

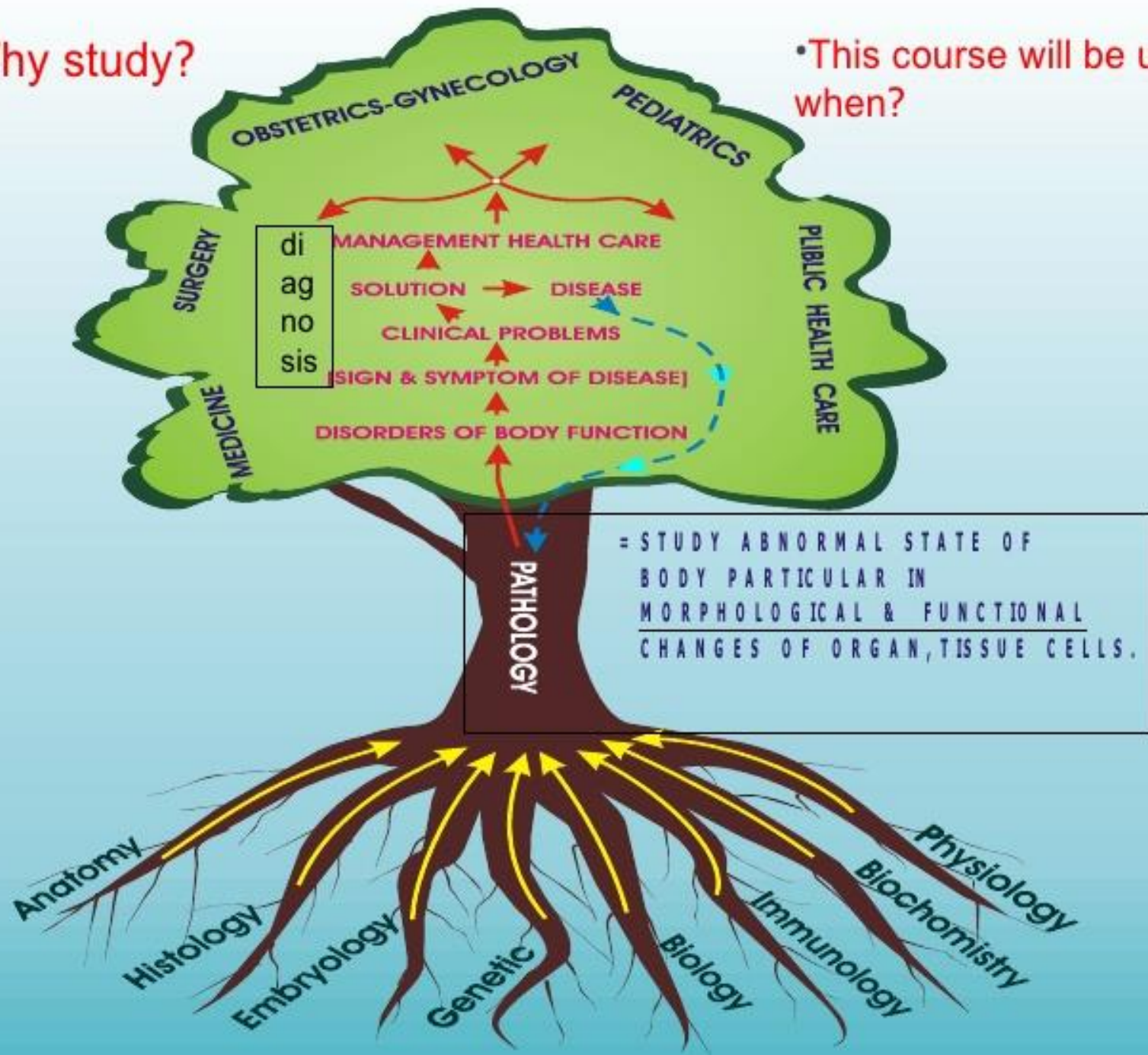
Pathology lecture

General pathology

1. Introduction to pathology
2. Cell injury and adaptation
3. Inflammation
4. Healing and repair
5. Neoplasm
6. Hemodynamics
7. Disease of blood and bone marrow
8. Infectious
9. Genetics
10. Environmental pathology
11. Transfusion medicine
12. Immunopathology

• Why study?

• This course will be used when?



What is **Pathology**?

