جامعة الانبار
كلية العلوم
قسم التقنيات الأحيائية

اسم المادة: المناعة
عنوان المحاضرة : Humoral immunity
الاستاذ المساعد الدكتور صفاء عبد لطيف المعيني

Humoral immunity

It is also referred as **"antibody-mediated immunity"** because of the major role played by antibodies in this immune response. In humoral immunity, binding of antibodies to microorganism (foreign agents) results in the formation of immune complex (Ag-Ab complex)

Immune complex initiates activation of complement system and other factors such as attraction of other immune cells near to it.

Immune system executes humoral response in three steps.

1. Activation of B Cells

Activation of B cells (naïve B cells) is the first step in humoral response to produce antibodies necessary for the humoral immune response. Activation of B cells may be direct or indirect.

Direct B cell activation, B cells interact with the T cell independent antigens and start multiplying to produce plasma cells and memory cells.

Indirect activation, B cells get stimulation from T helper cells. T helper cells induce B cells differentiation and colony formation after interacting with the antigen, processed and presented by the antigen presenting cell.

2. Effector Phase

Communication between helper-T cells and B-cells through lymphokines released by activated T cells initiate differentiation and multiplication of B cells to produce a colony.

Some cells from the colony become plasma cells to secrete antibodies that can react with the antigens responsible for their production.

The remaining cells become memory cells to retain "memory" of the foreign invader (antigen) and remain in the body in G_0 phase till they are used in future. If the immune system encounters with the same antigen for the second time, memory cells react very quickly and remove the pathogen very efficiently.

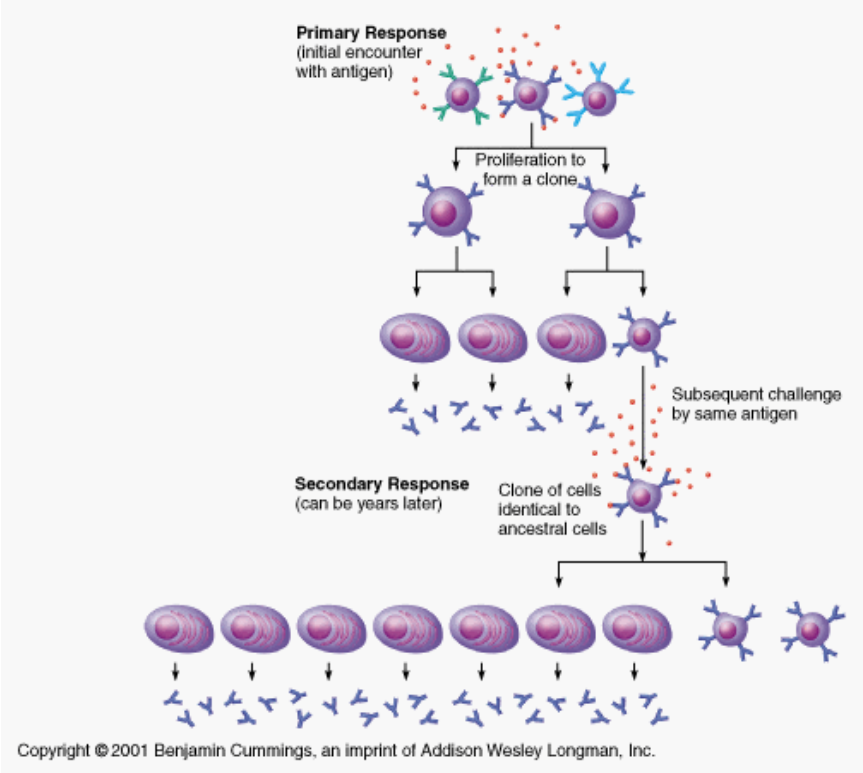
Life span of memory cells is much longer than life of plasma cells and it depends upon the strength and nature of antigen that has induced its production.

Memory of certain antigens such as polio virus, small pox virus etc. remains for the whole life to give life long protection.

3. Antibody Binding With Antigens:

Antibodies secreted by plasma cells interact with their respective antigens resulting in the formation of Ag-Ab complex.

The Ag-Ab complex initiates subsequent immune reactions for its removal from the body.


Primary Response
(initial encounter
with antigen)
Proliferation to
form a clone
Subsequent challenge
by same antigen
Secondary Response
(can be years later)
Clone of cells
identical to
ancestral cells
Copyright © 2001 Benjamin Cummings, an imprint of Addison Wesley Longman, Inc.

Cell mediated immunity

T- cells are the mediators of cell mediated immune response. T cells originate in bone marrow and mature in thymus. T cells interaction with other immune cells is via a receptor called T-Cell receptor (TCR), which can only interact with antigenic peptides bound to Class II MHC molecules on the surface of antigen presenting cells (APCs).

Mode of action:

When a TCR of naïve T cell interacts with an antigen MHC class II complex, it gets activated and undergoes differentiation and proliferation refers as clonal selection. The T cells differentiates into 2 types of cells

1) *Effector T cells* : There are two types of effector T cells

2) *Memory T cells:* has long life span and is responsible for immunologic memory.

Effector T cells:

a) T helper cells or T_H cells which has CD4 surface antigen and

b) T cytotoxic cells or T_C cells which has CD8 surface antigen.

T helper cells interact only with antigen-MHC class II complex. Upon activation, it proliferates and secretes variety of growth factors cytokines. Cytokines in turn activates T cells and B cells. The intensity of immune response depends on the production of cytokinins.

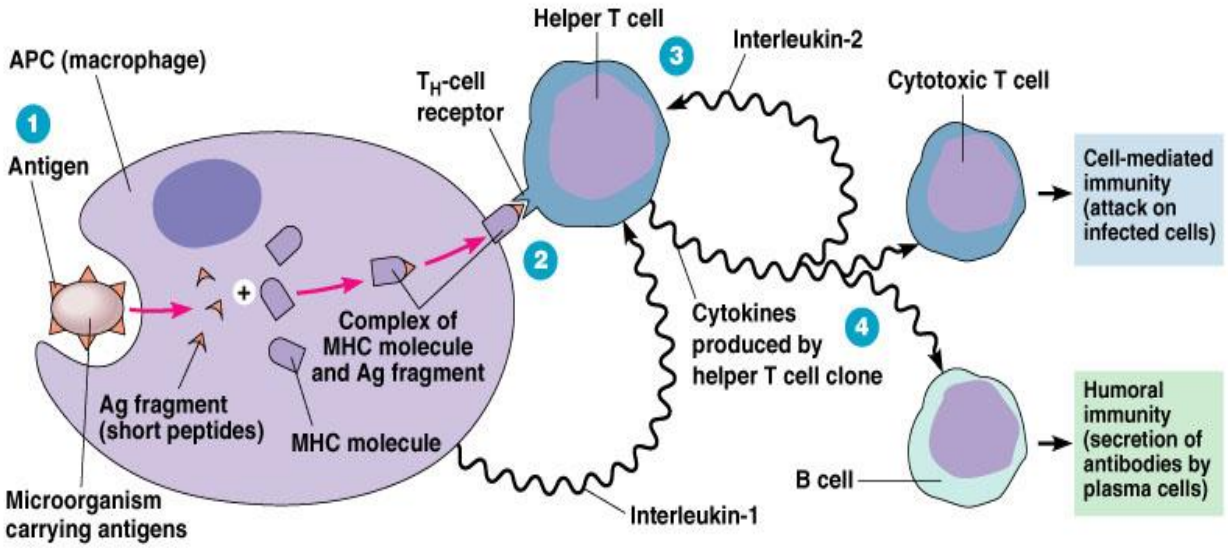
T cytotoxic cells or Tc cells recognizes antigen-MHC class I complex and proliferates under the influence of interleukin-2 (IL2) secreted by activated

T_H cells. The CD8 molecule of Tc cells associate with MHC class I molecule and activates Tc cells. These cells differentiate to form cytotoxic T lymphocytes (CTLs). CTLs has cytotoxic activity and directly kills virus infected cells, tumour cells and tissue graft cells. It has two enzymes, perforins and granyzyme that ensure the destruction of infected cells. Perforins create pores on the cell membrane and granyzymes are proteases that degrade cell contents.

Exogenous antigens or antigens produced outside host cells are generally phagocytised by APCs. They are degraded and antigenic peptides are displayed on the cell surface in association with Class II MHC molecules. These cells first interact with T_H cells.

In the case of endogenous antigens, antigens produced within the host cells, like viral proteins, cancer cells surface proteins etc are degraded in the cytosol by proteasome complex. This peptide fragment binds to MHC class I molecules. These cells with Class I MHC complex with antigenic peptides activates T_C cells to differentiate into CTLs.

The cytokines secreted by T_H cells regulate the proliferation and differentiation of B cells and Tc cells and also a number of non-specific effector cells like natural killer cells (NK) cells and activated macrophages. Activities of these cells are non-specific and don't have immunologic memory



1 An antigen-presenting cell (APC) encounters and ingests a microoganism. Antigen fragments (short peptides) from the microorganism combine internally with MHC (self molecules) and the complex of MHC molecules and antigen fragments is presented on the surface of the APC.

2 A helper T (T_H) cell receptor binds to the complex, stimulating the APC to secrete interleukin-1.

3 This interleukin-1 stimulates the helper T cell to produce interleukin-2, which then stimulates that helper T cell to form a clone of helper T cells.

4 The cells of this clone in turn produce cytokines, stimulating cells of both immune systems.

References:-

1- Richard Coioco and Geoffery Sunshine (2014). Immunology.Seventh edition.Wiley Blackwell.