Pathophysiology

Lecture 4 **Asst. Prof. Dr. Dalya Basil**

Inflammation:

Inflammation is a **protective response of living vascularized tissues** to harmful agents. It consists principally of vascular changes associated with leukocytes infiltration and systemic reactions. Inflammation is a protective body response, the aim of which is to minimize the effects of injury or infection, remove the damaged tissue, and to generate new tissue.

The nomenclatures used to describe inflammation in different tissues employs the tissue name and the suffix – itis – such as:

Pericarditis: inflammation of pericardium.

Meningitis: inflammation of meninges.

There are rare exceptions like pneumonitis (inflammation of lung tissue).

Causes of Inflammation:

Inflammatory reaction can be caused by:

Mechanical trauma, thermal injury, electrical injury, chemical injury, irradiation injury, and Biological cause.

Cardinal Signs of Inflammation:

Inflammation is a complex reaction of vascularized tissues to cell injury or death. Characterized by the elaboration of inflammatory mediators and the movements of fluid and leukocytes from the vascular system into the extravascular tissues, and depending on these events the signs of inflammation will be as follow:

Redness, heat, pain, swelling, and loss of function.

Cells of Inflammation:

Many cells and tissue components are involved in the inflammotry process, including the endothelial cells that line blood vessel, circulating platelets and leukocytes, connective tissue cells (mast cells, fibroblasts, tissue macrophages, and components of extracellular matrix).

Types of Inflammation:

On the basis of **severity, duration, onset and other factors,** inflammation can be categorized as:

1- Acute inflammation.

2- Chronic inflammation.

Acute inflammation

It is rapid in onset (seconds or minutes) and is of relatively short duration, lasting for minutes, several hours, or a few days; its main characteristics are the exudation of fluid and plasma proteins (edema) and the emigration of leukocytes, predominantly neutrophils.

Acute inflammation can be triggered by a variety of stimuli, including infections, immune reactions, blunt and penetrating trauma, physical or chemical agents (e.g., burns, frost-bite, irradiation, caustic chemicals), and tissue necrosis from any cause.

Cells of Acute Inflammation:

- Cells involved are phagocytes that are produced in the bone marrow. They are activated by tissue injury and by exposure to characteristic molecules found on pathogens.

1- Neutrophils, also called polymorphonucleocytes (PMN)

- Generally first cells to the scene of tissue injury, where they release mediators that promote inflammation, including vasodilators, and chemotactic factors that attract other immune cells to the site.

- Phagocytize and destroy bacteria and other particulate matter.

- Contain numerous granules of degradative enzymes and peroxidase.

2- Macrophages

- Circulating monocytes enter the tissues, and then are changed into macrophages. There are also resident macrophages in some sites, such as the lungs.

- They become activated by the presence of molecules that are characteristic of pathogens, including endotoxin, and muramyl dipeptide found on the surface of bacterial cells.

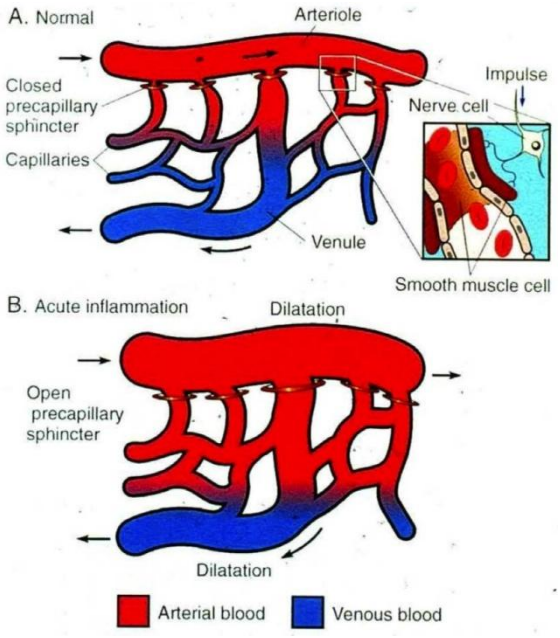
- Like neutrophils, they phagocytize foreign cells and particles, and destroy them with hydrolytic enzymes, which are contained in the cells lysosomes.

Acute inflammation involves:

- Alteration of vascular caliber, vasodilation leads to increased blood flow.

- Changes in microvasculature, increased permeability for plasma proteins and cells.

- Emigration of leukocytes from microcirculation, leukocytes activation leads to eliminatation of foreign agents.



