PATHOPHYSIOLOGY 3-TH STAGE
CELL INJURY

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Cell Injury

If the cells fail to adapt under stress, they undergo certain changes called **cell injury**. The affected cells may recover from the injury (reversible) or may die (irreversible).

Response to Injury

1-**Necrosis (irreversible)** – cell death

2-Adaptations (reversible):

Hypertrophy/ increase size of cells

Atrophy/ decrease in size of cells

Hyperplasia/ increase in number of cells

Accumulations - protein, fat, etc.

Extracellular calcium deposition

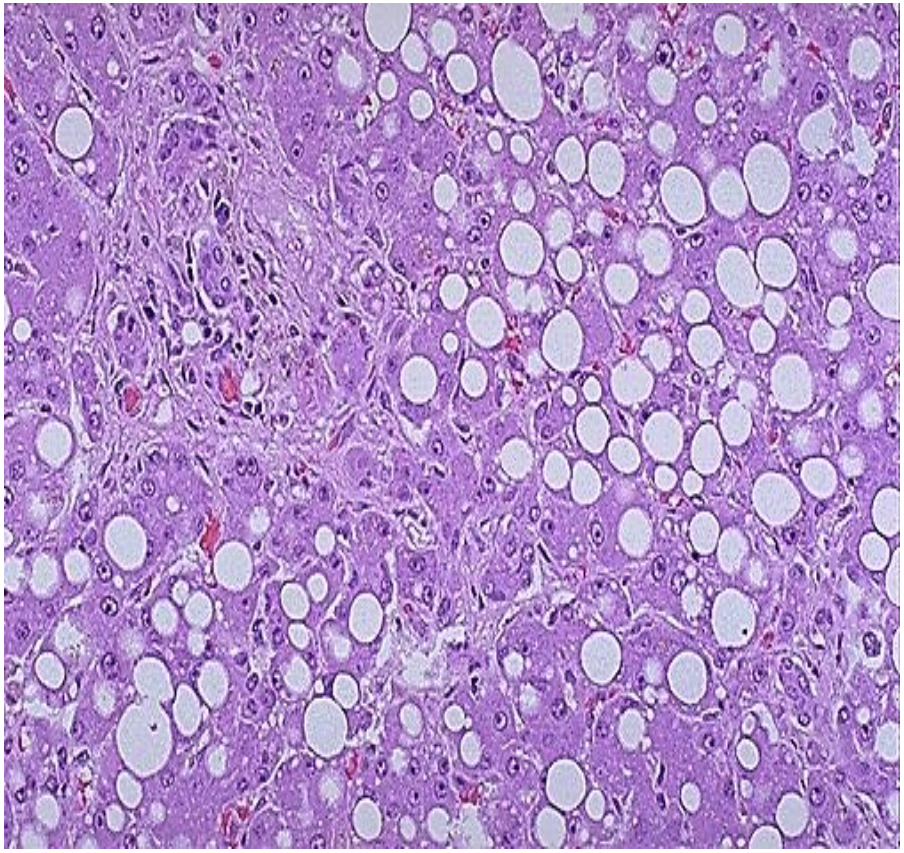
REVERSIBLE CELL INJURY (DEGENERATION)

1-Hydropic change: The accumulation of water in the tubular cells, it is usually due to hypoxia of the tissue with a resultant decrease in aerobic respiration in the mitochondria and a decreased production ATP.

2-Fatty change: Small or large lipid vacuoles (neutral lipid) in cytoplasm. Common in liver, heart and kidney

Causes: hypoxia, bacterial toxins, chemical agents as alcohol, carbon tetrachloride.





This is gross section of liver is slightly enlarged and has a pale yellow appearance (fatty change).

The lipid vacuoles within hepatocytes. The lipid accumulates when lipoprotein transport is disrupted and/or when fatty acids accumulate. The most common cause of fatty change in developed nations is alcoholism, Diabetes mellitus and obesity.

