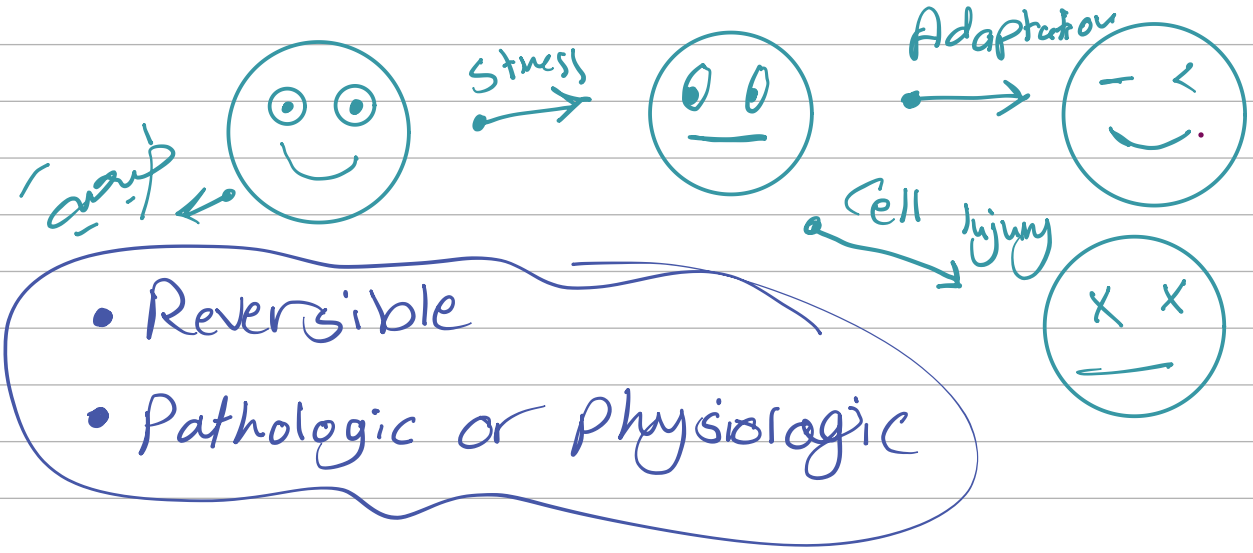
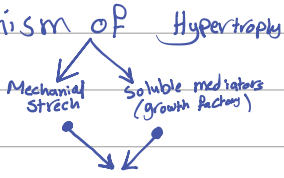
Adaptations



Type	Definition	Mechanism	Physiologic example	Pathologic example	Special points
Hypertrophy • In the tissues that are not capable of Replication	Increase in cell size → ↑ Organ size - No new cells	1. Increased stimulation (Hormones) (growth factor) 2. Increased demand Physiologic *Disease/Abnormal Stimuli Pathologic Organ Dysfunction	1. Physiologic hypertrophy of the uterus during pregnancy. (Estrogen) 2. Hypertrophy of skeletal muscle In response to exercise.	Increased workload on heart muscle like in HTN and Valves stenosis → Loss Myofibrillar contractile elements Fragmentation & → Cardiac Failure	• Limited • Can Coexist with Hyperplasia.
Atrophy	Decrease in cell size → ↓ organ size Loss of innervation	• Decreased workload (like immobilization), denervation, ↓ blood flow, poor nutrition, ↓ hormonal stim., and aging. 1. ↓ protein synthesis 2. ↑ protein degradation	1. Normal embryonic development 2. loss of hormonal stimulation in menopause	Atrophy as seen in the brain	• Cell loses function but it's not dead • Autophagy

