CHANGES IN ACUTE INFLAMMATION

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OBJECTIVES

- To be able to understand;
  a. Changes/Events During Acute Inflammation
  b. Morphologic Patterns of Acute Inflammation
  c. Chemical Mediators and Fate of Inflammation
  d. Outcomes of Acute Inflammation

INTRODUCTION

- An important function of the inflammatory response is to deliver leukocytes to the site of injury and to activate them.
- Leukocytes ingest offending agents, kill bacteria and other microbes, and eliminate necrotic tissue and foreign substances.
- Once activated, leucocytes may induce tissue damage and prolong inflammation, because leukocyte products that destroy microbes can also injure normal host tissues.

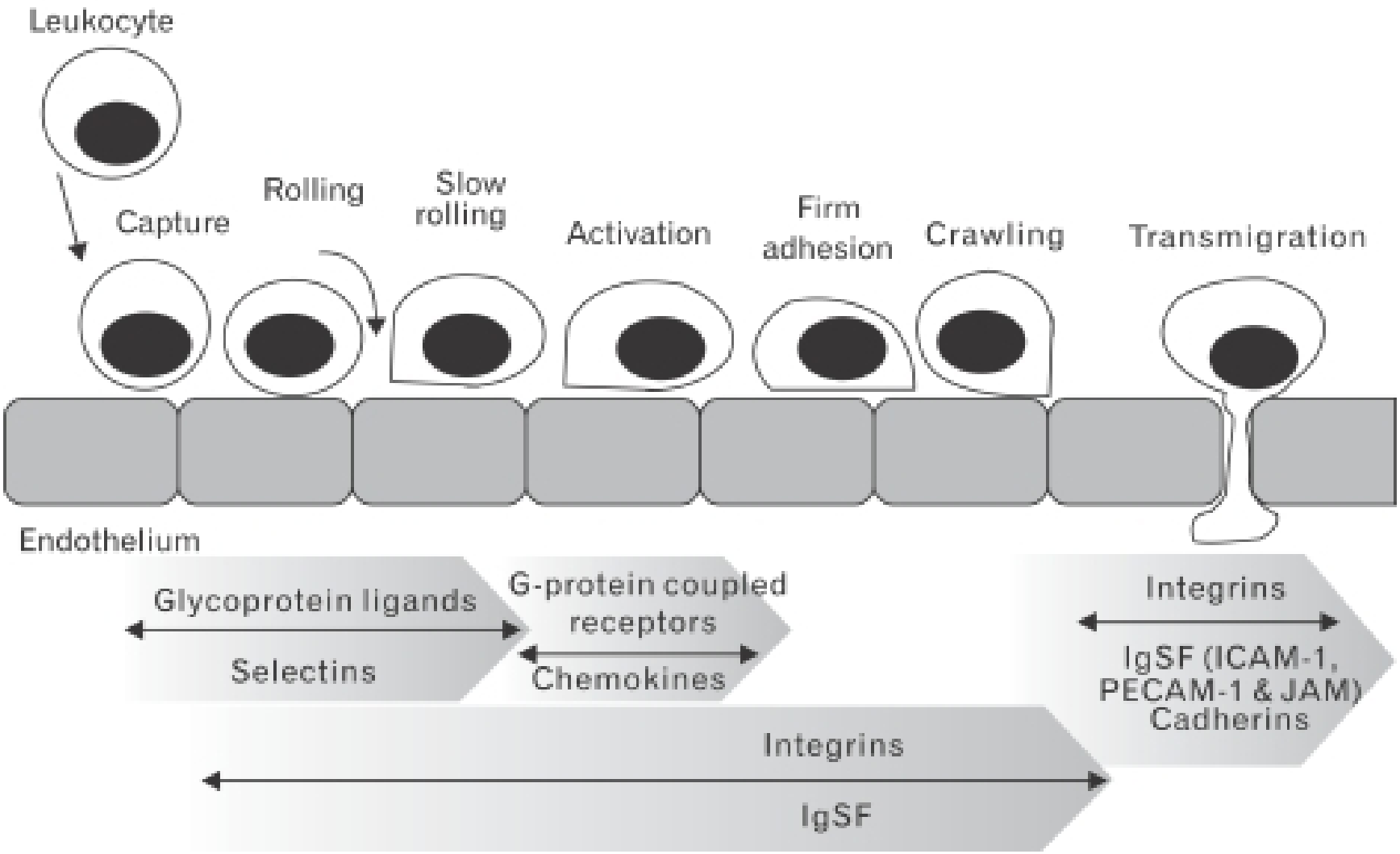
a)Changes/Events During Acute Inflammation

