Cellular Adaptations (Growth disturbances)

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Cellular adaptations

The adaptive responses include:

I. Congenital defect:

1) Agenesis.

2) Aplasia.

II. Acquired defect:

1) Atrophy.

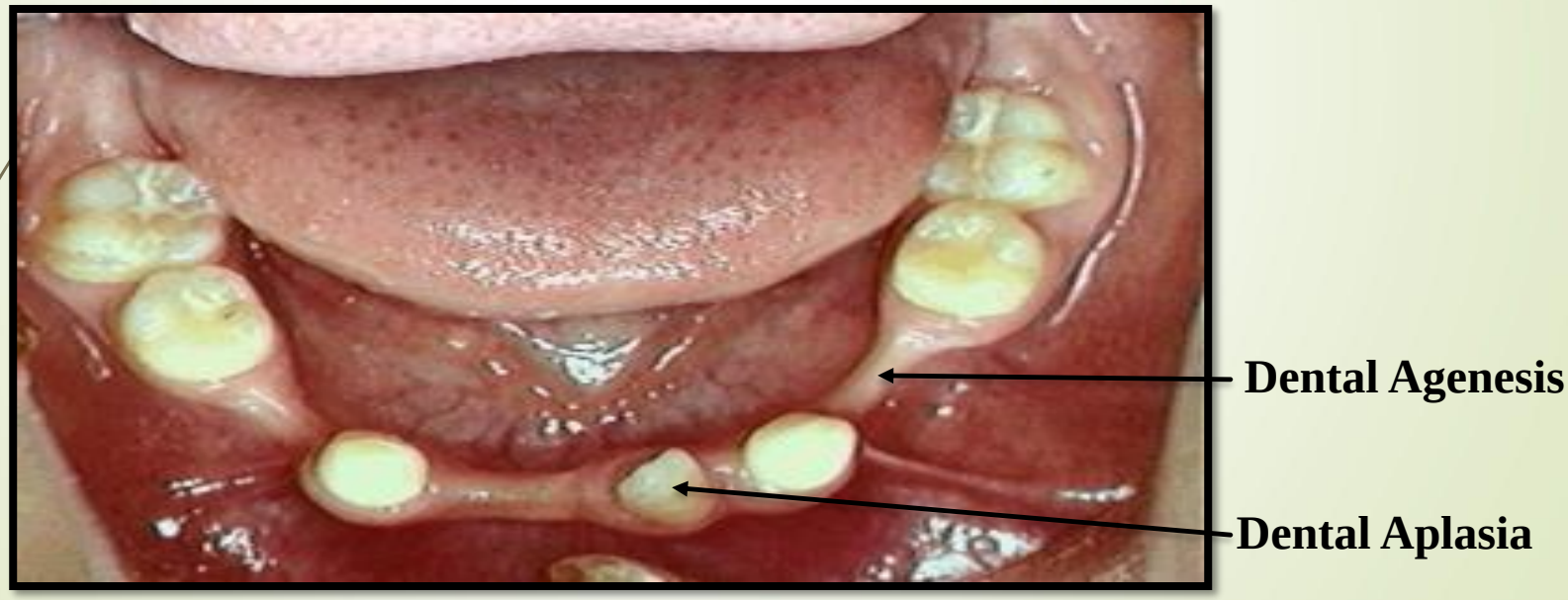
2) Hypertrophy.

3) Hyperplasia.

4) Metaplasia.

I. Congenital defect:

1. Agenesis: This means a complete absence of an organ.
2. Aplasia: This means complete failure of the organ to grow (failure of development).



