

Pathophysiology = Physiology of altered health

- It is mainly concerned with the physiological changes and responses that produce signs and symptoms in case of disease.
- So studying of pathophysiology is essential to understanding the rational for medical and surgical therapy.

Disease

Disease is abnormal variation in the structure or function or both of any part of body.

Causes of Diseases:

- Inherited diseases: Due to abnormality in the DNA of the fertilized ovum and the cells derived from it.
- Acquired diseases: Due to effect of some environmental factors.
 - a). Physical factors like mechanical injury, like heat, cold, radiation...ect.
 - b). Chemical factors like drug, poisons.
 - c). Nutritional factors like nutritional deficiency and hypervitaminosis.
 - d). Immunological factors like asthma.
 - e). Microorganisms like virus, bacteria, fungus, mycoplasma.....ect.
 - f). Psychogenic factors like depression.

Pathogenesis

- It means the mechanism of disease development.
- Each disease has a **characteristic natural history, a typical pattern of evolution, effect and duration that is observed.**

Manifestation

- The etiologic agent may provoke a number of changes in the biological process in the body, that lead to produce clinical signs.
- Many diseases have a subclinical stage.

The Cell

- The cell is composed of **protoplasm**
 - The protoplasm is composed of:
 1. **Water** (70-85%).
 2. **Proteins** (10-20)% which form cell structures , enzymes.
 3. **Lipids**(2-3)%
 4. Small amounts of **carbohydrates** are used as fuel.
 5. **Electrolytes** major intracellular electrolytes are, *K, Mg, PO₄, SO₄, HCO₃* and small quantity of *CL, Na, Ca, Fl.*

Structure of Cell under Microscope

- The cell is composed of:
 1. Nucleus
 2. Cytoplasm
 3. Cell membrane

Nucleus

- It is the control center for the cell. It is surrounded by nuclear membrane, and it contains the individual units of inheritance which called *genes*.

Genes

- are units of inheritance which are strung along the *chromosomes*.
- Gene control cell activity by determining the type of protein that is being synthesized in the cytoplasm.

Chromosome

- Is a double stranded helical molecule of deoxyribonucleic (DNA) containing variable sequences of four nitrogen bases (**Thymine, Guanine, Cytosine, and Adenine**) these bases form a **genetic code**.

Cytoplasm

- Cytoplasm is a colloidal solution that contains water, electrolytes, suspended proteins, neutral fats, and glycogen molecules.
- In the cytoplasm there are organelles.
- Organelles: inner organ of the cell.

Ribosome:

- Serve as site of protein synthesis. Some ribosomes are present free in the cytoplasm and others attached to the endoplasmic reticulum.

Endoplasmic Reticulum (ER):

- Acts as a tubular communication system which substances can be transported from one part of the cell to another. There are two types of endoplasmic reticulum; smooth (**SER**) and rough (**RER**).
- **SER** contains enzymes important for **metabolism**. While RER contains ribosomes on its surface.

Golgi Complex:

- The Golgi complex functions are to package substances (which are synthesized in the cell) into secretory granules.

Lysosomes

- Act as digestive system of the cell which contains hydrolytic enzymes.

Mitochondria

- Act as a site of energy production.

Microtubules

- The microtubules are slender tubular structures composed of globular proteins called tubulin. Microtubules control cell shape and movement. Function: 1). **Development and maintenance of cell form** 2). **Participation in intracellular transport mechanisms** 3). **Formation of *centrioles*.**

