Transplantation

Transplantation:- is the process of moving cells, tissues, or organs, from one site to another, either within the same person or between a donor and a recipient. If an organ system fails, or becomes damaged as a consequence of disease or injury, it can be replaced with a healthy organ or tissue from a donor.

The immune system plays a critical role in transplantation. The complex mechanisms of immunity, which under normal circumstances work to identify foreign microbes and direct the immune system to destroy them, pose a significant barrier to successful transplantation. Rejection of a transplant occurs in instances where the immune system identifies the transplant as foreign, triggering a response that will ultimately destroy the transplanted organ or tissue.

There are several types of transplantation involving tissues and organs

Autograft –Transplantation of cells, tissues or organs between sites within the same individual e.g. skin graft

Allograft – Transplantation of organs or tissues from a donor to a non-genetically identical individual of the same species. Allografts are the most common type of transplant.

Xenograft – Transplantation of an organ or tissue between two different species. 'Pig valves', for example, are commonly used to repair or replace a defective heart valve in humans

ABO incompatible – ABO refers to blood group, which can vary between individuals. For most transplant types, matching of blood group between donor and

recipient is a key strategy in reducing rejection risk. However, blood group compatibility is not always required for transplantations. For example, in the case of very young children with immature immune systems, ABO incompatible transplants can be carried out with less risk of transplant rejection.

Stem cell transplant – Stem cells are cells that have the capacity to develop into a range of different types of cells in the body. Blood stem cells (haematopoietic stem cells) can develop into all the different cells found in the blood and are donated to replace damaged or destroyed blood cells. Haematopoietic stem cell transplants are used to treat certain types of cancer e.g. leukaemia, and blood diseases where the bone marrow has become damaged preventing the production of healthy blood cells.

Transplant rejection occurs when transplanted tissue is rejected by the recipient's immune system, which destroys the transplanted tissue. Transplant rejection can be lessened by determining the molecular similitude between donor and recipient and by use of immunosuppressant drugs after transplant.

TYPES OF TRANSPLANT REJECTION

Rejection is generally classified into three main types:

- **Hyperacute Rejection**: Occurs within minutes to hours post-transplant due to pre-existing antibodies against donor antigens. This type is rare today due to improved matching techniques.
- **Acute Rejection**: Can occur within days to months after transplantation and involves T-cell mediated responses against the transplanted tissue. Acute rejection is common and often manageable with immunosuppressive therapy.

- **Chronic Rejection**: Develops over months or years, characterized by ongoing immune responses leading to gradual loss of function in the transplanted organ. Chronic rejection is a leading cause of transplant failure and is more complex to manage than acute rejection.

MECHANISMS OF GRAFT REJECTION

- **Antigen Recognition:** the immune system identifies foreign antigens on the transplanted tissue, primarily through MHC (major histocompatibility complex) molecules, which triggers an immune response.
- **Activation of Immune Cells:** T and B lymphocytes play central roles in rejection of organ transplant. T cells initiate the immune attack, while B cells produce antibodies that target the donor tissue.
- **Cytokine and Chemokine Release:** cytokines and chemokines facilitate communication between immune cells, amplifying the rejection process by attracting more immune cells to the transplant site.
- **Chronic Rejection:** occurs gradually and can result in fibrosis and blood vessel changes within the transplanted organ, leading to long-term failure.

KEY PLAYERS IN TRANSPLANTATION REJECTION

- **Antigen-Presenting Cells (APCs):** APCs such as dendritic cells initiate the immune response by presenting donor antigens to T cells, activating the rejection cascade.
- **T Lymphocytes (T Cells):** Activated T cells play a critical role in organ or tissue rejection by recognizing donor tissue as foreign and initiating an immune response against it.

- **Cytokines and Chemokines:** These signaling molecules facilitate communication among immune cells, amplifying inflammation and guiding immune cells to the transplant site.
- **B Lymphocytes (B Cells) and Antibodies:** B cells produce donor-specific antibodies, which can contribute to both acute and chronic rejection processes.
- **Natural Killer (NK) Cells:** NK cells can target donor cells lacking "self" markers, contributing to rejection, especially in cases of mismatched transplants.
- **Complement System:** This component of the immune system can cause direct damage to the transplanted tissue through the formation of the membrane attack complex, leading to cell lysis and inflammation.
- **Antibodies**: Antibody-mediated rejection occurs when recipient antibodies target donor antigens, particularly mismatched Human Leukocyte Antigens (HLA). This response can lead to chronic rejection, characterized by endothelial dysfunction and inflammation.