Pathophysiology of the immune system

- The overall function of the immune system is to prevent or limit infection.
- The Immune response is the body's ability to stay safe by affording protection against harmful agents and involves lines of defense against most microbes as well as specialized and highly specific response to a particular offender.
- This immune response classifies as either:

1. Natural Barriers
2. Innate Immune response (often our first line of defense against anything foreign) - defends the body against a pathogen in a similar fashion at all times. These natural mechanisms include

   A-Various cytokines, complement system (a complex system of more than 30 proteins that act in concert to help eliminate infectious microorganisms. Causes the lysis of foreign and infected cells, the phagocytosis of foreign particles and cell debris, and the inflammation of surrounding tissue), lysozymes, bacterial flora

   B-Numerous cells including neutrophils, basophils, eosinophils, monocytes, macrophages, reticuloendothelial system, natural killer cells (NK cells), epithelial cells, endothelial cells, red blood cells, and platelets.

3. Adaptive acquired Immune response (will utilize the ability of specific lymphocytes and their products (immunoglobulins, and cytokines) to generate a response against the invading microbes, its typical features are:

A. Specificity: as the triggering mechanism is a particular pathogen, immunogen or antigen.

B. Heterogeneity: signifies the production of millions of different effectors of the immune response (antibodies) against millions of intruders.

C. Memory: The immune system has the ability not only to recognize the pathogen on its second contact but to generate a faster and stronger response.

The two subsystems within the immune system (innate and the adaptive immune system) are closely linked and work together whenever a germ or harmful substance triggers an immune response.

Or classified as !- cellular and 2- humeral

Natural Barriers

1.The Skin

2.Mucous membranes

Many mucous membranes are bathed in secretions that have antimicrobial properties (e.g., cervical mucus, prostatic

And Local secretions also contain immunoglobulins, principally IgG and secretory IgA, which prevent microorganisms from attaching to host cells.

3.Respiratory tract

Coughing also helps remove organisms, If the organisms reach the alveoli, alveolar macrophages and tissue histiocytes engulf them.

4.GI tract

Barriers include the acid pH of the stomach and the antibacterial activity of pancreatic enzymes, bile, and