IRREVERSIBLE CELL INJURY (NECROSIS)

The changes are produced by enzymatic digestion of dead cellular elements, denaturation of proteins and autolysis (by lysosomal enzymes).changes include:

A-Nucleus - nonspecific breakdown of DNA leading to :

-karyopyknosis (shrinkage nucleus),
-karyolysis (faint dissolved nucleus)
-karyorrhexis (fragmentation of nucleus)

B-Cytoplasmic changes: The cells appear homogenous and indistinct from each other.

C-Architectural changes:

-Protein denaturation (coagulation) may precede cell lysis
-Necrotic tissue (structureless) due to cell lysis.

Death of cells occurs in two ways:

Necrosis--(irreversible injury) changes produced by enzymatic digestion of dead cellular elements .

Apoptosis--vital process that helps eliminate unwanted cells--an internally programmed series of events effected by dedicated gene products.

Patterns of Necrosis In Tissues or Organs

1- Coagulative necrosis: caused by accident such as ischemia or infarction.

2- Liquifactive necrosis: associated with transformation of the tissue into a liquid viscous mass, it is associated with cellular destruction and pus formation in bacterial and fungal infection (e.g. pneumonia).ischemia (restriction of blood supply) in the brain produces liquefactive rather than coagulative necrosis.

3-Caseous necrosis: specific form of coagulation necrosis, tissue appears as a cheese-like mass of dead tissue, caused by mycobacteria (e.g:tuberculosis lesions)

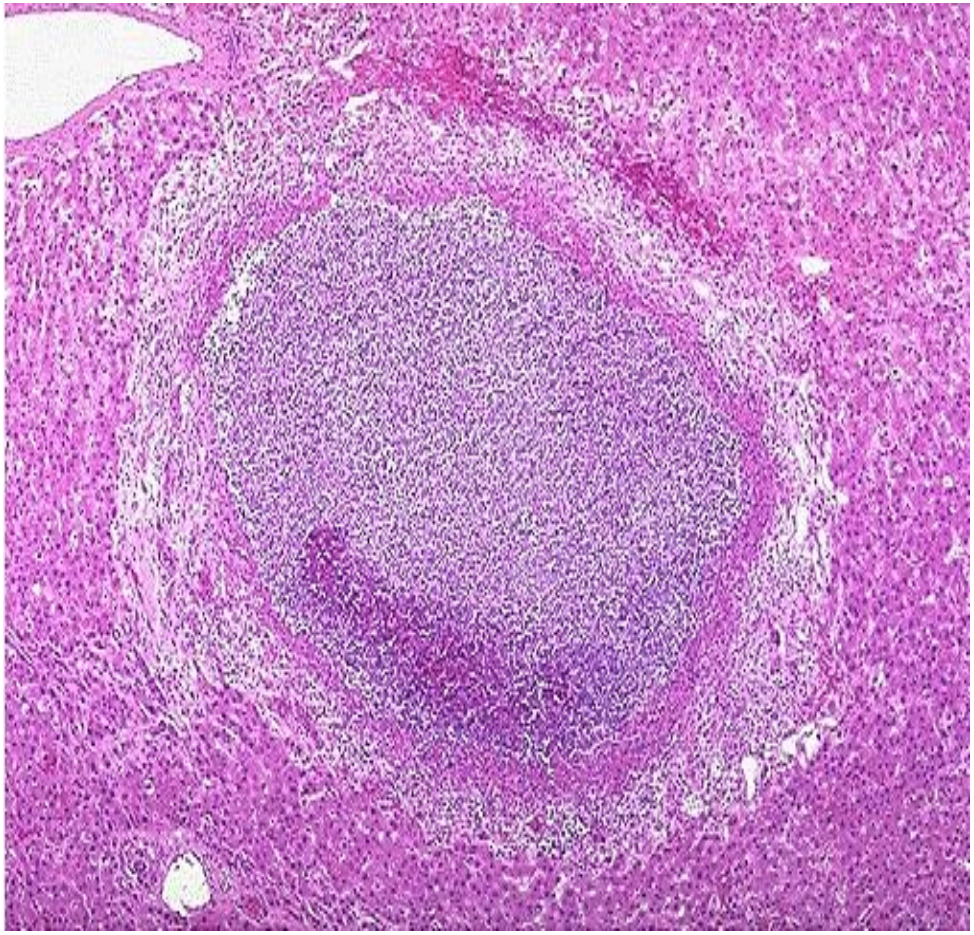
4-Fat necrosis: enzymatic digestion of fat. Example: necrosis of fat by pancreatic enzymes (tissue appears with white chalky deposits)

