Lecture 2

Cell injury

Reversible cell injury

Cellular swelling

If the damaging stimulus is removed —> injured cells can return to normal

➢cell swells (ER swells and mitochondria also) Because of failure of cell's ion pumps(especially Na+/K+ pump)
➢ presence of membrane blebs
➢ fatty change abnormal accumulation of fat droplets within the cytoplasm of cells
Histological example:- Normal hepatocytes appear pinkish , abnormal hepatocytes with hydropic change appear whitish .
➢plasma membrane alterations (blebbing, blunting)
➢mitochondrial change (swelling and densities);
➢dilation of ER
➢nuclear clumping of chromatin.(nucleus is still intact inside the cell)
➢Cytoplasmic myelin figures

Irreversible cell injury

Cell death

Membrane damage

Necrosis

Rapid,uncontrollable and severe disturbances

➢ mitochondrial dysfunction (No ATP production at all)
➢loss of plasma membrane & intracellular membranes
➢ cellular enzymes leak out (cardiac enzymes & liver enzymes)
➢ loss of DNA & chromatin structure
➢ **local inflammation**
➢ Increased cytoplasmic eosinophilia.
➢ Marked dilatation of ER , mitochondria.
➢ Mitochondrial densities.
➢ More myelin figures.(because of damage of membranes)

Nuclear changes:
- **Pyknosis**: shrinkage and increased basophilia;
- **Karyorrhexis** :fragmentation;
- **Karyolysis**: basophilia fades(degradation of nuclear material)

Necroptosis

Apoptosis

(clean cell suicide)
> Less severe injury.
> Regulated by genes and signaling pathways
> Precisely Controlled.
> Can be manipulated.
> In healthy tissues.

Table 2.1 Features of Necrosis and Apoptosis

Feature	Necrosis	Apoptosis
Cell size	Enlarged (swelling)	Reduced (shrinkage)
Nucleus	Pyknosis, karyorrhexis, karyolysis	Fragmentation into nucleosome-size fragments
Plasma membrane	Disrupted	Intact; altered structure, especially orientation of lipids
Cellular contents	Enzymatic digestion; may leak out of cell	Intact; may be released in apoptotic bodies
Adjacent inflammation	Frequent	No
Physiologic or pathologic role	Usually pathologic (culmination of irreversible cell injury)	Often physiologic, means of eliminating unwanted cells; may be pathologic after some forms of cell injury, especially DNA damage

Necrosis

Coagulative necrosis

➢Necrotic tissue that remains firm cell shape and organ structure are preserved by coagulation of proteins
➢Enzyme dysfunction.
➢ the nucleus disappears
➢Characteristic of ischemic infarction of any organ **except** the brain
➢Leukocyte lysosomal enzymes && phagocytosis required for clearance.
➢Area of infarcted tissue is often wedge-shaped (pointing to focus ofvascular occlusion) and pale

Liquefactive necrosis

➢ Necrotic tissue that becomes liquefied
➢Focal infections by Bacterial and fungal organisms.
...Producing Pus
➢Center liquefies and digested tissue is removed by phagocytosis
➢CNS infarcts

Gangrenous necrosis

➢Coagulative necrosis (dry gangrene)
➢ Characteristic of ischemia of lower limb and GI tract
➢ If superimposed infection of dead tissues occurs, then liquefactive necrosis ensues(wet gangrene).

Caseous necrosis

➢ Cheese like
➢ Tissue architecture is not preserved
➢ Acellular center
➢Usually enclosed by collection of macrophages. (granuloma)
➢ Most often seen in TB(tuberculosis)

Fat necrosis

➢Occurs in acute pancreatitis
➢ Due to release of pancreatic lipases
➢ Focal fat destruction
➢ Released FA's combine with Ca2+ (saponification) to produce the **whitish chalky appearance**
➢ Shadows of necrotic fat cells

Fibrinoid necrosis

➢Necrotic damage to blood vessel wall
➢ Leaking of proteins (including fibrin) into vessel wall results in bright pink staining ofthe wall microscopically
➢ Characteristic of malignant hypertension and vasculitis