

Organ & tissue transplantation: A second chance of life

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Abstract - Transplanting a healthy organ into a person who lacks that organ can save their life and boost their quality of living. While organ transplants have improved greatly over the past two decades, with generally excellent outcomes for children and young adults, the increased proportion of older transplant patients with comorbidities poses new challenges. Transplants are essential for the treatment of patients with irreversible diseases of the liver, heart, or lungs, and renal transplantation improves patient survival compared to dialysis. There has been a consistent increase in the number of solid organ transplant programmes, but this growth falls well short of meeting worldwide needs. Giving someone a second chance at life is possible only via organ and tissue donation. Giving to charity has far-reaching benefits for society as a whole, not just for the individual or family receiving the donation. In 2021, there were 1,44,302 organ transplants worldwide; India accounted for 8% of that total with its 42,259 transplants. Therefore, decreasing the number of patients in need (the waiting list) of an organ can be accomplished by increasing public awareness of the significance of volunteer enrolling for organ donation.

Index Terms- organ donation, tissue donation, body donation, transplantation, organs and tissues of transplantation.

I. INTRODUCTION

Human body systems: Body systems are collections of organs and tissues that collaborate to carry out crucial tasks for the body. Some of the organs in our bodies have multiple functions, therefore they are a part of multiple body systems. Other organs and tissues, aside from these, have just one function within the bodily system. An organism needs each and every one of its body systems to be able to survive and procreate. The body's several systems are listed here.

- i. Respiratory System
- ii. Digestive System or Excretory System
- iii. Cardiovascular or Circulatory System
- iv. Renal System or Urinary System
- v. Endocrine System
- vi. Nervous System
- vii. Musculoskeletal System
- viii. Integumentary System or Exocrine System
- ix. Lymphatic System or Immune System
- x. Reproductive System [1]

These systems are responsible for the anatomy and physiology of the body. Anatomy means the structure and location of the organs whereas physiology means the functions of the organ.

Human Body Systems

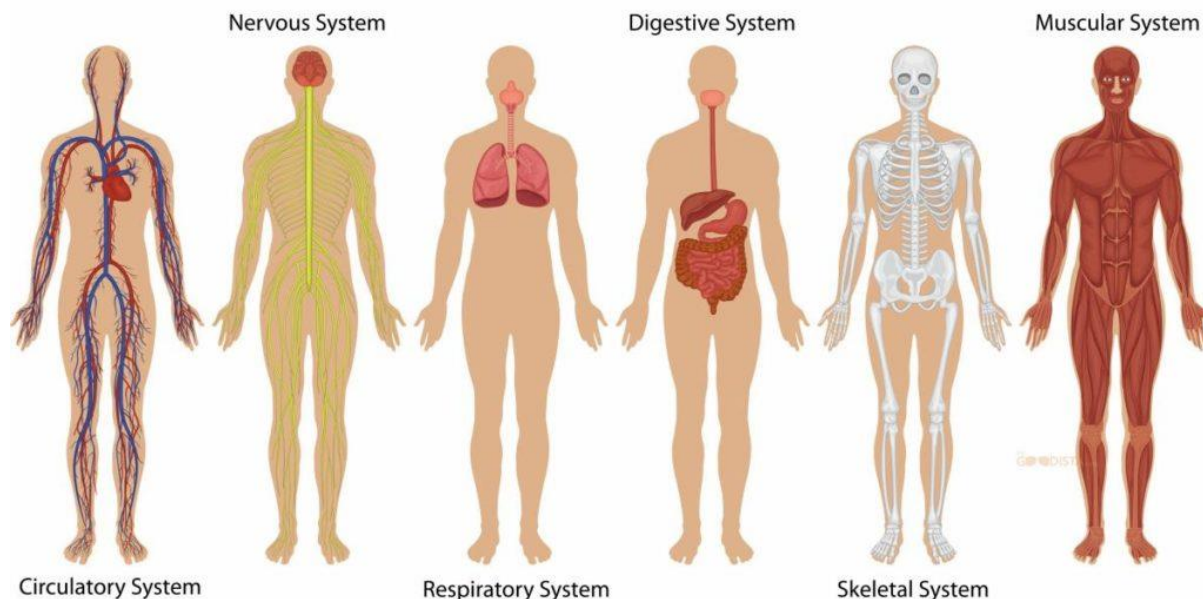


Fig 1: Human body systems, courtesy: <https://thegoodista.com/the-human-body-systems/>

