTTO and SOTTO)
Lack of Awareness	Various programmes to remove myths about transplantation To remove mistrust towards hospitals. Interfaith seminars, support from religious leaders CMEs for doctors
Lack of transplant coordinators	Mandatory qualified transplant coordinators in all transplant centres who are exclusively appointed for deceased donation. Regular training programmes
Consent	Clarity in the law of the consent process. The amendment should offer clear cut guidelines about the definition of "near relative" who should be authorised to give consent. It should also clarify the circumstances in which the consent can be withdrawn.
Donor maintenance	Hand books and protocol books to be developed by the local authorities detailing the medical issues of donor maintenance. Regular CMEs to be conducted with anaesthesiologists and intensivists.
Expanded criteria donation	Recent literature and practice patterns of expanded criteria donation to be circulated to all nephrologists. Incentives to centres accepting expanded criteria donors.
Specialised laboratory services	A centralised laboratory service for immunology and pathology services which should be operational round the clock should be set up in all cities/towns with deceased donor programmes.
Coordination between governmental agencies	Multi departmental team to give a single Table clearance. Waiver of NOC. Postmortem facilities in private hospitals. Sensitisation of police on organ donation.
Recipient follow up	A centralised data collection centre of the last follow up clinical details should be available at the time organ allocation.
Quality control of the programme	Alltransplant data including outcome to be maintained in a deceased donor registry of all multiorgan deceased donor programme.

Table 1: Challenges and possible solutions to Deceased Donor Transplantation in India

References

1. Transplantation of Human Organs and Tissues Rules,2014.The Gazette of India:Extraordinary Part II Section 3 Subsection (i). March 27 2014.
2. Singh P, Kumar A, Sharma RK. Factors influencing refusal by relatives of brain-dead patients to give consent for organ donation:Experience at a transplant centre.J Indian Med Assoc 2004;102:632-43.
3. Randhawa G.Death and organ donation:Meeting the needs of multiethnic and multifaith populations.br J Anaesth 2012;108 Suppl 1:i88-91.
4. Kumar L.Brain death and care of the organ donor.JAnaesthesiol Clin Pharmacol 2016;32:146-52.

CHAPTER 32

Psychosocial Issues in Organ Donation

Dr. Srilakshmi Pingali

Introduction

Organ transplantation provides a ray of hope for prolonging life and living a better quality of life. However the entire process is fraught with stress for both the recipient and the caregiver. For a person already battling with end stage organ disease, the numerous procedures one has to undergo while awaiting surgery, the long waiting period for a suitable donor, the surgical procedure itself, the life time adherence to medication and life style changes post-surgery pose serious challenges.[1] It requires the patient to mobilize all bio-psychosocial resources during the process of adaptation to the new foreign organ.[2]

Psychosocial issues play a major role in recovery and rehabilitation post transplantation. It is seen that pre-operative psychosocial variables predict post-transplant psychiatric adjustment. The Quality of life is seen to improve post transplantation in parameters like social and physical but not so much in psychological health.[3]. A psychiatrist's role in a multidisciplinary team of transplant coordinators therefore cannot be overemphasized. Assesing the capacity to give consent for surgery, enhancing the coping skills, treating any co morbid psychiatric illnesses, keeping a note of drug interactions and motivating them to lead a healthy lifestyle post-surgery are some of the functions of the psychiatrist.

Stages of psychosocial adjustment

A patient undergoing organ transplantation goes through various stages of psychosocial adjustment, each with its own set of challenges. For the sake of better understanding the stages can be classified as the pre-operative stage, the perioperative stage and the post-transplant stage.

The preoperative stage starts from the time the option of organ transplant is considered, to the time of the actual surgery. The patient has to deal with numerous procedures to determine suitability for transplantation. Added to it is the indeterminate and uncertain waiting period for the availability of a donor and

intercurrent medical illnesses. Around 10-18% would die during this period. Uncertainty of availability of organ, deteriorating medical condition, progressive debility, loss of family, social and occupational roles all cause distress during this period.

Enhancing coping skills and social support and counselling is helpful at this stage. Fears and ambivalence about surgery are addressed now. Individual or group psychotherapy sessions depending on the availability and skill of the therapist are administered. Deaddiction counselling is offered to those suffering from substance abuse. Periodic reassessment of candidates who have spent long time waiting for transplant is necessary.

The perioperative period has the issues of stress due to surgery, the stressful days in intensive care unit and the various drug interactions and side effects.

The post-operative period has its own psychosocial issues. The complex medical regime, multiple doctor visits, procedures and restriction in lifestyle like dietary modifications, driving, lifting weights and excessive dependence on care givers all add to the stress. Though some post-transplant patients readjust to life, there are some who are so psychologically adjusted to their sick role that they have difficulty adjusting to a new healthier state. They may feel pressured by the doctors to recover faster, feel apprehensive that the attention of the doctor is waning off when their physical health improves and may develop unexplained somatic complaints or become non adherent to treatment. There are others who may have had to undergo surgery on an emergency basis and therefore did not have adequate time to adjust. They may often be in denial about their illness or attempt to recover faster than normal pushing themselves too fast.[3]

Treatment adherence in the post-operative period generally includes regular intake of medications, monitoring vitals, undergoing diagnostic tests, following dietary and exercise protocols, abstinence from substance abuse, and regular follow up. It is very essential to identify candidates with ambivalence about treatment and prior history of non-adherence, substance abuse, poor social support, and poor organizational skills as they are more prone for treatment non-adherence.

Clinical evaluation prior to transplantation

The main goal of psychosocial evaluation prior to surgery is to establish rapport with the patients, evaluate their coping skills and treat any comorbid psychiatric illnesses. The psychiatrist also evaluates the patient's ability to give informed consent, his social support and ability to adhere to treatment and life style modifications post-surgery. The psychiatrist therefore plays a unique dual role in serving both the needs of the transplant team as well as the transplant patient, donor and the carers[3].

While it may not be feasible to evaluate all patients in detail for psychiatric disorders, all of them should be put through screening tests and a detailed assessment reserved for those scoring high on these tests. Transplant specific assessment like coping with illness, adherence, and illness behavior is done in addition to the comprehensive psychiatric assessment. Scales such as the transplant evaluation rating scale (TERS) are often used. This scale classifies the level of adjustment in psychosocial functioning among transplantation candidates and covers different dimensions of psychosocial functions (pre-existing psychiatric morbidity, substance abuse, compliance, coping strategies, cognitive performance). The total sum reflects the current level of psychosocial functioning of the particular transplantation candidate. The higher the score, the worse the current level of psychosocial functioning.[4]

Social support is evaluated by the presence of and the willingness, knowledge and ability of family members in caring for the patients.

Informed consent is taken after the psychosocial evaluation which helps to evaluate how well the patient understands his treatment, prognosis, transplant process itself and various available treatment options.

Adherence to treatment post-transplant is evaluated by pre transplant adherence to medication regimes and adherence to life style modifications like diet, exercise and abstinence from substance abuse which are fairly good indicators of adherence post transplantation. Adequate psychoeducation about the need for adherence and periodic evaluation helps to maintain the same. Substance use is an important area to be addressed as recurrence of substance use post-transplant enhances the chances of graft rejection.

Psychosocial issues of care givers

Care givers play a significant role both in the pre and post-operative period. Transplant recipients may depend upon caregivers for practical, emotional and financial issues. This in turn may increase the caregiver burden, especially those with negative coping styles like giving up or avoiding. The accompanying physical and emotional exhaustion leads to burn out manifesting as depression, interpersonal conflicts, and somatic symptoms.[5] Evaluation and management of caregiver stress is therefore essential for a successful post-transplant outcome. Positive coping strategies like problem solving and seeking social support can be taught to the caregiver. Recommending a secondary caregiver who would provide a much required respite care for the primary caregiver and actively treating any psychiatric disorders in the primary care giver are other methods.

Psychosocial issues in organ donors

A detailed psychological evaluation of donors should be carried out in order to understand their preparedness for surgery and the consequences of the same. Apart from psychosocial suitability, voluntariness of the donation, available support, preparation and concerns for donation should also be addressed.[6] Evaluation of long-term emotional consequences have shown that most donors are satisfied about the donation. Post donation periodic assessment of the psychological status of the donor is desirable. Majority show emotional wellbeing and satisfaction of helped another human being. A minority however report financial, psychological and physical health problems even after many years of follow up.[7] it is this subgroup which would benefit from continued psychological support.

Conclusion

The role of psychosocial issues in organ donation is very significant.To expedite the process of recovery and rehabilitation, these should be adequately addressed. A psychiatrist as part of the treatment team, therefore should be made mandatory.

References

1. Sadock, B. J., Sadock, V. A., & Ruiz, P. (2017). Kaplan & Sadock's comprehensive textbook of psychiatry: Behavioral sciences/clinical psychiatry (tenth edition.). Philadelphia: Wolters Kluwer
2. Concetta De Pasquale, Massimiliano Veroux, Luisa Indelicato et al. Psychopathological aspects of kidney transplantation:Efficacy of a multidisciplinary team. World J Transplant 2014 December 24; 4(4): 267-275
3. B.N. Anil Kumar and Surendra Kumar Mattoo. Organ transplant & the psychiatrist: An overview. Indian J Med Res. 2015 Apr; 141(4): 408–416
4. Twillman RK, Manetto C, Wellisch DK, Wolcott DL. The transplant evaluation rating scale. A revision of the psychosocial levels system for evaluating organ transplant candidates. Psychosomatics 1993,34(2):144–153.
5. Amy M. Goetzingera, James A. Blumenthala, C. Virginia O'Hayera et al. Stress and coping in caregivers of patients awaiting solid organ transplantation. Clin Transplant. 2012 ; 26(1): 97–104.
6. Krista L. Lentine,, Bertram L. Kasiske, Andrew S. Levey et al. KDIGO Clinical Practice Guideline on the Evaluation and Care of Living Kidney Donors. Transplantation 2017;101(8S): S1–S109.
7. Mary Amanda Dew, Andrea F. DiMartini,, Daniela P. Ladner. Psychosocial Outcomes 3 to 10 Years After Donation in the Adult to Adult Living Donor Liver Transplantation Cohort Study (A2ALL). Transplantation. 2016 Jun; 100(6): 1257–1269.

CHAPTER 33

Future of Transplant Coordinator in India

Dr. Noble Gracious

Introduction

The success of the transplantation programme is the good coordination and communication among the stakeholders, a duty that is basically done by the coordinators. Worldwide transplant coordinators come from different background. India has the most diversity in basic training - nurses, allied health science professionals, social workers are trained to become transplant coordinator, whereas the UK, US and Canada the registered nurses with training are certified as transplant coordinators, where as in Spain the transplant coordinators are medical doctors. Historically, transplant coordinators have been involved in the entire transplant continuum, from donor identification, organ retrieval to long term psychosocial support of the recipient. Over the years, as technology became more complex and transplant volume increased, the transplant coordinator's responsibilities expanded.

Clinical Transplant Coordinators (CTC) in the US have been functioning at an advanced practice level, and their role is defined with specialized expertise achieved over time. CTCs are key members in a multidisciplinary team providing support to patients and their families regarding decisions related to transplantation; facilitating communication and coordination within the transplantation team throughout the course of treatment.

Transplant coordinator as per Transplantation of Human Organs and Act (THOA)

The Government of India in the Amendment of the THOA has stated the definition and qualification for a transplant coordinator.

The Act defines a "transplant coordinator" as a person appointed by the hospital for coordinating all

matters relating to removal or transplantation of human organs or tissues or both and for assisting the authority for removal of human organs.

According to the Transplantation of Human Organs and Tissues Rules, 2014, the transplant coordinator shall be an employee of the registered hospital having qualification such as:

a. Graduate of any recognized system of medicine or

b. Nurse or

c. Bachelor's degree in any subject and preferably Master's degree in social work or Psychiatry or Sociology or Social Science or Public Health.

Role of transplant coordinator in deceased organ donation

1. Donor Identification

   It is the responsibility of the Intensive Care Unit (ICU) staff to identify potential organ or tissue donor(s) and inform the coordinator about the potential donor(s). The transplant donor coordinator along with the treating team counsels the relatives.

2. Declaration and Certification

   Transplant coordinator assists the hospital management in organizing the brain death certification process by the expert, as stipulated in the THOA and rules

3. Approaching Family

   The transplant coordinator of the hospital having ICU facility, in consultation with concerned registered medical practitioner, after certification of brain death of a patient, shall approach his/her adult near relative or, if no near relative is available, then, any other person related by blood or marriage, and in case of unclaimed body, from the person in lawful possession of the body as per rule 5 of THOTA 2014 for organ donation.

4. Obtaining Informed Consent

   It is the transplant coordinator that has the knowledge and expertise in all aspects of the organ and tissue donation process, therefore is the appropriate member of the team to participate in obtaining consent.

5. Donor Assessment/Management

   The transplant coordinator is responsible for ensuring the completion of the donor assessment, including:

   a. Arranging for blood samples to be sent to the laboratories

   b. Coordinating diagnostic tests as required

   c. Acting as a resource for the donor maintenance protocol

   d. Communicate with prospective transplant teams

e. Notifying the operating room

f. Obtaining privileges for outside teams.

The coordinator also provides appropriate documentation for retrieval teams.

6. Donor Registration and Organ Allocation

   Potential recipients can be register for organ transplant in network for organ sharing online registry.

7. Organ Retrieval

   The donor coordinator is a part of the retrieval team. The responsibilities will include: reviewing donor chart with nursing and medical staff prior to retrieval commencement; supporting the incoming and local teams; ensuring adherence to retrieval protocols; documentation and travel arrangements for organs, tissues and teams.

Role of transplant coordinator in live donation

1. Arranges for patient evaluation and pre-transplant work-up of live organ donors and recipients.
2. Informs potential donor, schedules workups, evaluates donor history and performs routine physical test.
3. Provides counselling for potential donor and recipients.
4. Acts as a liaison between patients, families, primary care givers, hospital departments, referring physician and other members of the health care team, including other healthcare facilities.
5. Prepares donor and recipient for transplant surgery
6. Provides patient and family education through all phases of transplant, discharge planning for the transplant patient, as well as education for the inpatient hospital staff.

Evolving concepts of rransplant coordinator

Diseases due to lifestyle modification have increased among Indians and has become one of the top five causes of death. End stage organ failure is one such complication resulting from lifestyle modification. Unfortunately India has one of the highest number of the road traffic accidents in the world. This does not lead to a natural increase in organ donors. Scope of a transplant coordinator profession is high but a structured training programme is lacking in our country. In Spain, a university certified course on transplant procurement management is followed. A similar system of formalized training can be generated to suit our social fabric.

The Spanish training promotes knowledge transfer and development of professional competences in organ donation as key factors to maximize donor potential and conversion rates. They use the "Learning by doing" methodology. It also offers a wide range of online, face-to-face and blended courses, providing

one with the opportunity to learn how to identify a potential donor and how to manage all the donation and transplantation process following standards of high quality and ethics. With the need for transplant coordinators increasing, a more formal system of training, examination and certification should be put in place, either by a State or central university.

To end the chapter I would like to quote statement from Dr. J. Amalorpavanathan who is pioneer in deceased organ transplantation programme in our country to the Transplant Coordinator. "Keep a log of every single activity during a transplant, including call logs and oral messages. Never trust oral messages of your bosses. They may not come to your rescue when you are crucified in public. Insist on written orders. Don't deviate from protocols. I know it is stupid to say, but I am saying it: don't show any extraordinary enthusiasm or initiative. After every transplant write a detailed note and file it. Documents, documents and documents. They are your only saviors".

Figure 1: Awareness session at Govt. Law College, Trivandrum

Figure 2: Transplant coordinators receiving award for best paper presentation

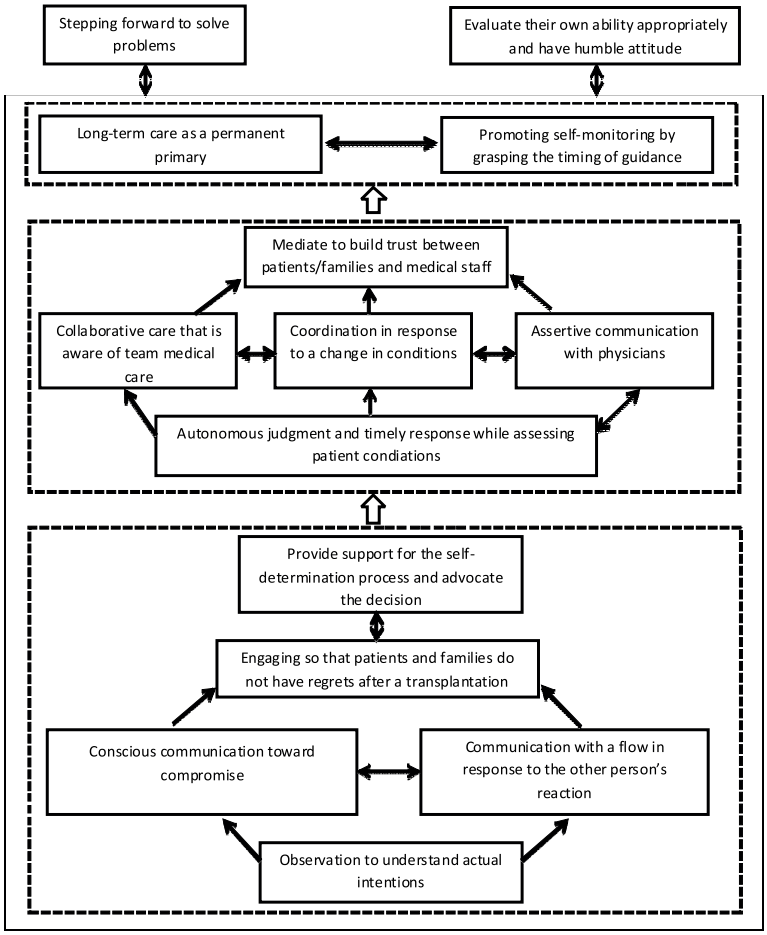


Figure.3: Expertise practice of clinical transplant coordinator

Reference

1. Kuniko Hagiwara, Natsuko Seto, Yasuko Shimizu. Expertise practice of clinical transplant coordinators in Japan. Journal of Nursing Education and Practice. January19,2018;8 (6):99 -102.

CHAPTER 34

Future Research in Organ Transplantation: Coordinators Perspective

Dr. Pavan Kumar Rao N | Dr. Subhramanyam SV | Dr. Nayak K S

Introduction

Solid organ transplant is one of the miracles of modern medicine, it saves lives and improves the quality of patient's lives. However, the waiting list of patients aiming for transplants are growing exponentially due to insufficient organ supply.

With the Chronic kidney disease (CKD) prevalence as high as 17% in some studies[1],the pool of patients progressing to end stage renal disease (ESRD) and those waiting for transplants are also high. Many ESRD patients have no access to proper dialysis with transplant being a distant dream. Even for patient registered for deceased donor transplantation, the waiting period is long, as organ donations are meagre despite aggressive organ donation campaigns. We have more than 5000 patients registered for cadaver transplant in the state of Telangana alone, to give an estimate of the problem in the country.

Research is underway in the field of transplant to develop artificial organs which can replace live and deceased donor organs, which can shorten the waiting for the expected recipients.

Areas of research in organ transplantation are as follows

1. Successful minimization / discontinuation of immunosuppressive medication therapy through utilization of pharmacogenetics.
2. Use of stem cells for organ regeneration
3. Xeno transplantation
4. New Bio medical devices
5. Newer organ perfusion and transport techniques.

Pharmacogenetics

Genetic background provides an insight into the inter individual variability of drug response. Use of pharmacogenetics is to avoid adverse drug reaction. As one is aware of the fact that calcineurin inhibitors like tacrolimus have narrow therapeutic window, that is higher or lower dose can cause nephrotoxicity or rejection respectively, hence drug levels should be maintained at within a very narrow level, which is to be monitored regularly. It has been observed that changes in CYP3A5[2] gene expression can affect the drug levels. The role of pharmacogenetics is also observed for Mycophenolate and Sirolimus, and also on the development of New Onset Diabetes After Transplantations (NODAT). All these factors predict the long term outcome of grafts, so efforts are on to identify genetic factors which effect the short and long term graft survival through genetic studies.

Stem cell transplants

Stem cells are biological cells that can differentiate into other types of cells and can divide to produce more of the same types of stem cells. They are formed in multicellular organisms and are of two types; embryonic and adult stem cells.[3]

Cell source for stem cells consist of progenitor cells of later stages of development for early function of these organs. Graft matrix consist of collagen, adhesion molecules, proteoglycans and glycosaminoglycans chain skeletons on which cell proliferation is allowed. Injectable grafts are currently under research which can fill any difficult shape or space and replace the organ function.

Xenotransplantation[4]

Xenotranspalntaion is the process of grafting or transplantation of organs or tissues between members of different species, in other words where animals like pigs or monkeys are source of organ for humans. It has been found that pigs are most suitable to replace human organs than our primates. Because they breed easily, similar to human organs and large quantum of available organs at any time. The function of pig's kidneys, heart and pancreatic islet are also similar to humans.

New Bio medical devices -Bio engineering

Organs can be bio engineered by Decellularisation, Recellularisation technology (DRT)[5,6]. In Decellularization scaffold or frame is developed to allow cells to form and function. The immunogenicity of scaffold is eliminated by removing antigens. Decellularization is done using physical, ionic chemical and enzymatic methods. In Recellularization, the process of obtaining renewable cell source and seeding the source on to the scaffold and growing them to the specific cell types is done. (Figure 1)

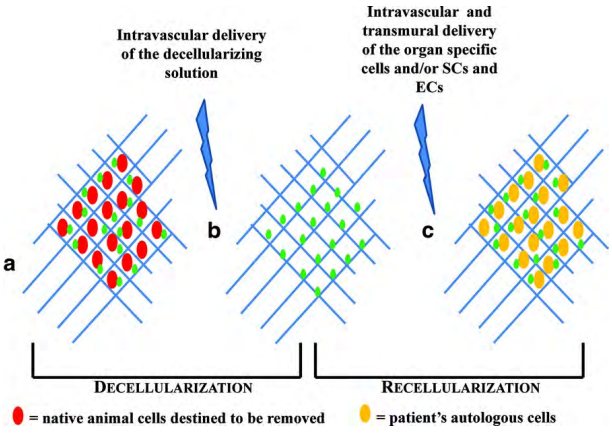


Figure1: Decellularization and Recellularization technology (DRT)

3D Bioprinting

3D Bioprinting[7] is an actively studied method in tissue engineering which involves scaffold fabrication and cell distribution. Modern 3D bioprinting techniques have a resolution of 10–10000 μm which is a wide range showing flexibility of bioprinting compared to other assembly methods such as molding and porous scaffolds.

3D bioprinting is based on deposition of biomaterials, either encapsulating cells or loaded with cells later on, in micrometer scale to form subtle structures comparable to tissue. In most cases, a three-axis mechanical platform controls the movements of extruders printing the bioink in the required algorithm and shape. This platform's movement is governed by coordinates created by the designer and saved in a file format such as g-code that could be easily followed by the printer. Newer bioinks provides required properties for successful printing, such as printability, printing fidelity, and mechanical properties. Extrusion-based, inkjet, stereolithography-based, and laser-assisted bioprinting methods are the different types of bioprinting methods used. (Figure 2)

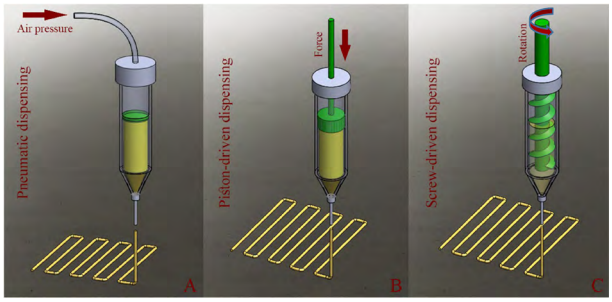


Figure 2: Different types of 3D bioprinting

Implantable bioartificial organs

Among implantable organs[8] kidneys are well researched and a breakthrough is expected in the near future. Here, the implantable bioartificial kidney builds upon the existing extracorporeal Renal Assist Device (RAD), which is a bioartificial kidney that combines a membrane hemofilter and a bioreactor of human renal tubule cells to mimic many of the metabolic, endocrine, and immunological functions of a healthy kidney. RAD applies microelectromechanical systems (MEMS) and nanotechnology to miniaturize the extracorporeal RAD into a surgically implantable, self-monitoring, and self-regulating bioartificial kidney.

The bioartificial kidney has to contain high efficiency ultrafiltration membranes, be able to autoregulate blood flow, and stabilize necessary cells within an engineered environment.

Three key technology developments are being used to implement these functions

1. High-efficiency ultrafiltration membranes
2. Control of blood-membrane interactions such as thrombosis and fouling
3. Stabilize differentiated function of renal cells in an engineered construct

Advanced silicon nanotechnology is being used to produce large reliable, high-porosity, robust, and compact membranes. Molecular coatings that impart blood compatibility and techniques to coat silicon membranes without blocking pores are used.

Haemofilter and biocell reactors are two important components of artificial kidney. Haemofilter uses silicon nanotechnology to produce a highly efficient and compact membranes, which relies on the body's blood pressure to perform filtration without needing pumps or a power supply. The haemofilter must be capable of generating meaningful ultrafiltration volumes at driving pressures similar to capillary perfusion pressure, while remaining free of fouling for months. This core concept is kept in mind while keeping, protein losses to a minimum.

For the cell bioreactor, application of recent advances in the field of tissue engineering to grow and maintain renal tubule cells is used. The bioreactor capable of high-volume salt and water reabsorption from the ultrafiltrate while maintaining a barrier to reabsorption of toxins is being used. In addition, care is taken that it imparts biological activity such as autoregulation of blood pressure and production of vitamin D. Similarly, other organs like heart and liver are being studied. (Figure 3, 4.)

Figure 3: Artificial kidney smaller than a coffee cup.

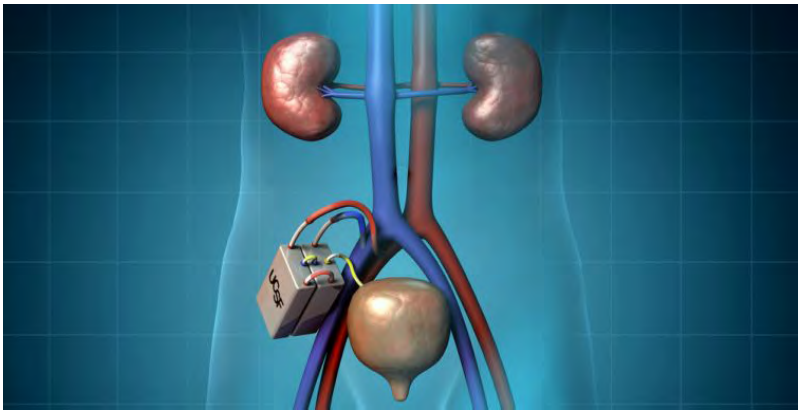


Figure 4: Artificial kidney after implantation.

Innovative organ perfusion and transport and storage devices

Newer storage devices

It has been shown that the theoretical perfect temperature for organ preservation is 4°C - 8°C. While higher temperatures lead to hypoxic injury of the organ because the metabolism is not decreased efficiently, lower temperatures than 4°C increase the risk of cold injury with protein denaturation. Heart preservation for transplantation is limited to 4 to 6 hours of cold ischemic storage, and longer periods of ischemia are known to adversely affect survival. This is in contrast to preservation of the liver, kidney, and pancreas, which have been successfully preserved for 24 to 36 hours although graft function may be transiently compromised.

The formulation of the preservation solution is based on three principles: (a) hypothermic arrest of metabolism; (b) provision of a physical and biochemical environment that maintains viability of the structural components of the tissue during hypothermic metabolic arrest; and (c) minimization of the effects of reperfusion injury.

Keeping this in mind, newer packaging material called Sherpa Pak's [9]cooling mechanism is being research which is based on phase-change material (PCM), that is a substance with a high heat of fusion, capable of storing and releasing large amounts of energy. The Sherpa Pak's PCM panels are designed to hold 5°C longer than conventional phase change material cold packs (which undergo phase change at 0°C, and have little heat capacity at 5°C). In addition, the PCM can be placed in direct contact with temperature sensitive products because there is no risk of freezing. (Figure 5).

The entire System is single-use and does not require power during operation. Management of preservation in the Sherpa Pak™ System is the same for both kidneys and hearts other than that the heart is connected to a connector in the inner hard shell assembly and the kidney is not.

