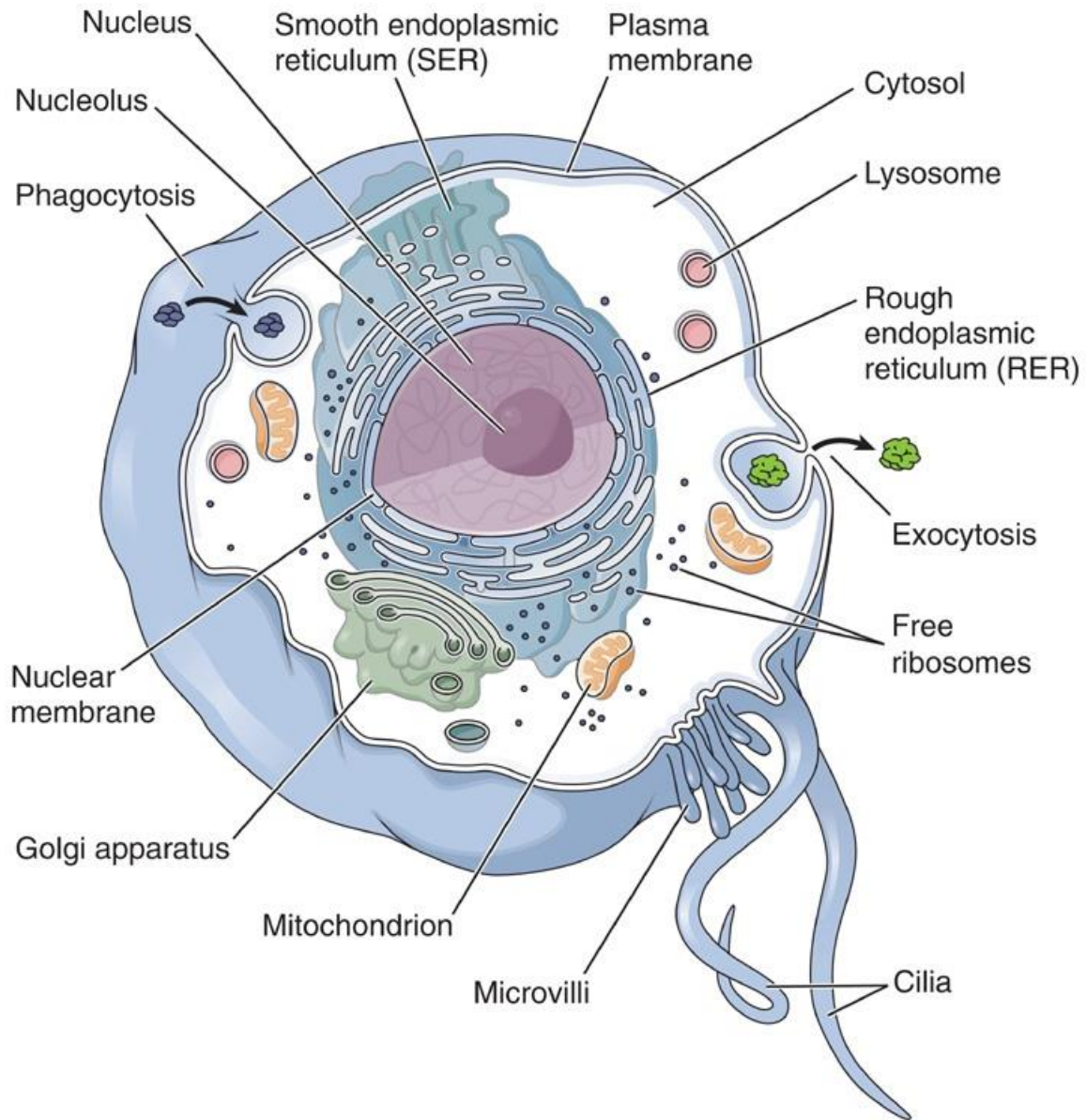
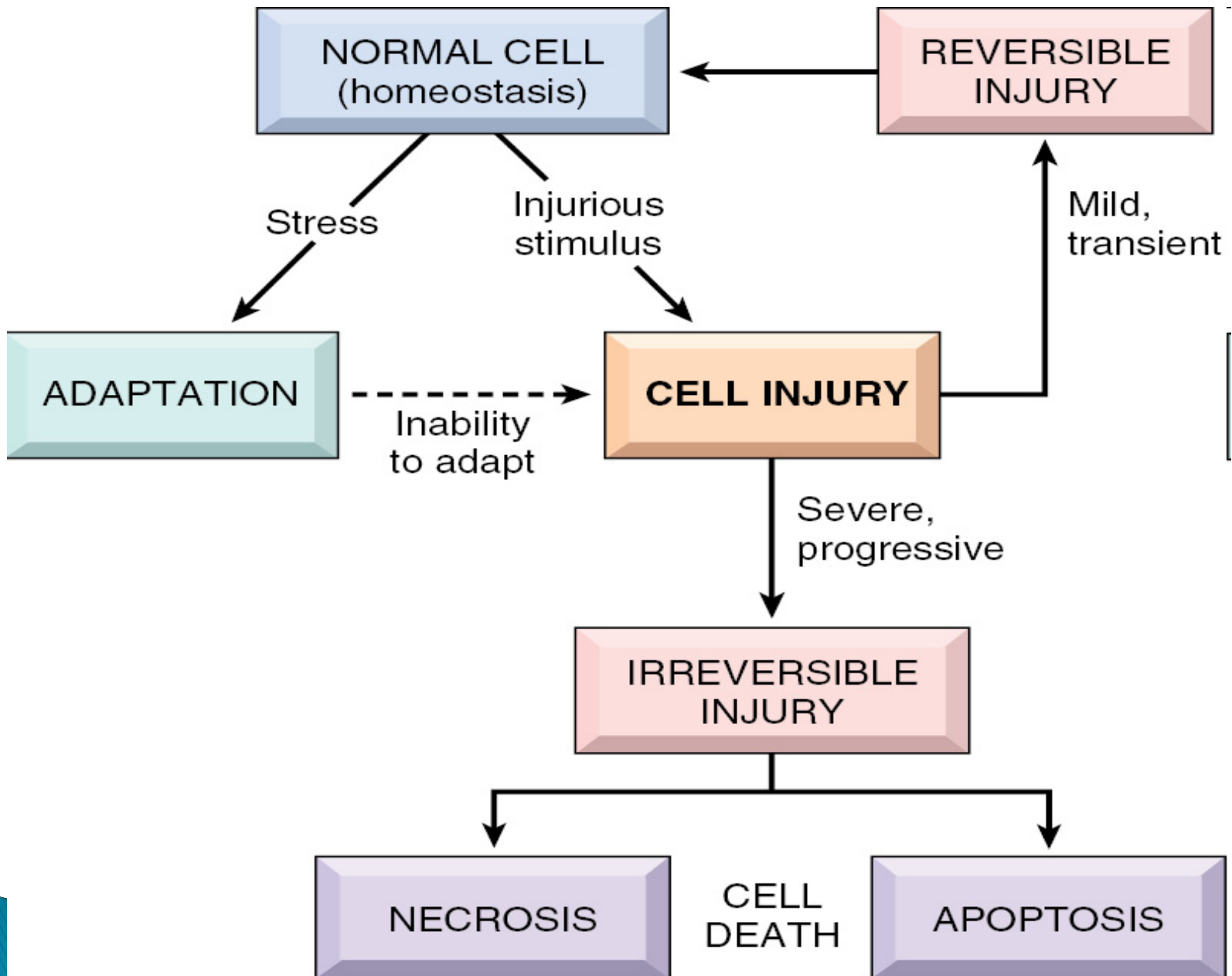


