

A Review on Organ Donation

Rajesh Yadav¹, Rahul Kumar Sharma¹, Shubham¹, Ashok Kumar Sharma²,
Mukesh Sharma³

¹Scholar Arya College of Pharmacy, Jaipur Rajasthan

²Associate Professor, Arya College of Pharmacy, Jaipur, Rajasthan

³Professor, Arya College of Pharmacy, Jaipur, Rajasthan

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Corresponding author: Rajesh Yadav

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Abstract

This review explores the multifaceted landscape of organ transplantation, encompassing living and deceased donation, intricate transplantation procedures, the critical role of medical evaluations and matching, immunosuppression challenges and advancements, and the ethical and legal considerations inherent in this life-saving field. Advancements such as personalized medicine, innovative organ preservation techniques, and ongoing efforts to expand the donor pool offer hope for improved outcomes. However, persistent challenges, including organ shortages and logistical hurdles, underscore the need for continued research, public awareness, and equitable access to transplantation. The future of organ transplantation holds promise through technological innovations, personalized approaches, and international collaboration, reflecting a dynamic and evolving field committed to enhancing patient care and addressing ethical complexities.

Keywords: Organ, Transplant, immunosuppression, Transplantation

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I. Introduction

Organ donation and transplantation represent pivotal advancements in modern medicine, offering hope and renewed life to individuals facing organ failure. This section sets the stage by defining organ donation, highlighting its profound significance, and providing a concise overview of the article's structure.[1]

A. Definition of Organ Donation[2]

Organ donation is the altruistic act of willingly providing one's organs or tissues, either from living or deceased individuals, to be transplanted into another person. These life-

saving donations aim to replace malfunctioning or failed organs, restoring health and extending the recipient's life.

B. Significance of Organ Transplantation in Modern Medicine[3]

The significance of organ transplantation in modern medicine cannot be overstated. This medical intervention has transformed the prognosis and quality of life for countless individuals suffering from end-stage organ diseases. Whether through living or deceased donation, transplantation has become a cornerstone in the continuum of patient care,

offering solutions to conditions that were once considered fatal.

The impact of organ transplantation extends beyond individual patients to their families and communities. It is a testament to human resilience, scientific progress, and the collaborative efforts of healthcare professionals, researchers, and donors.

C. Overview of the Article Structure[4]

To comprehensively explore the various facets of organ donation and transplantation, this article is structured to delve into different aspects of the topic. The subsequent sections will cover living and deceased donation, specific organ transplantation procedures, the critical role of medical evaluations and matching, the necessity of immunosuppression, ethical and legal considerations, and the latest advancements and challenges in the field.

This structured approach aims to provide readers with a holistic understanding of organ donation, from the fundamental concepts to the complex medical procedures and ethical considerations. As we navigate through the intricacies of organ transplantation, the goal is to shed light on the medical, social, and ethical dimensions that shape this remarkable field of medicine.

II. Types of Organ Donation[5]

Organ donation manifests in two primary forms: living and deceased. In this section, we focus on living donation, elucidating the eligibility criteria for donors, the commonly donated organs, and the comprehensive medical evaluation and associated risks.

A. Living Donation[6]

Living donation stands as a testament to the selflessness of individuals willing to contribute a part of themselves to save another's life. This

altruistic act often involves donating organs such as kidneys or portions of the liver.

1. Eligibility Criteria for Living Donors[7]

Living donors undergo rigorous assessments to ensure both their physical and psychological well-being. Key eligibility criteria include:

- **Good Physical Health:** Donors must be in excellent physical condition to withstand the donation process without compromising their own health.
- **Compatible Blood Type:** Blood type compatibility between the donor and recipient is critical to minimize the risk of rejection.
- **Tissue Compatibility:** Further matching of tissue characteristics helps enhance the success of the transplant.
- **Willingness and Informed Consent:** Donors must willingly choose to donate, fully understanding the risks and implications.