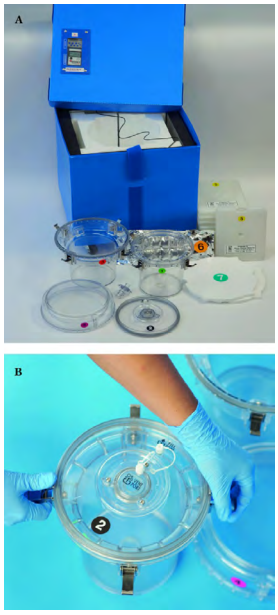


Figure 5: Sherpa Pak's cooling mechanism

Graft perfusion techniques

Normothermic machine perfusion

Graft reperfusion is a critical point during liver transplantation, because it is correlated with the greatest intraoperative hemodynamic and metabolic stresses. During reperfusion, the occurrence of severe hemodynamic instability is commonly referred to as "postreperfusion syndrome" and represents an important risk factor for graft injury, recipient mortality and morbidity/ It has been found that normothermic machine perfusion is associated with a stable intraoperative hemodynamic postreperfusion profile, requiring significantly less vasopressor infusions and blood product after graft reperfusion.[10,11.]

Subnormothermic machine perfusion

Newer models of organ perfusion have been devised where the viability of the organ can be tested and its post transplant performance can be evaluated. A novel model for ex situ reperfusion of the human liver following subnormothermic machine perfusion has been studied recently. The livers were first tested in an experimental organ preservation technique called subnormothermic machine perfusion (SNMP). This technique connects the liver to a device that perfuses the organ with a nutrient-rich and oxygenated solution that aims to sustain the liver at a temperature of 21 degrees celsius. After 3 hours of SNMP, the organ was connected to a new device that was used to simulate warm reperfusion of the liver as it would occur during transplantation. The liver was perfused with blood at body temperature for several hours, while the investigators took measurements relating to the function of the organ as well as the injury that it sustained.[12]

Conclusion

The knowledge of the latest research in organ transplant is important for transplant coordinators as it helps them to understand how we can biodesign organs and newer developments in organ perfusions and transport can be implemented for better graft survival. With this information the counseling of donors and recipients becomes easier as they can educate the patients of the future innovations and give courage, hope and not to get disappointed with long wait lists in organ donation programmes.

References

1. Rajapurkar MM, John GT, Kirpalani AL, Abraham G, Agarwal SK, Almeida AF, et al. What do we know about chronic kidney disease in India: First report of the Indian CKD registry. BMC Nephrol. 2012;13:10.
2. Gilbert.J.Burckrat, Richard .M.Watanabe, Pharmacogenomics and Organ Transplantation, Chapter 10.
3. Rachael Turner, David Gerber and Lola Reid, The Future of Cell Transplant Therapies: A Need for Tissue Grafting, Transplantation 2010;90: 807–810.
4. Burcin Ekser, David K.C. Cooper and A. Joseph Tector, The Need For Xenotransplantation As A Source Of Organs And Cells For Clinical Transplantation, Int J Surg. 2015 November ; 23(0 0): 199–204
5. Giuseppe Orlando, Kathryn J.Woo, RobertJ.Stratta ,JamesJ.Yoo, Anthony Atala,and Shay Soker, Regenerative Medicine and Organ Transplantation: Past, Present, and Future, Transplantation 2011;91: 1310–1317.
6. Ted Welma, Sebastian Michel, Nicholas Segaren, and Kumaran Shanmugarajah, Bioengineering for Organ Transplantation: Progress and Challenges, Bioengineered .2015; 6:5, 257—261.
7. Karthik Tappa and Udayabhanu Jammalamadaka, Novel Biomaterials Used in Medical 3D Printing Techniques, J Funct Biomater. 2018 Mar; 9(1): 17.
8. The Kidney Project ,UCSF, https://pharm.ucsf.edu/kidney
9. Gesine Pless, Artificial and Bioartificial Liver Support, Organogenesis. 2007 Jan-Mar; 3(1):20–24.
10. S.G Michel, G.M LaMuraglia II, M.L.L Madariaga, and Lisa M Anderson,Innovative cold storage of donor organs using the Paragonix Sherpa Pak ™ devices, Heart Lung Vessel. 2015; 7(3): 246–255.
11. Roberta Angelico,M. Thamara P. R Perera, Reena Ravikumar,David Holroyd,Constantin Coussios, Hynek Mergental,John R. Isaac, Asim Iqbal,Hentie Cilliers,Paolo Muiesan, Peter J. Friend, and Darius F. Mirza,Normothermic Machine Perfusion of Deceased Donor Liver Grafts Is Associated With Improved Postreperfusion Hemodynamics, Transplant Direct. 2016 Sep; 2(9): e97.
12. James H. Avruch, Bote G. Bruinsma, Pepijn D. Weeder, Gautham V. Sridharan, Robert J. Porte, Heidi Yeh, James F. Markmann, Korkut Uygun. A novel model for ex situ reperfusion of the human liver following subnormothermic machine perfusion. Technology, 2017; 1 DOI: 10.1142/S2339547817500108

Chapter 35 Coordinators' Review

CHAPTER 35.1

A Brain Dead Pregnant Woman

Mr. Girish Shetty

Introduction

An accident or a catastrophic disease may occasionally lead to brain death (BD) during pregnancy. Management of brain-dead pregnant patients needs to follow special strategies to support the mother in a way that she can deliver a viable and healthy child and, whenever possible, also be an organ donor.

The management of a brain-dead pregnant woman requires a multidisciplinary team which should follow available standards, guidelines and recommendations both for a non traumatic therapy of the fetus and for an organ-preserving treatment of the potential donor.

Therefore, two aspects must be considered in case of maternal BD:

1. Supporting the fetus until successful delivery and, if possible.
2. Supporting the brain-dead mother as an organ donor.

In such a situation, various clinical disciplines such as neurosurgery, intensive care medicine, obstetrics, neonatology, anesthesiology, transplantation surgery and an ethics committee should work together to minimize maternal and fetal morbidity as well as mortality.[1]

At present, there are no guidelines describing the management of extended maternal somatic support; as a result, it is difficult to form conclusions about the best care for the somatic support of pregnant patients who are BD and their fetuses. Some literature considers the appropriateness of continuing maternal somatic support in order to prolong gestation until the fetus can be delivered. A national registry could assist in making evidence based guidelines for the management of extended maternal somatic support.

This paper first considers the medical, ethical, cost, and legal issues surrounding such cases by considering a case report of brain death during a pregnant patient's first trimester.[2]

Case scenario

A 28-year-old female came to emergency room with road traffic accident and severe head injury. On examination pupils were dilate and not reacting, Glasgow coma scale (GCS) was 3/15, pulse was low volume: 45b/min, BP was not recordable, temp was 960 F. Immediately patient was intubated & resuscitated. CT Brain was advised, which showed Sub Arachnoid Hemorrhage (SAH) with midline shift. Patient was shifted to Neuro ICU for further management. As advised by neurologist after 72 hrs electroencephalogram (EEG) was done, which showed Iso-electric activity. Brain stem reflexes were examined which were absent and apnea test was positive, hence she was declared brain dead. Neuro critical care informed the same to family members.

Family meeting was done multiple times but family were not willing for organ donation and want to continue the treatment. After repeated consoling sessions, finally family decided to go for organ donation.

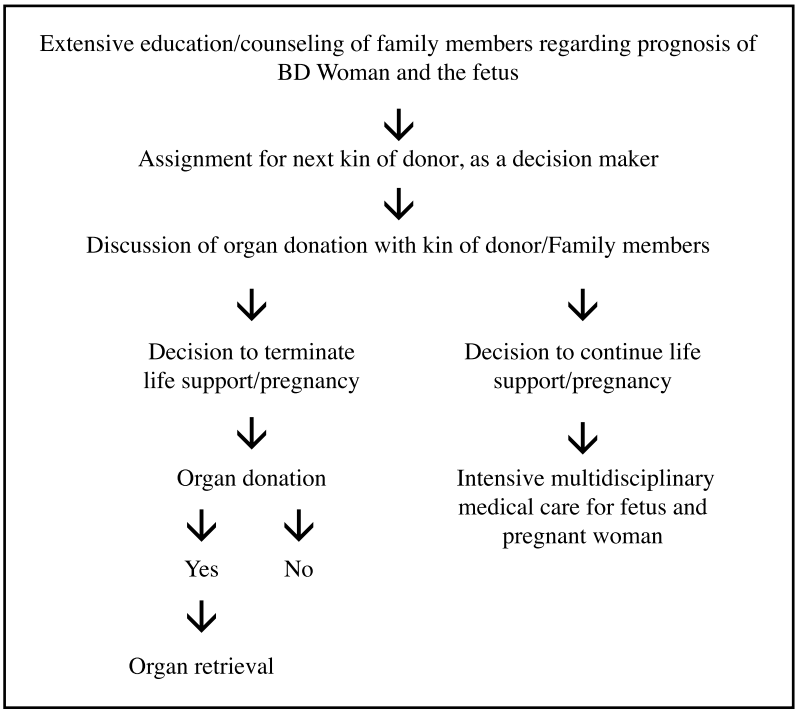
Donor Work up was done. Blood investigation, 2D Echo and Ultrasound were done. Ultrasound showed fetus corresponding to 12 weeks of gestational age. Gynecology opinion was taken, fetal doppler showed absent cardiac activity and nonviable fetus.

Family meetings were done regarding non-viability of the fetus and consent for organ donation was taken. Surgery was started by retrieval team along with Gynecologist and Forensic Doctors after obtaining legal clearance from the police. Fetal death was confirmed by Gynecologist and Forensic Doctors in the operation theater. The same was informed to family member and consent for organ donation was reconfirmed.

Legal issues

Legal issues can arise in the case of a pregnant woman who is brain dead. The legal rights of the fetus depend on the gestational age. These rights vary by country and are closely linked to the laws concerning abortion

1. Concerned Police Station has to be informed about the present status to get legal clearance. Panchanama has to be done by MRO (Mandal Revenue Officer) as per the State Government law (Telangana)
2. Forensic Medicine department has to be updated the present status



Discussion

The term "somatic support" is sometimes used to refer the non neurologic care provided after brain death. In a pregnant patient, particularly in late stage of pregnancy, the goal of such support is to extend the pregnancy to improve the fetal outcome. Although there is now fairly extensive experience with short term somatic support after brain death in case of heart beating deceased organ donors, support of brain death pregnant women is more complicated, because of the longer duration of support usually being attempted.

In a systematic review of 30 cases between 1982 and 2010, the mean maternal age at time of BD was 26.5 years.[1] The mean gestational ages at the time of BD and gestational age at delivery were 22 and 29.5 weeks respectively. Twelve live babies were born and survived the neonatal period.

A multidisciplinary approach should be used from the beginning. Ethical consultation with the patient's parents and in-laws would lay the groundwork for future decisions regarding the patient and the fetus and to determine whether the mother or the fetus would be the priority.

Conclusion

Brain injury during pregnancy raises difficult ethical, medical, and legal issues. Cases involving brain death during pregnancy require the management of an intensive multidisciplinary approach using expertise in the areas of cardiology, critical care, psychology, obstetrics and gynecology, neonatology, ethics, neurology, and social work.

Suggested reading

1. Esmaeilzadeh M, Dictus C, Kayvanpour E, et al. One life ends, another begins: management of a brain dead pregnant mother-a systematic review. BMC Medicine. Nov 2010; 8(74): 2-11.
2. http://jnep.sciedupress.com Journal of Nursing Education and Practice 2017, Vol. 7, No. 8
3. Bush MC, Nagy S, Berkowitz RL, et al. Pregnancy in a persistent vegetative state: case report, comparison to brain death, and review of literature. Obstet Gynecol Surv. 2003 Nov; 58(11): 738-748.
4. Ertelt S. Court allows hospital to kill brain-dead pregnant mom's 18 week unborn baby. 2014; Available from: http://www.lifenews .com/2014/12/26/court-allows-hospital-to-kill-bra in-dead-pregnant-moms-18-week-unborn-baby/
5. Lane A, Westbrook A, Grady D, et al. Maternal brain death: medical, ethical and legal issues. Intensive Care Med. 2004 Jul; 30(7): 1484- 1486.

CHAPTER 35.2

A Single Tree Can Make A Forest

Mr. Sagayam Francis

Mr. K, a caring husband and a loving father of two, was 36-year-old, when he succumbed to a fatal accident. It was just like any other day when Mr. K had left for his work at one of the Pizza Huts in Chennai. Tragedy struck the family later that day when Mr. K was hit by a speeding two wheeler. He sustained a severe head injury and was bleeding extensively. He was admitted in a nearby hospital A and was operated upon. While the treating team took all its efforts to save him, the family was praying for his life but destiny willed otherwise. He was pronounced brain dead.

The entire family was shattered and desperate to cope up with the heartbreaking message. After giving the family sometime, the transplant coordinator of the hospital approached the family with the organ donation request. While everyone in the family turned their back to the request, Mr. K's wife showed interest to discuss further. Amidst the tragedy, she remembered having a conversation with her husband about organ donation. She wanted to know more about organ donation and the procedures involved in it.

She gathered courage to discuss at length with the rest of the family members about what her husband had expressed about organ donation. It sort of eased the situation for the transplant coordinator to discuss and everyone in the family unanimously agreed for organ donation at the end. The transplant coordinator initiated the routine procedures and the family was kept cognizant of every step.

A little later, one of the members put across a request stating that Mr. K's aunt has been under dialysis in another hospital and registered on the state waitlist for a kidney transplant. They wanted to explore the possibility of giving Mr. K's kidney to his aunt. The request slowly became a demand and they decided that they would donate all his organs provided their relative gets the kidney. The transplant coordinator informed the family that directed donation is not permissible as per state's allocation system. But the family felt so strong about it and they shifted Mr. K to hospital B, where his aunt has been kept on dialysis.

After making himself familiar with the entire history, the transplant coordinator of hospital B invited the family for a discussion on 'directed donation'. The family was given justifications for not giving the organ to their relatives on medical, legal and ethical grounds. Meantime, the family was also encouraged to reach out to the government officials to have more clarity on state systems. This infact evoked the family's (at least the near relatives) trust on the donation professionals. The state organ allocation body echoed the same and the family was given adequate reasons for not considering their request for directed donation.

While the disagreement among the extended relatives was evident, patient's wife looked determined. She was clear what her husband wanted and determined not to get influenced by other's decision. With much patience and courage, she challenged them on their views and expectations. She told, **"If my husband had not died, his aunt would have continued to be on dialysis. Like her, so many have been waiting and if not for her, let my husband's organs save some other lives".** Through her strength, she was able to influence the entire family to believe in the noble cause. Mr. K saved 6 lives.

CHAPTER 35.3

Living Donor Transplantation: Challenging Yet Rewarding

Ms. Trilly Rachel Mathew

Introduction

A live related transplant is a process in which a living individual donates an organ or a part of an organ for transplantation to another person whose organ is permanently damaged. These transplants are the best and most sought after choice for patients in need of new organs.

The different organs that can be transplanted from living donors are:

1. One Kidney- the most common type of donation
2. A segment of the liver - since the liver has the ability to regenerate and regain back its full function.
3. The lobe of one lung – although the lung does not regenerate, individuals can donate a lobe of one lung.
4. Pancreas – a portion of the pancreas can be donated
5. Intestine – it is possible to donate a portion of the intestine

The most common organs that are transplanted are the kidney and the liver.

The Government of India passed the Transplantation of Human Organs (Amendment) Act in 2011 which lays down a set of prerequisites for hospitals to get registered as transplant centres. Here the Transplant Coordinator plays a pivotal role in human organ and tissues transplant (in simple words, acts as 'the point of contact'). The success of an organ donation and the entire transplant programme depends on the competence of the transplant coordinator.

Role of the transplant coordinator

The transplant coordinator guides the potential living donor through the work up process, the donation surgery and post-surgery follow-up as per protocol.

The first step is the evaluation process of the donor. This includes his/her medical history, surgical history and general lifestyle. If the donor clears this step, then the medical evaluation process starts for the donor (Blood tests, Urine tests, Radiology, Cardiac clearance, Psychiatry clearance for the donor etc.) as well as the recipient. Simultaneously, the legal work-up is also initiated for the patient and the donor so as to gather evidence regarding the relationship between them.

After compiling all the reports and on completing the legal workup, the file of the patient and the donor is forwarded to the Authorisation committee/ Competent Authority for their approval for transplant.

Once the committee accords its approval, the surgery is scheduled.

Challenges faced

Unlike in the West, in India transplant coordinators face multiple challenges, both on the legal and the medical front.

The first and foremost challenge in our country is that people are ready to sell their organs as a commodity for money. Here the patient colludes with the donor and jointly with the help of a third party tout visits hospitals and present very convincing cases proving their relationship (that is legally fit for donation) beyond a shadow of doubt. In these cases, the transplant coordinator has to be intelligent and vigilant enough to understand the actual facts by reading the psyche of the donor/ recipient and also meticulously scanning through the documents produced. The questionnaire to understand the psycho-social background of the donor and the patient plays a major role in this direction.

Selling of organs for monetary benefit and/or against the will of the donor is now becoming a common issue. Like child labour and prostitution, the ethics of organ donation is much more complex in our country and have taken deep roots within the corrupt fabric of our society. Our country has many hamlets of poverty which prove to be the fertile hunting grounds for these kinds of exploitation. As a transplant coordinator, one has a bigger role in identifying such cases and eradicating.

Secondly, many times we face a situation where a potential willing donor is rejected on medical or on legal grounds. This creates a difficult situation both for the patient and the transplant coordinator.

The transplant work-up is exhaustive and every test requested by the transplant team is to ensure that the organ donation is completely safe for the donor. There are times when the transplant team works together with the patient and donor for days and finally the donation is ruled out due to some new medical/ legal finding. Such situations make it difficult and disheartening for all concerned. In these cases, the patient should be given courage to cope up with the situation with a hope of looking for another living donor or to register and wait for a deceased donor.

Finally, donors and patients at times become overtly stressed with the time consuming workup process and occasionally vent their frustration on the hospital staff, including the transplant coordinator. But as a

transplant coordinator it is important during these times to step back and view the whole scenario from the perspective of the donor/ patient and respond to every situation with compassion and empathy. As a transplant team it is important to have a strong support system to help each other overcome tough times.

Sometimes, the challenges for transplant coordinators continue post-transplant also. This happens when the recipient has acute graft dysfunction or a failing graft. Here the transplant coordinators play a major role in counselling the family members and the patient to cope-up with the situation they are facing.

The greatest reward for transplant coordinators

The rewards outweigh the challenges. The biggest reward for a transplant coordinator is the time when they see their efforts fructifying into results. They see the patient starting to lead a normal life, leaving behind their misery and crippling past. Kidney donors are a special cohort. These are the people who are willing to part with a portion of themselves for their loved ones. As transplant coordinators we witness the miracle in front of our eyes, which is one of the greatest rewards one can think of.

Appendix

APPENDIX 1

Transplantation of Human Organ Act 1994

Ministry of Law, Justice and Company Affairs
(Legislative Department)
New Delhi, the 11th July, 1994
The following Act of Parliament received the assent of the President on the 8th July, 1994 and is hereby published for general information:-
THE TRANSPLANTATION OF HUMAN ORGANS ACT, 1994
No.42 OF 1994
[8th July, 1994]

An Act to provide for the regulation of removal, storage and transplantation of human organs for therapeutic purposes and for the prevention of commercial dealings in human organs and for matters connected therewith or incidental thereto.

Whereas it is expedient to provide for the regulation of removal, storage and transplantation of human organs for therapeutic purposes and for the prevention of commercial dealings in human organs;

And whereas Parliament has no power to make laws for the States with respect to any of the matters aforesaid except as provided in articles 249 and 250 of the Constitution;

And whereas in pursuance of clause (1) of article 252 of the Constitution, resolutions have been passed by all the Houses of the Legislatures of the States of Goa, Himachal Pradesh and Maharashtra to the effect that the matters aforesaid should be regulated in those States by Parliament by law;

Be it enacted by Parliament in the Forty-fifth Year of the Republic of India as follows:

Chapter I
Preliminary

Short title, application and commencement

1. (1). This Act may be called the Transplantation of Human Organs Act, 1994.
(2). It applies, in the first instance, to the whole of the States of Goa, Himachal Pradesh and Maharasthra and to all the Union territories and it shall also apply to such other State which adopts this Act by resolution passed in that behalf under clause (1) of article 252 of the Constitution.
(3). It shall come into force in the States of Goa, Himachal Pradesh and Maharashtra and in all the Union territories on such date as the Central Government may, by notification, appoint and in any other State which adopts this Act under clause (1) of article 252 of the Constitution, on the date of such adoption; and any reference in this Act to the commencement of this Act shall, in relation to any State or Union Territory, means the date on which this Act comes into force in such State or Union Territory.

Definitions

2. In this Act, unless the context otherwise requires:
(a) "advertisement" includes any form of advertising whether to the public generally or to any section of the public or individually to selected persons;
(b) "Appropriate Authority" means the Appropriate Authority

appointed under section 13;

(c) "Authorisation Committee" means the committee constituted under clause (a) or clause (b) of sub-section (4) of section 9;

(d) "brain-stem death" means the stage at which all functions of the brain stem have permanently and irreversibly ceased and is so certified under sub-section (6) of section 3;

(e) "deceased person" means a person in whom permanent disappearance of all evidence of life occurs, by reason of brain-stem death or in a cardio-pulmonary sense, at any time after live birth has taken place;

(f) "donor" means any person, not less than eighteen years of age, who voluntarily authorizes the removal of any of his human organs for therapeutic purposes under sub-section (1) or sub-section (2) of section 3;

(g) "hospital" includes a nursing home, clinic, medical centre, medical or teaching institution for therapeutic purposes and other like institution;

(h) "human organ" means any part of a human body consisting of a structured arrangement of tissues which, if wholly removed, cannot be replicated by the body;

(i) "near-relative" means spouse, son, daughter, father, mother, brother or sister;

(j) "notification" means a notification published in the Official Gazette;

(k) "payment" means payment in money or money's worth but does not include any payment for defraying or reimbursing –

  (i) the cost of removing, transporting or preserving the human organ to be supplied; or

  (ii) any expenses or loss of earnings incurred by a person so far as reasonably and directly attributable to his supplying any human organ from his body;

(l) "prescribed" means prescribed by rules made under this Act;

(m) "recipient" means a person into whom any human organ is, or is proposed to be, transplanted;

102 of 1956

(n) "registered medical practitioner" means a medical practitioner who possesses any recognized medical qualification as defined in clause (h) of section-2 of the Indian Medical Council Act, 1956, and who is enrolled on a State Medical Register as defined in clause (k) of that section;

(o) "therapeutic purposes" means systematic treatment of any disease or the measures to improve health according to any particular method or modality; and

(p) "transplantation" means the grafting of any human organ from any living person or deceased person to some other living person for therapeutic purposes.

Chapter II

Authority for the removal of human organs

Authority for removal of human organs

3. (1). Any donor may, in such manner and subject to such conditions as may be prescribed, authorise the removal, before his death, of any human organ of his body for therapeutic purposes.

(2). If any donor had, in writing and in the presence of two or more witnesses (at least one of whom is a near relative of such person), unequivocally authorized at any time before his death, the removal of any human organ of his body, after his death, for therapeutic purposes, the person lawfully in possession of the dead body of the donor shall, unless he has any reason to believe that the donor had subsequently revoked the authority aforesaid, grant to a registered medical practitioner all reasonable facilities for the removal, for therapeutic purposes, of that human organ from the dead body of the donor.

(3). Where no such authority as is referred to in sub-section (2), was made by any person before his death but no objection was also expressed by such person to any of his human organs being used after his death for therapeutic purposes, the person lawfully in possession of the dead body of such person may, unless he has reason to believe that any near relative of the deceased person has objection to any of the decease person's human organs being used for therapeutic purposes, authorize the removal of any human organ of the deceased person for its use for therapeutic purposes.

(4). The authority given under sub-section (1) or sub-section (2) or, as the case may be, sub-section (3) shall be sufficient warrant for the removal, for therapeutic purposes, of the human organ; but no such removal shall be made by any person other than the registered medical practitioner.

(5). Where any human organ is to be removed from the body of a deceased person, the registered medical practitioner shall satisfy himself, before such removal, by a personal examination of the body from which any human organ is to be removed, that life is extinct in such body or, where it appears to be a case of brain-stem death, that such death has been certified under sub-section (6).

(6). Where any human organ is to be removed from the body of a person in the event of his brain-stem death, no such removal shall be undertaken unless such death is certified, in such form and in such manner and on satisfaction of such conditions and requirements as may be prescribed, by a Board of medical experts consisting of the following namely:

(i) the registered medical practitioner in charge of the hospital in which brain-stem death has occurred;

(ii) an independent registered medical practitioner, being a specialist, to be nominated by the

registered medical practitioner specified in cause (i), from the panel of names approved by the Appropriate authority;

(iii) a neurologist or a neurosurgeon to be nominated by the registered medical practitioner specified in clause (i), from the panel of names approved by the Appropriate Authority; and

(iv) the registered medical practitioner treating the person whose brain-stem death has occurred.

(7). Notwithstanding anything contained in sub-section (3), where brain-stem death of any person, less than eighteen years of age, occurs and is certified under sub-section (6), any of the parents of the deceased person may give authority, in such form and in such manner as may be prescribed, for the removal of any human organ from the body of the deceased person.

Removal of human organs not to be authorised in certain cases.

4. (1). No facilities shall be granted under sub-section (2) of section 3 and no authority shall be given under sub-section (3) of that section for the removal of any human organ from the body of a deceased person, if the person required to grant such facilities, or empowered to give such authority, has reason to believe that an inquest may be required to be held in relation to such body in pursuance of the provisions of any law for the time being in force.

(2). No authority for the removal of any human organ from the body of a deceased person shall be given by a person to whom such body has been entrusted solely for the purpose of interment, cremation or other disposal.

Authority for removal of human organs in case of unclaimed bodies in hospital or prison.

5. (1). In the case of a dead body lying in a hospital or prison and not claimed by any of the near relatives of the deceased person within forty-eight hours from the time of the death of the concerned person, the authority for the removal of any human organ from the dead body which so remains unclaimed may be given, in the prescribed form, by the person in charge, for the time being, of the management or control of the hospital or prison, or by an employee of such hospital or prison authorised in this behalf by the person in charge of the management or control thereof.

(2). No authority shall be given under sub-section (1) if the person empowered to give such authority has reason to believe that any near relative of the deceased person is likely to claim the dead body even through such near relative has not come forward to claim the body of the deceased person within the time specified in such sub-section (1).

Authority for removal of human organs from bodies sent for post-

6. Where the body of a person has been sent for post-mortem examination-

(a) for medico-legal purposes by reason of the death of such person having been caused by accident or any other unnatural cause;

mortem examination for medico-legal or pathological purposes.

OR

(b) for pathological purposes,

the person competent under this Act to give authority for the removal of any human organ from such dead body may, if he has reason to believe that such human organ will not be required for the purpose for which such body has been sent for post-mortem examination, authorize the removal, for therapeutic purposes, of that human organ of the deceased person provided that he is satisfied that the deceased person had not expressed, before his death, any objection to any of his human organs being used, for therapeutic purposes after his death or, where he had granted an authority for the use of any of his human organs for therapeutic purposes after his death, such authority had not been revoked by him before his death.

Preservation of human organs.

7. After the removal of any human organ from the body of any person, the registered medical practitioner shall take such steps for the preservation of the human organ so removed as may be prescribed.

Savings

8. (1). Nothing in the foregoing provisions of this Act shall be construed as rendering unlawful any dealing with the body or with any part of the body of a deceased person if such dealing would have been lawful if this Act had not been passed.

45 of 1860

(2). Neither the grant of any facility or authority for the removal of any human organ from the body of a deceased person in accordance with the provisions of this Act nor the removal of any human organ from the body of a deceased person in pursuance of such authority shall be deemed to be an offence punishable under section 297 of the Indian Penal Code.

Restrictions on removal and transplantation of human organs.

9 (1). Save as otherwise provided in sub-section (3), no human organ removed from the body of a donor before his death shall be transplanted into a recipient unless the donor is a near relative of the recipient.

(2). Where any donor authorizes the removal of any of his human organs after his death under sub-section (2) of section 3 of any person competent or empowered to give authority for the removal of any human organ from the body of any deceased person authroises such removal, the human organ may be removed and transplanted into the body of any recipient who may be in need of such human organ.

(3). If any donor authorizes the removal of any of his human organs before his death under sub-section (1) of section 3 for transplantation into the body of such recipient, not being a near relative, as is specified by the donor by reason of affection or attachment towards the recipient or for any other special reasons, such human organ shall not be removed and transplanted without the prior approval of the Authorisation Committee.

(4). (a) The Central Government shall constitute, by notification, one or more Authorisation Committees

consisting of such members as may be nominated by the Central Government on such terms and conditions as may be specified in the notification for each of the Union Territories for the purposes of this section.

(b) The State Government shall constitute, by notification, one or more Authorisation Committees consisting of such members as may be nominated by the State Government on such terms and conditions as may be specified in the notification for the purposes of this section.

(5). On an application jointly made, in such form and in such manner as may be prescribed, by the donor and the recipient, the Authorisation Committee shall, after holding an inquiry and after satisfying itself that the applicants have complied with all the requirements of this Act and the rules made thereunder, grant to the applicants approval for the removal and transplantation of the human organs.

