



# NOVA

Charting New Horizons in Education

Necrosis

# 02

Pathology

# Normal cells in H&E stain

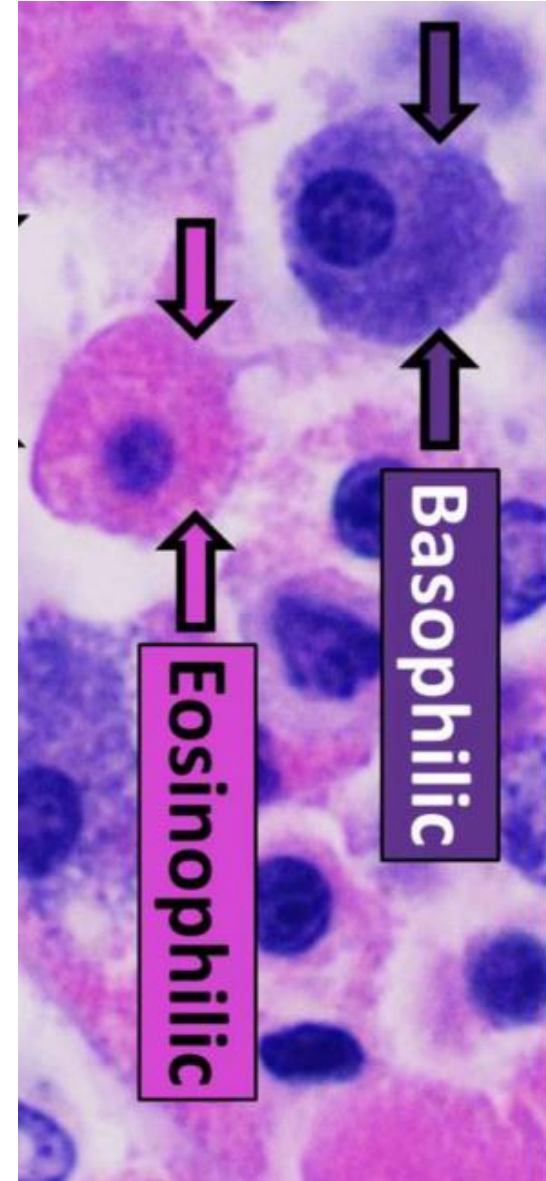
- H&E is the combination of two histological stains: hematoxylin and eosin.

## 1. Hematoxylin (Blue/Purple Staining) – Basic - Basophilia:

- Nuclei:** The nuclei of normal cells stain dark blue or purple due to the binding of hematoxylin to nucleic acids (DNA and RNA). This allows for clear visualization of the cell's genetic material and nuclear structure.

## 2. Eosin (Pink Staining) – Acidic - Eosinophilia:

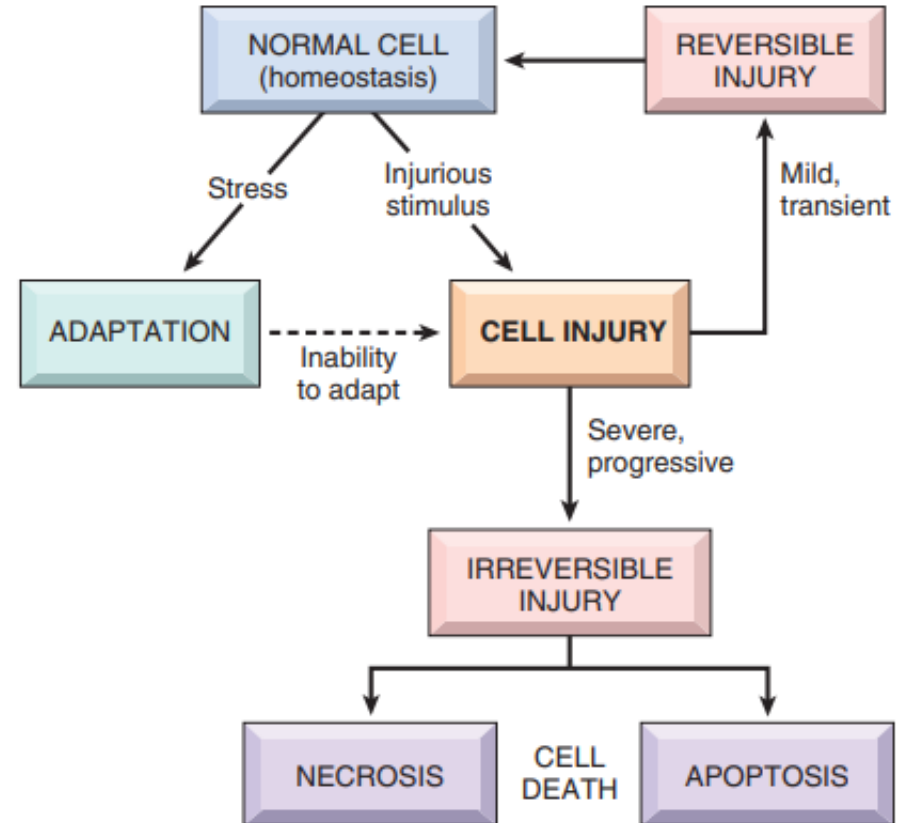
- Cytoplasm:** The cytoplasm of normal cells typically stains pink due to eosin binding to proteins. The intensity of the pink color can vary based on the protein content and activity of the cell.



