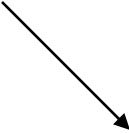


Cell injury, Cell death and Adaptations

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

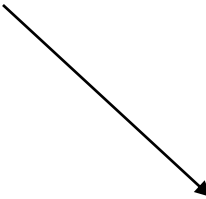
Cells



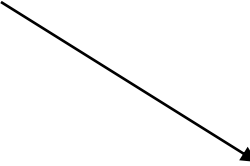
Tissues



Organs

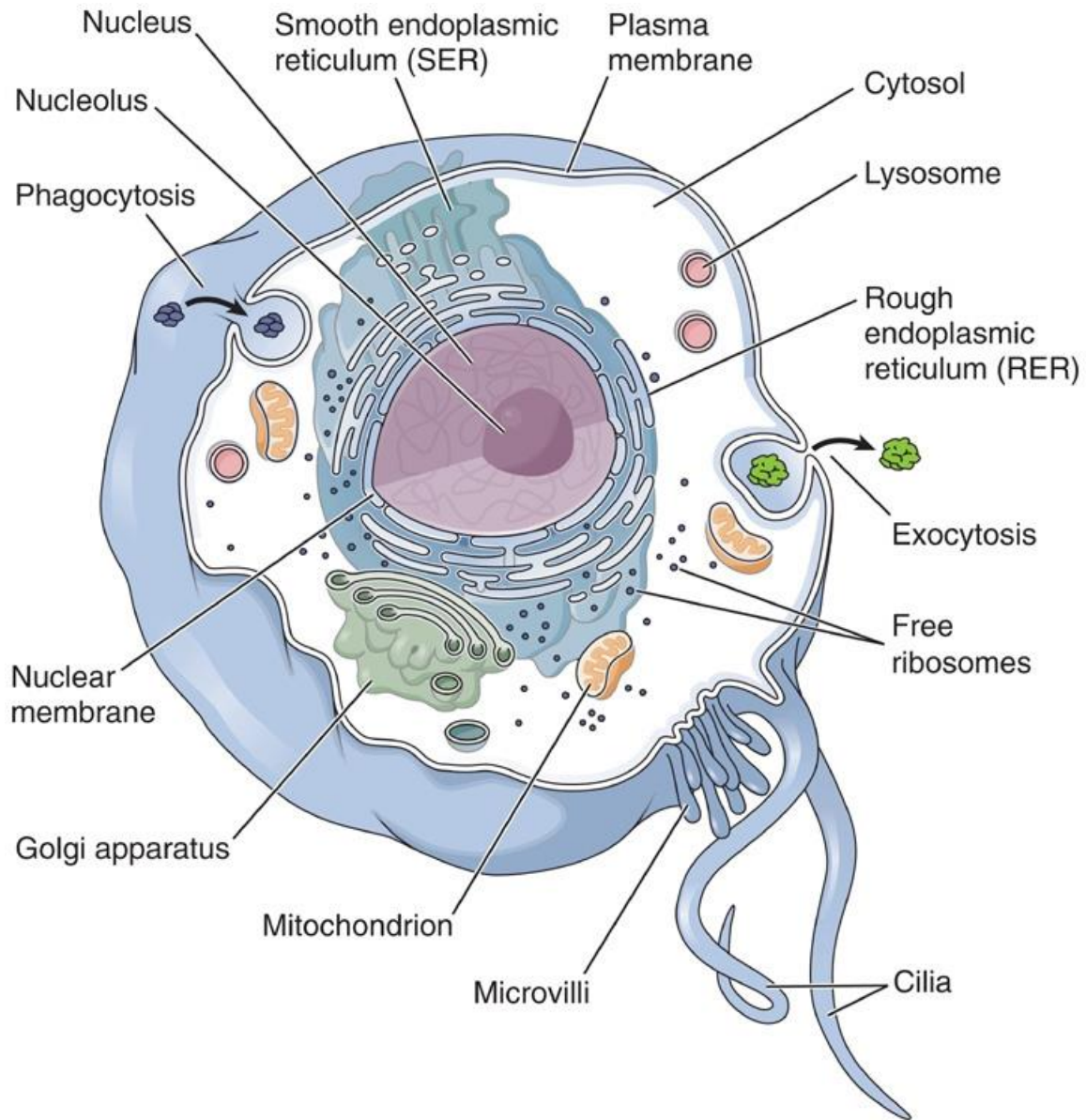


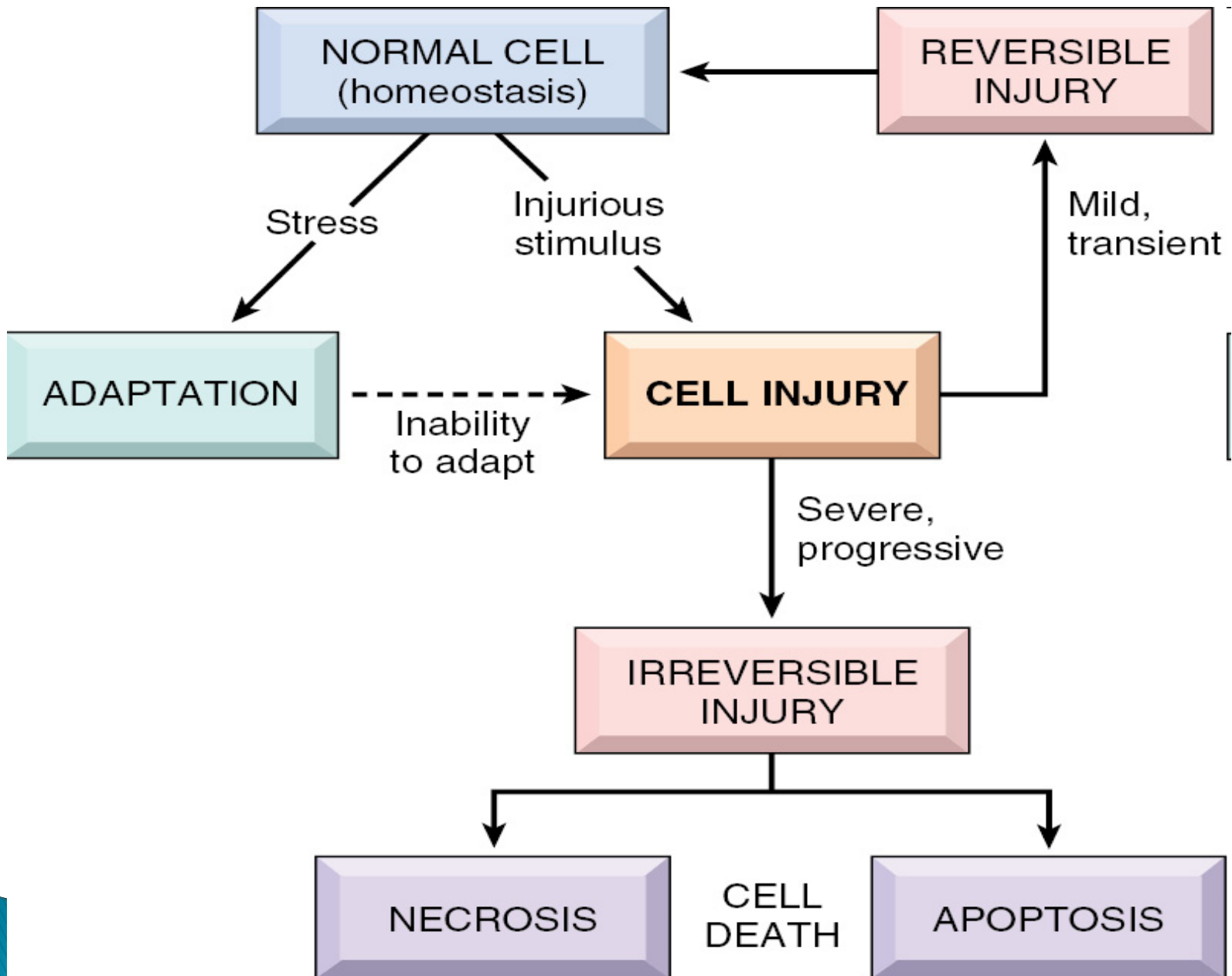
Systems



Organism







Adaptations

- ▶ Physiologic adaptation
- ▶ Pathologic adaptation.

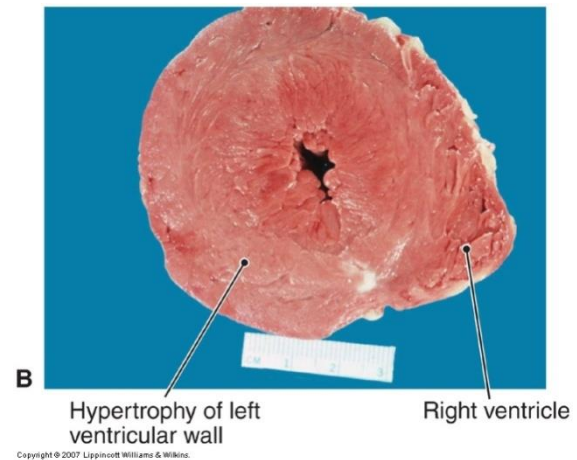
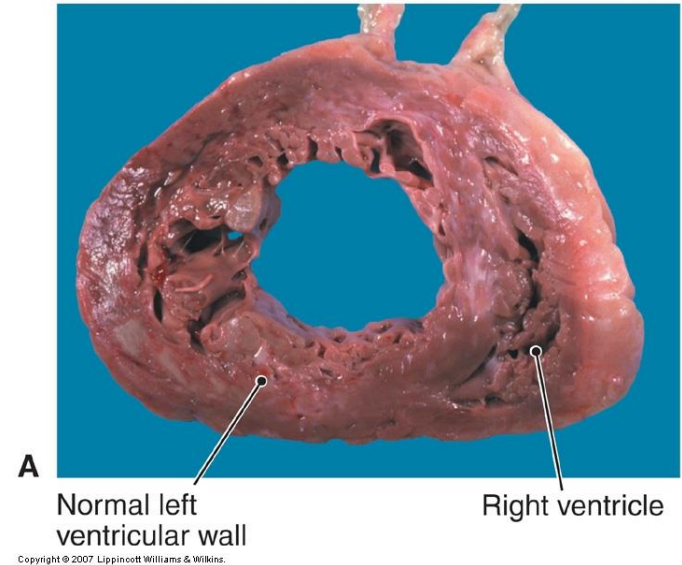
Adaptations