(6). If, after the inquiry and after giving an opportunity to the applicants of being heard, the Authorisation Committee is satisfied that the applicants have not complied with the requirements of this Act and the rules made thereunder, it shall, for reasons to be recorded in writing, reject the application for approval.

Chapter III
Regulation of hospitals

Regulation of hospitals conducting the removal, storage or transplantation of human organs

10. (1). On and from the commencement of this Act:

(a) no hospital, unless registered under this Act, shall conduct, or associate with, or help in, the removal, storage or transplantation of any human organ;

(b) no medical practitioner or any other person shall conduct, or cause to be conducted, or aid in conducting by himself or through any other person, any activity relating to the removal, storage or transplantation of any human organ at a place other than an place registered under this Act; and

(c) no place including a hospital registered under sub-section (1) of section 15 shall be used or cause to be used by any person for the removal, storage or transplantation of any human organ except for therapeutic purposes.

(2). Notwithstanding anything contained in sub-section (1), the eyes or the ears may be removed at any place from the dead body of any donor, for therapeutic purposes, by a registered medical practitioner.

Explanation: For the purposes of this sub-section, “ears” includes ear drums and ear bones.

Prohibition of removal or transplantation of human

11. No donor and no person empowered to give authority for the removal of any human organ shall authorise the removal of any human organ for any purpose other than therapeutic purposes.

organs for any purpose other than therapeutic purposes.

Explaining effects, etc., to donor and recipient.

12. No registered medical practitioner shall undertake the removal or transplantation of any human organ unless he has explained, in such manner as may be prescribed, all possible effects, complications and hazards connected with the removal and transplantation to the donor and the recipient respectively.

Chapter IV
Appropriate Authority

Appropriate Authority

13. (1). The Central Government shall appoint, by notification, one or more officers as Appropriate Authorities for each of the Union territories for the purposes of this Act.
(2). The State Government shall appoint, by notification, one or more officers as Appropriate Authorities for the purposes of this Act.
(3). The Appropriate Authority shall perform the following functions, namely:
(i) to grant registration under sub-section (1) of section 15 or renew registration under sub-section (3) of that section;
(ii) to suspend or cancel registration under sub-section (2) of section 16;
(iii) to enforce such standards as may be prescribed, for hospitals engaged in the removal, storage or transplantation of any human organ;
(iv) to investigate any complaint of breach of any of the provisions of this Act or any of the rules made thereunder and take appropriate action;
(v) to inspect hospitals periodically for examination of the quality of transplantation and the follow-up medical care to persons who have undergone transplantation and persons from whom organs are removed; and
(vi) to undertake such other measures as may be prescribed.

Chapter V
Registration of Hospitals

Registration of hospitals engaged in removal, storage or transplantation of human organs.

14. (1). No hospital shall commence any activity relating to the removal, storage or transplantation of any human organ for therapeutic purposes after the commencement of this act unless such hospital is duly registered under this Act.
Provided that every hospital engaged, either partly or exclusively in any activity relating to the removal, storage or transplantation of any human organ for therapeutic purposes immediately before the commencement of this Act, shall apply for registration within sixty days from the date of such commencement:
Provided further that every hospital engaged in any activity relating to the removal, storage or transplantation of any human organ shall cease to engage in any such activity on the expiry of three months from the date of commencement of this Act unless such hospital has applied for registration and is so registered or till such application is disposed of, whichever is earlier.

(2). Every application for registration under sub-section (1) shall be made to the Appropriate Authority in such form and in such manner and shall be accompanied by such fees as may be prescribed.

(3). No hospital shall be registered under this Act unless the Appropriate authority is satisfied that such hospital is in a position to provide such specialised services and facilities, possess such skilled manpower and equipments and maintain such standards as may be prescribed.

Certificate of registration

15. (1). The Appropriate Authority shall, after holding an inquiry and after satisfying itself that the applicant has complied with all the requirements of this Act and the rules made thereunder, grant to the hospital a certificate of registration in such form, for such period and subject to such conditions as may be prescribed.

(2). If, after the inquiry and after giving an opportunity to the applicant of being heard, the Appropriate Authority is satisfied that the applicant has not complied with the requirements of this Act and the rules made thereunder, it shall, for reasons to be recorded in writing, reject the application for registration.

(3). Every certificate of registration shall be renewed in such manner and on payment of such fees as may be prescribed.

Suspension or cancellation of registration

16. (1). The Appropriate Authority may, suo moto or on complaint, issue a notice to any hospital to show cause why its registration under this Act should not be suspended or cancelled for the reasons mentioned in the notice.

(2). If, after giving a reasonable opportunity of being heard to the hospital, the Appropriate Authority is satisfied that there has been a breach of any of the provisions of this Act or the rules made thereunder, it may, without prejudice to any criminal action that it may take against such hospital, suspend its registration for such period as

it may think fit or cancel its registration:
Provided that where the Appropriate authority is of the opinion that it is necessary or expedient so to do in the public interest, it may, for reasons to be recorded in writing, suspend the registration of any hospital without issuing any notice.

Appeals

17. (1). Any person aggrieved by an order of the Authorisation Committee rejecting an application for approval under sub-section (6) of section 9, or any hospital aggrieved by an order of the Appropriate Authority rejecting an application for registration under sub-section (2) of section 15 or an order of suspension or cancellation of registration under sub-section (2) of section 16, may, within thirty days from the date of the receipt of the order, prefer an appeal, in such manner as may be prescribed, against such order to:
(i) the Central Government where the appeal is against the order of the Authorisation Committee constituted under clause (a) of sub-section (4) of section 9 or against the order of the Appropriate Authority appointed under sub-section (1) of section 13; or
(ii) the State Government, where the appeal is against the order of the Authorisation Committee constituted under clause (b) of sub-section (4) of section 9 or against the order of the Appropriate Authority appointed under sub-section (2) of section 13.

Chapter VI
Offences and Penalties

Punishment for removal of human organ without authority.

18. (1). Any person who renders his services to or at any hospital and who, for purposes of transplantation, conducts associates with, or helps in any manner in, the removal of any human organ without authority, shall be punishable with imprisonment for a term which may extend to five years and with fine which may extend to ten thousand rupees.
(2). Where any person convicted under sub-section (1) is a registered medical practitioner, his name shall be reported by the Appropriate Authority to the respective State Medical Council for taking necessary action including the removal of his name from the register of the Council for a period of two years for the first offence and permanently for the subsequent offence.

Punishment for commercial dealings in human organs

19. Whoever –
(a) makes or received any payment for the supply of, or for an offer to supply, any human organ;
(b) seeks to find person willing to supply for payment any human organ;
(c) offers to supply any human organ for payment;
(d) initiates or negotiates any arrangement involving the making of any payment for the supply of, or for an offer to supply, any human organ;

(e) takes part in the management or control of a body of persons, whether a society, firm or company, whose activities consist of or include the initiation or negotiation of any arrangement referred to in clause (d); or

(f) publishes or distributes or causes to be published or distributed any advertisement-

(a) inviting persons to supply for payment of any human organ;

(b) offering to supply any human organ for payment; or

(c) indicating that the advertiser is willing to initiate or negotiate any arrangement referred to in clause (d),

shall be punishable with imprisonment for a term which shall not be less than two years but which may extend to seven years and shall be liable to fine which shall not be less than ten thousand rupees but may extend to twenty thousand rupees:

Provided that the court may, for any adequate and special reason to be mentioned in the judgement, impose a sentence of imprisonment for a term of less than two years and a fine less than ten thousand rupees.

Punishment for contravention of any other provision of this Act.

20. Whoever contravenes any provision of this Act or any rule made, or any condition of the registration granted, thereunder for which no punishment is separately provided in this Act, shall be punishable with imprisonment for a term which may extend to three years or with fine which may extend to five thousand rupees.

Offences by companies.

21. (1). Where any offence, punishable under this Act, has been committed by a company, every person who, at the time the offence was committed was in charge of, and was responsible to the company for the conduct of the business of the company, as well as the company, shall be deemed to be guilty of the offence and shall be liable to be proceeded against and punished accordingly:

Provided that nothing contained in this sub-section shall render any such person liable to any punishment, if he proves that the offence was committed without his knowledge or that he had exercised all due diligence to prevent the commission of such offence.

(2). Notwithstanding anything contained in sub-section (1), where any offence punishable under this Act has been committed by a company and it is proved that the offence has been committed with the consent or connivance of, or is attributable to any neglect on the part of, any director, manager, secretary or other officer of the company, such director, manager, secretary or other officer shall also be deemed to be guilty of that offence and shall be liable to be proceeded against and punished accordingly.

Explanation: For the purposes of this section:

(a) "company" means any body corporate and includes a firm or other association of individuals; and
(b) "director", in relation to a firm, means a partner in the firm.

Cognizance of offence

22. (1). No court shall take cognizance of an offence under this Act except on a complaint made by:
(a) the Appropriate Authority concerned, or any officer authorised in this behalf by the Central Government or the State Government or, as the case may be, the Appropriate Authority; or
(b) a person who has given notice of not less than sixty days, in such manner as may be prescribed, to the Appropriate Authority concerned, of the alleged offence and of his intention to make a complaint to the court.
(2). No court other than that of a Metropolitan Magistrate or a Judicial Magistrate of the first class shall try any offence punishable under this Act.
(3). Where a complaint has been made under clause (b) of sub-section (1), the court may, on demand by such person, direct the Appropriate Authority to make available copies of the relevant records in its possession to such person.

Chapter VII
Miscellaneous

Protection of action taken in good faith.

23. (1). No suit, prosecution or other legal proceeding shall lie against any person for anything which is in good faith done or intended to be done in pursuance of the provisions of this Act.
(2). No suit or other legal proceeding shall lie against the Central Government or the State Government for any damage caused or likely to be caused for anything which is in good faith done or intended to be done in pursuance of the provisions of this Act.

Power to make rules.

24. (1). The Central Government may, by notification, make rules for carrying out the purposes of this Act.
(2). In particular, and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely:
(a) the manner in which and the conditions subject to which any donor may authorise removal, before his death, of any human organ of his body under sub-section (1) of section 3;
(b) the form and the manner in which a brain-stem death is to be certified and the conditions and requirements which are to be satisfied for that purpose under sub-section (6) of section 3;
(c) the form and the manner in which any of the parents may give authority, in the case of brain-stem death of a minor, for the removal of any

human organ under sub-section (7) of section 3;

(d) the form in which authority for the removal of any human organ from an unclaimed dead body may be given by the person incharge of the management or control of the hospital or prison, under sub-section (1) of section 5;

(e) the steps to be taken for the preservation of the human organ removed from the body of any person, under section 7;

(f) the form and the manner in which an application may be jointly made by the donor and the recipient under sub-section (5) of section 9;

(g) the manner in which all possible effects, complications and hazards connected with the removal and transplantation is to be explained by the registered medical practitioner to the donor and the recipient under section 12;

(h) the standards as are to be enforced by the Appropriate authority for hospitals engaged in the removal, storage or transplantation of any human organ under clause (iii) of sub-section (3) of section 13;

(i) the other measures as the Appropriate Authority shall undertake in performing its functions under clause (vi) of sub-section (3) of section 13;

(j) the form and the manner in which an application for registration shall be made and the fee which shall be accompanied, under sub-section (2) of section 14;

(k) the specialised services and the facilities to be provided, skilled manpower and the equipments to be possessed and the standards to be maintained by a hospital for registration, under sub-section (3) of section 14;

(l) the form in which, the period for which and the conditions subject to which certificate of registration is to be granted to a hospital, under sub-section (1) of section 15;

(m) the manner in which and the fee on payment of which certificate of registration is to be renewed under sub-section (3) of section 15;

(n) the manner in which an appeal may be preferred under section 17;

(o) the manner in which a person is required to give notice to the Appropriate Authority of the alleged offence and of his intention to make a complaint to the court, under clause (b) of sub-section (1) of section 22; and

(p) any other matter which is required to be, or may be prescribed.

(3). Every rule made under this Act shall be laid, as soon as may be after it is made, before each House of Parliament, while it is in session, for a total period of

thirty days which may be comprised in one session or in two or more successive sessions, and if, before the expiry of the session immediately following the session or the successive sessions aforesaid, both Houses agree in making any modification in the rule or both Houses agree that the rule should not be made, the rule shall thereafter have effect only in such modified form or be of no effect, as the case may be; so, however that any such modification or annulment shall be without prejudice to the validity of anything previously done under that rule.

Repeal and saving
28 of 1982
29 of 1982

25. (1). The Ear Drums and Ear Bones (Authority for Use for Therapeutic Purposes) Act, 1989 and the Eyes (Authority for Use for Therapeutic Purposes) Act, 1982 are hereby repealed.

(2). The repeal shall, however, not affect the previous operation of the Acts so repealed or anything duly done or suffered thereunder.

APPENDIX 2

Transplantation of Human Organ Rules 1995

THE TRANSPLANTATION OF HUMAN ORGANS RULES, 1995

GSR NO. 51(E), In exercise of the powers conferred by sub-section (1) if section 24 of the Transplantation of Human Organs Act, 1994 (42 of 1994), the Central Government hereby makes the following rules, namely:-

1. Short title and commencement :- These rules may be called the Transplantation of Human Organs Rules, 1995.

(2) They shall come into force on the date[1] of their publication in the Official Gazette.

2. Definitions :- (a)"Act" means the Transplantation of Human Organs Act, 1994 (42 of 1994);

(b)"Form" means a form annexed to these Rules;

(c)"Section" means a section of the Act;

(d) "National Accreditation Board for Laboratories" (NABL) means a Board set up by the Quality Council of India (set up by the Government of India) for undertaking assessment and accreditation of testing and calibration of laboratories in accordance with the international standard ISO/IEC/17025 and ISO 15189;

(e) the Registered Medical Practitioner, as defined in clause (n) of section 2 of Transplantation of Human Organs Act, 1994 includes an allopathic doctor with MBBS or equivalent degree under the Medical Council of India Act.

(f)] Words and expressions used and not defined in these Rules, but defined in the Act, shall have the same meanings respectively assigned to them in the Act.

3. Authority for removal of human organ :- Any donor may authorise the removal, before his death, of any human organ of his body for therapeutic purposes in the manner and so such conditions as specified in [4][Forms 1(A), 1(B) and 1(C).

4. Duties of the Medical Practitioner :- (1) A registered medical practitioner shall, before removing a human organ from the body of a donor before his death, satisfy himself-

(a) that the donor has given his authorization in Form 1(A) or 1(B) or 1(C).

(b) that the donor is in proper state of health and is fit to donate the organ, and the registered medical practitioner shall sign a certificate as specified in Form 2.

(c) that the donor is a near relative of the recipient as certified in Form 3, who has signed Form 1(A) or 1(B) as applicable to the donor and that the donor has submitted an application in Form 10 jointly with the recipient and that the proposed donation has been approved by the concerned competent authority and that the necessary documents as prescribed and medical tests, if required, to determine the factum of near relationship, have been examined to the satisfaction of the Registered Medical Practitioner i.e. Incharge of transplant center.

(d) That in case the recipient is spouse of the donor, the donor has given a statement to the effect that they are so related by signing a certificate in Form 1(B) and has submitted an application in Form 10 jointly with the recipient and that the proposed donation has been approved by the concerned competent authority under provision of sub-rule (2) of rule 4A.

(e) In case of a donar who is other than a near relative and has sined Form 1(C) and submitted an application in Form 10 jointly with the recipient, the permission from the Authorisation Committee for the said donation has been obtained.]

(2) A registered medical practitioner shall, before removing a human organ form the body of a person after his death satisfy himself-

(a) that the donor had, in the presence of two or more witnesses (at least one of whom is a near relative of such person), unequivocally authorized as specified in Form 5 before his death, the removal of the human organ of his body, after his death, for therapeutic purposes and there is no reason to believe that the donor had subsequently revoked the authority aforesaid;

(b) that then person lawfully in possession of the dead body has signed a certificate as specified in Form 6.]

(3) A registered medical practitioner shall, before removing a human organ from the body of a person in the event of his brain-stem death, satisfy himself-

(a) that a certificate as specified in Form 8 has been signed by all the members of the Board of Medical Experts referred to in sub-section (6) of section 3 of the Act;

(b) that in the case of brian-stem death of a person of less than eighteen years of age, a certificate specified in Form 8 has been signed by all the members of the Board of Medical Experts referred to in sub-section (6) of section 3 of the Act and an authority as specified in Form 9 has been signed by either of the parents of such person.

4A. Authorisation committee :- (1) The medical practitioner who will be part of the organ transplantation team for carrying out transplantation operation shall not be a member of the Authorisation committee constituted under the provision of clauses (a) and (b) of sub-section (4) of section 9 of the Act.

(2) Where the proposed transplantation is between a married couple, the Registered Medical Practitioner i.e. Incharge of transplant center must evaluate the factum and duration of marriage and ensure that documents such as marriage certificate, marriage photograph etc. Are kept for records along with the information on the number of age of children and family photograph depicting the entire immediately family, birth certificate of children containing particulars of parents.

(3) When the proposed donor or recipient or both are not Indian Nationals/citizens whether 'near relatives' or otherwise, Authorisation Committees shall consider all such requests.

(4) When the proposed donor and the recipient are not "near relatives', as defined under clause (i) of section 2 of the Act, the Authorisation Committee shall evaluate that,-

(i) there is no commercial transaction between the recipient and the donor and that no payment or money or moneys worth as referred to the Act, has been made to the donor or promised to be made to the donor or any other person;

(ii) the following shall specifically be assessed by the Authorisation Committee:-

(a) an explanation of the link between them and the circumstances which led to the offer being made;

(b) reasons why the donor wished to donate;

(c) documentary evidence of the link, e.g. proof that the have lived together, etc;

(d) old photographs showing the donor and recipient together;

(iii) that there is no middleman or tout involved;

(iv) that financial status of the donor and the recipient is probed by asking them to give appropriate evidence of their vocation and income for the previous three financial years. Any gross disparity between the status of the two must be evaluated in the backdrop of the objective of preventing commercial dealing;

(v) that the donor is not a drug addict or known person with criminal record;

(vi) that the next of the kin of the proposed unrelated donor is interviewed regarding awareness about his or her intention to donate an organ, the authenticity of the link between the donor and the recipient and the reasons for donation. Any strong views or disagreement or objection such kin shall also be recorded and taken note of.

5. Preservation of organs :- The organ removed shall be preserved according to current and accepted scientific methods in order to ensure viability for the purpose of transplantation.

Provided that the eye-ball removed shall be preserved in the following three steps, namely;-

i. short-term preservation;
ii. medium-term preservation;
iii. long-term preservation;

and suitable media shall be used for preservation.

6. The donor and the recipient shall make jointly an application to grant approval for removal and transplantation of human organ, to the concerned competent authority or Authorisation Committee as specified in Form 10. The Authorisation Committee shall take a decision on such application in accordance with the guidelines in the rule 6A.

6A. Composition of Authorisation Committees :- (1) There shall be one State Level Authorisation Committee.

(2) Additional authorization committees may be set up at various levels as per norms given below, namely;-

i. no member from transplant team of the institution should be a member of the respective Authorisation committee. All Foreign Nationals (related and unrelated) should go to "Authorisation Committee" as abundant precaution needs to be taken in such cases;

ii. Authorisation Committee should be Hospital based in Metro and big cities if the number of transplants exceeds 25 in a year at the respective transplantation centers. In small towns, there are State or District level Committees if transplants are less than 25 in a year in the respective districts.

(A) Composition of Hospital Based Authorisation Committees*:* (To be constituted by the State Government and in case of Union Territory by the Central Government).

(a) the senior most person officiating as Medical Director or Medical Superintendent of the Hospital;
(b) two senior medical practitioners from the same hospital who are not part of the transplant team;
(c) two members being persons of high integrity, social standing and credibility, who have served in high ranking Government positions, such as in higher judiciary, senior cadre of police service or who have served as a reader or professor in University Grants Commission approved University or are self-employed professionals of repute such as lawyers, chartered accountants and doctors (of Indian Medical Association) etc.; and
(d) Secretary (Health) or nominee and Director Health Services or nominee.

(B) Composition of state or District Level Authorisation Committees: (To be constituted by the State Government and in case of Union territory by the Central Government).

(a) a Medical Practitioner officiating as Chief Medical Officer or any other equivalent post in the main/major Government Hospital of the District;

(b) two senior medical practitioners to be chosen from the pool of such medical practitioners who are residing in the concerned District and who are not part of any transplant team;

(c) two senior citizens, non-medical background (one lady) of high reputation and integrity to be chosen from the pool of such citizens residing in the same district, who have served in high ranking Government positions, such as in higher judiciary, senior cadre of police service or who have served as a reader or professor in University grants Commission approved University or are self-employed professionals of repute such as lawyers, chartered accountants and doctors (of Indian Medical Association) etc; and

(d) Secreatry (Health) or nominee and Director Health Services or nominee.

(Note: Effort should be made to have most of the members' *ex-officio* so that the need to change the composition of committee is less frequent.)

6B. The State level committees shall be formed for the purpose of providing approval or no objection certificate to the respective donor and recipient to establish the legal and residential status as a domicile state. It is mandatory that if donor, recipient and place of transplantation are from different states, then the approval or "no objection certificate" from the respective domicile State Government should be necessary. The institution where the transplant is to be undertaken in such case the approval of Authorisation committee is mandatory.

6C. The quorum of the Authorisation Committee should be minimum four. However, quorum ought not to be considered as complete without the participation of the chairman. The presence of Secretary (Health) or Nominee and Director of Health Services or nominee is mandatory.

6D. The format of the Authorisation Committee approval should be uniform in all the institutions in a State. The format may be notified by respective State Government.

6E. Secretariat of the Committee shall circulate copies of all applications received from the proposed donors to all members of the Committee. Such applications should be circulated along with all annexures, which may have been filed along with the applications. At the time of the meeting, the Authorisation committee should take note of all relevant contents and documents in the course of its decision making process and in the event any documents in the course of its decision making process and in the event any document or information is found to be inadequate or doubtful, explanation should be sought from the applicant and if it is considered necessary that any fact or information requires to be verified in order to confirm its veracity or correctness, the same be ascertained through the concerned officer(s) if the State/Union territory Government.

6F. The Authorisation committee shall focus its attention on the following, namely:-

(a) Where the proposed transplant is between persons related genetically, Mother, Father, Brother, Sister, Son or Daughter Above the age of 18 years), the concerned competent authority shall evaluate:-

(i) results of tissue typing and other basic tests;

(ii) documentary evidence of relationship e.g. relevant birth certificates and marriage certificate, certificate from Sub-divisional magistrate/Metropolitan Magistrate/or Sarpanch of the Panchayat;

(iii) documentary evidence of identity and residence of the proposed donor e.g. Ration Card or Voters identity Card or Passport or Driving License or PAN Card or Bank Account and family photograph depicting the proposed donor and the proposed recipient along with another near relative;

(iv) if in its opinion, the relationship is not conclusively established after evaluating the above evidence, it may in its discretion direct further medical tests as prescribed as below:

(a) the test for Human Leukocyte Antigen (HLA), Human Leukocyte Antigen-B alleles to be performed by the serological and / or Polymerase chain reaction (PCR) based Deoxyribonucleic acid (DNA) methods.

(b) test for Human Leukocyte Antigen-DR beta genes to be perfomed using the Polymerase Chain reaction (PCR) based Deoxyribonucleic acid (DNA) methods.

(c) the tests referred to in sub-rules (i) to (ii) shall be got done from a laboratory accredited with National Accreditation Board for Laboratories (NABL).

(d) where the tests referred to in (i) to (iii) above do not establish a genetic relationship between the donor and the recipient, the same tests to be performed on both or at least one parent, preferably both parents. If parents are not available, same tests to be performed on such relatives of donor and recipient as are available and are willing to be tested failing which, genetic relationship between the donor and the recipient will be deemed to have not been established.

(b) The papers for approval of transplantation would be processed by the registered medical practitioner and administrative division of the Institution for transplantation, while the approval will be granted by the Authorisation Committee.

(c) Where the proposed transplant is between a married couple (except foreigners, whose cases should be dealt by Authorisation Committee):

The concerned competent authority or authorization committee as the case may be must evaluate all available evidence to establish the factum and duration of marriage and ensure the documents such as marriage certificate, marriage photograph is placed before the committee along with the information on the number and age of children and a family photograph depicting the entire immediate family, birth certificate of children containing the particulars of parents.

(d) Where the proposed transplant is between individuals who are not "near relatives" the authorization committee shall evaluate;-

(i) that there is no commercial transaction between the recipient and the donor. That no payment of money or moneys worth as referred to in the sections of the Act, has been made to the donor or promised to be made to the donor or any other person. In this connection, the Authorisation Committee shall take into consideration:-

(a) an explanation of the link between them and the circumstances which led to the offer being made;
(b) documentary evidence of the link e.g. proof that they have lived together etc;
(c) reasons why the donor wishes to donate; and
(d) old photographs showing the donor and the recipient together.

(ii) that there is no middleman/tout involved;

(iii) that financial status of the donor and the recipient is probed by asking them to give appropriate evidence of their vocation and income for the previous three inancial years. Any gross disparity between the status of the two, must be evaluated in the backdrop of the objective of preventing commercial dealing;

(iv) that the donor is not a drug addict or a known person with criminal record;

(v) that the next of kin of the proposed unrelated donor is interviewed regarding awareness about his\her intention to donate an organ, the authenticity of the link between the donor and the recipient and the reasons for donation. Any strong view of disagreement or objection of such kin may also be recorded and taken note of; and

(e) When the proposed donor or the recipient or both are foreigners:-

(i) a senior Embassy official of the country of origin has to certify the relationship between the donor and the recipient.

(ii) Authorisation Committee shall examine the cases of Indian donors consenting to donate organs to a foreign national (who is a near relative), including a foreign national

of India origin, with greater caution. Such cases should be considered rarely on case to case basis.

(f) In the course, of determining eligibility of the applicant to donate, the applicant should be personally interview by the Authorisation Committee and minutes of the interview should be recorded. Such interviews with the donors should be videographed.

(g) In case where the donor is a woman greater precautions ought to be taken. Her identity and independent consent should be confirmed by a person other than the recipient. Any document with regard to the proof of the residence or domicile and particulars of parentage should be relatable to the photo identity of the applicant in order to ensure that the documents pertain to the same person, who is the proposed donor and in the event of any inadequate or doubtful information to this effect, the Authorisation committee may in its discretion seek such other information or evidence as may be expedient; and desirable in the peculiar facts of the case.

(h) The Authorisation Committee should state in writing its reason for rejecting / approving the application of the proposed donor and all approvals should be subject to the following conditions:-

(i) that the approved proposed donor would be subjected to all such medical test as required at the relevant stages to determine his biological capacity and compatibility to donate the organ in question.

(ii) futhter that the psychiatrist clearance would also be mandatory to certify his mental condition, awareness, absence of any overt or latent psychiatric disease and ability to give free consent.

(iii) all prescribed forms have been and would be filled up by all relevant persons involved in the process of transplantation.

(iv) all interviews to be video recorded.

(i) The authorization committee shall expedite its decision making process and use its discretion judiciously and pragmatically in all such cases where, the patient requires immediate transplantation.

(j) Every authorized transplantation center must have its own website. The Authorization Committee is required to take final decision with in 24hours of holding the meeting for grant of permission of rejection for transplant. The decision of the Authorisation committee should be displayed on the notice board of the hospital or institution immediately and should reflect on the website of the hospital or institution within 24 hours of taking the decision. Apart from this, the website of the hospital or institution must update its website regularly in respect of the total number of the transplantations done in that hospital or institution along with the details of each transplantation. The

same data should be accessible for compilation, analysis and further use by respective State Governments and Central Government.

7. Registration of hospital :- (1) An application for registration shall be made to the Appropriate Authority as specified in Form 11. The application shall be accompanied by a fee or rupees one thousand payable to the Appropriate Authority by means of a bank draft or postal order.

(2) The Appropriate Authority shall, after holding an inquiry and after satisfying itself that the applicant has complied with all the requirements, grant a certificate of registration as specified in Form 12 and shall be valid for a period of five years form the date of its issue and shall be renewable.

(3) Before a hospital is registered under the provisions of this rule, it shall be mandatory for the hospital to nominate a transplant co-ordinator.

8. Renewal of registration :- (1) An application for the renewal of a certificate of registration shall be made to the Appropriate Authority within a period of three months prior to the date of expiry of the original certificate of registration and shall be accompanied by a fee of rupees five hundred payable to the Appropriate Authority by means of a bank draft or postal order.

(2) A renewal certificate of registration shall be as specified in Form 13 and shall be valid for a period of five years.

(3) If, after an inquiry including inspection of the hospital and scrutiny of its past performance and after giving an opportunity to the applicant, the Appropriate Authority is satisfied that the application, since grant of certificate of registration under sub-rule (2) of rule 7 has not complied with the requirements of this Act and the Rules made thereunder and conditions subject to which the certificate of registration has been granted, shall, for reasons to be recorded in writing, refuse to grant renewal of the certificate of registration.