Cell injury, Cell death and Adaptations

Manar Hajeer, MD, FRCPath
University of Jordan , school of medicine







Adaptations

Physiologic
adaptation

Pathologic
adaptation.



Adaptations

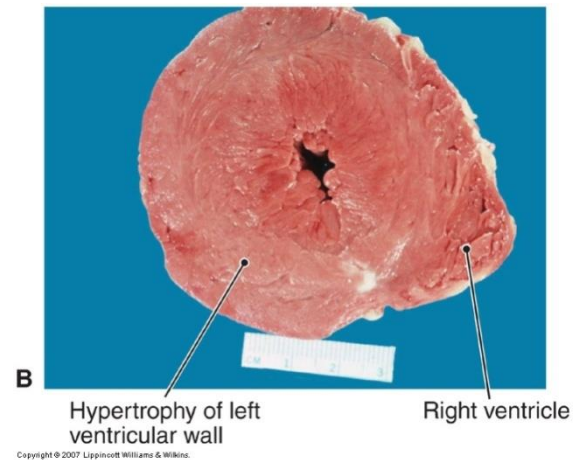
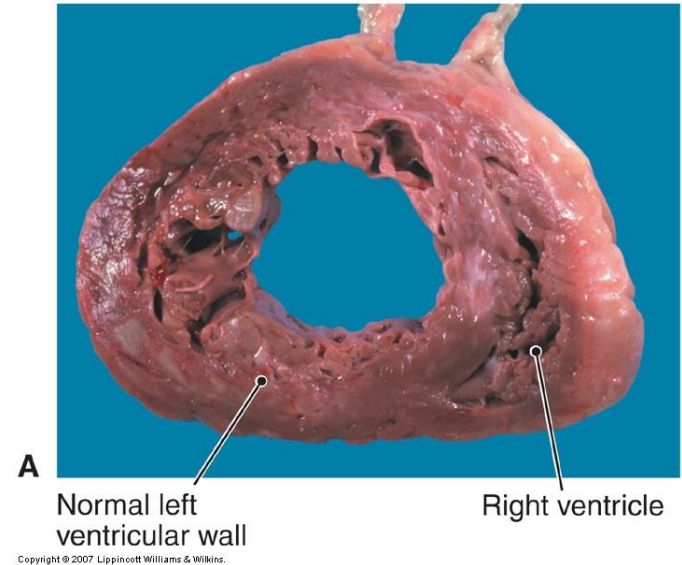
- **Many forms:**
 - Increase in cell size.
 - Decrease in cell size.
 - Increase in number of cells.
 - Change into another type of cell
-
- Adaptation to stress can progress to cell injury if the stress is not relieved.



