# Cellular Adaptations

cell injury and adaptations

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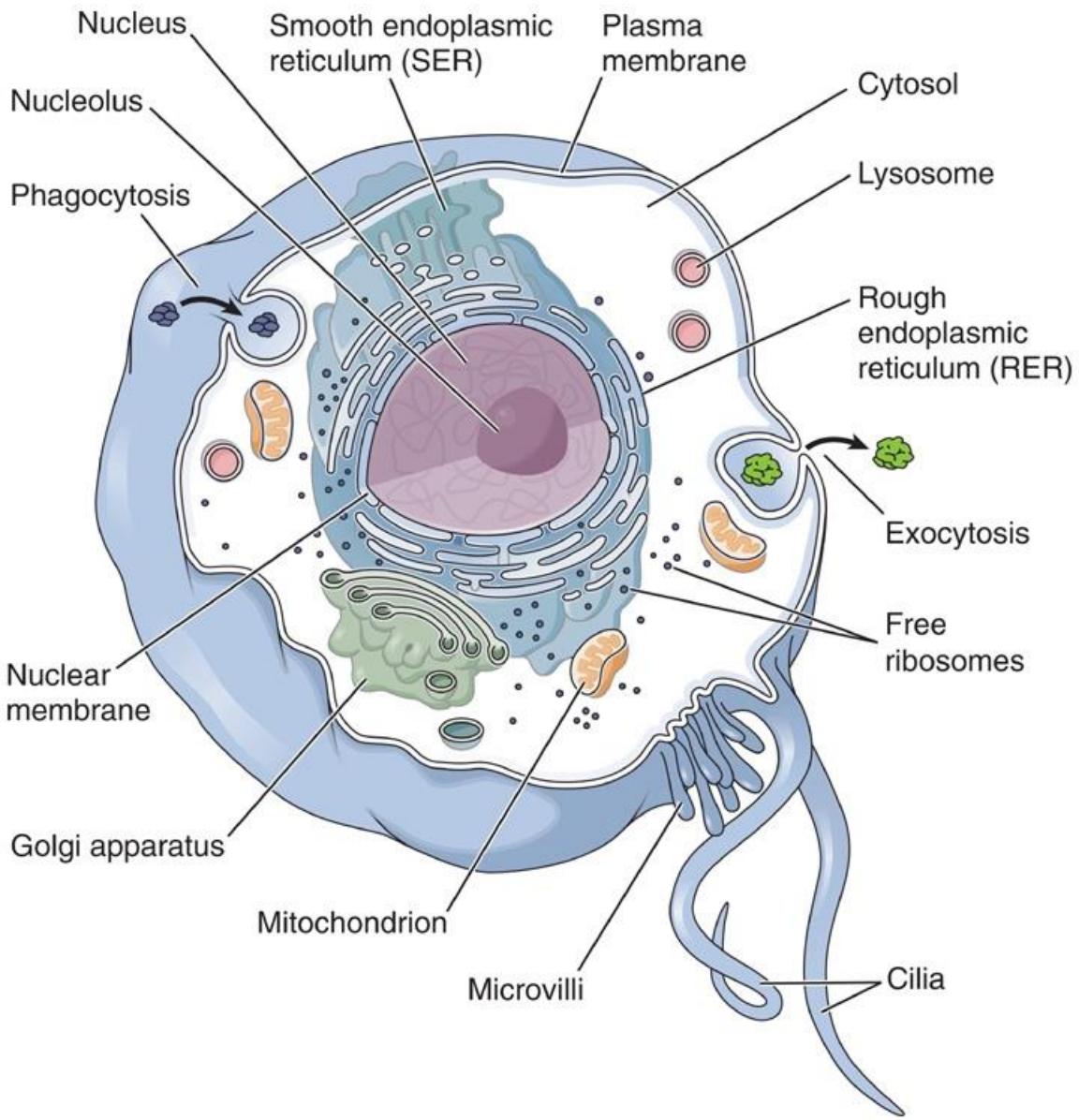
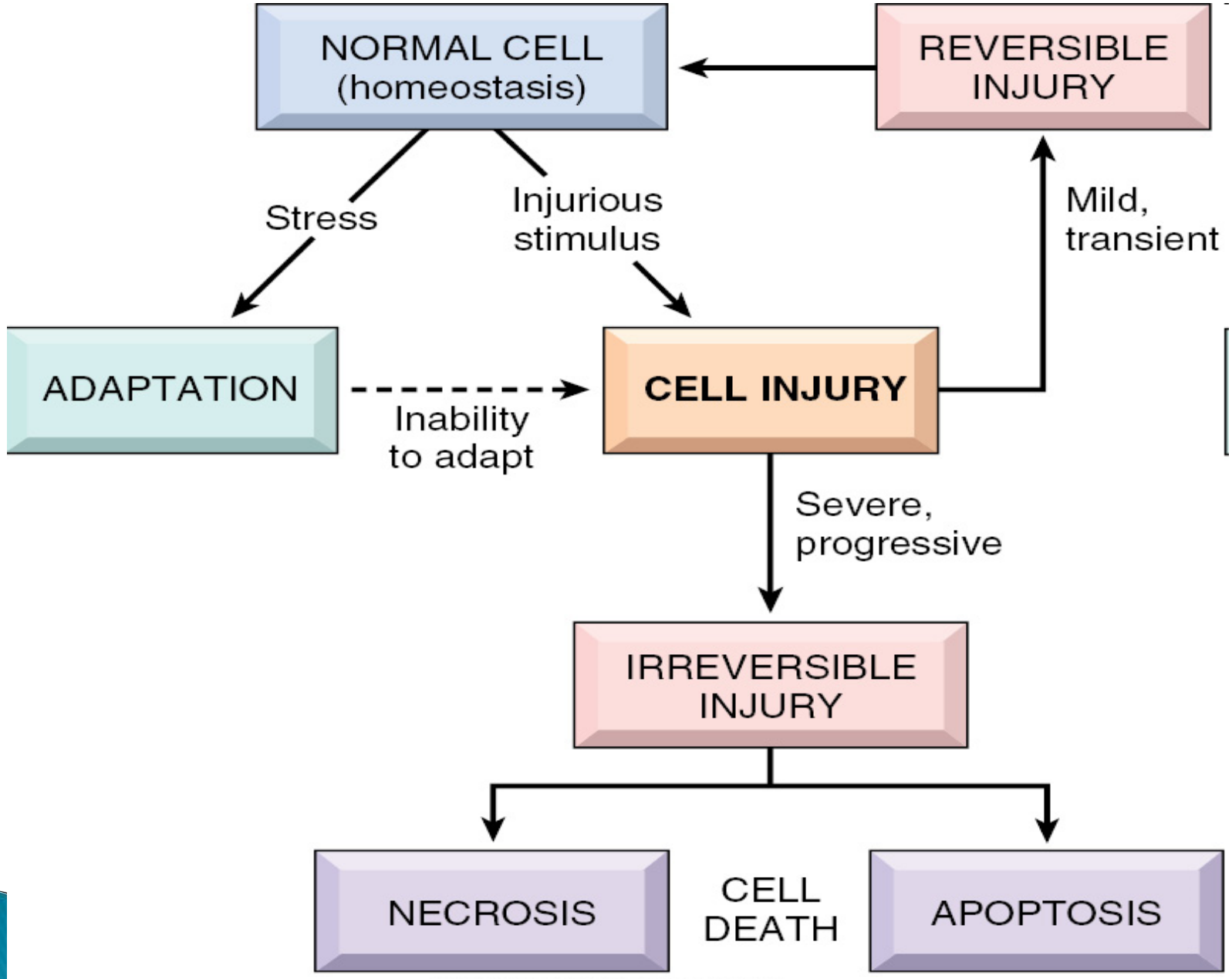
# Outlines:

- Adaptive mechanisms
- Hypertrophy
- Hyperplasia
- Atrophy
- Metaplasia
- Causes of cell injury.





# Adaptations

Physiologic adaptation

Pathologic adaptation.

# Adaptations

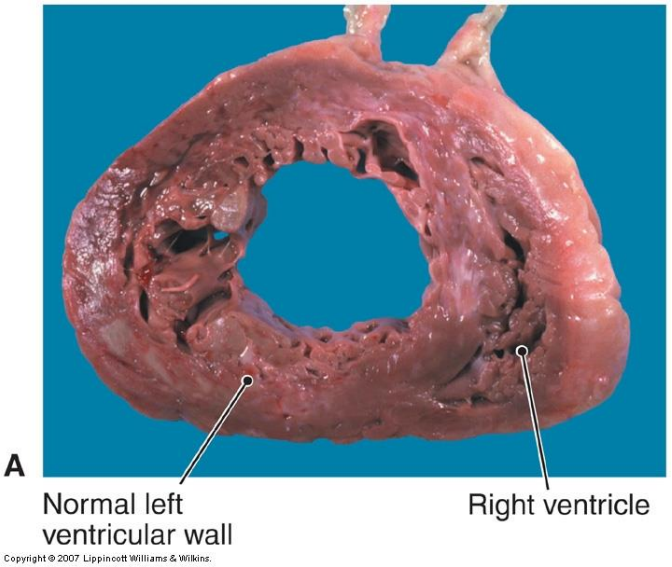
- **Many forms:**
- Increase in cell size.
- Decrease in cell size.
- Increase in number of cells.
- Change into another type of cell