9. Conditions for grant of certificate of registration :- No hospital shall be granted a certificate of registration under this Act unless it fulfills the following requirement of manpower, equipment, specialized services and facilities as laid down below;-

(A) General Manpower Requirement Specialised Services and Facilities:

1. 24 hours availability of medical and surgical, (senior and junior) staff.
2. 24 hours availability of nursing staff, (general and speciality trained).

3. 24 hours availability of Intensive Care Units with adequate equipments, staff and support system, including specialists in anaesthesiology, intensive care.
4. 24 hours availability of laboratory with multiple discipline testing facilities including but not limited to Microbiology, Bio-Chemistry, pathology and Hematology and Radiology departments with trained staff.
5. 24 hours availability of Operation Theatre facilities (OT facilities) for planned and emergency procedures with adequate staff, support system and equipments.
6. 24 hours availability of communication system, with power backup, including but not limited to multiple line telephones, public telephone system, fax, computers and paper photo-imaging machine.
7. Experts, (other than the experts required for the relevant transplantation) of relevant and associated specialties including but not limited to and depending upon the requirements, the experts in internal medicine, diabetology, gastroenterology, nephrology, neurology, paediatrics, gynaecology, immunology and cardiology etc. should be available to the transplantation center.

(B) Equipments:

Equipments as per current and expected scientific requirements specific to organ or organs being transplanted. The transplant center should ensure the availability of the accessories, spare-parts and back-up/maintenance/service support system in relation to all relevant equipments.

(C) Experts and their qualifications:

(A) Kidney Transplantation

M.S. (Gen.) Surgery or equivalent qualification with three years post M.S. training in a recognized center in India or abroad and having attended to adequate number of renal transplantation as an active member of team.

(B) Transplantation of liver and other abdominal organs

M.S. (Gen.) Surgery or equivalent qualification with adequate post M.S. training in an established center with a reasonable experience of performing liver transplantation as an active member of team.

(C) Cardiac, Pulmonary, Cardio-Pulmonary Transplantation

M.Ch. Cardio-thoracic and vascular surgery or equivalent qualification in India or abroad with at least 3 years experience as an active member of the team performing an adequate number of open heart operations per year and well-versed with Coronary by-pass surgery and Heart-Valve surgery.

(D) Cornea Transplantation

M.D./M.S. ophthalmology or equivalent qualification with one year post M.D./M.S. training in a recoginsed hospital carrying out Corneal transplant operations.]

10. Appeal :- (1) Any person aggrieved by an order of the Authorisation Committee under sub-section (6) of section9, or by an order of the Appropriate Authority under sub-section (2) of section 15 and section 16 of the Act, may, within thirty days from the date of receipt of the order, prefer an appeal to the Central Government.

(2) Every appeal shall be in writing and shall be accompanied by a copy of the order appealed against.

FORM 1(A)

[To be completed by the prospective related donor]

[See rule 3]

My full name is ……And this is my photograph

To be affixed and attested by Notary Public after it is affixed.

Photograph of the Donor

(Attested by Notary Public)

My permanent home address is

……. Tel:……

My present home address is

…… Tel:……...

Date of birth …….. (day/month/year)

- Ration/consumer Card number and Date of issue & place ……

  (Photocopy attached)

  and/or

- Voter's I-Card number, date of issue, Assembly Constituency …….

  (Photocopy attached)

  and/or

- Passport number and country of issue ……...

  (Photocopy attached)

  and/or

- Driving Licence number, Date of issue, licensing authority …….

and/or

- PAN ……...

and/or

- Other proof of identity and address ……...

I hereby authorize removal for therapeutic purposes/consent to donate my ……. (state which organ) to my relative (specify son / daughter / father / mother / brother / sister), whose name is …….. and who was born on …….

(day / month / year) and whose particulars are as follows:

To be affixed and attested by Notary Public after it is affixed.

Photograph of the Recipient

(Attested by Notary public)

- Ration / Consumer Card number and Date of issue & place ……

  (Photocopy attached)

and / or

- Voter's I-Card number, date of issue, Assembly Constituency …….

(Photocopy attached)

and/or

- Passport number and country of issue ……...

  (Photocopy attached)

  and/or

- Driving Licence number, Date of issue, licensing authority …….

  (Photocopy attached)

  and/or

- PAN ……...

  and/or

- Other proof of identity and address ……...

I solemnly affirm and declare that sections 2, 9, and 19 of the transplantation of Human Organs Act, 1994 have been explained to me and I confirm that: -

1. I understand the nature of criminal offences referred to in the sections.
2. No payment of money or money's worth as referred to in the sections of the Act has been made to me or will be made to me or any other person.
3. I am giving the consent and authorisation to remove my …….. (organ) of my own free will without any undue pressure, inducement, influence or allurement.
4. I have been given a full explanation of the nature of the medical procedure involved and the risks involved for me in the removal of my ……. (organ). That explanation was given by …….. (name of registered medical practitioner).
5. I understand the nature of that medical procedure and of the risks to me as explained by that practitioner.
6. I understand that I may withdraw my consent to the removal of that organ at any time before the operation takes place.
7. I state that particulars filled by me in the form are true and correct to my knowledge and nothing material has been concealed by me.

…….. …… ……

Signature of the prospective donor Date

Note : To be sworn before Notary Public, who while attesting shall ensure that the person / persons swearing the affidavit(s) signs (s) on the Notary Register, as well.

- Wherever applicable.

FORM 1(B)

[To be completed by the prospective spousal donor]

(see rule 3)

My full name is ……and this is my photograph

To be affixed and attested by Notary public after it is affixed.

Photograph of the Donor

(Attested by Notary Public)

My permanent home address is…….

…….. Tel:…….....

My present home address is

…… Tel:……. Date of birth …… (day / month / year)

I authorize to remove for therapeutic purposes / consent to donate my ……. (state which organ) to my husband/wife ……whose full name is ……was born on …… (day / month / year) and whose particulars are as follows:

To be affixed and attested by Notary public after it is affixed

Photograph of the Recipient

(Attested by Notary Public)

- Ration / Consumer Card number and Date of issue & place ……

  (Photocopy attached)

  and / or

- Voter's I-Card number, date of issue, Assembly constituency …….

  (Photocopy attached)

  and / or

- Passport number and country of issue ……..

  (Photocopy attached)

  and / or

- Driving Licence number, Date of Issue, licensing authority ……

  (Photocopy attached)

  and / or

- PAN …….

  and / or

- Other proof of identity and address ……..

I submit the following as evidence of being married to the recipient:-

(a) A Certified copy of a marriage certificate

OR

(b) An affidavit of a "near relative" confirming the status of marriage to be sworn before Class-I Magistrate / Notary Public.

(c) Family photographs.

(d) Letter from member of Gram Panchayat / Tehsildar / Block Development Officer / MLA / MP certifying factum and status of marriage.

OR

(e) Other credible evidence

I solemnly affirm and declare that Section 2, 9 and 19 of The Transplantation of Human Organs Act, 1994 have been esxplained to me and I confirm that: -

1. I understand that nature of criminal offences referred to in the sections.
2. No payment of money or money's worth as referred to in the sections of the Act has been made to me or will be made to me or any other person.

3. I am giving the consent and authorisation to remove my …… (organ) of my own free will without any undue pressure, inducement, influence or allurement.
4. I have been given a full explanation of the nature of the medical procedure involved and the risks involved for me in the removal of my …… (organ). That explanation was given by ……..(name of registered medical practitioner).
5. I understand the nature of that medical procedure and of the risks to me as explained by that practitioner.
6. I understand that I may withdraw my consent to the removal of that organ at any time before the operation takes place.
7. I state that particulars filled by me in the form are true and correct to my knowledge and noting material has been concealed by me.

…… ……..

Signature of the prospective donor Date

Note- To be sworn before Notary Public, who while attesting shall ensure that the person/persons swearing the affidavit(s) signs (s) on the Notary Register, as well.

- Tick Wherever applicable.

FORM 1(C)

[To be completed by the prospective spousal donor].

(see rule 3)

My full name is ……and this is my Photograph

To be affixed and attested by Notary Public after it is affixed.

Photograph of the Donor

(Attested by Notary Public)

My permananet home address is…….

…….Tel:……

My present home address is…….

…….....……Tel:…….

Date of birth……..(day/month/year)

- Ration/consumer Card number and Date of issue & place……

  (Photocopy attached)

  and/or

- Voter's I-Card number, date of issue, Assembly Constituency…….

  (Photocopy attached)

  and/or

- Passport number and country of issue ……...

  (Photocopy attached)

  and/or

- Driving Licence number, Date of issue, licensing authority …….

  (Photocopy attached)

  and/or

- PAN ……...

  and/or

- Other proof of identity and address ……...
- Details of last three years income and vocation of donor …….

  ……

  ……

I hereby authorize removal for therapeutic purposes / consent to donate my …… (state which organ) to a person

whose full name is ……..…… and who was born on …….

(day / month / year) and whose particulars are as follows:

To be affixed and attested by Notary Public after it is affixed.

Photograph of the Recipient

(Attested by Notary public)

- Ration / Consumer Card number and Date of issue & place ……

  (Photocopy attached)

  and / or

- Voter's I-Card number, date of issue, Assembly Constituency ……

  (Photocopy attached)

  and/or

- Passport number and country of issue ……...

  (Photocopy attached)

  and/or

- Driving Licence number, Date of issue, licensing authority ……

(Photocopy attached)

and/or

- PAN ……...

and/or

Other proof of identity and address ……..……..

I solemnly affirm and declare that sections 2, 9, and 19 of the transplantation of Human Organs Act, 1994 have been explained to me and I confirm that: -

1. I understand the nature of criminal offences referred to in the sections.
2. No payment of money or money's worth as referred to in the sections of the Act has been made to me or will be made to me or any other person.
3. I am giving the consent and authorisation to remove my …….. (organ) of my own free will without any undue pressure, inducement, influence or allurement.
4. I have been given a full explanation of the nature of the medical procedure involved and the risks involved for me in the removal of my ……. (organ). That explanation was given by …….. (name of registered medical practitioner).
5. I understand the nature of that medical procedure and of the risks to me as explained by that practitioner.
6. I understand that I may withdraw my consent to the removal of that organ at any time before the operation takes place.
7. I state that particulars filled by me in the form are true and correct to my knowledge and nothing material has been concealed by me.

…….. ……

Signature of the prospective donor Date

Note : To be sworn before Notary Public, who while attesting shall ensure that the person / persons swearing the affidavit(s) signs (s) on the Notary Register, as well.

- Tick Wherever applicable.

[1][FORM 2

[To be completed by the concerned medical practitioner]

[Refer rule 4(1) (b)]

I, Dr. …… possessing qualification of ……..

registered as medical practitioner at Serial No. …….. by the

…… Medical Council, certify that I have examined Shri/Smt./ Km

…….. s/o, w/o, d/o Shir …… aged ……who has given informed consent about donation of the organ, namely (name of the organ …….. to Shri/Smit./Km …….. who is a "near relative" of the donor / other that near relative of the donor, who had been approved by the Authorisation Committee / Registered Medical Practitioner i.e. In-charge of transplant center (as the case may be) and that the said donor is in proper state of health and is medically fit to be subjected to the procedure of organ removal.

Place …… …….

Date …….. Signature of Doctor

Seal

To be affixed (pasted and attested by the doctor concerned. The signatures and seal should partially appear on photograph and document without disfiguring the face in photograph.

Photograph of the Donor

(Attested by Doctor)

To be affixed (pasted and attested by the doctor concerned. The signatures and seal should partially appear on photograph and document without disfiguring the face in photograph.

Photograph of the recipient

(Attested by the Doctor)

FORM 3

[see rule 4(1) (c)]

I, Dr./Mr./Mrs.. ..……. working as …… at …… and possessing qualification of …….. certify that Shri / Smt. Km. ……. S / o, D / o, Wo Shri / Smt. ……. aged …….. the donor and Shri / Smt. ……. S / o, D /o, W/o, Shri / Smt …….. aged …… the proposed recipient of the organ to be donated by the said donor are related to each other as brother / sister / mother /father /sons /daughter as per their statement and the fact of this relationship has been established / not established by the results of the tests for Antigenic Products of the Human Major Histocompatibility Complex. The results of the test are attached.

Place …….

Signature

(To be signed by the Head of the Laboratory)

Date …….

Seal

FORM -5

[(See rule 4(2) (a)]

I ..... S/o, D/o, W/o ..... aged ..... resident of ..... in the presence of persons mentioned below hereby unequivocally authorise the removal of my organ/organs, namely, ... from my body after my death for therapeutic purposes.

Dated: Signature of the Donor

(Signature)

1. Shri/Smt./Km.....
   S/o, D/o, W/o ..... aged ..... resident of .....
   .....
   .....

(Signature)

2. Shri/Smt./Km.....of .....aged .....
   resident of ..... is a near relative to the donor as.....

   Dated .....

FORM 6

[see rule 4(2) (b)]

I, ……..…. s / o, w / o, d / o Shri ……aged…… resident of ……..having lawful possession of the dead body of Shri/Smt./Km. ……..s / o, w / o, d / o Shri …… aged …….. residen of …… having known that the deceased has not expressed any objection to his / her organ / organs being removed for therapeutic purposes after his / her death and also having reasons to believe that no near relative of the said deceased person has objection to any of his / her organs being used for therapeutic purposes, authorize removal of his / her body organs, namely, …….

Signature

Person in lawful possession of the dead body

Address……..

Date ……

Place ……

FORM -7

[(See rule 4(2) (b)]

I, Mr/ Mrs./Miss.....having lawful possession of the deadbody of Mr/ Mrs./Miss.....son of/ daughter of / wife of .... aged ..... resident of .....after having known that the objection was expressed by the deceased to any of his human organs being used after is death for therapeutic purposes and having reason to believe of deceased person has objection to any of the deceased person's organs being used for therapeutic purposes, hereby authorise the removal of the deceased's organ, namely, …… for therapeutic purposes.

Signature .....

Name .....

Address .....

.....

Time & Date .....

FORM 8

[see rule 4(3) (a) and (b)]

We, the following members of the Board of Medical Experts after careful personal examination, hereby certify that Shri/ Smt. / Km. ……. aged about …… s / o, w /o, d / o, Shri ……..…… resident of …… is dead on account of permanent and irreversible cessation of all functions of the brain-stem. The tests carried out by us and the findings therein are recorded in the brain-stem death certificate annexed hereto.

Date ……. Signature……...

1. R.M.P., Incharge of the Hospital in which brain-stem death has occurred.

2. R.M.P., nominated from the panel of names approved by the Appropriate Authority.

3. Neurologist / Neuro-Surgeon nominated from the panel of names approved by the Appropriate Authority.

4. R.M.P., treating the aforesaid deceased person.

BRAIN-STEM DEATH CERTIFICATE

(A) Patient Details:

1. Name of the Patient Shri/ Smt ./ Km. …….....

S.O. / W.O. / D.O. Shri ……

Sex…… Age…….

2. Home Address
…….....
.....
.....
.....

3. Hospital Number ……...

4. Name and address of next of kin or person responsible for the patient (if none exists, this must be specified)

……
……
……
……....

5. Has the patient or next of kin agreed to any transplant ?

……
……

6. Is this a Police Case? Yes……No……...

(B) Pre-Conditions:

1. Diagnosis: Did the patient suffer from any illness or accident that led to irreversible brain damage? Specify
   Details…….
   …….

Date and time of accident/onset of illness …….

Date and onset of non-responsible coma ……...

2. Findings of Board of Medical Experts:

(1) The following reversible cause of coma have been excluded:-

Intoxication (Alcohol)

Depressant Drugs

Relaxants (Neuromuscular blocking agents)

	first Medical Examination		Second Medical Examination	
	1st	2nd	1st	2nd
Primary hypothermia				
Hypovolaemic shock				

Metabolic of endocrine disorders

Test for absence of brain-stem functions

2. Coma
3. Cessation of spontaneous breathing
4. Pupillary size
5. Pupillary light reflexes
6. Doll's head eye movements
7. Corneal reflexes (Both sizes)
8. Motor response in any cranial nerve distribution, any responses to stimulation of face, limb or trunk
9. Gag reflex
10. Cough (Tracheal)
11. Eye movements on coloric testing bilaterally
12. Apnoea tests as specified
13. Were any respiratory movements seen ?

Date and time of first testing: ……...

Date and time of second testing: ……..

This is to certify that the patient has been carefully examined twice after an interval of about six hours and on the basis of findings recorded above,

Shri / Smt / Km. …… is declared brain-steam dead.

Signature ……..

1. Medical Administrator Incharge of the hospital.
2. Authorised Specialist.
3. Neurologist / Neuro-Surgeon.
4. Medical Officer treating the patient.

N.B. I. The Minimum time interval between the first testing and second testing will be six hours.

II. No. 2 and No. 3 will be co-opted by the Administrator Incharge of the hospital from the panel of experts approved by the Appropriate Authority.

FORM 9

[see rule 4(3) (a) (b)]

I, Shri/Smt. ……s / o. w / o, Shri …… resident of …… hereby authorize removal of the organ / organs, namely, ……...for therapeutic purpose from the dead body of my son / daughter Shri / Km. ……...aged …… Whose brain-stem death has been duly certified in accordance with the law.

Signature …….

Name …….

Place ……

Date …….

FORM 10

APPLICATION FOR APPROVAL FOR TRANSPLANTATION (LIVE DONOR)

[To be completed by the proposed recipient and the proposed donor]

[see Rule 4(1) (a) (b)]

To be self attested across the affixed photograph	To be self attested across the affixed photograph
Photograph of the Doctor (Self-attested)	Photograph of the recipient (Self-attested)

Whereas I …….. S / o, D / o, W /o, Shri/Smt. …… aged …….. residing at …… have been advised by my doctor ……..…….. that I am suffering form ……. and may be benefited by transplantation of ……. into my body.

And Whereas I ……. S / o, D / o, W / o, Shri / Smt. …… aged …….. residing at …….. by the following reason (s): -

(a) by virtue of being a near relative i.e. ……..

(b) by reason of affection / attachment / other special reason as explained below:-

……
……

I would therefore like to donate my (name of the organ) ……..to Shri / Smt. ……We …….. and ……..……...

(Donor) (Recipient)

hereby apply to Authorisation Committee for permission for such transplantation to be carried out.

We solemnly affirm that the above decision has been taken without any undue pressure, inducement, influence or allurement and that all possible consequences and options of organ transplantation have been explained to us.

Instructions for the applications: -

1. Form 10 must be submitted along with the completed Form 1(A), or Form 1(B) or Form 1 (C) as may be applicable.

2. The applicable Form i.e. From1(A) or Form 1(B) or Form 1(C), as the case may be, should be accompanied with all documents mentioned in the applicable form and all relevant queries set out in the applicable form must be adequately answered.

3. Completed Form 3 to be submitted along with the laboratory report.

4. The doctor's advice recommending transplantation must be enclosed with the application.

5. In addition to above, in case the proposed transplant is between unrelated persons, appropriate evidence of vocation and income of the donor as well as the recipient for the last three years must be enclosed with this application. It is clarified that the evidence of income does not necessarily mean the proof of income-tax returns, keeping in view that the applicant(s) in a given case may not be filing income-tax returns.

6. The application shall be accepted for consideration by the Authorisation Committee only if it is complete in all respects and any omission of the documents or the information required in the forms mentioned above, shall render the application incomplete.

7. As per the Supreme Court's judgement dt. 31-3-2005, the approval/No Objection Certificate from the concerned State / Union Territory Government or Authorisation Committees is mandatory from the domicile State / Union Territory of donor as well as recipient. It is understood that final approval for transplantation should be granted by the Authorisation Committee / Registered Medical Practitioner i.e. Incharge of transplant center (as the case may be) where transplantation should be done.

We have read and understood the above instructions.

Signature of the Prospective Donor	Signature of the Prospective Recipient
Date …… …….	Date……..
Place …….	Place…….

FORM 11

APPLICATION FOR REGISTRATION OF HOSPITAL TO CARRY

OUT ORGAN TRANSPLANTATION

To

The Appropriate Authority for organ transplantation……. (State or Union Territory)

We hereby apply to be recognized as an institution to carry out organ transplantation. The required data about the facilities available in the hospital are as follows: -

(A) Hospital

1. Name ……
2. Location……
3. Govt. /Pvt……..
4. Teaching/Non-teaching…….
5. Approached by:

Road:	Yes	No
Rail:	Yes	No
Air:	Yes	No

6. Total bed strength: …….
7. Name of the disciplines in the hospital……
8. Annualbudget …….
9. Patient turnover / year …….

(B) Surgical Team

1. No. ofbeds ……
2. No. of permanent staff members with their designations……..
3. No. of temporary staff with their designations……..
4. No. of operations done per year ……
5. Trained persons available for transplantation (Please specify organ for transplantation)

(C) Medical Team

1. No. of beds ……
2. No. of permanent staff members with their designations……..
3. No. of temporary staff members with their designations……...
4. Patient turnover per year ……..….
5. No. of potential transplant candidates admitted per year. …….

(D) Anaesthesiology

1. No. of permanent staff members with their designations……
2. No. of temporary staff members with their designations ……
3. Name and No. of operations performed …….
4. Name and No. of equipments available ……..…
5. Total No. of operation theatres in the hospital ……
6. No. of emergency operation theatres ……...
7. No. of separate transplant operation theatres ……..

(E) I.C.U./H.D.U. Facilities

1. ICU/HDU facilities: Present ……..... Not present…….

2. No. of ICU beds ……..……..

3. Trained Nurses ……..

Technicians ……..……..

4. Name and number of equipments in ICU ……..….

(F) Other supportive Facilities

Data about facilities available in the hospital. ……

(G) Laboratory Facilities

1. No. of permanent staff with their designations. …….
2. No. of temporary staff with their designations. …….
3. Names of the investigations carried out in the Deptt. …….
4. Name and no of equipments available. …….

(H) Imaging Services

1. No. of permanent staff with their designations. …….
2. No. of temporary staff with their designations. …….
3. Names of the investigations carried out in the Deptt. …….
4. Name and no of equipments available. …….

(I) Haematology services

1. No. of permanent staff with their designations. …….
2. No. of temporary staff with their designations. …….
3. Names of the investigations carried out in the Deptt. …….
4. Name and no of equipments available. …….

(J) Blood Bank Facilities Yes …… No ……

(K) Dialysis Facilities Yes. …… No ……

(L) Other Personnel

1. Nephrologist	Yes/No
2. Neurologist	Yes/No
3. Neuro-Surgeon	Yes/No
4. Urologist	Yes/No
5. G.I. Surgeon	Yes/No
6. Paediatrician	Yes/No
7. Physiotherapist	Yes/No
8. Social Worker	Yes/No
9. Immunologists	Yes/No
10. Cardiologist	Yes/No

The above said information is true to the best of my knowledge and I have no objection to any scrutiny of our facility by authorized personnel. A Bank Draft / Cheque of Rs. 1,000/- is being enclosed.

Head of the Institution.

FORM 12

CERTIFICATE OF REGISTRATION

This is to certify that …….. hospital located at ……..……...

has been inspected by the Appropriate Authority and certificate of registration is granted for performing the organ transplantation of the following organs: -

1. ……..
2. …….
3. …….
4. …….

This certificate of registration is valid for a period of five years form the date of issue.

Signature …… Signature ……...

FORM 13

[see sub-rule 8(2)]

OFFICE OF THE APPROPRIATE AUTHORITY

This is with reference to the application, dated …….. form ……. (Name of the hospital) for renewal of certificate of registration for performing organ transplantation, under the Act.

After having considered the facilities and standards of the above said hospital, the Appropriate Authority hereby renews the certificate of registration of the said hospital for the purpose of performing organ transplantation for a period of five years.

Appropriate authority……

Place …….

Date ……..…

* * * * * *

APPENDIX 3

Transplantation of Human Organ (Amendment) Act 2011

Bill No. 136-C of 2009

THE TRANSPLANTATION OF HUMAN ORGANS (AMENDMENT) BILL, 2011

A

BILL

to amend the Transplantation of Human Organs Act, 1994.

WHEREAS it is expedient to amend the said law enacted by Parliament relating to regulation of removal, storage and transplantation of human organs for therapeutic purposes and for prevention of commercial dealings in human organs;

AND WHEREAS Parliament has no power to make or amend laws for the States with respect to any of the matters aforesaid except as provided in articles 249 and 250 of the Constitution;

AND WHEREAS in pursuance of clause (1) of article 252 of the Constitution, resolutions have been passed by all the Houses of the Legislatures of the States of Goa, Himachal Pradesh and West-Bengal to the effect that the aforesaid Act should be amended by Parliament;

BE it enacted by Parliament in the Sixty-second Year of the Republic of India as follows:—

Short title, application and commencement.

1. (*1*) This Act may be called the Transplantation of Human Organs (Amendment) Act, 2011.

(*2*) It applies, in the first instance, to the whole of the States of Goa, Himachal Pradesh and West Bengal and to all the Union territories and it shall also apply to such other State which adopts this Act by resolution passed in that behalf under clause (*1*) of article 252 of the Constitution.

(*3*) It shall come into force in the State of Goa, Himachal Pradesh and West Bengal and in all the Union territories on such date as the Central Government may, by notification, appoint and in any other State which adopts this Act under clause (*1*) of article 252 of the Constitution on the date of such adoption; and any reference in this Act to the commencment of this Act shall, in relation to any State or Union terriotry, means the date on which this Act comes into force in such State or Union territory.

Amendment of long title.

2. In the Transplantation of Human Organs Act, 1994 (hereinafter referred to as the principal Act), in the long title, for the words "human organs for therapeutic purposes and for the prevention of commercial dealings in human organs", the words "human organs and tissues for therapeutic purposes and for the prevention of commercial dealings in human organs and tissues" shall be substituted. 42 of 1994.

Amendment of section 1.

3. In section 1 of the principal Act, in sub-section (*1*), for the words "Human Organs", the words "Human Organs and Tissues" shall be substituted.

Substitution of references to certain expressions by certain other expressions.

4. Throughout the principal Act [except clause (*h*) of section 2, sub-section (*5*) of section 9, sub-section (*1*) of section 18 and section.], unless otherwise expressly provided, for the words "human organ" and "human organs", wherever they occur, the words "human organ or tissue or both" and "human organs or tissues or both" shall respectively be substituted with such consequential amendments as the rules of grammar may require.

Amendment of section 2.

5. In section 2 of the principal Act,—

(*a*) after clause (*h*), the following clauses shall be inserted, namely:—

(*ha*) "Human Organ Retrieval Centre" means a hospital,—

(*i*) which has adequate facilities for treating seriously ill patients who can be potential donors of organs in the event of death; and

(*ii*) which is registered under sub-section (*1*) of section 14 for retrieval of human organs;

(*hb*) "minor" means a person who has not completed the age of eighteen years;

(*b*) for clause (*i*), the following clause shall be substituted, namely:—

'(*i*) "near relative" means spouse, son, daughter, father, mother, brother, sister, grandfather, grandmother, grandson or granddaughter;';

(*c*) in clause (*o*), the word "and" shall be omitted;

(*d*) after clause (*o*), the following clauses shall be inserted, namely:—

'(*oa*) "tissue" means a group of cells except blood performing a particular function in the human body;

(*ob*) "Tissue Bank" means a facility registered under section 14A for carrying out any activity relating to the recovery, screening, testing, processing, storage and distribution of tissues, but does not include a Blood Bank;'

(*e*) after clause (*p*), the following clause shall be inserted namely:—

(*pa*) "transplant co-ordinator" means a person appointed by the hospital for co-ordinating all matters relating to removal or transplantation of human organs or tissues or both and for assisting the authority for removal of human organs in accordance with the provisions of section 3.

Amendmnet of section 3.

6. In section 3 of the principal Act,—

(*a*) after sub-section (*1*), the following sub-sections shall be inserted, namely:—

(*1A*) For the purpose of removal, storage or transplantation of such human organs or tissues or both, as may be prescribed, it shall be the duty of the registered

medical practitioner working in a hospital, in consultation with transplant co-ordinator, if such transplant co-ordinator is available,—

(*i*) to ascertain from the person admitted to the Intensive Care Unit or from his near relative that such person had authorised at any time before his death the removal of any human organ or tissue or both of his body under sub-section (*2*), then the hospital shall proceed to obtain the documentation for such authorisation in such manner as may be prescribed;

(*ii*) where no such authority as referred to in sub-section (*2*) was made by such person, to make aware in such manner as may be prescribed to that person or near relative for option to authorise or decline for donation of human organs or tissues or both;

(*iii*) to require the hospital to inform in writing to the Human Organ Retrieval Centre for removal, storage or transplantation of human organs or tissues or both, of the donor identified in clauses (*i*) and (*ii*) in such manner as may be prescribed.

