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Commentary

Transplant Immunology: Innate and Adaptive Immune Responses in Transplantation

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DESCRIPTION

Transplant immunology is a field that focuses on understanding the immune response to organ and tissue transplantation. The transplant can be maintained functioning for a long time by regulating the immune system to reduce the risk of rejection. Prior to transplantation, the donor and recipient are carefully matched to reduce the possibility of rejection and mounts an immune response, which can lead to graft rejection. The immune response to organ and tissue transplantation is a complex process involving both innate and adaptive immune mechanisms.

Recognition of the transplanted tissue

When a person receives an organ or tissue transplant, the immune system recognizes the transplanted tissue as foreign. The recognition is primarily mediated by the recipient's immune cells, particularly Antigen-Presenting Cells (APCs) such as dendritic cells.

Alloantigens and major histocompatibility complex

Alloantigens are antigens present on the cells of the transplanted tissue that differ from the recipient's own cells. The most important alloantigens in transplantation are encoded by genes within the Major Histocompatibility Complex (MHC), also known as the Human Leukocyte Antigen (HLA) system in humans. The MHC molecules present peptides derived from the transplanted tissue to T cells, activating an immune response.

Innate immune response

The innate immune system plays an early role in the immune response to transplantation. It involves the activation of innate immune cells such as macrophages, Natural Killer (NK) cells and neutrophils. These cells can recognize and respond to the transplanted tissue through pattern recognition receptors (PRRs) that detect Pathogen-Associated Molecular Patterns (PAMPs) or Damage-Associated Molecular Patterns (DAMPs) released during tissue injury.

Adaptive immune response

The adaptive immune response is the main orchestrator of graft rejection. It includes the activation of T cells and B cells.

T cell response: T cells are crucial in recognizing and eliminating foreign tissues. Alloreactive T cells, which recognize alloantigens presented by MHC molecules, play a central role in graft rejection. Two types of T cells involved in transplantation are:

CD8+ cytotoxic T cells: These T cells directly recognize and kill cells of the transplanted tissue presenting foreign antigens on MHC class I molecules.

CD4+ helper T cells: These T cells provide help to other immune cells and play a key role in coordinating the immune response. They can differentiate into different subsets, including Th1, Th2, Th17 and regulatory T cells (Tregs), each with distinct functions and effects on graft acceptance or rejection.

B cell response: B cells can be activated by alloantigens and differentiate into plasma cells that produce alloantibodies. These antibodies can directly contribute to graft rejection by binding to the transplanted tissue and activating complement or recruiting other immune cells.

Acute and chronic rejection

Graft rejection can occur in two main forms:

Acute rejection: Acute rejection typically occurs within weeks to months after transplantation and involves a rapid immune response against the transplanted tissue. It is primarily mediated by T cells, cytokines and alloantibodies.

Chronic rejection: Chronic rejection is a slow and progressive process that can occur months to years after transplantation. It involves a combination of immune and non-immune factors and is associated with long-term graft dysfunction. Chronic rejection can involve immune cells, inflammation, fibrosis and vascular changes in the transplanted tissue.

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