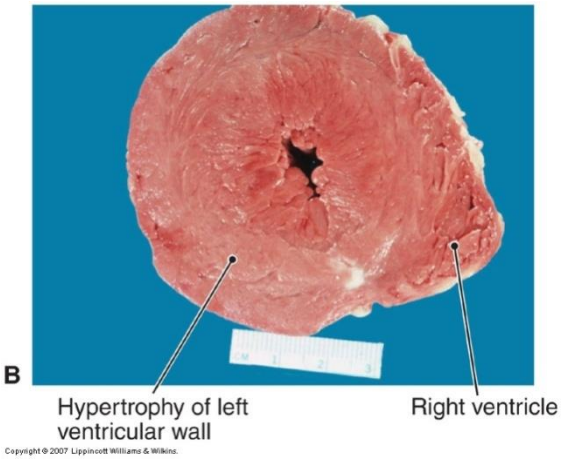
- Adaptation to stress can progress to cell injury if the stress is not relieved.

# Hypertrophy

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

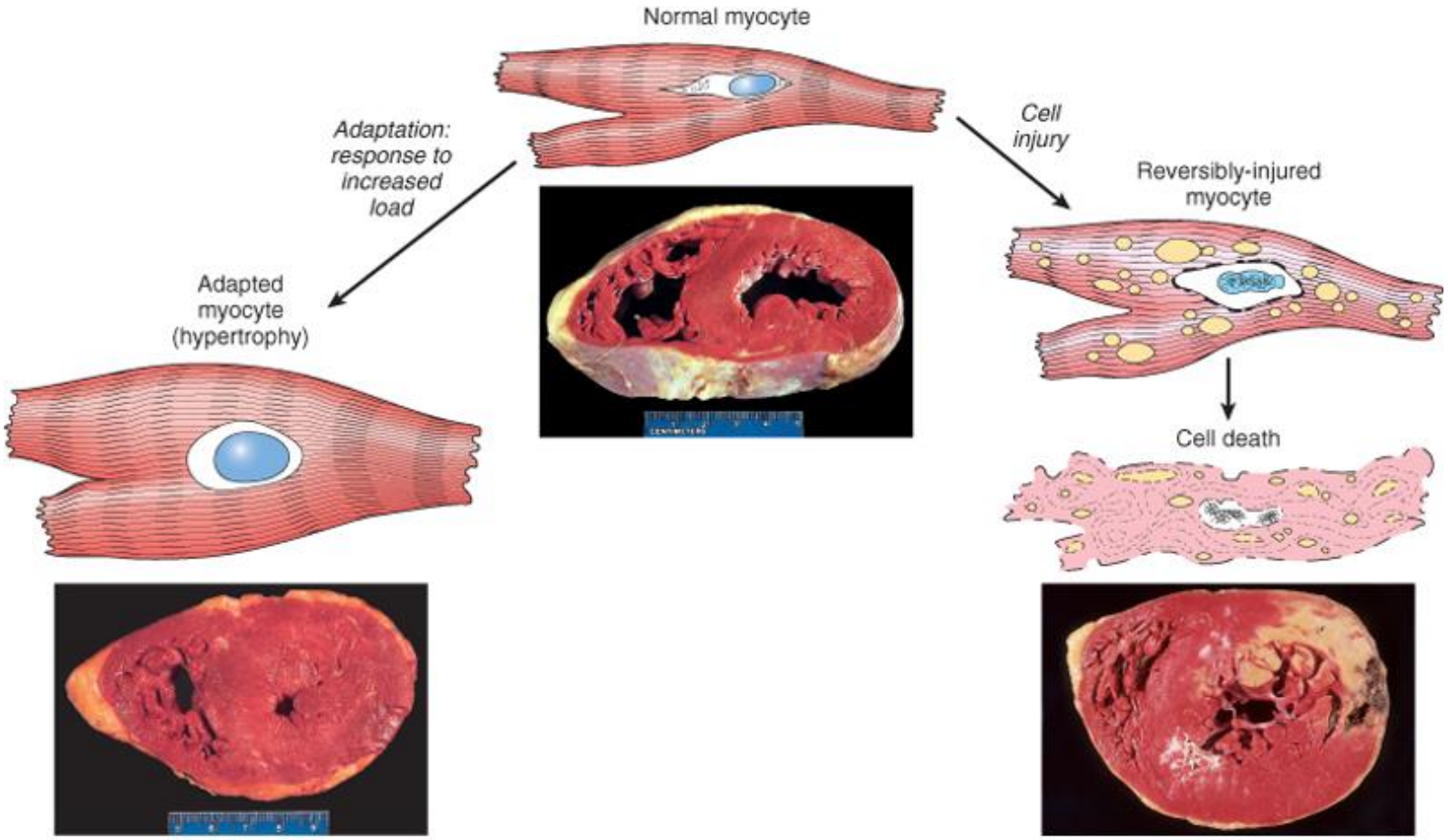
- Due to
  - hormonal stimulation
  - Growth factor stimulation
  - increased functional demand