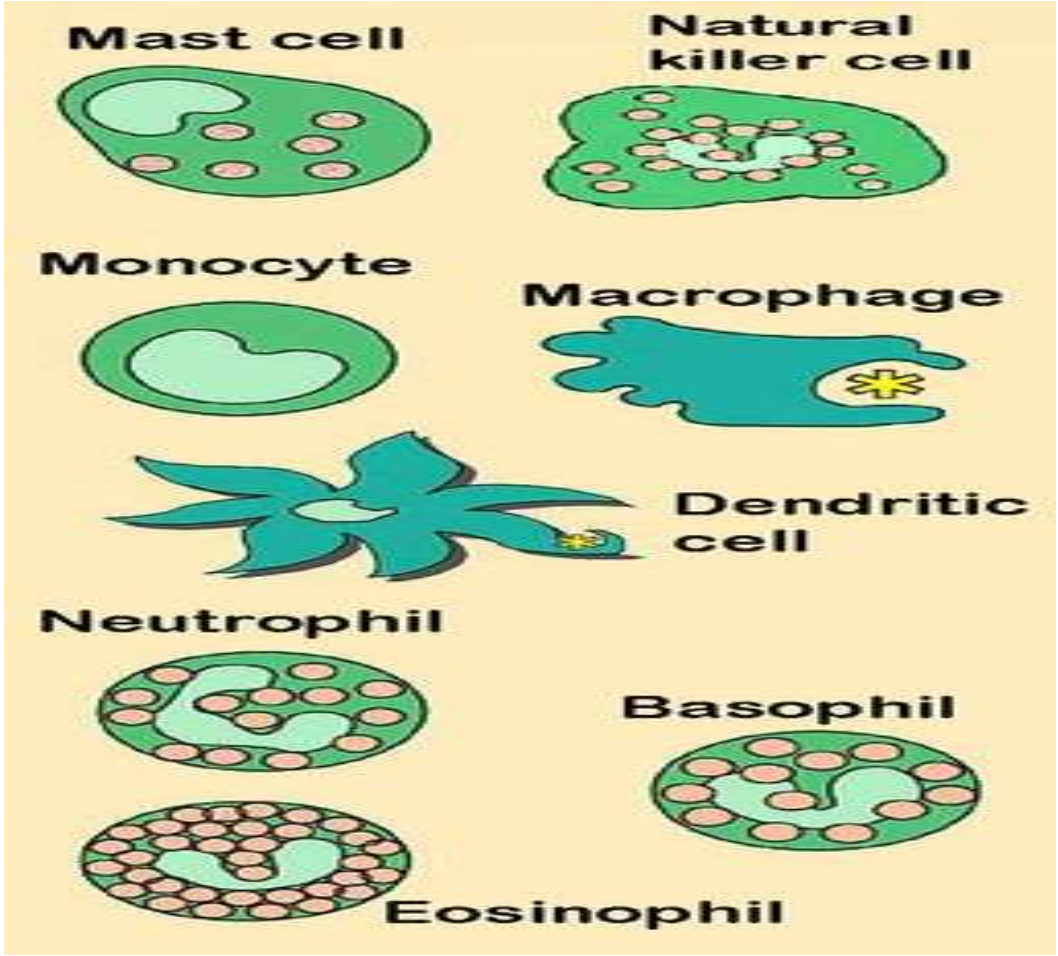
1- Innate Immune Response

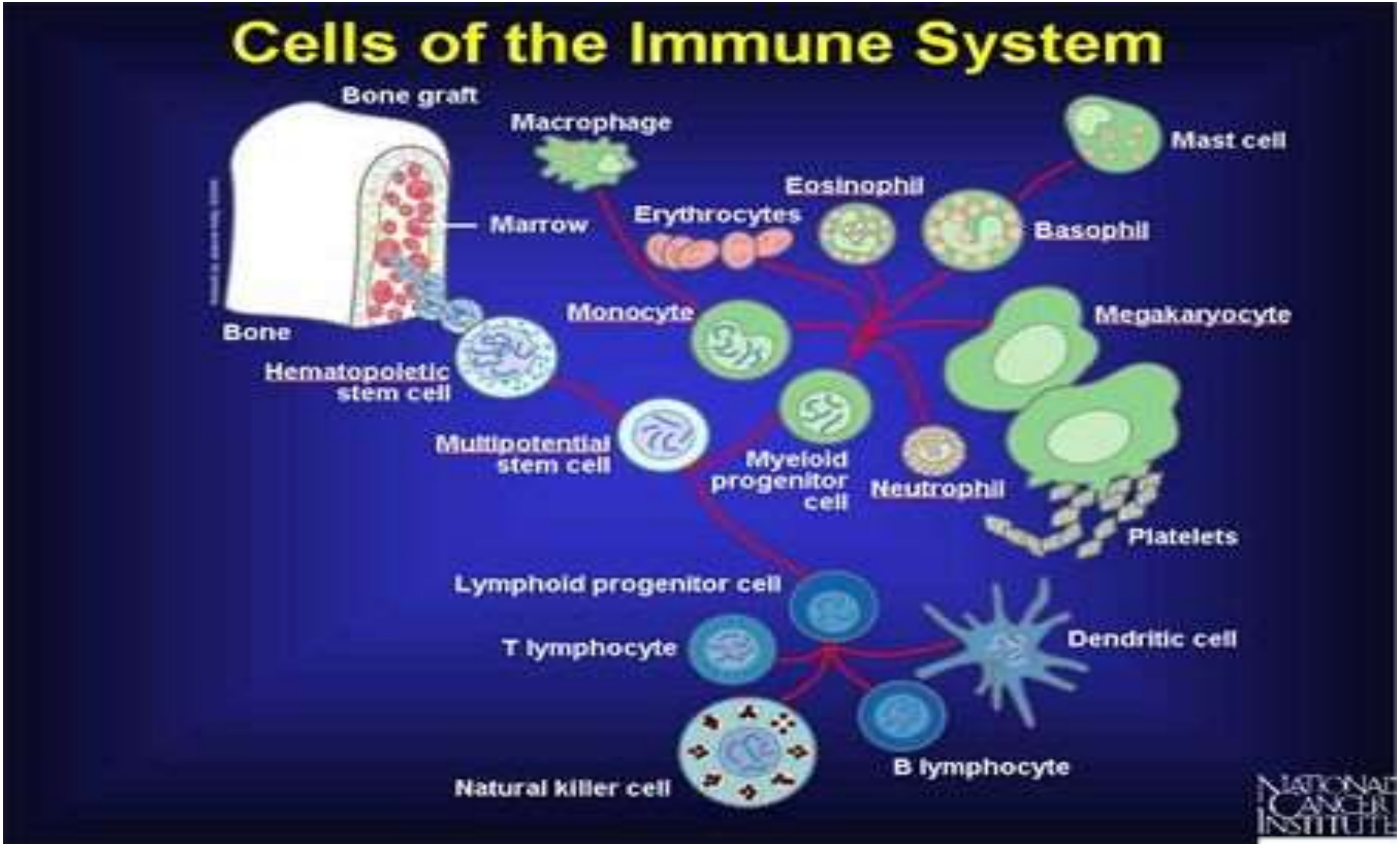
The primary function of innate immunity is the recruitment of immune cells to sites of infection and inflammation. Cytokines, complements , neutrophile, phagocytes, macrophages and other granulocytes.