2. Commonly Donated Organs[8]

Living donors predominantly contribute organs that the human body can function with a portion missing. The most common organs include:

- **Kidney:** Living kidney donation is the most prevalent form of living donation due to the organ's regenerative capacity.
- **Liver:** A portion of the liver, often the left lobe, can be transplanted from a living donor to a recipient.

3. Medical Evaluation and Risks for Living Donors[9]

Living donors undergo extensive medical evaluations to assess their overall health and the feasibility of the donation. Evaluations include:

- **Physical Examinations:** Comprehensive health assessments to identify any existing medical conditions.

- Psychological Evaluations: Assessments to gauge the donor's mental and emotional readiness for the donation process.
- Diagnostic Tests: Blood tests, imaging studies, and other diagnostic tools to evaluate organ function and rule out any underlying issues.

Living donation, while generally safe, is not without risks. Potential risks include surgical complications, infections, and psychological impacts. However, stringent evaluation processes aim to minimize these risks and ensure the well-being of the donor.[10]

Understanding the criteria, organs involved, and the careful evaluation process for living donors is crucial in appreciating the selfless act of individuals who choose to make this profound contribution to another person's life.

B. Deceased Donation[11]

Deceased organ donation plays a vital role in addressing the critical shortage of organs for transplantation. This section delves into the criteria for brain death, the organ retrieval process, and the challenges and ethical considerations associated with deceased donation.[12]

1. Criteria for Brain Death and Deceased Donation[13]

Deceased donation primarily relies on individuals who have suffered irreversible brain damage while their heart and other vital organs are still functioning due to life support. The criteria for brain death include:

- Irreversible Brain Damage: Comprehensive neurological assessments confirm the complete and irreversible loss of all brain functions, including the brainstem.
- Exclusion of Reversible Causes: Physicians ensure that brain damage is not caused by factors such as medication, hypothermia, or intoxication.

- Clinical Observations: A series of clinical tests, including reflex assessments and apnea tests, are conducted to confirm the absence of brain function.

Once brain death is determined, the deceased individual becomes a potential organ donor.

2. Organ Retrieval Process[14]

The organ retrieval process is a meticulously coordinated effort involving medical professionals and transplant teams. Key steps include:

- Notification and Consent: The potential for organ donation is explored with the deceased's family, and consent is obtained.
- Medical Evaluation: Assessments are conducted to determine the suitability of organs for transplantation.
- Organ Preservation: Organs are carefully preserved to maintain their viability during transportation to the recipient.
- Surgical Retrieval: Surgeons perform the retrieval procedure, ensuring the preservation of surrounding tissues and structures.
- Transportation to Recipient: Organs are transported to the recipient hospital for transplantation.

The success of deceased organ donation relies on swift and efficient coordination among healthcare professionals, organ procurement organizations, and transplant teams.

3. Challenges and Ethical Considerations[15]

Despite the life-saving potential of deceased donation, it is not without challenges and ethical considerations:

- Shortage of Organs: Demand often exceeds the supply of available organs, leading to long waiting lists and potential disparities in access to transplantation.
- Timely Coordination: The time-sensitive nature of organ retrieval requires seamless coordination, posing logistical challenges.

- Informed Consent: Ensuring informed and voluntary consent from the deceased's family is a delicate ethical consideration.
- Equitable Distribution: Ethical dilemmas may arise regarding the fair distribution of organs, emphasizing the need for transparent and equitable allocation policies.

Understanding the complexities and ethical nuances of deceased organ donation is crucial in fostering public awareness and addressing challenges associated with this essential aspect of transplantation medicine.

III. Organ Transplantation Procedures[16]

Organ transplantation procedures are intricate processes that involve surgical expertise, meticulous planning, and ongoing medical care. This section explores the nuances of kidney, liver, heart, lung, and pancreas transplantation.

A. Kidney Transplantation[17]

1. Matching and Compatibility

- Blood Type and Tissue Matching: Ensuring compatibility between the donor and recipient is crucial to minimize the risk of rejection.
- Crossmatching: Specific tests, including crossmatching, help further evaluate compatibility and reduce the likelihood of immune-related complications.