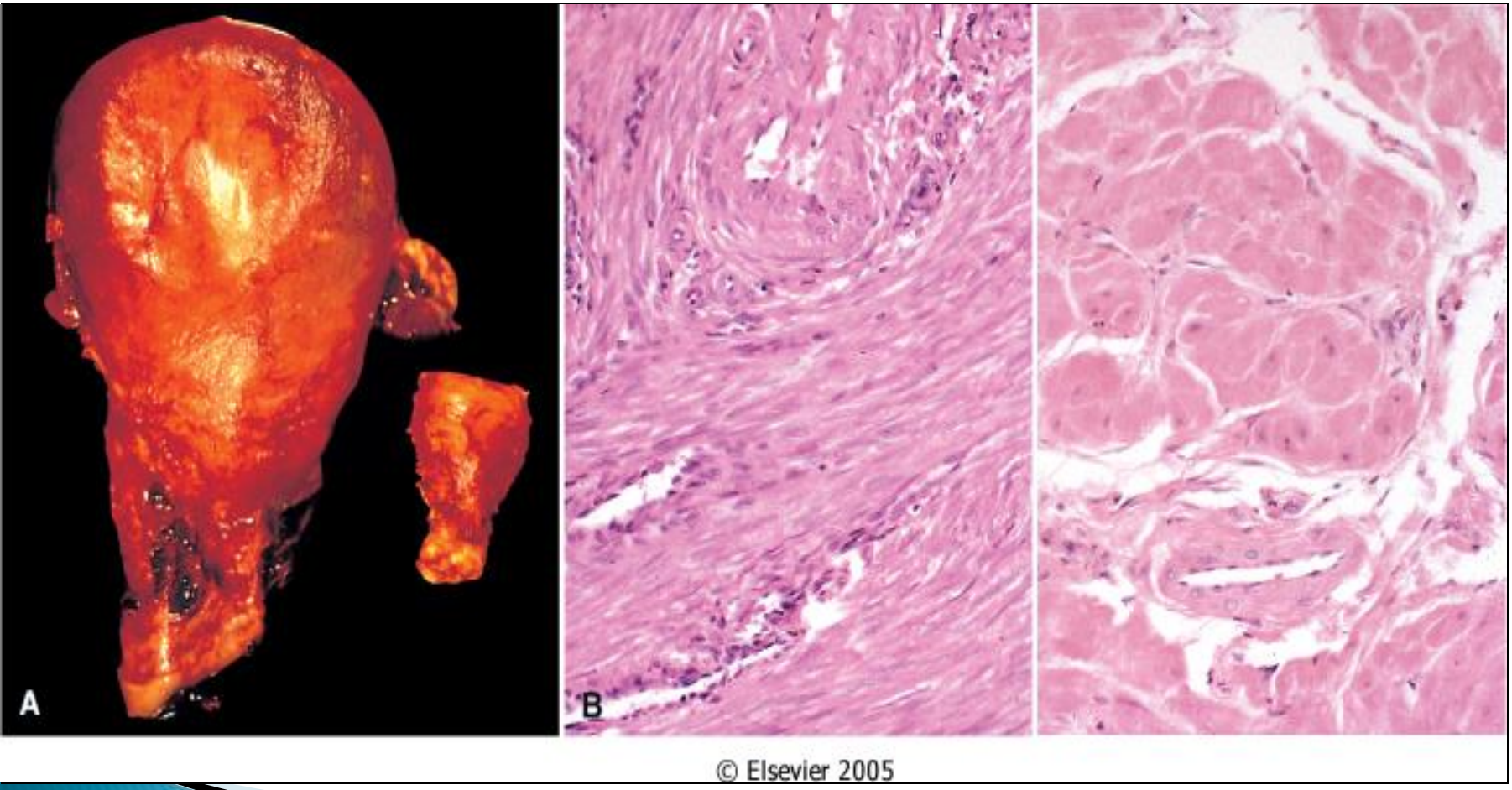
# Pathologic

# cardiac muscle in hypertension and aortic stenosis

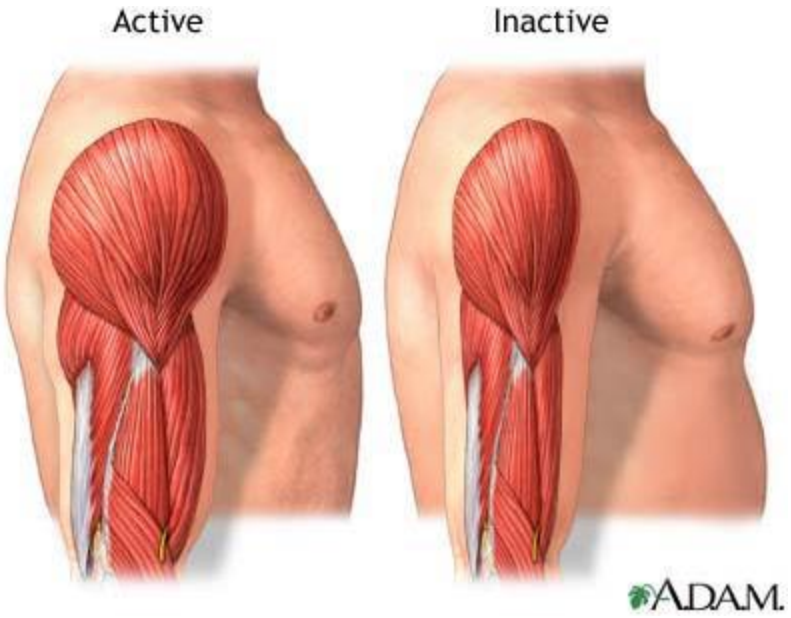


# Physiologic

## uterine smooth muscle in pregnancy



# 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

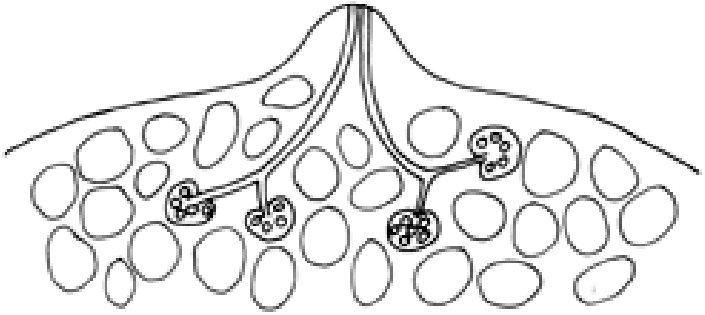
- **Pathologic hyperplasia**
  - excessive hormonal stimulation
  - Viral Infections

