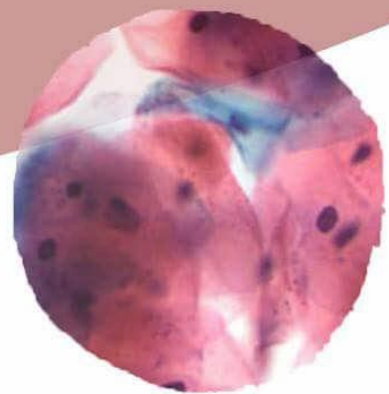
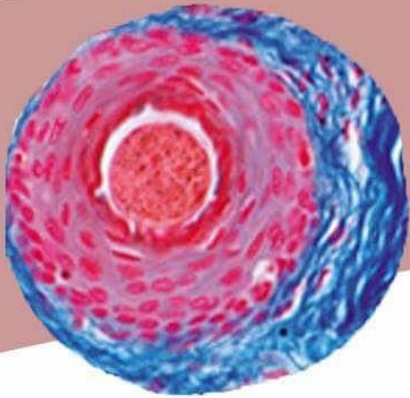




# INTRODUCTION TO PATHOLOGY



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Sheet# 6

## **Inflammation:**

### **What is Inflammation?**

- ❖ **It's a protective mechanism**; protecting our body from agents such as bacteria, infection or whatever causes cell injury.
- ❖ It's a type of the **innate immune system**; which is the **non-specific** immune system.
- ❖ The aim of an inflammation is to get rid of an offending agent and to get rid of the results caused by the offender; including the dead cells and necrotic cells. Meaning is to eliminate the initial cause of injury and to get rid of the damage and initiate repair.
- ❖ The process of inflammation involves three things that preform the response:
  1. Host cells: inflammatory cells
  2. Chemical mediators
  3. Blood vessels.

### **Note:**

- Inflammation and the process of repair are connected to one another because inflammation removes the damage and repair replaces the damage; thus completing one another.
- Keep in mind that inflammation is not a DISEASE, but a protective mechanism. Yet, doctors treat this mechanism by giving anti-inflammatory drugs. Why do we treat it if it's protective?

Because the same cells and chemical mediators that kill the bacteria, infection,...etc may cause damage for our own cells, therefore we need to limit the inflammation (by taking the anti-inflammatory drugs) in order to limit the damage that might be done on our own, healthy tissues.

This is known as the collateral damage or the un-intended outcomes.

- Inflammation is self-controlled, it cannot proceed forever. As soon as the offending agent is destroyed, inflammation **MUST** stop or else it will increase resulting in the un-intended outcomes (destroying neighboring healthy tissues), which may cause a severe disease. So inflammation is self-controlled; meaning that there is a very good balance between the inflammatory mechanisms and the anti-inflammatory mechanisms in our bodies.

Examples of some anti-inflammatory mechanisms:

1. Cells that causes inflammation are short lived and will undergo death a process known as **apoptosis**.
2. Chemical mediators will decay and there are enzymes in our bodies that will destroy them

So it all happens at the same time; inflammation, anti-inflammation and repair.

- Any word that ends with "itis" indicates an inflammation. Examples:

1. Hepatitis: liver inflammation
2. Bronchitis
3. Pneumonitis: lung inflammation (most commonly known as pneumonia)

**\*10 minutes**

**To summarize:**

**For an inflammation to start:**

- 1) There must be an offending agent or else the body would be attacking its own cells. This offending agent may be bacteria, infections, and any thing (like toxins) that causes cell injury as this will disturb the homeostasis of the cell and thus the cells start inflammation.
- 2) It should start directly whenever the body is attacked
- 3) It should stop at a certain point when all the goals are fulfilled
- 4) It may cause collateral damage.

**Signs of inflammations:**

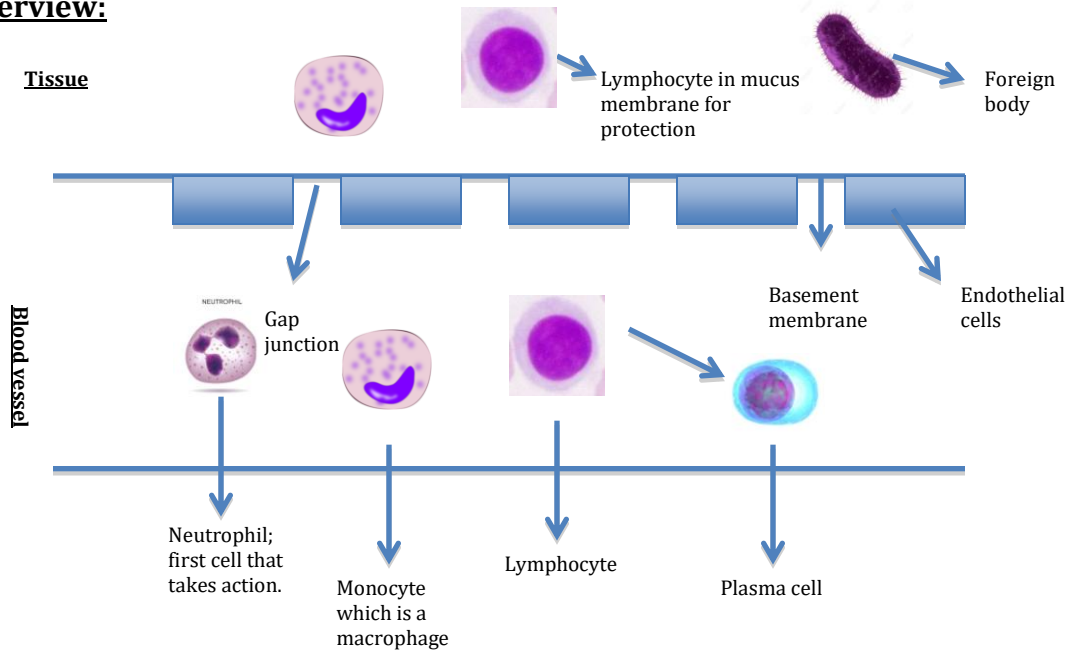
A) Four cardinal signs of inflammation:

- 1) Redness
- 2) Swelling
- 3) Pain
- 4) Hotness

B) Loss of function

## How does an inflammation occur?

### Overview:



### An overview of inflammation:

- Inflammation starts in the blood vessels.
- Main Inflammatory cells; neutrophils, monocytes, lymphocytes (B and T) and plasma cells (which is the same as the B-lymphocytes)
- Remember all these cells are made in the bone marrow they mature and then they are transported to the blood circulatory system.
- **Steps of the process:**
  - 1) The first step is **RECOGNITION** whether in the infectious agent is present in the blood vessels or the tissues. How?
    - By receptors; which are present in many cells such as inflammatory cells, dendritic cells...etc.
    - Receptors are not specific for a certain foreign body because there are unlimited number of foreign bodies that may attack us thus these receptors recognize certain patterns in these foreign bodies and not a individual, specific molecule. These receptors are known as the *pattern recognition receptors*.

- 2) **VASODILATION:** After the recognition the cell sends mediators/signals in order for immune cells (especially neutrophils that are the first line of defense and the first to act) to be transported to the inflammation sight. Yet, in order for more cells to be able to reach the sight of inflammation, we need more space therefore as the cells signals for more cells to move to the inflammatory site vasodilation happens.

As a result of Vasodilation:

Four cardinal signs of inflammation:

- Redness (erythema); blood vessels are larger thus closer to the surface and has more blood flow which causes the sight of inflammation to be red in color
  - Hotness; Core body temperature is higher than the surface temperature, thus when we have more blood flowing we have more heat.
  - Swelling; as the vessel becomes larger, endothelial cells will move apart thus gap junctions become wider which increase the vascular permeability allowing plasma fluid to escape resulting in swelling/edema.
  - Pain; in the tissue there are pain receptors that become more sensitive whenever swelling occurs. Pain is the effect of edema/swelling.
- 3) **TRANSMIGRATION:** cells migrate from the blood to the tissue. These cells will face two barriers, which are the endothelial cells and the basement membrane (they cannot pass through the gap junctions as they are small.)
- When these cells move to the tissue by transmigration they have a directional movement known as chemotaxis this movement is the movement of cells down a chemical gradient (the cells go wherever the chemicals tell them to go) so that they all move towards the infectious agents and not randomly.
- 4) As the neutrophil reaches the site of inflammation it starts releasing mediators to attract more neutrophils
- 5) If the inflammation lasts from 24-48 hours then the neutrophil starts calling stronger cells, which are the monocytes; thus monocytes require 24-48 hours (after initiation of inflammation) to reach the sight of inflammation.
- 6) As for the lymphocytes; if the inflammation lasted for several days then lymphocytes take action.
- 7) **ACTIVATION:** These cells are to be activated once they reach the infectious agents to be able to kill.

Thus;

- Acute inflammation (quick): cells present are neutrophils, which means that neutrophils are a mark/ indication of an acute inflammation.
- While in a chronic inflammation (stays for days or months or more); monocytes are the predominate cells and we start seeing lymphocytes.

**Important Notes:**

- The presence of inflammatory cells outside the blood vessels and in the blood tissues is important to recognize any bacteria, infection or any cause of cell injury-as described in previous lectures-...etc in the tissue. These inflammatory cells are lymphocytes (especially in the mucus membrane for permanent protection) and macrophages.

Thus the presence of inflammatory cells in both the blood vessels and the tissues is an indication that wherever the infectious agent is, our body is able to recognize it and take action.

- The first step, which is recognition, can occur by any cell carrying a receptor, but the first step of the inflammation is done by neutrophil that's why we said neutrophils are the first line of defense (it's the first cell that reaches the sight and starts the action but not necessarily the recognition).
- Difference between hotness and fever;  
Hotness is localized and is a cardinal sign of inflammation while fever is generalized (the whole body) and is not necessarily a sign of inflammation. (Not all who have inflammation have fever, but always have hotness.) In general, hotness is related to vasodilation while fever is related to mediators. (like prostaglandins)
- Difference between an infection and inflammation;  
Infection is a disease caused by infectious agents while inflammation is a protective mechanisms and not a disease caused by any foreign body including infectious agents. Infection is a cause of inflammation but it's not the only cause. (inflammation may be caused by toxins/ischemia/ necrotic tissue...etc).