Inflammation

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Lec. 4

Learning objectives

You should:

- **Recognize morphological pattern of acute inflammation.**
- **Know the systemic effect of inflammation**

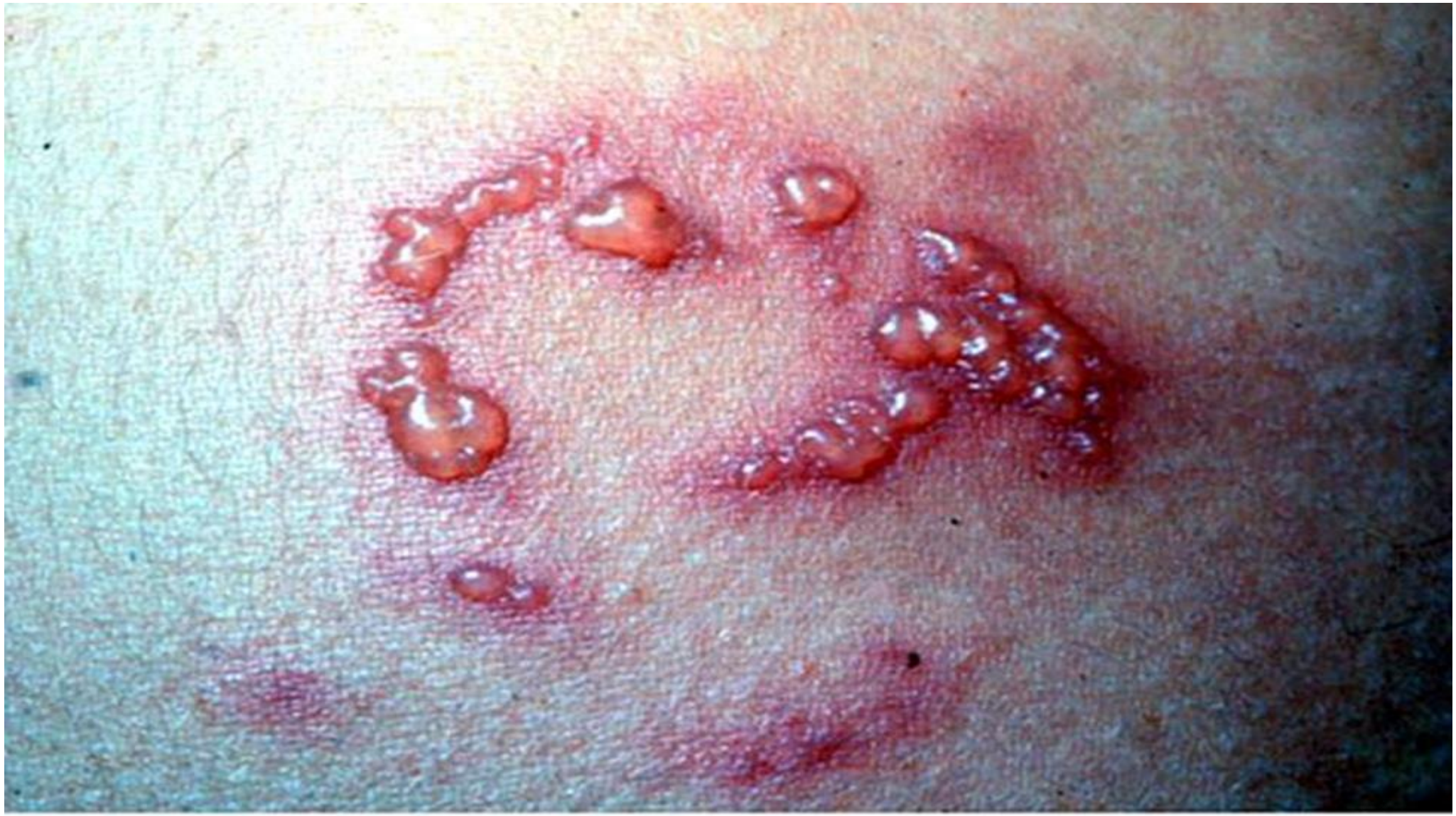
Morphological patterns of inflammation:

(according to types of exudate):

1- Serous inflammation: Characterized by outpouring of watery, protein poor fluid derives from either serum or from the mesothelial cells lining the cavities(peritoneal, pleural &pericardial cavities).

Type of inflammatory fluid: watery, relatively protein poor (Transudate).

- Source of fluid:
- Serum or mesothelial cells lining the body cavities
- Fluid in a serous cavity is called effusion.
- (pleura (pleural effusion),
- peritoneum (ascites) &
- pericardium (pericardial effusion).
- Blisters of burns or viral infection is a good example.



CONTACT DERMATITIS BLISTERS FROM THE POISON IVY PLANT'S TOXIC PRINCIPLE, URUSHIOL. THIS IS A CLASSIC EXAMPLE OF A SEROUS EXUDATE.

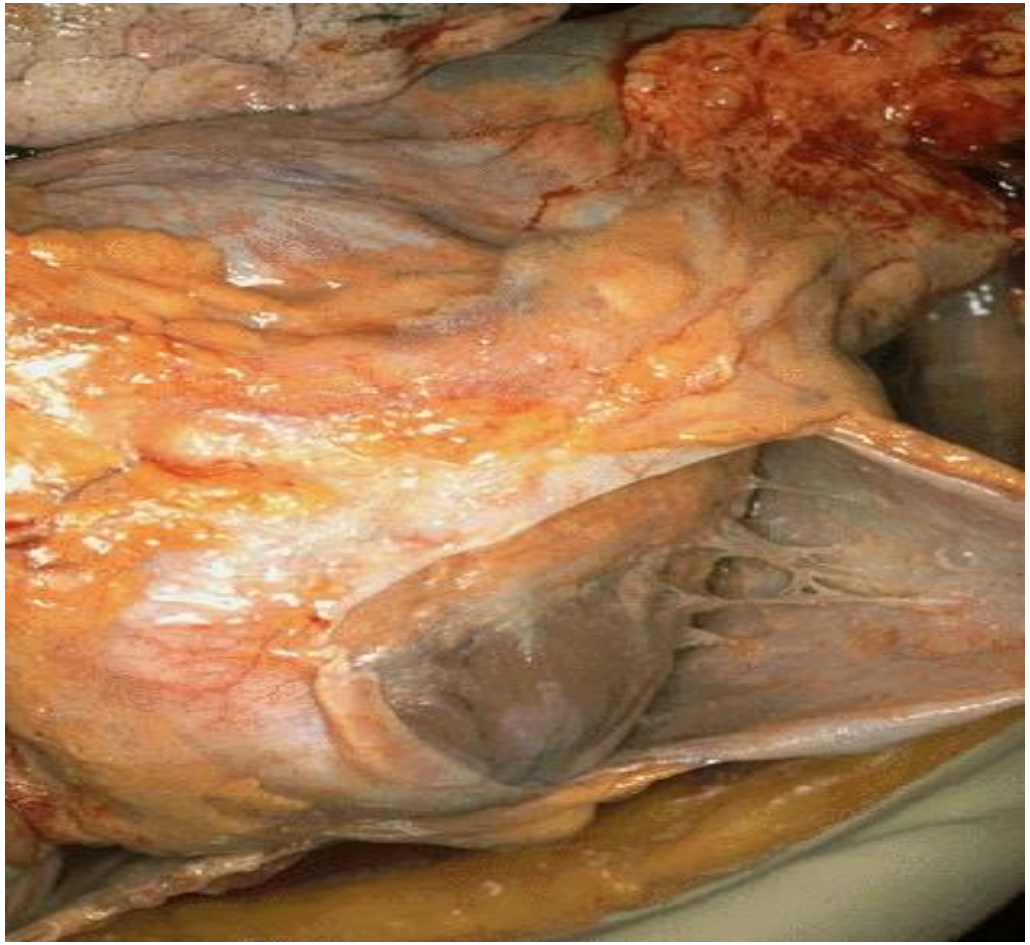
2- Fibrinous inflammation: Is the result of more severe injury---fibrinogen rich exudate appears as meshwork or threads lining the body cavities e.g fibrinous pericarditis.

