Ass. Prof. Dr. Kawther tuama Khalaf
First stage /Human biology / College of Pharmacy /Basra University

Immunity (Part I)

Nonspecific Defenses

Immunity the ability to combat diseases and cancer includes lines of defense.

- **The first line** of defense against microbes is a physical and chemical barrier.

Physical barrier:

Skin and mucous membranes the intact skin is generally a very effective physical barrier that prevents infection. The cells of epidermis are joined by special structures known as tight junctions which impede microbial penetration.

Mucous membranes lining the respiratory, digestive are also physical barriers to entry by pathogens. The ciliated cells that line the upper respiratory tract sweep mucus and trapped particles up into the throat, where they can be swallowed.

Chemical barriers:

The chemical barriers to infection include the **secretions of sebaceous (oil) glands** of the skin. These secretions contain chemicals that weaken or kill certain bacteria on the skin.

Perspiration, **saliva,** and **tears** contain an antibacterial enzyme called **lysozyme.** Saliva also helps to wash microbes off the teeth and tongue, and tears wash the eyes.

The **acid PH** of the stomach inhibits growth or kills many types of bacteria.

Resident bacteria finally**,** a significant chemical barrier to infection is created by the normal flora, microbes that usually reside in the mouth, intestine, and other areas. By using up available nutrients and releasing their own waste, these resident bacteria prevent potential pathogens from taking up residence. For these reason, abusing antibiotics can make a person susceptible to pathogenic infection by killing off the normal flora.

- **The second line** of defense combats infection agents that penetrate the first barrier and involves numerous chemical and cellular agents, include:

Inflammatory Reaction (Response)

Whenever the skin is broken due to a minor injury, a series of events occurs that is known as the inflammatory reaction (inflammation).The inflamed area has four symptoms, the four signs of inflammatory response are due to capillary changes in the damaged area, and all serve to protect the body. The main symptoms of inflammation include the following:

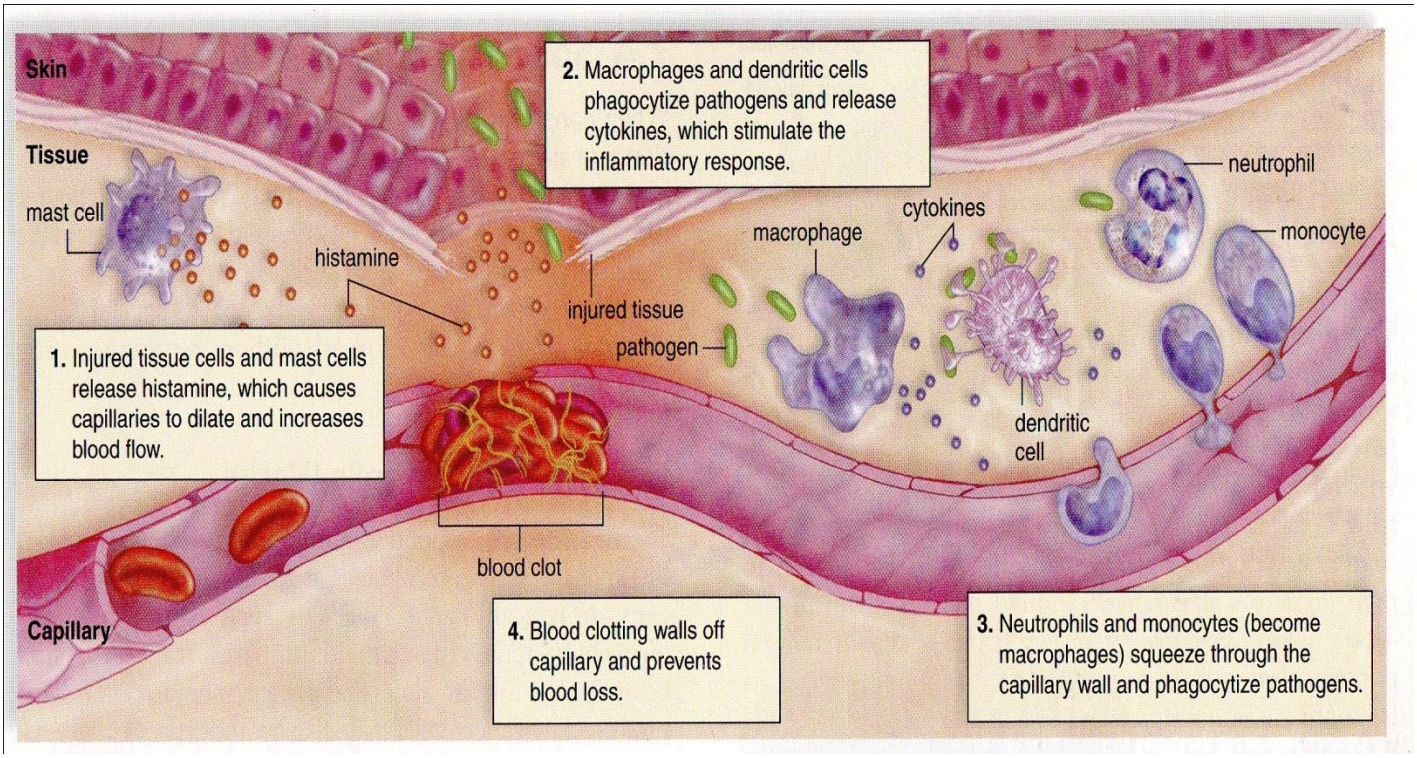
1- **Redness** is caused by dilation of the blood vessels in the area. Chemical mediators, such as **histamine** released by damage tissue cells and mast cells, cause the capillaries to dilate and become more permeable. Excess blood flow due to enlarged capillaries causes the skin to redden and become warm.