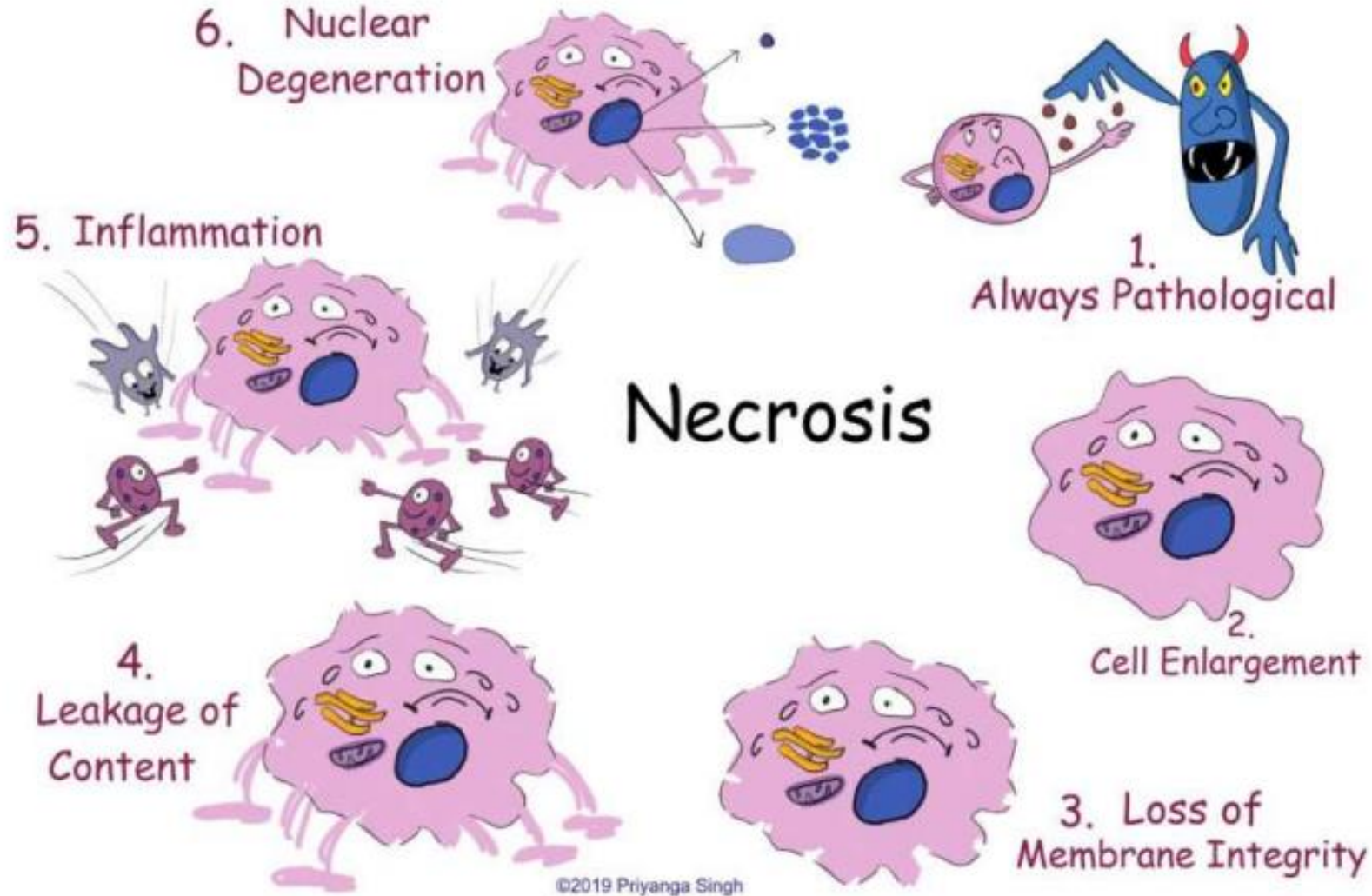
# Apoptosis vs Necrosis



- **A**Poptosis: **P**rogrammed cell death that occurs in a controlled and regulated manner.
- Causes: Can be triggered by normal physiological processes (e.g., development, aging).
- **Necrosis**: Uncontrolled cell death resulting from severe injury or damage (Rapid) (Irreversible injury).
- Causes: Typically caused by factors such as **ischemia (most common)**, toxins, infections, or physical trauma.



# ~ Necrosis



# ~ Necrosis



- It is an **uncontrolled** cell death that results in **swelling of the cell organelles, plasma membrane rupture** and **eventual lysis of the cell, and spillage of intracellular contents into the surrounding tissue leading to tissue damage.**
- Considered as culmination of reversible cell injury that cannot be corrected.
- **Usually elicits a local host reaction, inflammation** (due to the release of heat shock proteins, uric acid, ATP, DNA, and nuclear proteins).

# ~ Morphological features of necrosis – Grossly – Additional slide



Change	Description
<b>Color Changes</b>	<b>Pallor:</b> Affected tissue may appear pale due to loss of blood supply or cell death.
<b>Consistency Changes (Texture)</b>	<b>Softening:</b> Necrotic tissue may feel softer or more mushy than normal tissue, (esp. liquefactive necrosis.) <b>Firmness.</b>
<b>Tissue Breakdown</b>	Cavitation Caseation: cheese-like and crumbly.
<b>Boundaries</b>	<b>Well-Defined Edges</b> <b>Surrounding Inflammation:</b> Often, there is visible redness and swelling in the surrounding area due to inflammatory response.
<b>Foul Odor</b>	In cases of extensive necrosis, especially with bacterial involvement (e.g., gangrene), a foul smell may be present due to the breakdown of tissues and the presence of bacteria.



