

***Pathophysiology***  
***lab 2***

***Cellular injury and***  
***adaptation***

# ***Adaptation***

**Cellular changes that aim to preserve cell viability and prevent cell injury. The adaptive responses include:**

- 1. Atrophy***
- 2. Hypertrophy***
- 3. Hyperplasia***
- 4. Metaplasia***
- 5. Hypoplasia***
- 6. Dysplasia***

***Hypertrophy***: increase in cell size only ie cells will be bigger.

Hypertrophy could be:

***A. Physiological*** as in uterine hypertrophy during pregnancy and skeletal muscles in athletes.

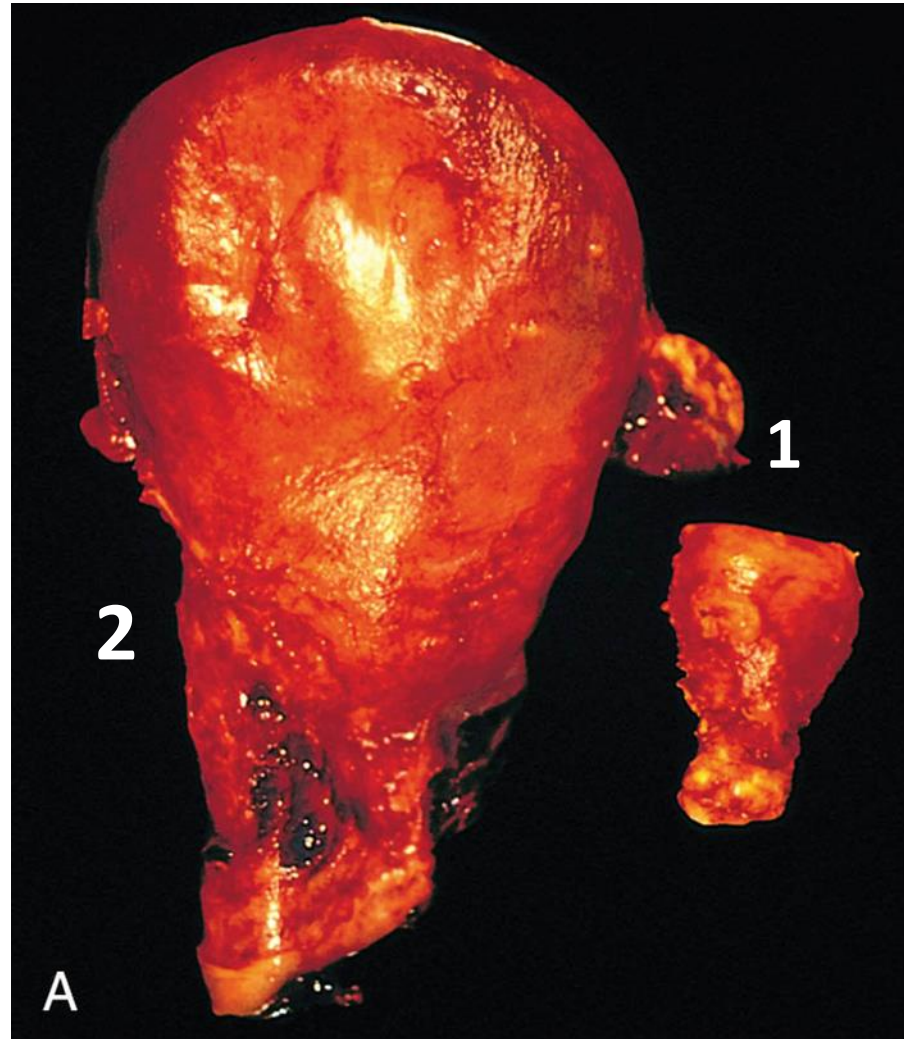
***B. Pathological*** as in left ventricle cardiac muscle hypertrophy due to systemic hypertension

# Hypertrophy

**gross:**

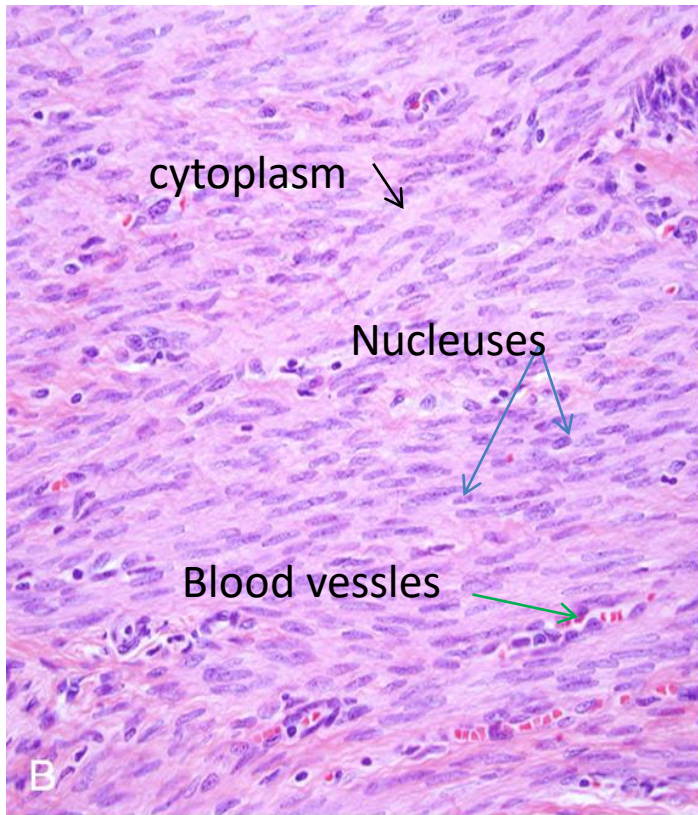
**1: normal uterine size**

**2: Hypertrophy of uterus during pregnancy, increase in size of the uterus as an adaptation for pregnancy and fetal growth.**