Pathology = Pathos +

Logos

Study

Suffering

Study of

THEORETICAL STUDY

Main object is to know the nature of DISEASE by study as the following :-

1. Etiology (causes of diseases)
2. Pathogenesis (mechanism of diseases)
3. Pathological changes : structural change → Lesion



THEORETICAL STUDY

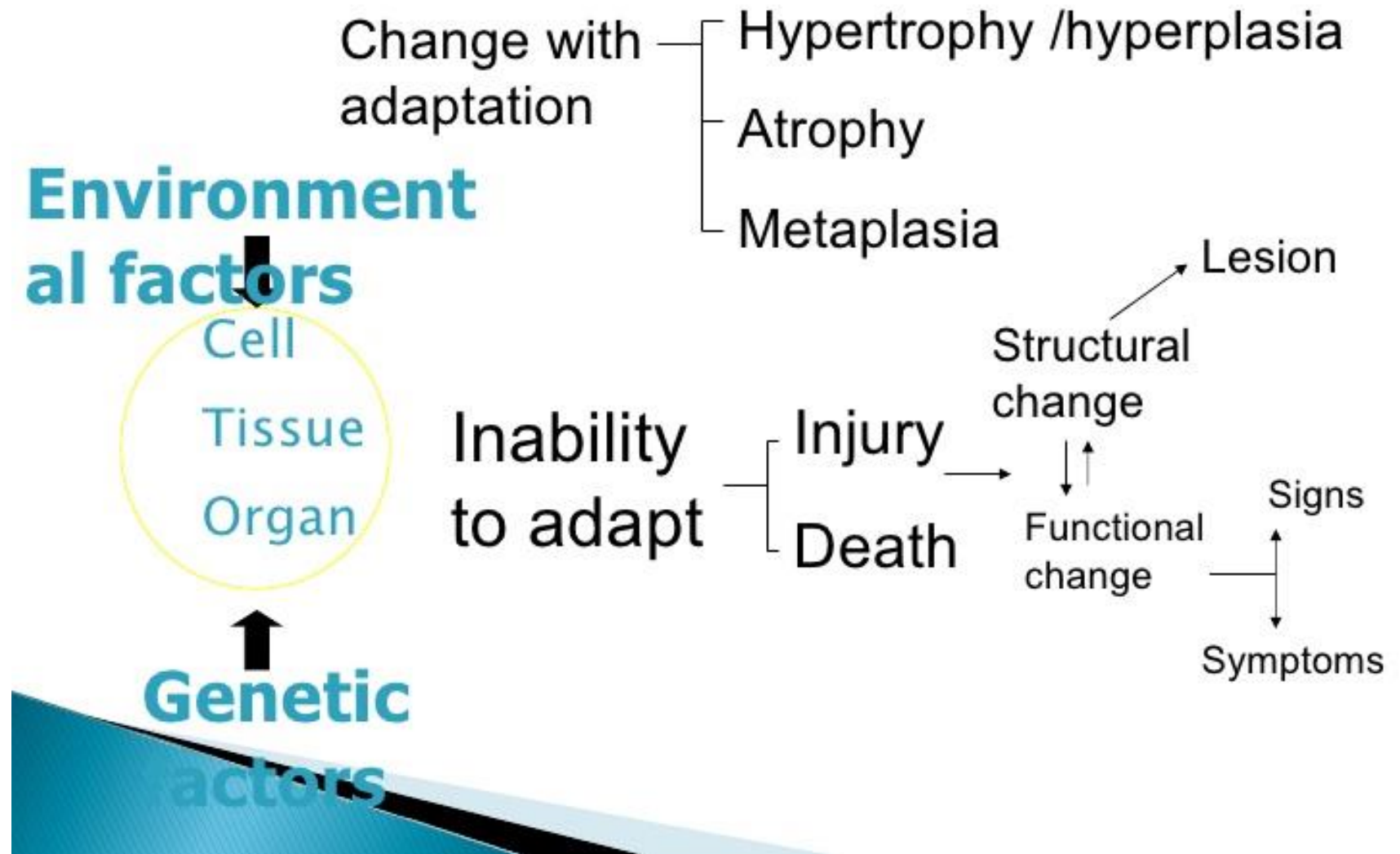
4. Clinical feature : functional & structural changes → symptoms & signs of patients

