DISORDERS OF GROWTH

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OUTLINES

- **Introduction**
- **Classification**
- **Abnormal cell growth**
  - **Atrophy**
  - **Hypertrophy**
  - **Hyperplasia**
  - **Neoplasia**
- **Abnormal cell differentiation**
  - **Metaplasia**
  - **Dysplasia**

INTRODUCTION

- **Definition of growth:**

  Growth is increase in size and/or weight of an organ or the whole body; resulting from

  - ↑ NUMBER of the cells
  - ↑ SIZE of the cells
  - ↑ BOTH NUMBER AND SIZE of the cells

- **Definition of differentiation:**

  Degree of **STRUCTURAL** and **FUNCTIONAL** maturity of the cells

INTRODUCTION

- **Factors affecting growth and differentiation:**
  1. ***Age***: children have rapid rate of growth
  2. ***Type of tissue:***
     - Thymus grows rapidly during childhood then stops growing or even regresses in adults.
     - Sex organs grow rapidly after puberty.
  3. ***Type of cells:***
     - Labile.....**???**
     - Stable.....**???**
     - Permanent.....**???**

INTRODUCTION

- **Factors affecting growth and differentiation:**
  4. ***Genetic factors:*** Tall and short individuals
  5. ***Nutritional state of the body.***
  6. ***Hormones:***

     ↑ growth hormone → Giagantism

     ↓ growth hormone → Critenism

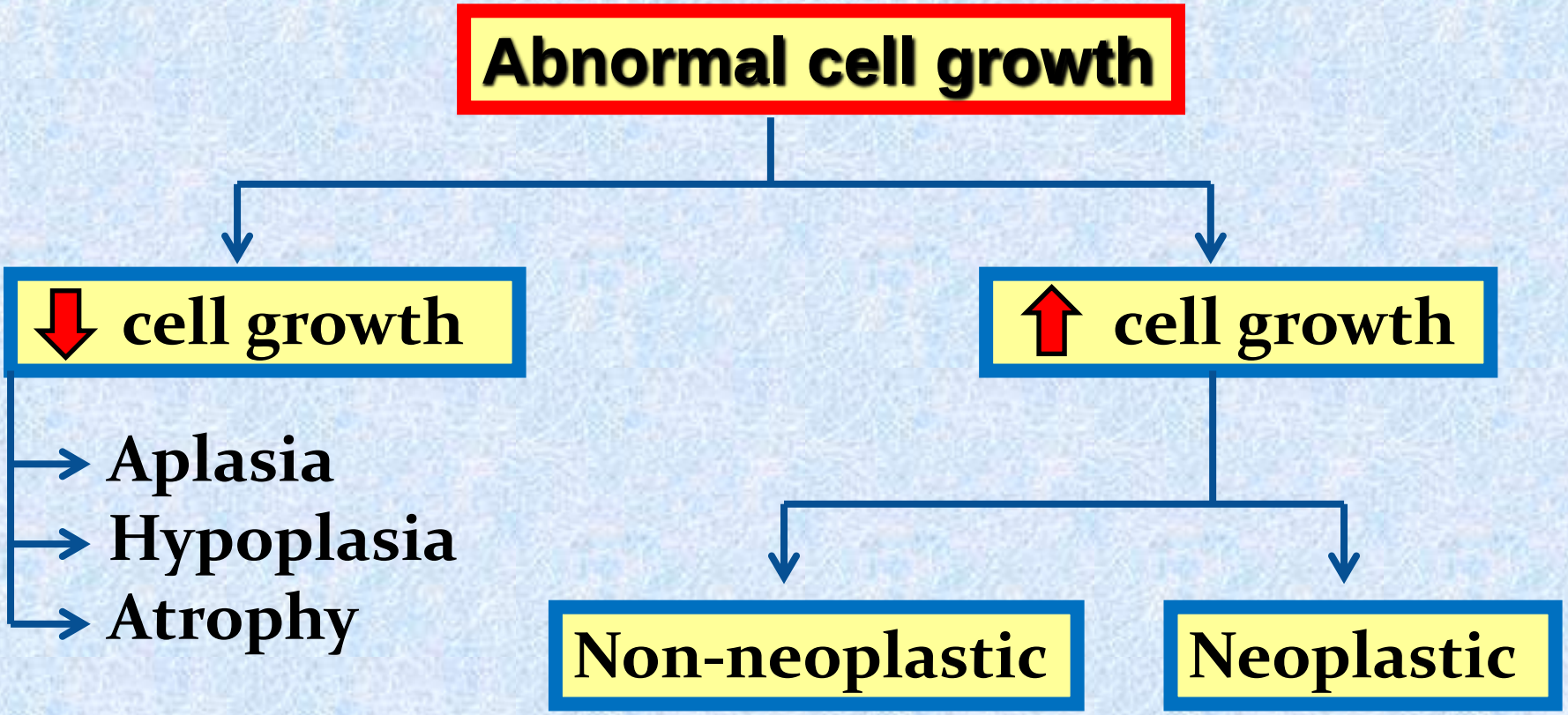
  7. ***Presence or absence of a chronic disease:***

     Diabetes, TB & anemia ↓ rate of growth

INTRODUCTION

- **Features of normal growth:**
  - Coordinated growth
  - Regular rate of growth
  - Limited rate of growth
- **Reparative growth:**
  - **Definition**: Physiological replacement of damaged cells with new healthy cells.
  - **Features**:
    - It has a stimulus
    - It has a purpose
    - It is limited

CLASSIFICATION



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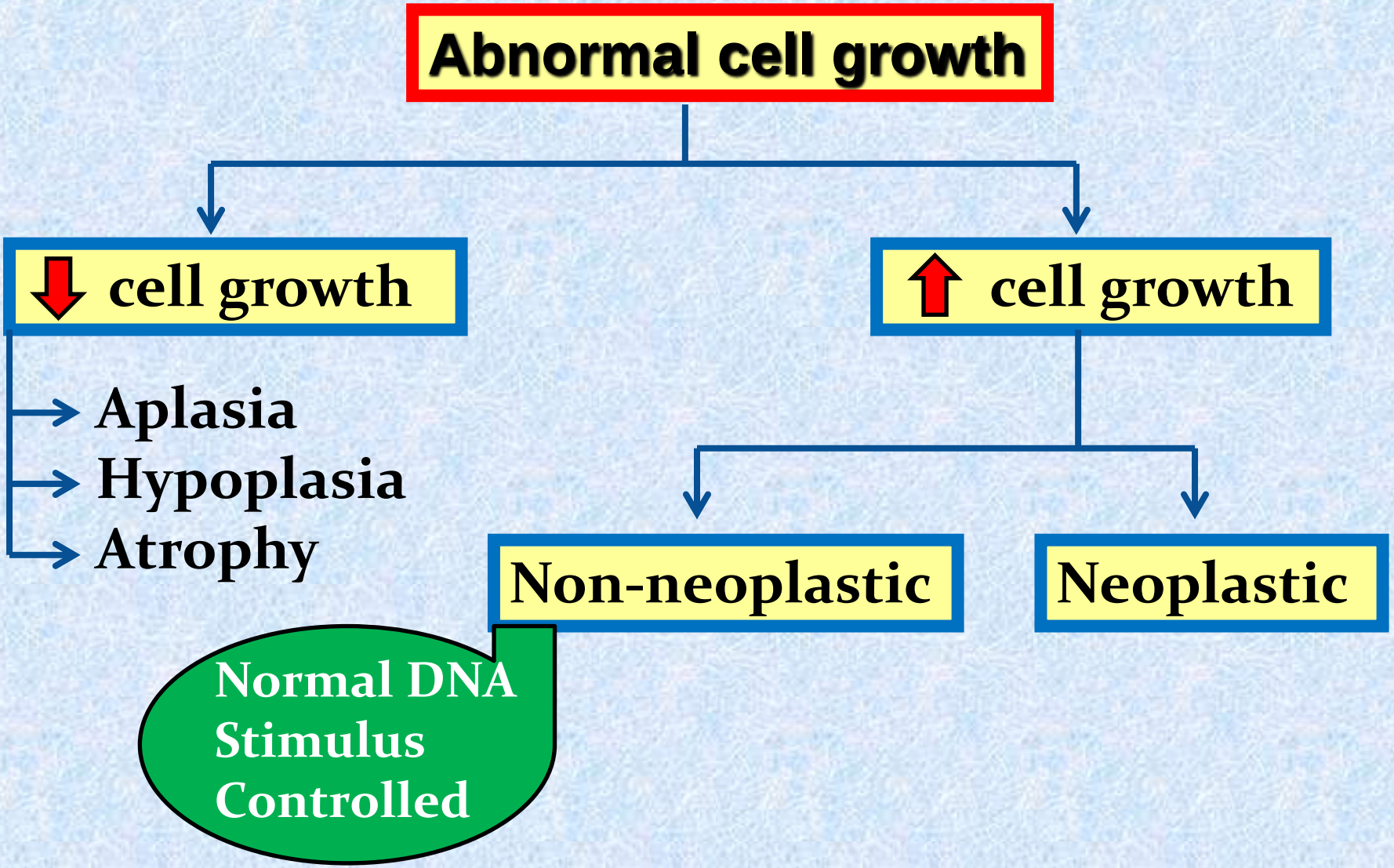

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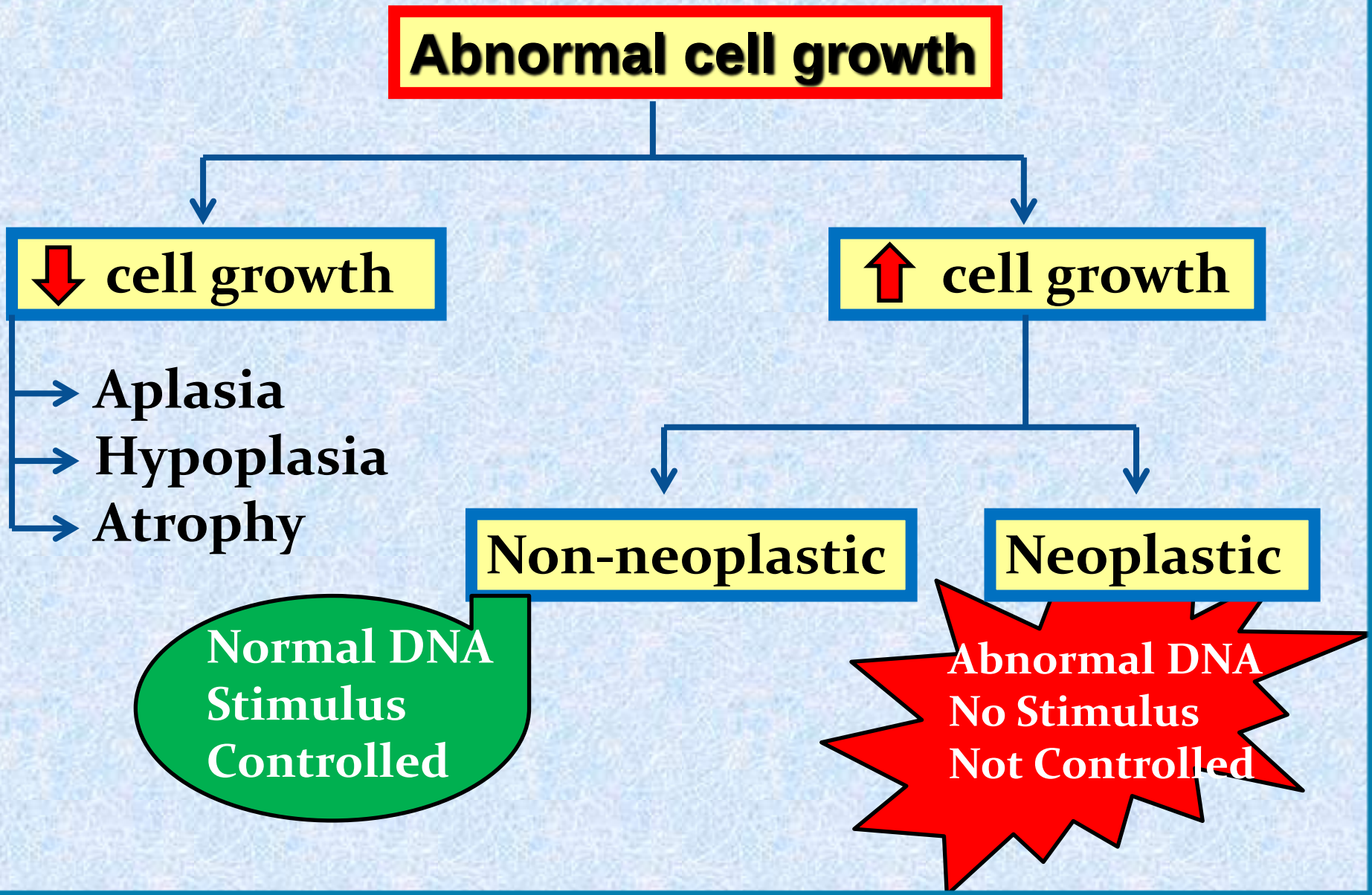

