Inflammation

Damage to the body's tissues triggers a local defensive response called inflammation, another component of the second line of defense. The damage can be caused by microbial infection, physical agents (such as heat, radiant energy, electricity, or sharp objects), or chemical agents (acids, bases, and gases). Inflammation is usually characterized by four signs and symptoms: **redness**, **pain**, **heat**, and **swelling**. Sometimes a fifth, loss of functions.

acute inflammation If the cause of an inflammation is removed in a relatively short period of time.

chronic inflammation. If the cause of an inflammation is difficult or impossible to remove, the inflammatory response is longer lasting but less intense. such as tuberculosis, caused by *M. tuberculosis.*

functions of inflammation:

(1) to destroy the injurious agent, if possible, and to remove it and its by-products from the body.

(2) if destruction is not possible, to limit the effects on the body by confining or walling off the injurious agent and its by products.

(3) to repair or replace tissue damaged by the injurious agent or its by-products.

During the early stages of inflammation, microbial structures, such as flagellin, lipopolysaccharides (LPS), and bacterial DNA stimulate the macrophages to produce cytokines, such as tumor necrosis factor alpha (α-TNF). In response to α-TNF in the blood, the liver synthesizes a group of proteins called **acute-**

phase proteins; other acute-phase proteins are present in the blood in an inactive form and are converted to an active form during inflammation. Acute-phase proteins induce both local and systemic responses and include proteins such as **C- reactive protein**, mannose-binding lectin and several specialized proteins such as fibrinogen for blood clotting and kinins for vasodilation.

Inflammation can be divide into three stages:

1-vasodilation and increased permeability of blood vessels,

2-phagocyte migration and phagocytosis,

3-tissue repair.

1-Vasodilation and Increased Permeability of Blood Vessels

- -The increase in permeability,which permits fluid to move from the blood into tissue spaces, is responsible for the **edema.**
- The release of histamine, kinins, prostaglandins and Leukotrienes causes vasodilation and increased permeability of blood vessels.
- Blood clots can form around an abscess to prevent dissemination of the infection.

2-Phagocyte Migration and Phagocytosis

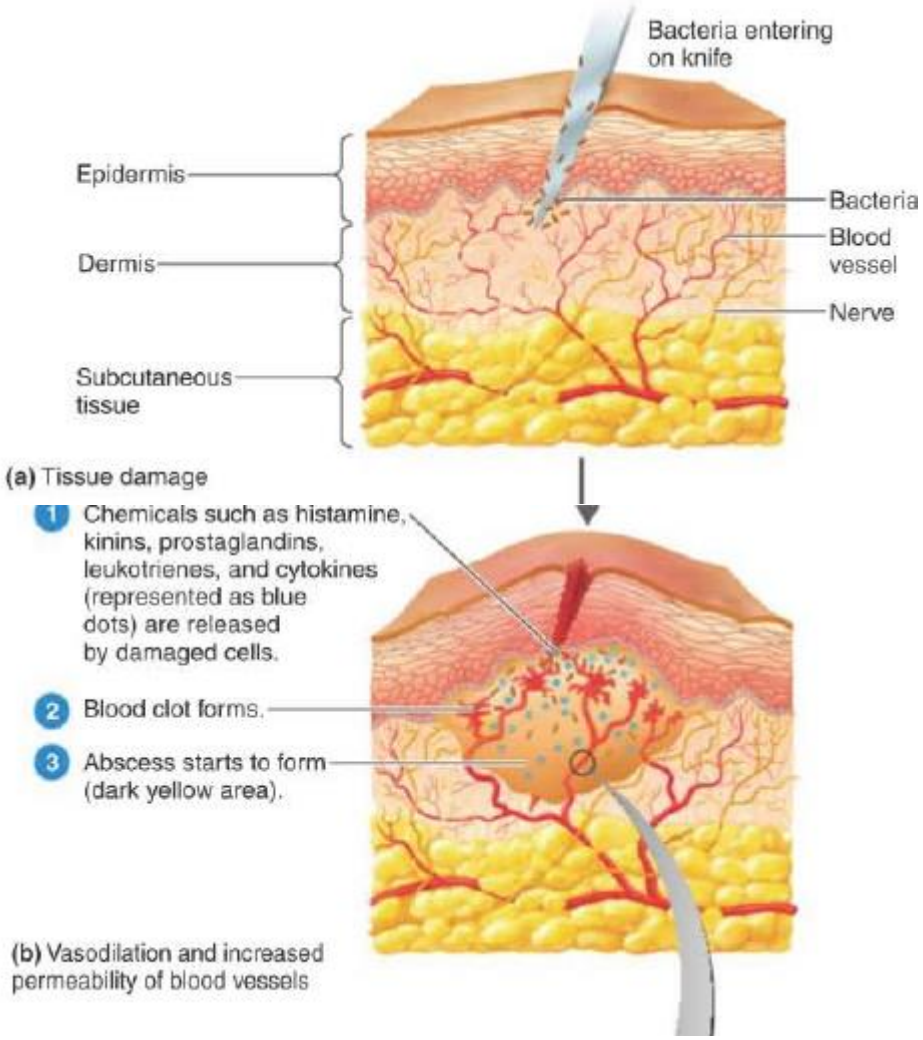
- Phagocytes have the ability to stick to the lining of the blood vessels (margination).
- They also have the ability to squeeze through blood vessels (diapedesis).
- Pus is the accumulation of damaged tissue and dead microbes, granulocytes, and macrophages.