- Many forms:
 - Increase 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

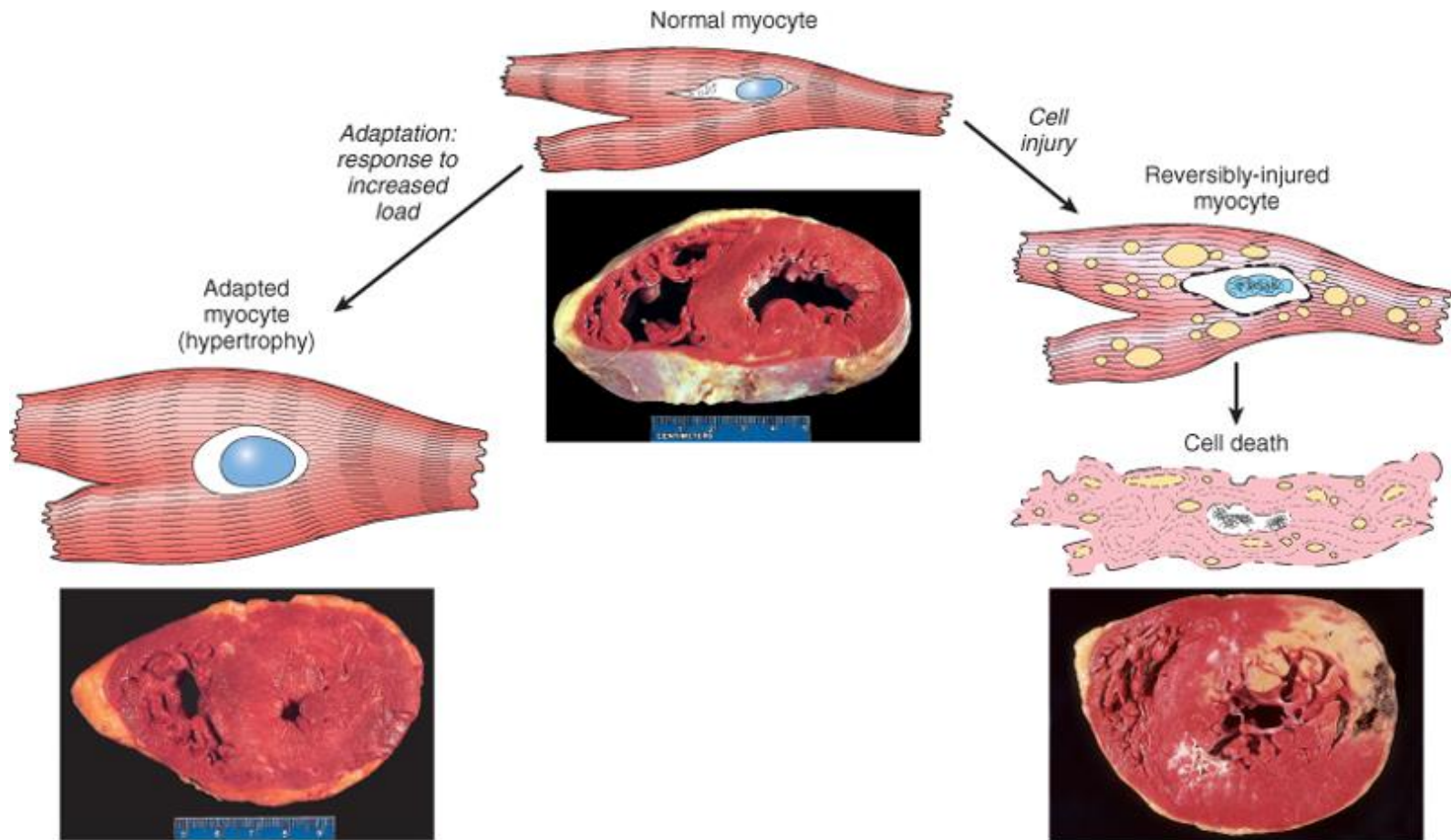
- Increased size & functional capacity
- Pure or mixed
- Increased structural proteins and organelles.
- Pathologic vs physiologic