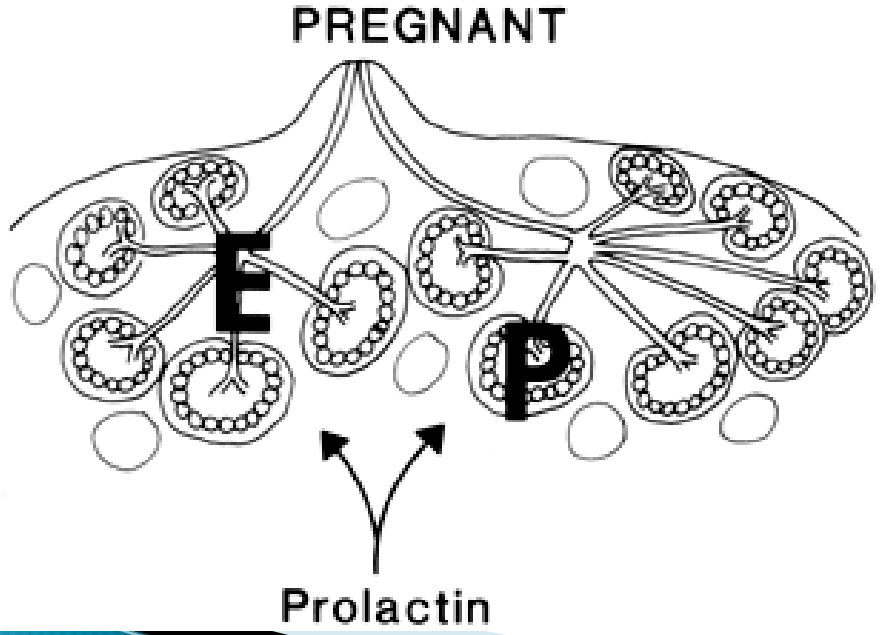
- Pathologic hyperplasia constitutes a fertile soil in which cancers may eventually arise. (endometrial)

- **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





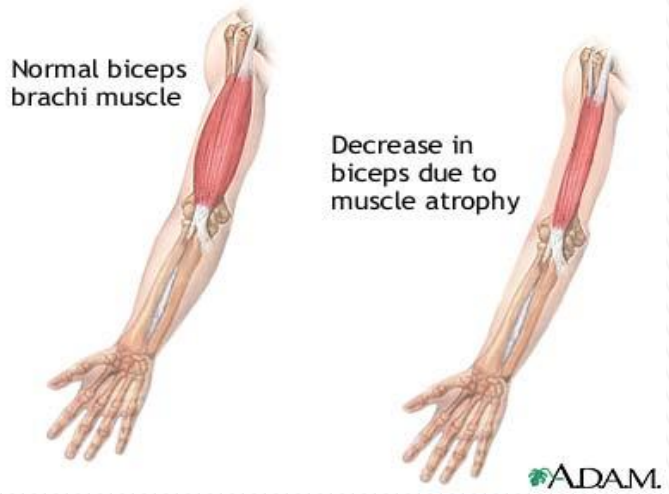
# Pathologic
# endometrial hyperplasia, estrogen induced

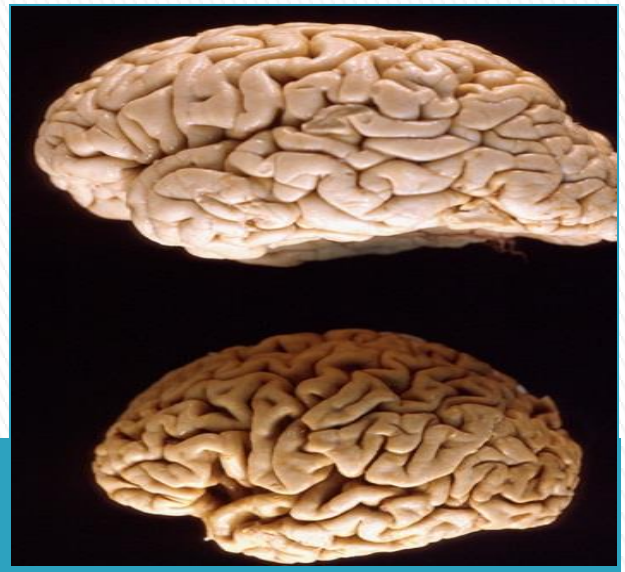

# Atrophy

- 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)



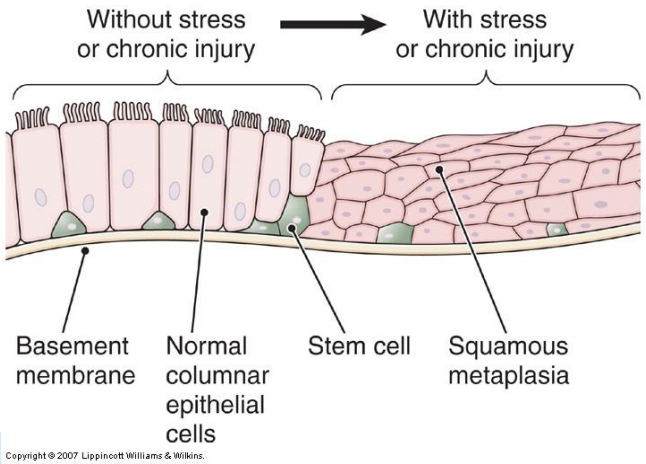



- **Physiologic**
- Loss of hormone stimulation in menopause (endometrial atrophy)