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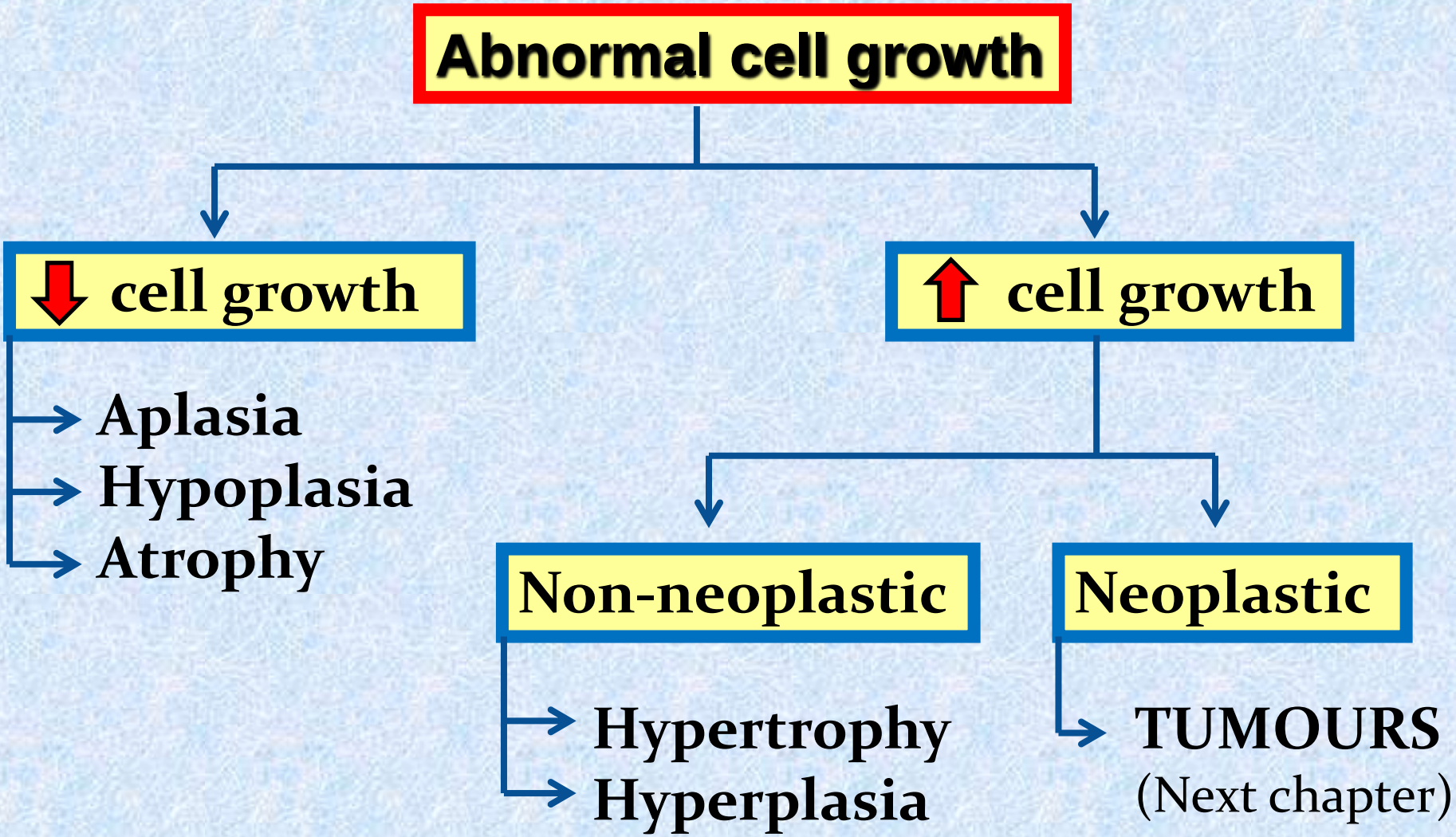

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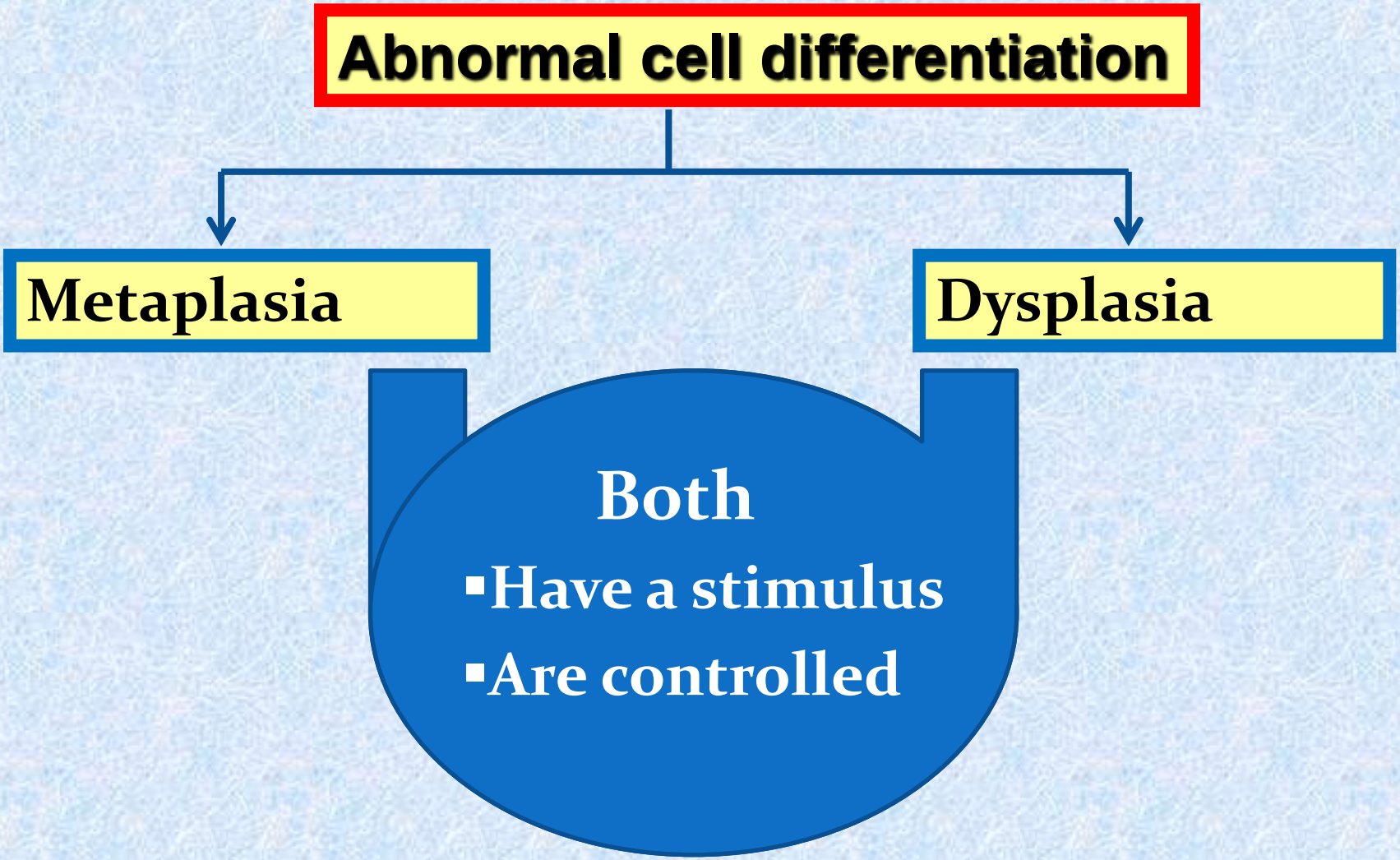
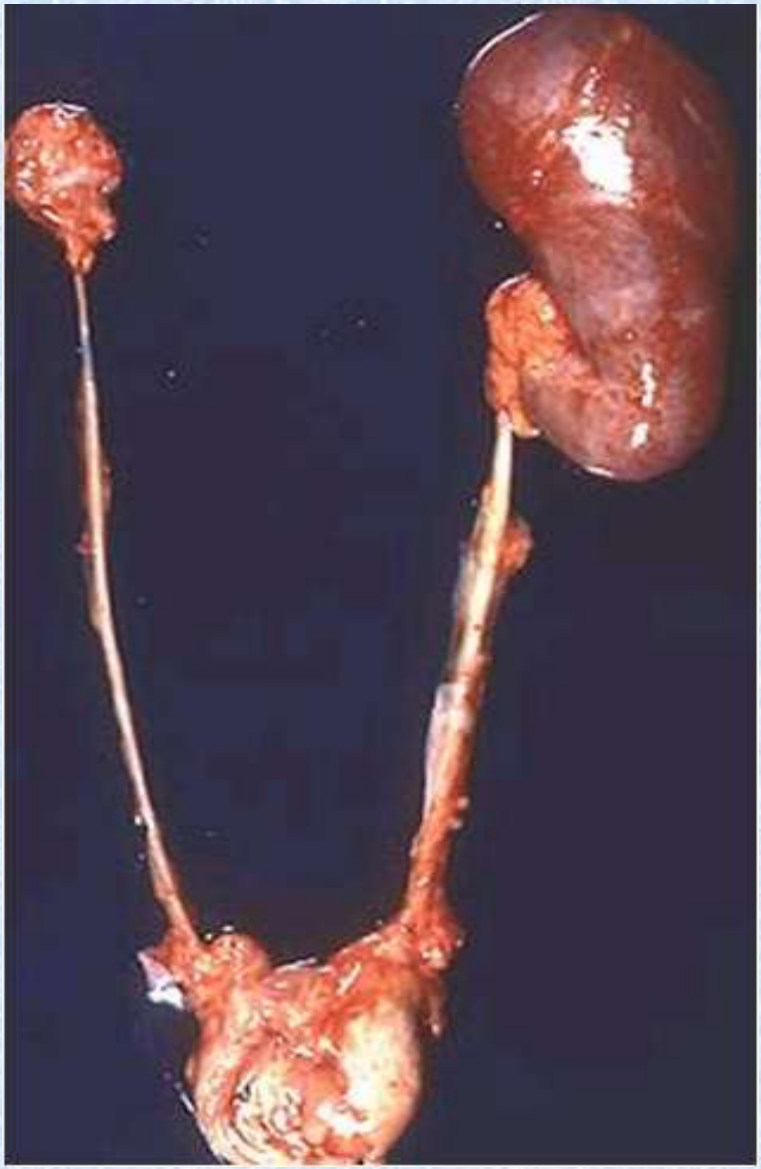


Abnormal cell GROWTH

ABNORMAL CELL GROWTH

- **Agenesis:**
  - Completely absent organ: e.g. absent kidney
- **Aplasia:**
  - Complete failure of development of an organ: e.g. Aplastic kidney
- **Hypoplasia:**
  - Failure of development of an organ to a full mature size: e.g. hypoplastic kidney, hypoplastic testis

ABNORMAL CELL GROWTH



Hypoplastic kidney

ABNORMAL CELL GROWTH

ATROPHY

ABNORMAL CELL GROWTH

- **Atrophy:**
  - ***Definition***:

    Acquired ⇩ in size and weight of an organ due to ⇩ number and/or size of its cell constituent.