2- **Heat** is noticeable in the area because of the increased blood volume rising to the surface. Increased temperature in an inflamed area tends to inhibit growth of some pathogens.

3- **Swelling** results from the increased permeability of the capillary walls, which allow fluids and proteins, include blood clotting factors, to escape into the tissues.

4- **Pain** the excess fluid in the area presses on nerve endings, causing the familiar pain.

White blood cells, such as the neutrophils enter the inflamed area. These cells move in an amoeboid manner and engulf foreign substances around the affected area. Some of these neutrophils are killed in this cleaning – up process and are found in the pus along with bacteria, tissue cells and living white blood cells. The presence of pus suggests that the body is having some success in destroying the infection.



The types of white cells that increase in number during an illness

Lymphocytes increase during tuberculosis, pernicious anemia and whooping cough.

Monocytes increase in malaria and typhoid fever.

Eosinophil increase when we are infected with parasitic hookworms or tapeworms.

Immunity (part II)

Specific Defenses

The immune system is third line of defense which called specific defenses. Specific defenses respond to **antigens**, which are molecules the immune system recognizes as foreign to the body. Antigens may consist of soluble molecules (such as proteins, polysaccharides) or molecules belonging to whole cells (bacteria, protozoa, tumor cells, or virus-infected cells). Our body produces antibodies to surround this antigen causing the foreigners to clump together (agglutination) or to be prepared for engulfing by the phagocytic cells. **Antibodies** belong to the **immunoglobulin** protein family

Not all antigens are foreign to our bodies. The red blood cell membranes have antigen protein on them. It is these antigens that determine our blood group.

Acquired immunity-

Acquired or adaptive immunity is the body's third line of defense. This is protection against specific types of pathogens. Acquired immunity may be either natural or artificial in nature. Both natural and artificial immunity have passive and active components. Active immunity results from an infection or an immunization, while passive immunity comes from naturally or artificially gaining antibodies.

1- Active immunity

Active immunity sometimes develops naturally after a person is infected with pathogen. When our bodies are invaded by germs we manufacture antibodies to them .This first exposure to the antigen causes us actively to make antibodies. On a second occasion our body is prepared to defend its tissues. This is called active naturally acquired immunity.