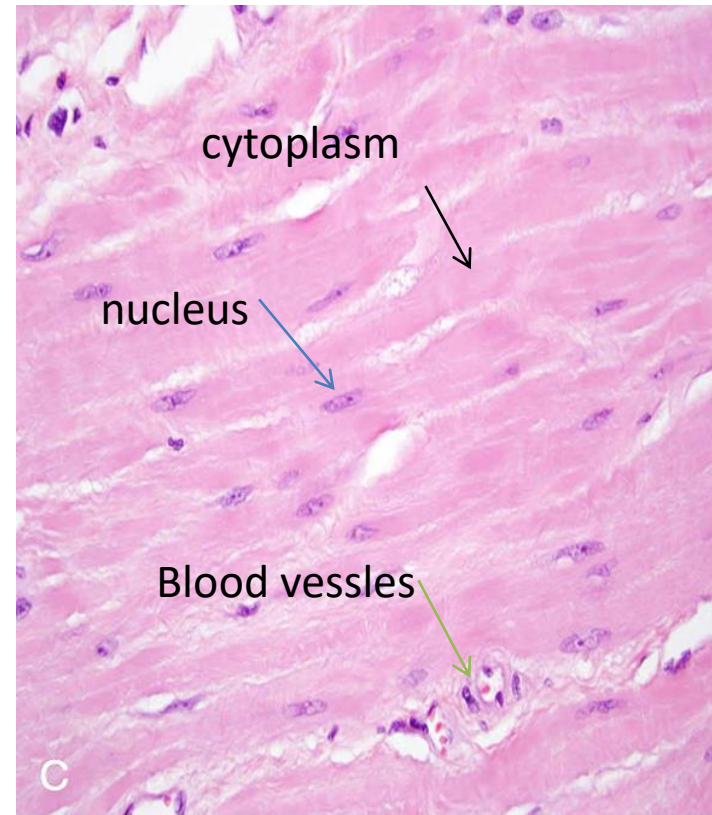
# Hypertrophy: under microscope

Normal uterine smooth muscle under LM



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Section showing uterine smooth muscles directly after delivery: no new cells it just increase in cell size by the increase in amount of cytoplasm



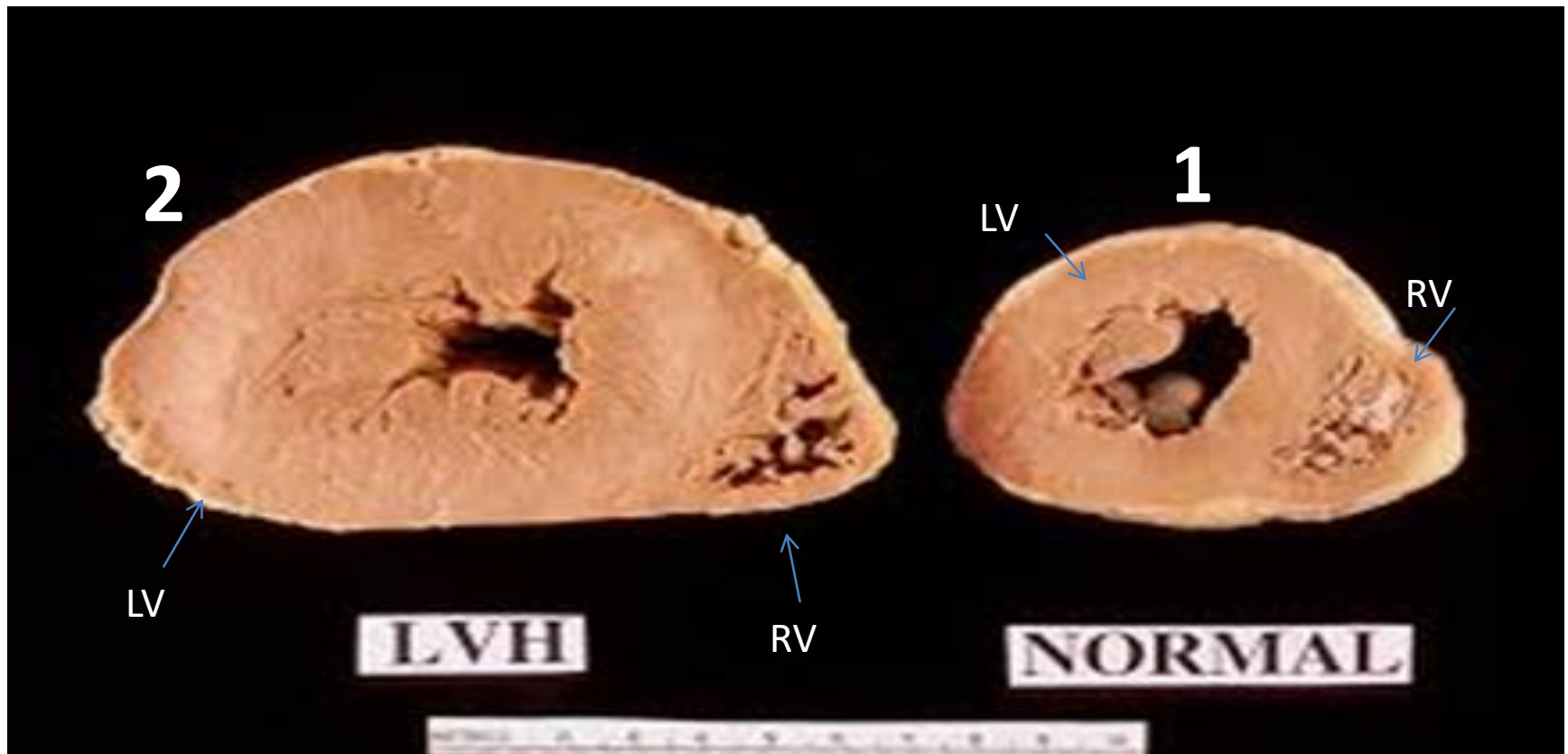
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# Pathological hypertrophy: LV hypertrophy