2. Surgical Techniques and Postoperative Care[18]

- Donor Nephrectomy: Techniques for removing the kidney from the donor, such as laparoscopic or open surgery.
- Recipient Surgery: Implantation of the donated kidney into the recipient, with variations in surgical approaches.
- Postoperative Care: Management of immunosuppressive medications, monitoring for complications, and follow-

up care to ensure the transplanted kidney's optimal function.

3. Long-Term Outcomes and Complications[19]

- Graft Survival: Factors influencing the long-term survival of the transplanted kidney.
- Complications: Common complications, including rejection, infections, and the impact of immunosuppressive medications.

B. Liver Transplantation[20]

1. Indications for Liver Transplantation

- End-Stage Liver Disease: Liver transplantation is considered for individuals with irreversible liver damage, often caused by cirrhosis, hepatitis, or genetic disorders.
- Acute Liver Failure: Rapid deterioration of liver function may necessitate urgent transplantation.

2. Living vs. Deceased Donor Liver Transplants[21]

- Living Donor Transplants: The benefits and considerations of using a portion of a living donor's liver.
- Deceased Donor Transplants: Availability, matching considerations, and challenges associated with deceased donor liver transplantation.

3. Complications and Survival Rates[22]

- Postoperative Complications: Surgical complications, infections, and rejection.
- Survival Rates: Factors influencing short-term and long-term survival after liver transplantation.

C. Heart Transplantation[23]

1. Cardiac Transplant Criteria

- End-Stage Heart Failure: Criteria for identifying individuals with severe heart

failure who may benefit from transplantation.

- Medical and Psychosocial Assessments: Evaluating overall health and psychological readiness for transplantation.

2. Surgical Procedures and Post-Transplant Care[24]

- Cardiac Transplant Surgery: The intricate process of removing the recipient's heart and implanting the donor heart.
- Postoperative Monitoring: Intensive care and monitoring to address potential complications.

3. Immunological Challenges and Rejection[25]

- Immunosuppression: The critical role of immunosuppressive medications in preventing rejection.
- Rejection Monitoring: Strategies for detecting and managing rejection episodes.

D. Lung and Pancreas Transplantation[26]

1. Respiratory and Endocrine Considerations

- Lung Transplantation: Indications, surgical techniques, and postoperative care for patients with severe respiratory conditions.
- Pancreas Transplantation: Addressing endocrine considerations in patients with diabetes.

2. Procedure Specifics and Outcomes[27]

- Lung Transplant Surgery: Techniques for lung transplantation and considerations for single or double lung transplants.
- Pancreas Transplant Outcomes: Factors influencing the success of pancreas transplantation, including glycemic control.

Understanding the intricacies of each organ transplantation procedure is vital for healthcare professionals, patients, and the broader public,

contributing to informed decision-making and improved post-transplant outcomes.

IV. Medical Evaluation and Matching[28]

The success of organ transplantation relies on meticulous medical evaluations and careful matching between donors and recipients. This section explores the critical factors in compatibility and the assessments conducted for both donors and recipients.

A. Compatibility Factors[29]

1. Blood Type Matching

Blood type compatibility is a fundamental consideration in organ transplantation to prevent ABO blood group incompatibility reactions. The matching process includes:

- ABO Compatibility: Ensuring compatibility between the blood types of the donor and recipient.
- Crossmatching: Further tests to identify any potential antibodies that may cause rejection.

2. Tissue Compatibility[30]

Beyond blood type, tissue compatibility is crucial for successful transplantation:

- HLA Typing: Assessing human leukocyte antigens (HLAs) to match the donor and recipient tissues.
- Crossmatching: Confirming compatibility at the tissue level to reduce the risk of rejection.

3. Size Considerations[31]

- Organ Size Matching: Ensuring the size of the donated organ is suitable for the recipient's anatomical dimensions.
- Pediatric Considerations: Special considerations for matching organs in pediatric cases, where size matching is particularly critical.