Organ: An organ is a structural unit within the human body that is responsible for carrying out a specialised physiological function. Examples of organs include the heart, lungs, kidneys, liver, and pancreas, among others. These organs have the potential to be donated.

Tissue: The term "tissue" refers to a collection of cells that work together to carry out a certain job within the human body. Examples of biological tissues include bone, skin, the cornea of the eye, heart valves, blood arteries, nerves, and tendons, among others. These tissues have the potential to be donated.

Donation: The act of donating an organ or tissue presents an exceptional opportunity to offer an individual a renewed opportunity for life. Donations have a profound effect not just on the individual or family receiving assistance, but also on the broader societal context.

Body donation: Donating one's corpse after death for the purposes of medical study and education is what is meant by the phrase "body donation." Anatomists and medical educators who teach gross anatomy continue to rely heavily on the donated cadavers as their primary instructional resource. Donating organs and tissues is described as the act of providing life to others after one's own death by donating one's organs to those in need who are suffering from the final stages of organ failure.

Cadaver: 'Cadaver' is defined as 'a dead human body' in the Oxford Dictionary. Cadavers are used in the medical field to refer to cadavers that have been dissected and studied. The term "cadaver" is used in the field of organ transplantation to describe a body that is brain-dead but nevertheless has a beating heart and is being kept alive by artificial means.

Organ Donation: Organ donation refers to the act of voluntarily providing an organ to an individual who is suffering from end-stage organ disease and requires a transplantation procedure. The Transplantation of Human Organs Act (THOA 1994) provides coverage for the use of organ donation for therapeutic reasons. There exist two distinct categories of organ donation:

i) **Living Donor Organ Donation:** A person can donate one kidney during their lifetime, along with a portion of their pancreas (half of which is sufficient to support pancreatic function), a portion of their liver (which will eventually regenerate in both the recipient and the donor), and a portion of their pancreas.

ii) **Deceased Donor Organ Donation:** After (heart/brain) death, a person is still capable of making multiple organ and tissue donations. His or her organ survives on in the body of another person.

The minimum age for organ donation varies depending on whether it involves cadaver or living donors; for example, a living donor must be at least 18 years old, and for the majority of organs, physical condition, not age, is the determining factor. Specialists in medicine select which organs are best for each individual patient. All across the world, organs and tissue from persons in their 70s and 80s have been successfully transplanted. Age often has no effect on tissues or the eyes.

Table 1: Age limit of deceased donor

ORGANS		
1	Kidneys	Up to 70 years
2	Liver	Up to 70 years
3	Heart	Up to 50 years
4	Lungs	Up to 50 years
5	Pancreas	Up to 60-65 years
6	Intestine	Up to 60-65 years
TISSUES		
1	Corneas	Up to 100 years

2	Skin	Up to 100 years
3	Heart valves	Up to 50 years
4	Bone	Up to 70 years

II. DIFFERENCE BETWEEN BODY DONATION AND ORGAN/TISSUE DONATION

A deceased person donates their body for medical study and teaching. Donated bodies are used to educate gross anatomy and conduct research, but organ and tissue donation is for therapeutic purposes exclusively. Noble donors' bodies are handed to their families with dignity for last rites after organ/tissue retrieval. The patient must die in the ICU and be brain stem dead to donate organs. Home death prevents organ retrieval. Even if a person dies at home, cornea and skin can be removed within a certain timeframe.