5. Complication

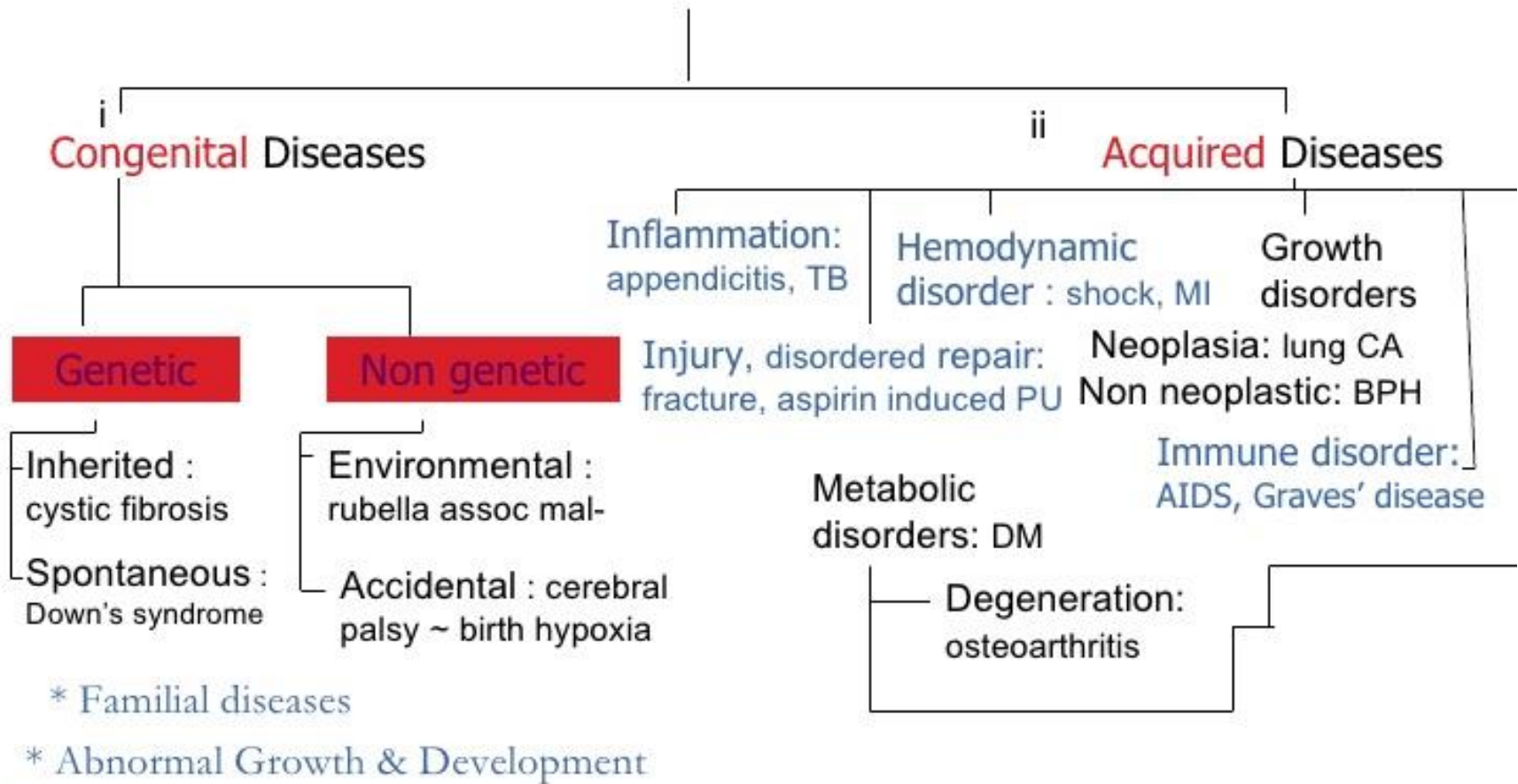
6. Prognosis (prediction the future of victim)



The concept of disease



The general main causes of disease



Iatrogenic disease

Cushing's syndrome ~ X steroids

Aplastic anemia ~ chloramphenicol

Cellular Injury And Adaptation:

Definition: These are the visible changes that occur in cells as a result of exposure to causative agents of disease, the ***degree*** of this changes are vary according to the ***severity*** and ***duration*** of damaging processes.

Cells injury can be divided into:

1. Reversible cell injury: Indicated that the changes will regress and disappear when the injurious agent is removed and the cell will return to the normal morphologically and functionally.

2. Irreversible cell injury: Occur when the injury is persist or when its sever from the outset. Here the cell alternations reach the point of no return and progression to cell death is inevitable.

e.g. If the blood supply to a portion of the heart musculature is cut off for few minutes and then restored, the muscles cells will sustain reversible injury i.e. after restoration of blood supply, the cell injury will recover and function normally as in ***angina pectoris*** **But** if cessation of blood supply is continuous for more than 60 minutes and then restored, the myocardial cells in this instance sustain irreversible injury that terminates invariably to death as in ***myocardial infarction..***

So there is ***spectrum*** of cellular changes in response to injurious agents ranging from ***adaptation*** to ***cell death***

Classification of Injurious Agents:

Injurious agents can be classified into:

1. Hypoxia (Oxygen deprivation).
2. Physical agent.
3. Chemical agents.
4. Infectious agents.
5. Immunological reaction.
6. Genetic derangement.
7. Nutritional.

1. Hypoxia (Oxygen deprivation): This refers to a decrease in the oxygen supply to the cells. It acts through interference with oxidative respiration of the cells.

Hypoxia results from:

A. Loss of the blood supply (Ischemia) which is the most common cause and occurs when arterial flow is interfered with by .e.g. narrowing of the lumen of an artery by atherosclerosis, thrombi or emboli.

B. Inadequate blood oxygenation due to for e.g. cardiac failure and or respiratory failure.

C. Decrease in oxygen –carrying capacity of the blood e.g. anemia and carbon- monoxide poisoning.

Depending on the severity and duration of hypoxia, the cells may show one of the following changes:

1. Adaptive atrophy.
2. Injury.
3. Necrosis (the morphological expression of the cell deaths).

e.g. If the femoral artery is narrowed , the muscles of the leg will shrink in size (atrophy),this adaptive response continuous till there is a balance between the metabolic needs of the cells(low in this instance)and available oxygen supply. More sever hypoxia (for e.g. when there is more sever narrowing or complete occlusion of the artery) will induce injury (reversible then irreversible that progress to cell death).