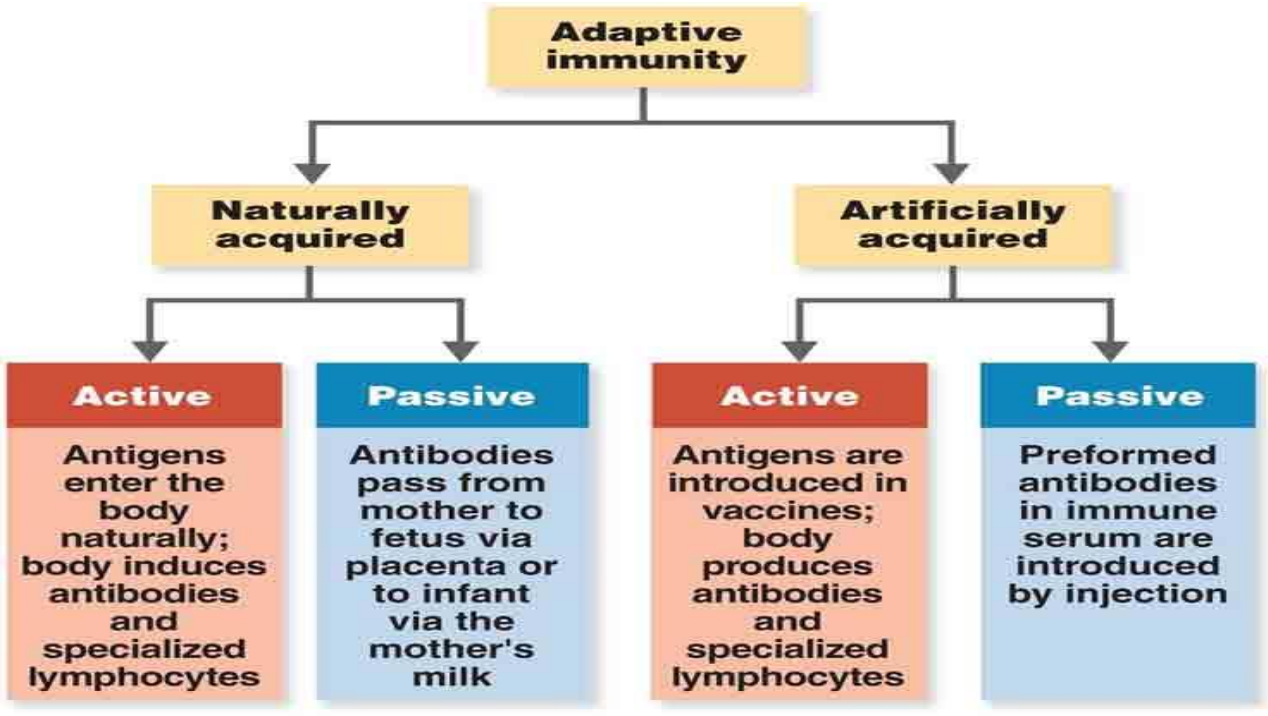
To prevent infections, people can be artificially immunized against them.

Immunization Involves the use vaccines contain inactivated or weakened bacteria or viruses or bacterial toxins. When injected into the body, the disabled antigens in vaccines elicit an immune response.

Vaccination provides a form of protection that call active immunity because the body actively produces memory T and B cells that protect a person against future infections.

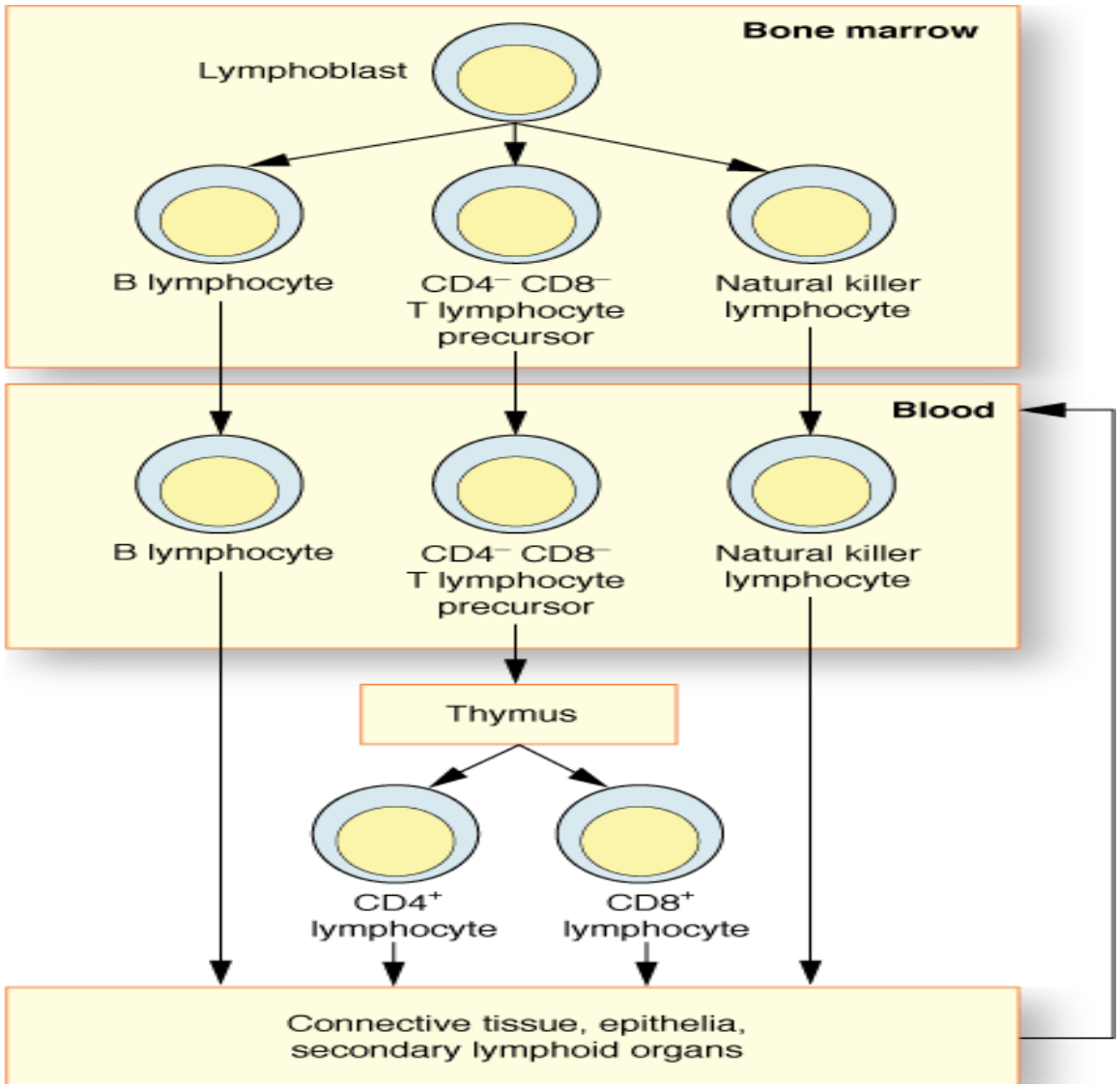
2- Passive immunity is a temporary form of protection, occurs when an individual is given prepared antibodies or immune cells to combat a disease. Passive immunity is so named because the cells of immune system are not activated. Immunoglobulin's (antibodies to specific antigens) remain in the blood for a few weeks, protecting an individual from infection.