# ~ Morphological features of necrosis - Grossly



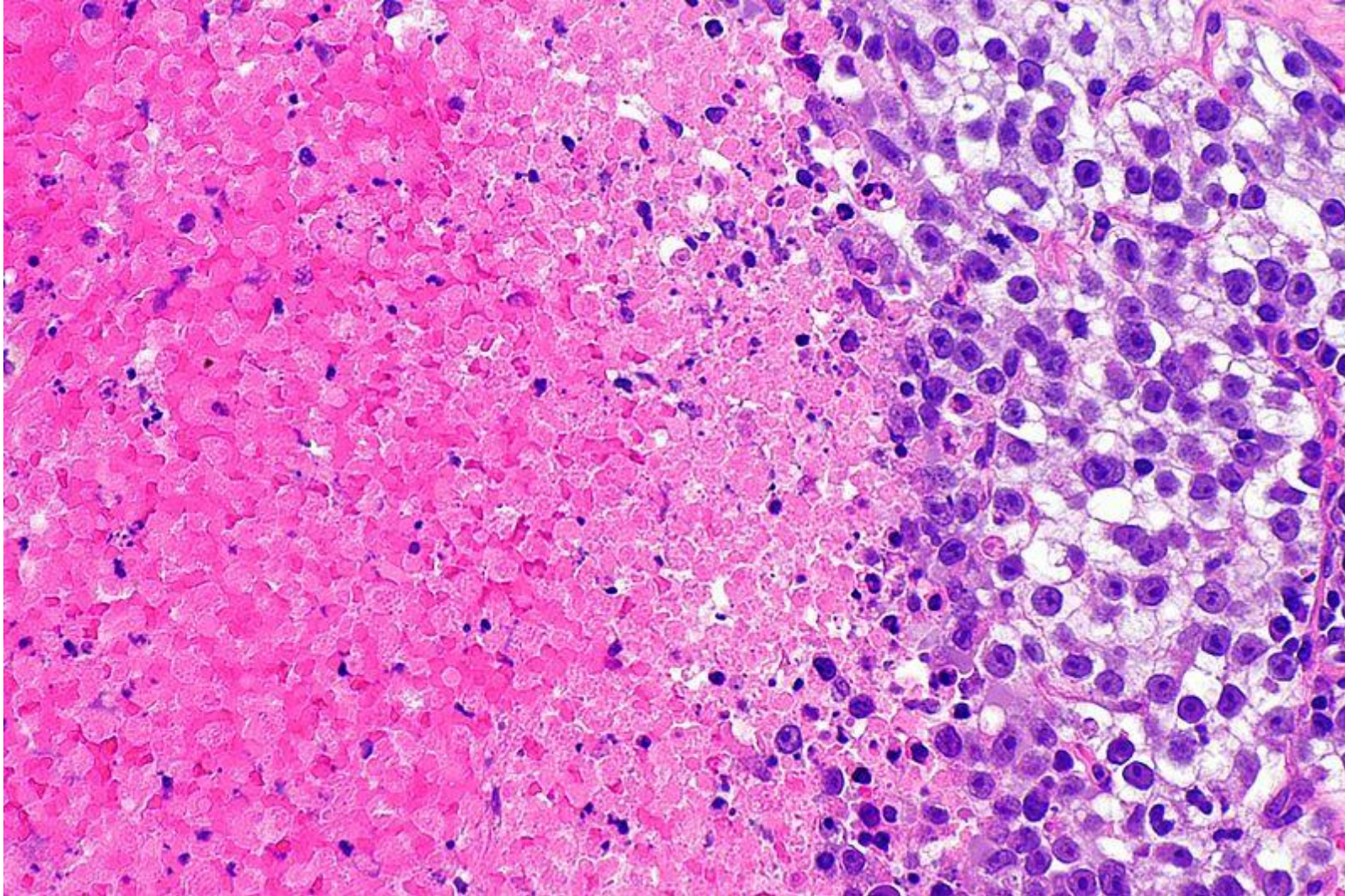
- Normal Lung



- Caseous necrosis in pulmonary TB



# ~ Morphological features of necrosis - Microscopic



- Seminoma with necrosis – Pinkish appearance



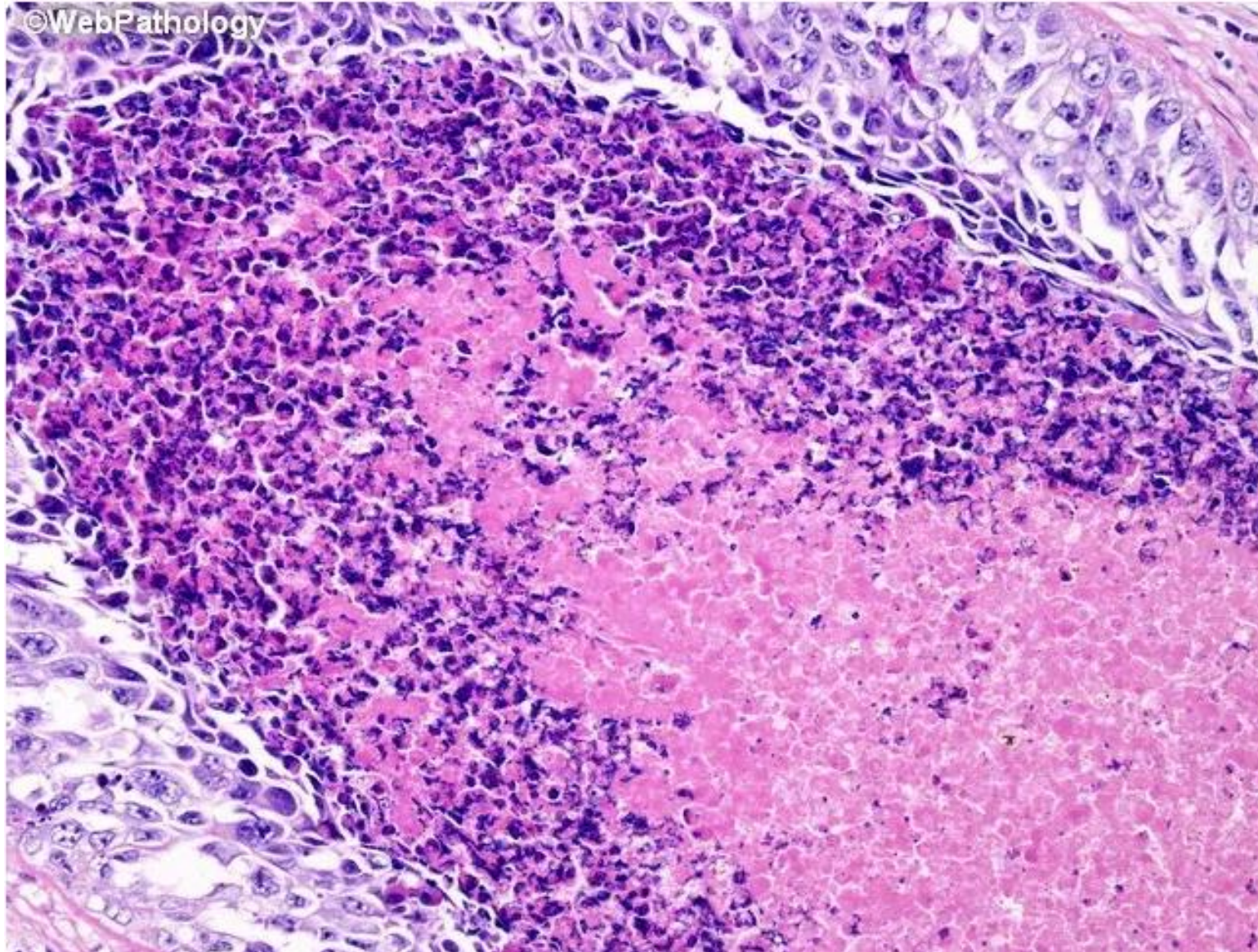
# ⚡ Morphological features of necrosis - Microscopic



- **Cytoplasmic** changes:

1. Increased binding of eosin to denatured cytoplasmic proteins, **loss** of basophilic ribonucleic acid (RNA) in the cytoplasm (Increased **e**osinophilia).
2. A **g**lassy, homogeneous appearance, mostly because of the loss of lighter staining **g**lycogen particles. – Normally glycogen gives granular appearance.
3. After organelle digestion by enzymes, the cytoplasm becomes vacuolated and appears **m**oth-eaten..

# ~ Morphological features of necrosis - Microscopic



- coagulative necrosis - Eosinophilia



## ~ Morphological features of necrosis - Microscopic

- Result from break down of DNA; appear as three patterns:

1. **P**yknosis: shrinkage and increased **b**asophilia.