Centrioles

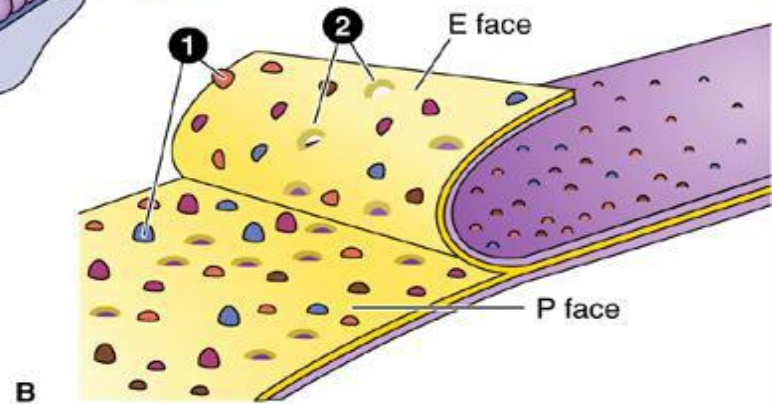
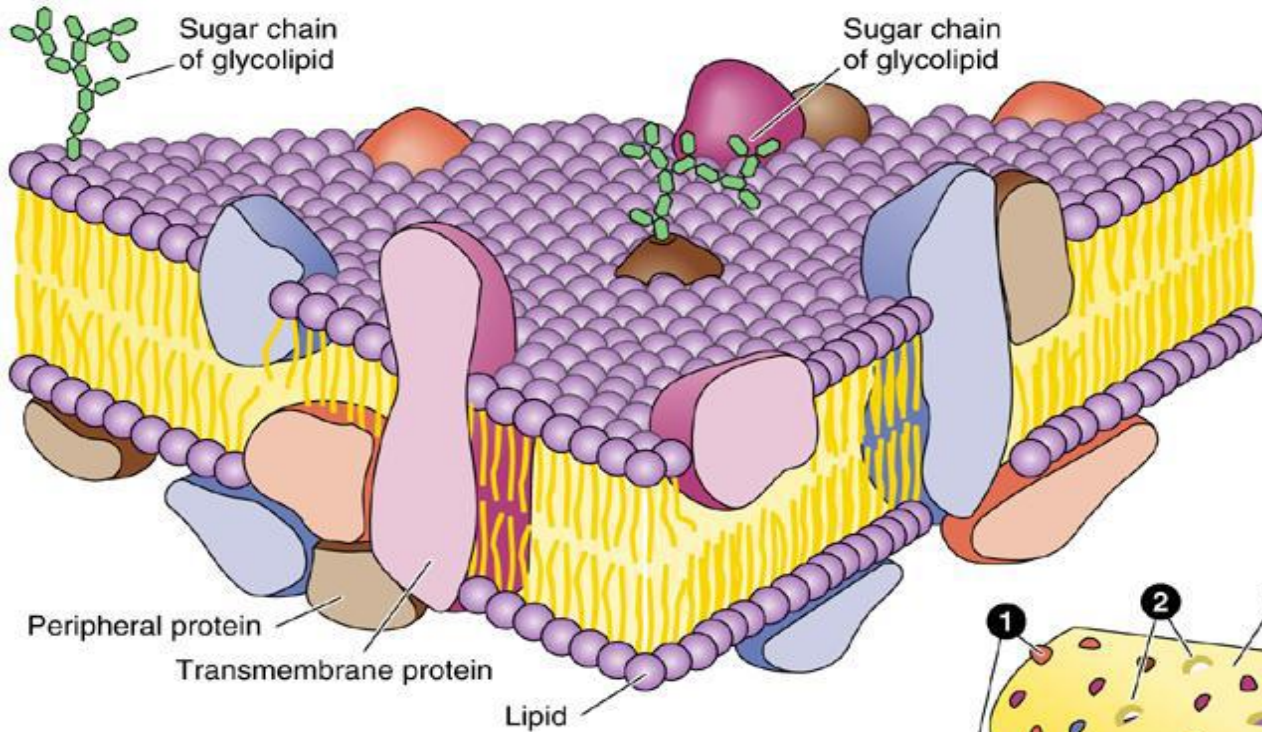
- These are cylindrical structure composed of highly organized microtubules. In dividing cells they form the mitotic spindle that aids in the separation and movement of chromosomes.

Cell Membrane

Surrounded the cell and prevent content of the cell get out and also prevent molecules from environment to get inside the cell. This membrane is semi permeable.

Cell membrane

A Carbohydrate chains bound to lipids and proteins



Cellular Adaptation

- Cells have ability to adapt when there is change in environment or when increase work demands.

Cellular adaptation occurs by:

- Changing in **size**.
- Changing in **cells number**
- Changing in **cells type**.