1. Leukocytes Recruitment
2. Leukocytes Activation
3. Phagocytosis

1)Leukocytes Recruitment

- The sequence of events in the recruitment of leukocytes from the vascular lumen to the extravascular space consists of the following:
  - **Margination:** this is the adhesion of leucocytes to endothelium, and rolling along the vessel wall.
  - **Transmigration**: this is the movement of leucocytes between endothelial cells
  - **Migration:** this is the entrance of the leucocytes in the interstitial tissues toward a chemotactic stimulus.
- Chemical mediators or chemo attractants and certain cytokines affect these processes by stimulating **directional movement of the leukocytes**

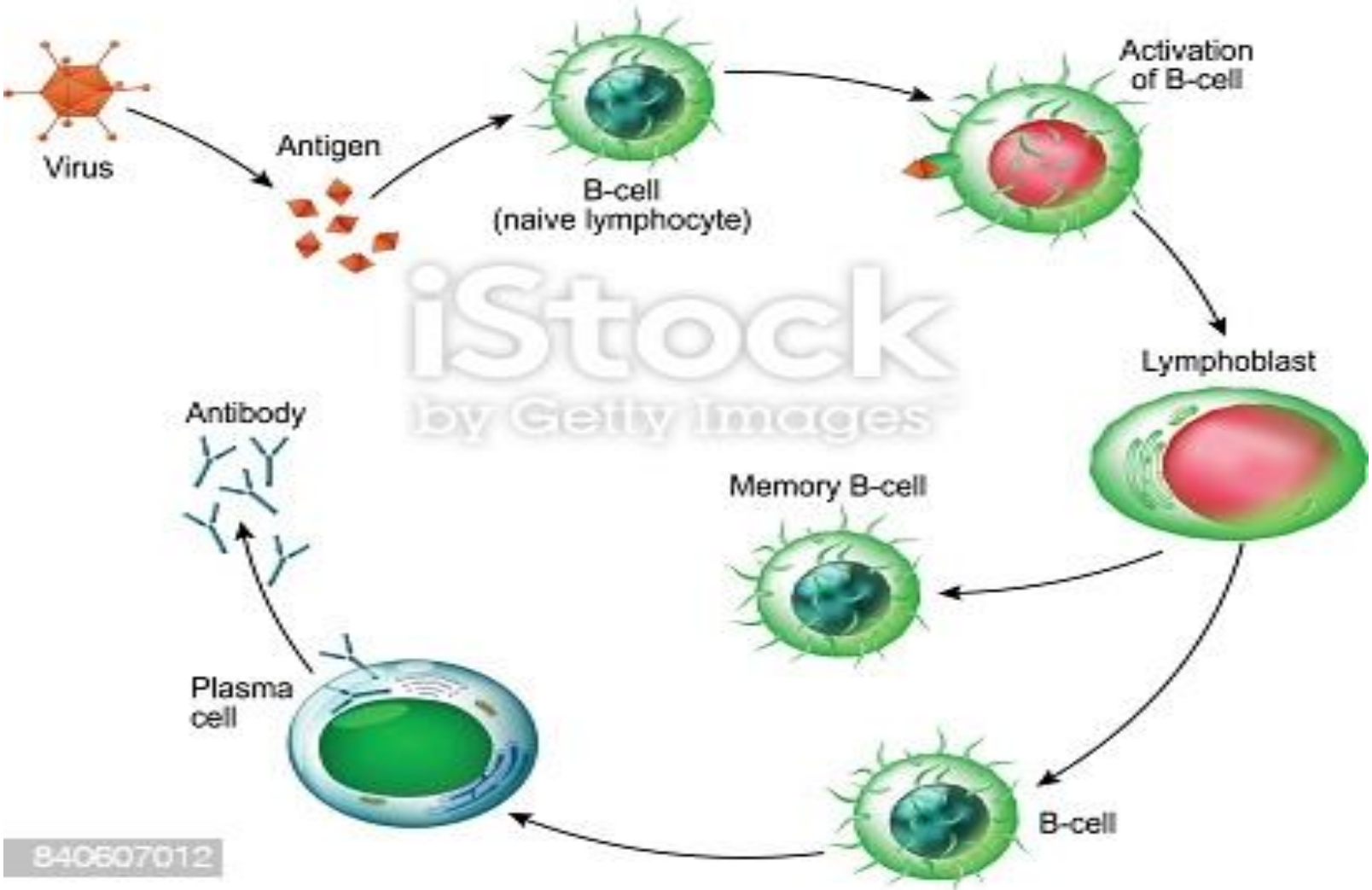
Leukocyte recruitment: Leukocyte-endothelial interactions