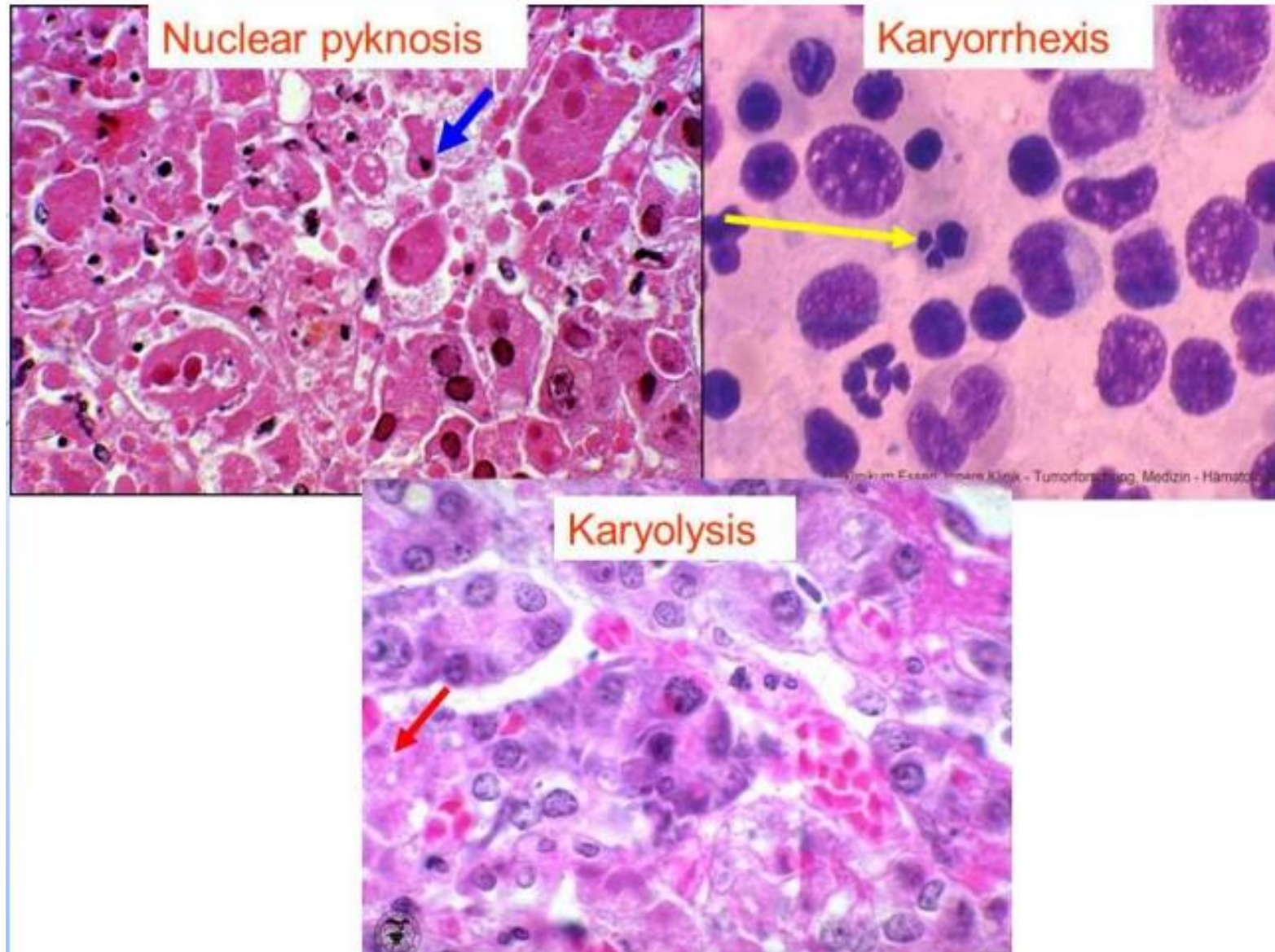
2. Karyorrhexis: fragmentation of **pyknotic** nucleus ( K-a-r-y-o-r-r-h-e-x—i-s).

3. Karyolysis: decrease basophilia of chromatin, DNAase: (deoxyribonuclease, **DNA digestion**).

- In 1-2 days the nucleus in a dead cell may completely disappear.

