

Hypertrophy :

effects :

- Increase in cell size and functional capacity
- Increase in proteins and organelles

Causes :

- Increase in hormonal stimulation
- Increase in growth factor stimulation
- Increase in functional demand

Physiological

- Uterine smooth muscle during pregnancy
- Skeletal muscle in athletes

Pathological

- Cardiac muscle in hypertension
- Cardiac muscle in aortic stenosis

# Atrophy effect:

Notes:  
\* Atrophic cells can still function

- decrease in cell size and function

mechanism:

- decreased protein synthesis

- Increased degradation

- Increased autophagy

Causes:

- decreased workload

- loss of innervations

- diminished blood supply

- Inadequate nutrition

- loss of endocrine stimulation

- aging

Physiologic:

- loss of hormone stimulation in menopause

pathologic:

- Denervation injury

- Chronic ischemia

# Hyperplasia effect:

## Notes:

- \* Hyperplasia occurs in tissues that have proliferative ability
- \* pathologic hyperplasia constitutes a fertile soil in which cancers may arise
- \* Endometrial hyperplasia is induced by estrogen
- \* Benign prostatic hyperplasia is induced by androgen

## Increase in number of cells

### Physiologic cause:

- hormonal stimulation
- Compensatory effect in the body

### Pathologic cause:

- excessive hormonal stimulation
- viral infection

### Physiologic

- breast in puberty or pregnancy
- liver after partial resection

### Pathologic

- Endometrial hyperplasia
- benign prostatic hyperplasia
- Warts (HPV)

# Metaplasia:

## Effect:

- Change from one cell type to another

## Causes:

- Smoking
- Vitamin A deficiency
- GERD

## Notes:

\* reprograms stem cells, not differentiated cells

\* persistent change increases risk of cancer

\* reversible process

\* new cell type **copies better with stress**, but **functions less**

\* Vitamin A is needed for normal epithelial differentiation

deficiency leads to squamous metaplasia of the bronchi