Atrophy

- Decrease in the cell size.

- **Causes**

- Disuse
- Endocrine stimulation
- Malnutrition
- Decrease in blood supply.
- De-energation

Brain atrophy



Hypertrophy

- Increase in cell size associated with increase amount of functioning tissue mass, e.g. Cardiac hypertrophy. So in hypertrophy there is increase in the functional component of the cell e.g. in muscle hypertrophy there is increase in: a). *actins* and *myosin filaments*. b). *Cell enzymes*. c). *Adenosine tri-phosphate (ATP)*.

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Cardiac hypertrophy



Causes:

- Hypertrophy may occur as the result of either *normal physiologic* or *abnormal pathologic conditions*.
- *Physiological condition* occurs due to increase functional demand like increase in muscle mass associated with exercise.
- *Pathological conditions* like in hormonal changes, nutritional deficiency, mild irritation, chemicals....ect.

Hyperplasia:

- Increase in the number of cells in the organ or tissue. Hyperplasia is a controlled process that occurs in response to an appropriate stimulus and ceases once the stimulus has been removed.

Causes: a).Chronic irritation b). Hormonal disturbances
c). Diet deficiency d). Infection.

Hyperplasia of the skin

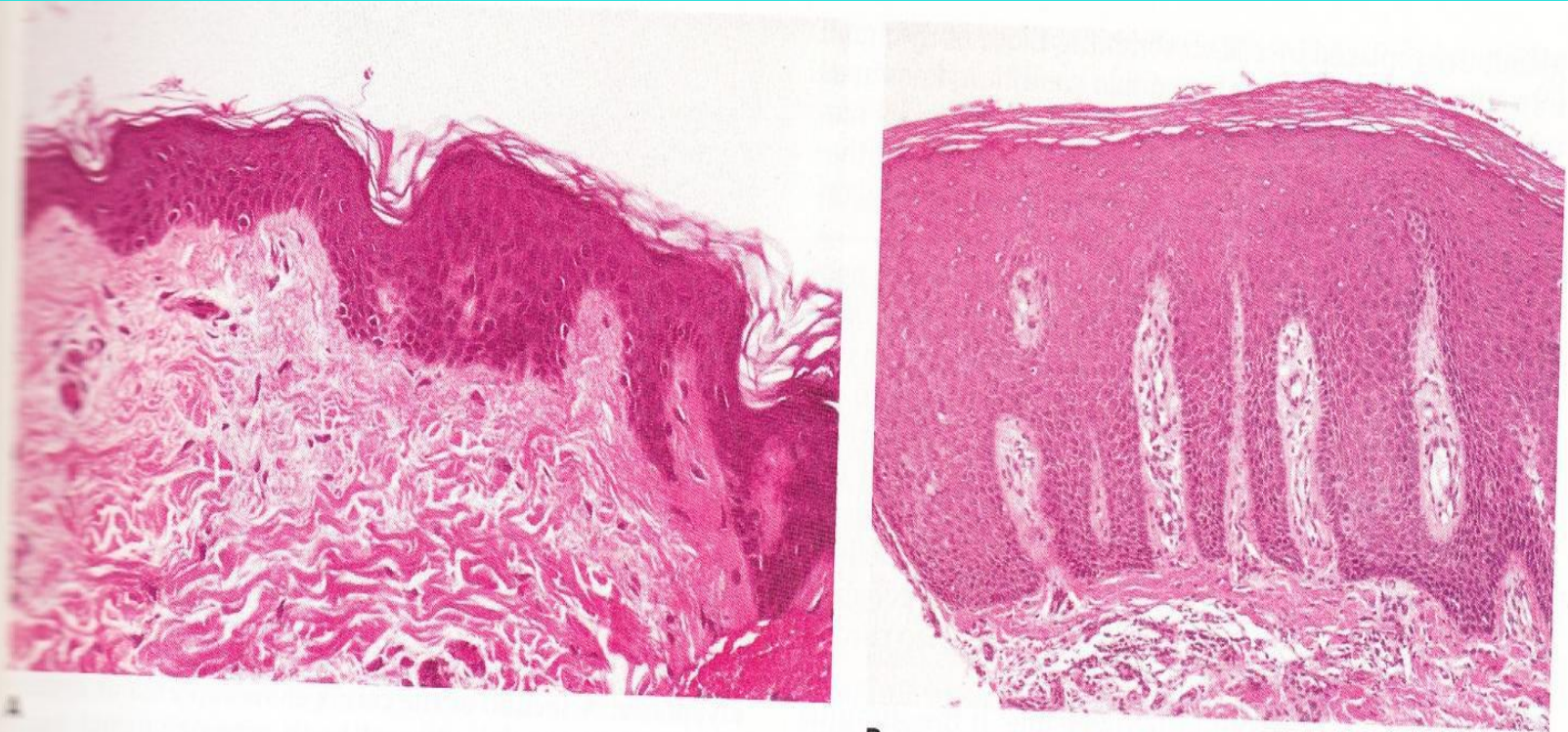


FIGURE 1-10
Epidermal hyperplasia. (A) Normal epidermis. (B) Epidermal hyperplasia in psoriasis, shown at the same magnification as in A. The epidermis is thickened, owing to an increase in the number of squamous cells.