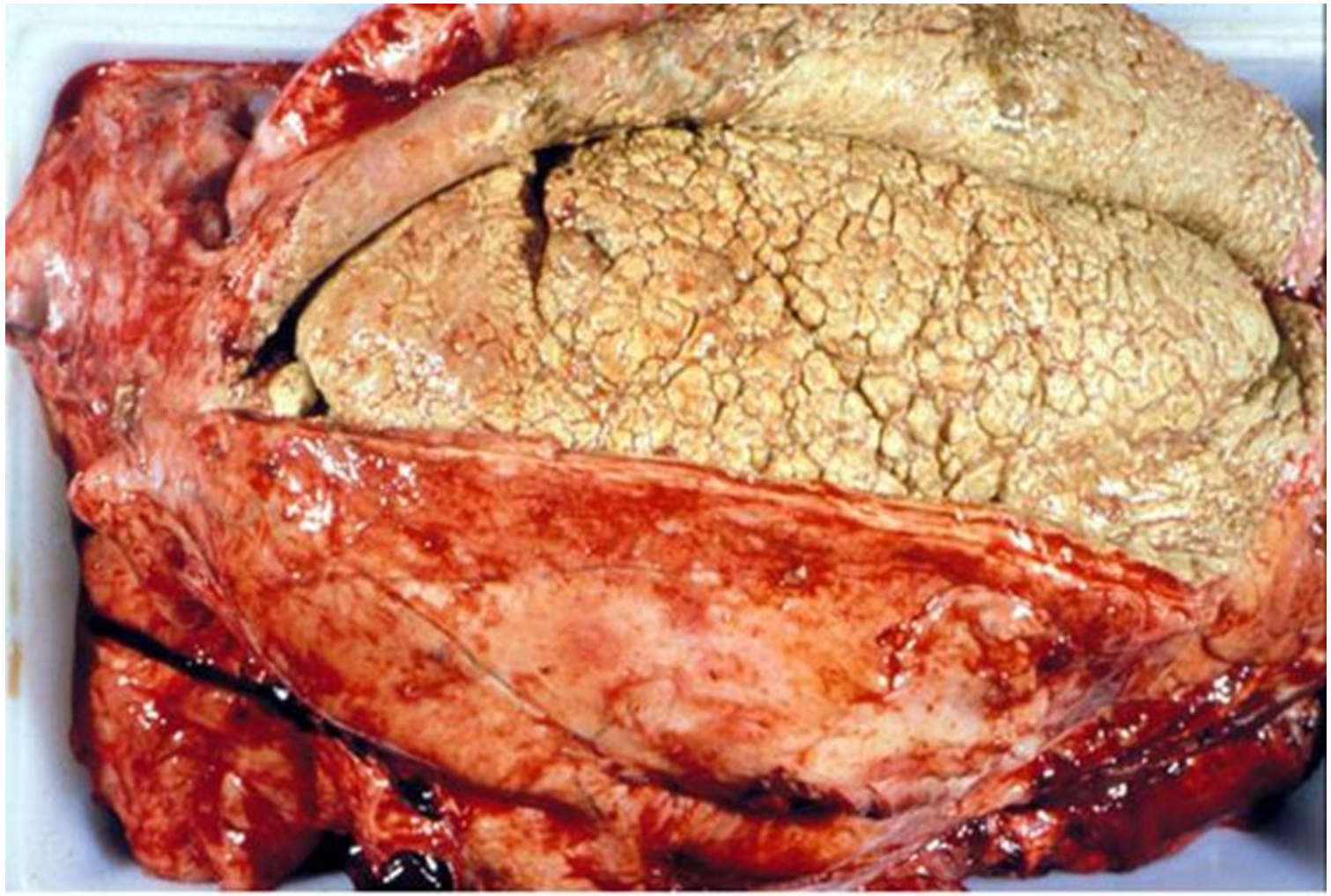
Type of inflammatory fluid: fibrin rich fluid.

*Source of fluid: in severe injury associated with greater increased of vascular permeability…… allowing the large molecules (fibrinogen) to pass the endothelial barrier, then fibrinogen converts into fibrin which appears as eosinophilic meshwork of threads.

- Such exudates degraded by the fibrinolytic system---resolution,
- but failure of completely remove the fibrin----ingrowth of fibroblasts &blood vessels (organization)----fibrous scar.
- like in fibrinous pericardial effusion will result in constrictive pericarditis.