(*1B*) The duties mentioned under clauses (*i*) to (*iii*) of sub-section (*1A*) from such date, as may prescribed, shall also apply in the case of registered medical practitioner working in an Intensive Care Unit in a hospital which is not registered under this Act for the purpose of removal, storage or transplantation of human organs or tissues or both.";

(*b*) in sub-section (*4*), the following proviso shall be inserted, namely:—

"Provided that a technician possessing such qualifications and experience, as may be prescribed, may enucleate a cornea.";

(*c*) in sub-section (*6*), in clause (*iii*),—

(*i*) the word "and" shall be omitted; and

(*ii*) the following proviso shall be inserted, namely:—

"Provided that where a neurologist or a neurosurgeon is not available, the registered medical practitioner may nominate an independent registered medical practitioner, being a surgeon or a physician and an anaesthetist or intensivist subject to the condition that they are not members of the transplantation team for the concerned recipient and to such conditions as may be prescribed;".

Amendment of section 9.

7. In sectin 9 of the principal Act,—

(*a*) after sub-section (*1*), the following sub-section shall be inserted, namely:—

"(*1A*) Where the donor or the recepient being near relative is a foreign national, prior approval of the Authorisation Committee shall be required before removing or transplanting human organ or tissue or both:

Provided that the Authorisation Committee shall not approve such removal or transplantation if the recipient is a foreign national and the donor is an Indian national unless they are near relatives.

(*1B*) No human organs or tissues or both shall be removed from the body of a minor before his death for the purpose of transplanation except in the manner as may be prescribed.

(*1C*) No human organs or tissues or both shall be removed from the body of a mentally challenged person before his death for the purpose of tranplantation.

Explanation.— For the purpose of this sub-section,—

(*i*) the expression "mentally challenged person" includes a person with mental illness or mental retardation, as the case may be;

(*ii*) the expression "mental illness" includes dementia, schizophrenia and such other mental condition that makes a person intellectually disabled;

(*iii*) the expression "mental retardation" shall have the same meaning as assigned to it in clause (*r*) of section 2 of the Persons With Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995."; 1 of 1996.

(*b*) after sub-section (*3*), the following sub-section shall be inserted, namely:—

"(*3A*) Notwithstanding anything contained in sub-section (*3*), where—

(*a*) any donor has agreed to make a donation of his human organ or tissue or both before his death to a receipient, who is his near relative, but such donor is not compatible biologically as a donor for the receipient; and

(*b*) the second donor has agreed to make a donation of his human organ or tissue or both before his death to such recipient, who is his near relative, but such donor is not compatible biologically as a donor for such recipient; then

(*c*) the first donor who is compatible biologically as a donor for the second recipient and the second donor is compatible biologically as a donor of a human organ or tissues or both for the first recipient and both donors and both recipients in the aforesaid group of donor and recipient have entered into a single agreement to donate and receive such human organ or tissue or both according to such biological compatibility in the group,

the removal and transplantation of the human organ or tissue or both, as per the agreement referred to above, shall not be done without prior approval of the Authorisation Committee.";

(*c*) for sub-section (*4*), the following sub-section shall be substituted, namely:—

"(*4*)(*a*) The composition of the Authorisation Committees shall be such as may be prescribed by the Central Government from time to time.

(*b*) The State Government and the Union territories shall constitute, by notification, one or more Authorisation Committees consisting of such members as may be nominated by the State Governments and the Union territories on such terms and conditions as may be specified in the notification for the purposes of this section.".

Amendment of section 10.

8. In section 10 of the principal Act, in sub-section (*1*),—

(*a*) in clause (*b*), the word "and" occurring at the end shall be omitted;

(*b*) in clause (*c*), the word "and" shall be inserted at the end;

(*c*) after clause (*c*), the following clause shall be inserted, namely:—

(*d*) no Tissue Bank, unless registered under this Act, shall carry out any activity relating to the recovery, screening, testing, processing, storage and distribution of tissues.

Amendment of section 13.

9. In section 13 of the principal Act, in sub-section (*3*),—

(*a*) for clause (*iii*), the following clause shall be substituted, namely:—

"(*iii*) to enforce such standards, as may be prescribed,—

(*A*) for hospitals engaged in the removal, storage or transplantation of any human organ;

(*B*) for Tissue Banks engaged in recovery, screening, testing, processing, storage and distribution of tissues;";

(*b*) after clause (*iv*), the following clause shall be inserted, namely:—

(*iva*) to inspect Tissue Banks periodically;'.

Insertion of new sections 13A, 13B, 13C and 13D.

10. After section 13 of the principal Act, the following section be inserted, namely:—

Advisory Committees to advice Appropriate Authority.

"13A. (*1*) The Central Government and the State Governments, as the case may be, by notification, shall constitute an Advisory Committee for a period of two years to aid and advise the Appropriate Authority to discharge its functions.

(*2*) The Advisory Committee shall consist of—

(*a*) one administrative expert not below the rank of Secretary to the State Government, to be nominated as Chairperson of the Advisory Committee;

(*b*) two medical experts have such qualifications as may be prescribed;

(*c*) one officer not below the rank of a Joint Director to represent the Ministry or Department of Health and Family Welfare, to be designated as Member-Secretary;

(*d*) two eminent social workers of high social standing and integrity, one of whom shall be from amongst representatives of women's organisation;

(*e*) one legal expert who has held the position of an Additional District Judge or equivalent;

(*f*) one person to represent non-governmental organisations or associations which are working in the field or organ or tissue donations or human rights;

(*g*) one specialist in the field of human organ transplantation, provided he is not a member of the transplantation team.

(*3*) The terms and conditions for appointment to the Advisory Committee shall be such as may be prescribed by the Central Government.

Power of Appropriate Authority.

13B. The Appropriate Authority shall for the purposes of this Act shall all the 5 of 1908 powers of a civil court trying a suit under the Code of Civil Procedure, 1908 and, in particular, in respect of the following matters, namely:—

(*a*) summoning of any person who is in possession of any information relating to violation of the provisions of this Act or the rules made thereunder;

(*b*) discovery and production of any document or material object;

(*c*) issuing search warrant for any place suspected to be indulging in unauthorised removal, procurement or transplantation of human organs or tissues or both; and

(*d*) any other matter which may be prescribed.

National Human Organs and Tissues Removal and Storage Network.

13C. **The Central Government may, by notification, establish a National Human Organs and Tissues Removal and Storage Network at one or more places and Regional Network in such manner and to perform such functions, as may be prescribed.**

National registry.

13D. The Central Government shall maintain a national registry of the donors and recipients of human organs and tissues and such registry shall have such information as may be prescribed to an ongoing evaluation of the scientific and clinical status of human organs and tissues.".

Amendment of section 14.

11. In section 14 of the principal Act,—

(*a*) in sub-section (*1*), *for* the words "No hospital", the words "No hospital (including Human Organ Retrieval Centre)" shall be substituted;

(*b*) after sub-section (*3*), the following sub-section shall be inserted, namely:—

"(*4*) No hospital shall be registered under this Act, unless the Appropriate Authority is satisfied that such hospital has appointed a transplant coordinator having such qualifications and experience as may be prescribed.

Insertion of new section 14A.

12. After section 14 of the principal Act, the following section shall be inserted, namely:—

Registration of Tissue Bank.

14A. (*1*) No Tissue Bank shall, after the commencement of the Transplantation of Human Organs (Amendment) Act, 2011, commence any activity relating to the recovery, screening, testing, processing, storage and distribution of tissues unless it is duly registered under this Act:

Provided that any facility engaged, either partly or exclusively, in any activity relating to the recovery, screening, testing, processing, storage and distribution of tissues immediately before the commencement of the Transplantation of Human Organs (Amendment) Act, 2011, shall apply for registration as Tissue Bank within sixty days from the date of such commencement:

Provided further that such facility shall cease to engage in any such activity on the expiry of three months from the date of commencement of the Transplantation of Human Organs (Amendment) Act, 2011, unless such Tissue bank has applied for registration and is so registered, or till such application is disposed of, whichever is earlier.

(*2*) Every application for registration under sub-section (*1*) shall be made to the Appropriate Authority in such form and in such manner and shall be accompanied by such fees as may be prescribed.

(*3*) No Tissue Bank shall be registered under this Act unless the Appropriate authority is satisfied that such Tissue Bank is in a position to provide such specialised services and facilities, possess such skilled manpower and equipments and maintain such standards as may be prescribed.".

Amendment of section 15.

13. In section 15 of the principal Act, in sub-section (*1*), for the words "grant to the hospital", the words "grant to the hospital or to the Tissue Bank, as the case may be," shall be inserted.

Amendment of section 16.

14. In section 16 of the principal Act, for the work "hospital", wherever it occurs, the words "hospital or Tissue Bank, as the case may be," shall be substituted,' or

Amendment of section 17.

15. In section 17 of the principal Act, after the words, brackets and figure "under sub-section (*6*) of section 9, or any hospital", the words "or Tissue Bank, as the case may be," shall be inserted.

Amendment of section 18.

16. In section 18 of the principal Act,—

(*a*) in sub-section (*1*), for the words "five years and with fine which may extend to ten thousand rupees", the words "ten years and with fine which may extend to twenty lakh rupees" shall be substituted;

(*b*) in sub-section (*2*), for the words "two years", the words "three years" shall be substituted.

(*c*) after sub-section (*2*), the following sub-section shall be inserted, namely:—

(*3*) Any person who renders his services to or at any hospital and who conducts, or associates with or helps in any manner in the removal of human tissues without authority, shall be punishable with imprisonment for a term which may extend to three years and with fine which may extend to five lakh rupees.

Amendment of section 19.

17. In section 19 of the principal Act,—

(*a*) after clause (*f*), the following clause shall be inserted, namely:—

"(*g*) abets in the preparation or submission of false documents including giving false affidavits to establish that the donor is making the donation of the human organs, as a near relative or by reason of affection or attachment towards the recipient.";

(*b*) for the words "two years but which may extend to seven years and shall be liable to fine which shall not be less than ten thousand rupees but may extend to twenty thousand rupees", the words "five years but which may extend to ten years and shall be liable to fine which shall not be less than twenty lakh rupees but may extend to one crore rupees" shall be substituted;

(*c*) the proviso shall be omitted.

Insertion of new section 19A.

18. After section 19 of the principal Act, the following section shall be inserted, namely:—

Punishment for illegal dealings in human tissues.

"19A. Whoever—

(*a*) makes or receives any payment for the supply of, or for an offer to supply, any human tissue; or

(*b*) seeks to find person willing to supply for payment and human tissue; or

(*c*) offers to supply any human tissue for payment; or

(*d*) initiates or negotiates any arrangement involving the making of any payment for the supply of, or for an offer to supply, any human tissue; or

(*e*) takes part in the management or control of a body of persons, whether a society, firm or company, whose activities consist of or include the initiation or negotiation of any arrangement referred to in clause (d); or

(*f*) publishes or distributes or causes to be published or distributed any advertisement—

(*i*) inviting persons to supply for payment of any human tissue; or

(*ii*) offering to supply any human tissue for payment; or

(*iii*) indicating that the advertiser is willing to initiate or negotiate any arrangement referred to in clause (d); or

(*g*) abets in the preparation or submission of false documents including giving false affidavits to establish that the donor is making the donation of the human tissues as a near relative or by reason of affection or attachment towards the recipient,

shall be punishable with imprisonment for a term which shall not be less than one year but which may extend to three years and shall be liable to fine which shall not be less than five lakh rupees but which may extend to twenty-five lakh rupees.".

Amendment of section 20.

19. In section 20 of the principal Act, for the words "three years or with fine which may extend to five thousand rupees", the words "five years or with fine which may extend to twenty lakh rupees" shall be substituted.

Amendment of section 24.

20. In section 24 of the principal Act, in sub-section (*2*),—

(*a*) after clause (*a*), the following clauses shall be inserted, namely:—

(*aa*) the human organs or tissues or both in respect of which duty is cast on registered medical practitioner, the manner of obtaining documentation for authorisation under clause (*i*) of sub-section (*1A*) of section 3;

(*ab*) the manner of making the donor or his relative aware under clause (*ii*) of sub-section (*1A*) of section 3;

(*ac*) the manner of informing the Human Organ Removal Centre under clause (*iii*) of sub-section (*1A*) of section 3;

(*ad*) the date from which duties mentioned in sub-section (*1A*) are applicable to registered medical practitioner working in a unregistered hospital under sub-section (*1B)* of section 3;

(*ae*) the qualifications and experience of a technician under the proviso to sub-section (*4*) of section 3;";

(*b*) after clause (*b*), the following clause shall be inserted, namely:—

"(*ba*) the conditions for nomination of a surgeon or a physician and an anaesthetist or intensivist to be included in the Board of medical experts under the proviso to clause (iii) of sub-section (*6*) of section 3;";

(*c) after clause (e*) the following clauses shall be inserted, namely:—

"(*ea*) the manner of removal of human organs or tissues or both from the body of a minor before his death for transplantation under sub-section (*1B*) of section 9;

(*eb*) the composition of the Authorisation Committees under sub-section (*4*) of section 9;";

(*d*) after clause (*i*), the following clauses shall be inserted, namely:—

"(*ia*) the qualifications of medical experts and the terms and conditions for appointment to Advisory Committee under sub-sections (*2*) and (*3*) of section 13A;

(*ib*) the power of the Appropriate Authority in any other matter under clause (*d*) of section 13B;

(*ic)* the manner of establishment of a National Human Organs and Tissues Removal and Storage Network and Regional Network and functions to be performed by them under section 13C;

(*id)* the information in the national registry of the donors and recipients of human organs and tissues and all information under section 13D;";

(*e*) after clause (*k*), the following clauses shall be inserted, namely:—

"(*ka*) the qualifications and experience of a transplant coordinator under sub-section (*4*) of section 14;

(*kb*) the form and the manner in which an application for registration shall be made, and the fee which shall be accompanied, under sub-section (*2*) of section 14A;

(*kc*) the specialised services and the facilities to be provided skilled manpower and the equipments to be possessed and the standards to be maintained by a Tissue Bank, under sub-section (*3*) of section 14A;";

(*f*) in clause (*l*), for the word "hospital", the words "hospital or Tissue Bank" shall be substituted.

LOK SABHA

———

A

BILL

to amend the Transplantation of Human Organs Act, 1994.

———

(*As passed by Lok Sabha*)

GMGIPMRND—1150LS(S3)—12-08-2011.

APPENDIX 4

Transplantation of Human Organ and Tissue Rule 2014

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
भाग II—खण्ड 3—उप-खण्ड (i)
PART II—Section 3—Sub-section (i)
प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

सं. 161] नई दिल्ली, बृहस्पतिवार, मार्च 27, 2014/चैत्र 6, 1936
No. 161] NEW DELHI, THURSDAY, MARCH 27, 2014/CHAITRA 6, 1936

अरुण के.पण्डा, संयुक्त सचिव

MINISTRY OF HEALTH AND FAMILY WELFARE
NOTIFICATION

New Delhi, the 27th March, 2014.

G.S.R. 218 (E).— In exercise of the powers conferred by section 24 of the Transplantation of Human Organs Act, 1994 (42 of 1994) and in supersession of the Transplantation of Human Organs Rules, 1995, except as respects things done or omitted to be done before such supersession, the Central Government hereby makes the following rules, namely:-

1. **Short title and commencement —** (1) These rules may be called the Transplantation of Human Organs and Tissues Rules, 2014.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. Definitions: - In these rules unless the context otherwise requires**,—**

(a) "Act" means the Transplantation of Human Organs Act, 1994;

(b) "cadaver(s)", "organ(s)" and "tissue(s)" means human cadaver(s), human organ(s) and human tissue(s), respectively;

(c) "competent authority" means the Head of the institution or hospital carrying out transplantation or committee constituted by the head of the institution or hospital for the purpose;

(d) "Form" means a Form annexed to these rules;

(e) National Accreditation Board for Testing and Calibration Laboratories (NABL) means the autonomous body established under the aegis of Department of Science and Technology, Government of India with the objective to provide Government, Regulators and Industry with a scheme of laboratory accreditation through third-party assessment for formally recognising the technical competence of laboratories and the accreditation services are provided for testing and calibration of medical laboratories in accordance with International Organisation for Standardisation (ISO) Standards;

(f) "the technician who can enucleate cornea" means the technician with any of the following qualifications and experience who can harvest corneas (enucleate eyeballs or excise corneas), namely:-

(i) Ophthalmologists possessing a Doctor of Medicine (M.D) or Master of Surgery (M.S) in Ophthalmology or Diploma in Ophthalmology (D.O.); and

(ii) registered Doctors from all recognised systems of medicine, Nurses, Paramedical Ophthalmic Assistant, Ophthalmic Assistant, Optometrists, Refractionists, Paramedical Worker or Medical Technician with recognised qualification from all recognised systems of medicine, provided the person is duly trained to enucleate a donated cornea or eye from registered, authorised and functional eye Bank or Government medical college and, the training certificate should mention that he has acquired the required skills to independently conduct enucleation of the eye or removal of cornea from a cadaver;

(g) words and expressions used and not defined in these rules, but defined in the Act, shall have the same meanings, respectively, assigned to them in the Act.

3. Authority for removal of human organs or tissues.—Subject to the provisions of Section 3 of the Act, a living person may authorise the removal of any organ or tissue of his or her body during his or her lifetime as per prevalent medical practices, for therapeutic purposes in the manner and on such conditions as specified in Form 1, 2 and 3.

4. Panel of experts for brain-stem death certification.—For the purpose of certifying the brain-stem death, the Appropriate Authority shall maintain a panel of experts, in accordance with the provisions of the Act, to ensure efficient functioning of the Board of Medical Experts and it remains fully operational.

5. Duties of the registered medical practitioner.— (1) The registered medical practitioner of the hospital having Intensive Care Unit facility, in consultation with transplant coordinator, if available, shall ascertain, after certification of brain stem death of the person in Intensive Care Unit, from his or her adult near relative or, if near relative is not available, then, any other person related by blood or marriage, and in case of unclaimed body, from the person in lawful possession of the body the following, namely:-

(a) whether the person had, in the presence of two or more witnesses (at least one of who is a near relative of such person), unequivocally authorised before his or her death as specified in Form 7 or in documents like driving license, etc. wherein the provision for donation may be incorporated after notification of these rules, the removal of his or her organ(s) or tissue(s) including eye, after his or her death, for therapeutic purposes and there is no reason to believe that the person had subsequently revoked the aforesaid authorisation;

(b) where the said authorisation was not made by the person to donate his or her organ(s) or tissue(s) after his or her death, then the registered medical practitioner in consultation with the transplant coordinator, if available, shall make the near relative or person in lawful possession of the body, aware of the option to authorise or decline the donation of such human organs or tissues or both (which can be used for therapeutic purposes) including eye or cornea of the deceased person and a declaration or authorisation to this effect shall be ascertained from the near relative or person in lawful possession of the body as per Form 8 to record the status of consent, and in case of an unclaimed body, authorisation shall be made in Form 9 by the authorised official as per sub-section (1) of section 5 of the Act;

(c) after the near relative or person in lawful possession of the body authorises removal and gives consent for donation of human organ(s) or tissue(s) of the deceased person, the registered medical practitioner through the transplant coordinator shall inform the authorised registered Human Organ Retrieval Centre through authorised coordinating organisation by available documentable mode of communication, for removal, storage or transportation of organ(s) or tissue(s).

(2) The above mentioned duties shall also apply to the registered medical practitioner working in an Intensive Care Unit in a hospital not registered under this Act, from the date of notification of these rules.

(3) The registered medical practitioner shall, before removing any human organ or tissue from a living donor, shall satisfy himself –

(a) that the donor has been explained of all possible side effects, hazards and complications and that the donor has given his or her authorisation in appropriate Form 1 for near relative donor or Form 2 for spousal donor or Form 3 for donor other than near relative;

(b) that the physical and mental evaluation of the donor has been done, he or she is in proper state of health and it has been certified that he or she is not mentally challenged and that he or she is fit to donate the organ or tissue:
Provided that in case of doubt regarding mentally challenged status of the donor the registered medical practitioner may get the donor examined by a psychiatrist and the registered medical practitioner shall sign the certificate as prescribed in Form 4 for this purpose;

(c) that the donor is a near relative of the recipient, as certified in Form 5, and that he or she has submitted an application in Form 11 jointly with the recipient and that the proposed donation has been approved by the competent authority as defined at rule 2(c) and specified in Form 19 and that the necessary documents as prescribed and medical tests, as required, to determine the factum of near relationship, have been examined to the satisfaction of the registered medical practitioner and the competent authority;

(d) that in case the recipient is spouse of the donor, the donor has given a statement to the effect that they are so related by signing a certificate in Form 2 and has submitted an application in Form 11 jointly with the recipient and that the proposed donation has been approved by the competent authority under the provisions of sub-rule (2) of rule 7;

(e) that in case of a donor who is other than a near relative and has signed Form 3 and submitted an application in Form 11 jointly with the recipient, the permission from the Authorisation Committee for the said donation has been obtained;

(f) that if a donor or recipient is a foreign national, the approval of the Authorisation Committee for the said donation has been obtained;

(g) living organ or tissue donation by minors shall not be permitted except on exceptional medical grounds to be recorded in detail with full justification and with prior approval of the Appropriate Authority and the State Government concerned.

(4) A registered medical practitioner, before removing any organ or tissue from the body of a person after his or her death (deceased donor), in consultation with transplant coordinator, shall satisfy himself the following, namely:-

(a) that caution has been taken to make inquiry, from near relative or person in lawful possession of the body of a person admitted in Intensive Care Unit, only after certification of Brain Stem death of the person that the donor had, in the presence of two or more witnesses (at least one of whom is a near relative of such person),unequivocally authorised before his or her death as specified in Form 7 or in documents like driving license etc. (wherein the provision for donation may be incorporated after notification of these rules), the removal of his or her organ(s) or tissue(s) after his or her death, for therapeutic purposes and it has been ascertained that the donor has not subsequently revoked the aforesaid authorisation, and the consent of near relative or person in lawful possession of the body shall also be required notwithstanding the authorisation been made by deceased donor:
Provided that if the deceased person who had earlier given authorisation but had revoked it subsequently and if the person had given in writing that his organ should not be removed after his death, then, no organ or tissue will be removed even if consent is given by the near relative or person in lawful possession of the body;

(b) that the near relative of the deceased person or the person lawfully in possession of the body of the deceased donor has signed the declaration as specified in Form 8.

(c) that in the case of brain-stem death of the potential donor, a certificate as specified in Form 10 has been signed by all the members of the Board of Medical Experts referred to in sub-section (6) of section 3 of the Act:
Provided that where a neurologist or a neurosurgeon is not available, an anesthetist or intensivist who is not part of the transplant team nominated by the head of the hospital duly empanelled by Appropriate Authority may certify the brain stem death as a member of the said Board;

(d) that in the case of brain-stem death of a person of less than eighteen years of age, a certificate specified in Form 10 has been signed by all the members of the Board of Medical Experts referred to in sub-section (6) of section 3 of the Act and an authority as specified in Form 8 has been signed by either of the parents of such person or any near relative authorised by the parent.

6. Procedure for donation of organ or tissue in medicolegal cases.— (1) After the authority for removal of organs or tissues, as also the consent to donate organs from a brain-stem dead donor are obtained, the registered medical practitioner of the hospital shall make a request to the Station House Officer or Superintendent of Police or Deputy Inspector General of the area either directly or through the police post located in the hospital to facilitate timely retrieval of organs or tissue from the donor and a copy of such a request should also be sent to the designated post mortem doctor of area simultaneously.

(2) It shall be ensured that, by retrieving organs, the determination of the cause of death is not jeopardised.

(3) The medical report in respect of the organs or tissues being retrieved shall be prepared at the time of retrieval by retrieving doctor (s) and shall be taken on record in postmortem notes by the registered medical practitioner doing postmortem.

(4) Wherever it is possible, attempt should be made to request the designated postmortem registered medical practitioner, even beyond office timing, to be present at the time of organ or tissue retrieval.

(5) In case a private retrieval hospital is not doing post mortem, they shall arrange transportation of body along with medical records, after organ or tissue retrieval, to the designated postmortem centre and the post mortem centre shall undertake the postmortem of such cases on priority, even beyond office timing, so that the body is handed over to the relatives with least inconvenience.

7 Authorisation Committee.—(1) The medical practitioner who will be part of the organ transplantation team for carrying out transplantation operation shall not be a member of the Authorisation Committee constituted under the provisions of clauses (a) and (b) of sub-section(4) of section 9 of the Act.

(2) When the proposed donor or recipient or both are not Indian nationals or citizens whether near relatives or otherwise, the Authorisation Committee shall consider all such requests and the transplantation shall not be permitted if the recipient is a foreign national and donor is an Indian national unless they are near relatives.

(3) When the proposed donor and the recipient are not near relatives, the Authorisation Committee shall,-

(i) evaluate that there is no commercial transaction between the recipient and the donor and that no payment has been made to the donor or promised to be made to the donor or any other person;

(ii) prepare an explanation of the link between them and the circumstances which led to the offer being made;

(iii) examine the reasons why the donor wishes to donate;

(iv) examine the documentary evidence of the link, e.g. proof that they have lived together, etc.;

(v) examine old photographs showing the donor and the recipient together;

(vi) evaluate that there is no middleman or tout involved;

(vii) evaluate that financial status of the donor and the recipient by asking them to give appropriate evidence of their vocation and income for the previous three financial years and any gross disparity between the status of the two must be evaluated in the backdrop of the objective of preventing commercial dealing;

(viii) ensure that the donor is not a drug addict;

(ix) ensure that the near relative or if near relative is not available, any adult person related to donor by blood or marriage of the proposed unrelated donor is interviewed regarding awareness about his or her intention to donate an organ or tissue, the authenticity of the link between the donor and the recipient, and the reasons for donation, and any strong views or disagreement or objection of such kin shall also be recorded and taken note of.

(4) Cases of swap donation referred to under subsection (3A) of section 9 of the Act shall be approved by Authorisation Committee of hospital or district or State in which transplantation is proposed to be done and the donation of organs shall be permissible only from near relatives of the swap recipients.

(5) When the recipient is in a critical condition in need of life saving organ transplantation within a week, the donor or recipient may approach hospital in-charge to expedite evaluation by the Authorisation Committee.

8. Removal and preservation of organs or tissues.—The removal of the organ(s) or tissue(s) shall be permissible in any registered retrieval or transplant hospital or centre and preservation of such removed organ(s) or tissue(s) shall be ensured in registered retrieval or transplant centre or tissue bank according to current and accepted scientific methods in order to ensure viability for the purpose of transplantation.

9. Cost for maintenance of cadaver or retrieval or transportation or preservation of organs or tissues.—The cost for maintenance of the cadaver (brain-stem dead declared person), retrieval of organs or tissues, their transportation and preservation, shall not be borne by the donor family and may be borne by the recipient or institution or Government or non-Government organisation or society as decided by the respective State Government or Union territory Administration.

10. Application for living donor transplantation.— (1) The donor and the recipient shall make jointly an application to grant approval for removal and transplantation of a human organ, to the competent authority or Authorisation Committee as specified in Form 11 and the papers for approval of transplantation would be processed by the registered medical practitioner and administrative division of the Institution for transplantation.

(2) The competent authority or Authorisation Committee shall take a decision on such application in accordance with the rule 18.

(3) If some State wants to merge Form 11 with Form 1, Form 2 or Form 3, they may do so, provided the content of the recommended Forms are covered in the merged Form and the same is approved by the State Government concerned.

11. Composition of Authorisation Committees.—(1) There shall be one State level Authorisation Committee.

(2) Additional Authorisation Committees in the districts or Institutions or hospitals may be set up as per norms given below, which may be revised from time to time by the concerned State Government or Union territory Administration by notification.

(3) No member from transplant team of the institution should be a member of the respective Authorisation Committee.

(4) Authorisation Committee should be hospital based if the number of transplants is twenty five or more in a year at the respective transplantation centres, and if the number of organ transplants in an institution or hospital are less than twenty-five in a year, then the State or District level Authorisation Committee would grant approval(s).

12. **Composition of hospital based Authorisation Committees.—** The hospital based Authorisation Committee shall, as notified by the State Government in case of State and by the Union territory Administration in case of Union territory, consist of,—
    (a) the Medical Director or Medical Superintendent or Head of the institution or hospital or a senior medical person officiating as Head - Chairperson;
    (b) two senior medical practitioners from the same hospital who are not part of the transplant team – Member;
    (c) two persons (preferably one woman) of high integrity, social standing and credibility, who have served in high ranking Government positions, such as in higher judiciary, senior cadre of police service or who have served as a reader or professor in University Grants Commission approved University or are self-employed professionals of repute such as lawyers, chartered accountants, doctors of Indian Medical Association, reputed non-Government organisation or renowned social worker - Member;
    (d) Secretary (Health) or nominee and Director Health Services or nominee from State Government or Union territory Administration - Member.