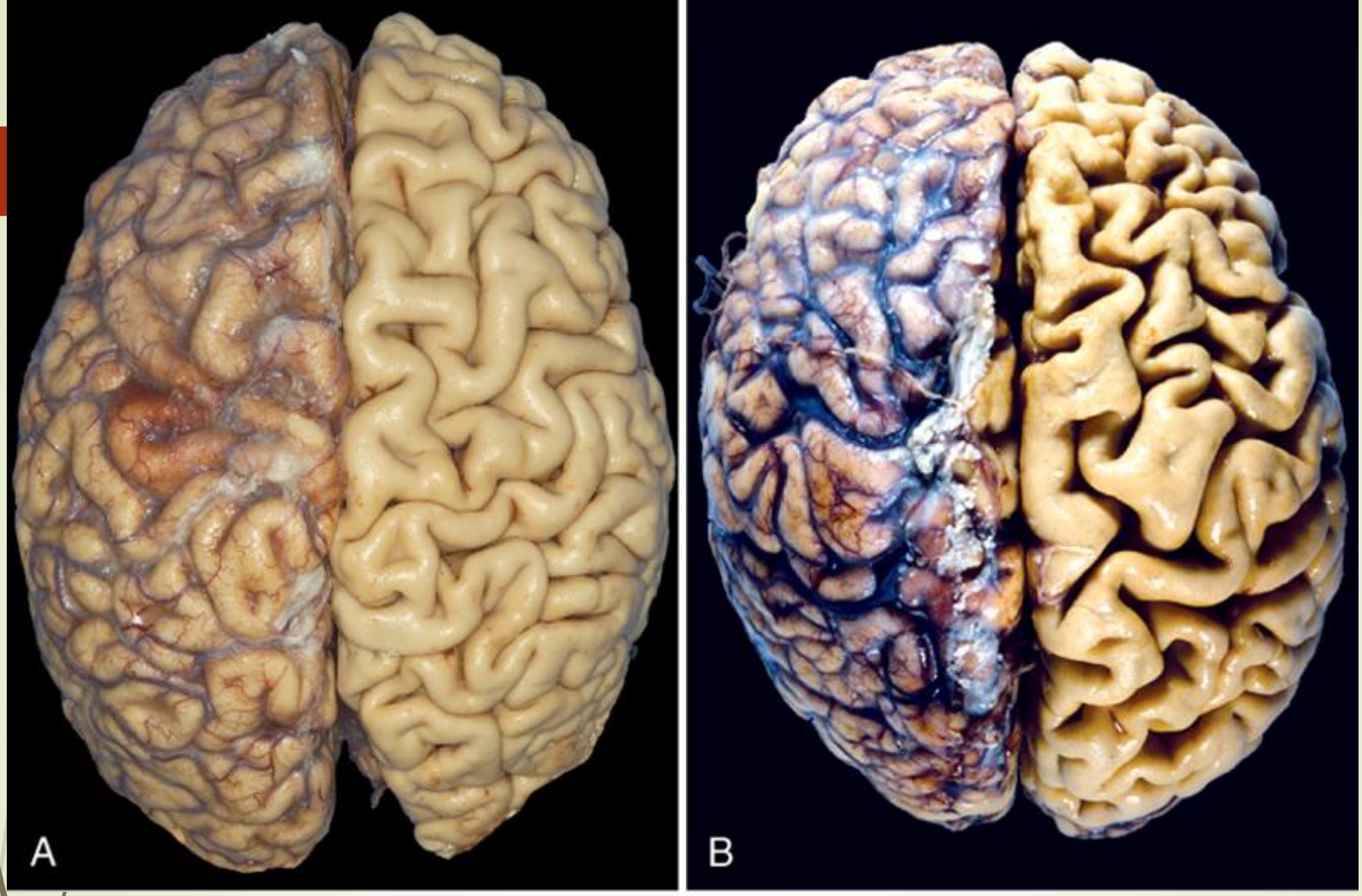
I. Acquired defect:

1. Atrophy:

- Refer to the **decrease in the organ's size due to the decrease in size of cells** with loss of cell substances.
- Cells exhibit autophagy with the increase in the number of autophagic vacuoles & lipofuscin pigment.

Causes of atrophy: (Pathological & physiological)

1) Decrease in the workload.
2) Denervation: e.g. paralysis of the limb due to nerve injury or poliomyelitis.
3) Undernutrition as in starvation.
4) Loss of endocrine stimulation e.g. atrophy of the gonads in hypopituitarism.
5) Aging.
6) Diminish blood supply.