2. Physical Agents: That include:

- Mechanical trauma.
- Deep cold.
- Extreme heat.
- Radiation.

3. Chemical Agents: That include:

- Simple chemicals such as glucose and salts in hypertonic solution.
- Oxygen in high concentration.
- Poisons such as arsenic or cyanide.
- Air pollutions.
- Insecticides.
- Occupational exposure e.g. to asbestos.
- Social poisons such as alcohols and narcotic drugs.

4. Infectious agents: These include viruses, bacteria, fungi and parasites.

5. Immunological reaction: These are primarily protective defense mechanism against for e.g. infectious agents; however, sometime they are harmful and injurious

e.g.

A. Hypersensitivity reactions (triggered for e.g. by drugs).

B. Directed to self-antigens (autoimmune disease).

6. Genetic derangements: Exemplified by the wide range of hereditary diseases that range from those that are the result of gross chromosomal defects leading to severe congenital malformation e.g. ***Downs syndrome***, to those that are caused by a single amino acid substitution in the structure of the hemoglobin that leading to the synthesis of abnormal Hb. e.g. Hb.s in ***Sickle cell anemia***.

7. Nutritional Imbalance:

-***Deficiency*** as of proteins-calorie malnutrition or vitamins deficiency, etc.

-***Excess*** as of lipids that leads to obesity with all its consequences including fatty changes in cells and predisposition to atherosclerosis.

Mechanisms of cells injury:

Injurious agents induce cell injury through their effects on one or more of the following cellular targets:

1. Aerobic respiration
2. Cell membrane.
3. Protein synthesis.
4. Cytoskeleton.
5. Genetic apparatus (chromosome and their contents of genes).

Factors influencing the severity of cell injury:

1. **Type, duration** and **severity** of the injurious agents.
2. **Type of the affected cells**: Cells differ in their susceptibility to the effects of injurious agents for e.g.

<i>Types of cells</i>	<i>Susceptibility to damage by ischemia</i>	<i>Time for damage</i>
<i>Neurons</i>	High	3-5 minutes
<i>Myocardial cells</i> <i>Hepatocytes</i>	Intermediate	30-60 minutes
<i>Skeletal muscles</i> <i>Epidermis of skin</i> <i>Fibroblast</i>	Low	Many hours

Types Of Cell And Tissues Damage:

1. Cell Death: This is **irreversible** processes; it's of two types either:

A. Apoptosis.

B. Necrosis.

2. Degeneration: This is **irreversible** processes, its include all the changes in the cells which is short of necrosis (i.e. before the stage of cells death and necrosis)

e.g. – Fatty changes.

– Pigmentation.

•
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Apoptosis:

Definition: Its **programmed** cell death, it's a **physiological** processes by which cell eliminated when they are no longer required by the body, its part of normal turn over of body cells.

_ Here there is **no inflammatory reaction** against apoptosis because it's normal physiological processes.

_ the cell become shrinkage and compact and become eosinophilic in color, later its fragmented and then other cell in the body will come and eat this fragment of cell by processes called **phagocytosis**.

_ Apoptosis is **irreversible processes**.

E.g. include

1. During embryogenesis i.e. it's responsible for shaping various organs and structure (morphogenesis).

2. Hormone-dependent involutionggg:

A. Physiological e.g. involution of endometrium during the menstrual cycle or lactating breast after weaning.

B. Pathological e.g. atrophy of prostate after castration.

Necrosis:

Definition: The morphological changes that follow cell death in living tissues or organ.

_ Necrosis represent cell death while still forming a part of living body.

_ It's always ***pathological***, and it's occur as a result of sever cell damage.

_ Its always associated ***with inflammatory reactions***.

_ Necrosis results from the degrading action of enzymes on irreversibly damage cells with denaturation of cellular protein.

In necrosis, there are ***cytoplasmic*** as well as ***a nuclear*** changes.

Cytoplasmic Changes:

In the Hematoxylin-Eosin stain (H&E stain), the **hematoxylin** stain **acidic** materials (Including the **nucleus**) **blue**, whereas **eosin** stains **alkaline** materials (including the **cytoplasm**) **pink**.

The necrotic cells are **more eosinophilic** than viable cells (i.e. more intensely pinkish) this is due to:

1. Loss of cytoplasmic RNA.
2. Increase binding of eosin to the denaturated protein.

The cells may have more glass homogenous appearance than normal cells; this is due to loss of glycogen particles (which normally give the granular appearance to the cytoplasm).