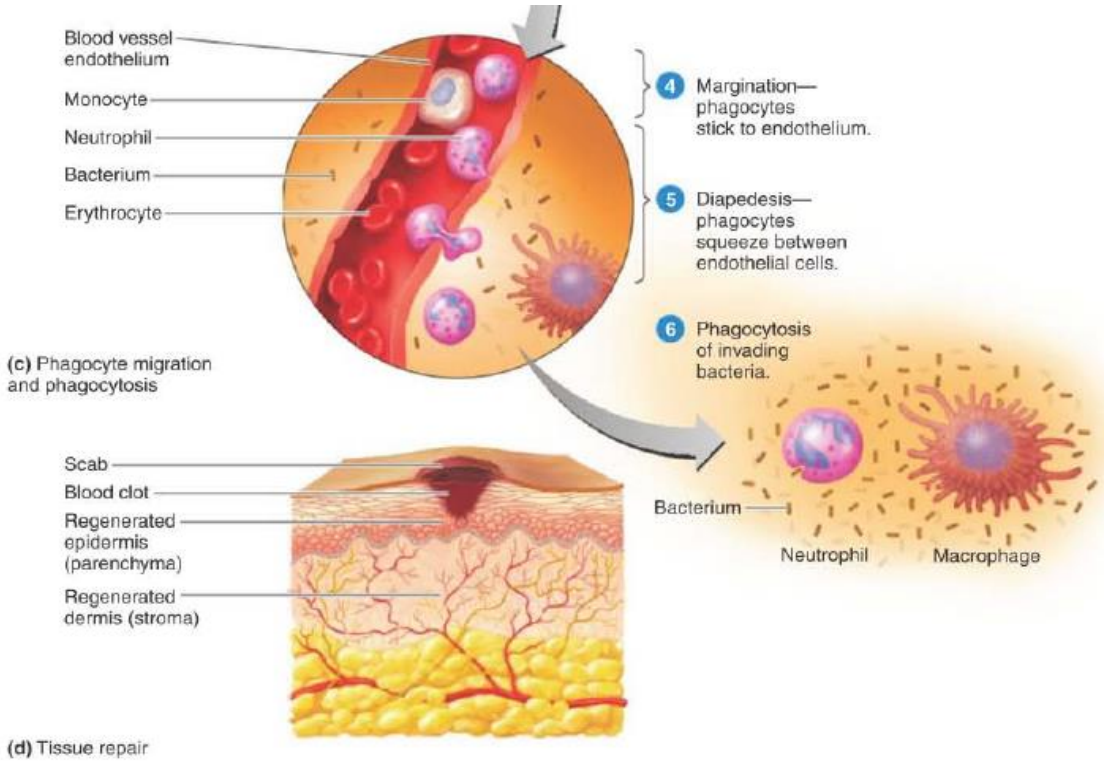
3-Tissue Repair

- A tissue is repaired when the stroma (supporting tissue) or parenchyma (functioning tissue) produces new cells.
- Stromal repair by fibroblasts produces scar tissue.