2)Leukocytes Activation

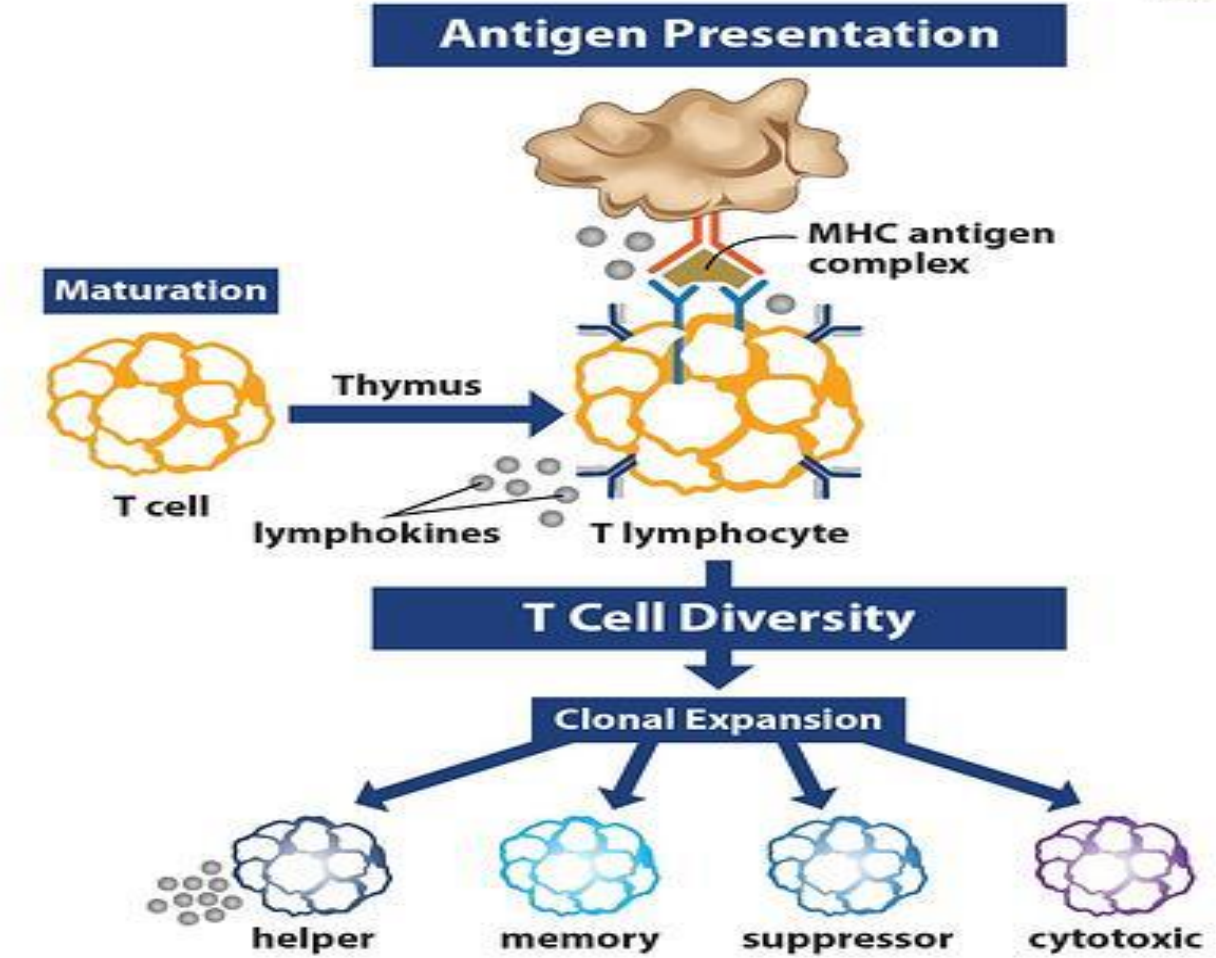
- Once leukocytes have been recruited to the site of infection or tissue necrosis, they must be activated to perform their functions.
- Stimuli for activation include
  i. microbes
  ii. products of necrotic cells
  iii. several mediators
- Engagement of these receptors by microbial products or by various mediators of inflammation induces a number of responses in leukocytes that are part of their normal defensive functions and are grouped under the generic term leukocyte activation.