- **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)

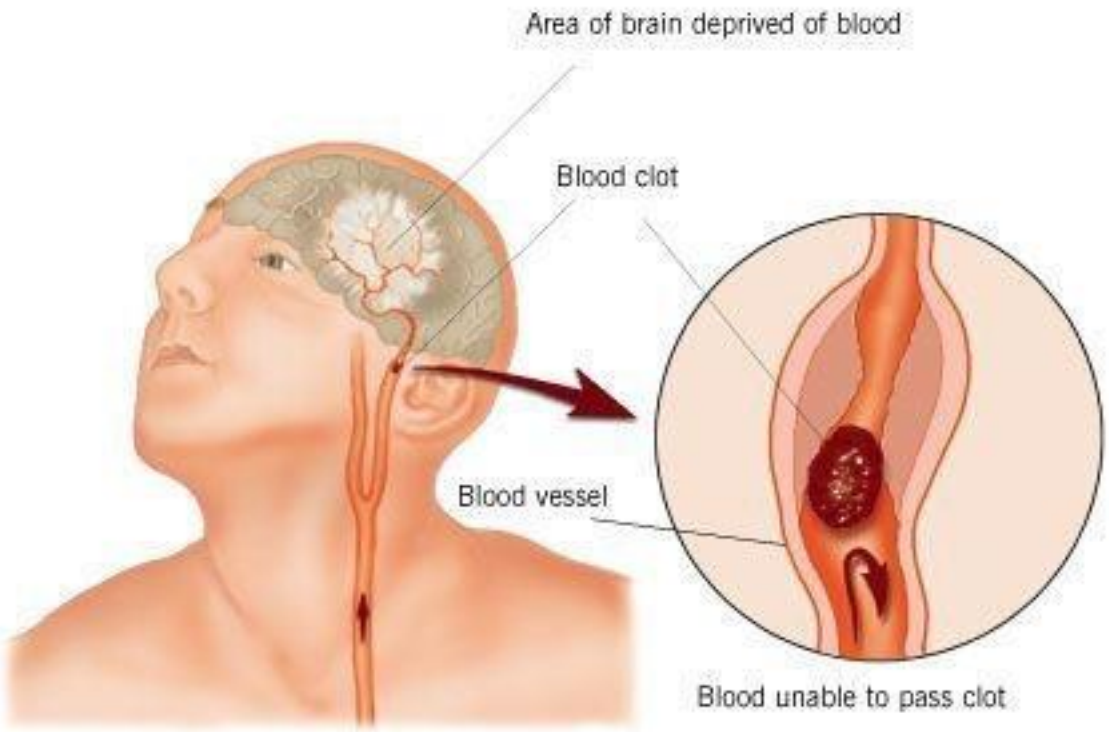


# Cell injury and death

# CAUSES OF CELL INJURY

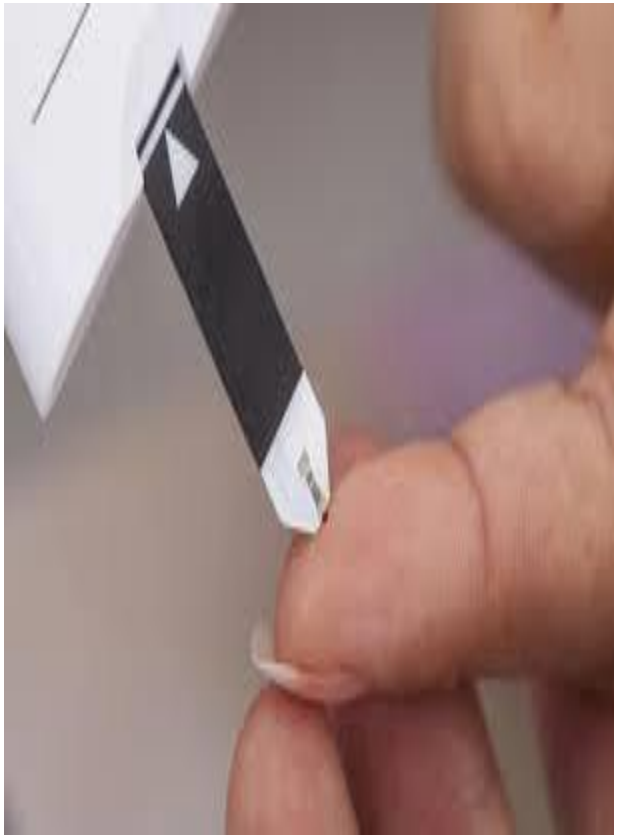
- Oxygen Deprivation (Hypoxia Vs ischemia)
- Chemical Agents
- Infectious Agents
- Immunologic Reactions
- Genetic Factors
- Nutritional Imbalances
- Physical Agents
- Aging