The newborn child has a temporary passive immunity to disease provided for him by the mother s antibodies that are passed across the placenta.



Immunity to disease

Our defense against disease is dependent upon the white blood cells called lymphocytes, which differentiate as either **B cells (B** lymphocytes**)** or **T cells (**T lymphocytes**).** B cells and T cells are capable of recognizing antigens because they have specific antigen receptors – plasma membrane receptor proteins, whose shape allows them to combine with particular antigens. Each lymphocyte has only one type of receptor. It is often said that the receptor and the antigen fit together like a lock and a key.



Immunocell type and function

Cell	Function
B cells	Production plasma cells and memory cells
Plasma cells	Produce specific antibodies
Memory cells	Ready to produce antibodies in the future
T cells	Regulate immune response, produce cytotoxic T cells and helper T cells.
Cytotoxic T cells	Kill virus- infected cells and cancer cells
Helper T cells	Regulate immunity
Memory T cells	Ready to kill in the future

There are two types of **immunity response** both related to types of lymphocytes,

1-Cellular immunity is mediated by T lymphocytes that (1) secrete cytokines that act on B lymphocytes, on other T cells, and on inflammatory cells such as macrophages and neutrophils, and (2) attack foreign cells or cells that exhibit foreign epitopes on their surfaces, such as cells infected by viruses or parasites, and some tumor cells. Take one or more days to get into action.

2-Humoral immunity is accomplished by antibodies produced by plasma cells derived from clones of activated B lymphocytes**.** After the B cell has done its job it divides and develops into a plasma cell which remains as an active antibody – producing lymphocytes. Some of the B cells do not produce antibodies, but remain in the blood as memory cells that are capable of producing antibody at a future date. These cells are the basic of active immunity.