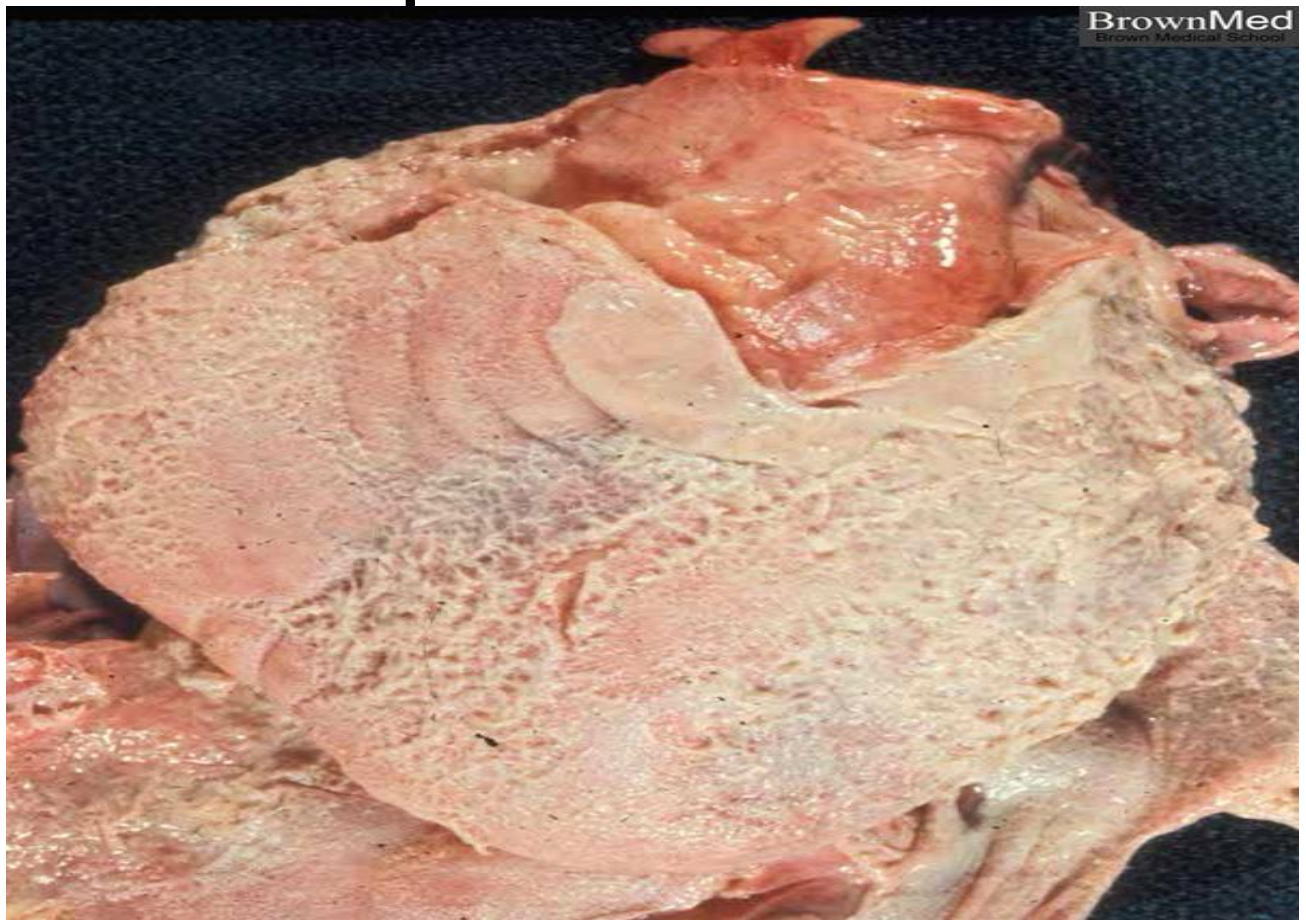
Fibrinous exudate: pericardial cavity has been opened to reveal a fibrinous pericarditis with strands of **fibrin** between visceral and parietal pericardium.



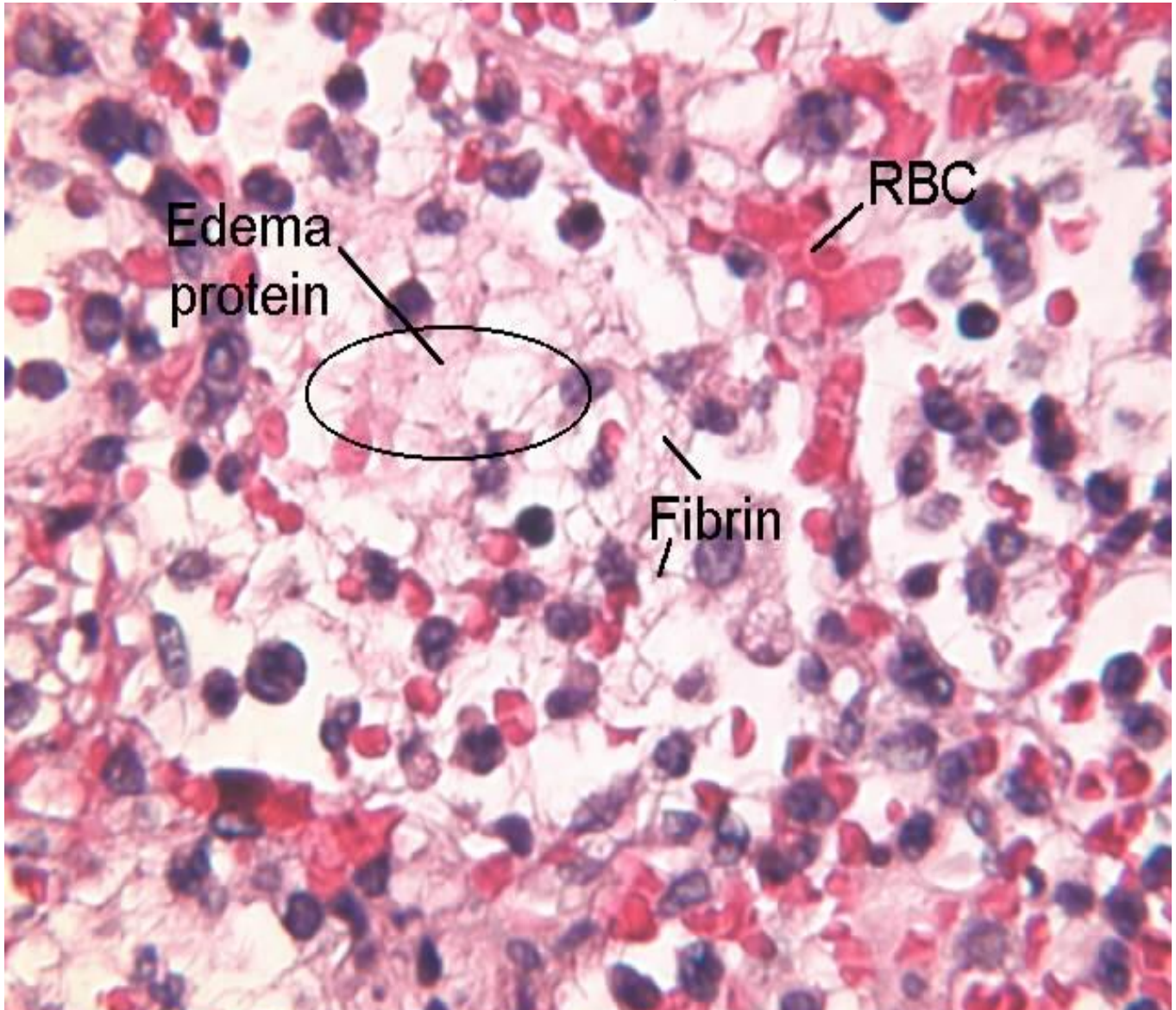


FIBRINOUS EXUDATE IN THE PERICARDIAL SAC: THE EXTRAVASATED FIBRINOGEN HAS SET UP, FORMING FIBRIN THREADS ON THE PERICARDIAL WALL AND ON THE SURFACE OF THE HEART ITSELF.