13. **Composition of State or District Level Authorisation Committees.—** The State or District Level Authorisation Committee shall, as notified by the State Government in case of State and by the Union territory Administration in case of Union territory, consist of,—
    (a) a Medical Practitioner officiating as Chief Medical Officer or any other equivalent post in the main or major Government hospital of the District – Chairperson;
    (b) two senior registered medical practitioners to be chosen from the pool of such medical practitioners who are residing in the concerned District and who are not part of any transplant team– Member;
    (c) two persons (preferably one woman) of high integrity, social standing and credibility, who have served in high ranking Government positions, such as in higher judiciary, senior cadre of police service or who have served as a reader or professor in University Grants Commission approved University or are self-employed professionals of repute such as lawyers, chartered accountants, doctors of Indian Medical Association, reputed non-Government organisation or renowned social worker - Member;
    (d) Secretary (Health) or nominee and Director Health Services or nominee from State Government or Union territory Administration–Member :

    Provided that effort shall be made by the State Government concerned to have most of the members' ex-officio so that the need to change the composition of Committee is less frequent.

14. **Verification of residential status, etc.—**When the living donor is unrelated and if donor or recipient belongs to a State or Union territory, other than the State or Union territory where the transplantation is proposed to be undertaken, verification of residential status by Tehsildar or any other authorised officer for the purpose with a copy marked to the Appropriate Authority of the State or Union territory of domicile of donor or recipient for their information shall be required, as per Form 20 and in case of any doubt of organ trafficking, the Appropriate Authority of the State or Union territory of domicile or the Tehsildar or any other authorised officer shall inform police department for investigation and action as per the provisions of the Act.

15. **Quorum of Authorisation Committee.—** The quorum of the Authorisation Committee should be minimum four and the quorum shall not be complete without the participation of the Chairman, the presence of Secretary (Health) or nominee and Director of Health Services or nominee.

16. **Format of approval of Authorisation Committee.—** The format of the Authorisation Committee approval should be uniform in all the institutions in a State and the format may be notified by the respective State Government as per Form 18.

17. **Scrutiny of applications by Authorisation Committee.— (1)** Secretariat of the Authorisation Committee shall circulate copies of all applications received from the proposed donors and recipients to all members of the Committee along with all annexures, which may have been filed along with the applications.

(2) At the time of the meeting, the Authorisation Committee should take note of all relevant contents and documents in the course of its decision making process and in the event any document or information is found to be inadequate or doubtful, explanation should be sought from the applicant and if it is considered necessary that any fact or information requires to be verified in order to confirm its veracity or correctness, the same be ascertained through the concerned officer(s) of the State Government or Union territory Administration.

18. **Procedure in case of near relatives.— (1)** Where the proposed transplant of organs is between near relatives related genetically, namely, grandmother, grandfather, mother, father, brother, sister, son, daughter, grandson and granddaughter, above the age of eighteen years, the competent authority as defined at rule 2(c) or Authorisation Committee (in case donor or recipient is a foreigner) shall evaluate;
    (i) documentary evidence of relationship e.g. relevant birth certificates, marriage certificate, other relationship certificate from Tehsildar or Sub-divisional magistrate or Metropolitan Magistrate or

Sarpanch of the Panchayat, or similar other identity certificates like Electors Photo Identity Card or AADHAAR card; and

(ii) documentary evidence of identity and residence of the proposed donor, ration card or voters identity card or passport or driving license or PAN card or bank account and family photograph depicting the proposed donor and the proposed recipient along with another near relative, or similar other identity certificates like AADHAAR Card (issued by **Unique Identification Authority of India**).

(2) If in the opinion of the competent authority, the relationship is not conclusively established after evaluating the above evidence, it may in its discretion direct further medical test, namely, Deoxyribonucleic Acid (DNA) Profiling.

(3) The test referred to in sub-rule (2) shall be got done from a laboratory accredited with National Accreditation Board for Testing and Calibration Laboratories and certificate shall be given in Form 5.

(4) If the documentary evidences and test referred to in sub-rules (1) and (2), respectively do not establish a genetic relationship between the donor and the recipient, the same procedure be adopted on preferably both or at least one parent, and if parents are not available, the same procedure be adopted on such relatives of donor and recipient as are available and are willing to be tested, failing which, genetic relationship between the donor and the recipient will be deemed to have not been established.

(5) Where the proposed transplant is between a married couple the competent authority or Authorisation Committee (in case donor or recipient is a foreigner) must evaluate the factum and duration of marriage and ensure that documents such as marriage certificate, marriage photograph etc. are kept for records along with the information on the number and age of children and a family photograph depicting the entire family, birth certificate of children containing the particulars of parents and issue a certificate in Form 6 (for spousal donor).

(6) Any document with regard to the proof of residence or domicile and particulars of parentage should be relatable to the photo identity of the applicant in order to ensure that the documents pertain to the same person, who is the proposed donor and in the event of any inadequate or doubtful information to this effect, the Competent Authority or Authorisation Committee as the case may be, may in its discretion seek such other information or evidence as may be expedient and desirable in the peculiar facts of the case.

(7) The medical practitioner who will be part of the organ transplantation team for carrying out transplantation operation shall not be a competent authority of the transplant hospital.

(8) The competent authority may seek the assistance of the Authorisation Committee in its decision making, if required.

19. **Procedure in case of transplant other than near relatives.—**
Where the proposed transplant is between other than near relatives and all cases where the donor or recipient is foreign national (irrespective of them being near relative or otherwise), the approval will be granted by the Authorisation Committee of the hospital or if hospital based Authorisation Committee is not constituted, then by the District or State level Authorisation Committee.

20. **Procedure in case of foreigners.—**
When the proposed donor or the recipient are foreigners;

(a) a senior Embassy official of the country of origin has to certify the relationship between the donor and the recipient as per Form 21 and in case a country does not have an Embassy in India, the certificate of relationship, in the same format, shall be issued by the Government of that country;

(b) the Authorisation Committee shall examine the cases of all Indian donors consenting to donate organs to a foreign national (who is a near relative), including a foreign national of Indian origin, with greater caution and such cases should be considered rarely on case to case basis:
Provided that the Indian living donors wanting to donate to a foreigner other than near relative shall not be considered.

21. **Eligibility of applicant to donate.—** In the course, of determining eligibility of the applicant to donate, the applicant should be personally interviewed by the Authorisation Committee which shall be videographed and minutes of the interview shall be recorded.

22. **Precautions in case of woman donor.—**
In case where the donor is a woman, greater precautions ought to be taken and her identity and independent consent should be confirmed by a person other than the recipient.

23. **Decision of Authorisation Committee.—** (1) The Authorisation Committee (which is applicable only for living organ or tissue donor)should state in writing its reason for rejecting or approving the application of the proposed living donor in the prescribed Form 18 and all such approvals should be subject to the following conditions, namely:-

(i) the approved proposed donor would be subjected to all such medical tests as required at the relevant stages to determine his or her biological capacity and compatibility to donate the organ in question;

(ii) the physical and mental evaluation of the donor has been done to know whether he or she is in proper state of health and it has been certified by the registered medical practitioner in Form 4 that he or she is not mentally challenged and is fit to donate the organ or tissue:

Provided that in case of doubt for mentally challenged status of the donor the registered medical practitioner or Authorisation Committee may get the donor examined by psychiatrist;

(iii) all prescribed forms have been and would be filled up by all relevant persons involved in the process of transplantation;

(iv) all interviews to be video recorded.

(2) The Authorisation Committee shall expedite its decision making process and use its discretion judiciously and pragmatically in all such cases where, the patient requires transplantation on urgent basis.

(3) Every authorised transplantation centre must have its own website and the Authorisation Committee is required to take final decision within twenty four hours of holding the meeting for grant of permission or rejection for transplant.

(4) The decision of the Authorisation Committee should be displayed on the notice board of the hospital or Institution immediately and should reflect on the website of the hospital or Institution within twenty four hours of taking the decision, while keeping the identity of the recipient and donor hidden.

24. Registration of hospital or tissue bank.— (1) An application for registration shall be made to the Appropriate Authority as specified in Form 12 or Form 13 or Form 14 or Form 15, as applicable and the application shall be accompanied by fee as specified below, payable to the Appropriate Authority by means of a bank draft, which may be revised, if necessary by the Central or State Government, as the case may be:-

(i) for Organ or Tissue or Cornea Transplant Centre: Rupees ten thousand;

(ii) for Tissue or Eye Bank: Rupees ten thousand;

(iii) for Non-Transplant Retrieval Centre: Nil.

(2) The Appropriate Authority shall, after holding an inquiry and after satisfying itself that the applicant has complied with all the requirements, grant a certificate of registration as specified in Form 16 and it shall be valid for a period of five years from the date of its issue and shall be renewable.

(3) Before a hospital is registered under the provisions of this rule, it shall be mandatory for the hospital to appoint a transplant coordinator.

25. Renewal of registration of hospital or tissue bank.— (1) An application for the renewal of a certificate of registration shall be made to the Appropriate Authority at least three months prior to the date of expiry of the original certificate of registration and shall be accompanied by a fee as specified below, payable to the Appropriate Authority by means of a bank draft, which may be revised, if necessary by the Central or State Government, as the case may be,-

(i) for Organ or Tissue or Cornea Transplant Centre: Rupees five thousand;

(ii) for Tissue or Eye Bank: Rupees five thousand;

(iii) for Non-Transplant Retrieval Centre: Nil.

(2) A renewal certificate of registration shall be as specified in Form 17 and shall be valid for a period of five years.

(3) If, after an inquiry including inspection of the hospital or tissue bank and scrutiny of its past performance and after giving an opportunity to the applicant, the Appropriate Authority is satisfied that the applicant, since grant of certificate of registration under sub-rule (2) of rule 24 has not complied with the requirements of the Act and these rules and the conditions subject to which the certificate of registration has been granted, shall, for reasons to be recorded in writing, refuse to grant renewal of the certificate of registration.

26. Conditions and standards for grant of certificate of registration for organ or tissue transplantation centres.— (1) No hospital shall be granted a certificate of registration for organ transplantation unless it fulfills the following conditions and standards, namely:-

A. General manpower requirement specialised services and facilities:

(a) Twenty-four hours availability of medical and surgical, (senior and junior) staff;

(b) twenty-four hours availability of nursing staff (general and specialty trained);

(c) twenty-four hours availability of Intensive Care Units with adequate equipment staff and support system, including specialists in anesthesiology and intensive care;

(d) twenty-four hours availability of blood bank (in house or access) , laboratory with multiple discipline testing facilities including but not limited to Microbiology, Bio-Chemistry, Pathology,-Hematology and Radiology departments with trained staff;

(e) twenty-four hours availability of Operation Theater facilities (OT facilities) for planned and emergency procedures with adequate staff, support system and equipment;

(f) twenty-four hours availability of communication system, with power backup, including but not limited to multiple line telephones, public telephone systems, fax, computers and paper photo-imaging machine;

(g) experts (other than the experts required for the relevant transplantation) of relevant and associated specialties including but not limited to and depending upon the requirements, the experts in internal medicine, diabetology, gastroenterology, nephrology, neurology, pediatrics, gynecology, immunology and cardiology, etc., shall be available in the transplantation centre;

(h) one medical expert for respective organ or tissue transplant shall be available in the transplantation hospital; and

(i) Human Leukocyte Antigen (HLA) matching facilities (in house or outsourced) shall be available.

B. Equipments:

Equipments as per current and expected scientific requirements specific to organ (s) or tissue (s) being transplanted and the transplant centre should ensure the availability of the accessories, spare-parts and back-up, maintenance and service support system in relation to all relevant equipments.

C. Experts and their qualifications:

(a) Kidney Transplantation:

M.S. (Gen.) Surgery or equivalent qualification with three years post M.S. training in a recognised transplant center in India or abroad and having attended to adequate number of renal transplantation as an active member of team;

(b) Transplantation of liver and other abdominal organs:

M.S. (Gen.) Surgery or equivalent qualification with three years post M.S. experience in the speciality and having one year training in the respective organ transplantation as an active member of team in an established transplant center;

(c) Cardiac, Pulmonary, Cardio-Pulmonary Transplantation:

M.Ch. Cardio-thoracic and vascular surgery or equivalent qualification in India or abroad with at least three years' experience as an active member of the team performing an adequate number of open heart operations per year and well-versed with Coronary by-pass surgery and Heart-valve surgery;

(d) the hospital registered under Clinical Establishment (Registration and Regulation) Act, 2010 (23 of 2010) shall also follow the minimum standards prescribed in respect of manpower, equipment, etc., as prescribed under that Act;

(e) the hospital registered shall have to maintain documentation and records including reporting of adverse events.

(2) No hospital shall be granted a certificate of registration for tissue transplantation under the Act unless it fulfills the following conditions and standards, namely:-

(a) Cornea Transplantation:

M.D. or M.S. or Diploma (DO) in ophthalmology or equivalent qualification with three months post M.D. or M.S or DO training in Corneal transplant operations in a recognised hospital or institution;

(b) Other tissues such as heart valves, skin, bone, etc.:

Post graduate degree (MD or MS) or equivalent qualification in the respective specialty with three months post M.D. or M.S training in a recognised hospital carrying out respective tissue transplant operations and for heart valve transplantation, and the qualification and experience of expert shall be MCh degree in Cardiothoracic and Vascular Surgery (CTVS) or equivalent qualification with three months post MCh training in a recognised hospital carrying out heart valve transplantation;

(c) the Hospital registered under Clinical Establishment (Registration and Regulation) Act, 2010(23 of 2010) shall also follow the minimum standards prescribed in respect of manpower, equipment, etc., as prescribed under that Act;

(d) the Hospital registered shall have to maintain documentation and records including reporting of adverse events.

27. Conditions and standards for grant of certificate of registration for organ retrieval centres.—

(1) The retrieval center shall be registered only for the purpose of retrieval of organ from deceased donors and the organ retrieval centre shall be a hospital having Intensive Care Unit (ICU) facilities along with manpower, infrastructure and equipment as required to diagnose and maintain the brain-stem dead person and to retrieve and transport organs and tissues including the facility for their temporary storage.

(2) All hospitals registered as transplant centres shall automatically qualify as retrieval centres.

(3) The retrieval centre should have linkages with nearby Government hospital designated for post-mortem, for retrieval in medico-legal cases.

(4) Registration of hospital for surgical tissue harvesting from deceased person and for surgical tissue residues, that are routinely discarded, shall not be required.

28. Conditions and standards for grant of certificate of registration for tissue banks.—

A. Facility and premises:

(1) Facilities must conform to the standards and guidelines laid down for the purpose and the States and Union territories may have separate registration fee and procedure to keep track of their tissue bank activities.

(2) The respective State or Union territory Appropriate Authority may constitute an expert committee for advising on the matter related to tissue specific standards and related issues.

(3) The tissue bank must have written guidelines and standard operating procedures for maintenance of its premises and facilities which include-

(a) controlled access;

(b) cleaning and maintenance systems;

(c) waste disposal;

(d) health and safety of staff;
(e) risk assessment protocol; and
(f) follow up protocol.

(4) Equipments as per scientific requirements specific to tissue (s) being procured, processed, stored and distributed and the tissue bank should ensure the availability of the accessories, spare-parts and back-up, maintenance and service support for all equipments.

(5) Air particle count and microbial colony count compliance shall be ensured for safety where necessary.

(6) Storage area shall be designated to avoid contact with chemicals or atmospheric contamination and any known source of infection.

(7) Storage facility shall be separate and distinguish tissues, held in quarantine, released and rejected.

B. **Donor screening:**

(8) Complete screening of donor must be conducted including medical or social history and serological evaluation for medical conditions or disease processes that would contraindicate the donation of tissues and the report of corneas or eyes not found suitable for transplantation and their alternate use shall be certified by a committee of two Ophthalmologists.

C. Laboratory tests:

(9) Facility for relevant Laboratory tests for blood and tissue samples shall be available and testing of blood and tissue samples shall begin at Donor Screening and continue during retrieval and throughout processing.

D. Procurement and other procedures:

(10) Procurement of tissue must be carried out by registered health care professionals or technicians having necessary experience or special training.

(11) Consent for the procurement shall be obtained.

(12) Procurement records shall be maintained.

(13) Standard operating procedure for following shall be followed, namely :-

(a) procurement or Retrieval and transplantation;
(b) processing and sterilisation;
(c) packaging, labeling and storage;
(d) distribution or allocation;
(e) transportation; and
(f) reporting of serious adverse reactions.

E. Documentation and Records:

(14) A log of tissue received and distributed shall be maintained to enable traceability from the donor to the tissue and the tissue to the donor and the records shall also indicate the dates and the identities of the staff performing specific steps in the removal or processing or distribution of the tissues.

F. Data Protection and Confidentiality:

(15) A unique donor identification number shall be used for each donor, and access to donor records shall be restricted.

G. Quality Management:

(16) The Quality Management System shall define quality control procedures that include the following, namely:-

(a) environmental monitoring;
(b) equipment maintenance and monitoring;
(c) in –process controls monitoring;
(d) internal audits including reagent and supply monitoring;
(e) compliance with reference standards, local regulations, quality manuals or documented standard operating procedures; and
(f) monitoring work environment.

H. Recipient Information:

(17) All tissue recipients shall be followed up and prompt and appropriate corrective and preventive actions taken in case of adverse events.

29. Qualification, role, etc., of transplant coordinator.— (1) The transplant coordinator shall be an employee of the registered hospital having qualification such as:

(a) graduate of any recognised system of medicine; or
(b) Nurse; or
(c) Bachelor's degree in any subject and preferably Master's degree in Social work or Psychiatry or Sociology or Social Science or Public Health

(2) The concerned organisation or institute shall ensure initial induction training followed by retraining at periodic interval and the transplant coordinator shall counsel and encourage the family members or near relatives of the

deceased person to donate the human organ or tissue including eye or cornea and coordinate the process of donation and transplantation.

(3) The transplant coordinator or counselor in a hospital registered for eye banking shall also have qualification specified in sub-rule (1).

30. Advisory committee of the Central or State Government to aid and advise appropriate authority.— (1) The Central Government and the State Government, as the case may be, shall constitute by notification an Advisory Committee under Chairpersonship of administrative expert not below the rank of Secretary to the State Government for a period of two years to aid and advise the Appropriate Authority and the two medical experts referred to in clause(b) of sub-section(2) of section 13A of the Act shall possess a postgraduate medical degree and at least five years' experience in the field of organ or tissue transplantation.

(2) The terms and conditions for appointment to the Advisory Committee are as under:

(a) the Chairperson and members of the Committee shall be appointed for a period of two years;

(b) the Chairperson and members of the Committee shall be entitled to the air fare and other allowances to attend the meeting of the Committee equivalent to the officer of the level of the Joint Secretary to the Government of India;

(c) the Central Government or State Government or Union territory Administration shall have full powers to replace or remove the Chairperson and the members in cases of charges of corruption or any other charges after giving a reasonable opportunity of being heard;

(d) the Chairperson and members can also resign from the Committee for personal reasons;

(e) there shall not be a corruption or criminal case pending against Chairperson and members at the time of appointment;

(f) the Chairperson or any of the members shall cease to function if charges have been framed against him or her in a corruption or criminal case after having been given a reasonable opportunity of being heard.

31. Manner of establishing National or Regional or State Human Organs and Tissues Removal and Storage Networks and their functions.— (1) There shall be an apex national networking organisation at the centre, as the Central Government may by notification specify.

(2) There shall also be regional and State level networking organisations where large number of transplantation of organ(s) or tissue (s) are performed as the Central Government may by notification specify.

(3) The State units would be linked to hospitals, organ or tissue matching laboratories and tissue banks within their area and also to regional and national networking organisations.

(4) The broad principles of organ allocation and sharing shall be as under**,—**

(a) The website of the transplantation center shall be linked to State or Regional cum State or National networks through an online system for organ procurement, sharing and transplantation.

(b) patient or recipient may get registered through any transplant centre, but only one centre of a State or region (if there is no centre in the State) and his or her details shall be made available online to the networking organisations, who shall allocate the registration number, which shall remain same even if patient changes hospital;

(c) the allocation of the organ to be shared, is to be decided by the State networking organization and by the National networking organization in case of Delhi;

(d) all recipients are to be listed for requests of organs from deceased donors, however priority is to be given in following order, namely:-

(i) those who do not have any suitable living donor among near relatives;

(ii) those who have a suitable living donor available among near relatives but the donor has refused in writing to donate; and

(iii) those who have a suitable living donor available and who has also not refused to donate in writing;

(e) sequence of allocation of organs shall be in following order: State list----Regional List-----National List---- Person of Indian Origin ----Foreigner;

(f) the online system of networking and framework and formats of national registry as mentioned under rule 32 shall be developed by the apex networking organisation which shall be followed by the States Governments or Union territory Administrations and the allocation criteria may be State specific which shall be finalised and determined by the State Government, in consultation with the State level networking organisation, wherever such organisation exists:

Provided that the organ sharing and networking policy of States or locations of hospitals shall not be binding on the Armed Forces Medical Services (AFMS) and the armed forces shall be free to have their own policy of organ or tissue allocation and sharing, and the Director General Armed Forces Medical Services shall have its own networking between the Armed Forces Medical Services hospitals, who shall be permitted to accept organs when available from hospitals with in their State jurisdiction.

(5) The networking organisations shall coordinate retrieval, storage, transportation, matching, allocation and transplantation of organs and tissues and shall develop norms and standard operating procedures for such activities and for tissues to the extent possible.

(6) The networking organisations shall coordinate with respective State Government for establishing new transplant and retrieval centres and tissue banks and strengthening of existing ones.

(7) There shall be designated organ and tissue retrieval teams in State or District or institution as per requirement, to be constituted by the State or Regional networking organisation.

(8) For tissue retrieval, the retrieval teams shall be formed by the State Government or Union territory Administration where ever required.

(9) Networking shall be e-enabled and accessible through dedicated website.

(10) Reference or allocation criteria would be developed and updated regularly by networking organisations in consultation with the Central or State Government, as the case may be.

(11) The networking organisation(s) shall undertake Information Education and Communication (IEC) Activities for promotion of deceased organ and tissue donation.

(12) The networking organisation(s) shall maintain and update organ or tissue Donation and Transplant Registry at respective level.

32. Information to be included in National Registry regarding donors and recipients of human organ and tissue.— The national registry shall be based on the following, namely:-

Organ Transplant Registry:

(1) The Organ Transplant Registry shall include demographic data about the patient, donor, hospitals, recipient and donor follow up details, transplant waiting list, etc., and the data shall be collected from all retrieval and transplant centers.

(2) Data collection frequency, etc., will be as per the norms decided by the Advisory Committee which may preferably be through a web-based interface or paper submission and the information shall be maintained both specific organ wise and also in a consolidated format.

(3) The hospital or Institution shall update its website regularly in respect of the total number of the transplantations done in that hospital or institution along with reasonable detail of each transplantation and the same data should be accessible for compilation, analysis and further use by authorised persons of respective State Governments and Central Government.

(4) Yearly reports shall be published and also shared with the contributing units and other stakeholders and key events (new patients, deaths and transplants) shall be notified as soon as they occur in the hospital and this information shall be sent to the respective networking organisation, at least monthly.

Organ Donation Registry:

(5) The Organ Donation Registry shall include demographic information on donor (both living and deceased), hospital, height and weight, occupation, primary cause of death in case of deceased donor, associated medical illnesses, relevant laboratory tests, donor maintenance details, driving license or any other document of pledging donation, donation requested by whom, transplant coordinator, organs or tissue retrieved, outcome of donated organ or tissue, details of recipient, etc.

Tissue Registry:

(6) The Tissue Registry shall include demographic information on the tissue donor, site of tissue retrieval or donation, primary cause of death in case of deceased donor, donor maintenance details in case of brain stem dead donor, associated medical illnesses, relevant laboratory tests, driving license or any other document pledging donation, donation requested by whom, identity of counsellors, tissue(s) or organ(s) retrieved, demographic data about the tissue recipient, hospital conducting transplantation, transplant waiting list and priority list for critical patients, if these exist, indication(s) for transplant, outcome of transplanted tissue, etc.

(7) Yearly reports in respect of National Registry shall be published and also shared with the contributing units and other stakeholders

Pledge for organ or tissue donation after death:

(8) Those persons, who, during their lifetime have pledged to donate their organ(s) or tissue(s) after their death, shall in Form 7 deposit it in paper or electronic mode to the respective networking organisation(s) or institution where the pledge is made, who shall forward the same with the respective networking organisation and the pledger has the option to withdraw the pledge through intimation.

(9) The Registry will be accessible on-line through dedicated website and shall be in conformation to globally maintained registry (ies), besides having national, regional and State level specificities.

(10) National or regional registry shall be compiled based on similar registries at State level.

(11) The identity of the people in the database shall not be put in public domain and measures shall be taken to ensure security of all collected information.

(12) The information to be included shall be updated as per prevalent global practices from time to time.

33. Appeal.— (1) Any person aggrieved by an order of the Authorisation Committee under sub-section (6) of section 9 or by an order of the Appropriate Authority under sub-section (2) of section 15 or sub-section (2) of section 16 of the Act, may, within thirty days from the date of receipt of the order, prefer an appeal to the Central Government in case of the Union territories and respective State Government in case of States.

(2) Every appeal shall be in writing and shall be accompanied by a copy of the order appealed against.

FORM 1

For organ or tissue donation from identified living near related donor

(to be completed by him or her)

(See rules 3 and 5(3)(a))

My full name (proposed donor) is …….

and this is my photograph

To be affixed here.

Photograph of the Donor
(Attested by Notary Public
across the photo after affixing)

My permanent home address is
……

……Tel: ……..

My present address for correspondence is

……

……..…….... Tel:……

Date of birth ……..…….(day/month/year)

I enclose copies of the following documents: (attach attested photocopy of at least two of following relevant documents to indicate your near relationship):

- Ration/Consumer Card number and Date of issue and place:……
  and/or
- Voter's I-Card number, date of issue, Assembly constituency……
  and/or
- Passport number and country of issue……
  and/or
- Driving License number, Date of issue, licensing authority……
  and/or
- Permanent Account Number (PAN)……..
  and/or
- AADHAAR No. …….
  and/or
- Any other valid proof of identity and address reflecting near relationship ……

I authorise removal for therapeutic purposes and consent to donate my ……
(Name of organ/tissue) to my relative …….. (Specify son/daughter/father/mother/ brother/sister/grand-father/grand-mother/grand-son/grand-daughter), whose particulars are as follows and name is ……. and who was born on ……(day/month/year) :

To be affixed here.

Photograph of the Recipient
(Attested by Notary Public
across the photo after affixing)

The copies of following documents of recipient are enclosed (attach attested photocopy of at least two relevant documents to indicate your near relationship):

- Ration/Consumer Card number and Date of issue and place:……
  and/ or

- Voter's I-Card number, date of issue, Assembly constituency……
and/or
- Passport number and country of issue……..
and/ or
- Driving License number, Date of issue, licensing authority…….
and/or
- Permanent Account Number (PAN) ……
and/or
- AADHAAR No (Issued by Unique Identification Authority of India).
and/or
- *Any* other valid proof of identity and address reflecting near relationship …….

I solemnly affirm and declare that:

Sections 2, 9 and 19 of The Transplantation of Human Organs Act, 1994 have been explained to me and I confirm that:

1. I understand the nature of criminal offences referred to in the sections.
2. No payment as referred to in the sections of the Act has been made to me or will be made to me or any other person.
3. I am giving the consent and authorisation to remove my …….. (name of organ/tissue) of my own free will without any undue pressure, inducement, influence or allurement.
4. I have been given a full explanation of the nature of the medical procedure involved and the risks involved for me in the removal of my …….. (name of organ)/tissue). That explanation was given by …… (name of registered medical practitioner).
5. I understand the nature of that medical procedure and of the risks to me as explained by that practitioner.
6. I understand that I may withdraw my consent to the removal of that organ at any time before the operation takes place.
7. I state that particulars filled by me in the form are true and correct to the best of my knowledge and belief and nothing material has been concealed by me.

…….. ……

Date Signature of the prospective donor
(Full Name)

Note: To be sworn before Notary Public, who while attesting shall ensure that the person/persons swearing the affidavit(s) signs(s) on the Notary Register, as well.

FORM 2

For organ or tissue donation by living spousal donor

(To be completed by him/her)

(See rules 3, 5(3)(a) and 5(3)(d))

My full name (proposed donor) is …….
and this is my photograph

Photograph of the Donor
(Attested by Notary Public
across the photo after affixing)

To be affixed here

My permanent home address is

……..……

…… Tel: ……

My present address for correspondence is ……

…… Tel: ……

Date of birth ……..…….(day/month/year)

I authorize removal for therapeutic purposes and consent to donate my ……. (Name of organ) to my husband/wife…….. …… whose particulars are as follows and full name is …… ……. and who was born on …… (Day/month/year):

Photograph of the Recipient
(Attested by Notary Public
across the photo after affixing)

To be affixed here

I enclose copies of the following documents **(attach attested photocopy of at least two of following relevant documents to indicate the spousal relationship):**

- Ration/Consumer Card number and Date of issue and place:……

and/or

- Voter's Identity-Card number, date of issue, Assembly constituency……

and/or

- Passport number and country of issue……

and/or

- Driving License number, Date of issue, licensing authority……

and/or

- Permanent Account Number (PAN)
……...

and/or

- AADHAAR No. (issued by Unique Identification Authority of India)
…….

and/or

- Any other proof of identity and address establishing spousal relationship
…….