B-cell activation



T Cells: Activation and Diversity

CrownBio
CONNECTING SCIENCE TO PATIENTS

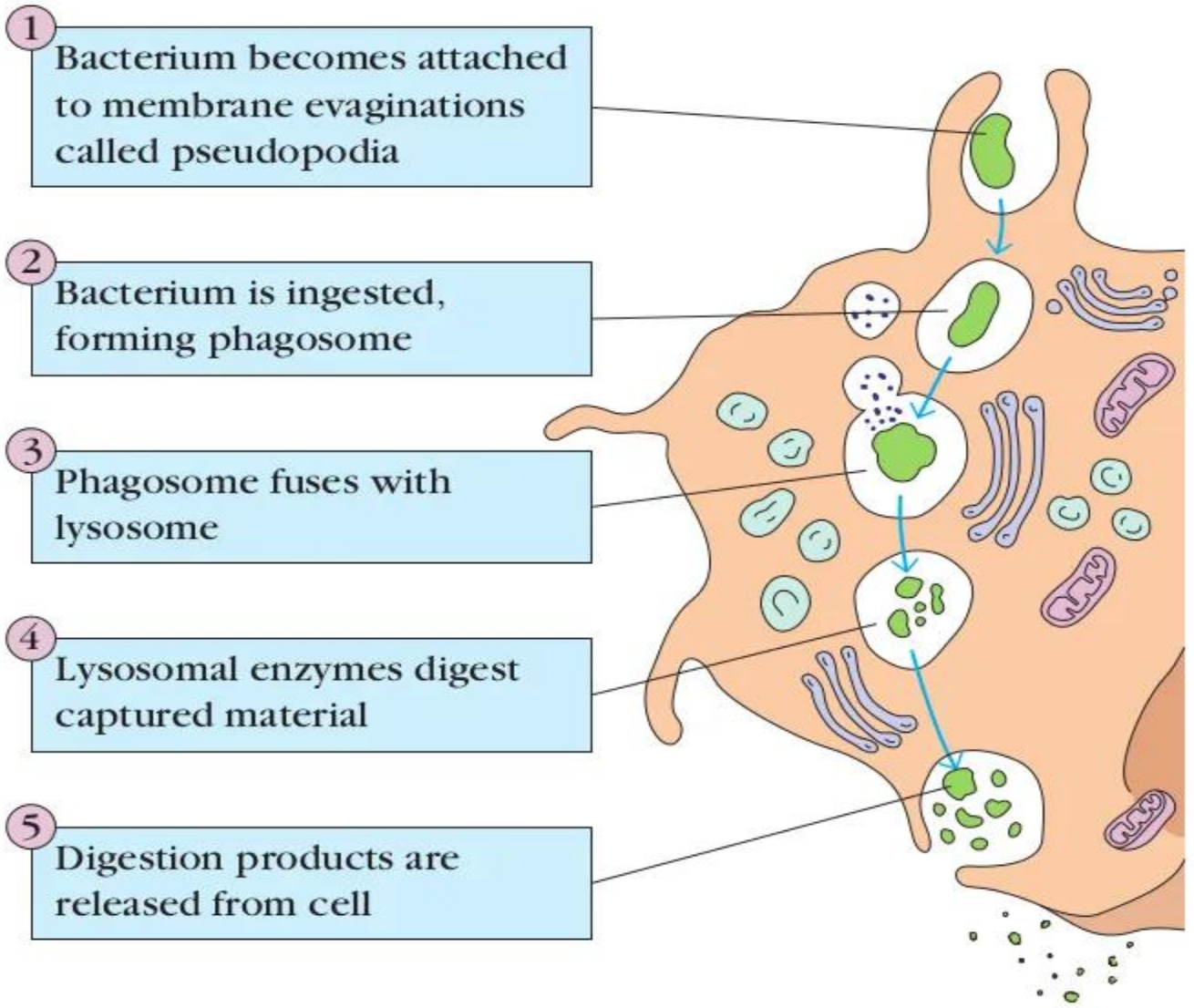


Phagocytosis

- It consists of three distinct but interrelated steps.
  - Recognition and attachment of the particle to the ingesting leukocyte;
  - Engulfment, with subsequent formation of a phagocytic vacuole; and
  - Killing and degradation of the ingested material.

- Leukocytes bind and ingest most microorganisms and dead cells via specific surface receptors, which recognize either components of the