5-Gangrenous necrosis:(secondary to ischemia) usually with superimposed infection. Example: necrosis of distal limbs, usually foot and toes in diabetes.

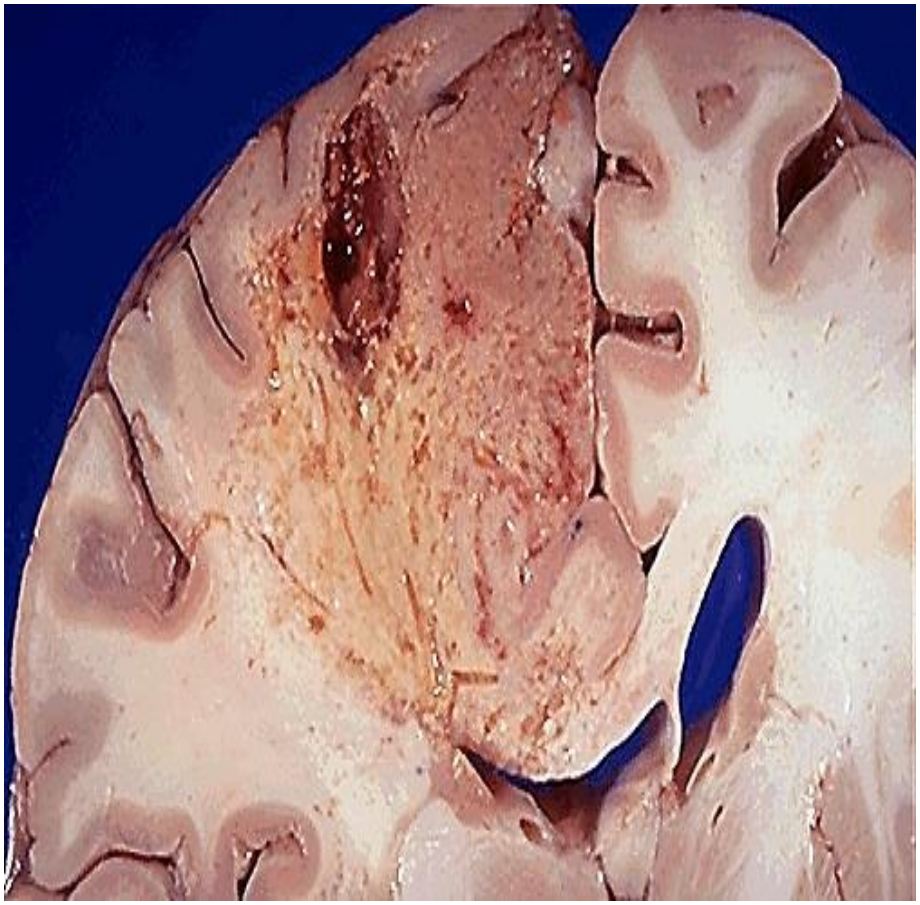
The differences between necrosis & apoptosis

- Necrosis
- death of cells within the living body caused by an irritant.
- occurs directly or follows reversible injury
- associated with release of chemical mediators
- Inflammation surrounds the necrotic area.
- accompanied by healing & calcification.accompanied by nucleus Karyolysis