## Gross:

1: normal heart size

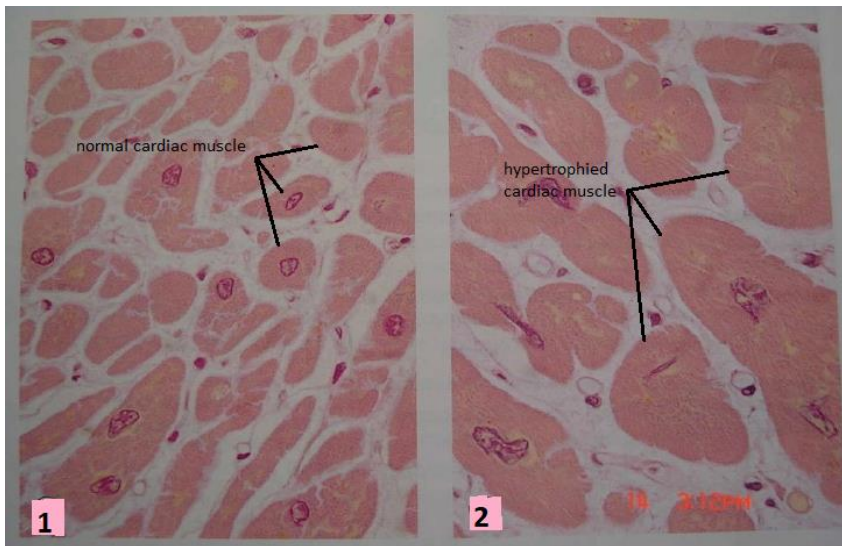
2: LV hypertrophy: increase LV size



# LV hypertrophy: under microscope

**1: cross section shows normal cardiac muscle fiber**

**2: cross section shows hypertrophy in cardiac muscle fiber increase in nuclear and cytoplasmic size**



# Atrophy:

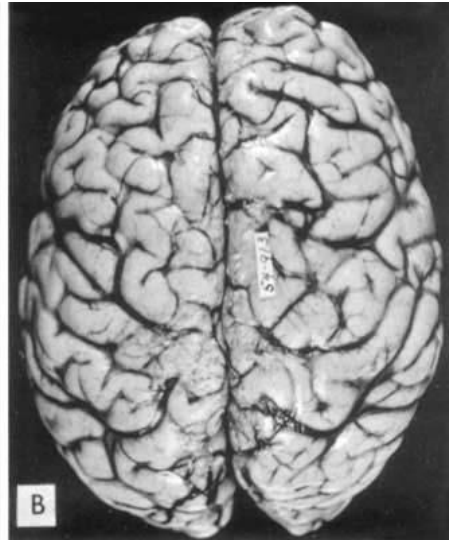
**Decrease** in the size of a cell or organ by loss of cell substance (both size and number)

**gross:**

**A: atrophied brain**



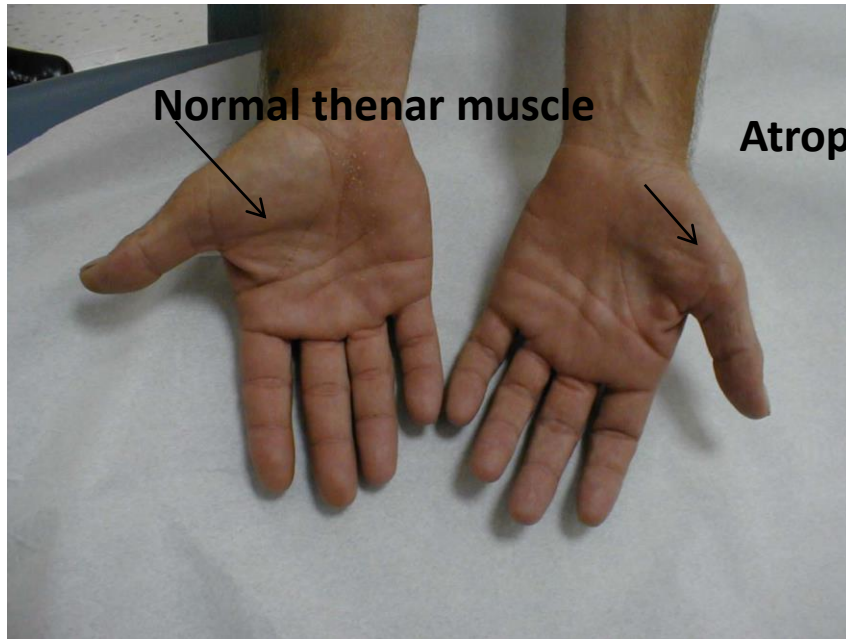
**B: normal brain**





# Atrophy: thenar muscle

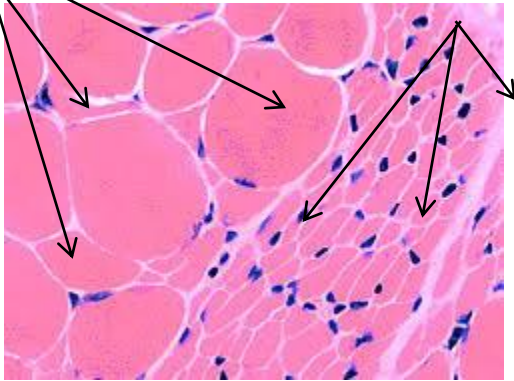
gross:



# Atrophy: skeletal muscle under microscope:

**Normal skeletal muscle fibers**

**Atrophied skeletal muscle fibers**



# ***Hyperplasia :***

**Increase in the number** of cells in an organ which may then increase organ size.

It could be:

**A: Physiologic:** as in hyperplasia of glandular tissue of female breast after puberty

**B: Pathologic:** as in benign prostatic hyperplasia (BPH), endometrial hyperplasia. Pathological hyperplasia also can be divided to:

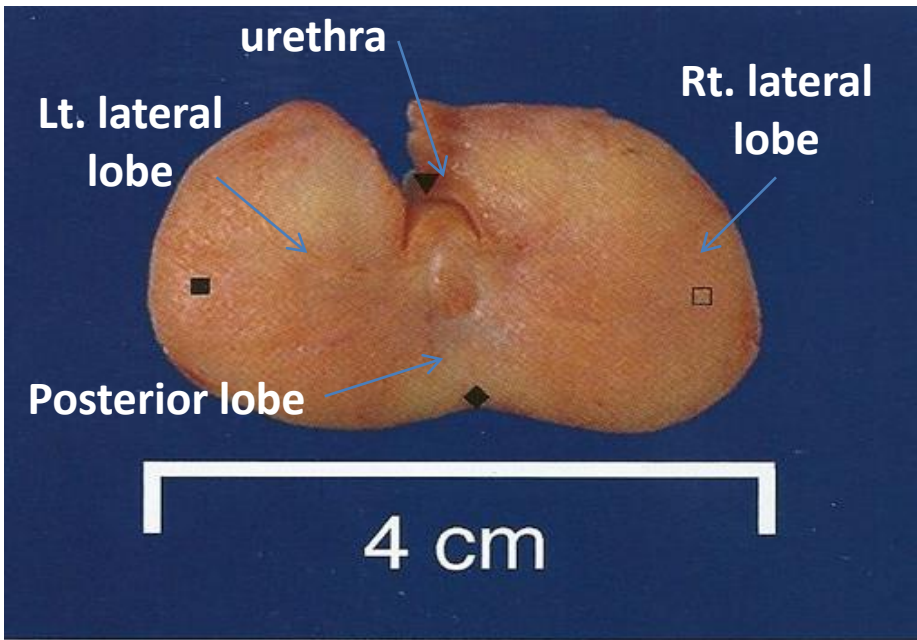
**1. Typical:** hyperplastic cells looks like normal cells regarding their size, nuclear morphology and orientation.