microbes and dead cells, or host proteins, called opsonins, that coat microbes and target them for phagocytosis (a process called opsonization).

- The most important opsonins are antibodies of the immunoglobulin G (IgG) class that bind to microbial surface antigens.

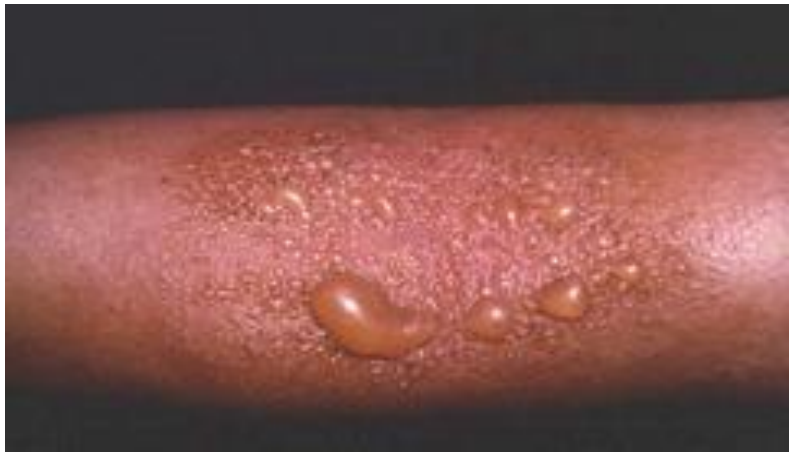

1
Bacterium becomes attached to membrane evaginations called pseudopodia
2
Bacterium is ingested, forming phagosome
3
Phagosome fuses with lysosome
4
Lysosomal enzymes digest captured material
5
Digestion products are released from cell