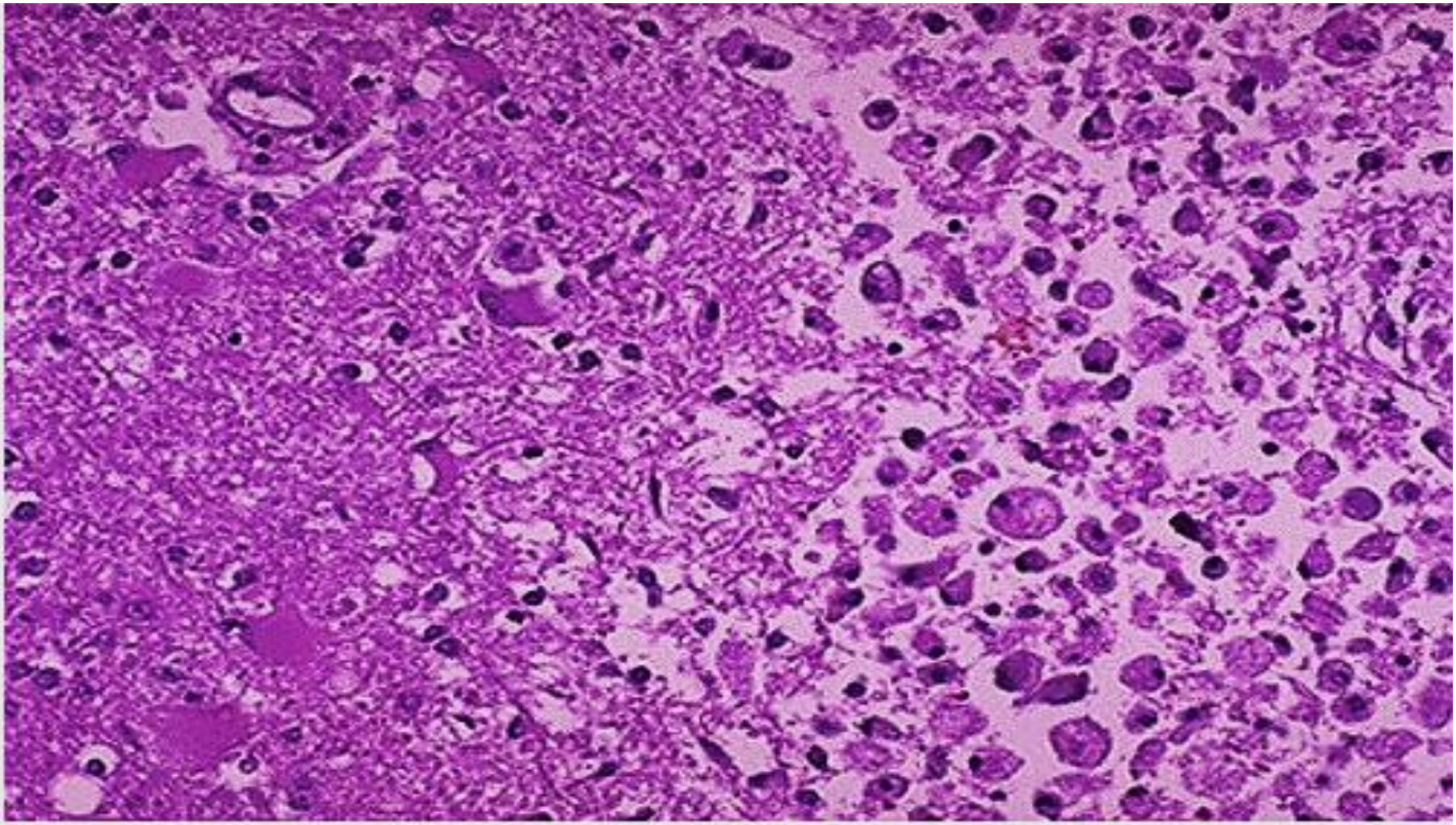
- Apoptosis
- involves few or single cells.
- It occurs without injury or mild injury not causing necrosis
- Not associated with release of chemical mediators,
- it does not excite inflammation.
- It is not accompanied by healing or calcification.Formation of apoptic bodies