I submit the following as evidence of being married to the recipient:-

(a) A certified copy of a marriage certificate

OR

(b) An affidavit of a 'near relative' confirming the status of marriage to be sworn before Class-I Magistrate/Notary Public.

(c) Family photographs

(d) Letter from Head of Gram Panchayat / Tehsildar / Block Development Officer/Member of Legislative Assembly/Member of Legislative Council (MLC)/Member of Parliament with seal certifying factum and status of marriage.

OR

(e) Other credible evidence

I solemnly affirm and declare that sections 2, 9 and 19 of the Transplantation of Human Organs Act, 1994 (42 of 1994), have been explained to me and I confirm that

1. I understand the nature of criminal offences referred to in the sections.

2. No payment of money or money's worth as referred to in the Sections of the Act has been made to me or will be made to me or any other person.
3. I am giving the authorisation to remove my …….. (organ) and consent to donate the same ,of my own free will without any undue pressure, inducement, influence or allurement.
4. I have been given a full explanation of the nature of the medical procedure involved and the risks involved for me in the removal of my …….. (organ). That explanation was given by …… (name of registered medical practitioner).
5. I understand the nature of that medical procedure and of the risks to me as explained by that practitioner.
6. I understand that I may withdraw my consent to the removal of that organ at any time before the operation takes place.
7. I state that particulars filled by me in the form are true and correct to to the best of my knowledge and nothing material has been concealed by me.

…….. ……
Signature of the prospective donor Date
(Full Name)

Note: To be sworn before Notary Public, who while attesting shall ensure that the person/persons swearing the affidavit(s) signs(s) on the Notary Register, as well

FORM 3

For organ or tissue donation by other than near relative living donor

(To be completed by him/her)

(See rules 3, 5(3)(a) and 5(3)(e))

My full name is …….
and this is my photograph

Photograph of the Donor
(Attested by Notary Public
across the photo after affixing)

To be affixed here

My permanent home address is
…… Tel: ……..
……..

My present address for correspondence is ……... ……
…….. Tel:……..

Date of birth ……. (day/month/year)

I enclose copies of the following documents: (attach attested photocopy of at least two of following relevant documents to prove your identity):

- Ration/Consumer Card number and Date of issue and place:……
  (Photocopy attached)

  and/or
- Voter's I-Card number, date of issue, Assembly constituency……
  (Photocopy attached)

  and/or
- Passport number and country of issue……
  (Photocopy attached)

  and/or
- Driving Licence number, Date of issue, licensing authority…….
  (Photocopy attached)

  and/or
- PAN……...

and/or

- AADHAAR No.……

and/or

- Other proof of identity and address …….

Details of last three years income and vocation of donor (enclose documentary evidence) …… ……

I authorize removal for therapeutic purposes and consent to donate my …….. (Name of organ/tissue) to a person whose full name is …… and who was born on …… (day/month/year) and whose particulars are as follows:

Photograph of the Recipient
(Attested by Notary Public across the Photo after affixing)

To be affixed here

(attach attested photocopy of at least two relevant documents to prove identity of recipient)

- Ration/Consumer Card number and Date of issue and place:……
  (Photocopy attached)

and/or

- Voter's I-Card number, date of issue, Assembly constituency……
  (Photocopy attached)

and/or

- Passport number and country of issue……
  (Photocopy attached)

and/or

- Driving Licence number, Date of issue, licensing authority…….
  (Photocopy attached)

and/or

- PAN……...

and/or

- AADHAAR No. …….

and/or

- Other proof of identity and address …….

I solemnly affirm and declare that sections 2, 9 and 19 of the Transplantation of Human Organs Act, 1994 (42 of 1994), have been explained to me and I confirm that

1. I understand the nature of criminal offences referred to in the Sections.
2. No payment of money or money's worth as referred to in the Sections of the Act has been made to me or will be made to me or any other person.
3. I am giving the consent and authorisation to remove my …….. (name of organ/tissue) of my own free will without any undue pressure, inducement, influence or allurement.
4. I have been given a full explanation of the nature of the medical procedure involved and the risks involved for me in the removal of my …….. (name of organ/tissue). That explanation was given by …… (name of registered medical practitioner).
5. I understand the nature of that medical procedure and of the risks to me as explained by the practitioner.
6. I understand that I may withdraw my consent to the removal of that organ at any time before the operation takes place.
7. I state that particulars filled by me in the form are true and correct to the best of my knowledge and nothing material has been concealed by me.

…….. ……

Signature of the prospective donor (Full Name) Date

Note: To be sworn before Notary Public, who while attesting shall ensure that the person/persons swearing the affidavit(s) signs(s) on the Notary Register, as well.

FORM 4

For certification of medical fitness of living donor

(To be given by the Registered Medical Practitioner)

[See proviso to rule 5(3)(b)]

I, Dr…….. possessing qualification of …….. registered as medical practitioner at serial no. …….. by the …… …… Medical Council, certify that I have examined Shri/ Smt./ Km. ……. S/o, D/o, W/o Shri …… aged …… who has given informed consent for donation of his/her ……. (Name of the organ) to Shri/Smt./Km …….. who is a 'near relative' of the donor/other than near relative of the donor and has been approved by the competent authority or Authorisation Committee (as the case may be) and it is certified that the said donor is in proper state of health, not mentally challenged * and is medically fit to be subjected to the procedure of organ or tissue removal.

Place: …… ……

Signature of Doctor

Seal

Date: …….

To be affixed (pasted) here	To be affixed (pasted) here
Photograph of the Donor (Attested by doctor)	Photograph of the recipient (Attested by the doctor)

The signatures and seal should partially appear on photograph and document without disfiguring the face in photograph

* In case of doubt for mentally challenged status of the donor, the Registered Medical Practitioner may get the donor examined by psychiatrist.

FORM 5

For certification of genetic relationship of living donor with recipient

(To be filled by the head of Pathology Laboratory certifying relationship)

[See rules 5(3)(c) and 18(3)]

I, Dr./Mr./Mr/Miss. …….. working as …… at …….. and possessing qualification of …… certify that Shri/ Smt./ Km. …….. S/o, D/o, W/o Shri/ Smt. ……..…… aged ……..…. the donor and Shri/ Smt. ……..…… S/o, D/o, W/o Shri/Smt……..…… aged …… the prospective recipient of the organ to be donated by the said donor are related to each other as brother/sister/mother/father/son/daughter, grandmother, grandfather, grandson and granddaughter as per their statement. The fact of this relationship has been established / not established by the results of the tests for DNA profiling. The results of the tests are attached.

Signature
(To be signed by the Head of the Laboratory)

Seal

Place ……

Date ……

FORM 6

For spousal living donor

(to be filled by competent authority and Authorisation Committee,of the hospital or district or state in case of foreigners)*

[See rule 18(2)]

I, Dr./Mr./Mrs/Miss. …….. possessing qualification of …… registered as medical practitioner at serial No. ……by the ……Medical Council, certify that:-

Mr……S/o……aged…….resident of ……and Mrs……D/o, W/o……aged……..resident of …….. are related to each other as spouse according to the statement given by them and their statement has been confirmed by means of following evidence before effecting the organ removal from the body of the said Shri/Smt/……. (Applicable only in the cases where considered necessary).

OR

In case the Clinical condition of Shri/Smt……. mentioned above is such that recording of his/her statement is not practicable, reliance will be placed on the documentary evidence(s). (mention documentary evidence(s) here).....

a.Marriage certificate indicate date of marriage

b.Marriage photographs

c.Date when transplantation was advised by the hospital (to be compared with duration of marriage):

d.Number and age of children and their birth certificates

e.Any other document

Signature of *competent authority*/Authorisation committee in case of foreigners along with Seal/Stamp*

Place ……

Date ……
*Director or Medical Superintendent or In Charge of the hospital or the internal committee of the hospital formed for the purpose.as defined under the rules of Transplantation of Human Organ Act, 1994(42 of 1994).

FORM 7

For organ or tissue pledging

(To be filled by individual of age 18 year or above)

[See rule 5(4)(a)]

ORGAN(S) AND TISSUE(S) DONOR FORM

(To be filled in triplicate)

Registration Number (To be allotted by Organ Donor Registry)…….

I……S/o,D/o,W/o……aged……

….and date of birth ……resident of ……in the presence of persons mentioned below hereby unequivocally authorise the removal of following organ(s) and/or tissue(s), from my body after being declared brain stem dead by the board of medical experts and consent to donate the same for therapeutic purposes.

Please tick as applicable

(Following tissues can also be donated after

brain stem death as well as cardiac death)

Heart	☐	Corneas/Eye Balls	☐
Lungs	☐	Skin	☐
Kidneys	☐	Bones	☐
Liver	☐	Heart Valves	☐
Pancreas	☐	Blood Vessels	☐
Any Other Organ (Pl. specify)	_____	Any other Tissue (Pl. specify) _____	
All Organs	☐	All Tissues	☐

My blood group is (if known)……

Signature of Pledger.....

Address for correspondence……..

Telephone No……..

Email : …….

Dated:

(Note: In case of online registration of pledge, one copy of the pledge will be retained by pledger, one by the institution where pledge is made and a hard copy signed by pledger and two witnesses shall be sent to the nodal networking organisation.)

(Signature of Witness 1)

1. Shri/Smt./Km.……S/o,D/o,W/o……

aged…….resident of..... Telephone

No.....Email:.....

(Signature of Witness 2)

2. Shri/Smt./Km.……S/o,D/o,W/o……

aged…….resident of …… Telephone

No.....Email:..... is a near relative to the donor as ……

Dated…….

Place ……..

Note: (i) Organ donation is a family decision. Therefore, it is important that you discuss your decision with family members and loved ones so that it will be easier for them to follow through with your wishes.

(ii) One copy of the pledge form/pledge card to be with respective networking organisation, one copy to be retained by institution where the pledge is made and one copy to be handed over to the pledger.

(iii) The person making the pledge has the option to withdraw the pledge.

FORM 8

For Declaration cum consent

(To be filled by near relative or lawful possessor of brain-stem dead person)

[See rules 5(1)(b), 5(4)(b) and 5(4)(d)]

DECLARATION AND CONSENT FORM

I……S/o,D/o,W/o……

aged…….resident of ……in the presence of persons mentioned below, hereby declare that:

1. I have been informed that my relative (specify relation) .....

S/o,D/o,W/o……aged…….has been declared brain-stem dead / dead.

2. To the best of my knowledge (Strike off whichever is not applicable):

a. He/She. (Name of the deceased)..... had / had not, authorised before his/her death, the removal of .....(Name of organ/tissue/both) of his/her body after his/her death for therapeutic purpose. The documentary proof of such authorisation is enclosed/not available

b. He/She. (Name of the deceased)..... had not revoked the authority as at No. 2 (a) above (If applicable) .

c. There are reasons to believe that no near relative of the said deceased person has objection to any of his/her organs/tissue being used for therapeutic purposes.

3. I have been informed that in the absence of such authorisation, I have the option to either authorise or decline donation of organ/tissue/both including eye/cornea of .....(Name of the deceased) for therapeutic purposes. I also understand that if corneas/eyes are not found suitable for therapeutic purpose, then may be used for education/research.

4. I hereby authorise / do not authorize removal of his/her body organ(s) and/or tissue(s), namely *(Any organ and tissue/ Kidney /Liver /Heart /Lungs /Intestine /Cornea /Skin /Bone /Heart Valves /Any other; please specify)* …….. for therapeutic purposes. I also give permission for drawing of a blood sample for serology testing and am willing to share social/behavioural and medical history to facilitate proper screening of the donor for safe transplantation of the organs/ tissues.

Date…… Signature of near relative /person in lawful possession of the dead body, and address for correspondence*.
Place …….. Telephone No.……Email: ……

* in case of the minor the declaration shall be signed by one of the parent of the minor or any near relative authorised by the parent. In case the near relative or person in lawful possession of the body refuses to sign this form, the same shall be recorded in writing by the Registered Medical Practitioner on this Form.

(Signature of Witness 1)

1.Shri/Smt./Km……S/o,D/o,W/o……

aged…….resident of..... Telephone

No.....Email: .....

(Signature of Witness 2)

2.Shri/Smt./Km……S/o,D/o,W/o……

aged…….resident of …… Telephone

No.....Email:.....

FORM 9

For unclaimed body in a hospital or prison

(To be completed by person in lawful possession of the unclaimed body)

[see rule 5(1)(b)]

I……S/o,D/o,W/o……

aged……..resident of ……having lawful possession of the dead body of Shri/Smt./Km……. S/o,D/o,W/o…… aged…….resident of ……and having known that no person has come forward to claim the body of the deceased after 48 hours of death and there being no reason to believe that any person is likely to come to claim the body I hereby, authorise removal of his/her body organ(s) and/or tissue(s), namely……..for therapeutic purposes.

Signature, Name, designation and Stamp of person in lawful possession of the dead body.

Dated……..Place……

Address for correspondence……...

……...

Telephone No.....Email .....

(Signature of Witness 1)

1.Shri/Smt./Km.……S/o,D/o,W/o……

aged…….resident of..... Telephone

No.....Email .....

(Signature of Witness 2)

2.Shri/Smt./Km.……S/o,D/o,W/o……

aged…….resident of …… Telephone No.....Email

……

FORM 10

For certification of brain stem death

(To be filled by the board of medical experts certifying brain-stem death)

[See rules 5(4)(c) and 5(4)(d)]

We, the following members of the Board of medical experts after careful personal examination hereby certify that Shri/Smt./Km.……

aged about …… son of /wife of / daughter of …… Resident of ……

is dead on account of permanent and irreversible cessation of all functions of the brain-stem. The tests carried out by us and the findings therein are recorded in the brain-stem death Certificate annexed hereto.

Dated…… Signature……..

1. R.M.P.- Incharge of the Hospital In which brain-stem death has occurred.
2. R.M.P. nominated from the panel of Names sent by the hospitals and approved by the Appropriate Authority.
3. Neurologist/Neuro-Surgeon
4. R.M.P. treating the aforesaid deceased person

(where Neurologist/Neurosurgeon is not available, any Surgeon or Physician and Anaesthetist or Intensivist, nominated by Medical Administrator Incharge from the panel of names sent by the hospital and approved by the Appropriate Authority shall be included)

BRAIN-STEM DEATH CERTIFICATE

(A) PATIENT DETAILS……

1. Name of the patient: Mr./Ms……..
   S.O./D.O./W.O. Mr./Ms……
   Sex……..Age……
2. Home Address: ……
   ……
   ……..
3. Hospital Patient Registration Number (CR No.): ……..
4. Name and Address of next of kin or person…… responsible for the patient …… (if none exists, this must be specified) ……
   ……
   ……..
5. Has the patient or next of kin agreed to any donation of organ and/or tissue? ……..
   ……..
6. Is this a Medico-legal Case? Yes…..No….

(B) PRE-CONDITIONS:

1. Diagnosis: Did the patient suffer from any illness or accident that led to irreversible brain damage?
   Specify details……
   ……

……

Date and time of accident/onset of illness…….

Date and onset of non-reversible coma……...

2. Findings of Board of Medical Experts:

		First Medical Examination	Second Medical Examination
(1)	The following reversible causes of coma have been excluded: Intoxication (Alcohol) Depressant Drugs Relaxants (Neuromuscular blocking agents) Primary Hypothermia Hypovolaemic shock Metabolic or endocrine disorders Tests for absence of brain-stem functions		
(2)	Coma		
(3)	Cessation of spontaneous breathing		
(4)	Pupillary size		
(5)	Pupillary light reflexes		
(6)	Doll's head eye movements		
(7)	Corneal reflexes (Both sizes)		
(8)	Motor response in any cranial nerve distribution, any responses to stimulation of face, limb or trunk.		
(9)	Gag reflex		
(10)	Cough (Tracheal)		
(11)	Eye movements on caloric testing bilaterally.		
(12)	Apnoea tests as specified.		
(13)	Were any respiratory movements seen?		

…….

Date and time of first testing: …….

Date and time of second testing: …….

This is to certify that the patient has been carefully examined twice after an interval of about six hours and on the basis of findings recorded above,

Mr./Ms……is declared brain-stem dead.

Date:

Signatures of members of Brain Stem Death (BSD) Certifying Board as under:

1. Medical Administrator Incharge of the hospital
2. Authorised specialist.
3. Neurologist/Neuro-Surgeon
4. Medical Officer treating the Patient.

Note.

I. Where Neurologist/Neurosurgeon is not available, then any Surgeon or Physician and Anaesthetist or Intensivist, nominated by Medical Administrator Incharge of the hospital shall be the member of the board of medical experts for brain-stem death certification.

II. The minimum time interval between the first and second testing will be six hours in adults. In case of children 6 to 12 years of age, 1 to 5 years of age and infants, the time interval shall increase depending on the opinion of the above BSD experts.

III. No.2 and No.3 will be co-opted by the Administrator Incharge of the hospital from the Panel of experts (Nominated by the hospital and approved by the Appropriate Authority).

FORM 11

APPLICATION FOR APPROVAL OF TRANSPLANTATION FROM LIVING DONOR

(To be completed by the proposed recipient and the proposed living donor)

[See rules 5(3)(d), 5(3)(e) and 10]

To be self attested across the affixed photograph without disfiguring face	To be self attested across the affixed photograph without disfiguring face
Photograph of the Donor	Photograph of the recipient

Whereas I ……..……..…… S/o, D/o, W/o, Shri/Smt. ……..…..…….. aged ……. residing at ……... have been advised by my doctor ……. that I am suffering from …… and may be benefited by transplantation of …….. into my body.

And whereas I ……. S/o, D/o, W/o, Shri/Smt. ……... aged ……. residing at …….. by the following reason(s):-

a) by virtue of being a near relative i.e. ……

b) by reason of affection/attachment/other special reason as explained below :-

……

……

……

I would therefore like to donate my (name of the organ) ……... to Shri/Smt. ……

We …… ……. and ……. ……

(Donor) (Recipient)

hereby apply to competent authority / Authorisation Committee for permission for such transplantation to be carried out.

We solemnly affirm that the above decision has been taken without any undue pressure, inducement, influence or allurement and that all possible consequences and options of organ transplantation have been explained to us.

Instructions for the applicants:-

1. Form 11 must be submitted along with the completed Form 1 or Form 2 or Form 3 as may be applicable.
2. The applicable Form i.e. Form 1 or Form 2 or Form 3 as the case may be, should be accompanied with all documents mentioned in the applicable form and all relevant queries set out in the applicable form must be adequately answered.
3. Completed Form 5 must be submitted along with the laboratory report.
4. The doctor's advice recommending transplantation must be enclosed with the application.
5. In addition to above, in case the proposed transplant is between unrelated persons, appropriate evidence of vocation and income of the donor as well as the recipient for the last three years must be enclosed with this application. It is clarified that the evidence of income does not necessarily mean the proof of income tax returns, keeping in view that the applicant(s) in a given case may not be filing income tax returns.
6. The application shall be accepted for consideration by the competent authority / Authorisation Committee only if it is complete in all respects and any omission of the documents or the information required in the forms mentioned above, shall render the application incomplete.
7. When the donor is unrelated and the donor and/or recipient belong to a State/Union Territory other than the State/Union Territory, where the transplant is intended to take place, then the Tehsildar or the officer authorised for the purpose of the domicile state of the donor or recipient as the case may be, would provide the verification certificate of domicile of donor/recipient as the case may be as per Form 20. The approval for transplantation would be considered by the authorisation committee of the State/District/hospital (as the case may be) where the transplantation is intended to be done. Such verification Certificate will not be required for near relatives including cases involving swapping of organs (permissible between near relatives only).

We have read and understood the above instructions.

Signature of the Prospective Donor	Signature of Prospective Recipient
Address for correspondence:	Address for correspondence:
Date :	Date :
Place :	Place :

FORM 12

APPLICATION FOR REGISTRATION OF HOSPITAL TO CARRY OUT ORGAN OR TISSUE TRANSPLANTATION OTHER THAN CORNEA

(To be filled by head of the institution)

(See rule 24(1))

To

The Appropriate Authority for organ transplantation…….

(State or Union territory)

We hereby apply to be registered as an institution to carry out organ/tissue transplantation.

Name(s) of organ (s) or tissue (s) for which registration is required…….

The required data about the facilities available in the hospital are as follows:-

(A) HOSPITAL:

1. Name:
2. Location:
3. Government/Private:
4. Teaching/Non-teaching:
5. Approached by:

Road:	Yes	No
Rail:	Yes	No
Air:	Yes	No

6. Total bed strength:
7. Name of the disciplines in the hospital:
8. Annual budget:
9. Patient turn-over/year:

(B) SURGICAL FACILITIES:

1. No. of beds:
2. No. of permanent staff members with their designation:
3. No. of temporary staff with their designation:
4. No. of operations done per year:
5. Trained persons available for transplantation (Please specify Organ for transplantation):

(C) MEDICAL FACILITIES:

1. No. of beds:
2. No. of permanent staff members with their designation:
3. No. of temporary staff members with their designation:
4. Patient turnover per year:
5. Trained persons available for transplantation (Please specify Organ for transplantation):
6. No. of potential transplant candidates admitted per year:

(D) ANAESTHESIOLOGY:

1. No. of permanent staff members with their designations:
2. No. of temporary staff members with their designations:
3. Name and No. of operations performed:
4. Name and No. of equipments available:
5. Total No. of operation theatres in the hospital:
6. No. of emergency operation-theatres:
7. No. of separate transplant operation theatre:

(E) I.C.U./H.D.U. FACILITIES:

1. I.C.U./H.D.U. facilities: Present……. Not present…….
2. No. of I.C.U. and H.D.U. beds:
3. Trained:-

Nurses:

Technicians:

4. Name of equipment in I.C.U.

(F) OTHER SUPPORTIVE FACILITIES:

Data about facilities available in the hospital:

(F1) LABORATORY FACILITIES:

1. No. of permanent staff with their-designations:
2. No. of temporary staff with their designations:
3. Names of the investigations carried out in the Department:
4. Name and number of equipments available:

(F2) IMAGING FACILITIES :

1. No. of permanent staff with their-designations:
2. No. of temporary staff with their designations:
3. Names of the investigations carried out in the Department:
4. Name and number of equipments available:

(F3) HAEMATOLOGY FACILITIES:

1. No. of permanent staff with their-designations:
2. No. of temporary staff with their designations:
3. Names of the investigations carried out in the Department:
4. Name and number of equipments available:

(F4) BLOOD BANK FACILITIES (Inhouse or access): Yes …….. No……

(F5) DIALYSIS FACILITIES : Yes …….. No……

F 6. Transplant coordinators (Eye Donation Counselors, in case of Cornea Transplantaion):

Yes No

Number Posted :

Number Trained

(F 7) OTHER SUPPORTIVE EXPERT PERSONNEL:

1. Nephrologist Yes/No
2. Neurologist Yes/No
3. Neuro-Surgeon Yes/No
4. Urologist Yes/No
5. G.I. Surgeon Yes/No
6. Paediatrician Yes/No
7. Physiotherapist Yes/No
8. Social Worker Yes/No
9. Immunologists Yes/No
10. Cardiologist Yes/No
11. Respiratory physician Yes /No
12. Others……. Yes / No

The above said information is true to the best of my knowledge and I have no objection to any scrutiny of our facility by authorised personnel. A Bank Draft/cheque of Rs. 10000/ (for new registration) and Rs. 5000 (for renewal) in favour of _____is enclosed.

Sd/-

HEAD OF THE INSTITUTION

FORM 13

APPLICATION FOR REGISTRATION OF HOSPITAL TO CARRY OUT ORGAN/TISSUE RETRIEVAL OTHER THAN EYE/CORNEA RETRIEVAL

(To be filled by head of the institution)

(See rule 24(1))

Note: Retrieval Hospitals may also be identified based on pre-defined criteria and registered as retrieval hospital by the appropriate authority.

To

The Appropriate Authority for organ transplantation…….

(State or Union territory)

We hereby apply to be registered as an institution to carry out organ/tissue retrieval.

The required data about the facilities available in the hospital are as follows:-

(A) HOSPITAL:

1. Name:
2. Location:
3. Government/Private:
4. Teaching/Non-teaching:

5. Approached by:

Road:	Yes	No
Rail:	Yes	No
Air:	Yes	No

6. Total bed strength:
7. Name of the disciplines in the hospital:
8. Annual budget:
9. Patient turn-over/year:

(B) SURGICAL FACILITIES:

1. No. of beds:
2. No. of permanent staff members with their designation:
3. No. of temporary staff with their designation:
4. No. of operations done per year:
5. Trained persons available for retrieval (Please specify Organ and/or tissue for retrieval):

(C) MEDICAL FACILITIES:

1. No. of beds:
2. No. of permanent staff members with their designation:
3. No. of temporary staff members with their designation:
4. Patient turnover per year:
5. Trained persons available for retrieval (Please specify Organ and/or tissue for retrieval):
6. No.of critical trauma cases admitted per year.
7. No.of brain stem death declared per year.

(D) ANAESTHESIOLOGY:

1. No. of permanent staff members with their designations:
2. No. of temporary staff members with their designations:
3. Name and No. of operations performed:
4. Name and No. of equipments available:
5. Total No. of operation theatres in the hospital:
6. No. of emergency operation-theatres:
7. No. of separate retrieval operation theatre:

(E) I.C.U./H.D.U. FACILITIES:

1. I.C.U./H.D.U. facilities: Present……. Not present……
2. No. of I.C.U. and H.D.U. beds:
3. Trained:-
   - Nurses:
   - Technicians:
4. Name of equipment in I.C.U.

(F) OTHER SUPPORTIVE FACILITIES:

Data about facilities available in the hospital:

(F1) LABORATORY FACILITIES:

1. No. of permanent staff with their-designations:
2. No. of temporary staff with their designations:
3. Names of the investigations carried out in the Deptt.:
4. Name and number of equipments available:

(F2) IMAGING FACILITIES:

1. No. of permanent staff with their-designations:
2. No. of temporary staff with their designations:
3. Names of the investigations carried out in the Deptt.:
4. Name and number of equipments available:

(F3) HAEMATOLOGY FACILITIES:

1. No. of permanent staff with their-designations:
2. No. of temporary staff with their designations:
3. Names of the investigations carried out in the Deptt.:
4. Name and number of equipments available:

(F4) BLOOD BANKFACILITIES: (in house or access) Yes ……. No…….

(F 5) Transplant coordinators: Yes No

Number Posted:

Number Trained

The above said information is true to the best of my knowledge and I have no objection to any scrutiny of our facility by authorised personnel. I hereby give an undertaking that we shall make the facilities of the hospital including the retrieval team of the hospital available for retrieval of the organ/tissue as and when needed.

Sd/-
HEAD OF THE INSTITUTION

FORM 14

APPLICATION FOR REGISTRATION OF TISSUE BANKS OTHER THAN EYE BANKS

(To be filled by head of the institution)

(See rule 24(1))

To

The Appropriate Authority for organ transplantation…….
(State or Union Territory)

We hereby apply to be registered as Tissue bank , Name :
Name(s) of tissue (s)(Bone, heart valves, skin, cornea etc) for which Registration is required…….
The required data about the facilities available in the institution are as follows:-

A. General Information :

1. Name
2. Address
3. Government/Private/NGO
4. Teaching /Non- teaching
5. Approached by:

Rail:	Yes	No
Road:	Yes	No
Air:	Yes	No

5.Information Education and Communication (IEC) for Tissue Donation

6.Type of tissue bank: Auto Logons /Allograph/Both

B. DONOR SCREENING

REMOVAL OF TISSUE AND STORAGE:

1.Availability of adequate trained and qualified Personnel for removal Tissue (annex detail).	Yes/No
2. Names, qualification and address of the doctors/technician who will be doing removal of tissue. (annex details)	Yes/No
3.Facilities for removal of Tissues	Yes/No
4.Whether register of recipient waiting list available.	Yes/No
5. Telephone arrangement available. (Telephone Number…….)	Yes/No
6. Availability of ambulance/ vehicle or funds to Pay taxi for collecting tissue from outside:	Yes/No
7. Sets of instruments for removal of tissue	Yes/No
8. Facilities for processing of tissue	Yes/No
9. Refrigerator for preservation of tissue	Yes/No
10. Special containers for preservation of tissue during transit.	Yes/No
11. Suitable preservation media	Yes/No
12. Any other specific requirement as per tissue	Yes/No

C.PRESERVATIONS OF TISSUE

Arrangement of preservation of Tissue	Yes/No

D.RECORDS

1. Arrangement for maintaining the records	Yes/No

. 2. Arrangement for registration of cases, donors and follow up of cases. Yes/ No

E.EQUIPMENT:

Instruments specific for the tissue Yes/No

F.LABORATORY FACILITIES(If the information is exhaustive please annex it)

a. Names of the investigations carried out in the department.

b. Facility for testing for :

i. Human Immunodeficiency Virus Type I and II . Yes/No

ii. Hepatitis B Virus – HBc and HBs

iii. Hepatitis C Virus – HCV

iv. Syphilis – VDRL

c. If no where do you avail it ? Please mention name and address of institute.

d. Facility for culture and sensitivity of tissue Yes/No

G.OTHER PERSONNEL

1. No. of permanent staff member with their designation.
2. No. of temporary staff with their designation
3. No. of trained persons

ANY OTHER INFORMATION

The above said information is true to the best of my knowledge and I have no objection to any scrutiny of our facility by authorised personnel. A Bank Daft/cheque of Rs. 10000/ (for new registration) and Rs. 5000 (for renewal) in favour of _____is enclosed.