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



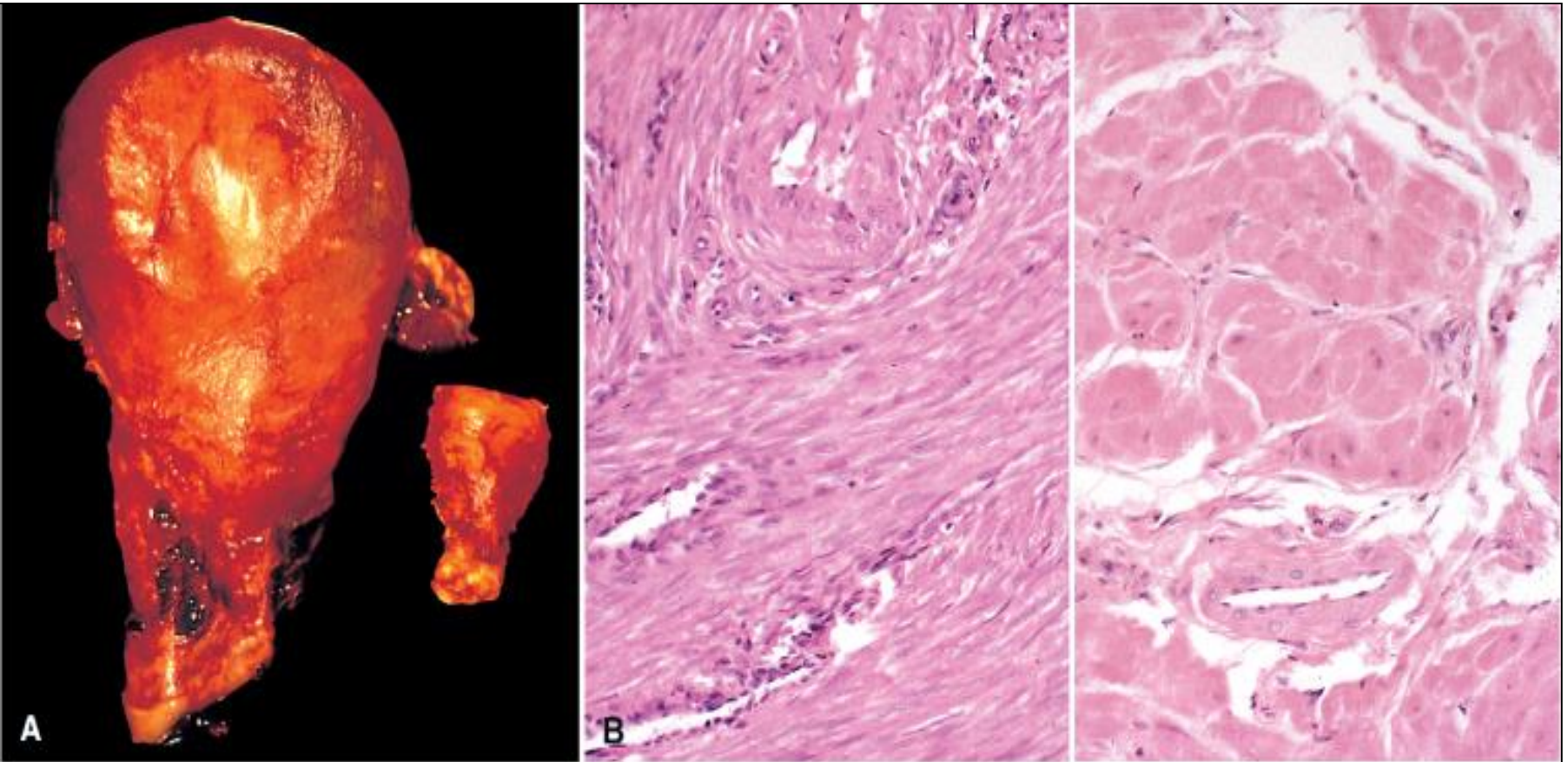
Pathologic

cardiac muscle in hypertension and aortic stenosis

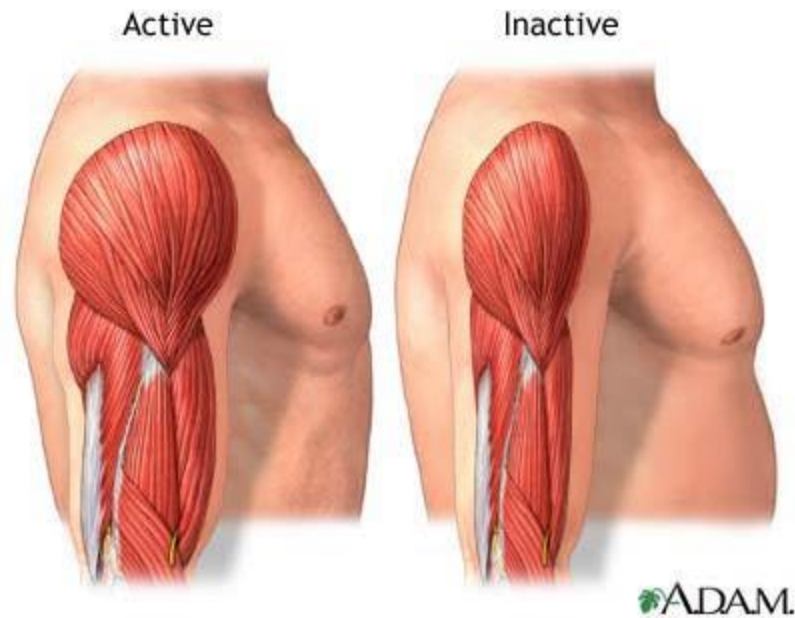


Physiologic

uterine smooth muscle in pregnancy



Physiologic skeletal muscle in athletes



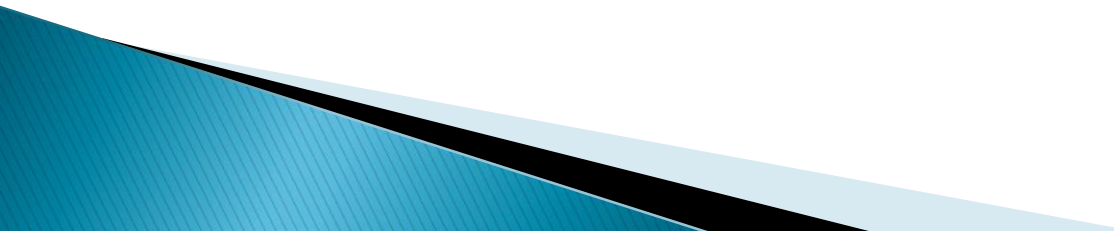
Hyperplasia

- 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.