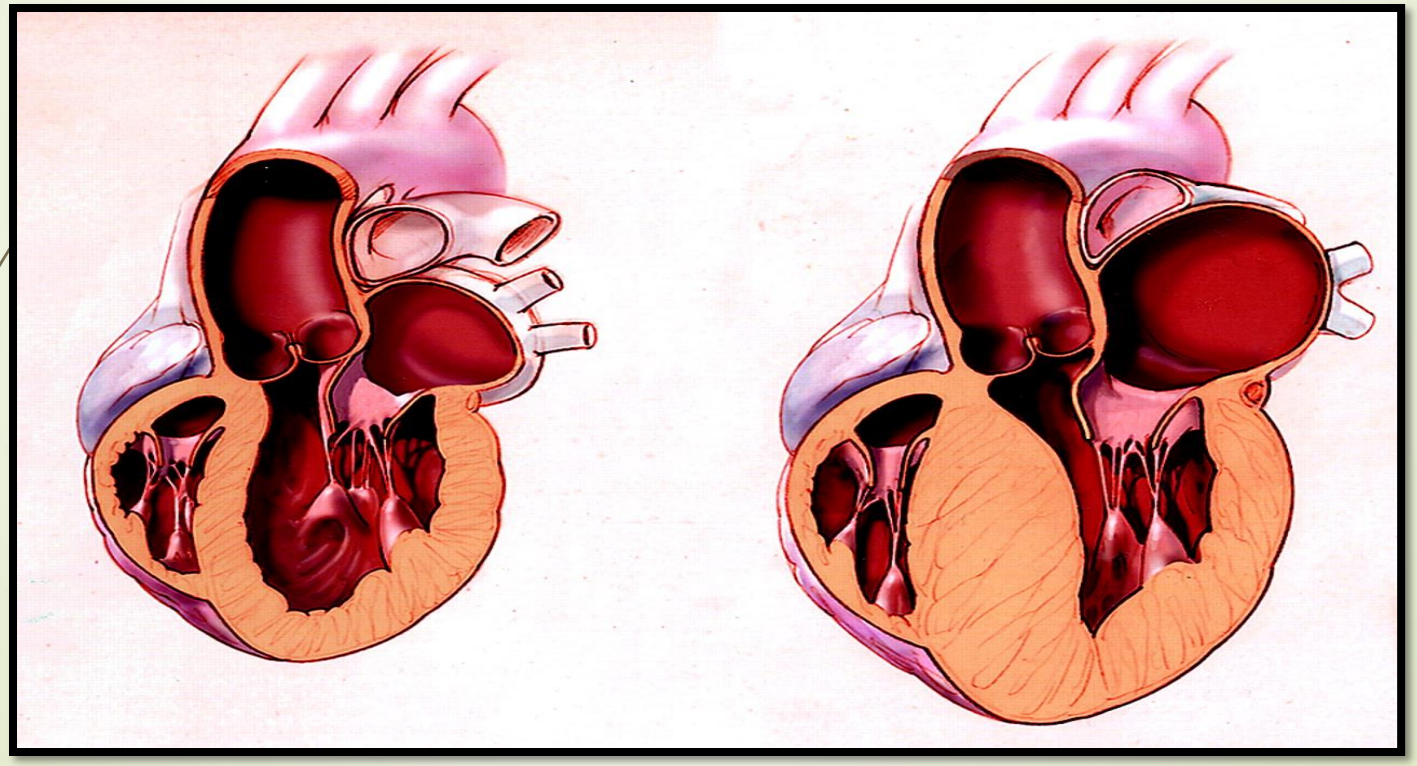


A. Normal brain of a young adult. B. Atrophy of the brain in an old male with atherosclerotic disease. Atrophy of the brain is due to aging and reduced blood supply. Note that loss of brain substance narrows the gyri and widens the sulci.