Hypertrophy

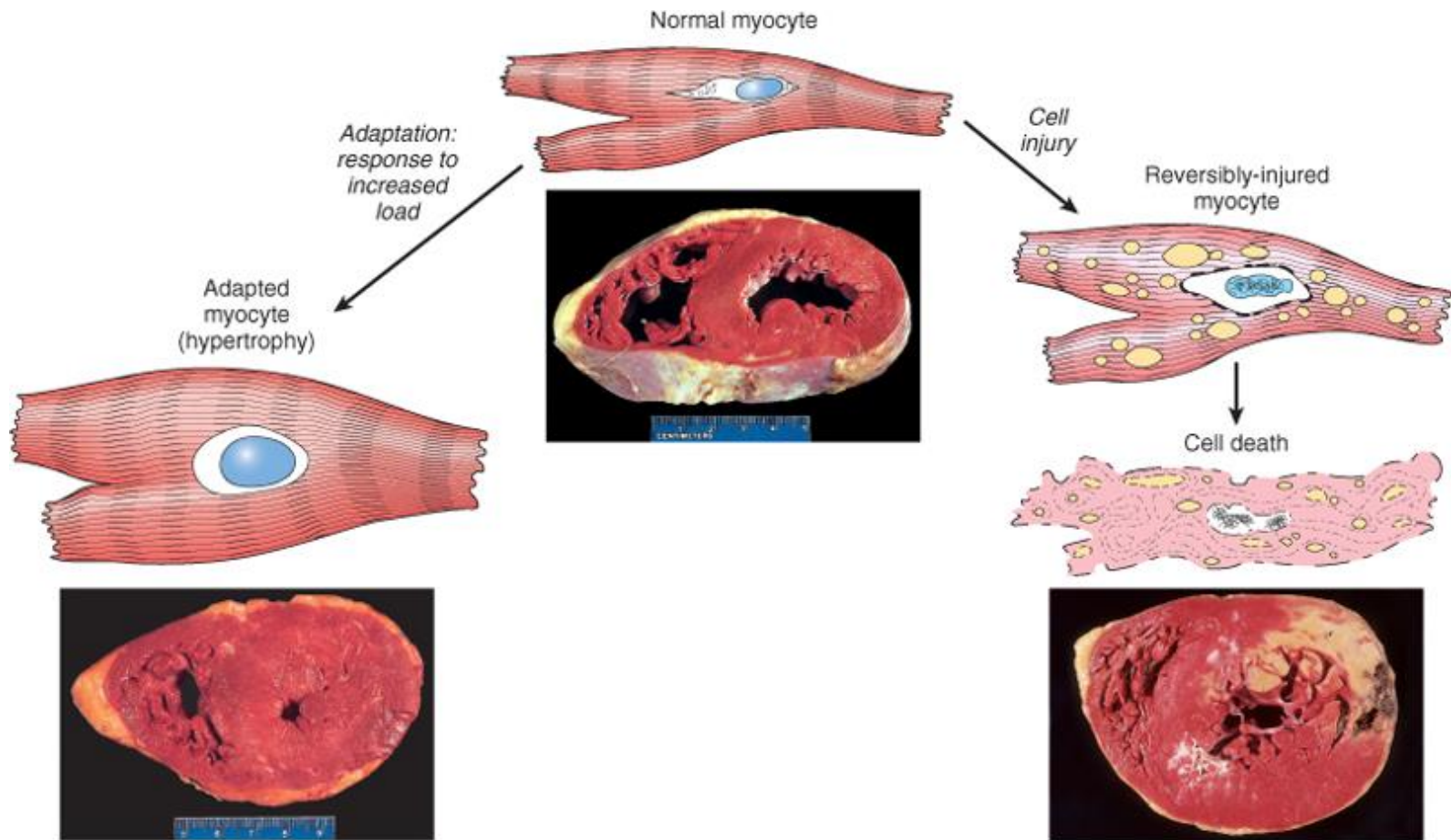
- Increased size & functional capacity
- Pure or mixed
- Increased structural proteins and organelles.
- Pathologic vs physiologic