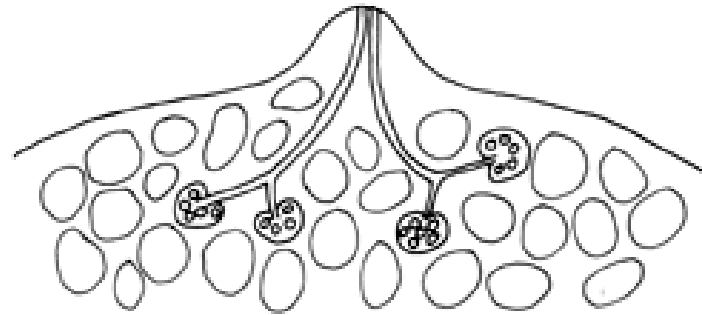
- ▶ **Physiologic**

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

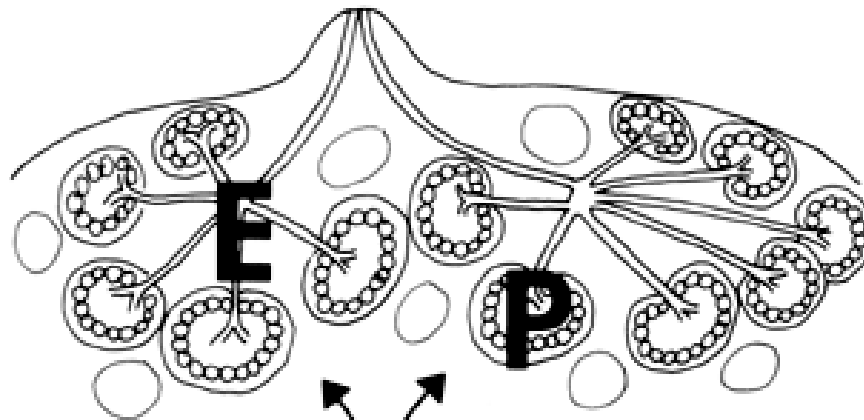
- ▶ **Pathologic**

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

Physiologic breast in pregnancy and lactation

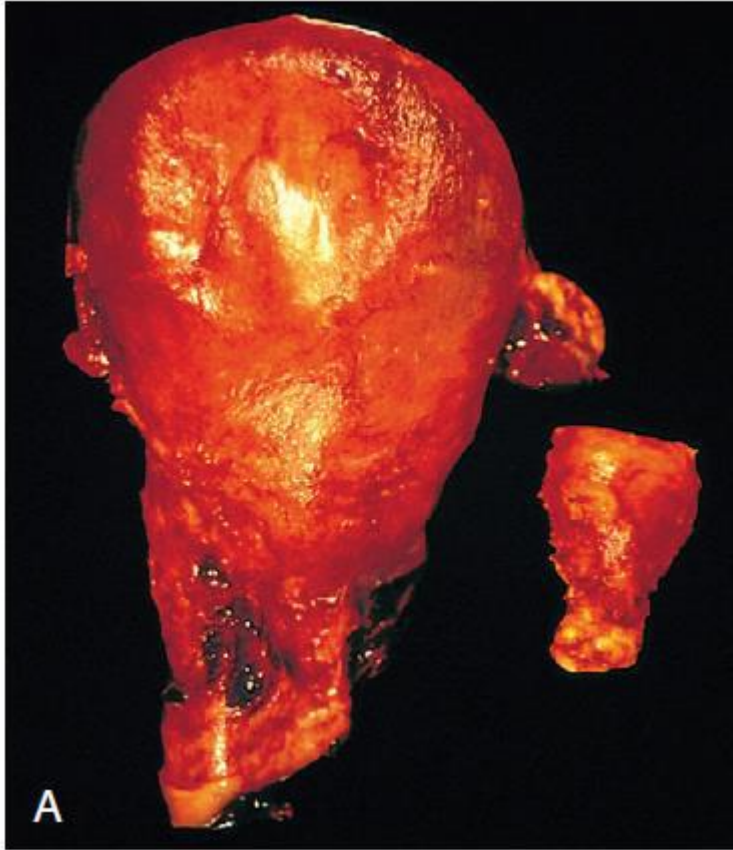


PREGNANT



Prolactin

Pathologic endometrial hyperplasia, estrogen induced

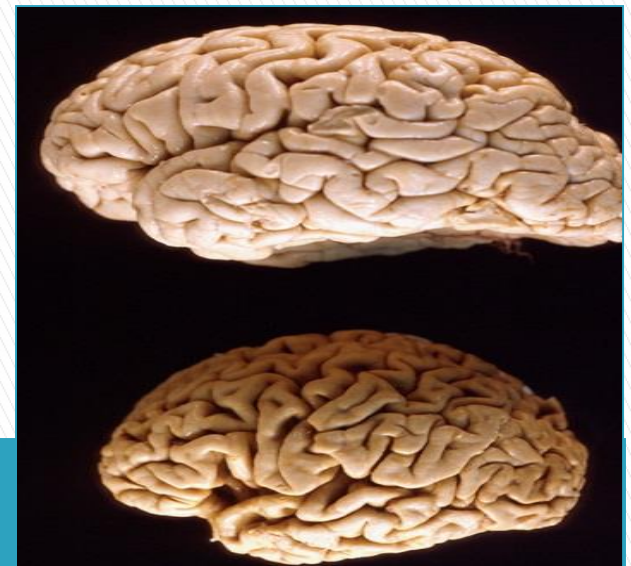
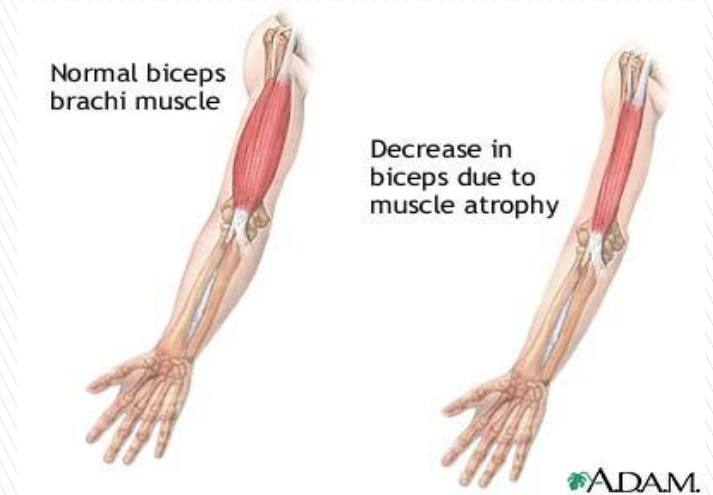