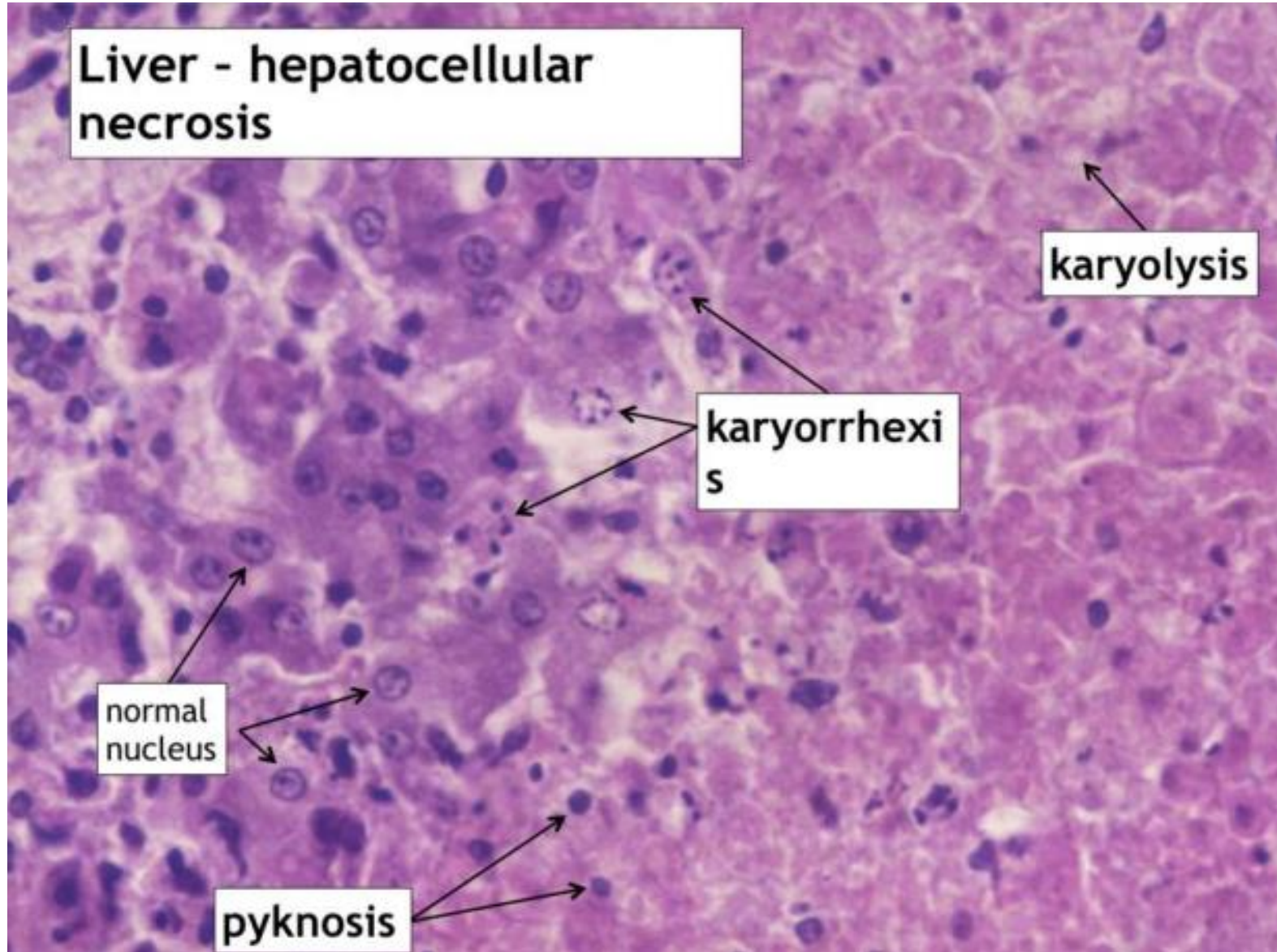


# ~ Morphological features of necrosis - Microscopic





# ~ Morphological features of necrosis - Microscopic





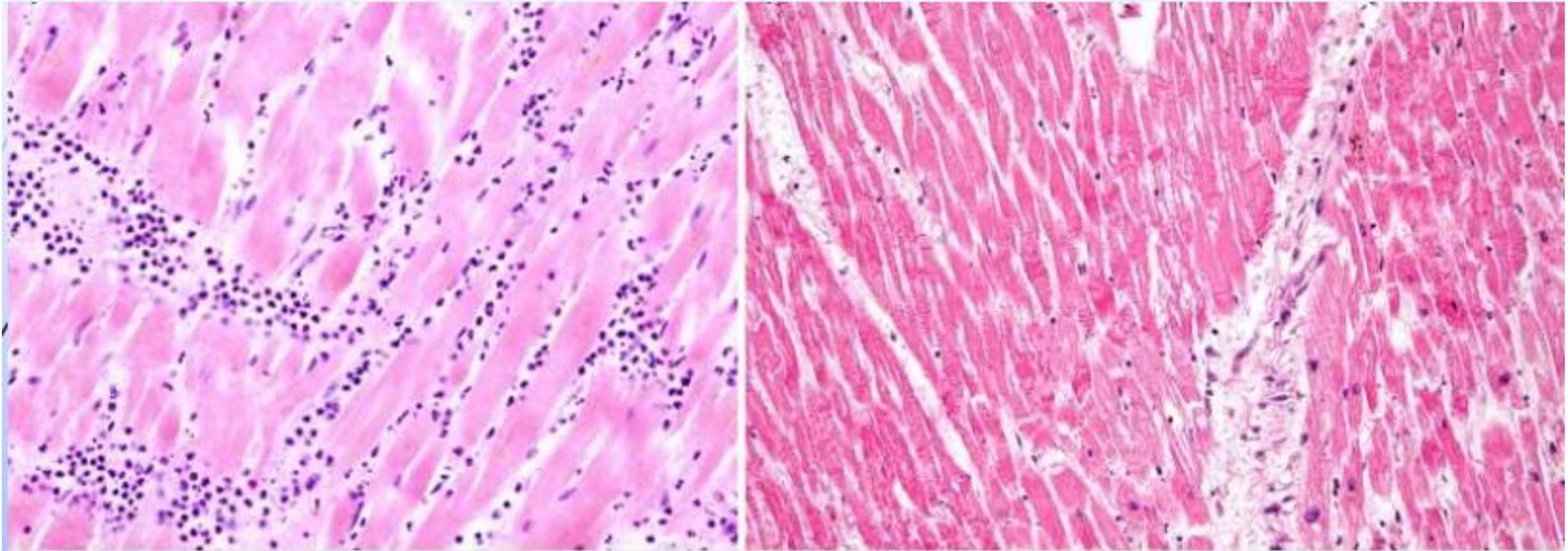
# ~ Morphologic Patterns of Necrosis

## 1. Coagulative necrosis:

2. Proteins can denature (coagulate) to leave 'ghost' outlines behind.
3. The dead cells lose their nuclei and may stain more intensely.
4. The most common form of necrosis (particularly in myocardium, liver, kidney)
5. Characteristic of hypoxic cell death in all tissues except in the brain
6. A localized area of coagulative necrosis is referred to as an infarct.
7. Eosinophilic Appearance: Necrotic cells appear intensely eosinophilic (pink-staining) with indistinct or reddish nuclei, which may persist for days to weeks.
8. Ghost cells are characterized by their pale, empty appearance with a faint outline, often observed in specific coagulative necrosis. They result from the loss of cellular contents while the cell membrane may remain intact or partially preserved.



# ~ Morphologic Patterns of Necrosis - additional slide



- Neutrophilic infiltration within 1-2 days of a myocardial infarct (left), Ghost cells “Right picture”

# ~ Morphologic Patterns of Necrosis



## 2. Liquefactive necrosis:

- Infiltration of dead tissue by large numbers of neutrophils leads to digestion of cell proteins → This leads to loss of normal tissue architecture and is known as liquefactive necrosis → Liquefactive necrosis is common after cell death in lipid rich tissue such as the brain (cerebral infarction).



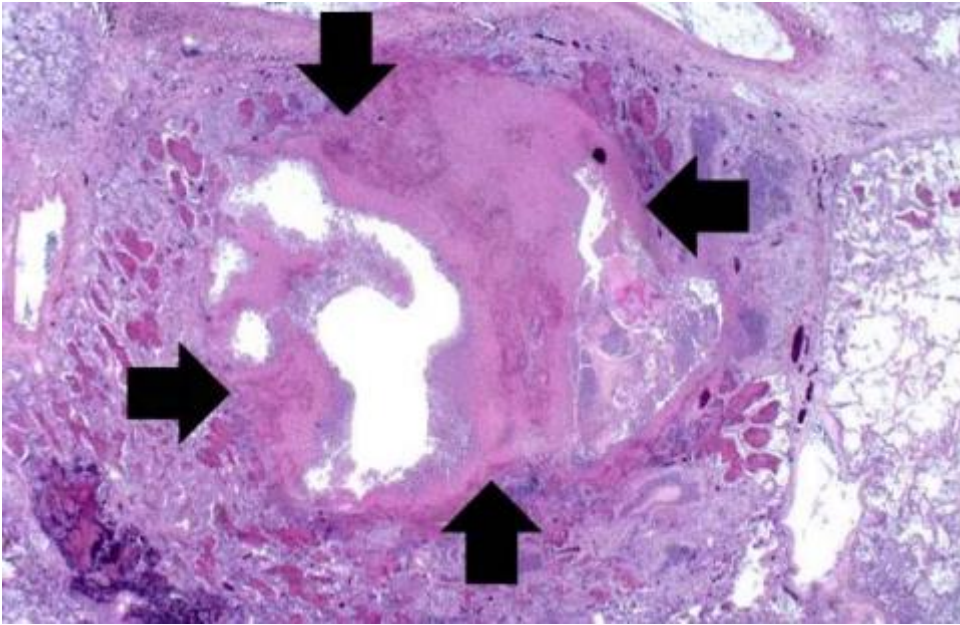
- Cerebral infarct with hemorrhage and liquefaction.