ABNORMAL CELL GROWTH

- **Atrophy:**
  - ***Definition***:

    Acquired ⇩ in size and weight of an organ due to ⇩ number and/or size of its cell constituent.
  - ***Types***

    → **Physiological** → **Generalized**
    → **Localized**

    → **Pathological** → **Generalized**
    → **Localized**

ABNORMAL CELL GROWTH

- **Atrophy:**

  Physiological atrophy: Also called INVOLUTION

  - **<u>Generalized</u>**: ⇩ size and weight of the whole body; e.g. senile atrophy in old age
  - **<u>Localized</u>**: ⇩ size and weight of a certain organ; e.g.
    - *In children*: Remnants of tyhyroglossal duct, ductus arterioses and umbilical vessels
    - *In adults*:
      - Atrophy of lymphoid tissue specially thymus after the age of puberty.
      - Atrophy of breast and gonads after menopause.

ABNORMAL CELL GROWTH

- **Atrophy:**

  Pathological atrophy:

  - **Generalized**:
    - **Definition**: ⇩ size and weight of the whole body due to a disease process.
    - **Examples**:
      1. Starvation atrophy: in chronic malnutrition
      2. Chronic debilitating disease (due to ⇧ rate of catabolism): e.g. TB, diabetes, thyrotoxicosis.
      3. Malignant cachexia: in malignant tumours.

ABNORMAL CELL GROWTH

- **Atrophy:**

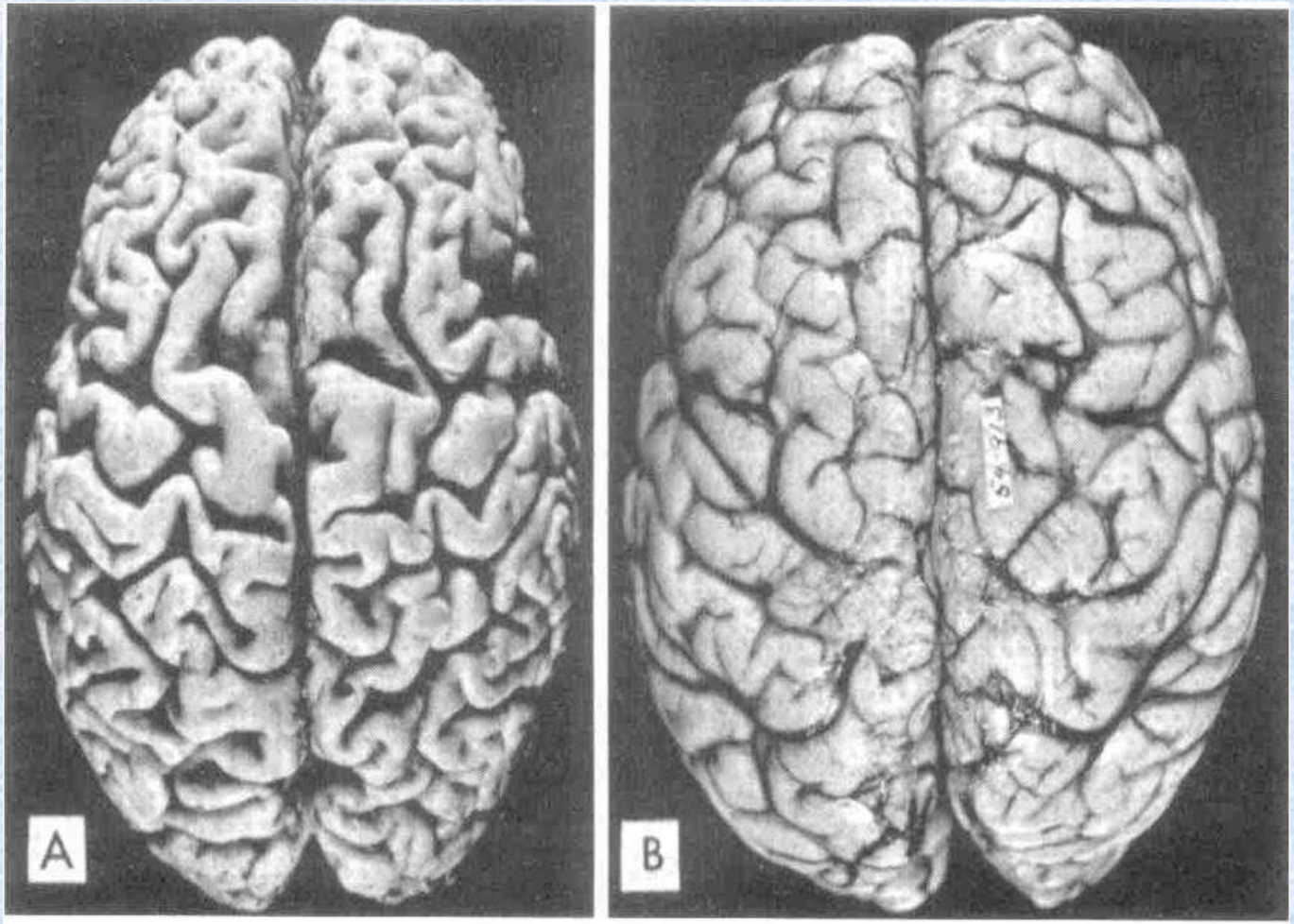
  Pathological atrophy:

  - **Generalized**:
    - **General features**:
      - ***Skin***: Wrinkled (due to loss of subcutaneous fat), thin and non elastic.
      - ***Bones***: rarified and easily fractures due to decalcification and osteoporosis.
      - ***Visceral organs***: Brown atrophy of the heart and brain atrophy.

ABNORMAL CELL GROWTH

- **Atrophy:**

Pathological atrophy:



ABNORMAL CELL GROWTH

- **Atrophy:**

  Pathological atrophy:

  - **<u>Brown atrophy of the heart</u>**:
    - Occurs in cases of sever starvation.
    - Pathological features:
      - ➢The heart become reduced in size
      - ➢The peri-cardial fat is replaced by pale translucent material
      - ➢The blood vessels become tortuous.
      - ➢Lipofuscin pigment accumulate in the cardiac muscle fibers leads to brown color, so called brown atrophy

ABNORMAL CELL GROWTH

- **Atrophy:**

  Pathological atrophy:

  - **<u>Localized</u>**:
    - ***Definition***: ⇩ size and weight of a diseased organ.
    - ***Types***:

      1. Ischemic atrophy
      2. Pressure atrophy
      3. Disuse atrophy
      4. Neuropathic atrophy
      5. Hormonal atrophy
      6. Idiopathic atrophy

ABNORMAL CELL GROWTH

- **Atrophy:**

  Pathological atrophy:

  - **Localized**:

    1.Ischemic atrophy:

    - Pathogenesis: ↓ blood supply and hypoxia ⟶ gradual apoptosis of the ischemic cells
    - Examples:
      - Atherosclerosis of coronary arteries ⟶ ischemic atrophy of the heart and replacement by fibrous tissue
      - Atherosclerosis of cerebral arteries ⟶ ischemic atrophy of brain tissue with replacement by glial tissue.

ABNORMAL CELL GROWTH

- **Atrophy:**

  Pathological atrophy:

  - **Localized**:

    2. Pressure atrophy:

    - Pathogenesis: Pressure on organ tissue ↓ blood supply and hypoxia ⟶ gradual organ ischemia
    - Examples:
      - Aortic aneurysm ⟶ atrophy of sternum and vertebrae but not the inter-vertebral discs (they are avascular).
      - Peri-portal fibrosis and amyloidosis ⟶ atrophy of liver cells

ABNORMAL CELL GROWTH

- **Atrophy:**

  Pathological atrophy:

  - **Localized**:

    3. Disuse atrophy:

    - Pathogenesis: Prolonged unused organ ⟶ atrophy of its cells.
    - Examples:
      - Prolonged limb immobilization ⟶ Atrophy of the affected muscles, ligaments and even bone.
      - Atrophy of the renal tubules that drain non-functioning renal glomeruli.

ABNORMAL CELL GROWTH

- **Atrophy:**

  Pathological atrophy:

  - **Localized**:

    4. Neuropathic atrophy:

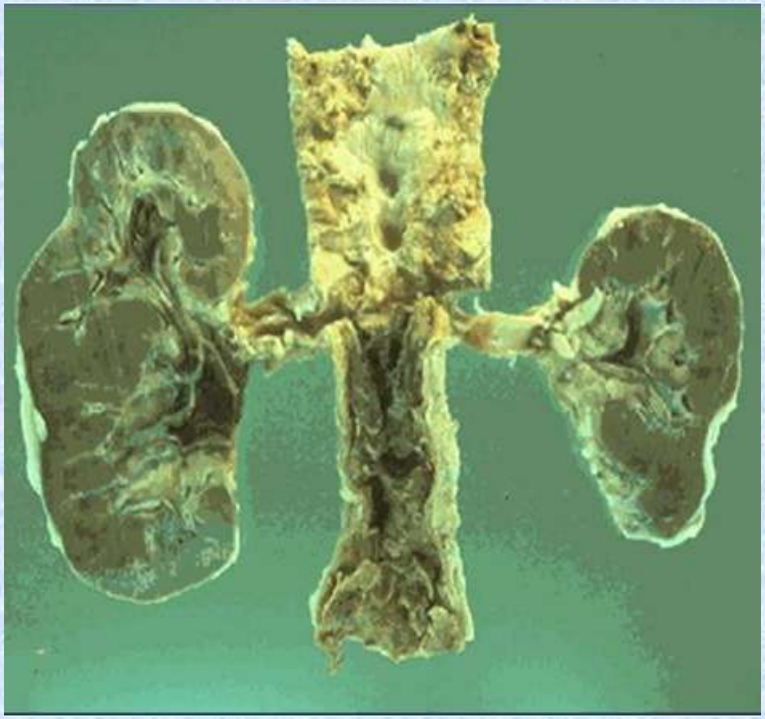
    - Pathogenesis: Prolonged unused organ → atrophy of its cells.
    - Examples: Hemiplegia, paraplegia and poliomyelitis → Atrophy of affected muscles, ligaments and bone.