Atrophy

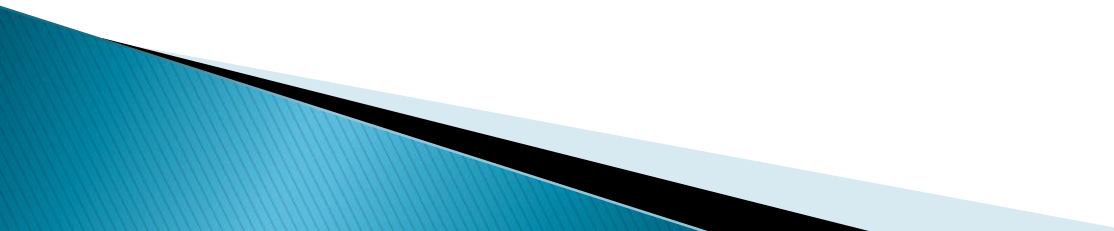
- Decreased cell size & function
- Mechanism: ↓ Protein synth
 ↑ Degradation
 ↑ Autophagy
- Atrophic cells can still function

Causes:

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

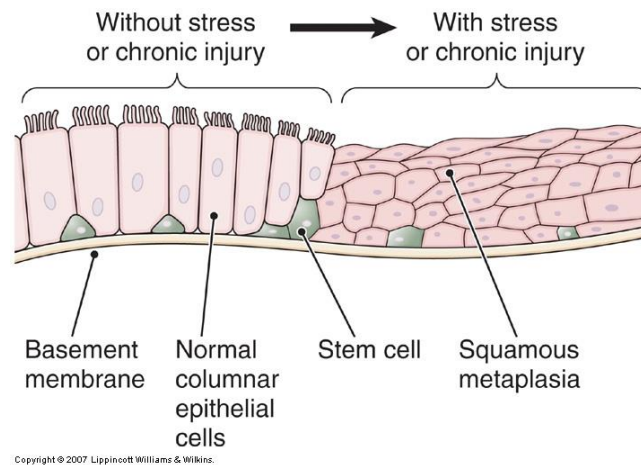


- ▶ **Physiologic**
 - ▶ Loss of hormone stimulation in menopause (endometrial atrophy)

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

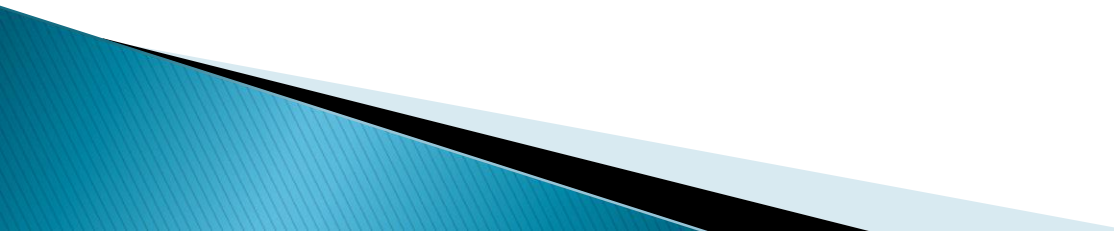
Metaplasia

- 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.