- Liquefactive necrosis. An infarct in the brain shows dissolution of the tissue



# ~ Morphologic Patterns of Necrosis



- Lung: Liquefactive necrosis



# ~ Granuloma

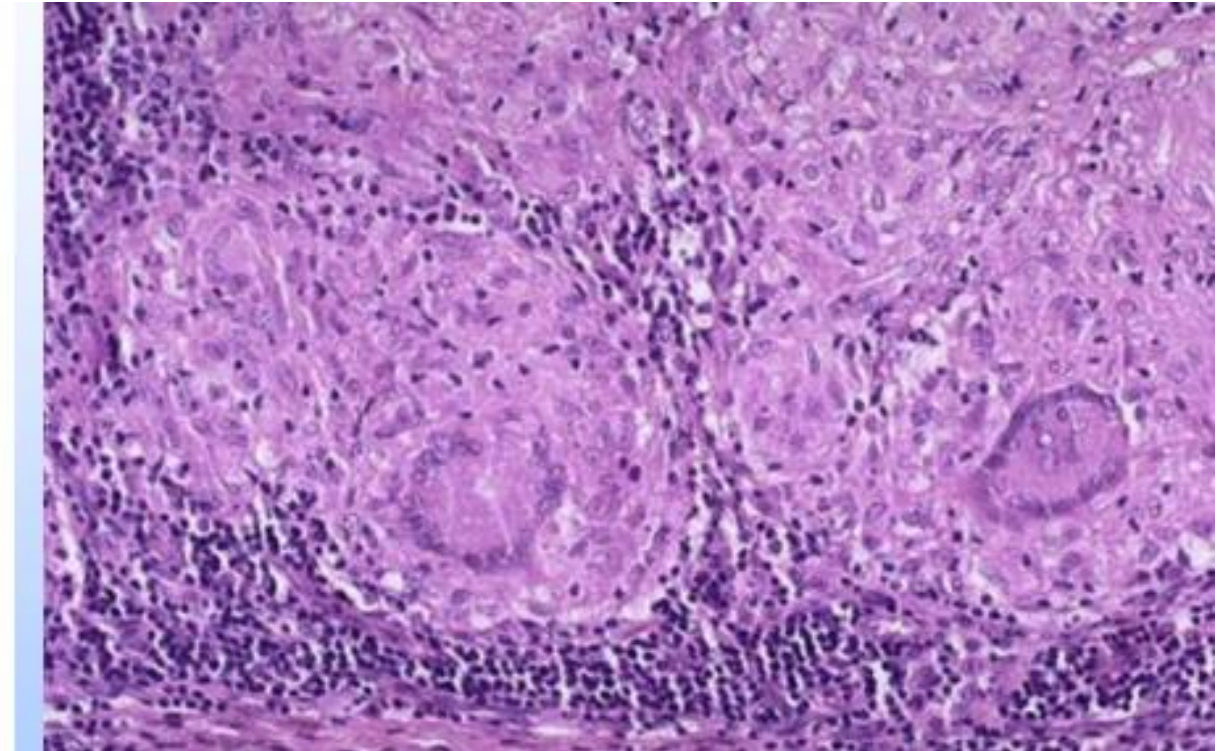
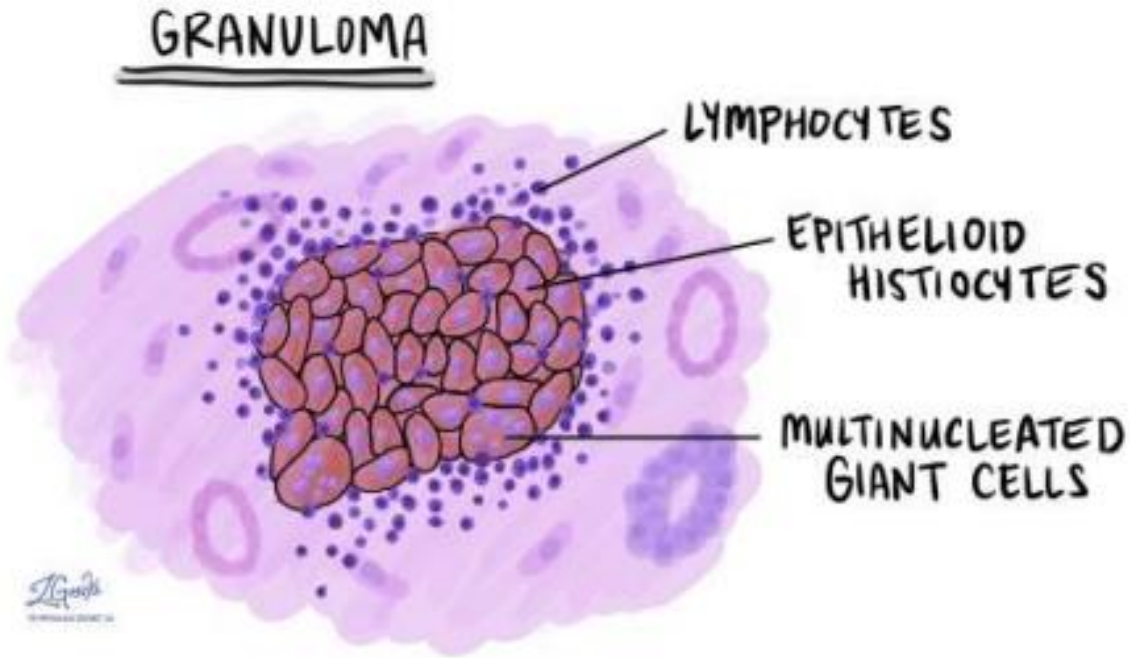
- A granuloma is a small, organized collection of macrophages that have transformed into epithelioid cells, often surrounded by a rim of lymphocytes, fibroblasts, and other immune cells.
- Granulomas are a form of chronic inflammatory response and are typically seen in various pathological conditions.
- **Composition:**
  1. Epithelioid Cells: Activated macrophages that resemble epithelial cells.
  2. Giant Cells: Multinucleated giant cells may form, resulting from the fusion of macrophages.
  3. Surrounding Lymphocytes: A perimeter of lymphocytes and other immune cells is often present.
- **Causes:**
  - Granulomas develop in response to persistent infections (e.g., tuberculosis, fungal infections), foreign bodies, autoimmune diseases, and certain conditions like sarcoidosis.



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# Granuloma



- Granulomas with Langhans giant cells

- Does all type of granuloma contain necrosis? **No, not all types of granulomas contain necrosis.**

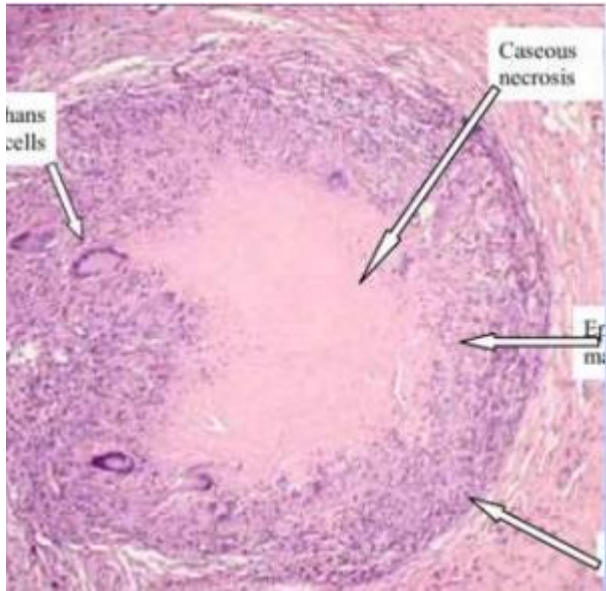




# ~ Morphologic Patterns of Necrosis

## 3. Caseous necrosis:

- Type of necrosis that occur in the center of granulomas, typically seen in **mycobacterial infection**.
- Granulomas are found as a response to foreign bodies, in some autoimmune diseases, and in mycobacterial infection (**e.g. M.tuberculosis**).
- Gross morphology of caseous necrosis appear as **cheese-like**.