# Oxygen Deprivation

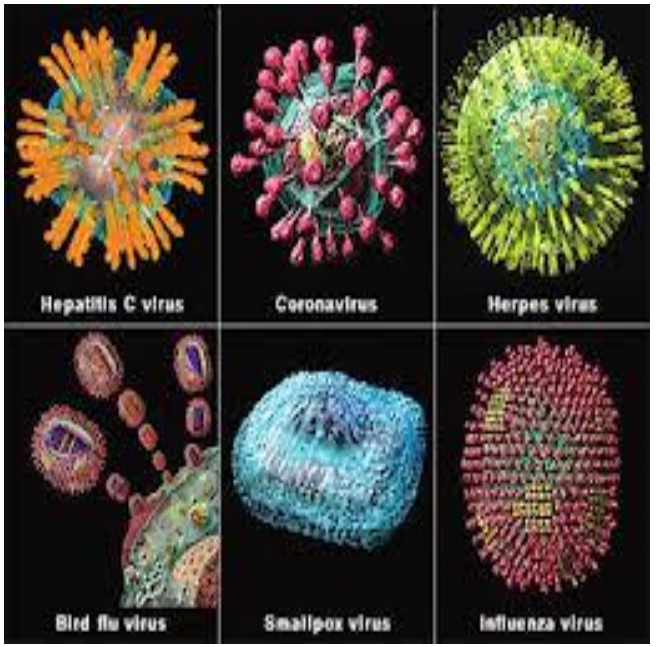



LACK OF OXYGEN!

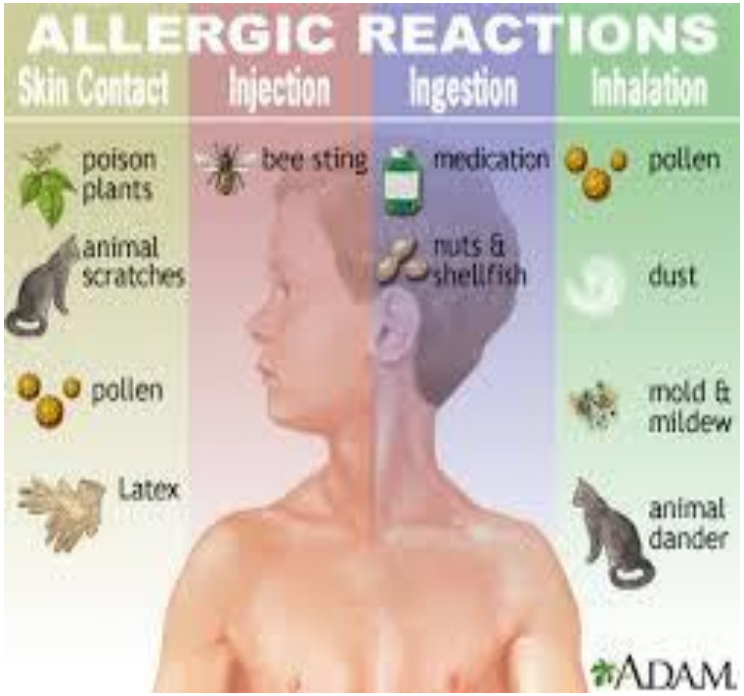
# Chemical Agents



# Infectious Agents

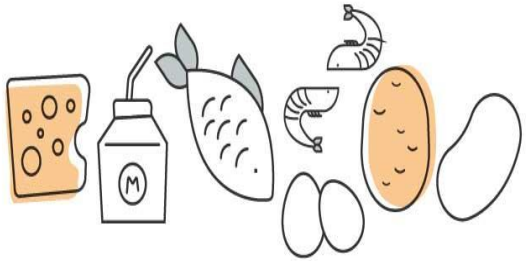



# Immunologic Reactions
# autoimmune, allergic, microbes




# Genetic Factors

# Nutritional Imbalances

# Physical Agents