- Due to
 - hormonal stimulation
 - Growth factor stimulation
 - increased functional demand

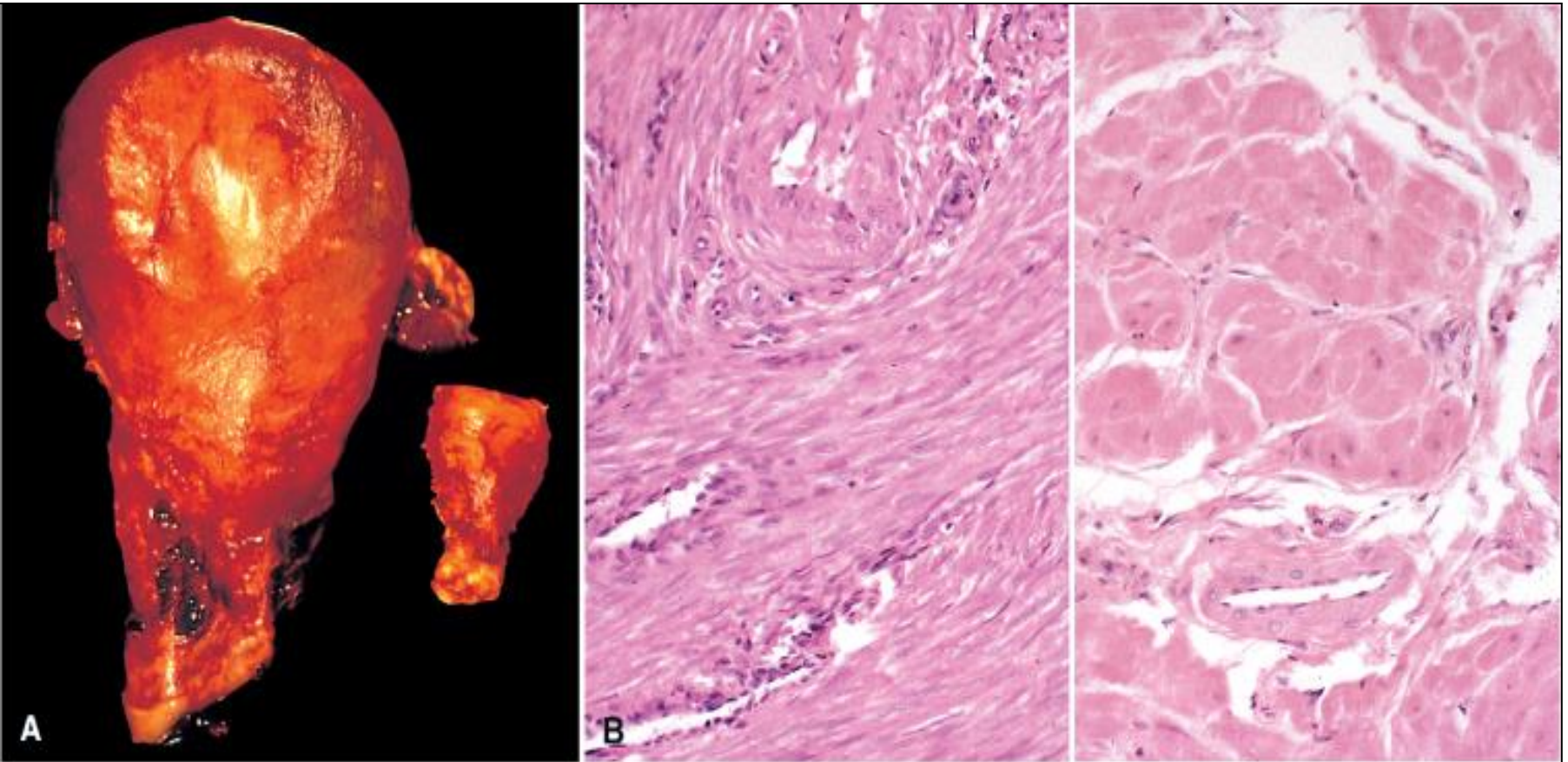


Pathologic

cardiac muscle in hypertension and aortic stenosis



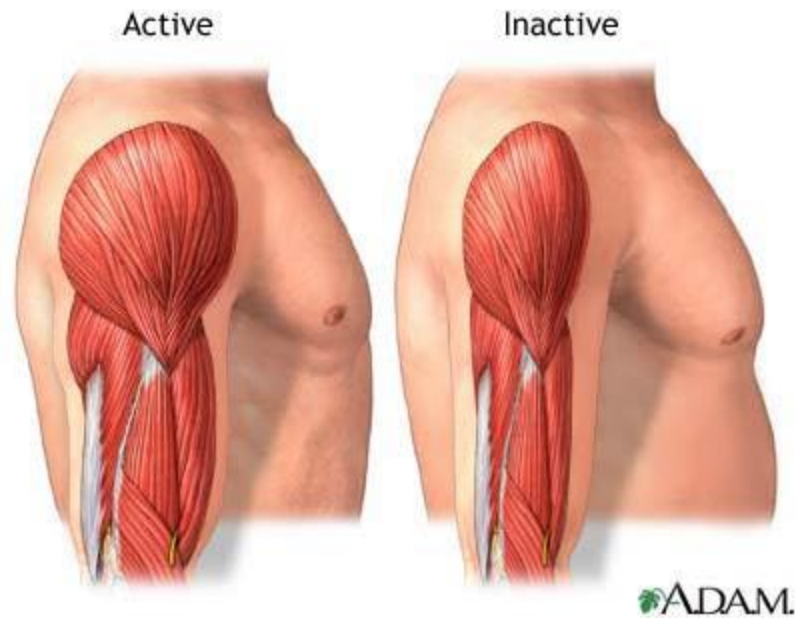
Physiologic uterine smooth muscle in pregnancy



© Elsevier 2005



Physiologic skeletal muscle in athletes



Hyperplasia

- Increase in number of cells
- Tissues that have proliferative ability
- Pure vs Mixed
- Physiologic vs Pathologic vs cancer
- **Physiologic hyperplasia:**