**2. Atypical:** hyperplastic cells clearly differ than normal cell size, nuclear morphology and orientation

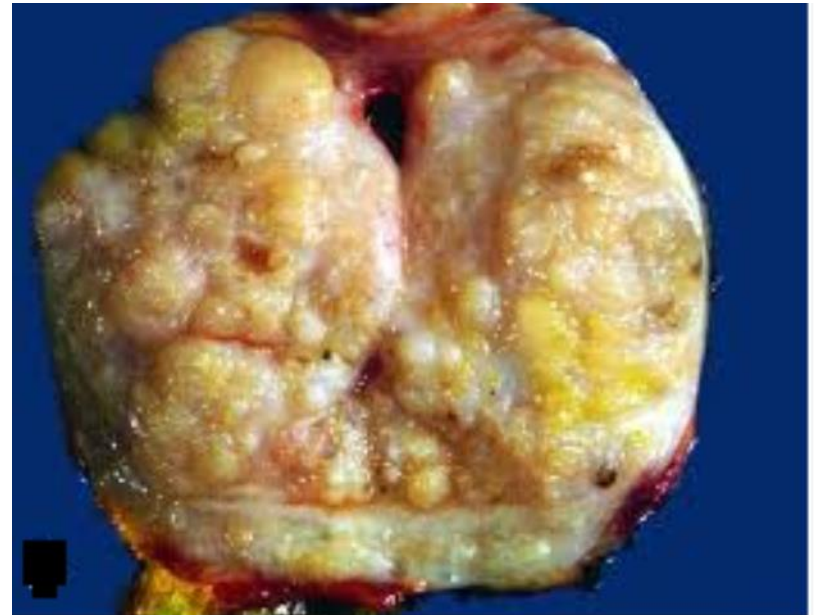
# *Hyperplasia*

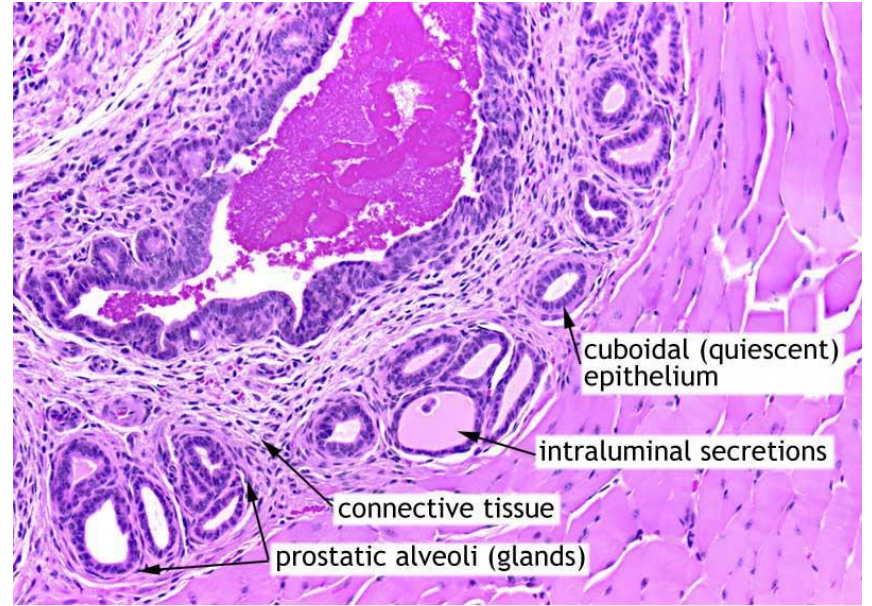
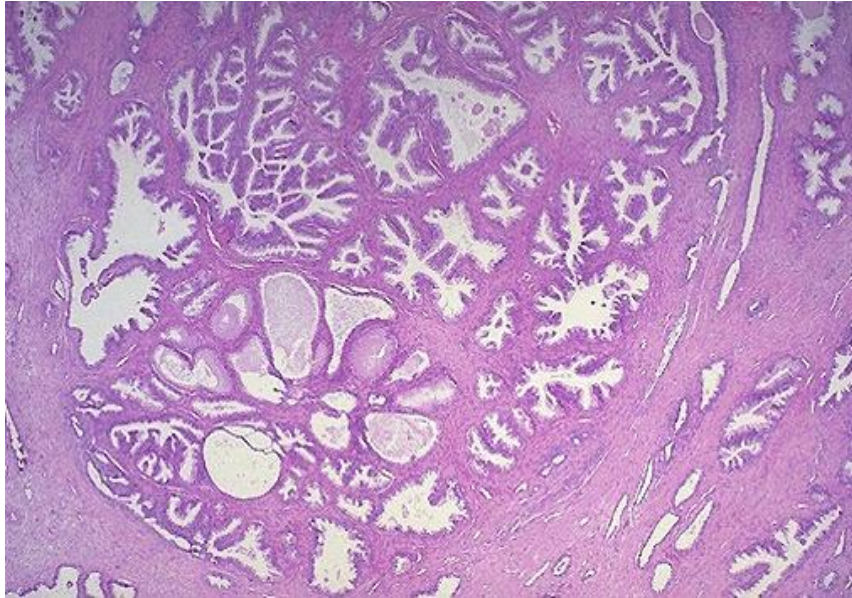
## *normal and BPH prostate: gross*

Cross section of normal prostate  
about 4 cm length homogenous in  
texture

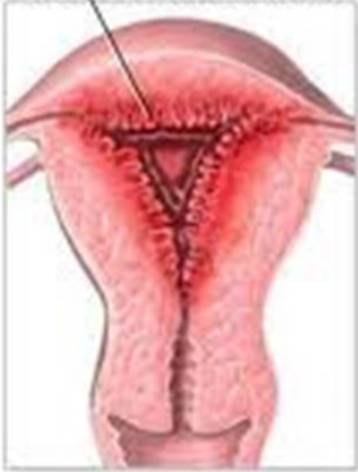


Benign prostate hyperplasia BPH:  
cross section shows increase size  
and nodular appearance