The typical “bread and butter” appearance of fibrinous pericarditis.



Fibrin Microscopically: looks like a mesh



3- Suppurative inflammation:

Type of the fluid :pus rich exudate consisting of neutrophils, necrotic cells &edema fluid.

It is caused by highly virulent m.o. e.g. staphylococci.

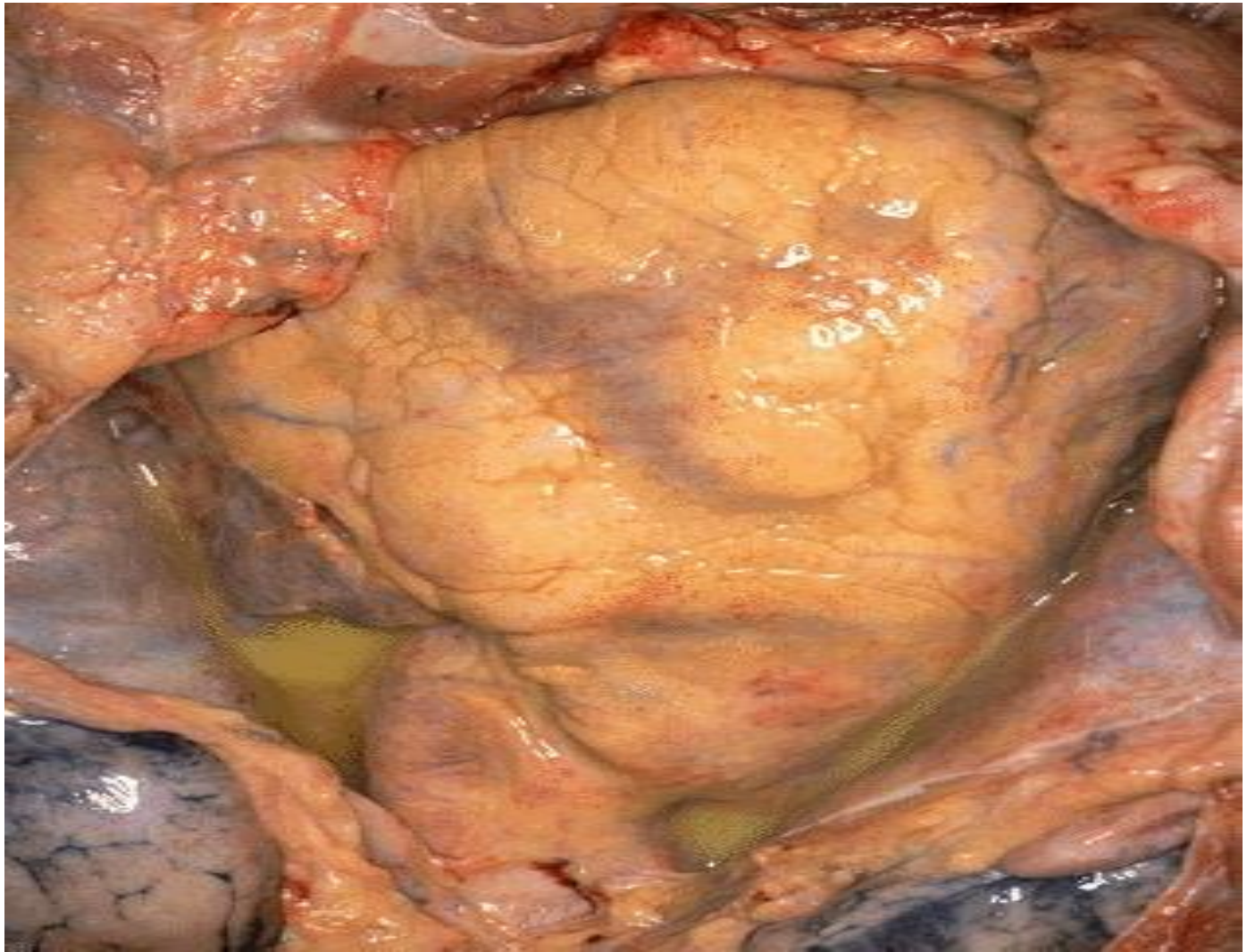
Source of fluid: Pyogenic bacteria.

*Fate: large amount of pus will result in formation of Abscess.