 - hormonal stimulation
 - Compensatory
- **Pathologic hyperplasia**
 - excessive hormonal stimulation
 - Viral Infections
- ▶ Pathologic hyperplasia constitutes a fertile soil in which cancers may eventually arise. (endometrial)



- ▶ **Physiologic**

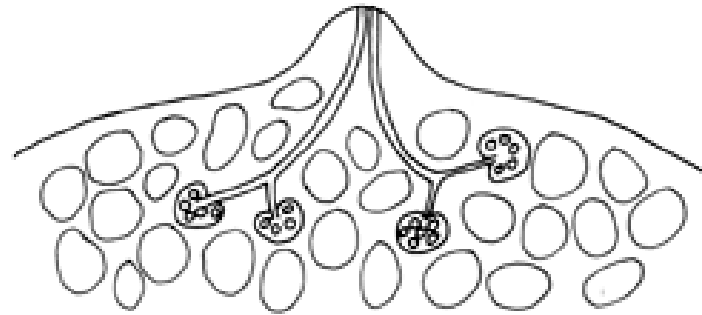
- ▶ Breast in puberty and pregnancy
- ▶ Liver after partial resection

- ▶ **Pathologic**

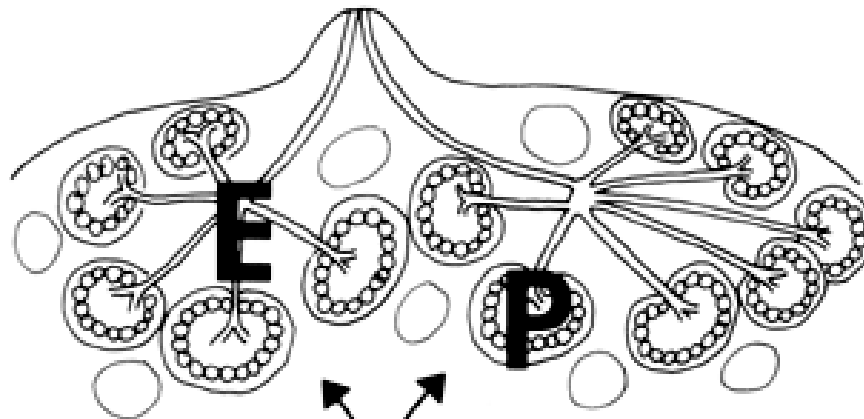
- ▶ Endometrial hyperplasia, estrogen induced.
- ▶ Benign prostatic hyperplasia, androgen induced.
- ▶ Warts (HPV).