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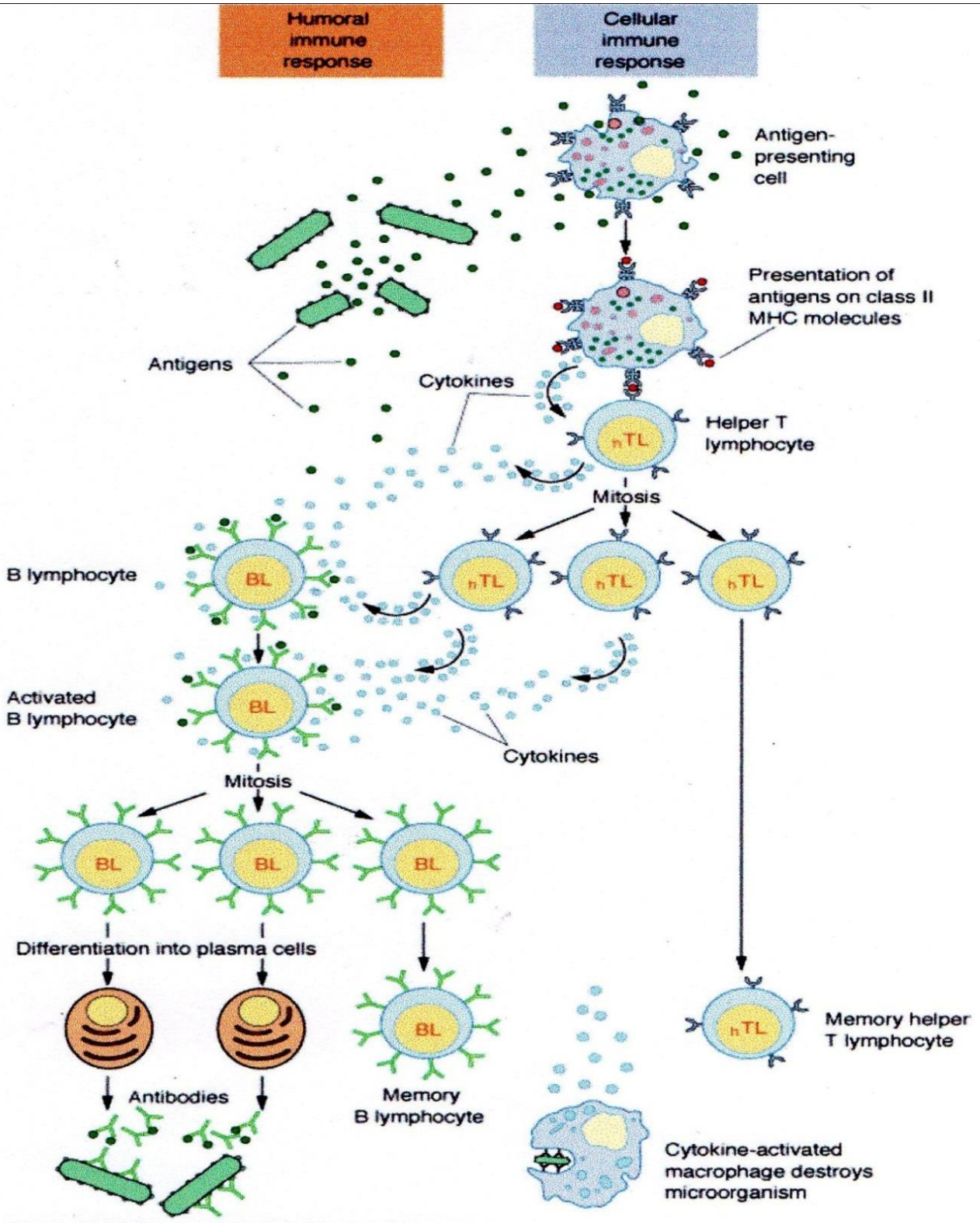
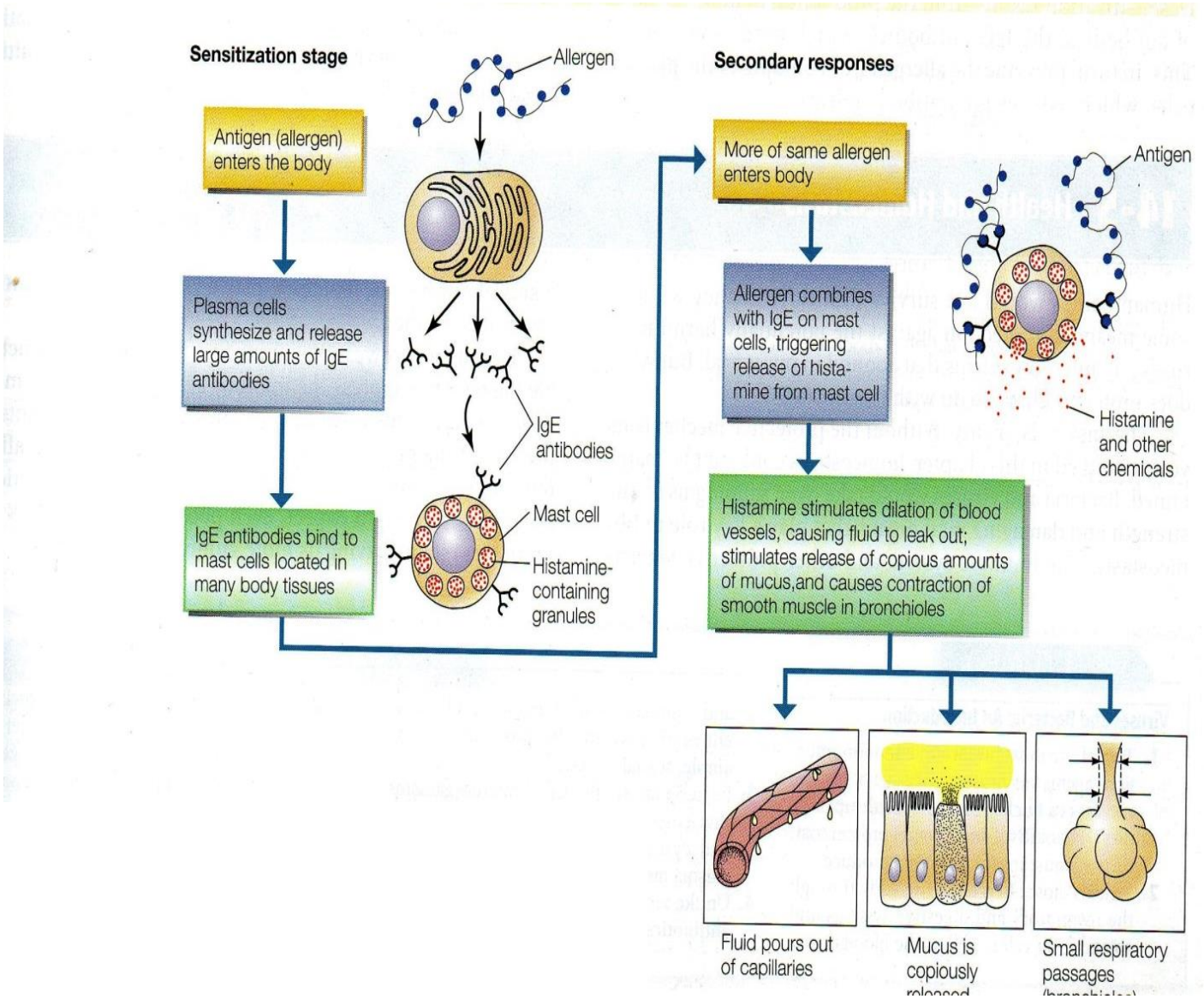