2- Hypertrophy:

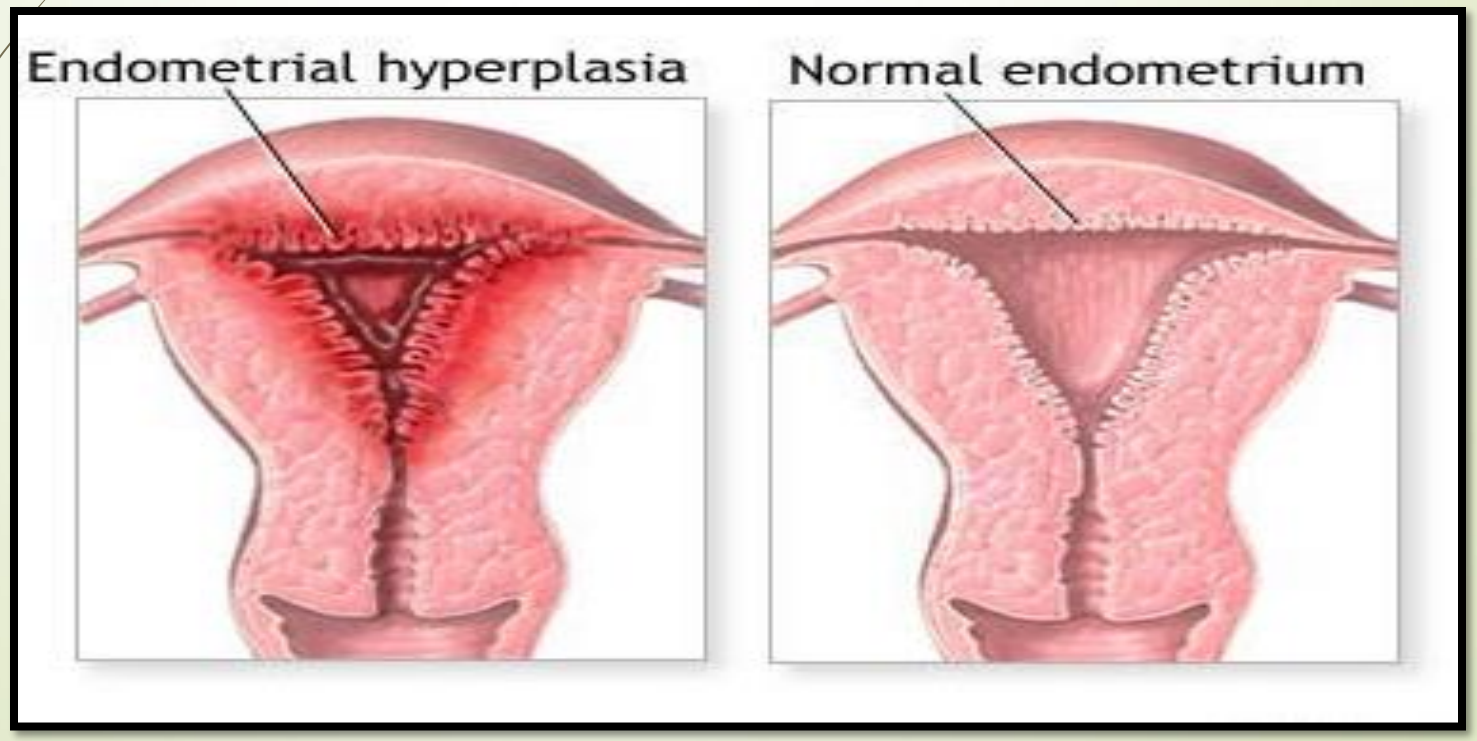
- Refer to the **increase in the size of organs** as a consequence of the **increase in cell size**.
- The causes can be **physiological or pathological** e.g:
  1) Uterus in pregnancy.
  2) Skeletal muscles in athletes, or manual workers.
  3) left ventricular hypertrophy (pathological).
  4) Hepatocytes hypertrophy in barbiturate drug therapy.
  5) Compensatory mechanism after nephrectomy.