Physiologic breast in pregnancy and lactation



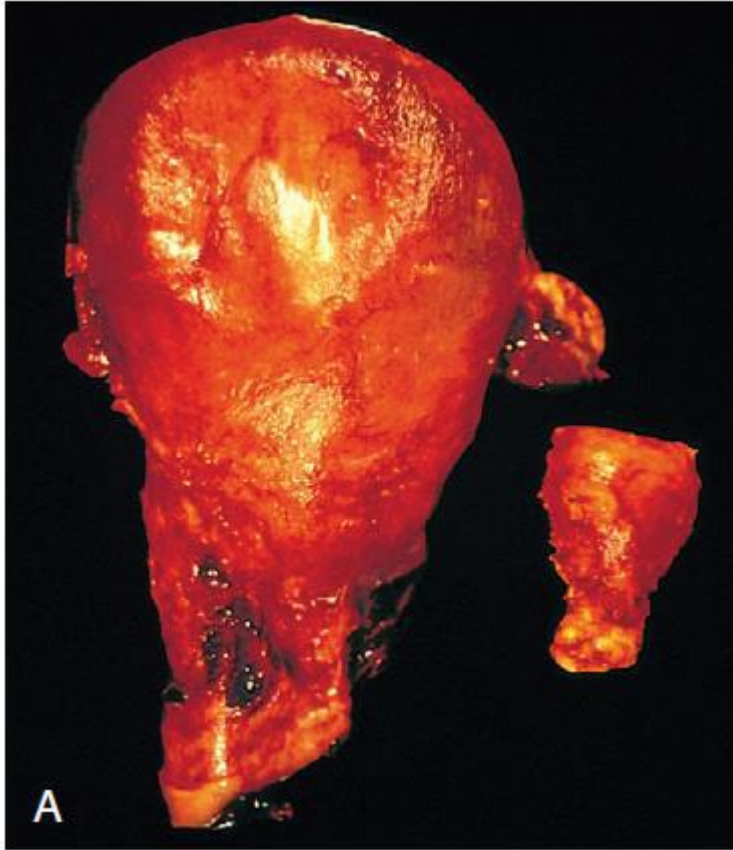
PREGNANT



Prolactin



Pathologic endometrial hyperplasia, estrogen induced



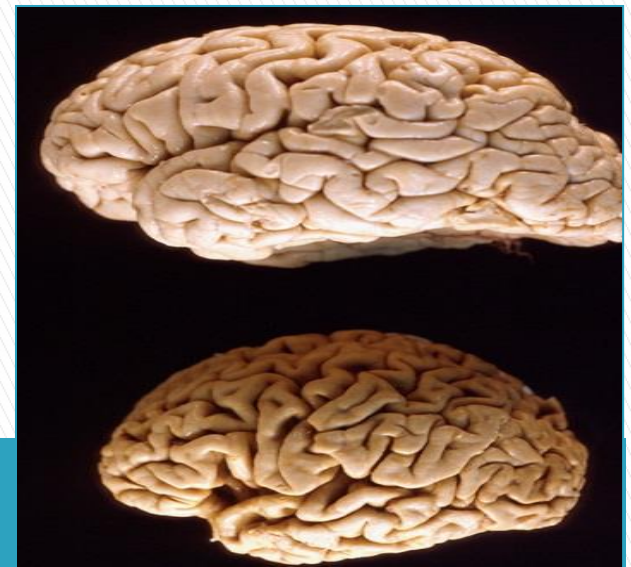
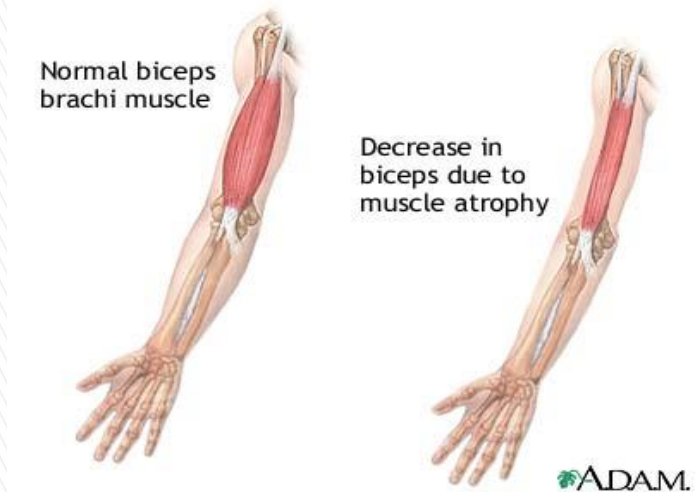
Atrophy

- Decreased cell size & function
- Mechanism: ↓ Protein synth
 ↑ Degradation
 ↑ Autophagy
- Atrophic cells can still function



Causes:

- ▶ Decreased workload (immobilization of a limb after fracture)
- ▶ Loss of innervations
- ▶ Diminished blood supply,
- ▶ Inadequate nutrition
- ▶ Loss of endocrine stimulation
- ▶ Aging (senile atrophy)