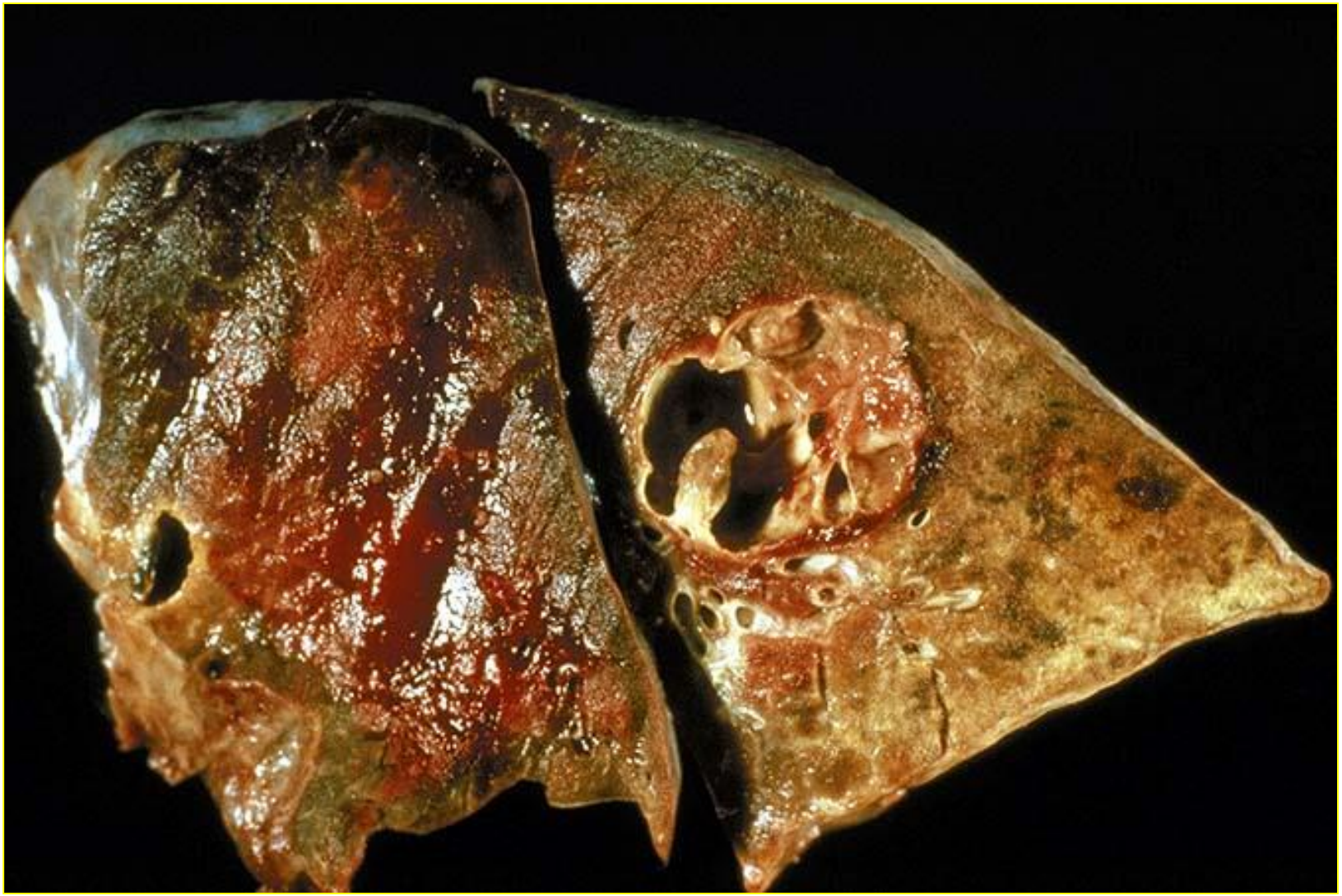
Abscess: is a focal collection of pus that may be caused by pyogenic bacteria or by secondary infection of necrotic tissue.

Abscesses have central zone of necrosis rimmed by well preserved layer of neutrophils & then surrounded by zone of dilated vessels & proliferating fibroblasts (repair).

Purulent exudate:the yellowish fluid in this opened pericardial cavity is a **purulent exudate**.



Lung : suppurative /purulent- abscess appear as a cavity



4- Catarrhal inflammation:

- This is mild form of inflammation,
- characterized by inflammation of **mucous membrane**(like lining of respiratory tract and GIT) leads to increase **mucous production,**
- (e.g. respiratory epithelium inflammation in common cold or hay fever).

5- Hemorrhagic inflammation:

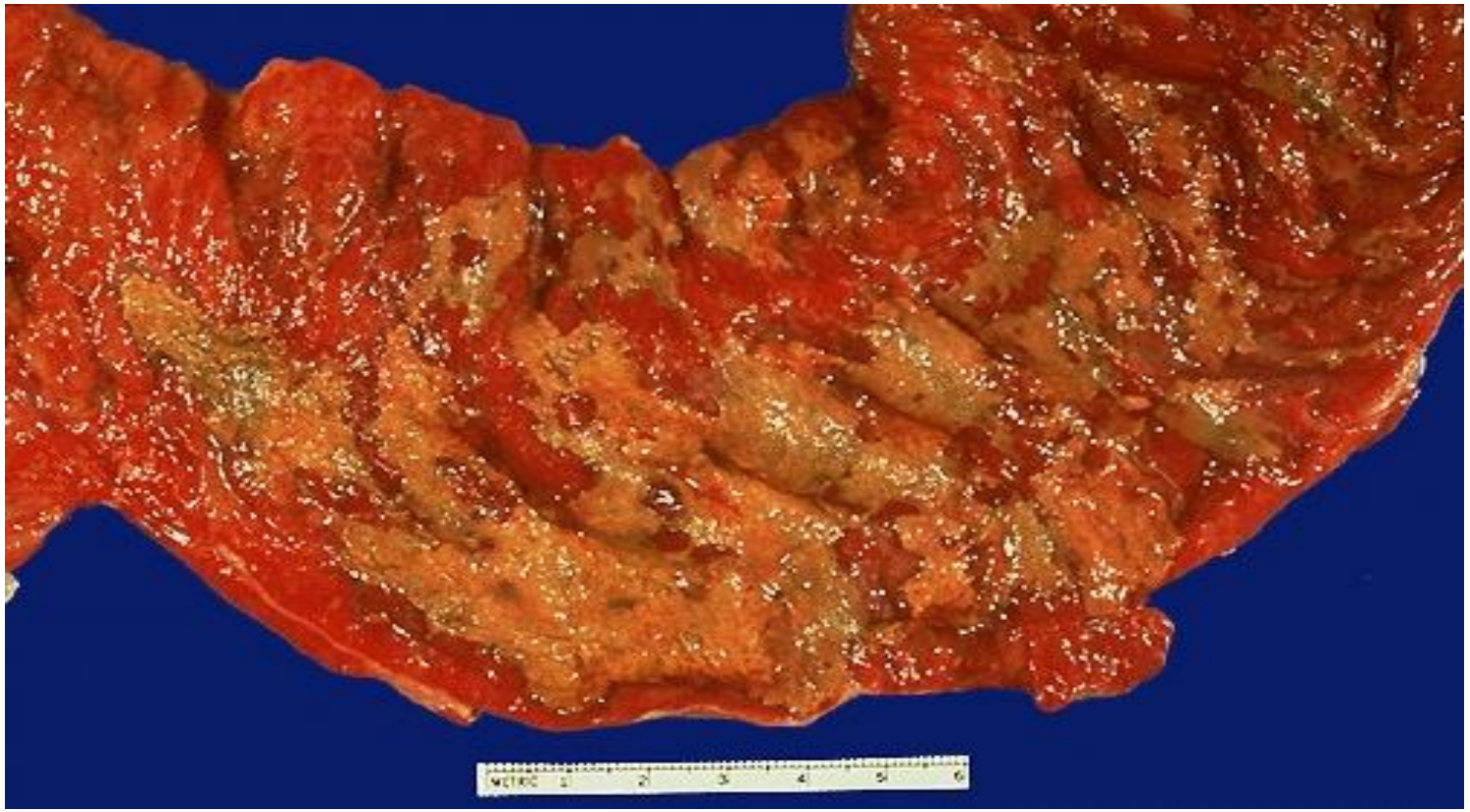
*This is severe type of inflammation in which the presence of hemorrhage(bloody exudate) is the striking feature, which is due to rupture or damage of all blood vessels at the site of injury, resulting in leakage of large number of RBC leading to the red coloration of the inflammatory exudate.

e.g. Hemorrhagic pneumonia (viral pneumonia), meningitis, hemorrhagic fever.