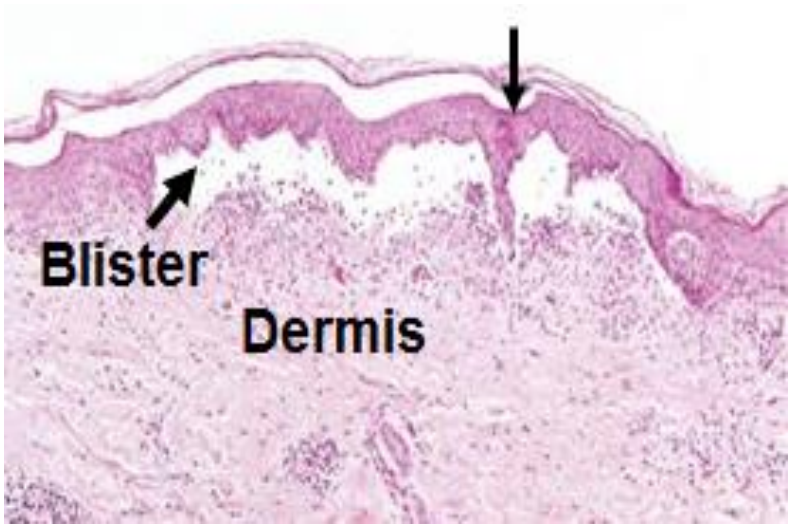
Morphologic Patterns of Acute Inflammation

1. Serous Inflammation
2. Fibrinous Inflammation
3. Suppurative (Purulent) Inflammation

1.Serous Inflammation

- It is characterized by the **outpouring of a watery**, relatively protein-poor fluid that, depending on the site of injury, derives either from the serum or from the secretions of mesothelial cells lining the peritoneal, pleural, and pericardial cavities.
- The **skin blister** resulting from a burn or viral infection is a good example of a serous effusion accumulated either within or immediately beneath the epidermis of the skin
- Fluid in a serous cavity is called an effusion



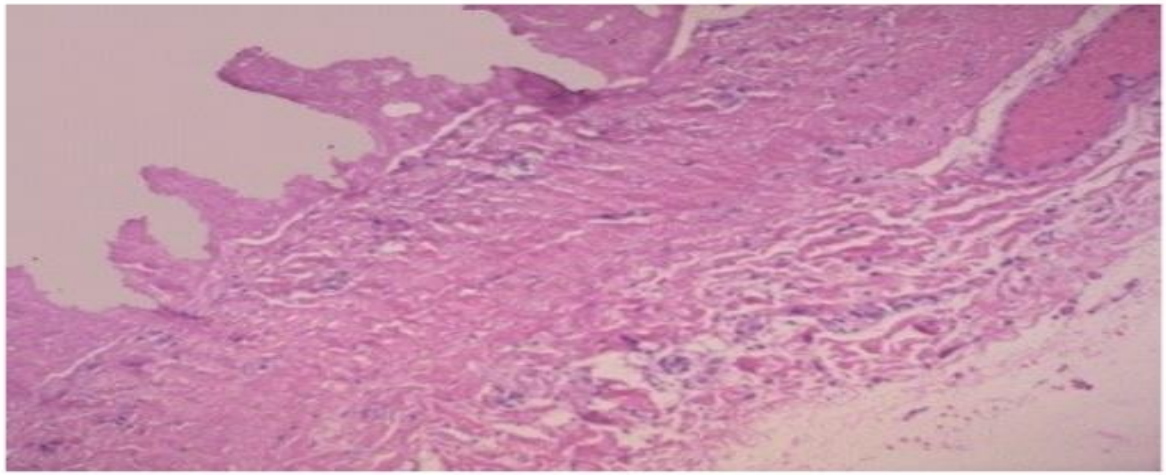

Blister
Dermis


F 27 : Serous inflammation: Subepidermal bullous. The epidermis is separated from the dermis by a focal collection of serous effusion.