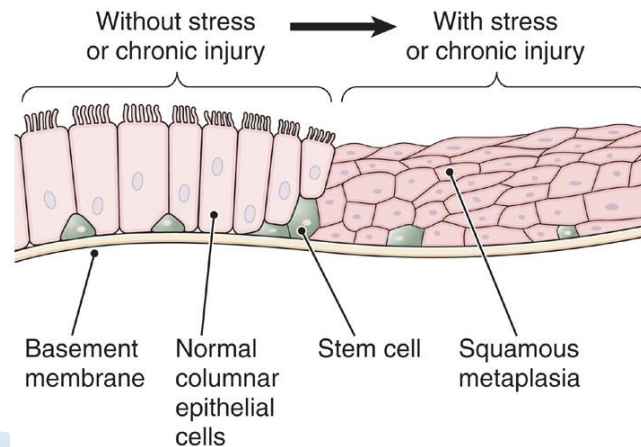
- ▶ **Physiologic**
- ▶ Loss of hormone stimulation in menopause (endometrial atrophy)

- ▶ **Pathologic**
- ▶ Denervation injury.
- ▶ Chronic ischemia.



Metaplasia

- Change from one cell type to another
- Reprogramming of stem cells NOT differentiated cells
- Persistent change increases risk of cancer
- New cell type copes better with stress but function less.
- Reversible
- Causes: Smoking , Vitamin A deficiency, GERD.
- Vitamin A is needed for normal epithelial differentiation, deficiency leads to squamous metaplasia of the bronchi)



Cell injury and death

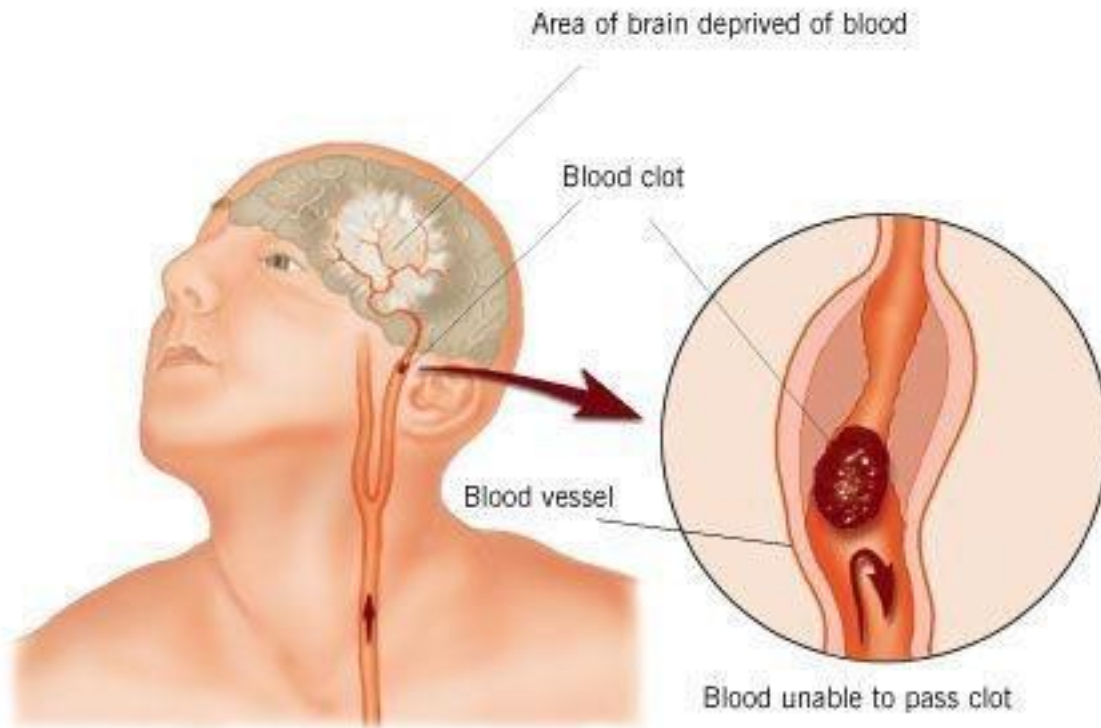


CAUSES OF CELL INJURY

- Oxygen Deprivation (Hypoxia Vs ischemia)
- Chemical Agents
- Infectious Agents
- Immunologic Reactions
- Genetic Factors
- Nutritional Imbalances
- Physical Agents
- Aging