    5. Endocrine atrophy:

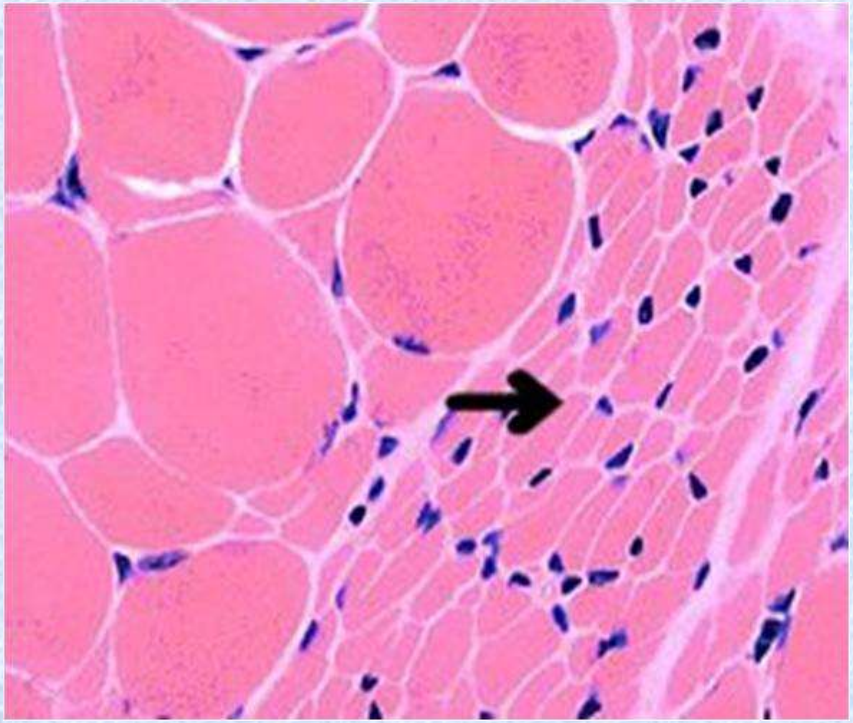
    - Pathogenesis: depletion of a hormone → atrophy of this hormone dependent organ.
    - Example: atrophy of the breast and uterus after removal of the ovary (oophrectomy).

ABNORMAL CELL GROWTH

- **Atrophy:**



Atrophic kidney



Muscle atrophy

ABNORMAL CELL GROWTH

HYPERPLASIA

ABNORMAL CELL GROWTH

- **Hyperplasia:**
  - ***Definition***: Increased size of an organ or tissue due to increase in the NUMBER of its cell constituent.

ABNORMAL CELL GROWTH

- **Hyperplasia:**
  - ***Definition***: Increased size of an organ or tissue due to increase in the NUMBER of its cell constituent.
  - ***Features***:
    - Occurs as a result of a specific stimulus.
    - It continues as the stimulus persists
    - Stops when the stimulus is removed.
    - Reversible cell proliferation
    - Has a useful purpose
    - Hyperplasia may be focal or diffuse

ABNORMAL CELL GROWTH

- **Hyperplasia:**
  - ***Examples***:

A. Physiological: e.g.

- Increased size of the breast after puberty, during pregnancy and lactation due to excess estrogen and progesterone
- Increased in size of the gonads (ovary and testis) and the secondary sexual organs after puberty due to hormonal change.

ABNORMAL CELL GROWTH

- **Hyperplasia:**

B. Pathological: e.g.

1.Compensatory hyperplasia: e.g.

- Hyperplasia of bone marrow after hemorrhage or excessive haemolysis.
- Hyperplasia of one testis after surgical removal of the other one.

2.Hormonal hyperplasia: e.g.

- Endometrial and breast hyperplasia as a result of exposure to excess estrogenic stimulation.
- Thyroid epithelial hyperplasia in response to excess TSH leading to thyrotoxicosis.

ABNORMAL CELL GROWTH

- **Hyperplasia:**

B. Pathological: e.g.

3. Reparative (regenerative) hyperplasia: e.g.

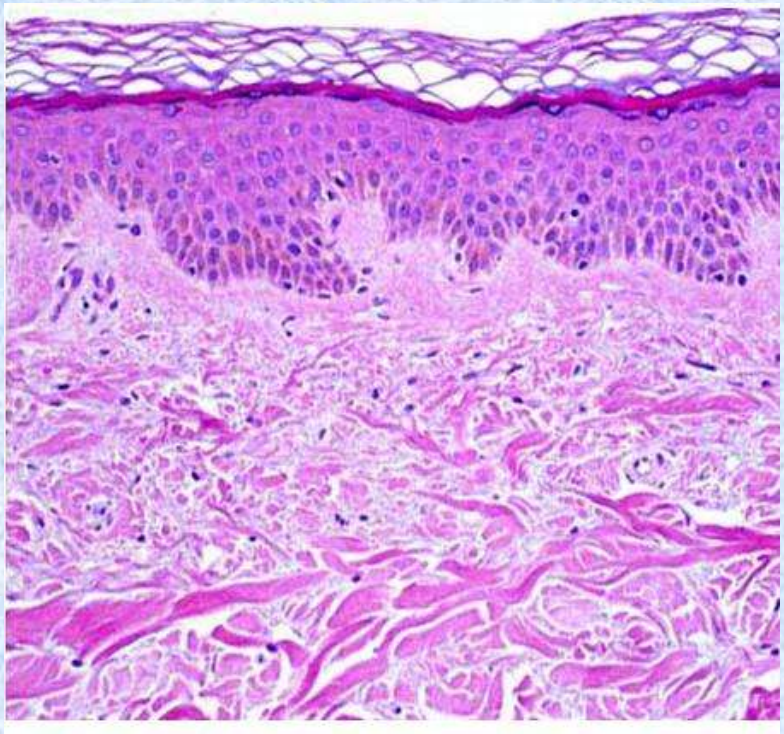
- Formation of regeneration nodules in case of liver cirrhosis

4. Irritative hyperplasia e.g.

- Hyperplasia of lymphoid tissue during chronic infection and toxemia which is due to antigenic stimulation.

ABNORMAL CELL GROWTH

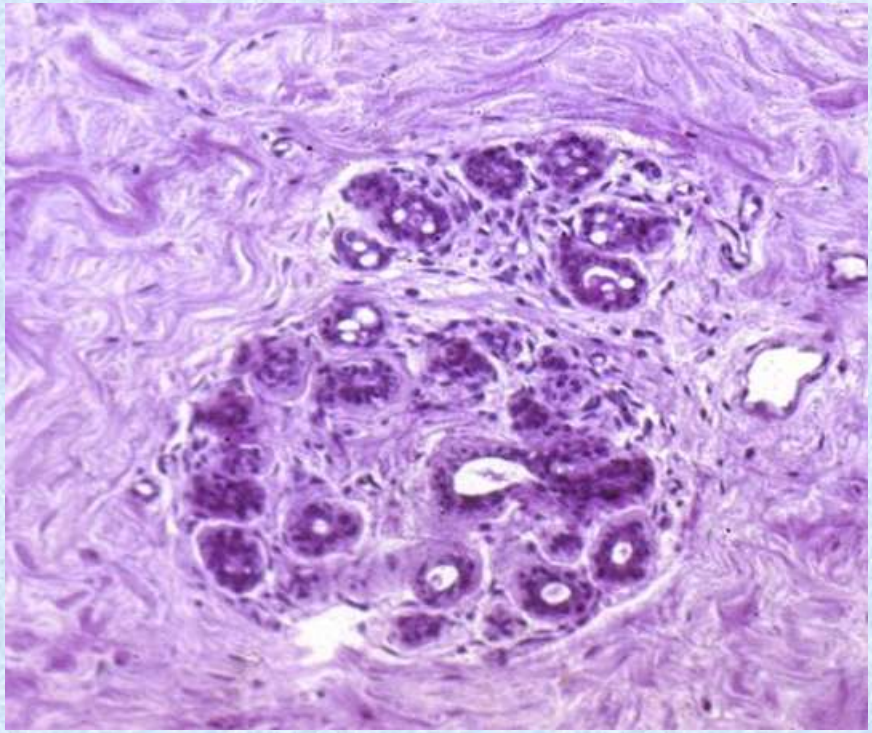
- **Hyperplasia:**

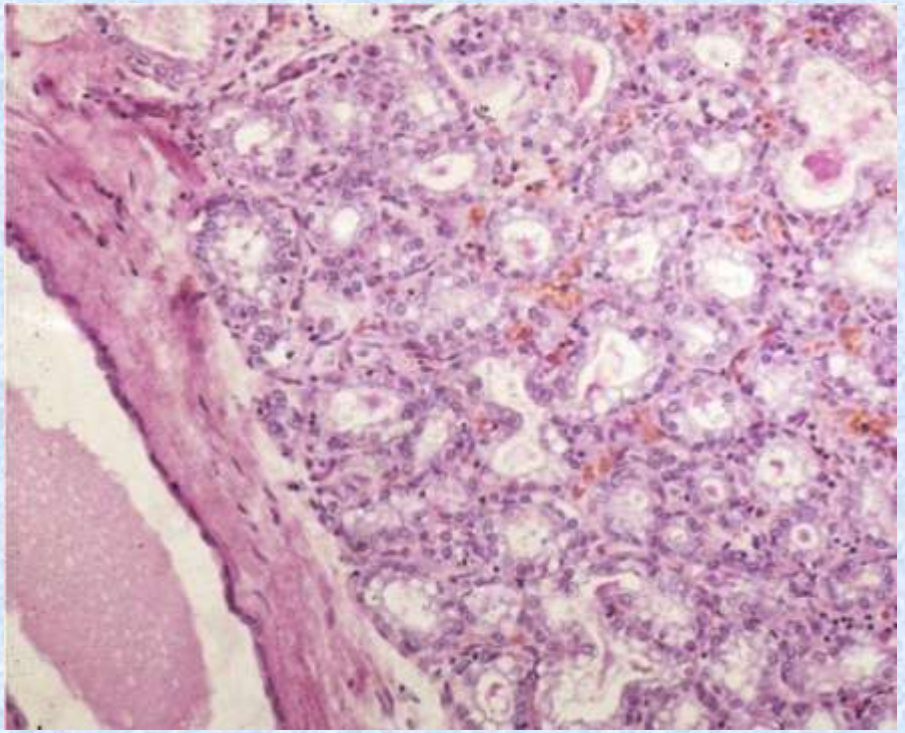


Please……Comment???