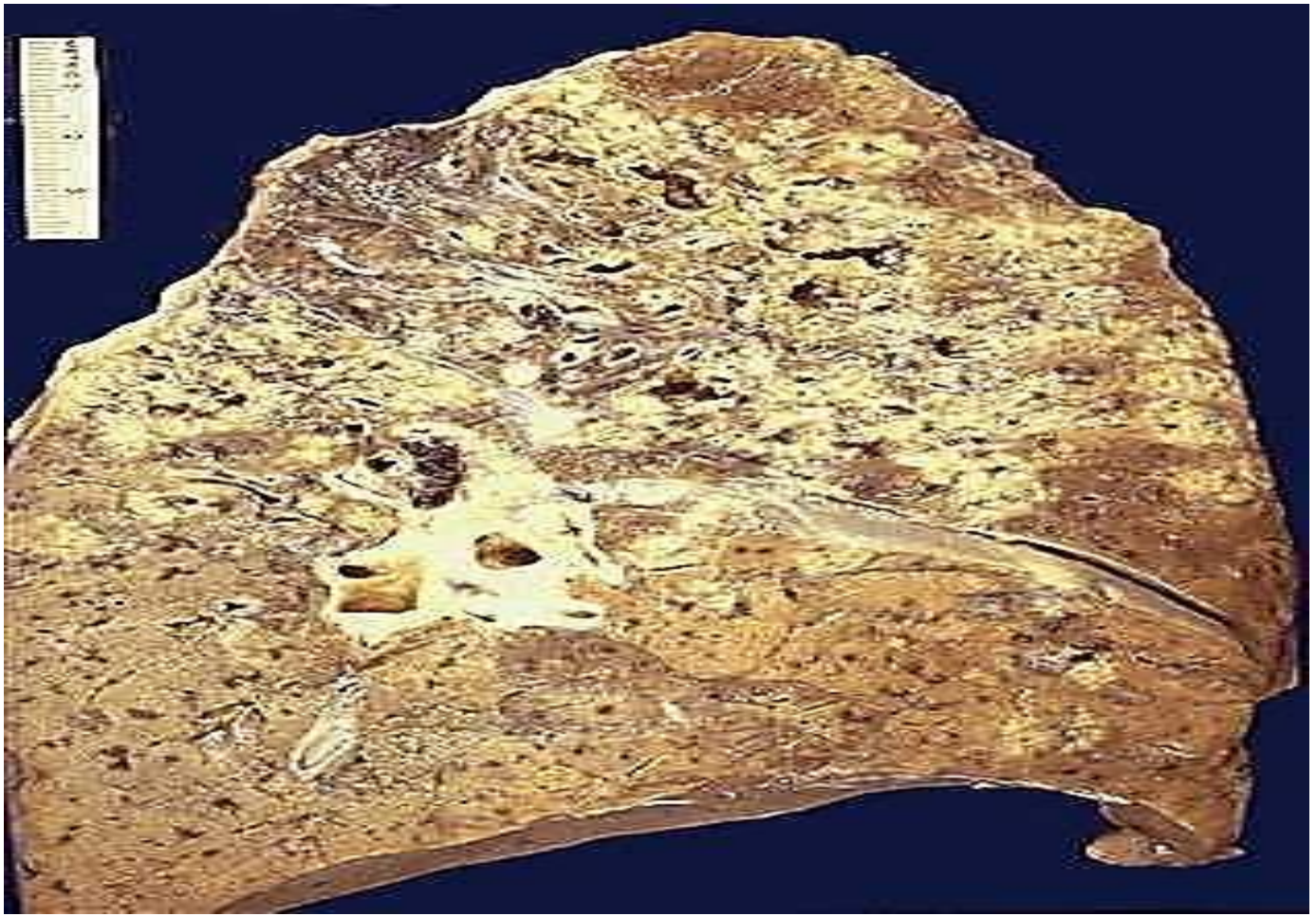
The liver shows a small abscess here filled with many neutrophils. This abscess is an example of localized liquefactive necrosis.