2. Fibrinous Inflammation

- This occurs as a consequence of more severe injuries, resulting in greater vascular permeability that allows large molecules (such as **fibrinogen)** to pass the endothelial barrier.
- Histologically, the accumulated extravascular fibrin appears as an **eosinophilic meshwork of threads** or sometimes as an **amorphous coagulum**.

Fibrinous pericarditis
"Bread and butter" pericarditis



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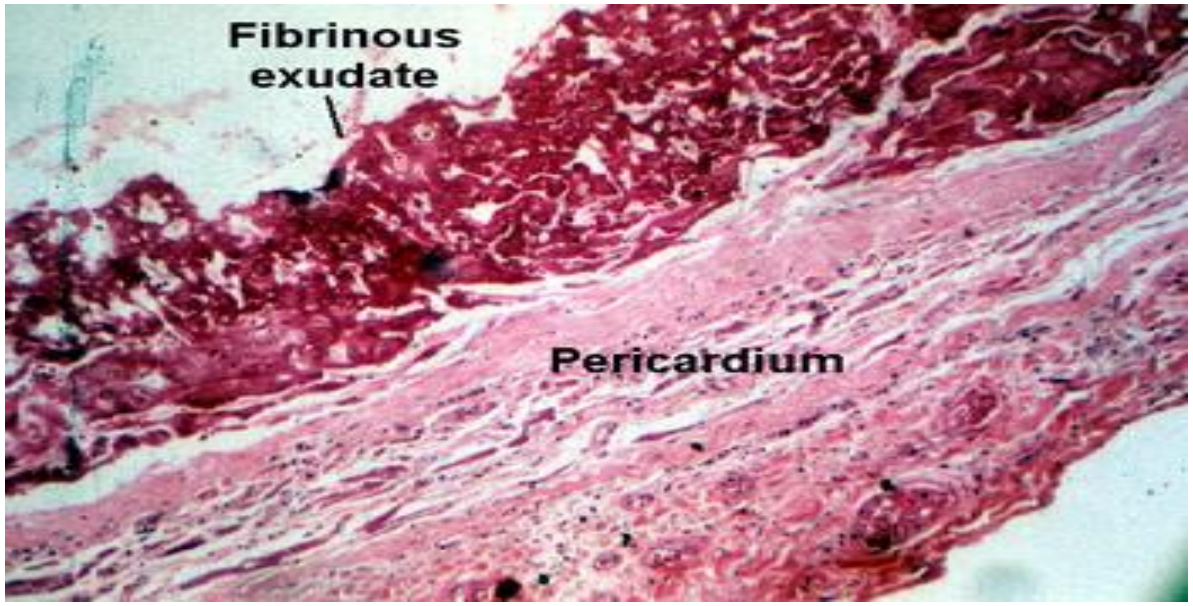
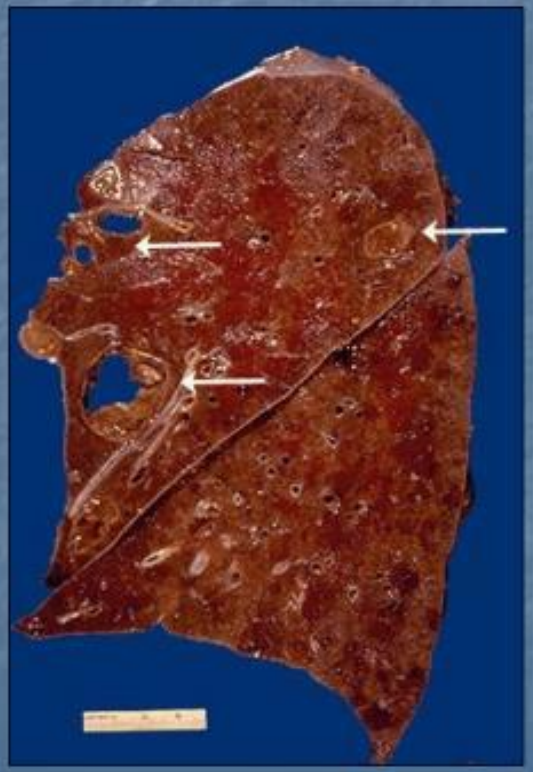