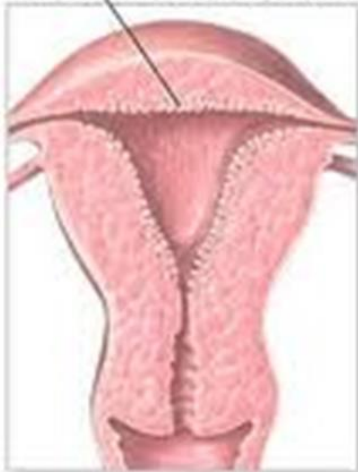




Endometrial hyperplasia



Normal endometrium

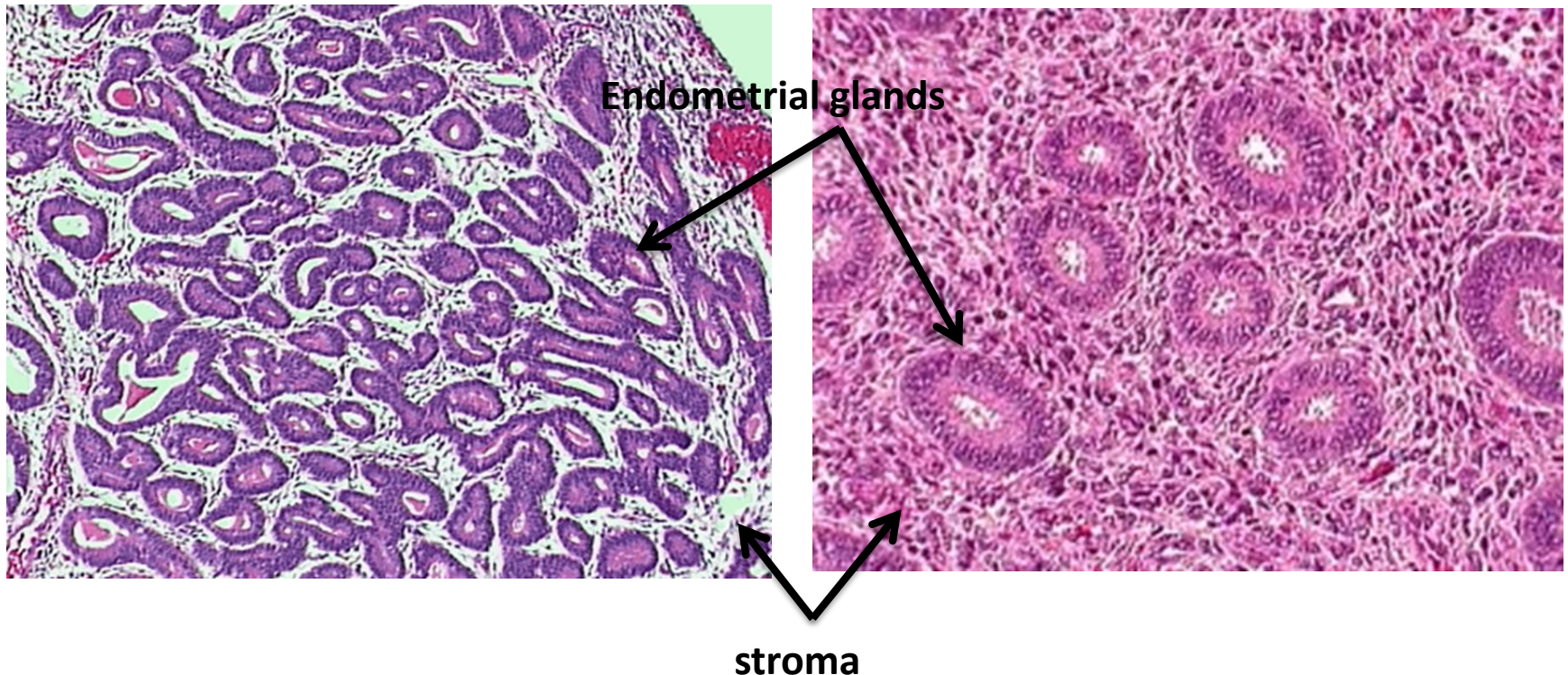


**A: normal proliferative endometrium with discrete glands embedded in normal amount of stroma.**

**B: endometrial hyperplasia, clearly there is an increase in number of glands with very few amount of stroma in between, merge of some glands together with benign looking epithelia (case of typical hyperplasia).**