Hypertrophic cardiomyopathy is an example of pathological hypertrophy due to increase demand, this ultimately results in an increase in the size of the organ



3- Hyperplasia:

- Refer to the **increase in the size of the organ** due to the **increase in the number of cells.**
- Cells that undergo hyperplasia are those capable of cell division **(labile cells).**



Hyperplasia is divided into:

1. **Physiological hyperplasia:**

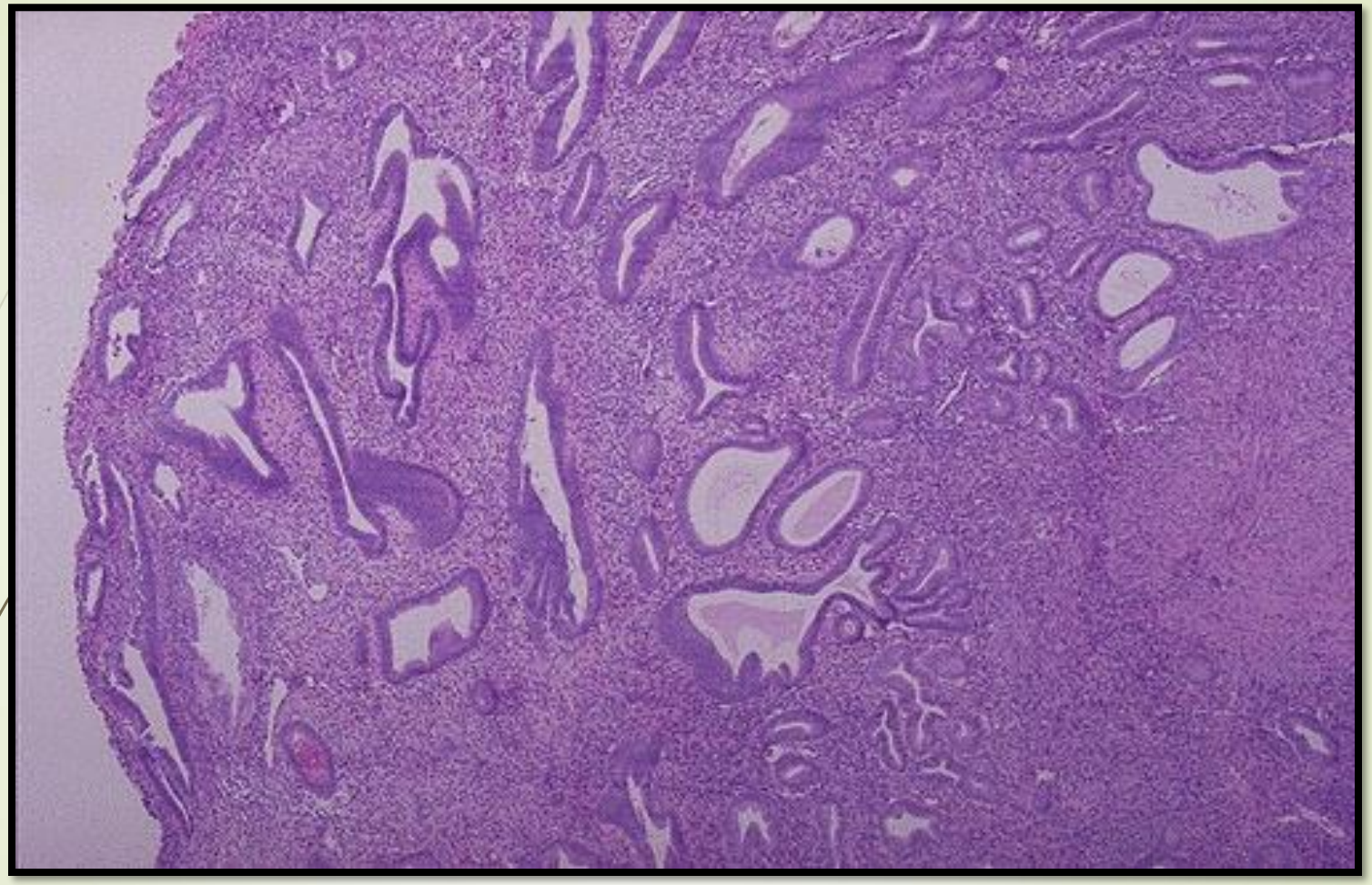
a) Hormonal (proliferation of the breast glandular epithelium of female at puberty, or during pregnancy).

b) Compensatory (e.g. after partial hepatectomy).