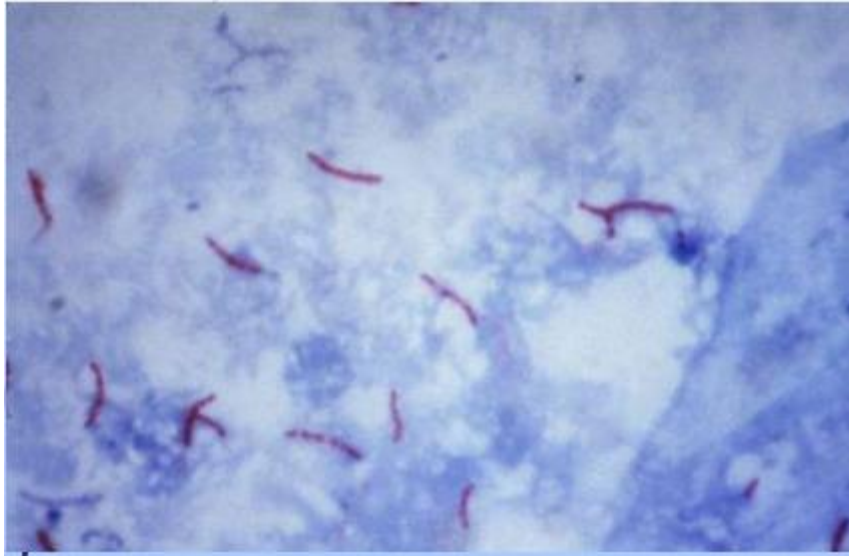


- **Ocular TB**

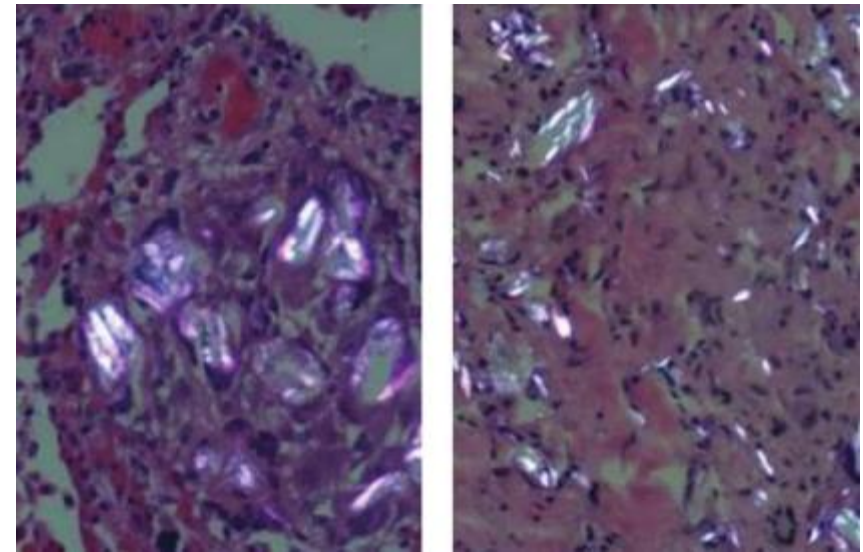


- **Renal tuberculosis**

# ~ Morphologic Patterns of Necrosis



- Mycobacterium tuberculosis - Ziehl neelsen stain



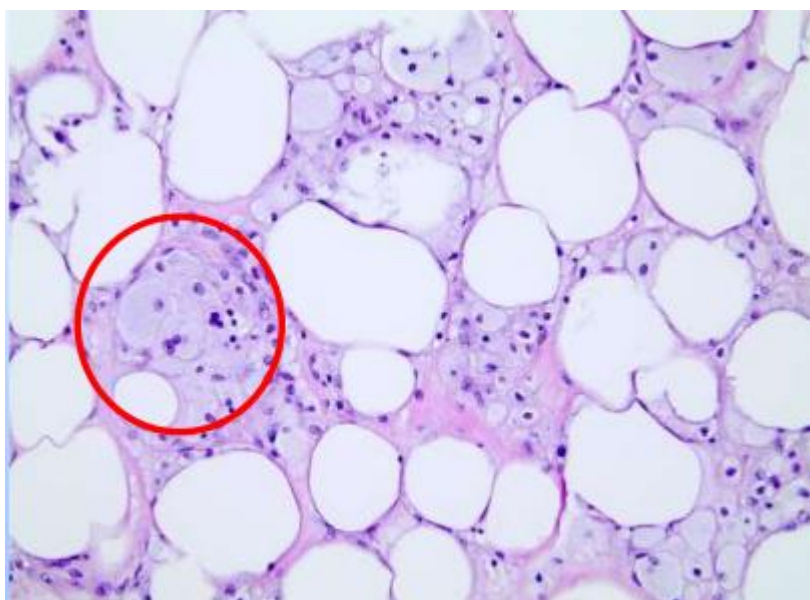
- Foreign bodies



# ~ Morphologic Patterns of Necrosis

## 4. Fat necrosis:

- A pattern of necrosis that occurs due to degradation of fatty tissue by lipases (released from dead cells) to form chalky deposits.
- This can be seen in acute pancreatitis (acute inflammation of the pancreas causing necrosis of pancreatic acinar cells and lipase release), or from trauma to fatty tissues.



- Foamy macrophages adjacent to adipose tissue

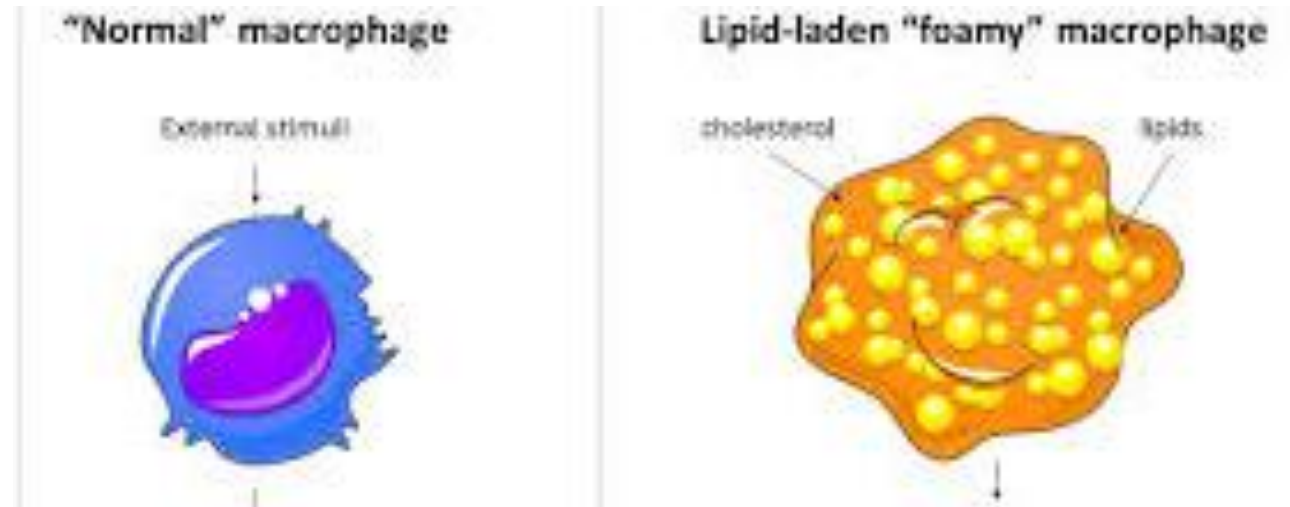
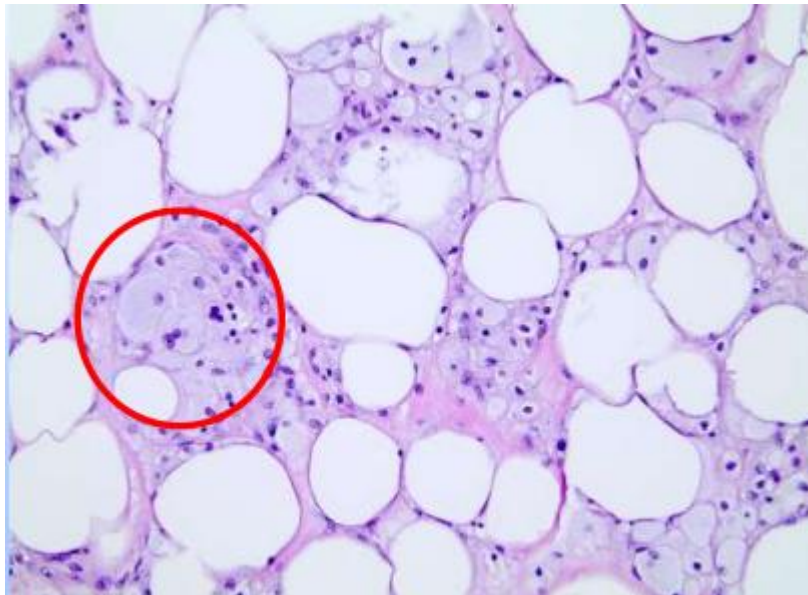
- Fatty acids bind and precipitate calcium ions, forming insoluble salts.