Sd/-
HEAD OF THE INSTITUTION

FORM 15

APPLICATION FOR REGISTRATION OF EYE BANK, CORNEAL TRANSPLANTATION CENTRE, EYE RETRIEVAL CENTRE UNDER TRANSPLANTATION OF HUMAN ORGANS ACT

[See rule 24(1)]

I. EYE BANKING:

A.	EYE BANK and institution affiliated Ophthalmic / General Hospital	
	1. Name 2. Address 3. Government/Private/Voluntary 4. Teaching /Non- teaching 5. IEC for Eye Donation	
B.	REMOVAL OF EYE BALLS AND STORAGE:	
	1. Availability of adequate trained and qualified personnel for removal of whole globe or corneal (annex detail)	Yes/No
	2. Names, qualification and address of the designated staff who will be doing removal of whole globe / cornea retrieval. (annex details)	Yes/No
	3. Availability of following as per requirement: a. Whether register maintained for tissue request received from surgeon of corneal transplant centre.	Yes/No
	b. Telephone arrangement available. (Dedicated Telephone Number…….)	Yes/No
	c. Transport facility for collecting Eyeballs from outside:	Yes/No
	d. Sets of instruments for removal of whole globe / cornea as per requirement	Yes/No

	e. Special bottles with stands for preservation of Eye balls/ cornea during transit.	Yes/No
	f. Suitable preservation media	Yes/No
	g. Biomedical Waste Management.	Yes/No
	h. Uninterrupted Power supply.	Yes/No
C	Manpower 1. Incharge / Director (Ophthalmologist) -1 2. Eye Bank Technician- 2 3. Eye Donation Counselors (EDC)-2 per attached HCRP (Hospital Cornea Retrieval Cornea Programme) Hospital, who will be posted at eye Bank. 4. Multi task Staff(MTS) -2	
D.	Space requirement for eye Banks (400sqft minimum)	Yes/No
E.	RECORDS	
	1. Arrangement for maintaining the records	Yes/ No
	2. Arrangement for registration of pledges,/ donors and maintenance of utilization report	Yes/ No
	3. Computer with internet facility and Printer	Yes/ No
F.	EQUIPMENT:	
	1. Slit Lamp Biomicroscope-1 2. Specular Microscope for Eye Bank-1 3. Laminar flow(Class II)-1 4. Sterilization facility (In-house or outsourced) 5. Refrigerator with temperature monitoring for preservation of eye balls/Cornea-1	Yes/No
G	LABORATORY FACILITIES	
	1. Facility for HIV, Hepatitis B and C testing.	Yes/No
	2. If no where do you avail it? Please mention Name and address of institute.	
	3. Facility for culture and sensitivity of Corneoscleral ring.	Yes/No
H	RENEWAL OF REGISTRATION: Period of renewal 5years after last registration. Minimum of 500 corneas to be collected in 5 years. Maintenance of eye bank standards(as per Guidelines)	
II. EYE RETRIEVAL CENTRE (ERC):		
A.	RETRIEVAL CENTRE– A Centre affiliated to an Eye Bank 1. Name 2. Address 3. Government/Private/Voluntary 4. Teaching /Non- teaching 5. Information, Education and Communication Activities for Eye Donation 6. Name of Eye Bank to which ERC is affiliated.	
B	REMOVAL OF EYE BALLS AND STORAGE: 1. Manpower : Adequate trained and qualified personnel for removal of eye balls/cornea (annex detail): a. Incharge / Director) -1 b. Technician -1 c. MTS (Multi task Staff) -1 2. Transport facility(or outsource) with storage medium	
C	Names, qualification and address of the personnel who will be doing enucleation/ removal of cornea. (annex details)	
D	AVAILABILITY OF FOLLOWING: 1. Telephone. (Number…….) 2. Ambulance/ vehicle or funds to pay taxi for collecting eyeballs from outside: 3. Sets of instruments for removal of Eye Balls/cornea 4. Special bottles with stands for preservation of 5. Eye balls/ cornea during transit: 6. Suitable preservation media 7. Waste Disposal (Biomedical waste Management)	

	8. Space requirement: Designated area	
E	RECORDS 1. Arrangement for maintaining the records	
F	EQUIPMENT: 1. Sterilization facility 2. Refrigerator temperature control 24 hrs for preservation of Eye balls/Cornea.(power back up) - 1 3. The retrieval centre is affiliated with an Eye bank and Eye Bank is only authorised to distribute corneas.	
III. CORNEAL TRANSPLANTATION CENTRE		
A	1. Name of the Transplant Centre /hospital: 2. Address: 3. Government/Private/Voluntary: 4. Teaching /Non- teaching: 5. IEC for Eye Donation: Yes/No 6. Name of the registered Eye Bank for procuring tissue:	
B	Staff details: 1. No. of permanent staff member with their designation. (Note : Eye Surgeon's Experience : 3 month post MD/MS/DNB/DO)	
	2. No. of temporary staff with their designation	
	3. Trained persons for Keratoplasty and Corneal Transplantation with their names and qualifications: 2 (one Corneal Transplant surgeon should be on the pay roll of the Institute)	
C	Equipment : Slit lamp, Clinical Specular, Keratoplasty or intraocular instruments	
D	OT facilities	
E	Safe Storage facility	
F	Records Registration and follow up	
G	Any other information	

The above said information is true to the best of my knowledge and I have no objection to any scrutiny of our facility by authorised personnel. A Bank draft/cheque of Rs. 10000- for new registration and Rs 5000/ for renewal of registration drawn in favour of _____ is enclosed.

Head of the Institute
(Name and designation)

FORM 16

CERTIFICATE OF REGISTRATION FOR PERFORMING ORGAN/TISSUE TRANSPLANTATION/RETRIEVAL AND/OR TISSUE BANKING

(See rule 24(2))

This is to certify that …….. Hospital/Tissue Bank located at…… has been inspected and certificate of registration is granted for performing the organ/tissue retrieval/transplantation/banking of the following organ(s)/tissue(s) (mention the names) under the Transplantation of Human Organs Act, 1994 (42 of 1994):-

1. ……
2. ……
3. ……
4. ……

This certificate of registration is valid for a period of five years from the date of issue.

This permission is being given with the current facilities and staff shown in the present application form. Any reduction in the staff and/or facility must be brought to the notice of the undersigned.

Place…… Signature of Appropriate Authority…….

Seal: ……..

Date…….

FORM 17

Certificate of Renewal of Registration

(To be given by the appropriated authority on the letter head)

[See rule 25(2)]

This is with reference to the application dated……. from…… (Name of the hospital/tissue bank) for renewal of certificate of registration for performing organ(s)/tissue(s) retrieval/transplantation/banking under the Transplantation of Human Organs Act, 1994 (42 of 1994).

After having considered the facilities and standards of the above-said hospital/tissue bank, the Appropriate Authority hereby renews the certificate of registration of the said hospital/tissue bank for a period of five years.

This renewal is being given with the current facilities and staff shown in the present application form. Any reduction in the staff and/or facility must be brought to the notice of the undersigned.

Place…… Signature of Appropriate Authority…….

Date……Seal……

FORM 18

Certificate *by the Authorisation Committee of Hospital (If Hospital Authorisation committee is not available then the Authorisation Committee of the district/State) where the transplantation has to take place*

(To be issued on the letter head)

[See rules 16 and 23]

.

This is to certify that as per application in form-10 for transplantation of _____(Name of Organ/tissue) from living donor, other than near relative/ swap donation cases/ all foreigner under the Transplantation of Human Organs Act,1994 (42 of 1994) *submitted on…… by the donor and recipient, whose details and photographs are given below, along with their identifications and verification documents, the case was considered after the personal interview of donor and recipient (if medically fit to be interviewed) and their relatives as applicable by the Authorisation Committee in the meeting held on …dated……*

Details of Recipient	*Details of Donor*
Name……..	*Name:……*
Age……	*Age ……*
Sex ……	*Sex ……*
Father / Husband Name ……	*Father / Husband name……*
……	……
Adddress:	*Address:*
……	……
……	……
Hospital Reg. No ……..	*Hospital Reg. No……*

Relation of donor with Recipient ……

Recipient *Donor*

(Photo of recipient and donor must be signed and stamped across the photo after affixing)

Permission is granted, as to the best of knowledge of the members of the committee, donation is out of love and affection and there is no financial transaction between recipient and donor and there is no pressure on / coercion of the donor.

Permission is withheld pending submission of the following documents……

……

Permission is not granted for the following reasons……

……

(Member)	*(Member)*	*(Member)*	*(Member)*
Name and Designation	*Name and Designation*	*Name and Designation*	*Name and Designation*
(Member)	*(Member)*		*(Sign of Chairmanwith stamp)*
Health Secretary	*DHS or Nominee*		*Name and Designation*
Or Nominee	*Name and Designation*		

Date and place……

** In case of SWAP transplants, details are to be annexed*

FORM 19

Certificate by competent authority [as defined at rule 2(c)] For Indian near relative, other than spouse, cases (In case of spousal donor, Form 6 will be applicable)

[See rule 5(3)(c)]

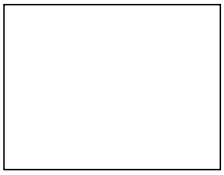
(Format for the decision of Competent Authority)

This is to certify that as per application in Form-11 for transplantation of _____(Name of Organ or Tissue) from living donor who is a near relative of the recipient under the Transplantation of Human Organs Act, 1994(42 of 1994), submitted on……. by the donor and recipient, whose details and photographs are given below, along with their identifications and verifications documents, the case was considered after the personal

interview of donor and recipient (if medically fit to be interviewed) by the competent authority in the meeting held on ……

Details of Recipient	Details of Donor
Name……..	Name:…….
Age…….	Age …….
Sex ……	Sex …….
Father or Husband Name ……	Father or Husband name……..
……	…….
Adddress:	Address:
…….	…….
…….	…….
……..	…….
Hospital Reg. No ……..	Hospital Reg. No……

Relation of donor with Recipient ……



Recipient Donor

(Photo of recipient and donor must be signed and stamped across the photo after affixing)

Permission is granted, as to the best of knowledge of the members of the committee, donation is out of their being near relative and there is no financial transaction between recipient and donor and there is no pressure on / coercion of the donor.

Permission is withheld pending submission of following documents……..

……

Permission is not granted for the following reasons……

……

……..

(Signature and stamp of competent authority)

Date and place…….

FORM 20

Verification certificate *in respect of domicile status of recipient or donor*

[To be issued ***by tehsildar or any other authorised officer*** *for the purpose (required only for the donor - other than near relative or recipient if they do not belong to the state where transplant hospital identified for operation is located)]*

[See rule 14]

Part I (To be filled by applicant donor or recipient separately in triplicate)

In reference to application for verification of domicile status for donation of _____(Name of organ/Tissue) from living donor (other than near relative) or recipient under Transplantation of Human Organ Act, 1994 (42 of 1994), submitted on (date)……. by the applicant donor or recipient, with following details and photograph , along with his or her identification and domicile status for verification

Details of Applicant Recipient or Donor

Name……..

Age…….

Sex ……

Father or Husband Name ……

……

Address:

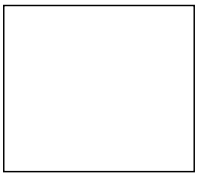
……

……

……..

Hospital Reg. No ……..

……



(Recent Photo of Applicant must be signed by him or her across the photo after affixing it)

The detail of my donor or recipient are as under and I have enclosed his or her self-signed recent photograph :

Name……..

Age……
Sex ……
Father or Husband Name ……
……
Address:
……
……..
Hospital Reg. No ……..

Signature of Applicant
Enclosure : Self signed copy of the donor or recipient for the applicant (to be enclosed)

Part II (To be filled by the certificate issuing authority):

The above request has been examined and it is certified that the domicile status of the applicant donor or recipient mentioned as above has been verified as under:
Name …… Son or Daughter or Wife of ……
resident of village or ward ……,……,Tehsil or Taluka……..District……..State or UT……..
and found correct or incorrect
……
……

Date ……Place ……
Reference No

Authorised Signatory
Name and Designation
Office Stamp

2.The authorised signatory will hand over this verification certificate to the applicant or his or her representative for submission to the Chairperson of the Authorisation Committee of the hospital or district or state (as the case may be), where transplantation has to take place.

3.The authorised signatory shall keep one copy of the above verification certificate for his records and send a copy to the Secretary, Health and Family Welfare of the State Government (Attention Appropriate authority for organ transplant) for information.

4.In case of any suspicion of organ trading, the authorised signatory mentioned above or Appropriate Authority of the state may inform police for making enquiry and taking necessary action as per the Transplantation of Human Organs Act, 1994 (42 of 1994).

FORM 21

Certificate of relationship between donor and recipient in case of foreigners

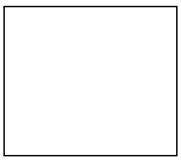
(To be issued by the Embassy concerned)

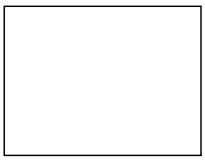
[See rule 20(a)]

The embassy of _____(Name of Country) in India, is in receipt of an application received from_____(Name of Organ donor and recipient) on _____(Date) recommended by_____(Name of Government Department of country of origin) for facilitation of donation of _____(Name of Organ or Tissue) from living donor _____(Name of donor) to the recipient _____(Name of recipient) for therapeutic purposes under the Transplantation of Human Organ Act, 1994(42 of 1994). The details of donor and recipient and photographs are as given below.

Details of Recipient
Name……..
Age……
Sex ……
Father or Husband Name ……
……
Adddress:
……
……
……..

Details of Donor
Name:……
Age ……
Sex ……
Father or Husband name……..
……
Address:
……
……
……





Recipient Donor

(Photo of recipient and donor must be signed and stamped across the photo after affixing)

1, This is to certify that relationship between donor and Recipient is……

2. The authenticity of following enclosed identification and verification documents is certified

a._____

b._____

_____

'No objection certificate' is granted, as to the best of my knowledge, the donor is donating out of love and affection or affection and attachment towards the recipient, and there is no financial transaction between recipient and donor and there is no pressure on or coercion of the donor.

(Signature of Senior Embassy Official)

Date: Name: …….

Place: Designation……..

[No S.12011/28/2012-MG/MS]

ARUN K. PANDA, Jt. Secy.

Printed by the Manager, Government of India Press, Ring Road, Mayapuri, New Delhi-110064
and Published by the Controller of Publications, Delhi-110054.

DIRECTORY OF TRANSPLANT COORDINATORS

S. No	Name	Contact	Mail	Hospital Name
ANDHRA PRADESH				
1	Jeevandan, Andra Pradesh	866-2454648		
2	Aravind	8801535281	aravind.mhm@gmail.com	Simhapuri Hospital, Nellore
3	Arokya rao	9493502526	anil76739@gmail.com	Government General Hospital, Guntur
4	Benarji	8143646996	benarjimsw2002@gmail.com	Seven Hills Health Care Hospital, Vizag
5	Chaitanya	9704613212	anumolg01@gmail.com	Krishna Inst.of Medical Sciences, Nellore
6	Dr. A.Srinivas	9849100144	aswinihospgnt@gmail.com	Aswini Hospitals, Guntur
7	Dr. Vijay Kumar	9849432746		GSL General Hospital, Rajahmundry
8	Ganga	8247303460		Sentini Hospitals, Vijayawada
9	Indira	9133353535	ch.indira@pinnaclehospitals.com	Pinnacle Hospitals, Vizag
10	Kishor	9912414314		Swarupa Super Specialty Hospital, Vijayawada
11	Lalitha	8019190025		Sraddha Hospital, Collector Office Junction, Vizag
12	Madhubabu	9032405334		Guntur City Hospital, Guntur
13	Kiran	9866656493	kiran.psims@gmail.com	Dr.Pinnamaneni Siddhartha Hospitals, Gannavaram
14	N. Lakshmi	8008822003		Apollo Hospitals, Kakinada
15	Poonam	9346920478	ktcoordinator@mycurehospitals.com	Mycure Hospitals, Vizag
16	Prasad	8985555766	prasadnvs.reddy@gmail.com	SVIMS, Tirupathi
17	Rajyalakshmi	8008177878		Queens 'NRI Hospital, Vizag
18	Rama Krishna	8985359119		NRI General Hospital, Guntur
19	Ramesh	9912054816		Sri Lakshmi Super Speciality Hospital, Guntur
20	Ribka	7306138162		Ramesh multi Specialty Hospital, Guntur
21	Sai	7680017868		Care Hospitals, Vizag
22	Satya	9014994555		Arun Kidney Center, Vijayawada

23	Selva	7658970066	renaltransplant_ nlrapollohospitals.com	Apollo Hospitals, Nellore
24	Shanthi	9247824787		Narayana Medical College Hospital, Nellore
25	Shobha	9951563456	metrossh@gmail.com	Metro Super Specialty Hospital, Vijayawada
26	Sireesha	9133661678		KGH, Vizag
27	Srinivas	9949908946	vasuchittineni@gmail.com	Manipal Hospitals, Vijayawada
28	Sudhanath	8466996328	ahmuaactcoordinator@gmail.com	Andhra Hospitals, Vijayawada
29	Surekha	8498061152	kkdsurekha@yahoo.com	Aayush Hospitals, Vijayawada
30	Usha	8374811666	ushasri_v@apollohospitals.com	Apollo Hospitals, Vizag
31	Vamsi	8125919309	vamsijanjala@gmailcom	Aravind Kidney Centre, Nellore
32	Vinay	9642316700	vinaykumarbdd@gmail.com	Kamineni Hospitals, Vijayawada
TAMIL NADU				
33	TNOS	044-25333676	organstransplant@gmail.com	
34	Bala Krishnan	9940517478 / 8015997588	bala5mmc@gmail.com	PSG Hospital, Coimbatore
35	K. Jothi	8098766248	livertransplant@kmchhospitals.com	Kovai Medical Center and Hospital,coimbatore
36	Joseph Sunny	9442065056 / 7708068062	josephcsunny83@gmail.com	Cethar Hospital,Tiruchirappalli
37	Manigandan M	8124856810 / 9944752911	yuvanmanish.m@gmail.com	Fortis Malar Hospital, Chennai
38	Sathish L	9840453522 / 9444924422	alfasathish@gmail.com	Fortis Malar Hospital, Chennai
39	Akilandeswari Ramu	9094595968 / 7092780297	akilasekar76@gmail.com	Kumaran Hospital,Chennai
40	Augustin Joe	9176286587 / 7299015323	augu.tinny@gmail.com	Apollo Hospitals Chennai
41	Chandrasekaran CB	9500970666 / 9994260481	cbckghmgr@gmail.com	PSG Hospitals IMSR,Coimbatore
42	Chinni Priyanka	7397079672 / 8220428880	priyaravindhar1992@gmail.com	Gleneagles Global Health City,Chennai
43	Dhanraj P	9884483222 / 9445998878	dhanrajops@gmail.com	Fortis Malar Hospital, Chennai
44	Gowri Chandru	9994171044	chandruchandru02@gmail.com	Vadamalayan Hospital Pvt Ltd, Madurai
45	James Varghese	9962866563 / 8754578800	james@annaiarulhospital.com	Annai Arul Hospital,Chennai

46	Johnson A	9884568110 / 7299001807	logon2johnson@gmail.com	Apollo Hospitals, Chennai
47	Joshua Kingsley Jabaraj	9894095618 / 9489037057	giftedking90@gmail.com	Billroth Hospitals, Chennai
48	Jothi Dhanabal	8098766248, 9994112163	jothibalasrh@gmail.com	Sri Ramakrishna Hospital, Coimbatore
49	Karthic Sreedharan	9092091361	karthicsv70@gmail.com	Rps Hospitals, Chennai
50	Karthik Venkatesan	9789445055	karthikrdtech@gmail.com	Fortis Malar Hospital, Chennai
51	Lakshmana Kumar K	9944276754	laksh_jai2004@yahoo.co.in	Sacred Heart Collegetirupattur, Tirupattur
52	Mageshwari Shanmugam	7667999246 / 9092036750	mageshkvs@yahoo.com	Sims Hospital, Chennai
53	Mukesh Ganesan	9894070876	muki.mukesh@gmail.com	Velammal Medical College Hospital, Madurai
54	Murali Ramasamy	9842291270 / 8903040270	muralikmchrenal@gmail.com	Kovai Medical Center And Hospital, Coimbatore
55	Nandakumar U	8939035832 / 9952023943	nandaonweb@gmail.com	Fortis Malar Hospital, Chennai
56	Nethaji J	7299003489 / 8754492005	nethaji.iatc@gmail.com	Sims Hospital, Chennai
57	Prabakaran Ravi	9944757399 / 8667842941	rprabakaranmsw@gmail.com	Sri Ramakrishna Hospital
58	Ragavan Ranjithkumar	9944640894 / 9944640894	raghavriya90@gmail.com	Mohan Foundation, Chennai
59	Rathi Baskaran	9790156324 / 9942537131	rathibaskaran@gmail.com	Psg Hospitals, Coimbatore
60	Ruban Victor	9940579826 / 9962343804	rubanvictor.n@gmail.com	Pims, Chennai
61	S Senthil Kumar	9994107043 / 8608512868	senthil2784@gmail.com	Govt Stanley Medical College and Hospital
62	Sagayam Francis	9791793333 / 7299068286	sagayam.iatc@gmail.com	Miot Hospitals
63	Santhosh Kumar G	8939963342	santhosh.sekeran@gmail.com	Govt Stanley Hospital, Chennai
64	Selvi Sebastin	9791144090 / 9551413866	selviseba2003@gmail.com	Kumaran Hospital, Chennai
65	Sendhamarai Selvi	7299940617	sendhamaraisairam@gmail.com	The Madras Medical Mission Hospital, Chennai
66	Shankarganesh K	9444712514 / 4426447000	ganeeshk@rediffmail.com	Gleneagles Global Health City, Chennai
67	Shanmuga Sundaram K	9629086290 / 9962709915	krshanu.om@gmail.com	Fortis Malar Hospital, Chennai
68	Shivakumar M	9894179922 / 9894179922	shivamsw@gmail.com	Gleneagles Global Health City

69	Vijayalakshmi Jeevanandham	9894032406	vijiathiba@gmail.com	KG Hospital,C oimbatore
70	Sujatha Suriyamoorthi	7708662670 / 7708662670	ssujatha.msw@gmail.com	MOHAN Foundation, Chennai
71	Tom Michael	7667234615	tommichael007@gmail.com	Gleneagles Global Health City, Chennai
72	Sunitha Velankanni	9176693270 / 9176075602	atsunitha06@gmail.com	MOHAN Foundation, Chennai
TELANGANA				
73	Jeevandan Telangana	040-23489494	Jeevandan.telangana@gmail.com	
74	A. Aruna	9490294984	aruna.aleti1@gmail.com	Kamineni Hospital , Hyderabad
75	Akkineni Nagendra	9440804007	ninethreenaga@gmail.com	Care Banjara, Hyderabad
76	Dr. Bhanu chandra	9966658979	bcd.sreevari@gmail.com	Osmania General Hospital, Hyderabad
77	Dr. Bhaskarrao	8008884873	dr.baskarrao@yashodamail.com	Yashoda Hospital, Malkpet, Hyderabad
78	Dr.P. Swamy	9347357200	papswamy@yahoo.co.in	Yashoda Somajiguda, Hyderabad
79	E.Venkat	9848150767	venkat.enj7@gmail.com	KIMS Hospital, Hyderabad
80	Eshwar	9133356658	eshwarquality@gmail.com	Max Cure Medicity, Hyderabad
81	G Laxmi	9908695222	LaxmiGuri@gmail.com	Care Banjara, Hyderabad
82	G. Jaya Laxmi	8978026262	jrm3gs@gmail.com	Global Lakdikapool, Hyderabad
83	Girish Shetty	9652222655	shettygirish171@gmail.com	Apollo Hospital, Hyderabad
84	Jai Ganesh	7093800130	jaiganesh@ainuindia.org	Asian Institute of Nephrology and urology, Hyderabad
85	K. Nagaraju	9494047237	knagaraju876@gmail.com	Deccan Hospital, Hyderabad
86	Kakoli Biswas	9000484621	kakolibiswas0807@gmail.com	Care Hospital, Nampally, Hyderabad
87	M.Sudhakar	9849705112	mskrhyd@gmail.com	Sai Vani Hospital, Hyderabad
88	Naresh	9100062900	nareshvijju564@gmail.com	Star Hospital, Hyderabad
89	P.J.Dilieena	9701550388	pdileena@yahoo.com	Century Hospital, Hyderabad
90	Pradeep kumar	9492129909	Paddujakka@gmail.com	NIMS, Hyderabad
91	R.Sanjeev	8686975637	Sanju8n@gmal.com	KIMS Hospital, Hyderabad
92	Dr. Bhanu prakash	9290094245	bhanuprakashsomoju@gmail.com	Gandhi Hospital, Hyderabad
93	S.Prakash	9505292317	prakash.s@yashodamail.com	Yashoda hospital, Secunderabad, Hyderabad
94	Sahana	9701230283	gisurgerytransplant@gmail.com	ASIAN Institute of Gastroenterology, Hyderabad
95	U. Sreenivisa Reddy	9703366684	sreenivasareddy.ulavala@Carehospitals.com	Care Hospital, Hitech City, Hyderabad

96	Y. Ganesh	9100090737	ganesh.yetty@ Globalhospitalsindia.com	Aware Global Hospital, Hyderabad
KARNATAKA				
97	Sarala A	9886732927	a.sarala43@yahoo.com	BGS Global Hospital, Banglore
98	Dadapeer Tadas	9945999736	tadas.517@gmail.com	Tatwadarsha Hospital Pvt.ltd, Hubbli
99	Aparajita Dhal	9035138713	aparajitadhalappu@gmail.com	Columbia Asia Hospital, Hebbala, Benglore
100	Parimala.V.K	9620162277	prarthanabhat06@gmail.com	Sagar hospitals, Jayanagar, Banglore
101	Gipson John	9742751765	gipsnj5kerala@gmail.com	Aster CMI, Bangalore
102	Yuvaraj Boopathi	9790702614	yuvarajboopathi7@gmail.com	Manipal Hospitals, Bangalore
103	Savitha H R	9731452576	transplantcoordinator@ sparshhospital.com	Sparsh Super Speciality Hospital, Bangalore
104	Patricia Namitha Maria Viego	8861770385	pnmviego@hotmail.com	Jeevasarthakathe,Bengaluru
105	Lijamol Joseph	8197064127 / 9538026645	lijamoljo@gmail.com	Narayana Health, Bommasandra, Bangalore
106	Jaslin James	9741824180 / 9901664800	jasjames89@gmail.com	Banglore Medical Collage & Research Institute
KERALA				
107	Mrithasanjeevani	0471-2528658, 0471-2528386	principalmct@gmail.com	Kerala Network for Organ Sharing
108	Aneesh PV	09048 60 00 55	aneeshknos@gmail.com	Kerala Network for Organ Sharing
109	Vinod Kumar SL	9349157250	vinodkumarknos@gmail.com	Kerala Network for Organ Sharing
110	Puja Kumari	7738432869 / 9122396182	pujabgp2016@gmail.com	INHS Aswini
111	Lt Col Jaya	9650378824 / 9650378805	knjaya@gmail.com	Army Hospital
112	Shishir Kumar	8368087141 / 7836851651	shishirkr83@gmail.com	Nayati Hospital, Mathura
113	Trilly Rachel Mathew	8800466476 / 8800466476	trillymathew@gmail.com	Fortis Memorial Research Institute, Gurgaon

Indian Journal of Transplantaion (IJT)

Official Journal of Indian society of Organ Transplantation
(ISOT)

Journal website www.ijtonline.in
Article submission: www.ijtonline.in

4 issues per year

For any Queries Contact
Dr. Manisha Sahay, Editor in chief
E: editorinchiefijt@gmail.com | drmanishasahay@gmail.com
M: +91 98490 97507

Notes:

Notes: