The immune response

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Immune response

The immune response is how your body recognizes and defends itself against bacteria, viruses, and substances that appear foreign and harmful . The environment contains a great variety of infectious agents, including bacteria, viruses, fungi and parasites and chemicals which can enter the body and cause diseases and sometimes death. The primary function of the immune system is to eliminates infectious agent and minimize the damage they cause. It ensures that most infections in normal individuals are short lived and leave little permanent damage. **The ability of any given cell in the body to distinguish self from non-self is called the immune response**. All cells in the body are recognized as self. Any microorganism (for example, a foreign body or tumor) that invades or attacks the cells is recognized as non-self—or foreign—requiring the immune system to mount a combat against the non-self.

Ones inside the body, the site of infection and the nature of pathogen largely determine which type of immune response will be induced , whether the pathogen is:

1-**intracellualr pathogen**: invade the host cell to divide and reproduce .

2- **extracellular pathogen**: doesn't invade the host cells.

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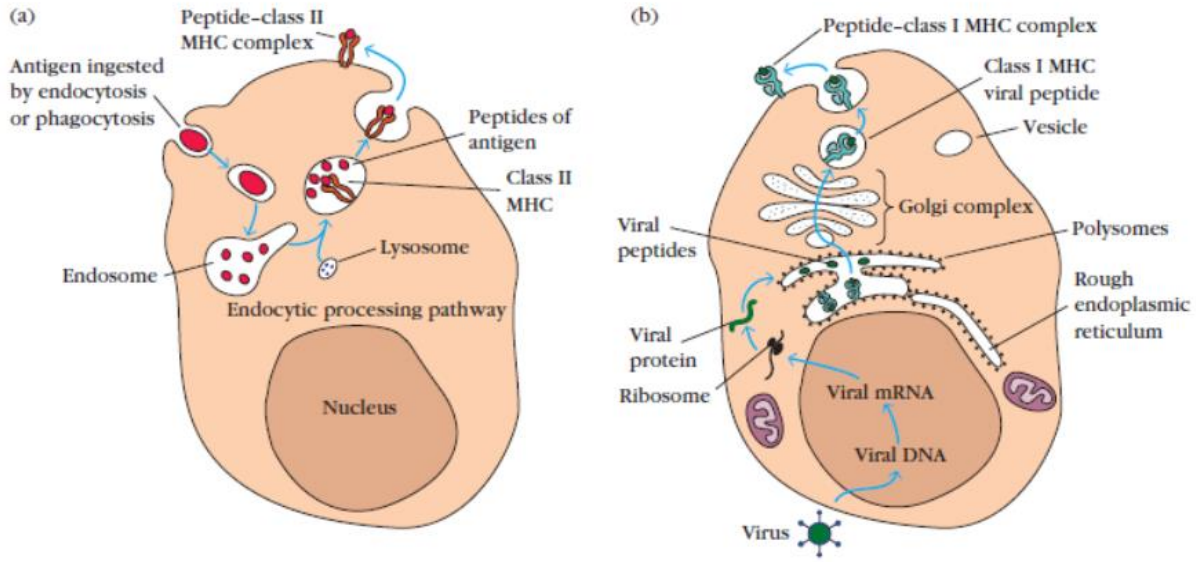

, while intracellular
pathogens evade these defenses by being intracellular and replicating within host cells. So, to clear these infections, the immune system has developed ways to specifically recognize and destroy infected cells by **(Cell mediated immunity)**

When a foreign antigen, infective or chemical enters into the body through the suitable route, this antigen will be recognized by antigen presenting cells (APCs) (Dendritic cells) in organs and monocytes in blood circulation. This antigen will be phagocytosed by these cells and it will undergo processing inside these cells.
It will be presented to T. or B. cells in association with class -2 MHC or HLA antigens. Ag. presentation will attract suitable T. cells and leads to T. cell activation , this is the **first signal of T. cell activation**. **The second signal** includes the release of IL-1, this acts as co-stimulatory factor via full activation of T. cell which leads to the production of lymphocytes subsets.

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Characteristics of Immune Response

1-Discrimination: The immune system distinguishes between self and non self-antigen , break of this character leads to an autoimmune disease.

2-Specificity : A response to a particular antigen is specific for that antigen or a few closely related antigens.

3- Memory : When an antigen was given to an individual , this is known as first dose of the antigen and leads to the primary immune response . If the same antigen is given for the same individual next , it will lead to the secondary immune response. Memory cells are capable of responding to the same antigen in the future.

4-Immune Diversity: At birth, there will be a generation of a vast diversity of lymphocytes (each bearing a unique antigen receptor). A human is capable of producing more than 1 trillion (10_8) different antibody molecules.

5- Clonality: When a specific antigen enters the body, at least a few cells will have receptor sites that will respond to the antigen, and they will be stimulated to multiply and produce new copies, or clones, of themselves.

6- Self limitation: The immune system doesn't react continuously with the Ag to ovoid exhaustion so the is a down regulation to control the reaction with the M.O.

7- Specialization: there is a special immune response to each microbe e.g. in viral infection the T-lymphocyte is the primary weapon while in nematode infection the primary weapon is Eosinophils**.**

Humoral immune response

Many bacteria and larger parasites live in tissues, body fluids or other extracellular spaces, are susceptible to the immune defenses , such as antibodies and complement because these components present in the tissue fluids of the body, it consist of 3 steps:

1-Entry and distribution of Ags in tissues and its contact with immunocompetenet cells.

2-Processing of Ags and control of Ab forming process.

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3-Secretion of Abs , its distribution in tissue, body fluid and manifestation of its effects.

The primary immune response

1- It has longer time and passes through different phases, IgM is predominant there.

a- Lag phase : It is the duration at the beginning of reaction , In this phase, the antigen is recognized as foreign and the cells begin to proliferate and differentiate in response to the antigen there is no immunoglobulin production . Lag phase may take 5 or more days . This phase depends on different factors

1- Nature of antigen 2- Dose of antigen 3- Route of antigen exposure . 4-Molecular weight of the antigen .

b-Log phase : In this phase, the antibody concentration **increases exponentially** as the **B cells** that were stimulated by the antigen differentiate into **plasma cells** which secrete antibody and antibody titer increase logarithmically. .

c- Plateau phase : During which the antibody titer stabilizes (the antibody level do not show more increase in serum). In this phase, **antibody synthesis is balanced by antibody decay** so that there is no net increase in antibody concentration.

d- Decline phase : Antibody is catabolized or cleared in it . In this phase, the **rate of antibody degradation exceeds that of antibody synthesis** and the level of antibody falls.

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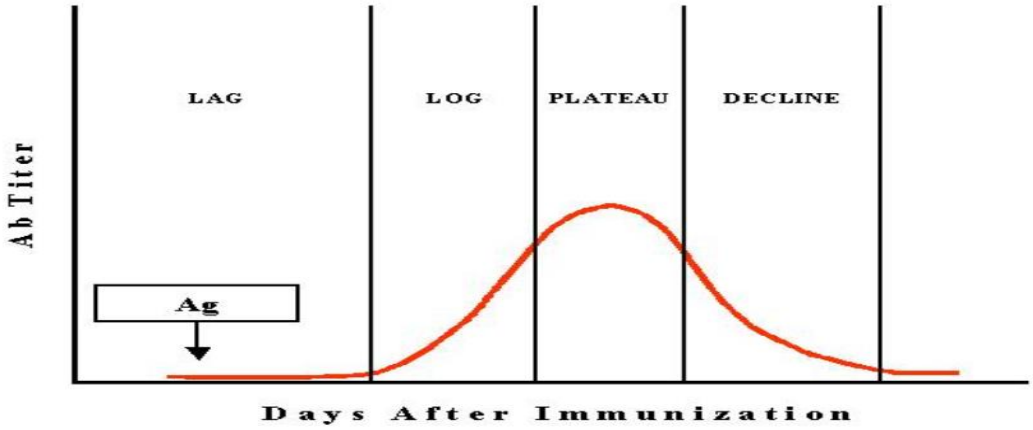

Secondary (2o), memory or anamnestic response

1- Lag phase

In a secondary response, there is **no lag phase**

*(*or it is normally shorter than that observed in a primary response*.)

