**T Lymphocytes (Cells)**

The T cells constitute 65 to 80% of the recirculating pool of small lymphocytes. Within lymph nodes, they are located in the inner subcortical region. The lifespan of T cells is between months or years.

**General characteristics of T cells**

Like B cells, T cells have multiple copies of a receptor on their surface that recognizes a specific epitope. T cell receptor (TCR) can be compared to one arm of the B cell receptor.

Unlike the B cells, T cells do not interact with a free antigen. Instead the antigen must be resented by another host cell. The host cell does this by partly degrading (processing) the antigen then displaying (resenting individual peptides of the antigens proteins. The peptides from the antigen are cradled in the groove of proteins called Major Histocompatibility Complex (MHC) molecules on the surface of the resenting cell.

When a T cell recognizes an antigen, it is actually recognizing both the peptide and MHC molecule simultaneously hence the peptide: MHC Complex. Two types of MHC molecules present antigens, i.e. MHC Class I and MHC Class II.

MHC Class I molecules present endogenous antigens (antigens made within the cell). MHC Class II molecules present exogenous antigens (antigens taken up by a cell). All nucleated cells present MHC Class I molecules but only specialized cell types (Dendritic cells, B cells and Macrophages) collectively referred to as antigen presenting cell (APC) make MHC Class II molecules.

Two functionally distinct T cell populations are involved in eliminating antigens, Cytotoxic T cells and Helper T cells. These differ in their roles and also how they recognize antigens. Cytotoxic T cells recognize antigen resented on MHC class I molecules whereas helper T cells recognize antigen resented on MHC class II molecules therefore Effector Cytotoxic T cells respond to endogenous antigens whereas Effector Helper T cells respond to exogenous antigens.

Cytotoxic and helper T cells are identified microscopically based on the presence of surface proteins called Cluster of Differentiation (CD) Markers. Most Cytotoxic T cells have the CD8 marker and are frequently referred to as CD8 T cells, most helper T cells carry the CD4 marker and are often called CD4 T cells.

NB. CD4 is also receptor for HIV which explains why the virus infects helper T cells. .

**Effector functions of T cells**

There are two important components of host defenses mediated by T cells; Delayed hypersensitivity and cytotoxity.

1. **Delayed hypersensitivity**

Delayed hypersensitivity reactions are produced particularly against antigens of intracellular microorganisms including certain fungi e.g. *Histoplasma* and *Coccidiodes* and certain intracellular bacteria e.g. Mycobacterium tuberculosis.

Delayed hypersensitivity is mediated by macrophages and CD4 cells.

1. **Cytotoxicity**

The cytotoxic response is concerned primarily with destroying virus infected cells and tumor cells but also plays an important role in graft rejection. In response to virus infected cells the CD8 lymphocytes must recognize both viral antigen and class I molecules on the surface of infected cells. To kill virus infected cell, the cytotoxic T cell must be activated by IL2 produced by a helper (CD4 positive) T cell.

To become activated to produce IL2, helper T cells recognize viral antigens bound to class II molecules on an APC e.g. A macrophage. The activated helper T cells secrete cytokines such as IL2, which stimulates which stimulates the virus specific cytotoxic T cell to form a clone of activated cytotoxic T cells. These cytotoxic T cells kill the virus infected cells by inserting perforins and degradative enzymes called granzymes into the infected cell.

**Regulatory function of T cells**

T cells lay a central role in regulating both the humoral (antibody) and cell mediated arms of the immune system.

1. **Antibody production**

Antibody production by B cells usually requires the participation of helper T cells (T cell dependent response). But antibodies to some antigens e.g. macromolecules such as bacterial capsular polysaccharide are T cell independent. In the T cell dependent response, all classes of antibody are made whereas in T cell independent response, primarily IgM is made.

1. **Cell mediated immunity**

In the cell mediated response the antigen is processed by macrophages, is fragmented and is resented in conjunction with class II MHC molecules on the surface. These interact with the receptor on the helper T cell, which is then stimulated to produce lymphokines such as IL2 (T cell growth factor) which stimulates the specific helper and cytotoxic T cells to grow.

1. **Suppression of certain immune responses**

A subset of T cells called regulatory T cells (TR) has been shown to inhibit several immune mediated diseases, especially autoimmune diseases in animals. It is not known how regulatory cells reduce or suppress the immune response.

**Natural Killer (NK) Cells**

Natural killer (NK cells descend from lymphoid progenitor cells, but lack the antigen specific receptors that characterize B cells and T cells. Their activities however assist the adaptive immune response.

NK Cells induce apoptosis in antibody bound self-cells. This process, Antibody Dependent Cellular Cytotoxicity (ADCC allows them to destroy host cells that have viral or other foreign proteins inserted into their membrane. NK cells can do this because they have Fc receptors for IgG molecules on their surface.

NK cells also recognize and destroy stressed host cells that do not have MHC class I molecules on their surface. This is important because some viruses have evolved mechanisms to dodge the action of cytotoxic T cells by interfering with the process of antigen presentation.