liquefactive necrosis in the brain in a patient who suffered a "stroke" with focal loss of blood supply to a portion of cerebrum

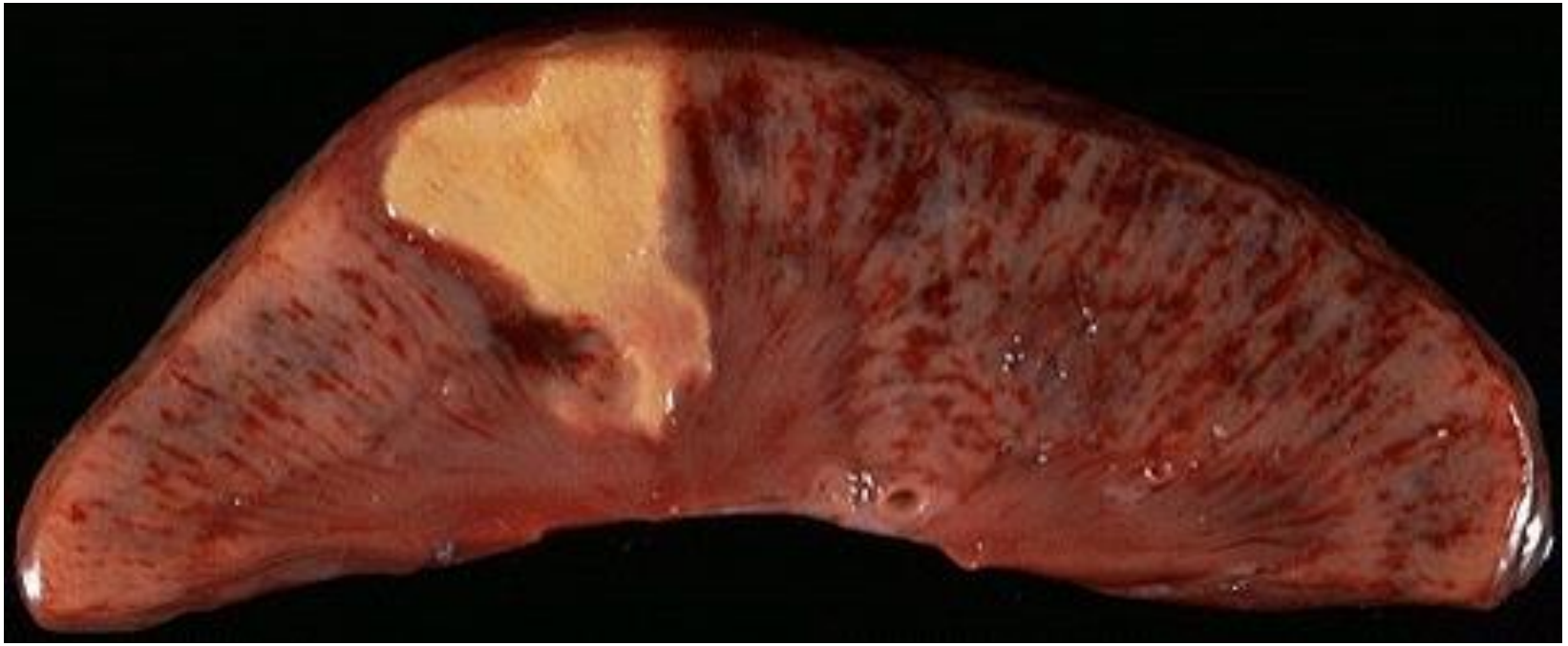


At high magnification, liquefactive necrosis of the brain demonstrates many macrophages at the right which are cleaning up the necrotic cellular debris. The job description of a macrophage includes janitorial services such as this, particularly when there is lipid.



Caseous Necrosis: Typical for tuberculous lesions.