B. Donor and Recipient Assessments[32]

1. Pre-transplant Evaluations

Comprehensive evaluations are conducted for both donors and recipients to assess their overall health and suitability for transplantation:

- **Medical History and Physical Examination:** Gathering detailed information about the individual's health history and conducting a thorough physical examination.
- **Diagnostic Tests:** Blood tests, imaging studies, and other diagnostic assessments to evaluate organ function and identify any underlying medical conditions.
- **Cardiac and Pulmonary Assessments:** Evaluating the cardiovascular and respiratory systems to ensure the patient can withstand the surgical procedure.

2. Psychosocial Considerations[33]

Assessing the psychological and social aspects of both donors and recipients is integral to the transplantation process:

- **Mental Health Screening:** Evaluating the psychological well-being of individuals, including their ability to cope with the transplant process.
- **Social Support:** Assessing the availability of a support system, as social factors can significantly impact the post-transplant recovery.
- **Substance Use and Lifestyle Factors:** Evaluating substance use, lifestyle choices, and adherence to medical recommendations.

Understanding the compatibility factors and the depth of pre-transplant evaluations is critical for transplant teams in selecting suitable donors and recipients. These assessments contribute to successful transplant outcomes and ensure the well-being of both parties involved.

V. Immunosuppression in Organ Transplantation[34]

Immunosuppression is a cornerstone in organ transplantation, aimed at preventing the recipient's immune system from rejecting the transplanted organ. This section delves into the purpose and mechanisms of immunosuppressive medications, the delicate balance between preventing rejection and managing infection risks, and the long-term challenges and advancements in immunosuppression.

A. Purpose and Mechanisms of Immunosuppressive Medications

1. Preventing Rejection:

- **Inhibition of Immune Response:** Immunosuppressive drugs, such as calcineurin inhibitors (e.g., cyclosporine, tacrolimus), target T-cell activation and proliferation, reducing the immune response against the transplanted organ.
- **Anti-Proliferative Agents:** Medications like mycophenolate mofetil and azathioprine inhibit the proliferation of B and T cells, further suppressing the immune system.
- **Corticosteroids:** These anti-inflammatory agents, such as prednisone, help control the immune response and reduce inflammation.

2. Mechanisms:

- **Calcineurin Inhibition:** Blocking the calcineurin pathway disrupts interleukin-2 production, hindering T-cell activation.
- **mTOR Inhibition:** Inhibiting the mammalian target of rapamycin (mTOR) pathway limits cell proliferation and antibody production.
- **Antibody-Mediated Therapies:** Monoclonal antibodies, like basiliximab or anti-thymocyte globulin, target specific immune cells to prevent rejection.

B. Balancing Rejection Prevention and Infection Risks

1. Optimizing Immunosuppression:

- Individualized Treatment Plans: Tailoring immunosuppressive regimens based on the patient's risk profile and transplant type.
- Drug Combinations: Combining medications to achieve synergistic effects and minimize individual drug doses.

2. Managing Infection Risks:

- Prophylactic Antibiotics and Antivirals: Prescribing medications to prevent bacterial and viral infections, which can be more prevalent in immunocompromised individuals.
- Vaccination Protocols: Implementing vaccination strategies to protect against preventable infections.
- Regular Monitoring: Monitoring for signs of infection and adjusting immunosuppressive medications accordingly.

C. Long-Term Challenges and Developments in Immunosuppression

1. Long-Term Effects:

- Nephrotoxicity: Chronic exposure to certain immunosuppressive drugs may impact kidney function over time.
- Metabolic Effects: Increased risk of diabetes, hyperlipidemia, and other metabolic complications.

2. Advancements in Immunosuppression:

- Biological Therapies: Targeting specific immune pathways with biological agents to achieve more precise immunosuppression.
- Tolerance Induction: Research into inducing transplant tolerance to minimize the need for long-term immunosuppression.
- Personalized Medicine: Utilizing genetic and molecular information to tailor

immunosuppressive regimens to individual patient profiles.