Some Questions

1- What purposes does inflammation serve?
2- What causes the redness, swelling, and pain associated with inflammation?
3- What is margination?

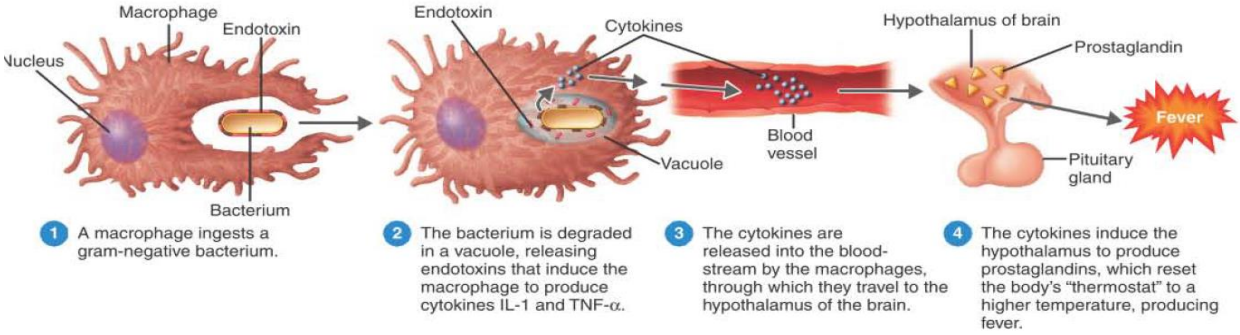

Bacteria entering on knife
Epidermis
Dermis
Subcutaneous tissue
Bacteria
Blood vessel
Nerve
(a) Tissue damage
1 Chemicals such as histamine, kinins, prostaglandins, leukotrienes, and cytokines (represented as blue dots) are released by damaged cells.
2 Blood clot forms.
3 Abscess starts to form (dark yellow area).
(b) Vasodilation and increased permeability of blood vessels



Fever

Inflammation is a local response of the body to injury. There are also systemic, or overall, responses; one of the most important is fever, an abnormally high body temperature, a third component of the second line of defense. The most frequent cause of fever is infection from bacteria (and their toxins) or viruses.

Body temperature is controlled by a part of the brain called the hypothalamus. The hypothalamus is sometimes called the body's thermostat, and it is normally set at 37°C . It is believed that certain substances affect the hypothalamus by setting it at a higher temperature. Recall that when phagocytes ingest gram-negative bacteria, the lipopolysaccharides (LPS) of the cell wall (endotoxins) are released, causing the phagocytes to release the cytokines interleukin- I (formerly called endogenous pyrogen), along with TNF- α. These cytokines cause the hypothalamus to release prostaglandins that reset the hypothalamic thermostat at a higher temperature, thereby causing fever.



Assume that the body is invaded by pathogens and that the thermostat setting is increased to 39°C. To adjust to the new thermostat setting, the body responds by constricting blood vessels, increasing the rate of metabolism, and shivering, all of which raise body temperature. Even though body temperature is

climbing higher than normal, the skin remains cold, and shivering occurs. This condition, called a **chill**, is a definite sign that body temperature is rising. When body temperature reaches the setting of the thermostat, the chill disappears. The body will continue to maintain its temperature at 39"C until the cytokines are eliminated. The thermostat is then reset to 37°C. As the infection subsides, heat-losing mechanisms such as vasodilation and sweating go into operation. The skin becomes warm, and the person begins to sweat. This phase of the fever, called the **crisis**, indicates that body temperature is falling. Interleukin-I helps step up the production of T cells. High body temperature intensifies the effect of antiviral interferons and increases production of **transferrins** that decrease the iron available to microbes. Also, because the high temperature speeds up the body's reactions, it may help body tissues repair themselves more quickly. Among the complications of fever are tachycardia (rapid heart rate), which may compromise older persons with cardiopulmonary disease; increased metabolic rate, which may produce acidosis; dehydration; electrolyte imbalances; seizures

in young children; and delirium and coma. As a rule, death results if body temperature rises above 44 to 46"C.