Nuclear Changes:

The earliest changes is ***Chromatin Clumping***, which is followed by one of two changes

1. The nucleus may shrink and transformed into small wrinkled mass (***Pyknosis***)

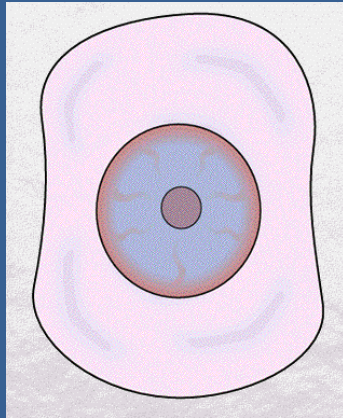
With time there is progressive disintegration of the chromatin with subsequent disappearance of nucleus together (***karyolysis***) or

2. The nucleus may break into many clumps (***Karyorrhexis***).

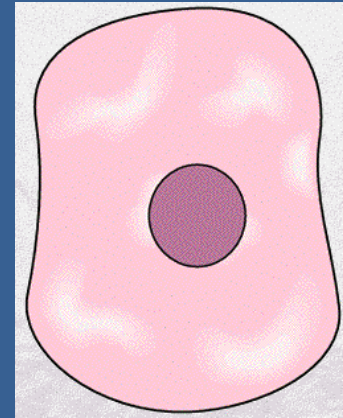
Cell necrosis

Nuclear changes

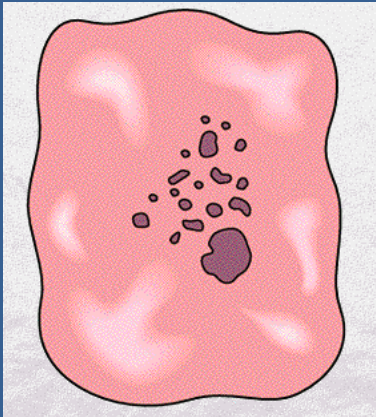
normal



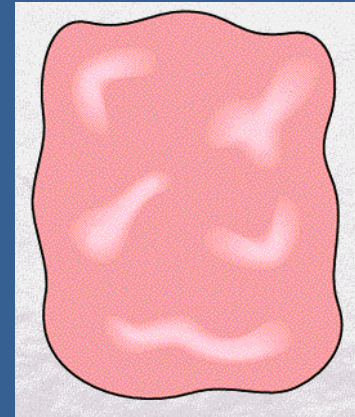
pyknosis



karyorrhexis



karyolysis



Types Of Necrosis: Macroscopically there are ***five*** types of necrosis:

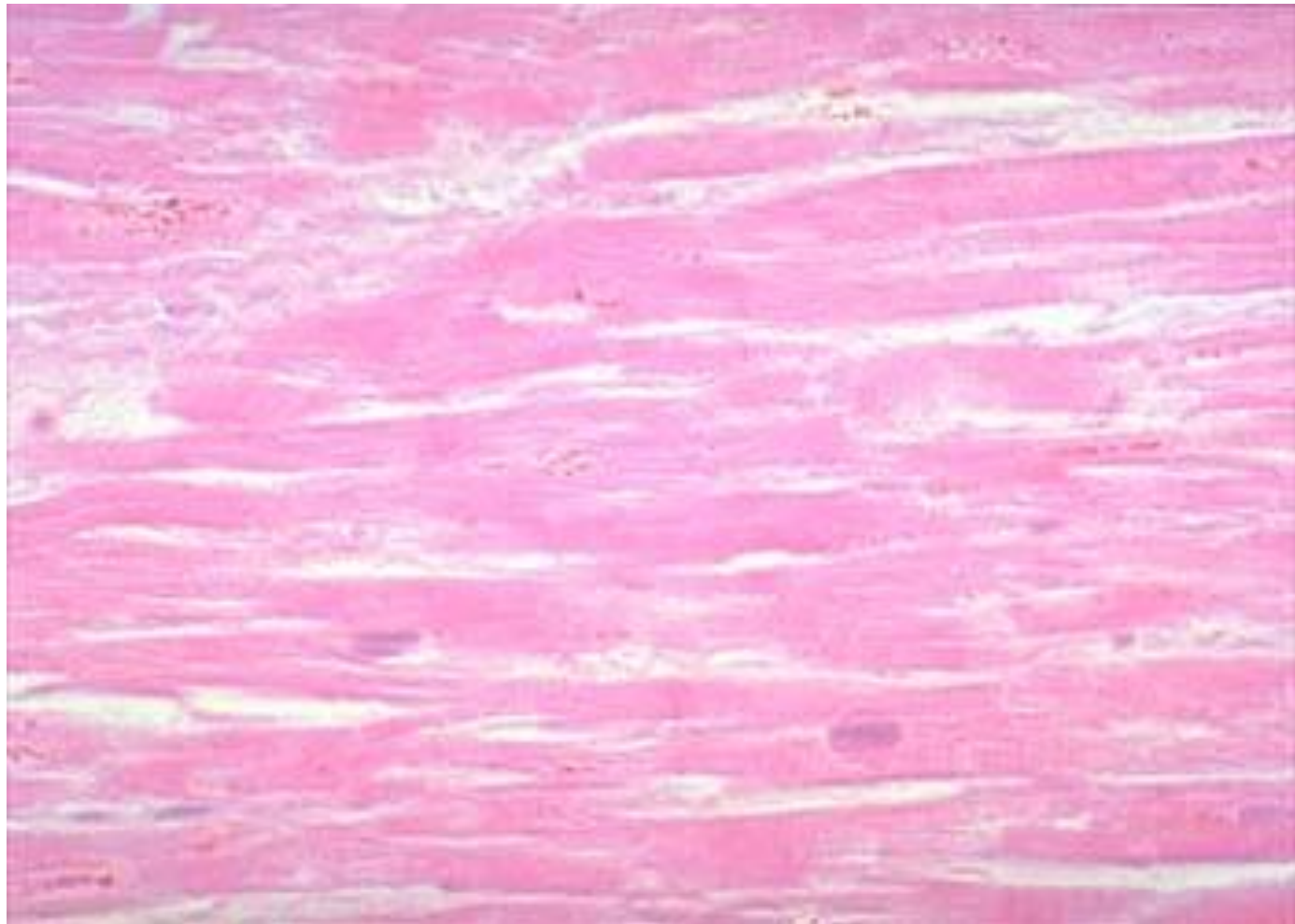
1. Coagulative Necrosis.
2. Liquefactive Necrosis.
3. Fat Necrosis.
4. Caseation (Gaseous) Necrosis.
5. Gangrenous Necrosis.