Conclusion

Balancing the delicate equilibrium between preventing rejection and managing infection risks is a constant challenge in organ transplantation. Ongoing research and advancements in immunosuppressive therapies aim to enhance long-term outcomes, minimize side effects, and pave the way for more personalized and effective approaches to post-transplant care. Understanding these complexities is crucial for healthcare professionals involved in the ongoing care of transplant recipients.

VI. Ethical and Legal Considerations
A. Consent issues in organ donation
B. Determination of death and organ retrieval
C. Equitable distribution and allocation policies

VI. Ethical and Legal Considerations

Ethical and legal considerations in organ transplantation are paramount, addressing issues such as consent, determination of death, and the fair distribution of organs. This section examines the intricacies of these ethical and legal aspects.

A. Consent Issues in Organ Donation

1. Informed Consent:

- Donor Consent: Ensuring that living and deceased donors provide informed and voluntary consent for organ donation.
- Family Consent: For deceased donors, obtaining consent from the next of kin is crucial, necessitating sensitivity and clear communication.

2. Consent for Living Donation:

- Autonomy and Voluntariness: Respecting the autonomy of living donors and ensuring their decisions are voluntary, without coercion.

- Psychosocial Evaluation: Assessing the mental and emotional readiness of living donors to ensure informed decision-making.

B. Determination of Death and Organ Retrieval

1. Brain Death:

- Diagnostic Criteria: Establishing clear criteria for determining brain death to ensure accurate diagnosis.
- Family Communication: Sensitively communicating the diagnosis and potential for organ donation to the deceased's family.

2. Circulatory Death:

- Ethical Guidelines: Establishing ethical guidelines for cases where death is determined based on circulatory criteria.
- Timing and Consent: Ensuring a proper waiting period after circulatory death is confirmed before organ retrieval, and obtaining consent from the family.

3. Organ Retrieval Process:

- Respect and Dignity: Handling the organ retrieval process with the utmost respect and dignity for the deceased and their family.
- Minimizing Ischemia Time: Efficiently conducting the retrieval to minimize ischemia time and enhance organ viability.

C. Equitable Distribution and Allocation Policies

1. Fair Allocation:

- Organ Procurement Organizations (OPOs): Ensuring that OPOs follow fair and transparent allocation policies.
- Geographic Considerations: Addressing geographic disparities in organ distribution to promote equitable access to transplantation.

2. Medical Need vs. Utilitarian Considerations:

- Balancing Medical Need: Allocating organs based on medical urgency and the likelihood of successful transplantation.
- Avoiding Discrimination: Developing policies that avoid discrimination based on factors such as age, socioeconomic status, or pre-existing conditions.

3. Policy Transparency and Accountability:

- Public Trust: Maintaining public trust by ensuring transparency in the development and implementation of allocation policies.
- Regular Review and Updates: Periodically reviewing and updating allocation policies to reflect advancements in medical knowledge and changing ethical standards.

Conclusion

Ethical and legal considerations in organ transplantation are pivotal in ensuring the integrity of the process and maintaining public trust. As medical advancements continue, ongoing ethical discussions and legal frameworks are essential for navigating the complex landscape of organ donation and transplantation. Transparent communication, respect for autonomy, and fair allocation policies are foundational elements in upholding the ethical principles that underpin the field.

VII. Advancements and Challenges

The landscape of organ transplantation is dynamic, characterized by continuous advancements and persistent challenges. This section explores the latest research and technological innovations shaping the field, as well as ongoing challenges and areas for improvement.

A. Research and Technological Innovations

1. Organ Preservation Techniques:

- Hypothermic Perfusion: Advances in hypothermic perfusion technologies to better preserve organs during transportation, extending the acceptable ischemia time.
- Normothermic Perfusion: Exploring normothermic perfusion techniques to maintain organs at body temperature, potentially reducing ischemia-reperfusion injuries.