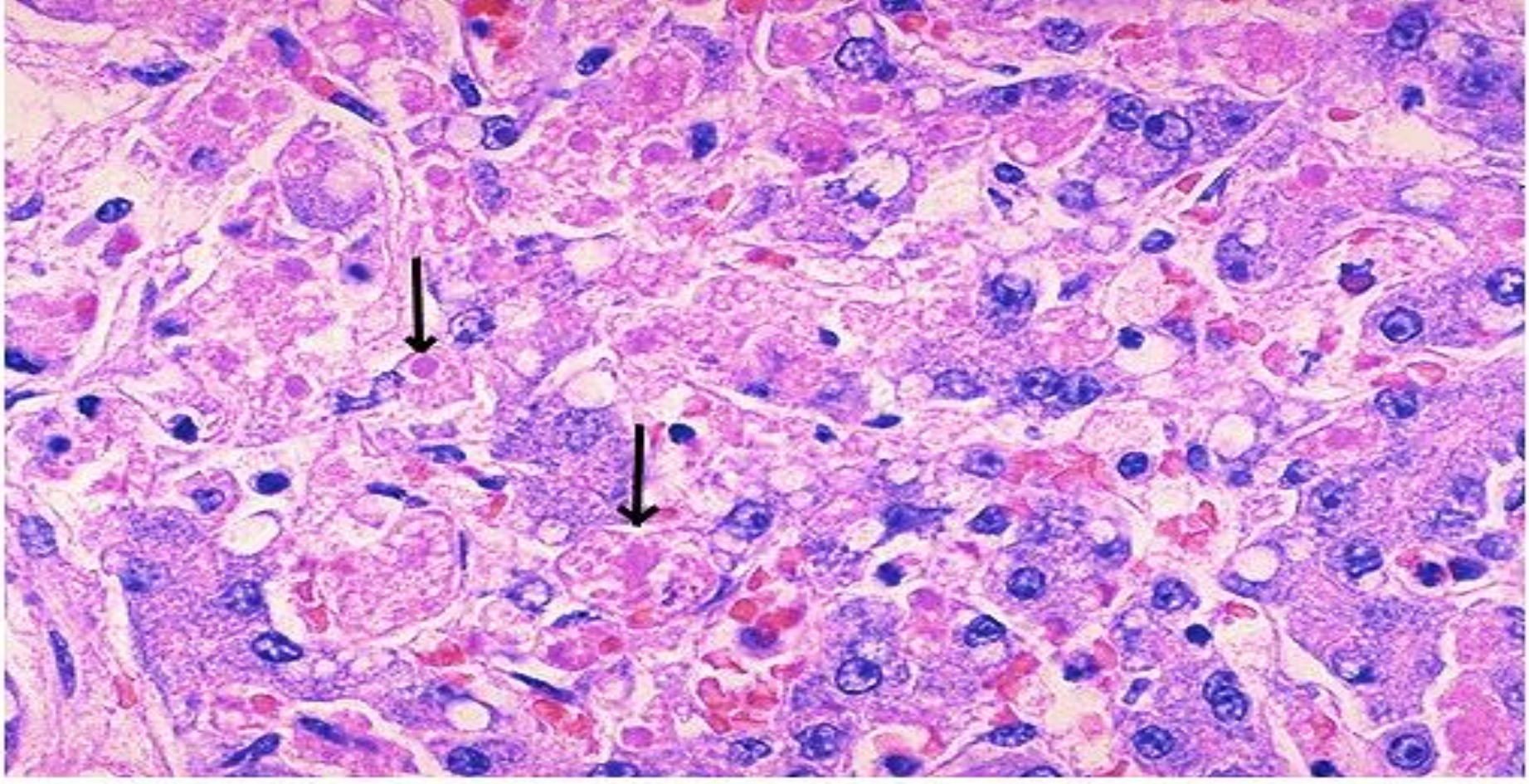
caseous because the necrotic tissue appears yellowish-white “cheesy”



When many cells undergo necrosis at once, then definable patterns of necrosis are produced, depending upon the nature of the injury, the type of tissue, and the length of time. This is an example of coagulative necrosis. This is the typical pattern with ischemia and infarction (loss of blood supply and resultant tissue anoxia). Here, there is a wedge-shaped pale area of coagulative necrosis (infarction) in the renal cortex of the kidney.