1. Coagulative Necrosis:

_ Results from sudden severe ***ischemia*** in such organs as the heart, kidneys, etc.....

_ Microscopically, the fine structural details of the affected tissues and cells are lost but their outlines are maintained.

- The nucleus is lost.
- The cytoplasm is converted into homogenous deeply eosinophilic and structure less material.
- The outlines of the affected cells are still discernible.



2. Liquefactive Necrosis:

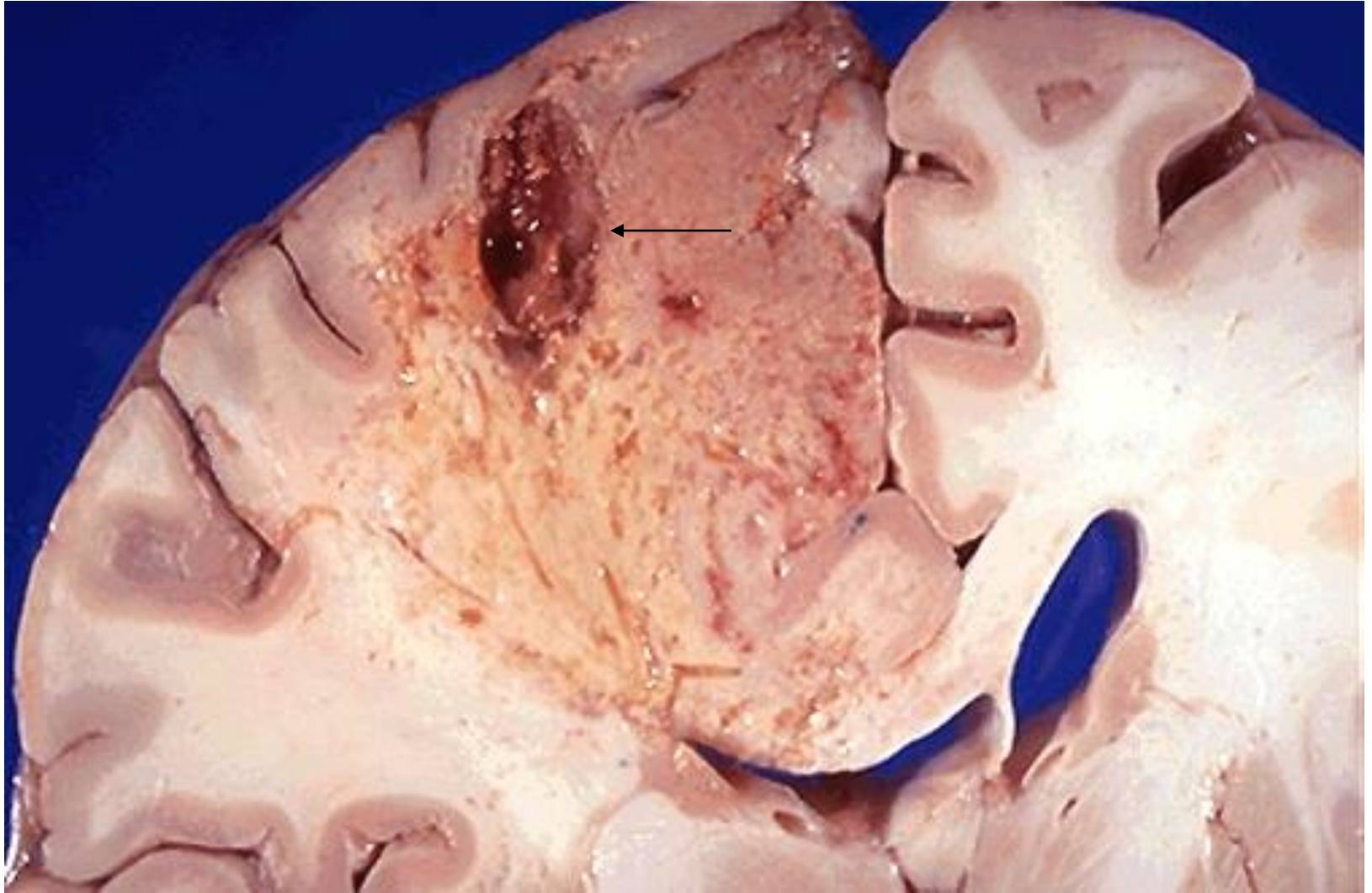
This type of necrosis usually seen in two situations:

1. Brain infarctions i.e. ischemic destruction of the brain tissues.

2. Abscesses i.e. suppurative bacterial infections.

Liquefactive necrosis is characterized by complete digestion of dead cells by enzymes and thus necrotic area is eventually liquefied i.e. converted into a cyst filled with debris and fluid.

Liquefactive necrosis brain

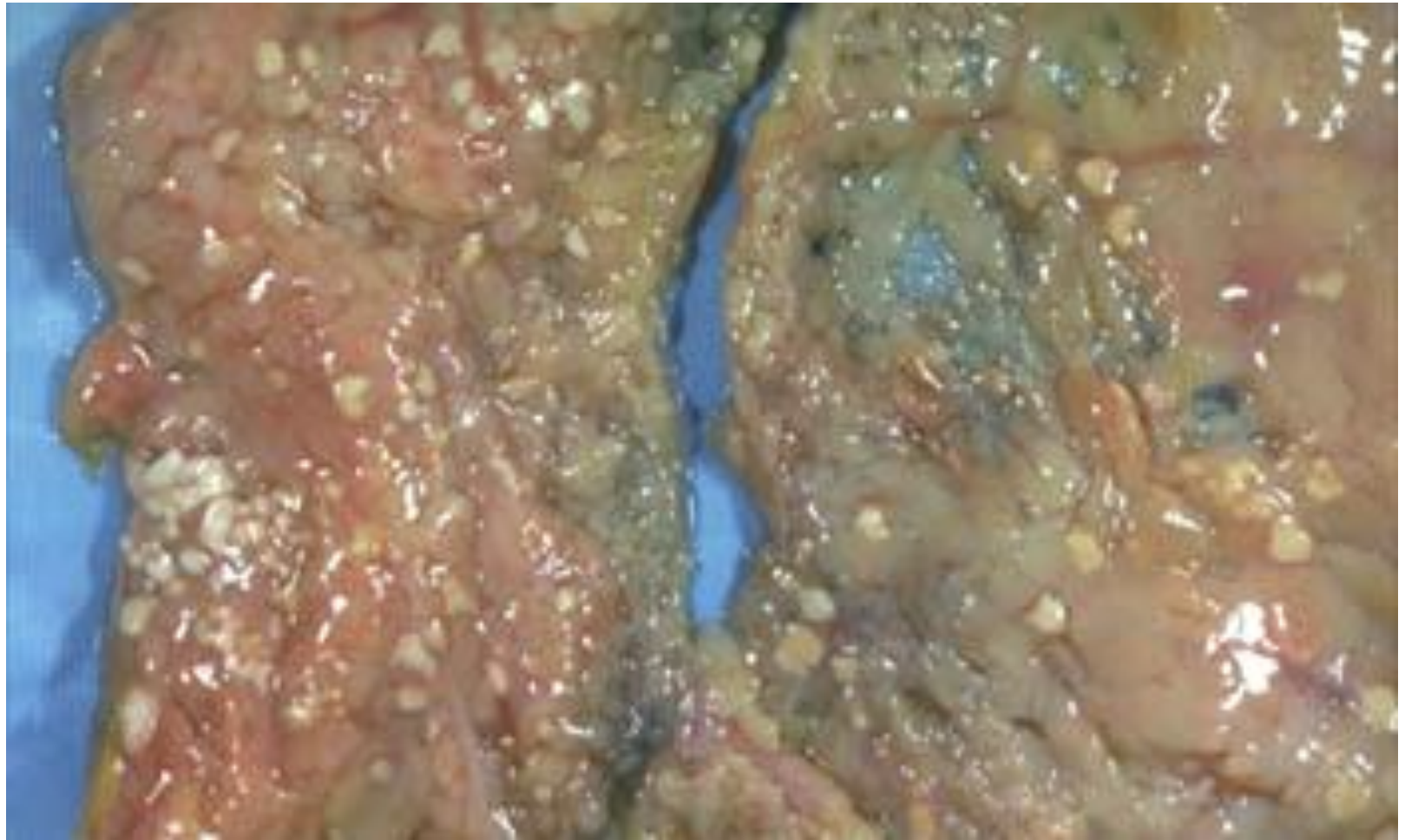


. Fat Necrosis:

_ This is a specific pattern of cell deaths seen in adipose tissues due to actions of lipase.

_ Its more commonly seen in acute pancreatitis. The released fatty acids from necrotic cells, complex with calcium to create calcium soaps. These are seen grossly as chalky white deposit.

_ Fat necrosis can also be inducing by mechanical trauma as female breast (traumatic fat necrosis).