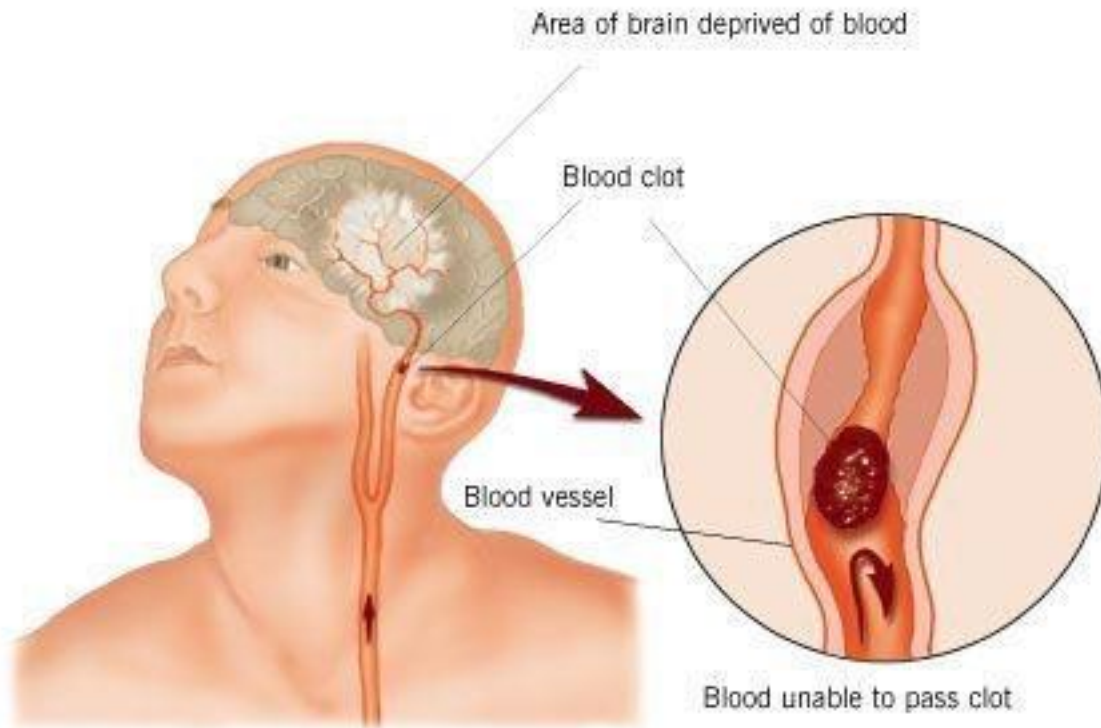


Cell injury and death

CAUSES OF CELL INJURY

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

Oxygen Deprivation



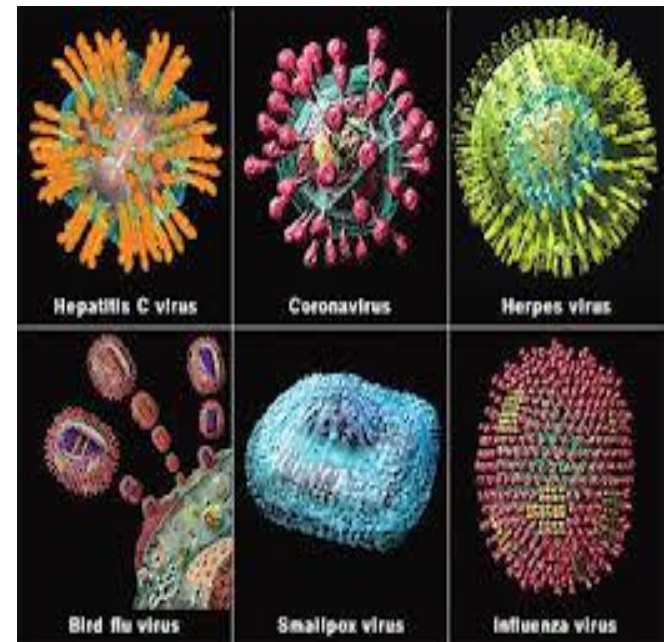
**LACK OF
OXYGEN!**

.. . . .

Chemical Agents



Infectious Agents



Immunologic Reactions

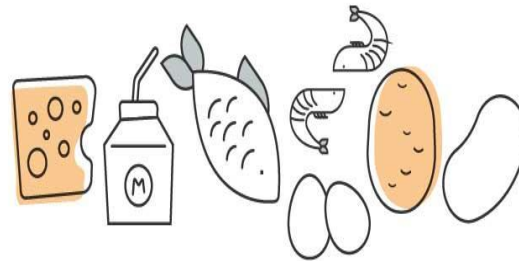
autoimmune, allergic, microbes



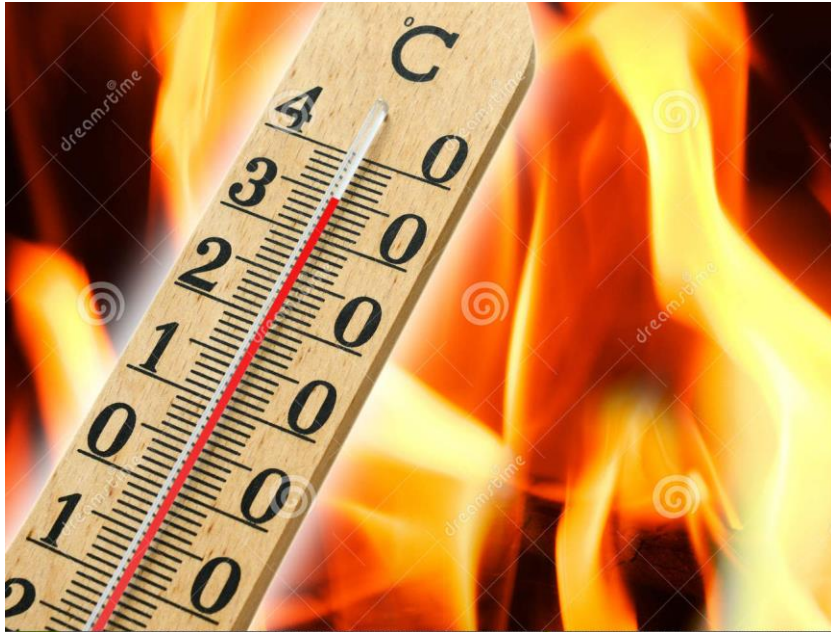
Genetic Factors



Nutritional Imbalances



Physical Agents



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Electric Shock

People commonly experience electric shocks from man-made objects like electrical appliances, electrical circuitry and electrical wires. Other than the man-made objects, a person can also experience an electric shock from natural sources, such as lightning strikes.

shockcase.com