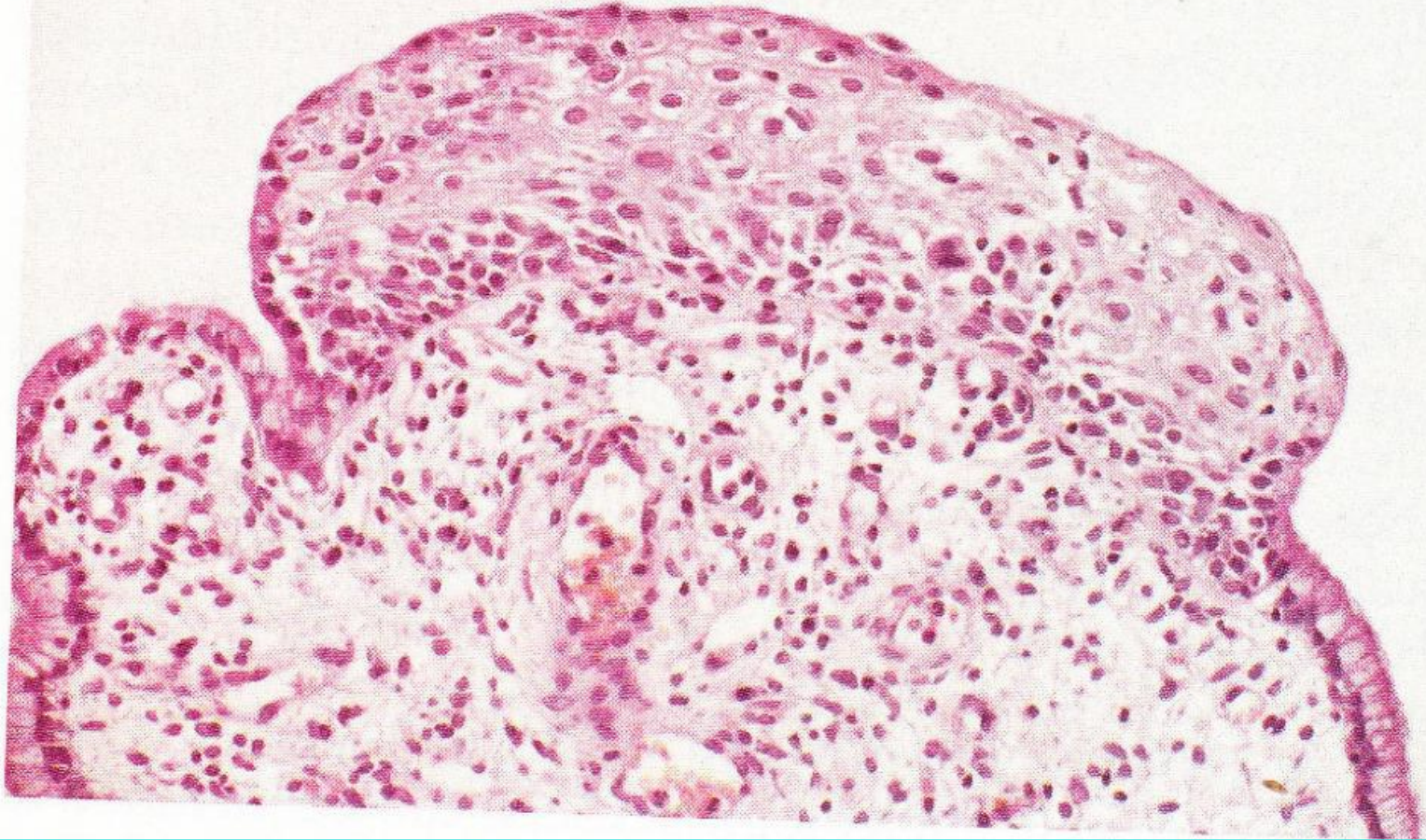
Metaplasia

- It means conversion from one tissue to another type like simple epithelium converted to stratified epithelium.
- *Causes:*
- Chronic irritation and Persist inflammation.

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Metaplasia



Injury & Cell Death

- Injury:
- Any abnormal changes in cell induced by causal agent.
- Cell injury is reversible up to certain point.