2. Expanding the Donor Pool:

- Extended Criteria Donors: Investigating the use of organs from extended criteria donors, such as older donors or those with certain medical conditions.
- Ex Vivo Organ Perfusion: Techniques that allow for assessment and potential rehabilitation of marginal organs outside the body, expanding the pool of viable organs.

3. Improving Transplant Outcomes:

- Personalized Medicine: Utilizing genetic and molecular information for personalized immunosuppressive regimens.
- Precision Matching: Advancements in matching techniques, including HLA matching and compatibility assessments, to enhance transplant success rates.

B. Ongoing Challenges and Areas for Improvement

1. Shortage of Organs:

- Public Awareness and Education: Addressing the lack of awareness regarding organ donation and encouraging more individuals to register as donors.
- Opt-out Systems: Exploring opt-out organ donation systems to increase the donor pool, shifting the default to presumed consent.

2. Logistical Hurdles in Transplantation:

- Transportation Challenges: Addressing logistical challenges in transporting organs over long distances and across regions.
- Coordination and Communication: Enhancing coordination and communication among transplant teams, organ procurement organizations, and healthcare facilities.

3. Equitable Access:

- Socioeconomic Disparities: Mitigating socioeconomic disparities in access to transplantation and post-transplant care.
- Geographic Disparities: Addressing variations in organ distribution to ensure equitable access for all patients.

Conclusion

While advancements in research and technology offer promising avenues for improving organ transplantation, persistent challenges such as organ shortages and logistical hurdles necessitate ongoing efforts. The future of organ transplantation lies in the integration of innovative solutions, ethical considerations, and a commitment to addressing disparities, ultimately working towards a more accessible and effective transplantation process for individuals in need.

VIII. Conclusion

A. Summary of Key Points

Organ transplantation stands at the intersection of medical innovation, ethical considerations, and the ongoing quest for improved patient outcomes. Throughout this comprehensive review, key points have been explored:

1. Types of Organ Donation:

- Living and deceased donation each play a crucial role, addressing the diverse needs of patients in need of life-saving organ transplants.

2. Organ Transplantation Procedures:

- Procedures for kidney, liver, heart, lung, and pancreas transplantation involve

intricate surgical techniques, careful matching, and postoperative care.

3. Medical Evaluation and Matching:

- Compatibility factors, including blood type and tissue matching, along with thorough pre-transplant evaluations, are essential for successful transplantation.

4. Immunosuppression:

- Immunosuppressive medications prevent rejection but require a delicate balance to manage infection risks, with ongoing research exploring personalized approaches.

5. Ethical and Legal Considerations:

- Consent issues, determination of death, and equitable distribution policies underscore the ethical and legal foundations of organ transplantation.

6. Advancements and Challenges:

- Ongoing research and technological innovations in organ preservation, donor pool expansion, and transplant outcomes offer hope for improved success rates. However, challenges such as organ shortages and logistical hurdles persist.

B. Future Prospects and Directions in Organ Transplantation

The future of organ transplantation is marked by promising avenues and evolving trends:

1. Technological Innovations:

- Continued advancements in organ preservation techniques and ex vivo organ perfusion hold the potential to further extend the viability of organs.

2. Personalized Medicine:

- The integration of personalized medicine, including genetic and molecular profiling, is likely to lead to more precise immunosuppressive regimens and improved long-term outcomes.

3. Public Awareness and Policy Changes:

- Efforts to address the shortage of organs may involve enhanced public awareness campaigns, changes in consent systems,

and policy initiatives to encourage organ donation.

4. Equitable Access:

- Future directions may include initiatives to reduce disparities in access to transplantation, both in terms of geography and socioeconomic factors.

5. International Collaboration:

- Collaborative efforts on a global scale can contribute to addressing logistical challenges, sharing best practices, and ensuring equitable access to transplantation.

As the field of organ transplantation continues to evolve, a comprehensive approach that considers medical, ethical, and logistical dimensions will be essential. By navigating the complexities with innovation, empathy, and a commitment to equity, the future holds the promise of further improving the lives of those in need of life-saving organ transplants.

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