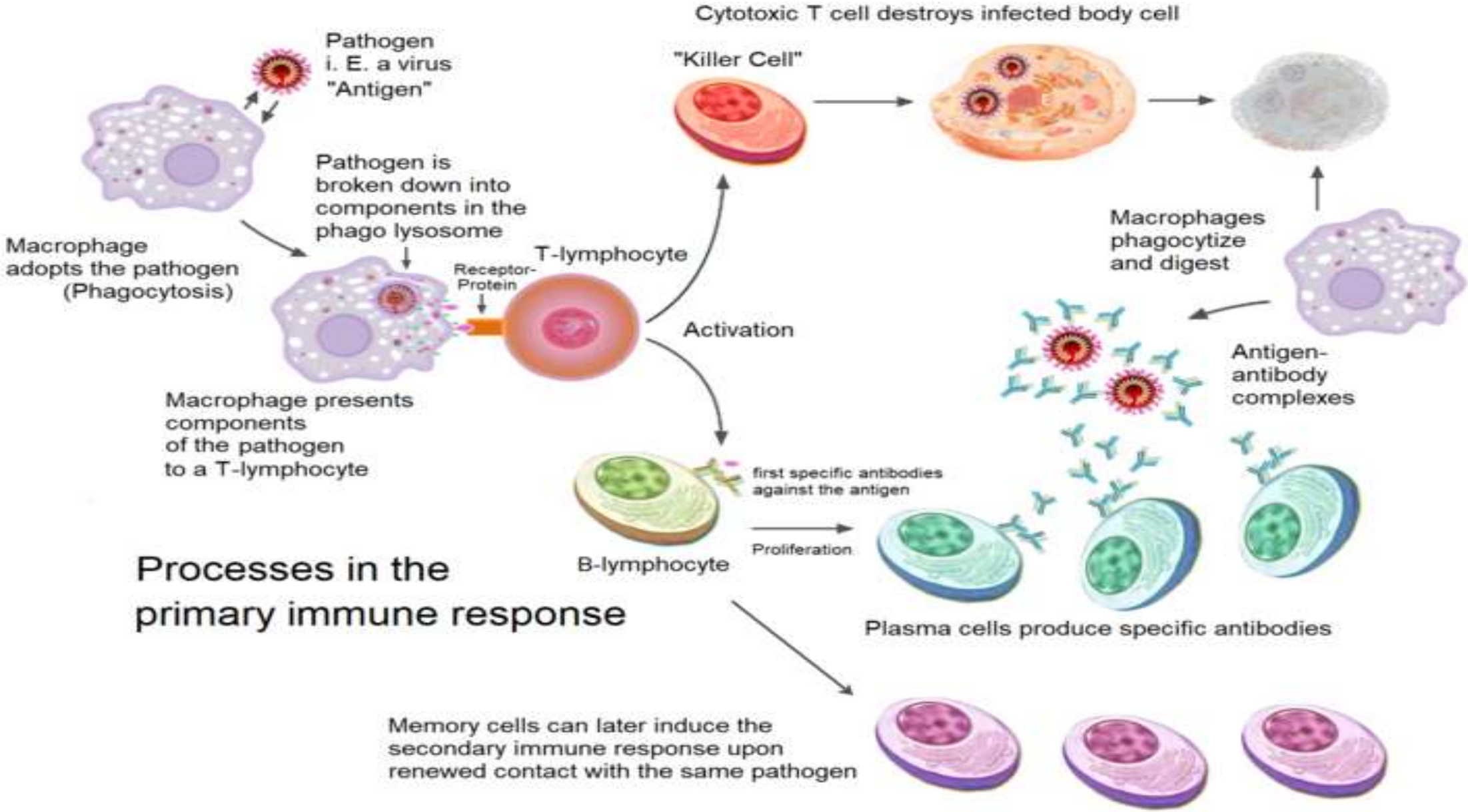
2- Adaptive Acquired Immune Response

Lymphocytes cells: T lymphocytes(cellular immunity) and

B lymphocytes --→mast cells ---→ Antibodies (IGM,IGG, IGA, IGE) which represent the humeral immunity