- if the stimulus persists or severe enough from the beginning The cell reaches to “ point of no return”.

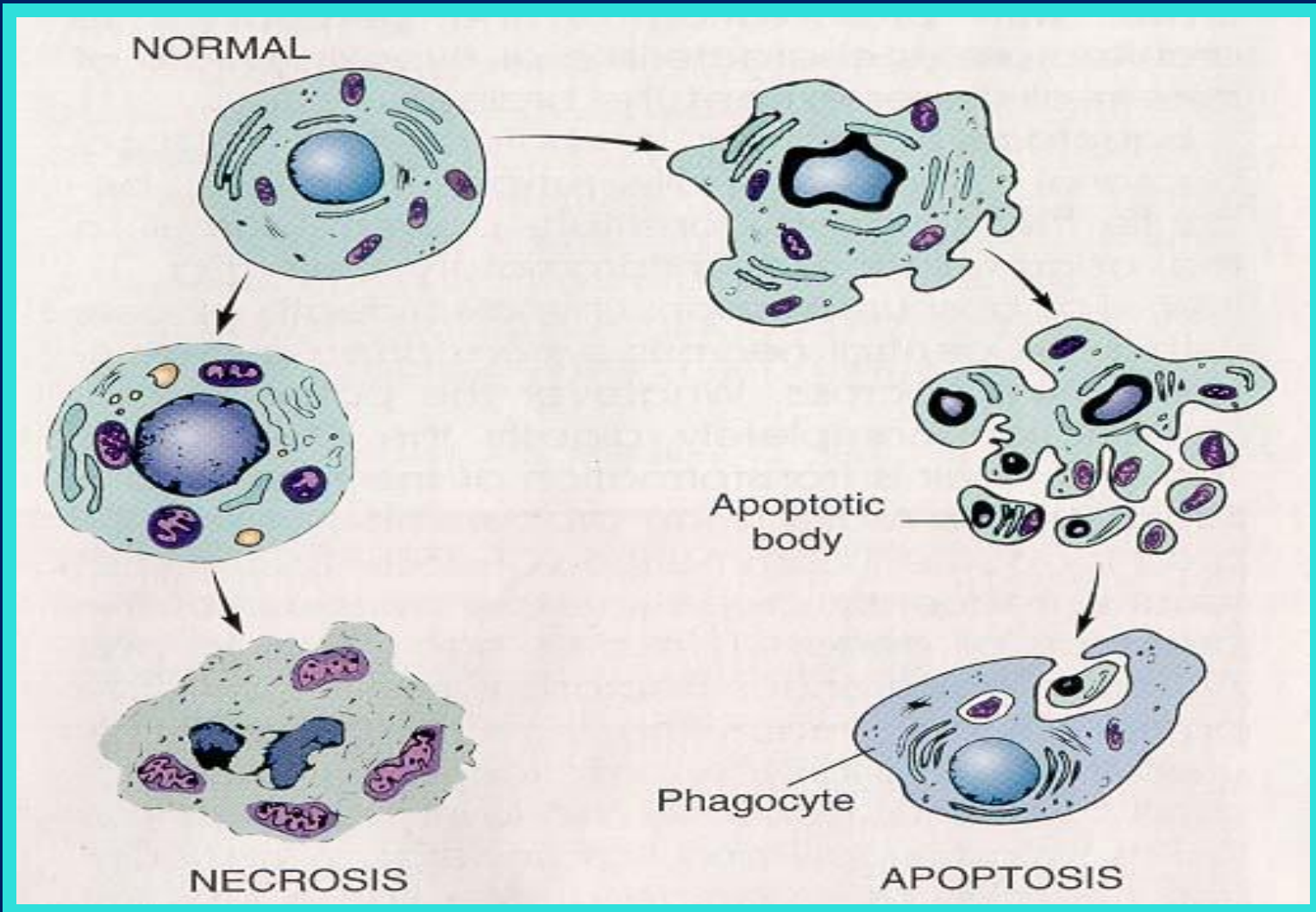
- There are two effects of cellular injury:
 1. Cell death:
 - There is irreversible changes occur in the cell and there is no further integrated function occur like respiration
 2. Lesser form of damage: Reversible changes and also called degeneration