2. Pathological hyperplasia:

a) Extensive hormonal stimulation (e.g. endometrial hyperplasia).

b) Effect of growth factors as in the healing of wounds forming keloid (exaggerated scar).



Organ: uterus.

Lesion: there is hyperplasia of both glandular & stromal elements.

Diagnosis: Endometrial hyperplasia.

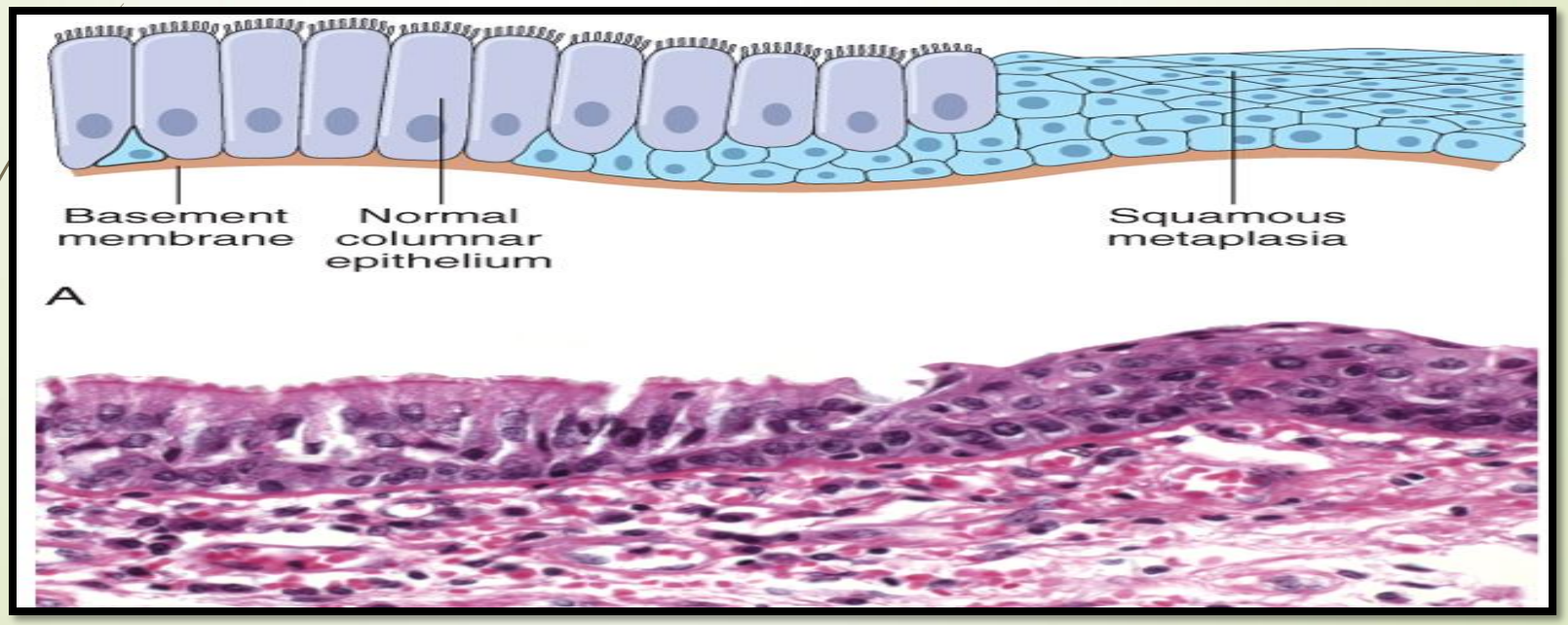
Organ: uterus.

Lesion: there is hyperplasia of entire uterine body.

Diagnosis: Endometrial hyperplasia.

