

Necrosis and Apoptosis

Necrosis: Local death, the stage of dying, is a form of cell injury that results in the premature death of cells in living tissue by autolysis.

Necrosis (from the Greek "death, the stage of dying, the act of killing") is caused by factors external to the cell or tissue, such as infection, toxins, or trauma that result in the unregulated digestion of cell components.

Autolysis : death of the cell or the tissue in the body through the action of its own enzymes (self digestion).

Necrosis	Autolysis
Both necrotic and living tissue present in the section	Only dead necrotic tissue occur
Dead tissue is surrounded by inflammatory cells	Only dead tissue without surrounding inflammatory cells
No hemolysis in the RBCs	Hemolysis of RBCs
Active hyperemia with congestion	No hyperemia and congestion

Apoptosis: Programmed cell death PCD (cell suicide) occur in multicellular organisms lead to characteristic cell changes (morphology) and death, these changes include cell shrinkage, nuclear fragmentation, chromatin condensation, and chromosomal DNA fragmentation.

Apoptosis Is responsible for several physiologic and pathologic processes including: **Embryogenesis, Hormone dependent physiologic processes**

(breast, uterus), **Cell deletion in proliferating populations (tumor)**. So failure of cells to undergo physiologic apoptosis may result in the development of tumor or an autoimmune disease. No tissue reaction or inflammation occur in apoptosis. Unlike necrosis, apoptosis produces cell fragments called apoptotic bodies that phagocytic cells are able to engulf and quickly remove before the contents of the cell can spill out onto surrounding cells and cause damage.

Comparison between Necrosis and Apoptosis

Necrosis	Apoptosis
A pathologic stimuli (irreversible cellular change).	A physiologic genetically regulated process & may be pathologic.
Large number of cells affected.	Few cells affected.
Inflammation around necrotic tissue.	No tissue reaction or inflammation.
Loss of membrane integrity.	Cell breaks down into membrane bound fragments (apoptotic bodies)
Random nuclear fragmentation.	Orderly nuclear fragmentation.

Causes of necrosis:

- A) Cut of blood supply.
- B) Lack of nutrition (deficiency of vitamin E and selenium)
- C) Infection.
- D) Trauma.
- E) Pressure.
- F) Poisoning: 1- Chemical poisoning 2- Chemical toxin and animal toxin such as snake venom.

Classification of Necrosis depend on Morphological patterns:-

1) Coagulative necrosis: Characterized by the formation of a gelatinous (gel-like) substance in dead tissues in which the architecture of the tissue is maintained hypoxic (low-oxygen) environment, cellular details are not seen, the tissue has opaque appearance such as area of **infarction in kidney or heart**.

Zenker's necrosis: Special type of coagulative necrosis of skeletal muscles occur due to vitamin E and selenium deficiency and in acute infectious diseases characterized by coagulation of muscle sarcoplasm.

Grossly: the muscles appear pale and friable.

Microscopically: loss of cellular details (breakdown of nuclei) the muscle fibers are swollen, have a loss of cross striations.

2) Liquefactive necrosis: In contrast to coagulative necrosis, is characterized by the digestion of dead cells to form a viscous liquid mass frequently creamy yellow due to the presence of dead leukocytes and is commonly known as pus (abscess) specially in the **brain** cause by pyogenic bacteria (streptococci and staphylococci).

Grossly: Brain cavity filled with fluid and pus.

Microscopically: presence of dead and living neutrophils and bacterial colony.

3) Caseous necrosis: Considered a combination of coagulative and liquefactive necrosis the necrotic tissue appears as white and friable,

like clumped cheesy like or greasy like material typically caused by mycobacterium (e.g. Tuberculosis).

Grossly: Cheesy material in the center of granuloma (it is a collection of immune cells known as macrophages).

Granulomas form when the immune system attempts to wall off the foreign substances (infectious organisms)but is unable to eliminate.

Microscopically: Loss of nuclei, cellular detail and tissue structure.

- 4) **Fat necrosis** : occur in fat tissue which become solid and pale resulting from the action of activated lipases on fatty tissues such as the pancreas.

Grossly: the organ or tissue is solid and pale.

Microscopically: fat tissue decomposed to fatty acid and glycerol.

5) **Fibrinoid necrosis:** a special form of necrosis usually caused by immune-mediated vascular damage. It is marked by complexes of antigen and antibodies, sometimes referred to as “immune complexes” deposited within arterial walls together with fibrin.

Fate of necrosis :-

- a) Liquefaction and removal by blood vessels or lymph.
- b) Replace by cyst.
- c) Change into abscess by pyogenic bacteria.
- d) Encapsulation by fibrous tissue.
- e) Scar tissue formation.
- f) Gangrene formation.