# ~ Foamy macrophages

- Foamy macrophages are a type of macrophage characterized by their appearance when they accumulate lipid material within their cytoplasm, giving them a "foamy" or "frothy" look.



- Foamy macrophages adjacent to adipose tissue



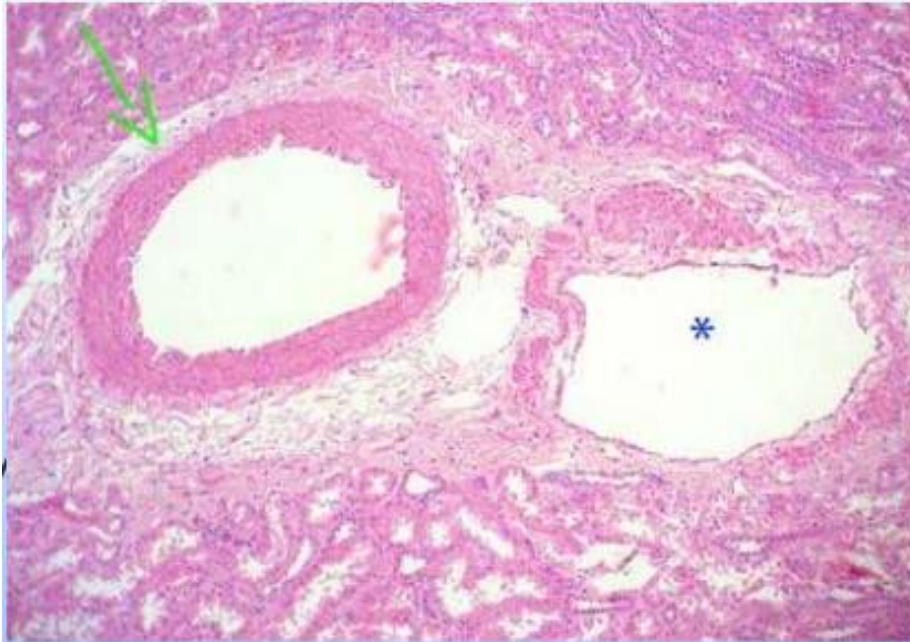
# ~ Morphologic Patterns of Necrosis



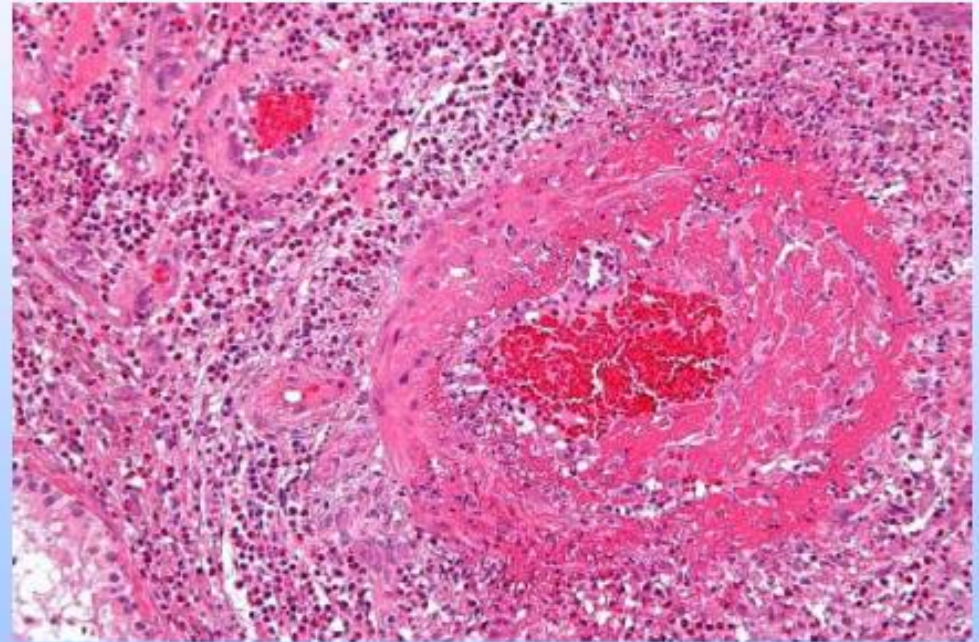
## 5. Fibrinoid necrosis:

- Specific pattern of cell death that occurs when **antigen antibody complexes** are deposited in the walls of blood vessels along with **fibrin**.
- Usually seen in immune reactions, when complexes of antigens and antibodies are deposited in **the walls of blood vessels** as seen in **Severe hypertension**.
- Deposited immune complexes and plasma proteins that leak into the wall of damaged vessels produce a bright pink, amorphous appearance....**FIBRIN**

# ~ Morphologic Patterns of Necrosis



**Normal B.V**



**Fibrinoid necrosis**



## ~ Fate of necrosis

- Most of necrotic tissue is removed by leukocyte (Phagocytosis) combined with extracellular enzyme digestion
- If necrotic tissue is not eliminated it attracts  $\rightarrow$   $\text{Ca}^{+2}$  salts  $\rightarrow$  dystrophic calcification
- **Dystrophic calcifications** refer to the abnormal deposition of calcium salts in damaged or necrotic tissues.





## ~ Fate of necrosis

- Leakage of intracellular proteins through the damaged cell membrane and ultimately into the circulation provides a means of detecting tissue-specific necrosis using blood or serum samples:
- Creatine kinase → Cardiac muscle
- Aspartate transaminase (SGOT) → Hepatocytes





«Education is the passport to the future, for tomorrow  
belongs to those who prepare for it today»

- Maclom X-