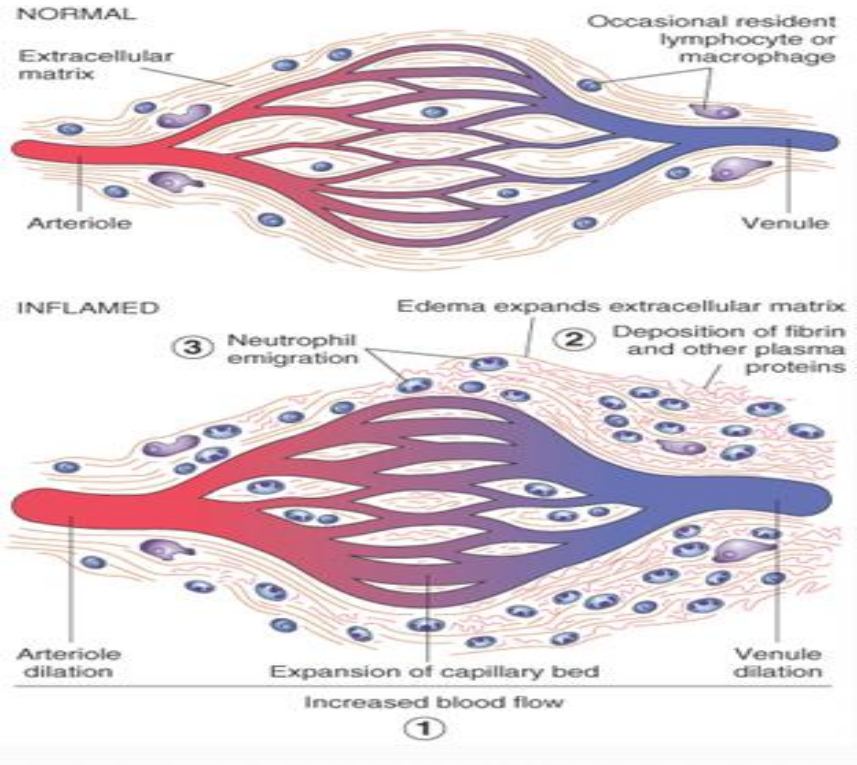
Stages of Acute Inflammation

Acute inflammation has two main stages:

1- Vascular stage: characterized by vascular caliber alteration and change in vascular structure.

- Vasoconstriction for seconds, then vasodilatation is induced by chemical mediators such as histamine (is the cause of erythema and stasis of blood flow causing redness and warmth).

- Increased vascular permeability by histamine, kinins, and other mediators that produce gaps between endothelial cells and increase passage or exudation of protein rich fluids through the endothelium into the extravascular space causing swelling.



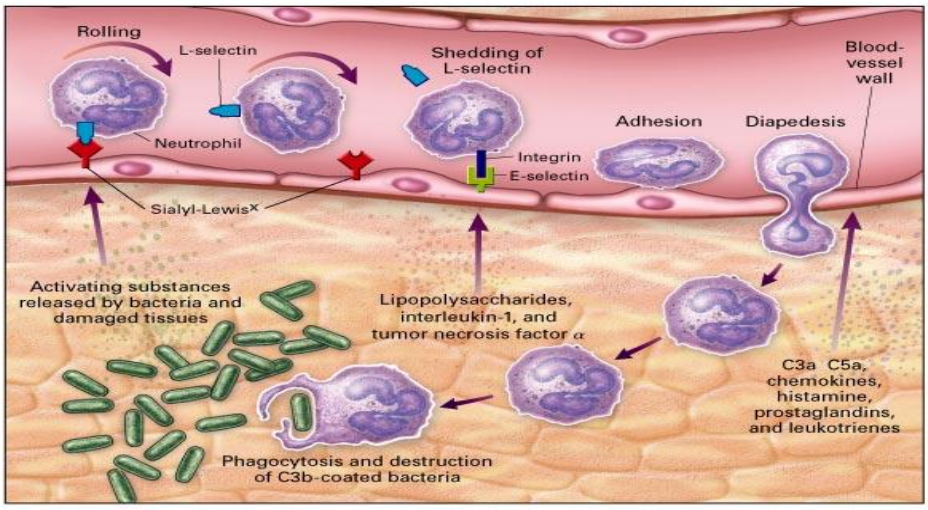
2- Cellular stage: characterized by Leukocytes emigration.

- Leukocyte recruitment

Leukocytes are recruited from the blood into the extravascular tissue to the site of infection or tissue injury, and are activated.

- Leukocyte activation- To perform their functions

Ingest foreign agents, kill bacteria and other microbes, and eliminate necrotic tissue and foreign substances.



Local manifestation of Acute Inflammation:

Local manifestation of acute inflammation can be range from mild swelling and redness to abscess or ulceration.

Charactestically the acute inflammatory response involves the production of exudates, which vary in terms of fluid type, plasma protein content, and presence or absence of cells. Exudates can be:

Serous exudates characterized by watery and clear exudates (e.g. skin blister and pericarditis).

Fibrinous exudates with increased fibrinogen like in adhesions and post surgery.

Catarrhal exudates which is cloudy and mucus such as runny nose in common cold.

Purulent exudates which is yellow green opaque such as in abscesses, boils and cellulites.

Hemorrahgic exudates in which increased red blood cells content like in hematoma.

Outcomes of Acute Inflammation:

Acute inflammation may have one of three outcomes

1. Complete resolution

The battle between the injurious agent and the host may end with restoration of the site of acute inflammation to normal. This is called resolution and is the usual outcome when

a. the injury is limited or short-lived

b. there has been little tissue destruction

c. the damaged parenchymal cells can regenerate

2. Healing by fibrosis

This occurs

a. after extensive tissue destruction

b. when the inflammatory injury involves tissues that are incapable of regeneration

c. when there is abundant fibrin exudation.

When the fibrinous exudate in tissue or serous cavities (pleural, peritoneal, synovial) cannot be adequately cleared, connective tissue grows into the area of exudate, converting it into a mass of fibrous tissue—a process also called organization.

3. Progression to chronic inflammation

Acute to chronic transition occurs when the acute inflammatory response persists, owing either to the perseverance of the injurious agent or to some interference with the normal process of healing. For example, failure of acute bacterial pneumonia to resolve may lead to extensive tissue destruction and formation of a cavity in which the inflammation continues to smolder, leading eventually to a chronic lung abscess.