ABNORMAL CELL GROWTH

- **Hyperplasia:**

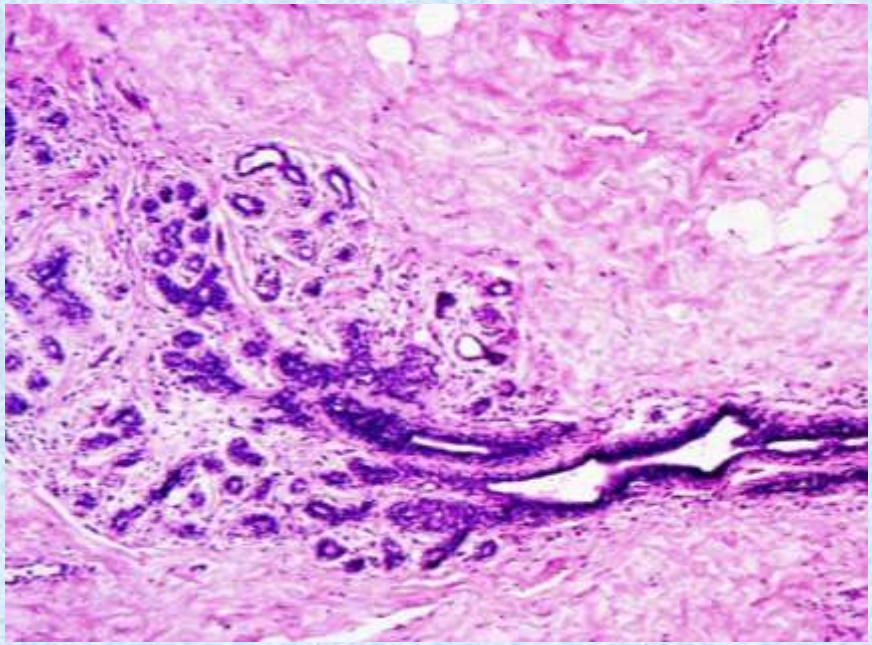


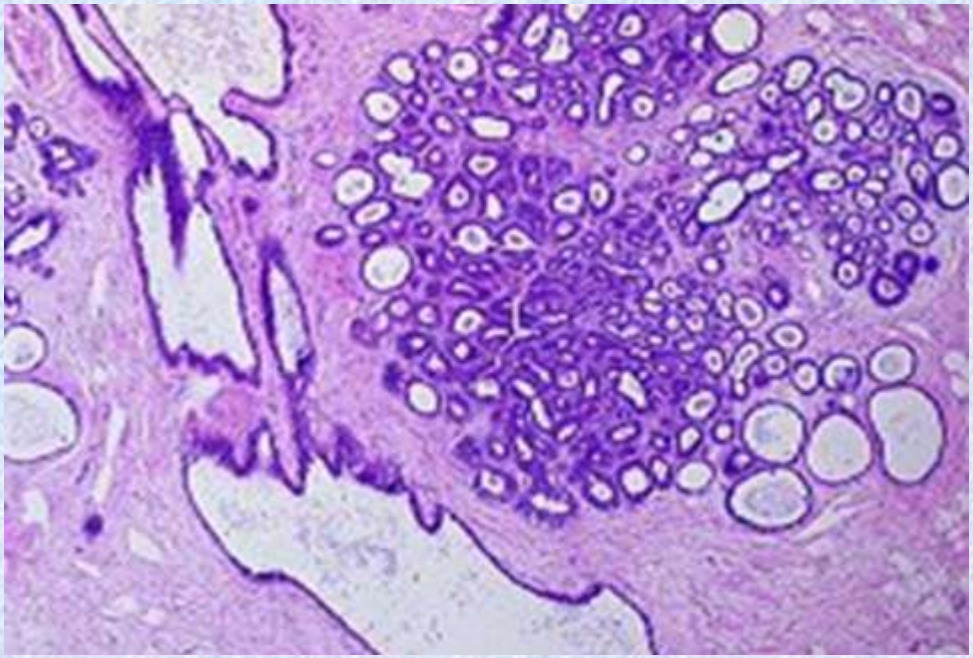


Breast……Comment???

ABNORMAL CELL GROWTH

- **Hyperplasia:**

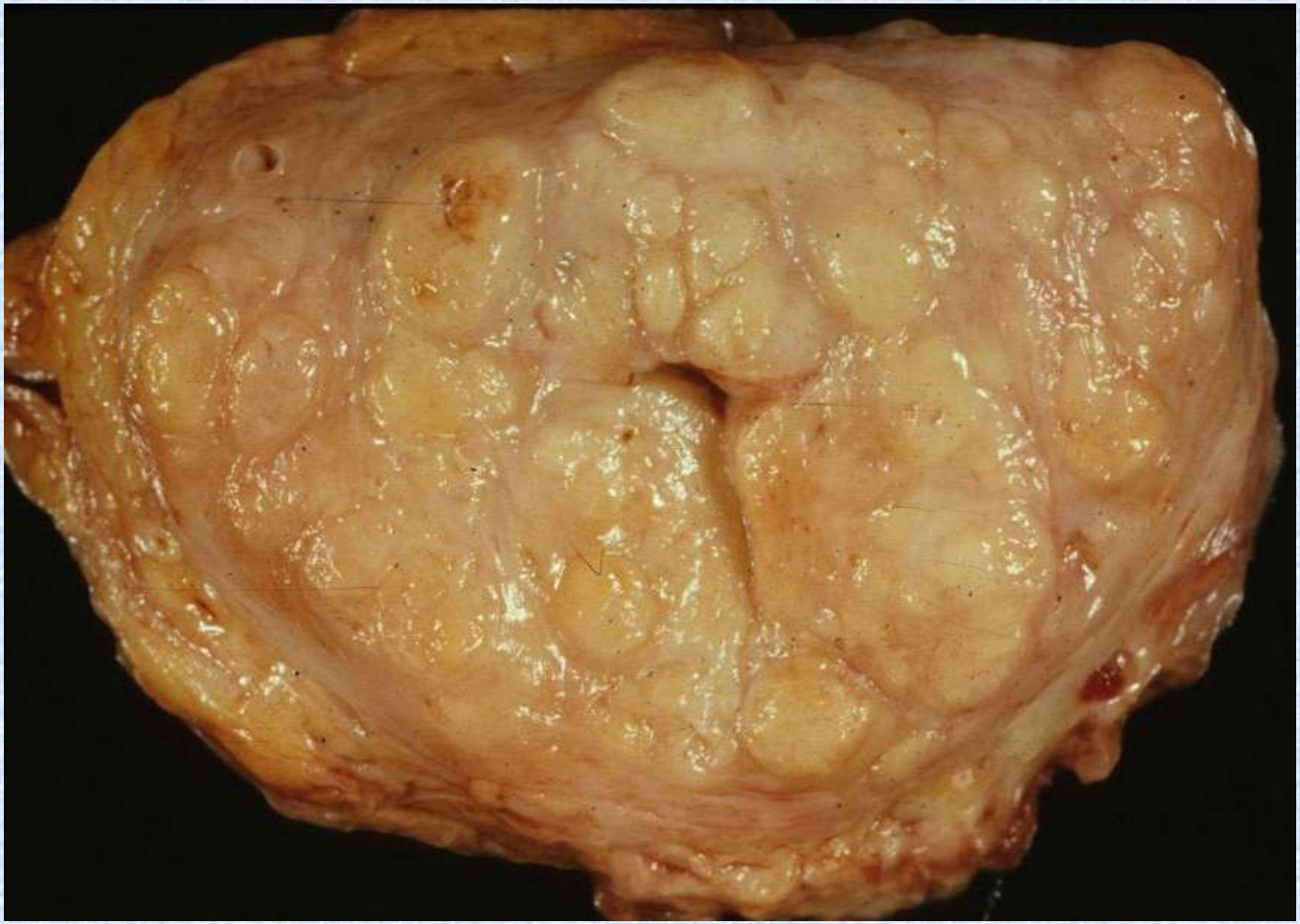




Breast……
Comment???

ABNORMAL CELL GROWTH

- **Hyperplasia:**



Prostate……Comment???

ABNORMAL CELL GROWTH

Hypertrophy

ABNORMAL CELL GROWTH

- **Hypertrophy:**

  Definition:

  - Increase in size of an organ or tissue due to increase in the **SIZE** of its cell constituent.

ABNORMAL CELL GROWTH

- **Hypertrophy:**

  Features

  - The stimulus is always a mechanical.
  - Occurs in permanent cells which cannot divide to compensate excessive functional demand.
  - Hypertrophy should be distinguished from hyperplasia, in which there is ⇧ in cell number.
  - Hypertrophy and hyperplasia occur frequently together, e.g. enlargement of uterus during pregnancy.
  - Pure hypertrophy without accompanying hyperplasia occurs only in athletic muscles.

ABNORMAL CELL GROWTH

- **Hypertrophy:**

  Types:

  A. Physiological hypertrophy: e.g.

  - Uterus in pregnancy in which is partly mechanical and partly hormonal due to estrogen effect.

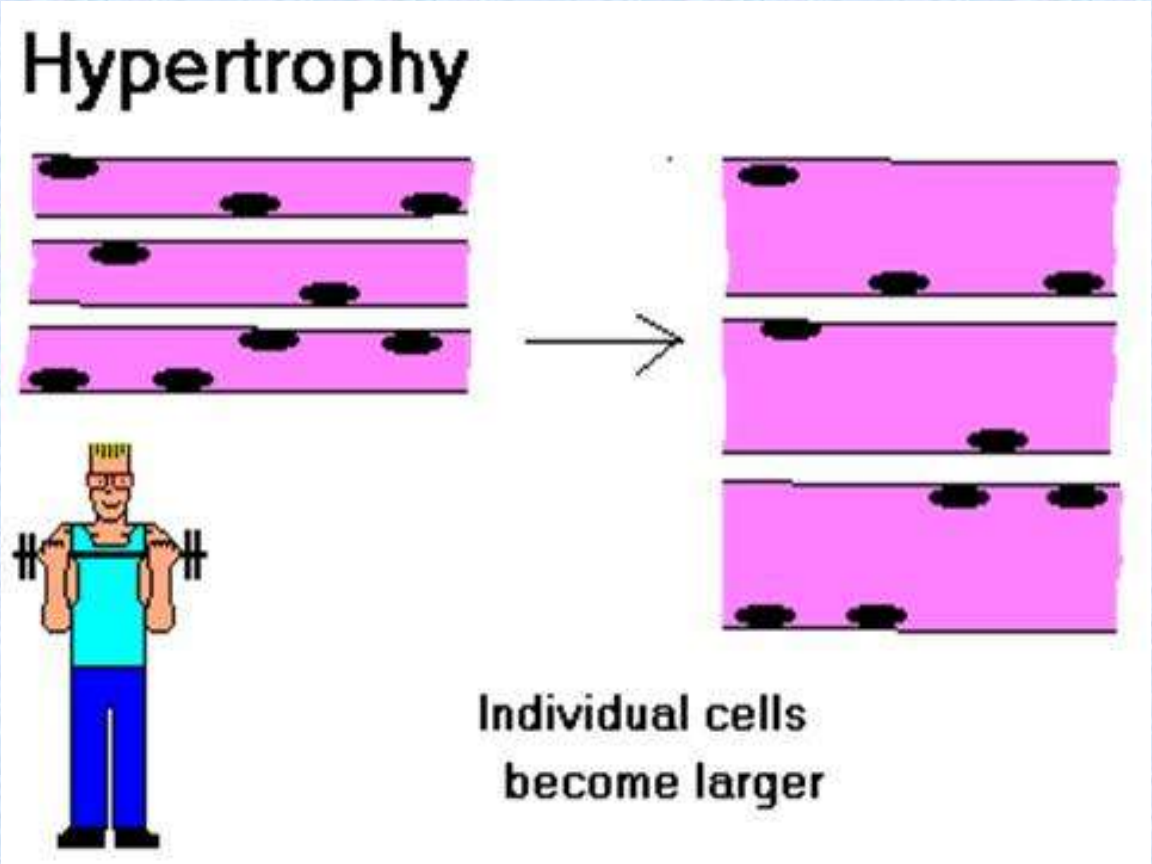
  - Skeletal muscle: in muscles of the athlete due to the mechanical work overload.