4. Metaplasia:

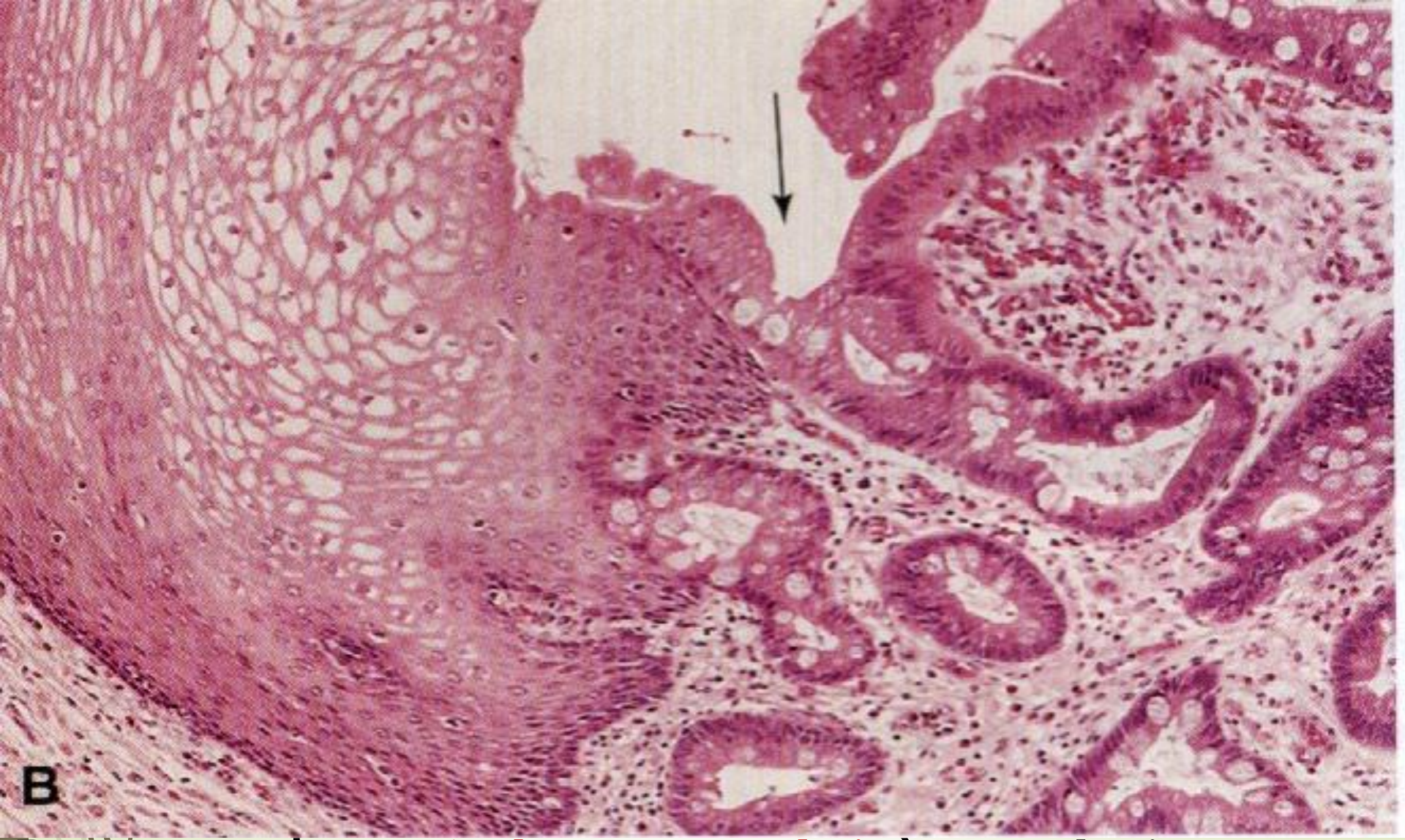
It is an adaptive reversible process refers to the **replacement of one mature cell type** by **another mature cell type**, which could be either epithelial or mesenchymal.



Metaplasia of normal columnar (left) to squamous epithelium (right) in a bronchus

Types of metaplasia:

1) **Squamous metaplasia** of the laryngeal and bronchial respiratory epithelium due to smoking.
2) **Columnar metaplasia** of esophageal sq. epithelium. as a result of prolonged reflux esophagitis.
3) **Squamous metaplasia** of urothelium of the bladder due to bilharzia or stone.



Barrett esophagus (Columnar metaplasia): Metaplastic transformation (arrow) of the normal esophageal stratified squamous epithelium (Lt) to mature columnar epithelium

Thank You