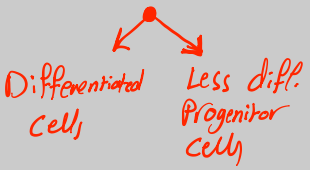
Mechanism of Hypertrophy

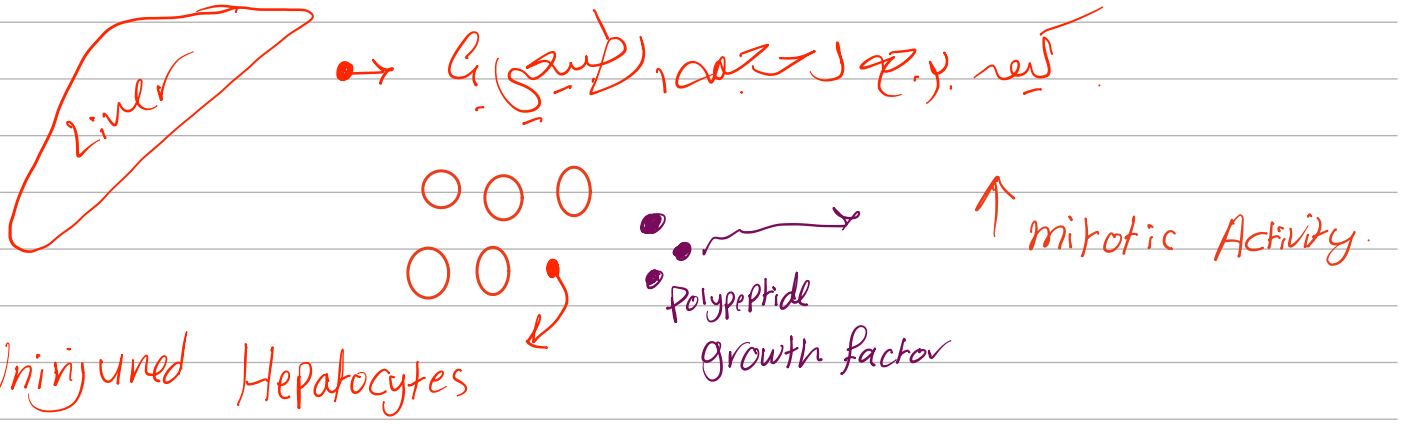


1. ↑ Induction of Genes → ↑ Protein → ↑ Contraction
2. Switch from Adult contractile proteins → Fetal

ليش بتصير؟ وشو الفائدة؟

α-heavy chain is Replaced by β-heavy chain

Type	Definition	Mechanism	Physiologic example	Pathologic example	Special points
Hyperplasia In tissue that are Capable of Replicatio	Increase in cell number		1. Hormonal hyperplasia: female breast at puberty & during pregnancy (estrogen & progestrone). 2. Compensatory*** (12hr) hyperplasia: Liver	1. Endometrial hyperplasia 2. Benign (Androgen) prostatic hyperplasia 3. Certain viral infections (Papilloma) (Skin-warts)	• Can occur together with hypertrophy • A fertile soil for cancerous lesions.
Metaplasia	One adult cell type (epithelial or mesenchymal) is replaced by another adult cell type.	• Here a cell type is sensitive to a particular stress is replaced by another cell type better able to withstand the adverse environment.			• Often coexist with cancers



After anormal menstrual Period
↑ Uterine epithelial proliferation
stimulated by → Estrogen (+)
Inhibited by → Progestrone
Hyperplasia لو زاد ال (+) جبير

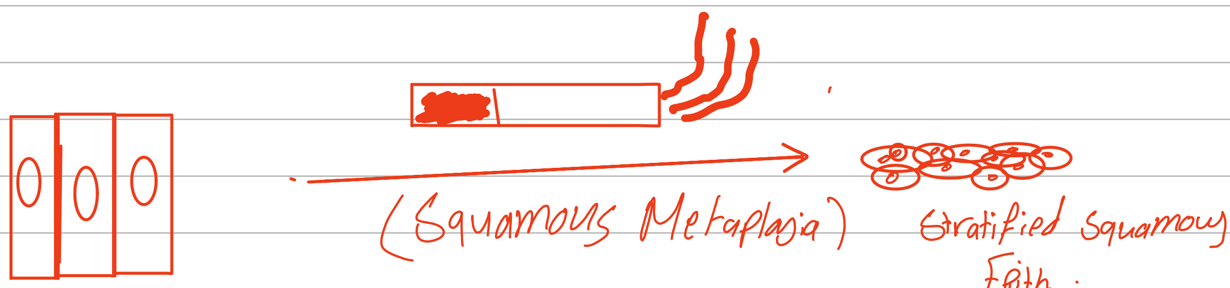
Hyperplasia is tightly Regulated & it's the responsivness to normal (regulatory mechanisms) ↔ Distinguish Pathologic from Cancer

Growth control becomes Permanently Dysregulated

Pathologic Hyperplasia is a fertile soil for Cancers.

Metaplasia:

It arise by the reprogramming of stem cells to differentiate along a new pathway
&
not by a phenotypic change (trans-differentiation) of already differentiated cells.