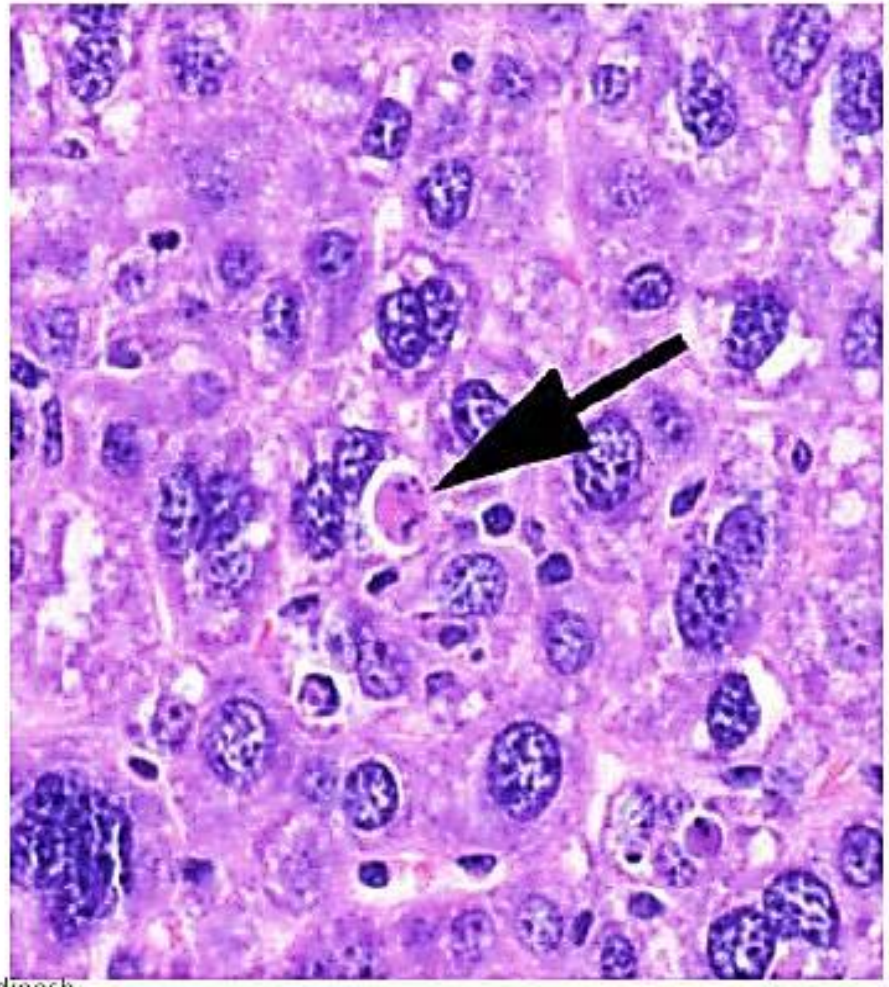
In this case, the toes were involved in **a frostbite injury**. This is an example of "dry" gangrene in which there is mainly coagulative necrosis from the anoxic injury



Apoptosis is a more orderly process of cell death. Apoptosis is individual cell necrosis, not simultaneous localized necrosis of large numbers of cells. In this example, hepatocytes are dying individually (arrows) from injury through infection by viral hepatitis. The apoptotic cells are enlarged, pink from loss of cytoplasmic detail, and without nuclei. The cell nucleus and cytoplasm become fragmented as enzymes such as caspases destroy cellular components.

Apoptotic bodies

- Round oval mass of intensely eosinophillic cytoplasm
- Fragments of dense nuclear chromatin



Thank you!