2- Log phase

The log phase in a secondary response is **more rapid and higher antibody levels are achieved.**

3- Steady state phase

4- Decline phase

The decline phase is **not as rapid and antibody may persist for months, years or even a lifetime.**

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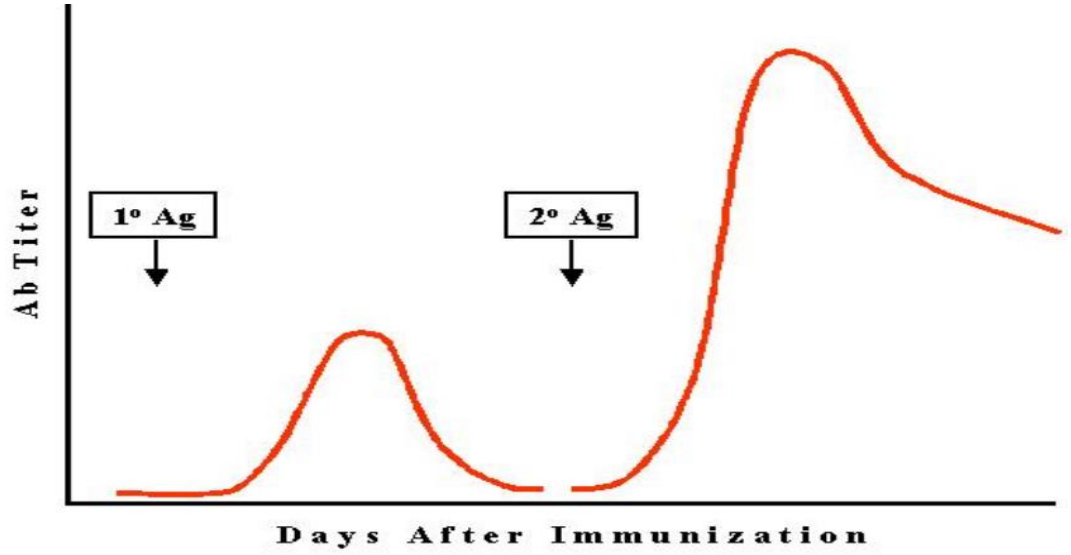