Living Donor: Any person over the age of 18 who voluntarily consents to the removal of his or her organs and/or tissues for therapeutic purposes in accordance with current medical practises.

Deceased Donor: Anyone can donate organs and tissue after their Death (Brainstem/Cardiac), regardless of their age, race, or gender. A close relative or someone who is legally in possession of the dead body must consent. If the deceased donor is under the age of 18, one of the parents or another close family who has been given permission by the parents must give their approval. At the moment of death, medical eligibility for donation is assessed.

Tissue donation – Tissue is made up of groups of cells that work together to do a certain job in the body. Examples of tissue include the lens (in the eye), bones, skin, heart valves, nerves, tendons, and so on. Many people can improve their quality of life by getting different kinds of cells transplanted.

Table 2: If different organs and tissues are in medically fit conditions, following organs and tissues can be donated:

Organs	Tissues
Two kidneys	Two corneas
Liver	Skin
Heart	Heart valves
Two lungs	Cartilage / Ligaments
Intestine	Bones /Tendons
Pancreas	Vessels

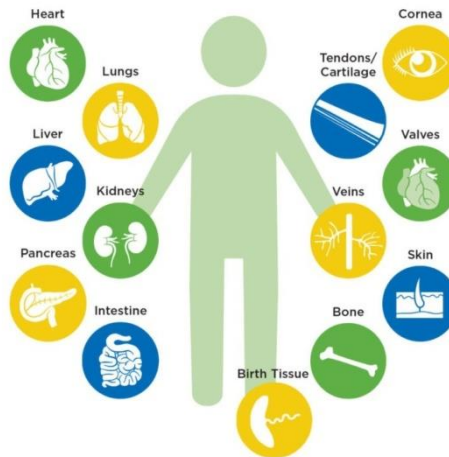


Fig 2: Organs and tissues for donation.

Courtesy: <https://www.youthkiawaaz.com/2021/12/organ-tissue-donation/>

III. NECESSITY OF ORGANS/TISSUES FOR TRANSPLANTATION IN A YEAR

Organ and tissue transplants are becoming more and more important in India because so many organs are failing. The numbers given are only guesses because there isn't any organised data for those parts.

Table 3: Every year, following number of persons needs organ/tissue transplant as per organ specified.

Organ/tissue	Required number
Kidney	2,50,000
Liver	80,000
Heart	50,000
Cornea	1,00,000

IV. TRANSPLANTATION

An organ transplant involves the surgical removal of a donor organ and its subsequent implantation into a recipient. When an organ in the recipient has failed or been damaged due to illness or injury, transplantation is necessary.

Table 4: Some end stage diseases which can be cured by the transplantation

Diseases	Organs
Heart failure	Heart
Terminal lung illnesses	Lungs
Kidney failure	Kidneys
Liver failure	Liver
Diabetes	Pancreas
Corneal Blindness	Eyes
Heart Valvular disease	Heart valve
Severe burns	Skin

When should transplants of donated organs take place?

Healthy organs should be transplanted as soon as possible.

Table 5: Different organs can be transplanted within different time frame

S.No.	Organ name	Time duration
1	Heart	4-6 hours
2	Lungs	4-8 hours
3	Intestine	6-10 hours
4	Liver	12-15 hours
5	Pancreas	12-24 hours
6	Kidneys	24-48 hours

Living Near Related Donors: Only immediate blood relatives, such as parents, siblings, children, grandparents, and great-grandchildren, are often approved as donors (THOA Rules 2014). In the category of a close family, a spouse is also accepted as a living donor and is allowed to donate.

Living Non- near relative Donors: These individuals are distinct from the close relatives of the recipient or patient. Individuals may choose to contribute for various reasons, including as a deep emotional connection or a sense of attachment towards the receiver, or for other unique motivations.