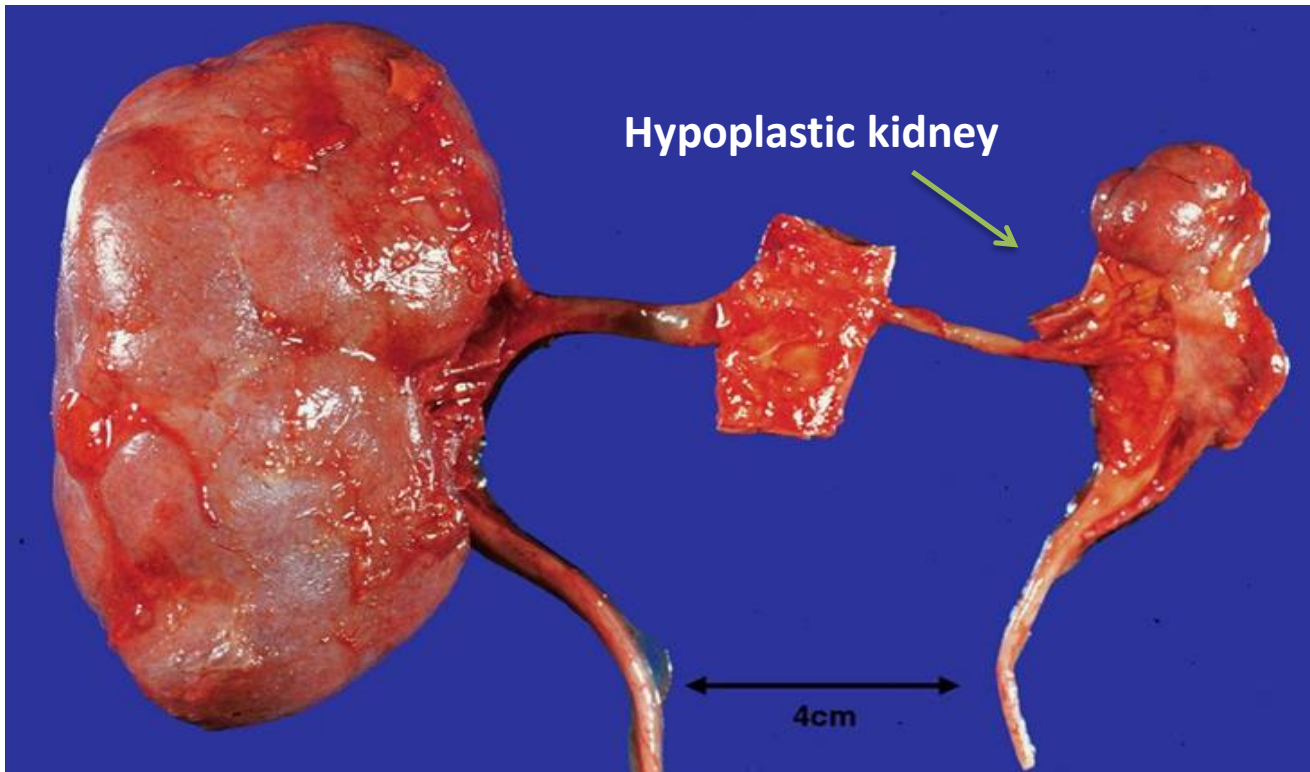
**B. Endometrial hyperplasia**

**A. Normal endometrium**



# *Hypoplasia:*

- Incomplete development of an organ so that it fails to reach adult size. It can occur at any organ in the body especially paired organs.





# *Metaplasia*

- **Change in which one ADULT cell type is replaced by another ADULT cell type**

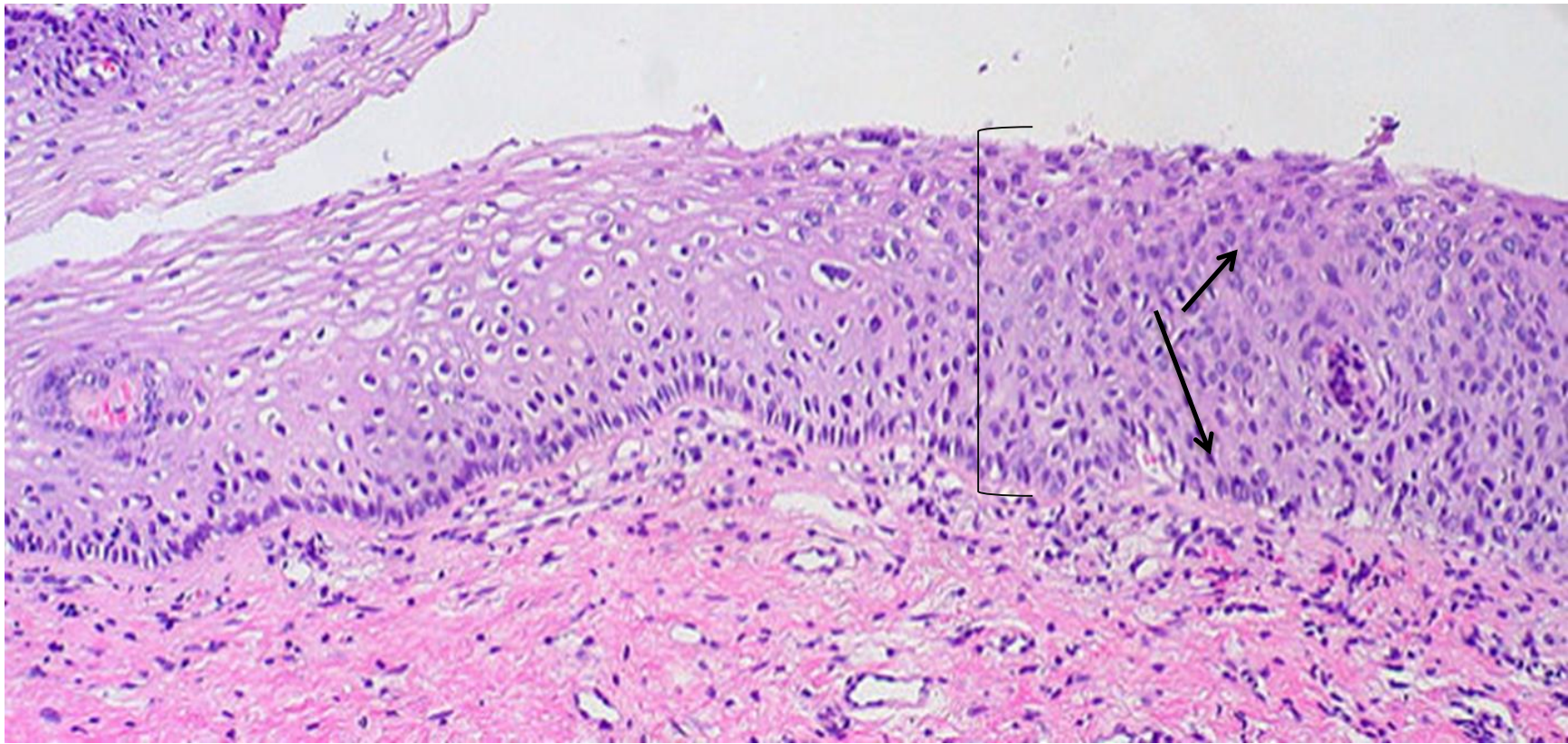
- **Caused by:** Chronic irritation (inflammation, cigarette smoke; calculi in ducts):
- **Cervix-** squamous epithelium of the endocervix replaces columnar (dysplasia and squamous CA may develop)
- **Barrett esophagus-** gastric reflux results in columnar epithelium replacing squamous epithelium in the esophagus (dysplasia and adenocarcinoma may occur)

***Barret esophagus:*** squamous epithelia replaced by glandular epithelia in the lower (abdominal) part of the esophagus due to chronic irritation by reflexed gastric juice



## ***Dysplasia:***

- **Disturb organization and orientation of the cells**
- **Sever dysplasia equal intraepithelial neoplasia.**
- **Chronic irritation by radiation, inflammation considered the major cause.**



# *Cell injury*

Occur in two situations:

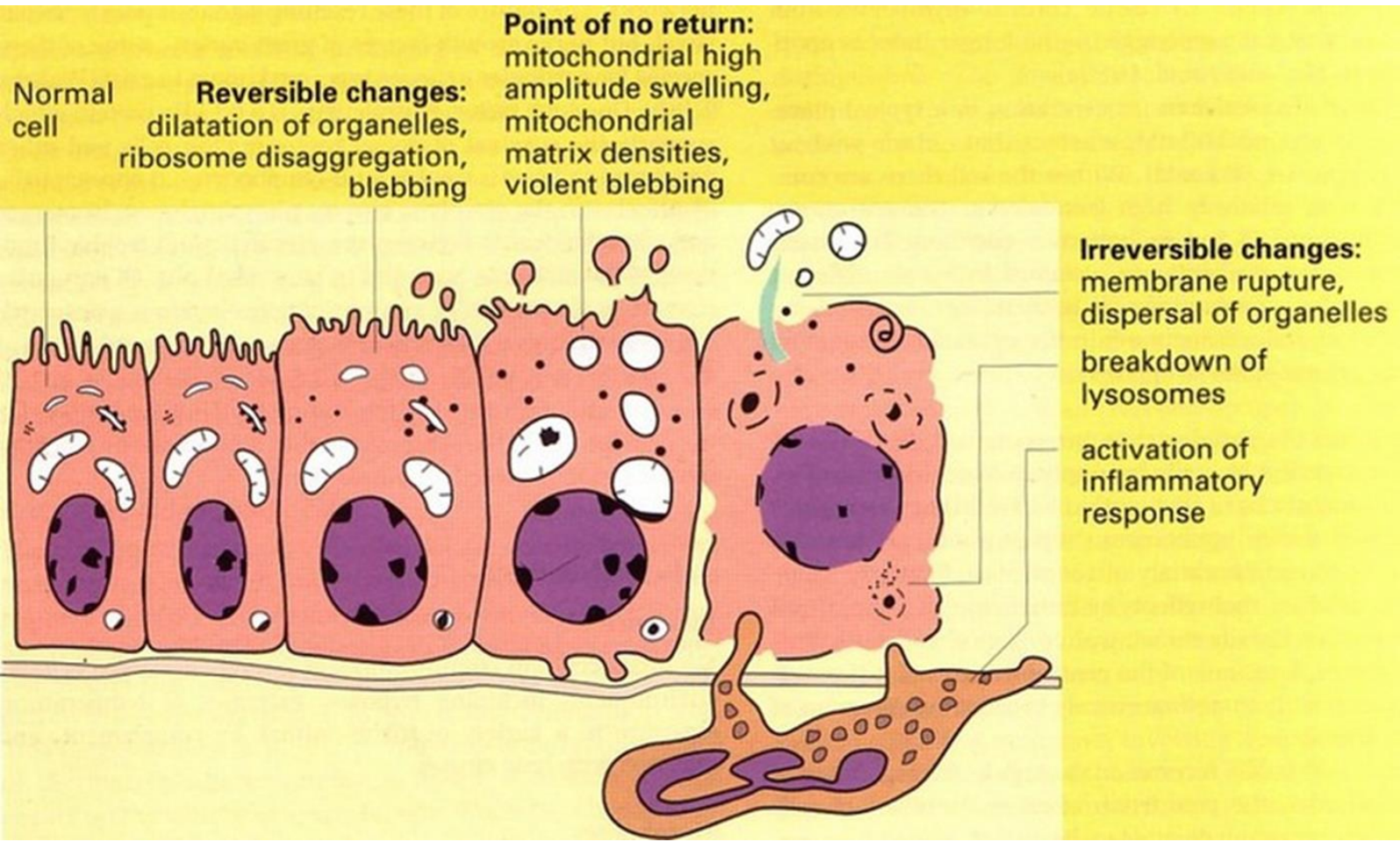
- i. The limits of adaptive response are exceeded.
- ii. When there is no enough time for adaptive responses to take place as in sever injurious agent.

Cell injury divided to:

**1. Reversible cell injury:** cellular changes will regress and disappear when the injurious agent is removed i.e. cells return to normal both morphologically and functionally e.g. cellular swelling (hydropic changes) and fatty changes.