Oxygen Deprivation



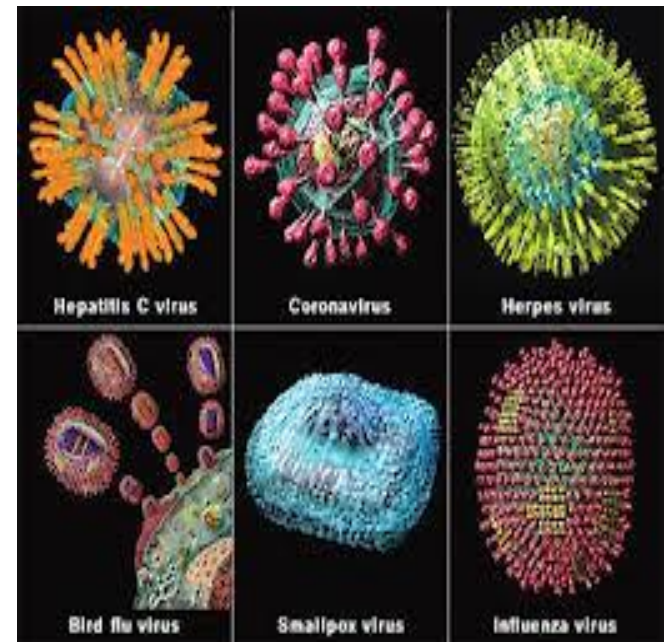
**LACK OF
OXYGEN!**



Chemical Agents



Infectious Agents



Immunologic Reactions

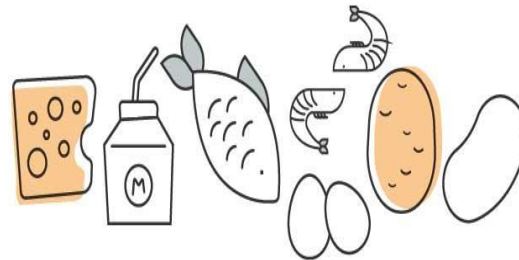
autoimmune, allergic, microbes



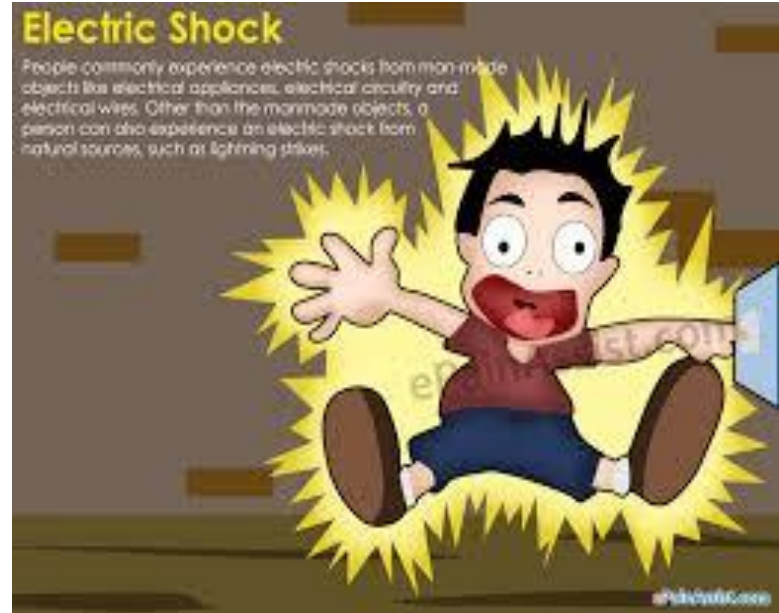
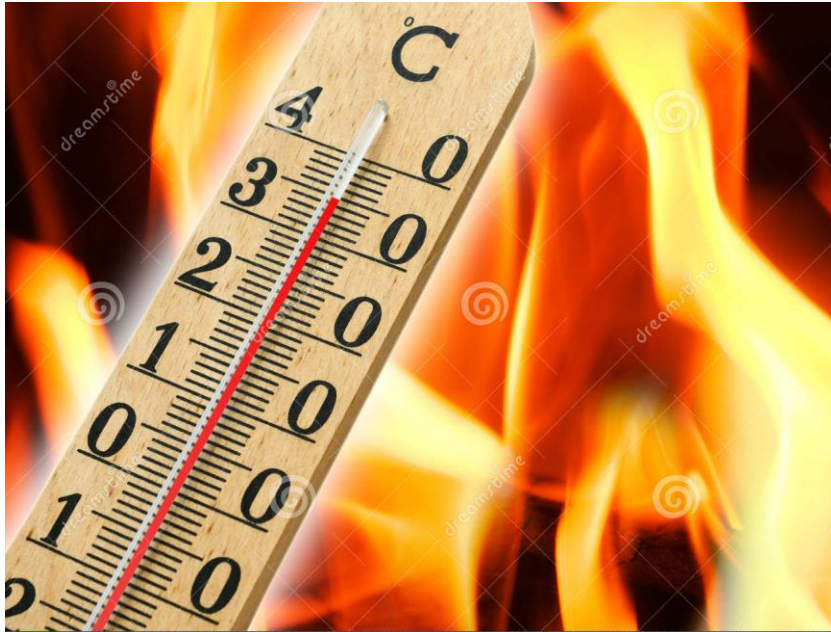
Genetic Factors



Nutritional Imbalances



Physical Agents



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