SWAP Donors: If the living near-relative donor is not suitable with the recipient, there is a way for the donors of two pairs to switch places if the donor of the first pair matches with the second recipient and the donor of the second pair matches with the first recipient. This is only okay for givers who are close family members.

The living gift programme is based on the idea that the person who donates will be completely healthy for the rest of their lives. In other words, the donor is not medically unfit for any reason. But there are times when a living organ donor is viewed differently. Like people who serve in the military, organ donors are not seen as regular, and they have trouble getting promoted at work and other things.

V. BRAIN-STEM DEATH/BRAIN DEATH

When irreparable injury occurs to the brain stem, all brain stem functions cease. This is a fatal ailment and the patient cannot recover. A person who has suffered a blow to the brain stem is unable to breathe on his own, but his heart still has the ability to pump blood and oxygen as long as it is supplied with the two. Brain stem dead patients have their breathing tubes kept in place, their hearts kept pumping with oxygenated blood, and their blood pressure maybe maintained with medication. Even though the heart may continue to beat for some time after brain stem death, this in no way indicates that the person is alive or that they will survive. After getting permission from the family, organs can be removed. Donating an organ is never life-threatening for the recipient.

The diagnosis of brain stem death is made in accordance with recognised medical guidelines. The parameters emphasise the three clinical signs that must be present to indicate the complete and permanent termination of all brain and brain stem functions:

- i. Coma (loss of consciousness) with a known cause
- ii. Absence of brainstem reflexes
- iii. Apnea (absence of spontaneous breathing)

These tests are carried out twice at the interval of at-least 6-12 hours by the team of Medical Experts. Brain-stem Death is accepted under the Transplant Human Organ Act since 1994.[2]

Offences and Punishments [2]

Table 6: As per the amended 2011 THO Act (Transplantation of human organs act), offences/punishments are as follows:

S.No.	Offense	Punishment
1	Removal of human organ and tissue or both without authority	Upto 10 years imprisonment and a fine up to 5,00,000/-
2	Commercial dealings in human organ	Upto 5-10 years imprisonment and a fine between 20,00,000/- to 1 crore.

Transplantation of human cells, tissues and organs

Transplanting human cells, tissues, or organs saves many lives and returns vital functions in situations where there are no other options that work as well. In the past 50 years, transplantation has spread around the world and become a great method. But there are big differences between countries in how easy it is to get the right transplant and how safe, effective, and high-quality it is to donate and transfer human cells, tissues, and organs. The moral issues surrounding transplants are very important. In particular, the fact that patients' needs aren't being met and there aren't enough transplants makes people want to trade body parts for transplantation.

Human transplantation

Transplanting human cells and organs can save lives or bring back important functions. As an example

- A corneal graft can help people who are blind in the cornea see again;
- Transplanting hemopoietic stem cells can cure some leukaemias and other congenital or acquired diseases;
- Transplanting a human heart valve is often the best way to replace one, and the recipients don't need to take anticoagulation drugs for a long time.

Xenotransplantation

Xenotransplantation refers to the transplantation of living cells, tissues, or organs from animals into humans, along with the use of human body fluids, cells, tissues, or organs that have been in contact with these living, xenogeneic materials. This practise holds promise as a potential alternative to human-derived materials and could help address the shortage of human material available for transplantation.[3]

The miracles of 20th-century medicine include antibiotics, mass immunisations to avoid infectious diseases, and organ transplantation. Terminal and irreversible organ failure is best treated with transplantation. The first solid organ transplant for end-stage renal disease (ESRD) was kidney transplantation in the 1950s. The progressive introduction of dialysis expanded the pool of kidney transplant candidates, who may discontinue dialysis following successful transplantation. In the era of conventional immunosuppression using azathioprine and steroids, rejection rates and early graft failure were high. Without supportive replacement therapies, nonrenal solid organ transplant programmes had poor results and low activity until the early 1980s. Cyclosporine improved transplant results 30 years ago, and solid organ transplant programmes were implemented worldwide.[4]