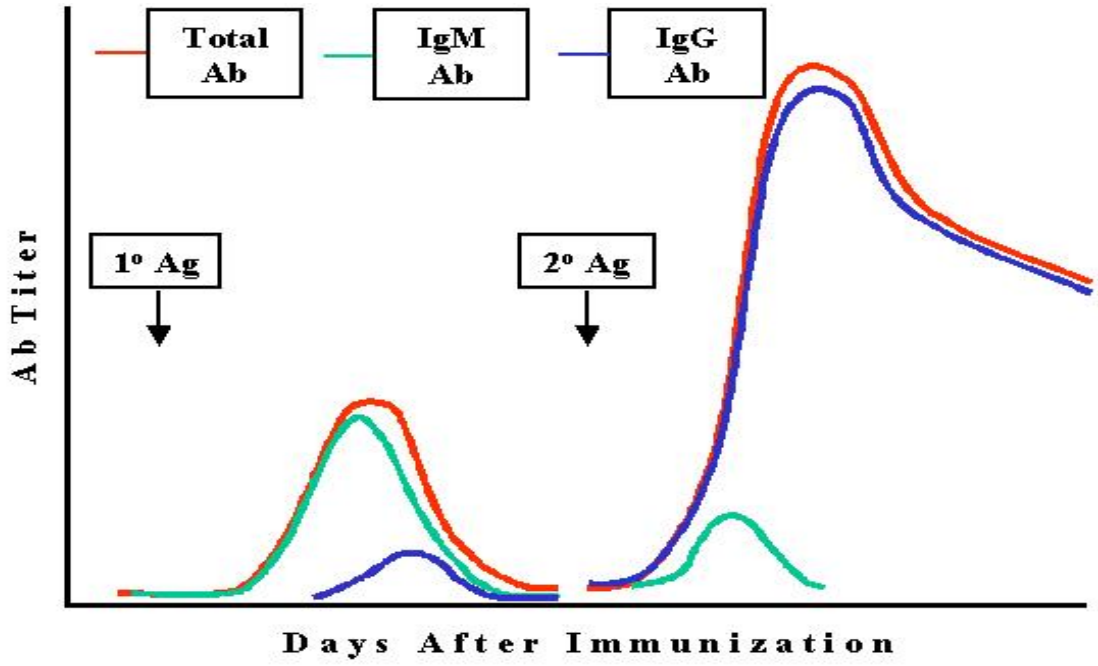

Specificity of 1₀ and 2₀ responses

Antibody elicited in response to an antigen is specific for that antigen, although it *may also cross react with other antigens which are structurally similar to the eliciting antigen*.

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In general secondary responses are only elicited by the same antigen used in the primary response. However, in some instances a *closely related antigen may produce a secondary response*, but this is a rare exception

Types of Ags

- Autoantigens-"self"
- Alloantigens-"same species"
- Heteroantigens-"different species"
- T-cell independent antigens-Does not require T cell involvement; polysaccharides, The antigen which directly approaches B cell for antibody production, Do not induce immunological memory Antibodies to T-ID, developed after the age of 2 years • Biochemical structure polymeric protein antigen trinitrophenyl-ficoll (TNP) Dinitrophenyl-ficoll (DNP) Eg., Polysaccharides of bacterial capsule – Streptococcus, Haemophilys, Neisseria
- T DEPENDENT ANTIGENS • Do not directly activates antibodies • Depends on T cells for the production of cytokines • Cytokines supports the activation, proliferation and differentiation of B cells • Cytokines helpful for both cell mediated and humoral immune response
- T-D antigens elicit memory B cells, which develop in T-D germinal centers • Can be identified by somatic mutation in their Ig loci or by surface expression of secondary Ig isotypes

Table 9.4. Comparison of thymus-dependent (TD) antigens and thymus-independent (TI) antigens

	TD antigens	**TI antigens**
Activation of B cells	Can only activate B cells in the presence of Th cells	Can activate B cells in the absence of Th cells
Structural properties	Complex	Simple
Composition	Proteins, polypeptides, hapten-carrier complexes,	Polysaccharides that contain repeating epitopes or

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	TD antigens	TI antigens
	erythrocytes, and many other antigens that have diverse epitopes	lipopolysaccharides derived from Gram-negative microorganisms
Presence in most pathogenic microbes	Yes	No
Antibody class induced	IgG, IgM, IgA, IgD, IgE	IgM
Immunological memory response	Yes	No
Examples	Microbial proteins, non-self or alter-self proteins	Pneumococcal polysaccharide, lipopolysaccharide, flagella

Ab response to T-independent antigen

Responses to T-independent antigen are characterized by the production of almost exclusively IgM antibody and no secondary response. Secondary exposure to the antigen results in another primary response to the antigen as illustrated in Figure.

Not all of the T and B cells that are stimulated by antigen during primary challenge with antigen die. Some of them are long lived cells and constitute what is refer to as the **memory cell pool**. Both memory T cells and memory B cells are produced and **memory T cells survive longer than memory B cells.** Upon secondary challenge with antigen not only are virgin T and B cells activated, the memory cells are also activated and *thus there is a shorter lag time in the secondary response*., IgG is produced earlier in a secondary response. Furthermore since there is an expanded clone of memory T cells which can help B cells to switch to IgG (IgA or IgE) production, the predominant class of Ig produced after secondary challenge is **IgG** and (IgA or IgE).

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