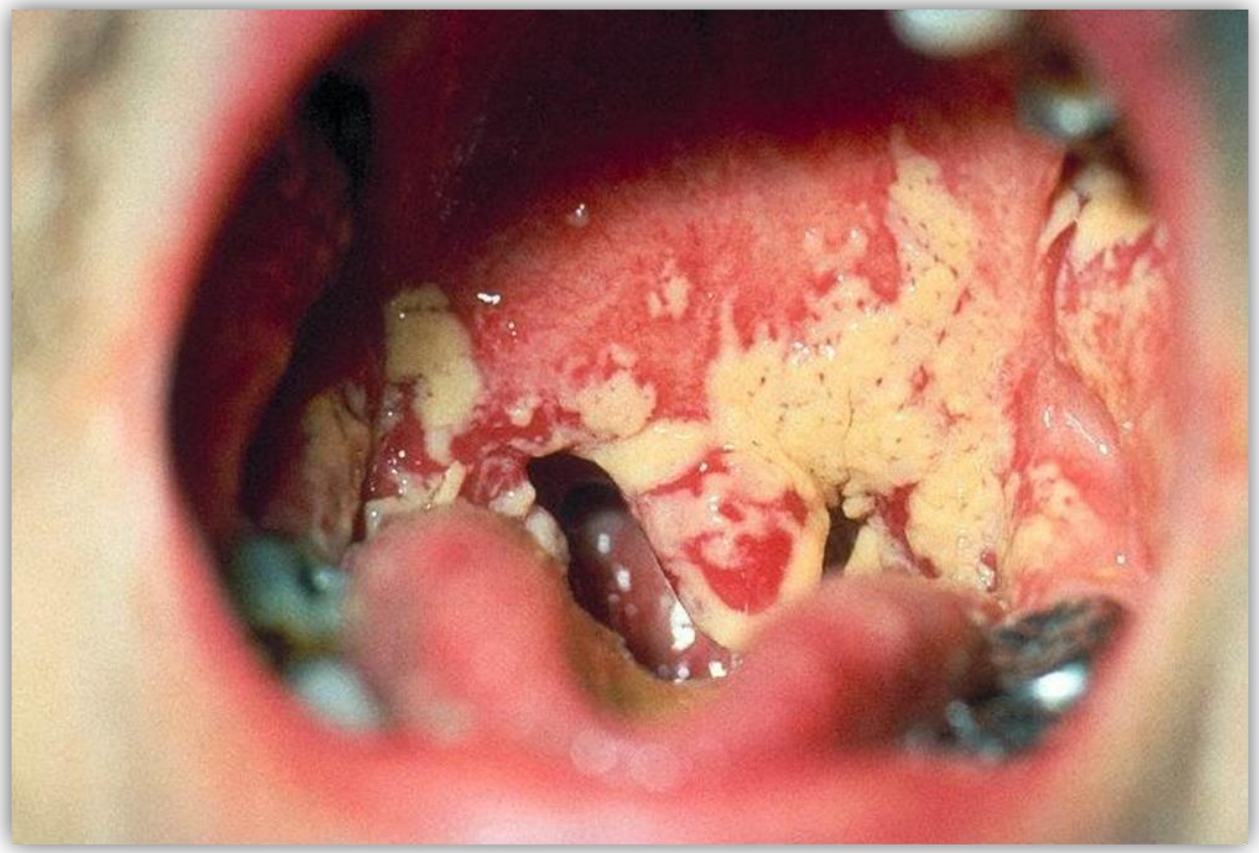
6- Pseudomembraneous:

- Characterized by formation of necrotic membrane composed of (inflammatory cells + fibrin + necrotic cellular debris) adherent to lining epithelium of organs e.g. Pseudomembraneous colitis (colitis follow antibiotic abuse mainly ampicillin, cephalosporin, lincomycin……result in death of flora of colon with overgrowth of specific bacterial flora called clostridia difficile …… which result in formation of this necrotic membrane).

psedomembranous



Pseudo membrane, Diphtheria :consisting of exudate, fibrin, neutrophils RBC, Bacteria and tissue debris



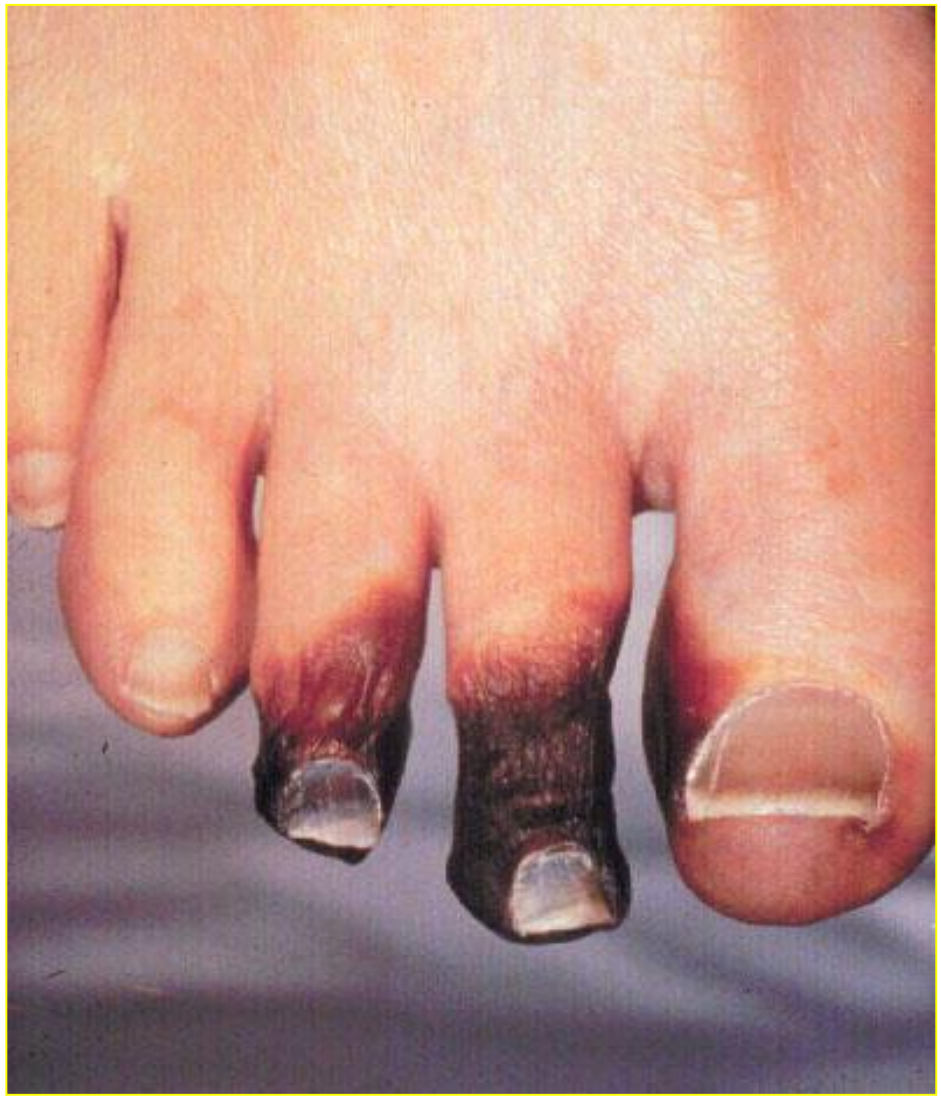
7- Necrotizing (gangrenous) inflammation:

Inflammation + widespread necrosis due to vascular occlusion.

e.g acute severe appendicitis .

- Gangrene of the bowel
- Gangrene of the limbs
- Vasscular occlusion….dead tissue …..no inflammation in dead tissue but there is obvious inflammatory reaction at its borders.

GANGRENOUS




Gangrene is the death of tissue in part of the body.
Foul-smelling discharge
Surface and subsurface discoloration
A.D.A.M.

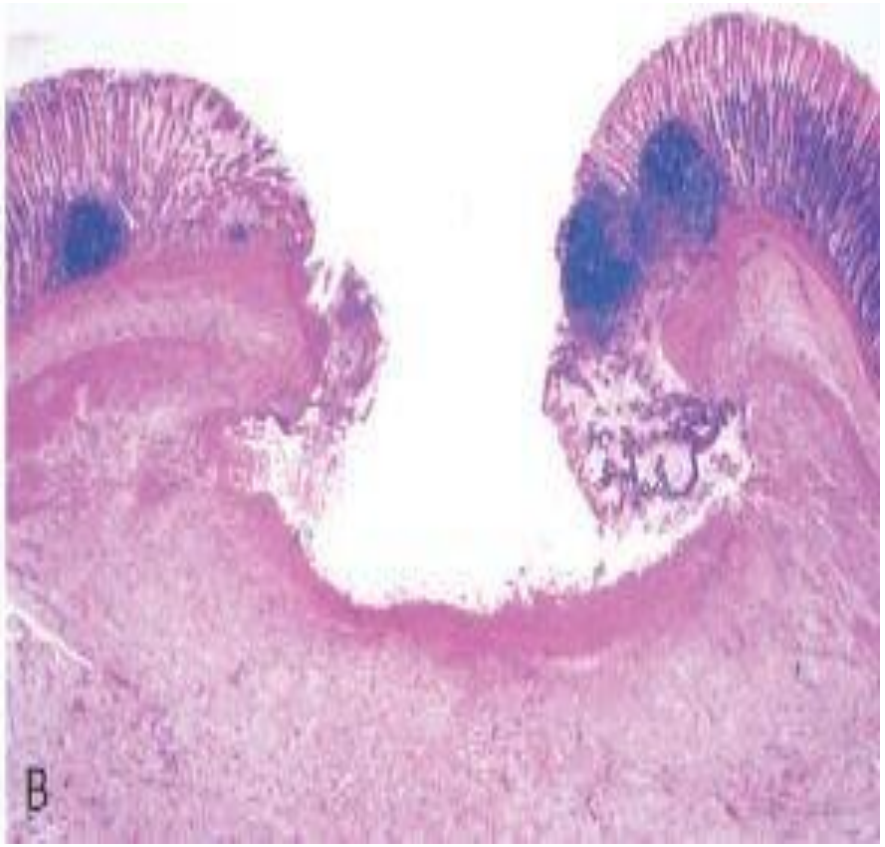
8. Ulcerative inflammation:

- **Ulcer:** it is refers to site of inflammation where an epithelial surface (skin, GIT, bladder) has become necrotic & eroded, often associated with subepithelial acute & chronic inflammation.

*Ulcers could be simple or malignant ulcers,

*Ulcers could be due to traumatic injury of surface epithelium by toxic substance e.g. Peptic ulcer due to high level of HCL within the stomach, or due to vascular insufficiency e.g. ulcers of diabetic foot.

The morphology of an ulcer. A, A chronic duodenal ulcer. B, Low-power cross-section of a duodenal ulcer crater with an acute inflammatory exudate in the base.



Systemic manifestation of inflammation:

- The systemic changes associated with inflammation, especially infections, are collectively called the **acute phase response** (Systemic inflammatory response syndrome [**SIRS**]).
- These changes are reactions to **cytokines** produced in response to bacterial infections and other inflammatory stimuli.

Systemic manifestation of inflammation:

1- Pyrexia (fever):

*Fever is the most obvious systemic effects of inflammation.

Sometimes it is associated with rigor(shivering)

Mechanism of fever:

- Cytokines **(IL1, IL6, & TNF)** are produced from leukocytes in response to infection or immune or toxic injury……. Stimulate production of **Prostaglandins** locally at thermoregulatory center within hypothalamus to induce fever.
- Other systemic effects of inflammation are:
- increase sleep, malaise, anorexia(decrease appetite), accelerated degradation of skeletal muscles proteins; all these features are due to action of IL1, IL6 & TNF.

2- Increase plasma level of acute phase proteins which are plasma proteins synthesized in the liver

e.g fibrinogen, C-reactive proteins.

Fibrinogen binds to erythrocytes &forms rouleaux that sediment more rapidly--- increase ESR.

3- Leukocytosis:

*Normal WBC count is 4000 – 11000 cells per microliter.

*Leukocytes count is typically increased in inflammation (bacterial infection) may reach up to 15000 – 20000 cells per microliter.

***In some infection may reach to the level of 40000 or 100000 (this is called Leukemoid reaction).**

This increased WBC count is due to accelerated release of WBC from bone marrow in response to IL1 & TNF.

Most bacterial infection induce neutrophilia,

Viral inf.----lymphocytosis,

While parasitic inf.-----eosinophilia.