Estimated number of organ transplantations worldwide in 2021

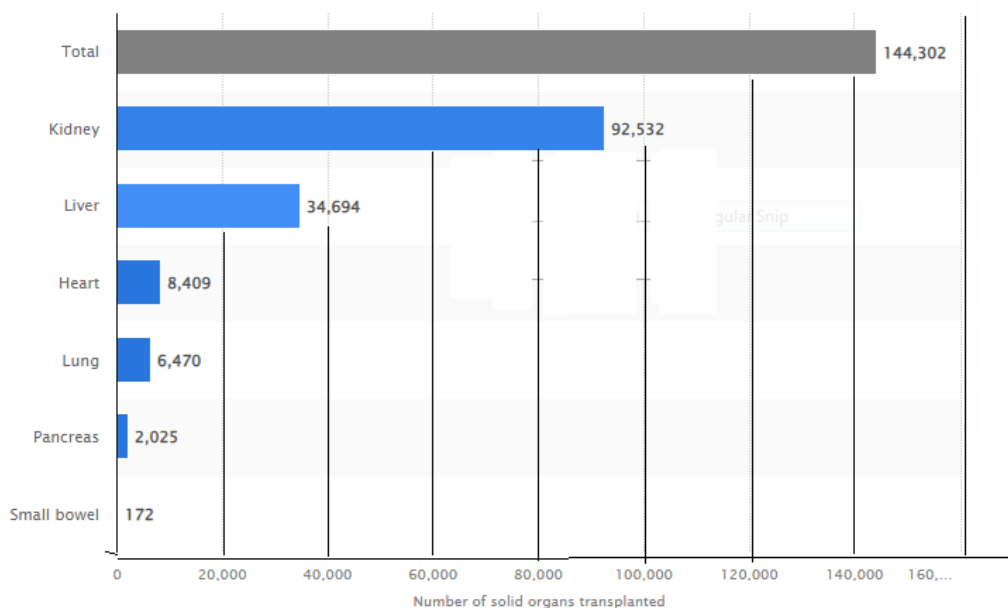


Fig 3: Worldwide organ transplantation in 2021

The kidney is the most transplanted organ worldwide followed by the liver and the heart. Globally, there were approximately 144,302 organ transplants in 2021.[5]

In 2021, 26.44% (38,156) of organ donations will be from deceased donors, while the total number of transplants from deceased donors in India is 4.5% (552). The number of global organ transplants was 1,44,302, and the number of transplants in India was 42,259, or 8% of the global total.

Table 7: Percentage share of organs transplanted in India in 2021

S.No.	Organ	Share
1	Kidneys	74.27%
2	Liver	23.22%
3	Heart	1.23%
4	Lung	1.08%

5	Pancreas	0.15%
6	Small bowel	0.03%

More than 1.5 lakh fatalities associated with accidents were reported, according to the 2021 report from the Indian Ministry of Road Transport and Highways. According to the 2021 worldwide organ donation report, only 552 died brain deaths had organ transplants. Therefore, increasing public awareness of the significance of volunteering for organ donation will assist many individuals who are in need of an organ for their survival and therefore decrease the number of patients on the waiting list.[6]

V. ACKNOWLEDGEMENT

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VI. CONCLUSION

An organ transplant involves the surgical removal of a donor organ and its subsequent implantation into a recipient. When an organ in the recipient has failed or been damaged due to illness or injury, transplantation is necessary. The Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India established the National Organ and Tissue Transplant Organisation (NOTTO) to handle transplantation cases on a national scale in India. The National Human Organ and Tissue Removal and Storage Network and the National Biomaterial Centre are two of its departments. In 2021, there were 1,44,302 organ transplants worldwide; India accounted for 8% of that total with its 42,259 transplants. Therefore, decreasing the number of patients in need (the waiting list) of an organ can be accomplished by increasing public awareness of the significance of volunteer enrolling for organ donation.

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