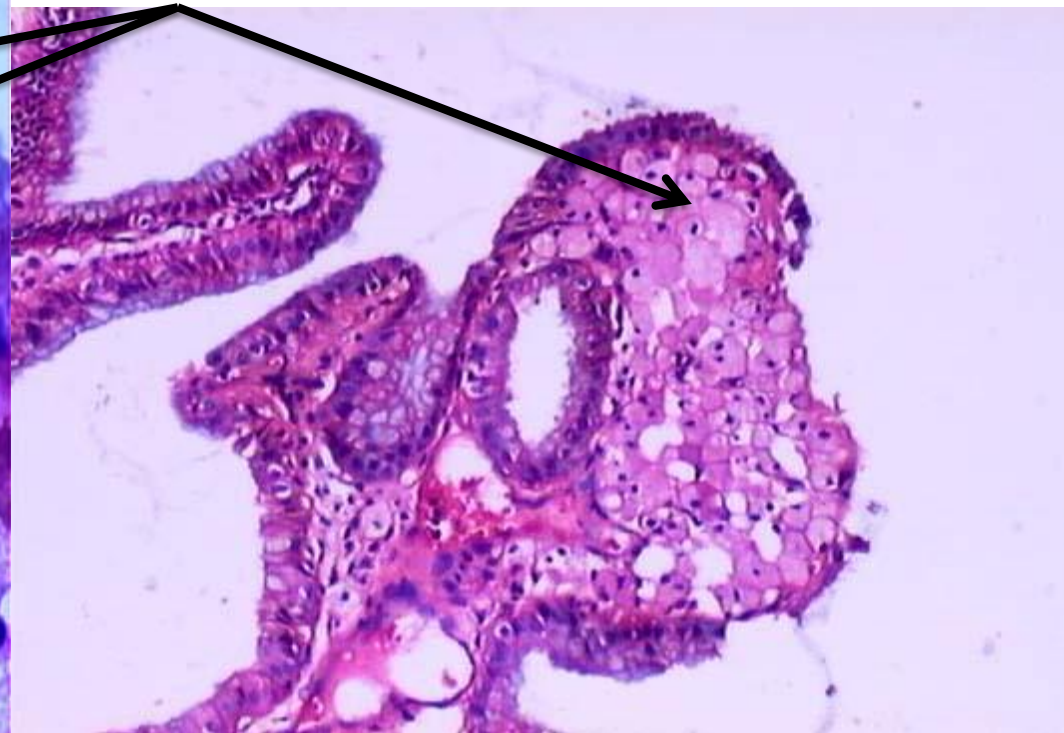
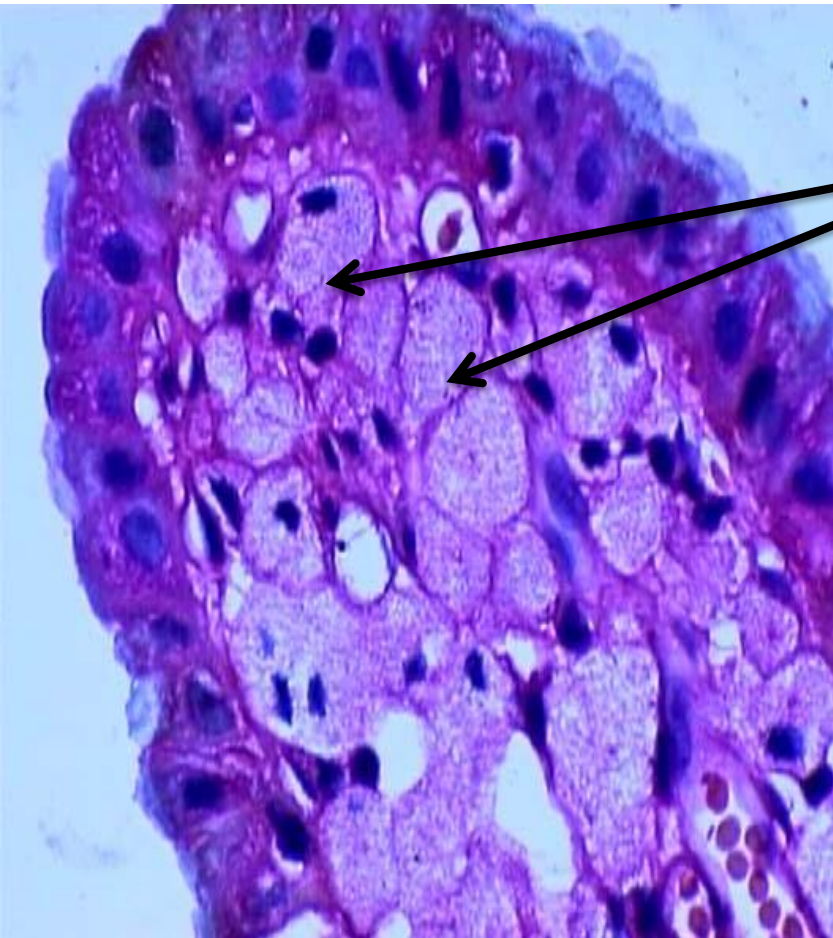
**2. Irreversible cell injury (cell death):** in which cell death is inevitable e.g. mitochondrial damage and autolysis by lysosomal enzymes.

# Cell injury



# Fatty changes or accumulation

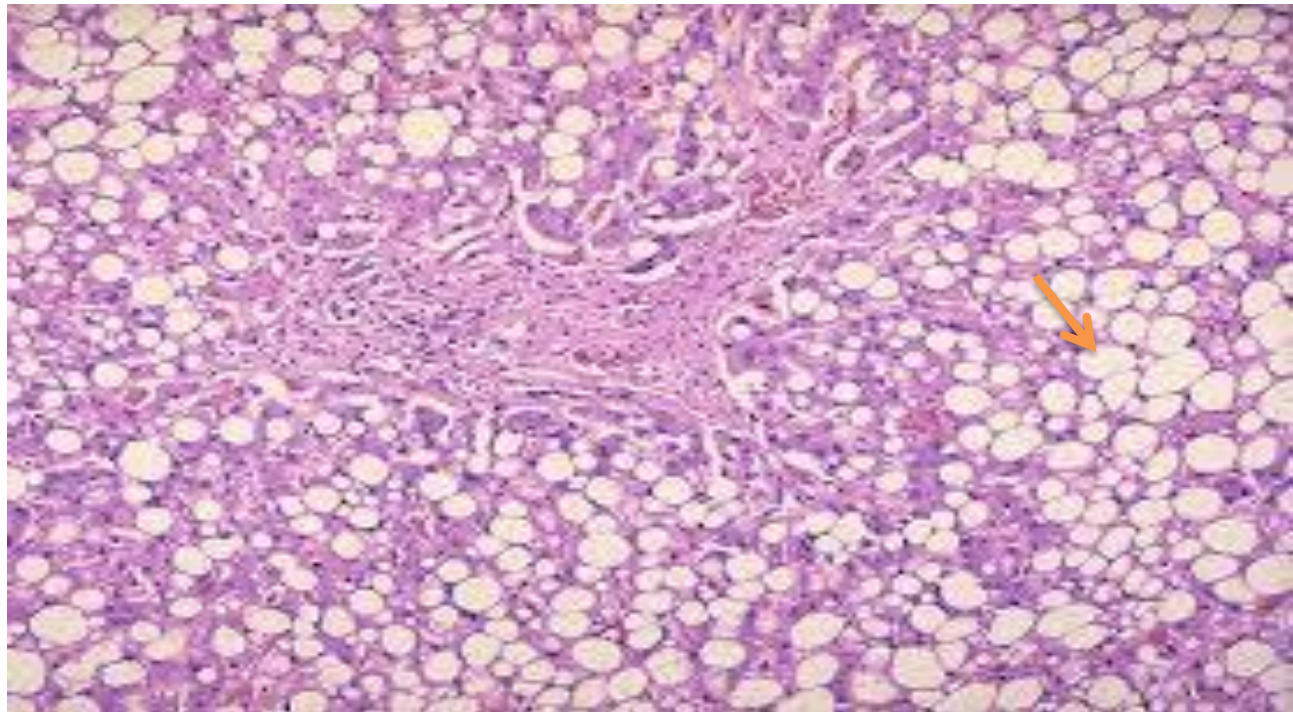
1. Cholesterol-laden macrophages (foam cells) from a focus of gallbladder cholesterosis.



(foam cells)



**2. Liver fatty changes:** Intracellular accumulations of fat in response to alcoholic hepatocellular injury. Here is fatty change of the liver due to deranged lipoprotein transport from alcoholism leads to accumulation of lipid in the cytoplasm of hepatocytes (arrow)



# *Cell death*

- 1. Necrosis**
- 2. Apoptosis**

THANK YOU