4. Caseation (gaseous necrosis):

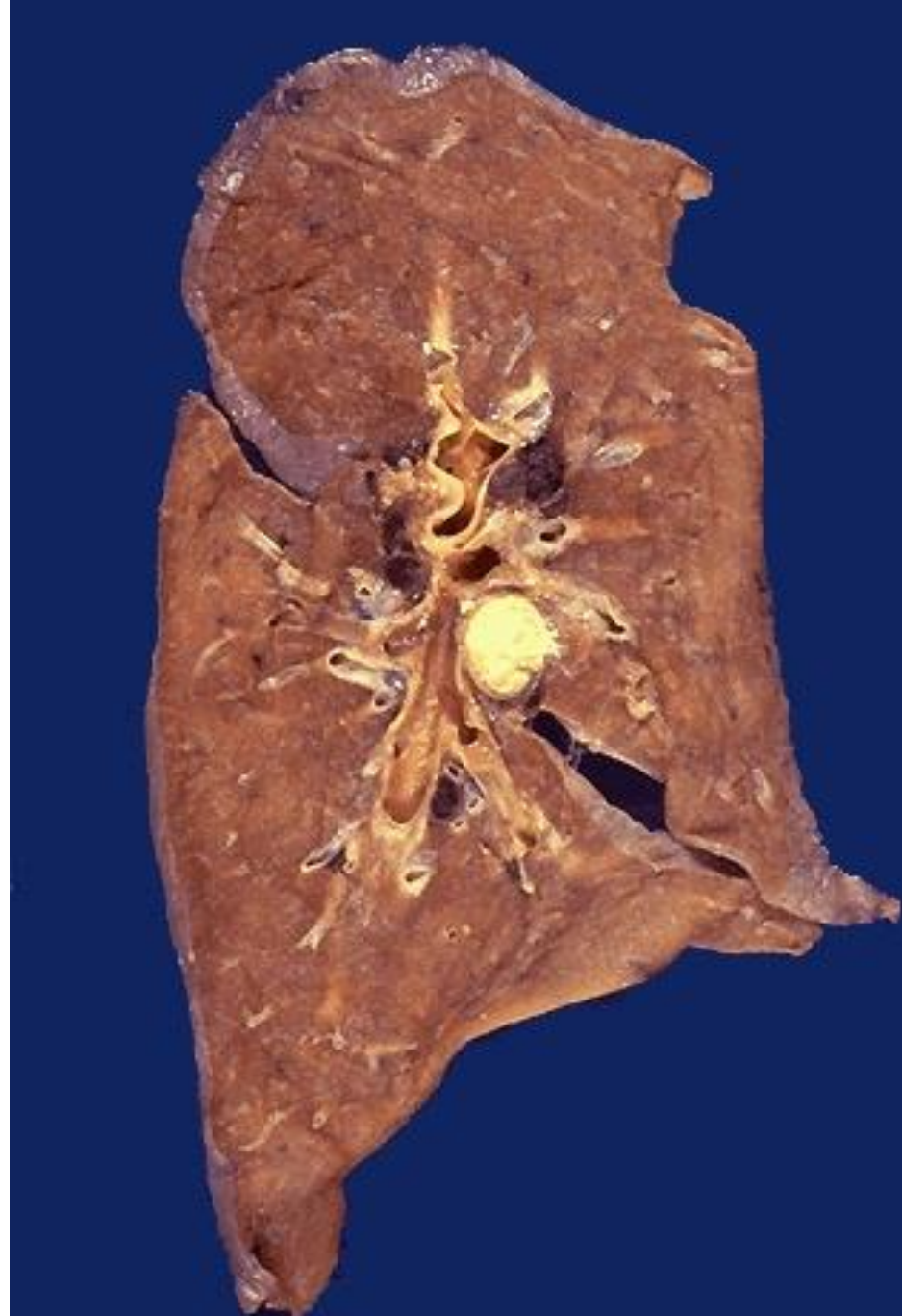
_ This combined the features of **Coagulative** and **Liquefactive** necrosis.

_ Its encountered principally in the center of **Tuberculous Granuloma**.

_ The body response to Tuberculous infections is specific form of chronic inflammation, the morphologic unit of this is called **Granuloma**.

_ Grossly, the caseous material is soft, friable, whitish-gray cheesy material.

_ Microscopically, the area is surrounded by granulomatous inflammation, it has distinctive amorphous granular pinkish debris.



5. Gangrenous necrosis:

_ Its describe the limb (usually the lowegggr)that has lost its blood supply and has subsequently attacked by bacteria, so its a combination of **Coagulative** necrosis modified by **Liquefactive** action of enzymes derived from bacteria and inflammatory cells.

_ When Coagulative pattern is dominates ,the affected parts shrink and appear contracted (dry),the processes is termed **dry gangrene**, conversely when the Liquefactive action is more prominent, the affected parts are swollen (edematous), so the processes termed **wet gangrene**.

Gangrene-lower limb



Chinese proverb

I hear, I forget;

I see, I remember;

I do, I understand.