ABNORMAL CELL GROWTH

- **Hypertrophy:**

  Types:

  A. Physiological hypertrophy: e.g.



ABNORMAL CELL GROWTH

- **Hypertrophy:**

Types:

B. Pathological hypertrophy: e.g.

- *Adaptive hypertrophy:*

1. **Cardiac muscle:** Due to work overload; e.g.:

Left ventricle:

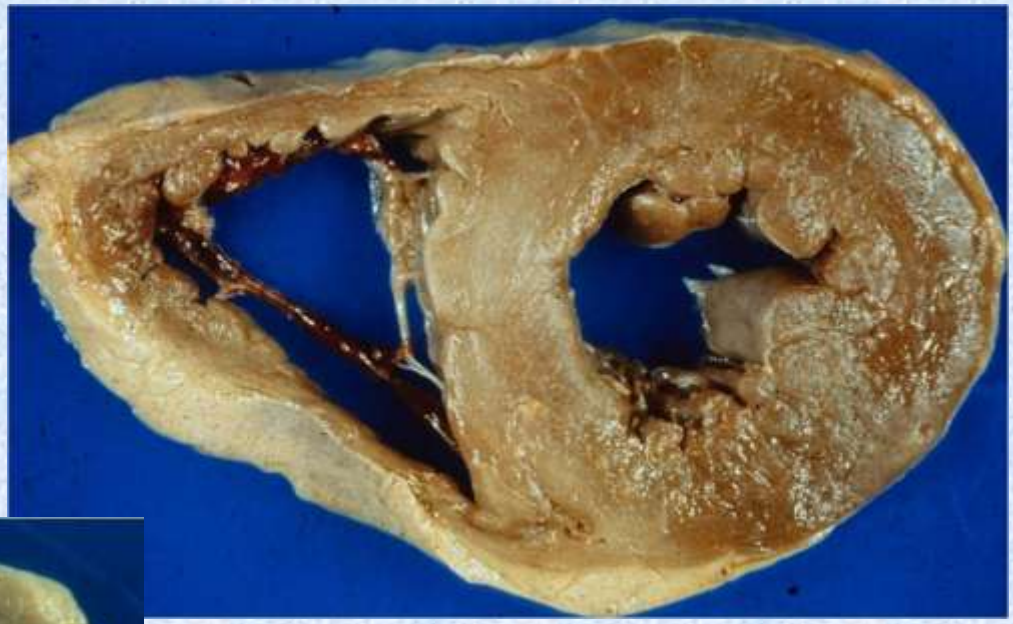
- Aortic stenosis or incompetence
- Mitral incompetence
- Systemic hypertension
- Severe anemia
- Thyrotoxcosis

Right ventricle:

- Pulmonary stenosis and incompetence
- Mitral stenosis
- Pulmonary hypertention
- Congenital left to right shunt as ASD, VSD, PDA

ABNORMAL CELL GROWTH

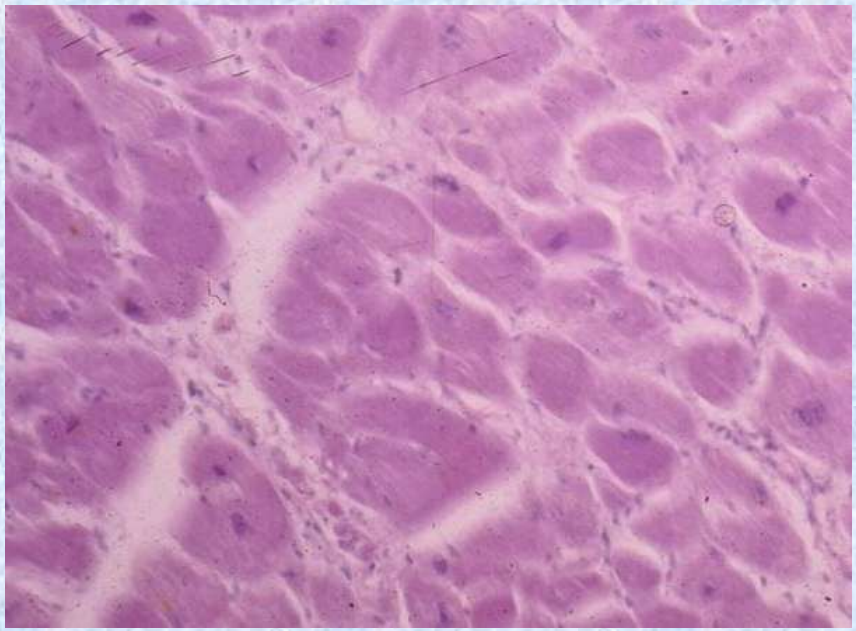
- **Hypertrophy:**

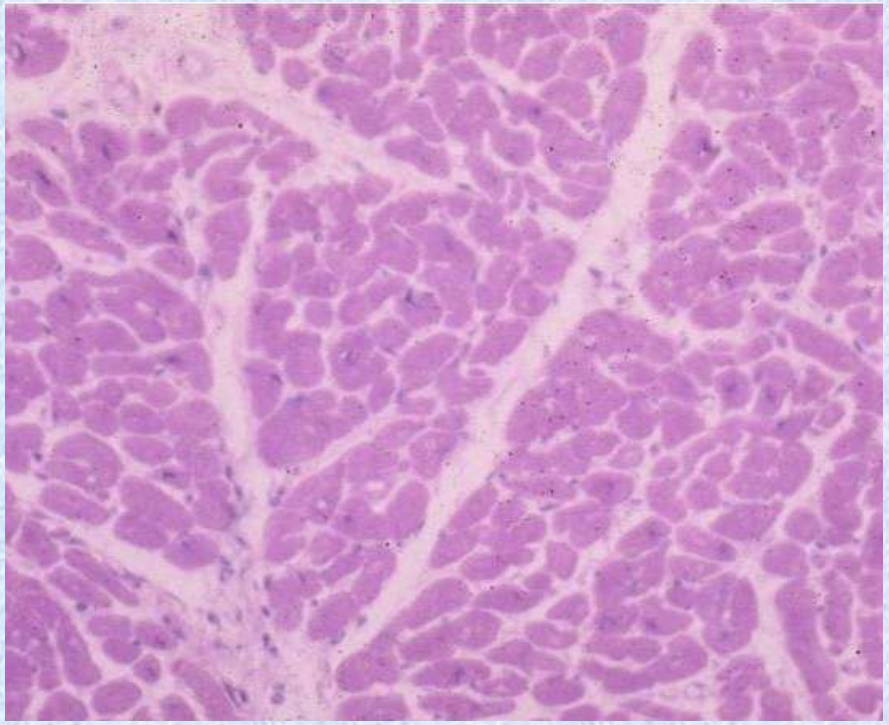


Myocardium…….
…….Comment???

ABNORMAL CELL GROWTH

- **Hypertrophy:**





Myocardium…….
…….Comment???

ABNORMAL CELL GROWTH

- **Hypertrophy:**

Types:

B. Pathological hypertrophy: e.g.

- *Adaptive hypertrophy:*

2. GIT hypertrophy: Due to work overload; e.g.:

- Esophagus: as in post inflammatory stenosis or stricture by a tumour at distal esophagus.
- Stomach: as in congenital pyloric stenosis or healed peptic ulcer or stenosis by a tumour.
- Intestine: as in healed TB, healed gastroenteritis, or annular tumour.

ABNORMAL CELL GROWTH

- **Hypertrophy:**

  Types:

  B. Pathological hypertrophy: e.g.

  - *Adaptive hypertrophy*:

    3. **Wall of Urinary bladder**: as in bladder neck obstruction by benign prostatic hyperplasia and urethral stricture.
    4. **Arteries**: in muscle wall due to hypertension

  - *Compensatory hypertrophy*: in paired organs when one is pathologically destroyed or surgically removed; nepherectomy of one kidney leads to hypertrophy and enlarged size of the other kidney.

ABNORMAL CELL GROWTH

- **Hypertrophy:**

Which is more serious??

- ***ATROPHY***
- ***HYPERPLSIA***
- ***HYERTROPHY***

Abnormal cell DIFFERNTIATION

Abnormal cell DIFFERNTIATION

METAPLASIA

Abnormal cell DIFFERNTIATION

- **Metaplasia:**

  Definition:

  A change of one type of **differentiated (mature)** tissue to another type of **differentiated** tissue of the same category.

Abnormal cell DIFFERNTIATION

- **Metaplasia:**

Definition:

A change of one type of **differentiated (mature)** tissue to another type of **differentiated** tissue of the same category.

Types:

A. Epithelial metaplasia

B. Connective tissue metaplasia

C. Tumor metaplasia

Abnormal cell DIFFERNTIATION

- **Metaplasia:**

A. Epithelial metaplasia:

1. ***Squamous metaplasia:*** Any type of epithelium change to sq. epithelium due to persistent chronic irritation, chronic infection or stones e.g.

➢UB and renal pelvis: transitional → sq. epithelium in bilharziasis, cystitis, pyelonephritis or renal stones

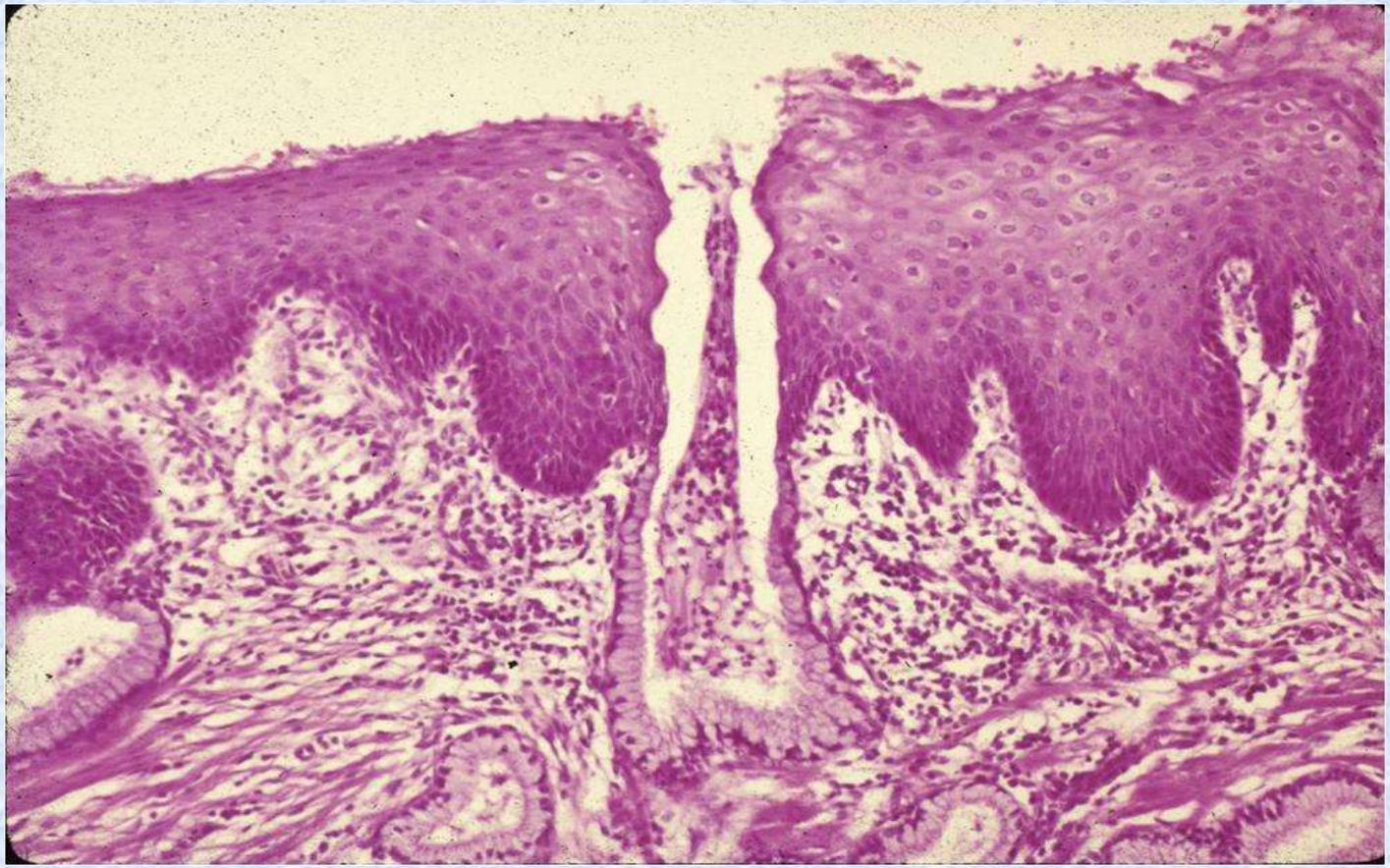
➢Gall bladder: columnar to → sq. epithelium as in chronic cholecystitis and gall stones.