Some inf. like typhoid fever, protozoal inf. will lead to leucopenia (decrease WBCs count) .

4- Other manifestations like increase heart rate &blood pressure, wasting syndrome called cachexia which is mainly the result of TNF mediated appetite suppression &mobilization of fat stores.

5- Amyloidosis: as a complication of long standing inflammation.

- Tissue repair

Tissue repair: Is restoration of tissue architecture &function after an injury,

* Repair begins very early in the process of inflammation & involves two processes:

it includes:

1- Regeneration of specialized cells (in tissue that are able to replace the damaged components).

Regeneration of injured tissue by parenchymal cells of the same type.

2- Connective (fibrous) tissue response (healing) that result in scar formation (in tissue that are incapable of complete restoration or in severe injury of the supporting structures.

Organization: if fibrosis develops in a tissue space occupied by an inflammatory exudate.

- Commonly, tissue repair involves a combination of both processes.
- * Regeneration required intact basement membrane (intact Extra Cellular Martrix),
- while if the basement membrane is destroyed then fibrosis & scarring will occur.
- * Both regeneration & fibrosis are controlled by soluble growth factors.

Cellular regeneration:

According to regenerative capacity of cells, we have three types of cells in our body: (remember cell cycle (G0, G1, S, G2, M……. then G0)

Types of cells: 3 groups according to their regenerative capacity.

1- **Labile cells**: They continue to proliferate throughout their life replacing the lost cells they are not enter the G0 phase of cell cycle.

e.g hematopoietic cells in the bone marrow &the majority of surface epithelia e.g skin, GIT, urinary tract, uterus...etc.

2- **Stable cells**: They are quiescent in the G0 stage of cell cycle &have minimal replicative capacity in normal state but are capable of proliferating in response to injury or tissue loss. They include

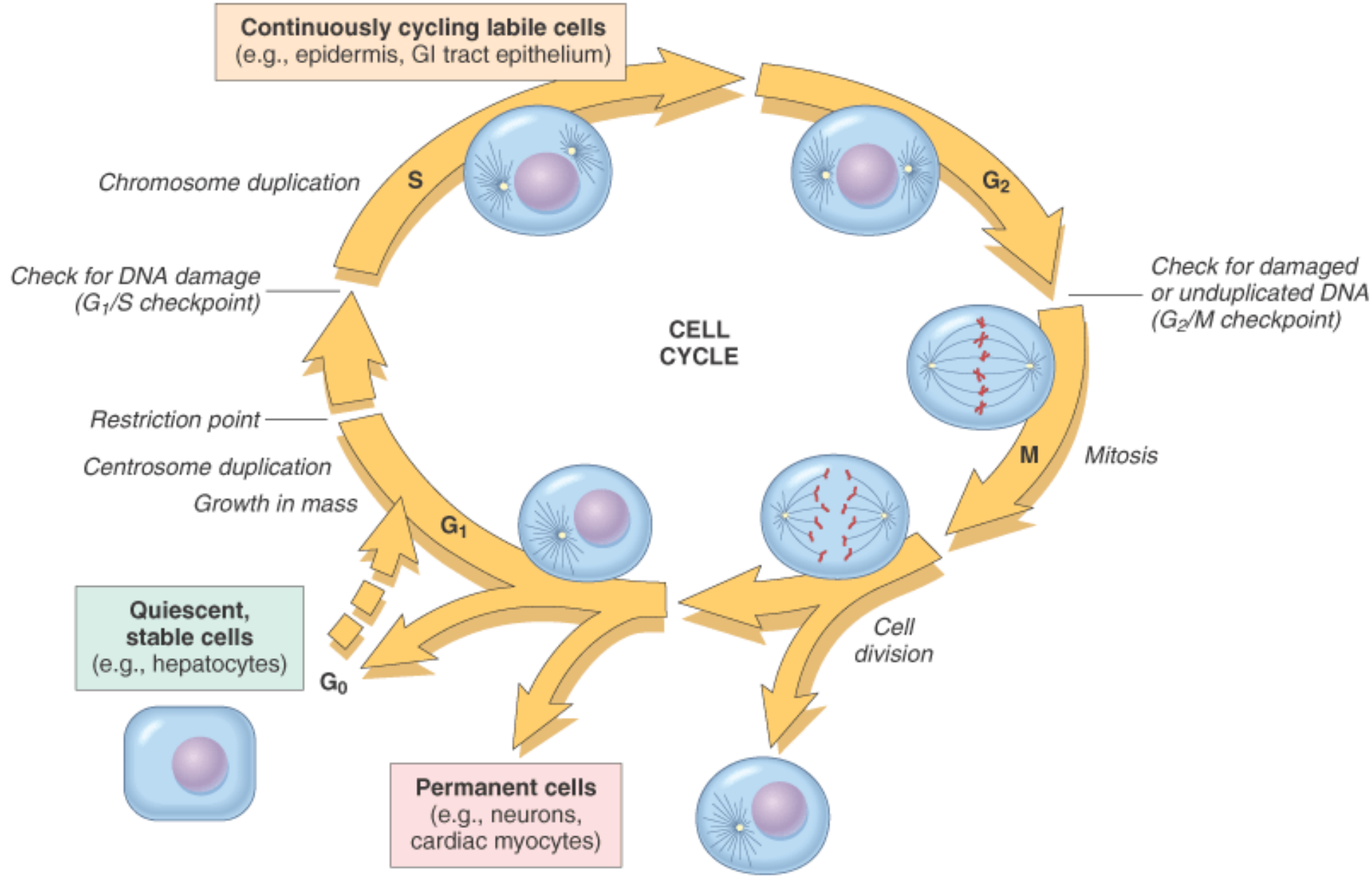
- The parenchyma of solid tissue e.g. liver, kidney &pancreas.
- Endothelial cells, fibroblasts (their proliferation is important in wound healing).
- Stable cells have limited ability to regenerate after injury except the liver.

3- **Permanent cells**:

They are remain permanently within the G0 phase of cell cycle (have no replicative capacity), they are usually healed by fibrosis & scarring.

E.g. nerve cells, cardiac & skeletal muscles.

they cannot divide (they considered terminally differentiated) &healing here is by fibrosis.


Continuously cycling labile cells
(e.g., epidermis, GI tract epithelium)
Chromosome duplication
S
G2
Check for damaged
or unduplicated DNA
(G2/M checkpoint)
Check for DNA damage
(G1/S checkpoint)
CELL
CYCLE
Restriction point
Centrosome duplication
Growth in mass
G1
M
Mitosis
Quiescent,
stable cells
(e.g., hepatocytes)
G0
Cell
division
Permanent cells
(e.g., neurons,
cardiac myocytes)