Cell Death

- Cell death means number of cells in the certain tissue are dead.
- Somatic death means death of individual (all body).

- Necrosis : Death occurs due to exposure to injurious agent.
- Apoptosis: Cell death occurs in case of physiological cell death or due to irreversible cell damage.

Types of Cell Death



Necrosis

Causes of

- Marked impaired of blood supply.
- Toxin and chemical poisonous.
- Immunological injury.
- Physical agents.
- Infection.

Types of Necrosis

- **Coagulative Necrosis:**

This type of necrosis is characteristic of hypoxic injury and seen in *infarcted* area.

- **Caseous Necrosis:**

This type has a soft cheese like center so called caseous . It associated with T.B.

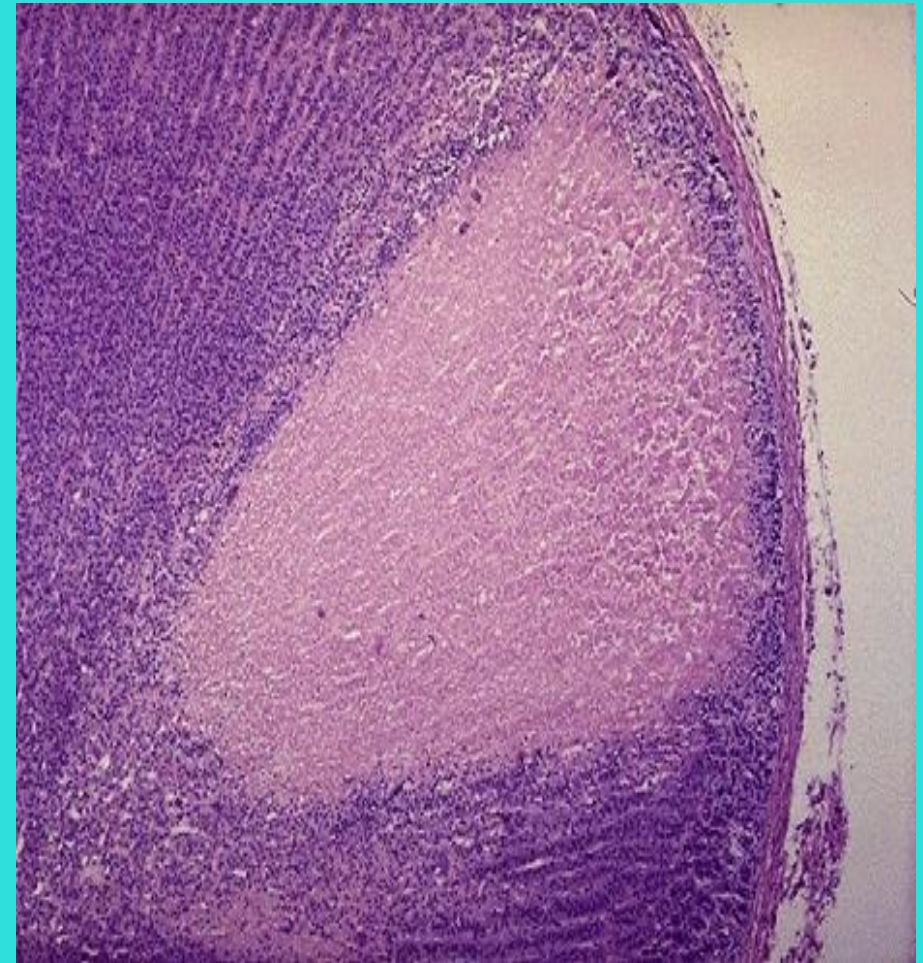
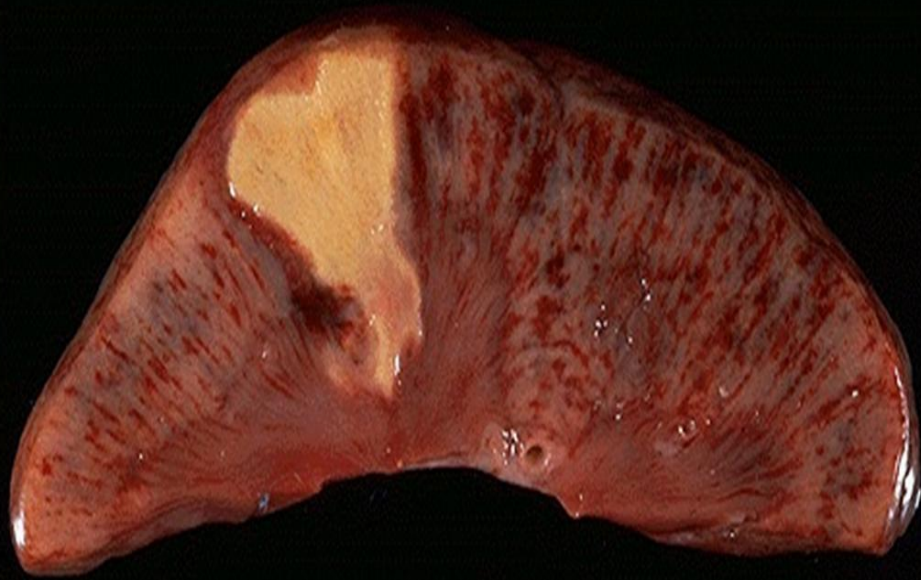
- **Liquefactive Necrosis:**

It occurs in softening tissue like brain.

- **Fat Necrosis:**

It occurs due to damage to the pancreas which leads to release the lipase enzyme. This enzyme attack fat tissues and lyses fat.

Coagulative necrosis



Gangrene

- The term gangrene means **digestion of dead tissue by saprophytic bacteria** (i.e. bacteria which are incapable of invading and multiplying in living tissue). And it associated with **foul odor** and the **color of the tissue changes into dark brown or greenish brown**.
- Gangrene may be either primary which necrosis (death) of tissue is due to production of exotoxins by bacteria (which may then invade and digest the dead tissue), or secondary in which necrosis of tissue due to other cause like obstruction of blood supply lead to necrosis and then invasion by bacteria.

Primary Gangrene:

- Like gas gangrene caused by group of bacteria called *Clostridia*, especially *Clostridia welchii*, *Clostridia oedematous* and *Clostridia septicum*. These organisms are intestinal commensals in man and animals. These organisms are anaerobic and saprophytic.

Gas gangrene



Secondary Gangrene

- Usually result of ischemic necrosis followed by invasion and digestion of dead tissue by putrefactive micro-organisms. It is most often occur in the foot and leg and in the intestine. It is of two forms **wet** and **dry** gangrene.

Dry gangrene

- Occurs in the part of body when there is no excessive fluids like in leg when infarction preceded by gradual arterial occlusion. The skin becomes cold and waxy.

Wet Gangrene:

- Occur in the part of the body when there is excessive fluid ischemic in ischemic area like intestine and edematous leg.