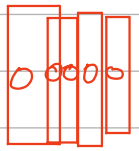
- هذول بحمّلوا التدخين أكثر

Metaplasia here has survival advantages, but important protective mechanisms are lost, such as mucus secretion and ciliary clearance

GERD

Chronic gastric Reflux → (Intestinal Metaplasia)

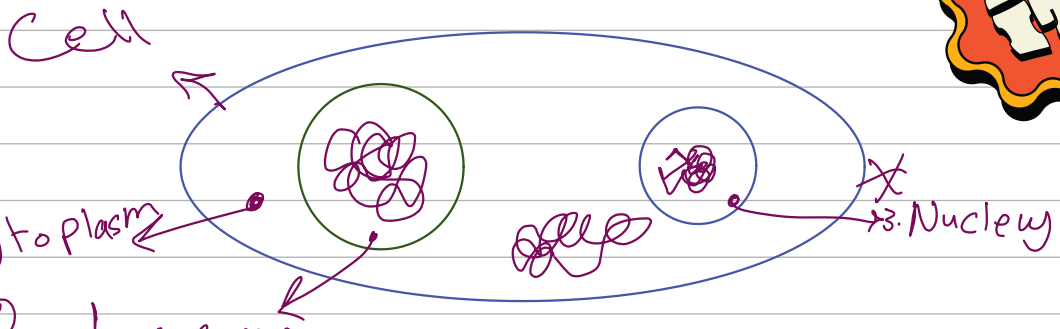
normal stratified squamous epith. of Esophagus



Gastric / Intestinal type - Columnar

Persistent metaplastic Changes
→ May predispose to Malignancy.

Accumulation



Accum.
- I. Can occur in the 1, 2 & 3
- II. Can be Harmless or Harmful
- III. Synthesized by the same cell or other cells

1. ↓ Removal & degradation
2. ↑ Excessive production of Endogenous Material
3. Deposition of Abnormal Exogenous material

Type	Definition	Causes	Example	Special points
Lipids → Fatty changes	Any accumulation of triglycerides within parenchymal cells.	1. Toxins 2. Protein malnutrition 3. Diabetes mellitus 4. Obesity 5. Anoxia.	Steatosis in liver → Alcohol abuse and diabetes associated with obesity are the most common causes of fatty change in the liver. • Heart • Skeletal muscle • kidneys	• Called steatosis
Lipids → Cholesterol and Cholesteryl Esters	Phagocytic cells may become overloaded in different pathologic processes	Mostly increased intake or decreased catabolism of lipids.	Atherosclerosis	Atheroma
Glycogen	Excessive intracellular accumulation of glycogen		Uncontrolled DM → abnormal glucose metabolism, glycogen accumulates in renal tubular epithelium, cardiac myocytes, and β cells of the islets of Langerhans.	• Glycogen also accumulates within cells → glycogen storage diseases.

Pigments

Type	Definition	Color	Example	Special points
Carbon	• Ubiquitious air polutant • When inhaled → Alveolar macrophages → by lymph → lymph nodes	Black	Aggregates of the pigment blacken the draining lymph nodes and pulmonary parenchyma (called anthracosis	• The most common exogenous pigment
Lipofuscin	Lipofuscin represents complexes of lipid & protein that are produced by the free radical–catalyzed peroxidation of polyunsaturated lipids of subcellular membranes.	Brownish-yellow	Lipofuscin granules in cardiac myocytes • Liver • Brain	• Not injurious, a marker of past free radical injury. • In large amounts → brown atrophy
Melanin	Although melanocytes are the only source of melanin, adjacent basal keratinocytes in the skin can accumulate the pigment (e.g., in freckles), as can dermal macrophages.	Brown - black	Moles	• Protect from UV

Pigments - Hemosiderin

- A hemoglobin-derived granular pigment that is **golden yellow to brown**.
- Accumulates in tissues when there is a local or systemic excess of iron.
- Iron is normally stored within cells in association with the protein apoferritin, forming ferritin micelles.
- Hemosiderin pigment represents large aggregates of these ferritin micelles, readily visualized by light and electron microscopy.

Pigments - Hemosiderin

- The iron can be unambiguously identified by the Prussian blue histochemical reaction
- Small amounts of this pigment are normal in the mononuclear phagocytes of the bone marrow, spleen, and liver, where aging red cells are normally degraded.
- Excessive deposition of hemosiderin, called hemosiderosis.
- More extensive accumulations of iron seen in hereditary hemochromatosis