➢Bronchi: pseudo-stratified columnar ciliated → sq. epithelium in cases of smoking, chronic bronchitis, bronchiectasis, lung abscess , and TB.

Abnormal cell DIFFERNTIATION

- **Metaplasia:**

  A. Epithelial metaplasia:

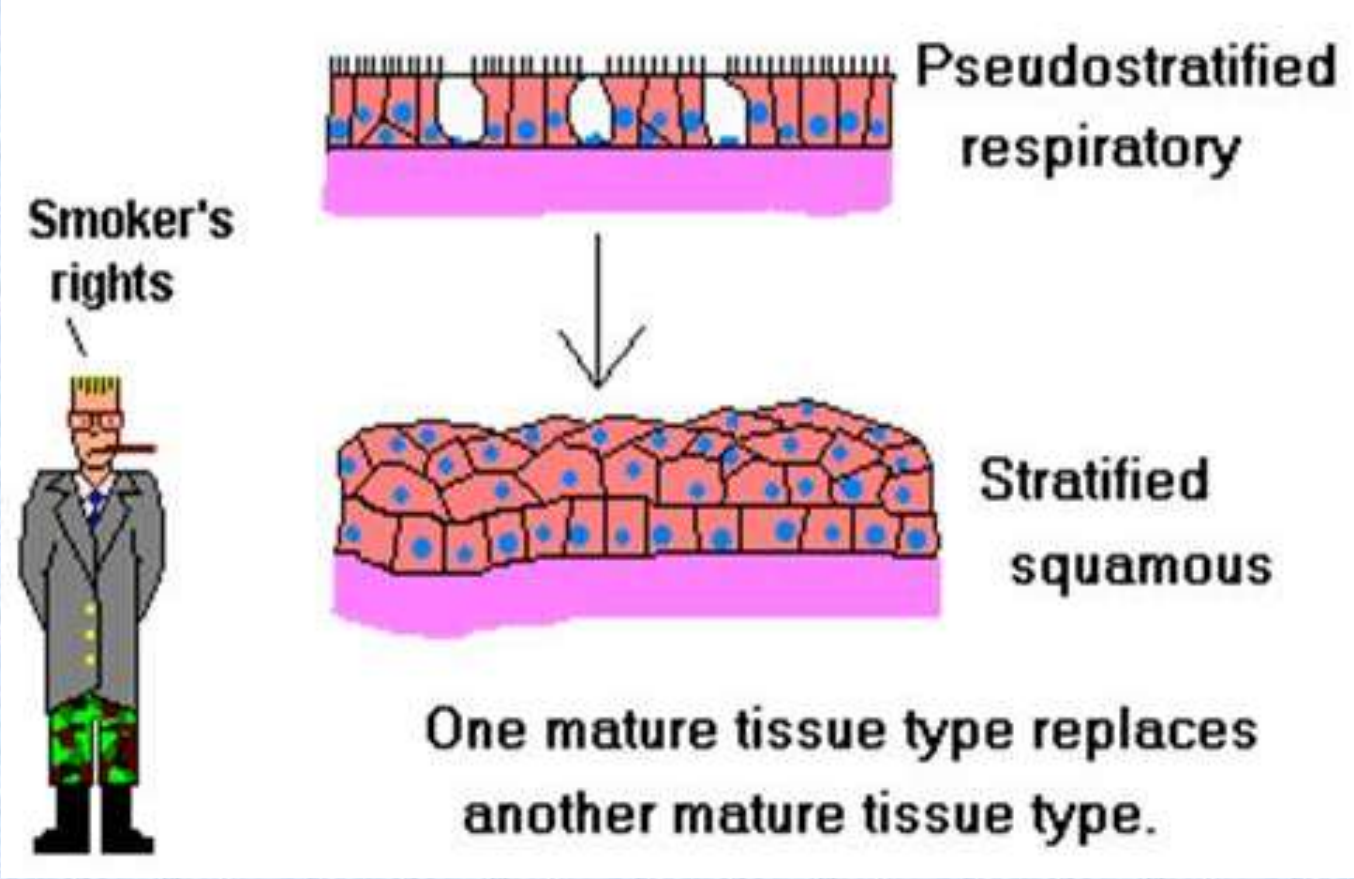


Endocervix……Comment???

Abnormal cell DIFFERNTIATION

- **Metaplasia:**

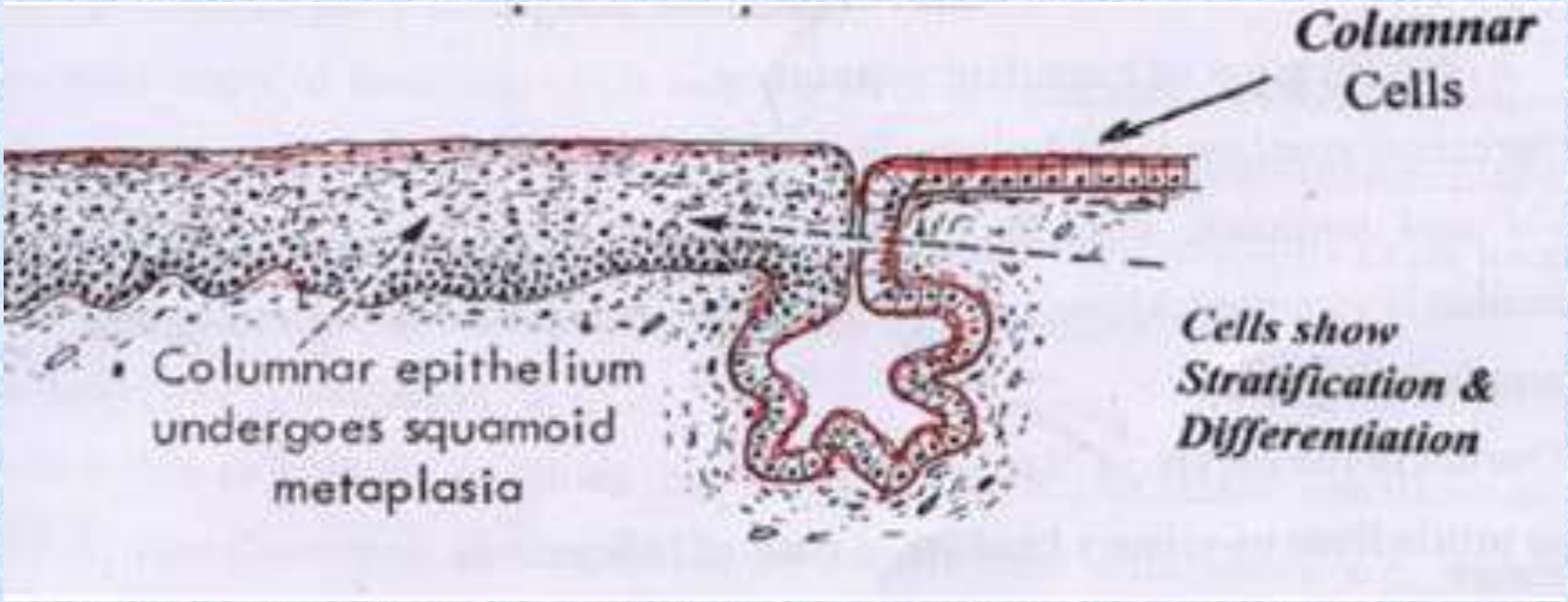
  A. Epithelial metaplasia:



Abnormal cell DIFFERNTIATION

- **Metaplasia:**

  A. Epithelial metaplasia:



Abnormal cell DIFFERNTIATION

- **Metaplasia:**

A. Epithelial metaplasia:

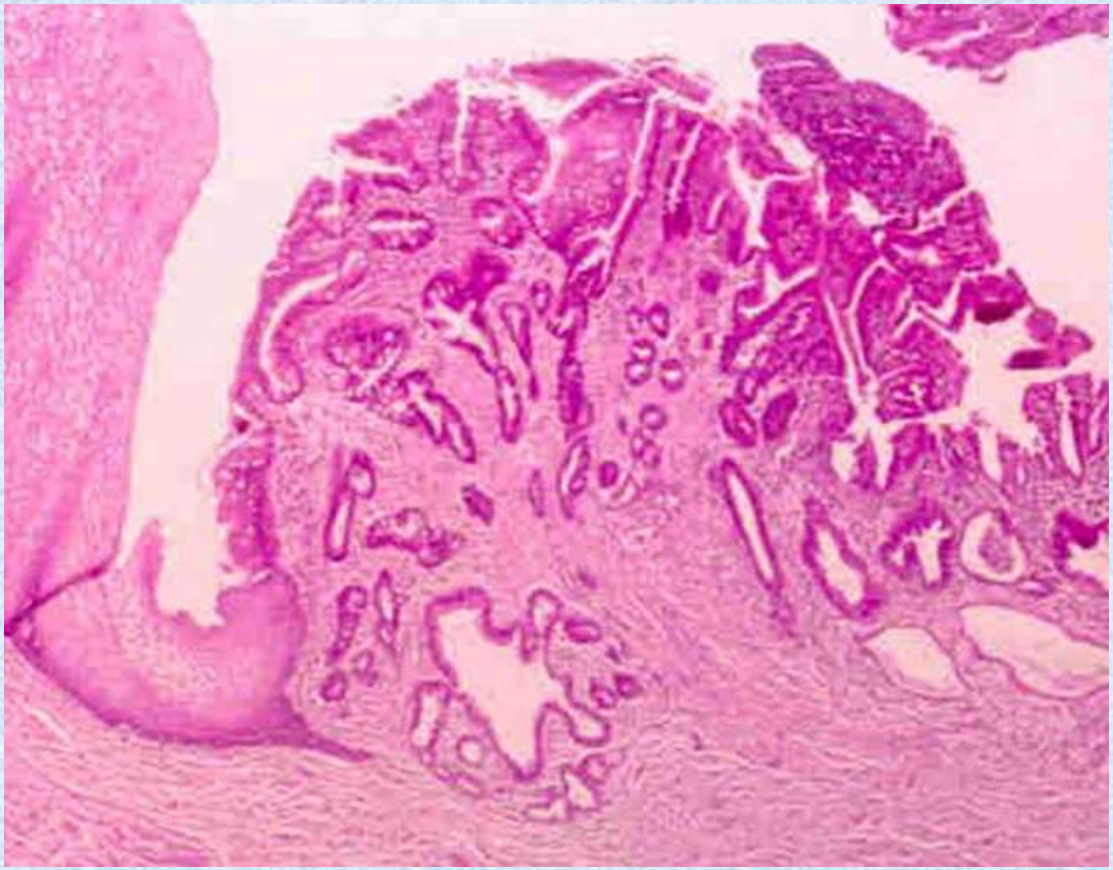
2. Glandular metaplasia: change of one type of epithelium into columnar epithelium e.g.