Cells of the Immune System
Bone graft
Macrophage
Mast cell
Eosinophil
Erythrocytes
Marrow
Basophil
Monocyte
Megakaryocyte
Bone
Hematopoietic stem cell
Multipotential stem cell
Myeloid progenitor cell
Neutrophil
Platelets
Lymphoid progenitor cell
T lymphocyte
Dendritic cell
B lymphocyte
Natural killer cell
NATIONAL CANCER INSTITUTE


Cytotoxic T cell destroys infected body cell
Pathogen
i. E. a virus
"Antigen"
"Killer Cell"
Pathogen is
broken down into
components in the
phago lysosome
Macrophage
adopts the pathogen
(Phagocytosis)
T-lymphocyte
Receptor-
Protein
Activation
Macrophages
phagocytize
and digest
Antigen-
antibody
complexes
Macrophage presents
components
of the pathogen
to a T-lymphocyte
first specific antibodies
against the antigen
Proliferation
B-lymphocyte
Plasma cells produce specific antibodies
Processes in the
primary immune response
Memory cells can later induce the
secondary immune response upon
renewed contact with the same pathogen

CHAPTER 1: FIGURE 1

Major Organs of the Immune System

A. **Thymus:** The thymus is an organ located in the upper chest. Immature lymphocytes leave the bone marrow and find their way to the thymus where they are "educated" to become mature T-lymphocytes.

B. **Liver:** The liver is the major organ responsible for synthesizing proteins of the complement system. In addition, it contains large numbers of phagocytic cells which ingest bacteria in the blood as it passes through the liver.

C. **Bone Marrow:** The bone marrow is the location where all cells of the immune system begin their development from primitive stem cells.

D. **Tonsils:** Tonsils are collections of lymphocytes in the throat.

E. **Lymph Nodes:** Lymph nodes are collections of B-lymphocytes and T-lymphocytes throughout the body. Cells congregate in lymph nodes to communicate with each other.

F. **Spleen:** The spleen is a collection of T-lymphocytes, B-lymphocytes and monocytes. It serves to filter the blood and provides a site for organisms and cells of the immune system to interact.

G. **Blood:** Blood is the circulatory system that carries cells and proteins of the immune system from one part of the body to another.

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3- passive immunity
Passive immunity is provided when a person is given antibodies to a disease rather than producing them through his or her own immune system. A newborn baby acquires passive immunity from its mother through the placenta.

Pathophysiology

The immune system protects the body against many diseases including recurrent infections, tumors , and may be responciple on many diseases e.g., allergy and autoimmune diseases.
The consequences of an altered immunity will manifest in the development of many immunological disorders some of which are listed below:

•Crohn disease

•Melanoma
Melanoma, the most serious type of skin cancer, develops in the cells (melanocytes) that produce melanin — the pigment that gives your skin its color. Melanoma can also form in your eyes and, rarely, inside your body, such as in your nose or throat.
Look for anything new, changing or unusual on both sun-exposed and sun-protected areas of the body. Melanomas commonly appear on the legs of women. The number one place they develop on men is the trunk. Keep in mind, though, that melanomas can arise anywhere on the skin, even in areas where the sun doesn't shine.

•Systemic lupus erythematosus SLE
Systemic lupus erythematosus (SLE), is the most common type of lupus. SLE is an autoimmune disease in which the immune system attacks its own tissues, causing widespread inflammation and tissue damage in the affected organs.

•*Rheumatoid arthritis RA*
is an autoimmune and inflammatory disease, which means that your immune system attacks healthy cells in your body by mistake, causing inflammation (painful swelling) in the affected parts of the body. RA mainly attacks the joints, usually many joints at once.

•Acquired immunodeficiency syndrome
HIV (human immunodeficiency virus) is a virus that attacks the body's immune system. If HIV is not treated, it can lead to AIDS (acquired immunodeficiency syndrome). There is currently no effective cure. Once people get HIV, they have it for life. But with proper medical care, HIV can be controlled.

•Food or drug Allergy

•Asthma

Why Some COVID-19 Patients Crash: The Body's Immune System Might Be To Blame
•Critically important studies emerging from China suggest that for many patients who die of Covid-19, it may be their own immune system, rather than the virus itself, that deals the fatal blow. This is called a cytokine storm (see image R)
•Cytokines are small proteins released by many different cells in the body, including those of the immune system where they coordinate the body's response against infection and trigger inflammation.
•Cytokine storms are a common complication not only of covid-19 and flu but of other respiratory diseases caused by coronaviruses such as SARS and MERS. They are also associated with non-infectious diseases such as multiple sclerosis and pancreatitis.[