- A fibrinous exudate is characteristic of inflammation in the lining of body cavities, such as the meninges, pericardium, and pleura.
  - Such exudates may be degraded by **fibrinolysis,** and the accumulated debris may be removed by macrophages, resulting in restoration of the normal tissue structure (**resolution**).
  - Failure to completely remove the fibrin results in the in growth of fibroblasts and blood vessels (**organization**), leading ultimately to scarring that may have significant clinical consequences. □

3.Suppurative (Purulent) Inflammation

- This is manifested by the presence of **large amounts of purulent** exudate or pus consisting of neutrophils, necrotic cells, and oedema fluid
- Certain organisms (e.g. staphylococci) are more likely to induce such localized suppuration and are therefore referred to as **pyogenic**
- Local accumulation of pus is known as **abscess**

Purulent-suppurative inflammation



Bronchopneumonia

- **Ulceration**
  - An ulcer is a local defect or excavation of the surface of an organ or tissue which is produced by **necrosis of cells** and **sloughing of inflammatory necrotic tissue**.
  - Ulceration can occur only when tissue necrosis and resultant inflammation exist on or near a surface. It is most commonly encountered in inflammatory necrosis of the mucosa of the mouth, stomach, intestines, or genitourinary tract.

Chemical Mediators and Fate of Inflammation

- Mediators of inflammation can be defined as any soluble substance that act on the blood vessel, inflammatory cells or any other cell to contribute to an inflammatory response.
- Mediators of inflammation can be classified according to their source as follows:

I. Cellular derived mediators

II. Plasma derived mediators

a)Cellular Derived Mediators

- The main/principal cell derived mediators include
  - **Histamine**
    - From basophils, mast cells and platelets
    - Their principal actions are vasodilation, increase vascular permeability and endothelia activation
  - **Serotonin**
    - From platelets
    - Their principal actions are vasodilatation and increase vessel permeability

Cont……

- **Prostaglandins**
  - Derived from mast cells and leucocytes
  - Their principal actions are vasodilatation, induction of pain and fever

- **Platelet activating factor**
  - Derived from leucocytes and endothelial cells
  - Their principal actions are vasodilation, increase vascular permeability, leucocyte adhesion and chemotaxis

b)Plasma Protein-Derived Mediators

- **Complement proteins**
  - Produced by the liver
  - Their principal actions are chemotaxis, opsonisation and stimulation of mast cells
- **Coagulation proteins**
  - Produced by the liver
  - Activated factor XII triggers the clotting, kinin and complement cascades, and activates the fibrinolytic system
- **Kinins**
  - Produced by the liver
  - Their principal actions are to increase vascular permeability, smooth muscle contraction, induce pain and vasodilation

OUTCOMES OF ACUTE INFLAMMATION

- **Resolution**
  - Complete healing when tissue damage is minimal or process is short lived and the tissue has the ability of regeneration.
- **Progression**
  - The acute inflammation can progress to chronic inflammation when the tissue damage is extensive or when the exudates is not completely eliminated or cleared.
- **Fibrosis**
  - This occurs when there is extensive tissue damage, exudates are not timely cleared and tissue involved has no capacity to regenerate.

- **Spread**
  - **Direct** e.g.cellulitis
  - **Lymphatic**-lymphangitis progressing to acute lymphadenitis
  - **Blood vessels**
    - Pyaemia-spread of pyogenic organisms in infected micro-thrombi via the blood stream possibly giving rise to secondary (metastatic) abscesses.
    - Septicaemia-multiplication of organisms in the blood stream in the absence of adequate host defences.
- **Death resulting from**
  - Septicaemia, e.g. endotoxic shock and its complications
  - Involvement of vital organs, e.g. encephalitis, myocarditis

END OF ACUTE INFLAMMATION