Humoral immune response
Cellular immune response
Antigen-presenting cell
Presentation of antigens on class II MHC molecules
Antigens
Cytokines
Helper T lymphocyte
hTL
Mitosis
B lymphocyte
BL
Activated B lymphocyte
Cytokines
Mitosis
Differentiation into plasma cells
Antibodies
Memory B lymphocyte
Memory helper T lymphocyte
Cytokine-activated macrophage destroys microorganism

Allergy

Allergy is an overreaction to some environmental substance. Antigens that stimulate an allergic reaction are called allergens.



People differ in their allergies; some react immediately, while other shows a delayed response. The immediate response involves antibodies in the blood stream whereas the delayed response involves the cell mediated defense.

1- **Immediate response allergy** can be grouped into three categories:

(a) Anaphylaxis. This is a response resulting from the prolonged effects of histamine. There is constriction of the respiratory pathways and some swelling.

(b) Serum sickness an individual will become sick after being given a serum injection as a means of inducing passive immunity**.**

(c) **Blood transfusion reaction** if a person is given blood of an incompatible group in transfusion there will be an immediate response. The red blood cells will clump together and some cells will rupture and released their hemoglobin. Kidney failure and death may result.

2- **Delayed response allergy** may also be grouped into three categories:

(a) **Auto- immune responses**. There are some diseases which are a reaction by the body against its own tissues. Maybe for some reason the body loses its ability to recognize what is self and what is foreign or non self. This may happen after some bacterial infection. Rheumatoid arthritis is an auto-immune disorder, as are some of forms of anemia.

(b) **Dermatitis by contact**. Some individuals respond to chemicals, plants drugs. Metals or cosmetics when they touch the skin. The inflammation or dermatitis that follows causes the death of many cells in skin.

(c) **Tissue rejection**. When a tissue is transplanted from one individual to another we have to be sure that the tissues are of similar type otherwise rejection will take place. The body of the host produces antibodies against the foreign tissue which is eventually destroyed.