- Uterus: squamous epithelium of the ectocervix ⟶ columnar epithelium in cases of cervical erosion.
- Oesophagus: squamous epithelium of lower oesophagus ⟶ columnar epithelium in cases of reflux oesophagitis (Barrett's oesophagitis, pre-cancerous lesion)
- Stomach: gastric epithelium ⟶ columnar intestinal epithelium in cases of peptic ulcer

Abnormal cell DIFFERNTIATION

- **Metaplasia:**

  A. Epithelial metaplasia:



Lower oesophagus……..Comment???

Abnormal cell DIFFERNTIATION

- **Metaplasia:**

B. Connective tissue metaplasia:

- Osseus metaplasia: soft tissue lesions → bone due to dystrophic calcification. e.g.
  - Scars, atheromatous lesion, long standing goiter, and caseous foci of tuberculosis.
  - Haematoma change to bone due to dystrophic calcification in case of myositis ossificans

C. Serosal metaplasia:

- Change of the flat serosal cells to cuboidal columnar, glandular or squamous cells

Abnormal cell DIFFERNTIATION

- **Metaplasia:**

D. Tumour metaplasia:

- Adenocarcinoma of the uterus, gall bladder or lung may contain foci of squamous cells carcinoma.
- Adenocarcinoma of the breast may contain foci of mucoid metaplasia.
- Stromal tumours or connective tissue tumours may show foci of bone differentiation.

Abnormal cell DIFFERNTIATION

DYSPLASIA

Abnormal cell DIFFERNTIATION

- **Dysplasia:**
  - ***Definition:*** means partial loss of differentiation.

Abnormal cell DIFFERNTIATION

- **Dysplasia:**
  - ***Definition:*** means partial loss of differentiation.
  - ***Features***

➢The involved epithelium shows features of **cellular atypia or features of malignancy**

- Pleomorphism (variation in cell size and shape).
- Hyperchromatic nuclei
- Increased nucleo-cytoplasmic ratio
- Increased mitotic activity.
- Loss of polarity (orientation) of cells.
- Impaired function.
- No invasion of basement membrane.

Abnormal cell DIFFERNTIATION

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  - ***Definition:*** means partial loss of differentiation.
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- Impaired function.
- **No invasion of basement membrane.**

Abnormal cell DIFFERNTIATION

- **Dysplasia:**
  - ***Aetiology:***

    It represents reaction to underlying inflammation or to chronic irritation.
  - ***Grades:***
    1. Mild: Dysplastic change involve only basal 1/3 of the epithelium.
    2. Moderate: Dysplastic change involve only basal 2/3 of the epithelium.
    3. Severe: Dysplastic change involve all layers of the epothelium.

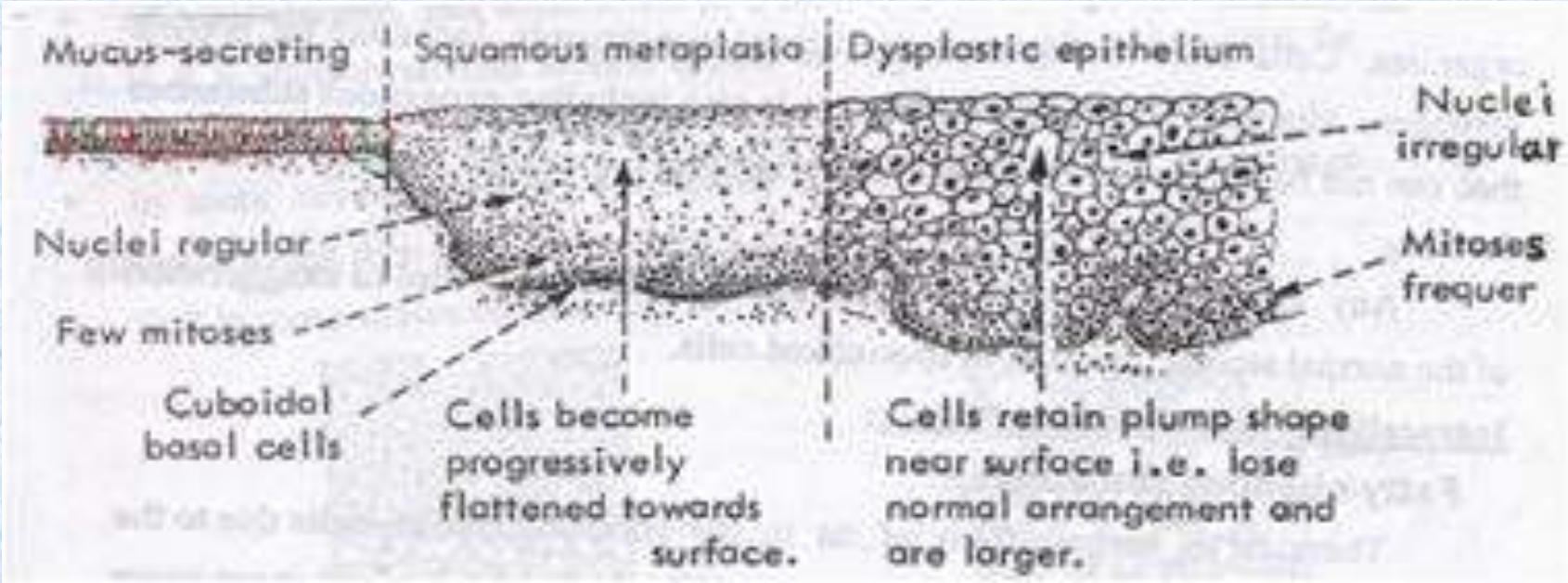
    NB: Sever dysplasia = carcinoma in situ

Abnormal cell DIFFERNTIATION

- **Dysplasia:**
  - ***Common sites***
    1. Cervix uteri
    2. Skin and mucous membranes
    3. Liver
  - ***Fate:***
    - Mild and moderate dysplasia are reversible when the evoking stimulus is removed.
    - Severe degree is **pre-malignant.**

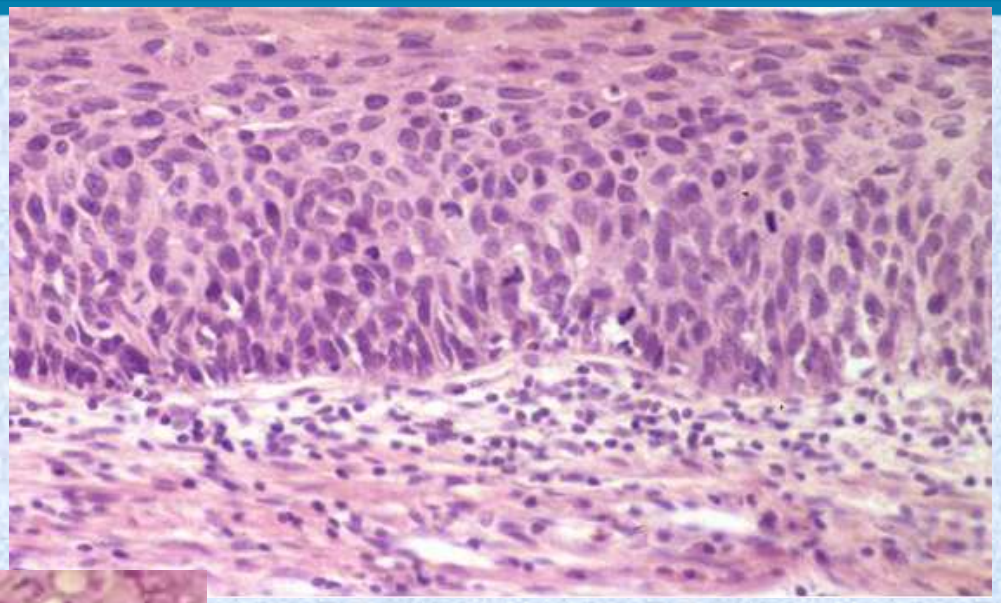
Abnormal cell DIFFERNTIATION

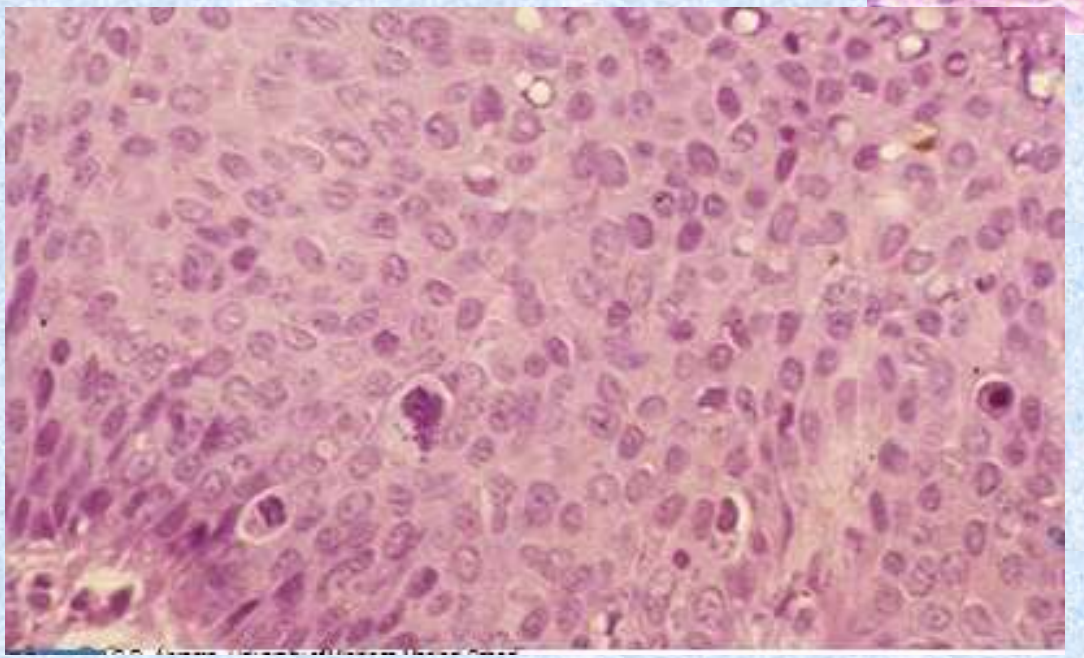
- **Dysplasia:**



Abnormal cell DIFFERNTIATION

- **Dysplasia:**





Comment???

GOOD LUCK

Dr. Ahmed Roshdi