

# GROWTH ADAPTATIONS

— PATHOMA

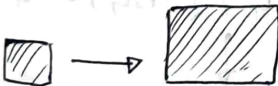
- organ is in homeostasis with physiologic stress placed on it. NOTES.
- eg: heart is in homeostasis with pumping against SBP.
- Increase, decrease, or change in stress on an organ can result in growth adaptations.

## hypertrophy & hyperplasia

- increase in stress leads to increase in organ size.
- occurs by increase in number or size of cells.
- increase in only cell size - hypertrophy
- increase in cell number - hyperplasia.

### hypertrophy

- involves gene activation, protein synthesis, and production of organelles.



### hyperplasia

involve production of new cells from stem cells.

→ hyperplasia & hypertrophy generally occur together.

eg: uterus during pregnancy.

→ Exception → permanent tissues cannot make new cells  
 ↓  
 undergo hypertrophy only.

- cardiac myocyte
- skeletal muscle
- nerve.

Hyperplasia does not occur.

• Pathological hyperplasia can progress to dysplasia and cancer.

eg → endometrial hyperplasia.

over estrogen exposure

except → benign prostatic hyperplasia no cancer risk.

## Atrophy

- Decrease in stress leads to a decrease in organ size.
- occurs via a decrease in the size & number of cells.

↓ cell no. → occurs via apoptosis  
 ↓ cell size → ubiquitin-proteasome degradation of cytoskeleton.  
 → autophagy of cellular components.

proteasome ubiquitin tagged & destroyed

## Metaplasia

- change in stress on organ leads to change in cell type.
- most commonly involves surface epithelium.
- Metaplastic cells are better able to handle new stress.

▲ Barrett oesophagus is classic example

→ due to acid reflux.  
 → squamous → columnar.  
 noniliated.

autophagic vacuoles in cells will be formed.

adaptation). - continuation.

## metaplasia.

**Mechanism:** metaplasia occurs by reprogramming of stem cells.

Stem cells are present in Esophagus & when they see acid, they get reprogrammed. i.e., produces columnar cells instead of squamous cells.

Metaplasia occurs by reprogramming of Stem cells.

\* But metaplasia is reversible with removal of driving stressor.

eg: treatment of GERD → reversal of metaplasia.

\* Metaplasia can progress to dysplasia & cancer.

eg: Barrett Esophagus

Exception - Apocrine metaplasia of Breast.

\* Vitamin A deficiency can result in metaplasia. eg: Keratomalacia.

Vitamin A is required for proper maturation of cells in Immune system.

when patient gets a 15 → 17 translocation they get - acute promyelocytic leukemia.

15-17 translocation involves

retinoic acid receptor

- retinoic acid receptor -

when there is 15 → 17 translocation, there is destruction of vitamin A receptor. { vit A can't act? }

this causes cells to remain trapped in blast state.

they accumulate → result in promyelocytic leukemia.

PML

tx of PML is Atra.

all from retinoic acid

It is a derivative of retinoic acid that can bind to mutated receptor.

How Vitamin A deficiency leads to metaplasia?

• Vitamin A is necessary for maintenance of.  
 esp: Specialised in the body epithelia.

• eg: Conjunctiva of eye.  
 ↓  
 very thin delicate membrane covering eye.

• when there is vit A deficiency,  
 the highly specified squamous epithelium of conjunctiva cannot remain in that state.

↓  
 metaplasia occurs  
 ↓  
 thickening

↓  
Keratomalacia.  
 Keratomalacia occurs due to metaplasia in conjunctiva due to vitamin A deficiency.



\* mesenchymal / connective tissue can also undergo metaplasia.

\* Inflammation of skeletal muscle {after trauma}  
 ↓  
 metaplasia.  
 ↓  
 ossification of muscles.

presence of bone in skeletal muscle.

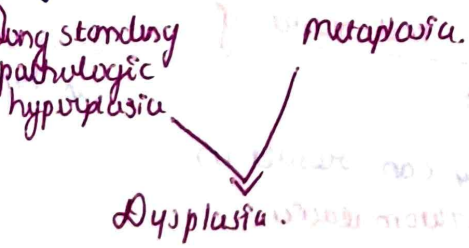
↓  
 ↓ due to metaplasia.  
 ↓  
 Myositis Ossificans

• It is not a sarcoma. don't confuse in x ray.

**DYSPLASIA**

Dys - bad, plasia - growth  
 \* disordered cellular growth.  
 \* refers to proliferation of precancerous cells.  
 (eg: CIN)

• dysplasia usually arises from a long standing pathological hyperplasia or from metaplasia.



★ Dysplasia is REVERSIBLE ★

• dysplasia & metaplasia is reversible.

• Carcinoma  
 → Irreversible.

Some similar terms

aplasia  
 failure of cell production during embryogenesis.

eg: unilateral renal agenesis.

Hypoplasia  
 • decrease in cell production during embryogenesis.  
 • results in relatively small organ.  
 • eg: streak ovaries in Turner syndrome.

# Cell Injury

- injury occurs when the stress exceeds cell's ability to adapt.
- the factors that determine whether cell injury occurs or adaptations occur.

- \* type of stress.
- \* severity → sudden stress / gradual.
- \* type of cell affected.

neurons poor tolerance.  
skeletal muscle → good tolerance to hypoxia.

\* kidney → slow ↓ blood supply over time → atrophy.

↓ sudden ↓ in blood supply due to thrombus.  
↓ cell injury.

## Common Causes of Cell Injury.

- \* Inflammation
- \* Nutritional excess / deficiency
- \* Hypoxia.
- \* Trauma.
- \* Genetic Mutations

# Hypoxia

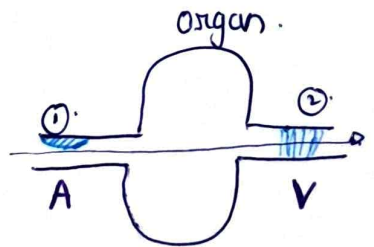
- low oxygen delivery to tissue.
- tissues are dependent on  $O_2$  as it is final  $e^-$  acceptor in phosphorylation.
- ↓
- ↓  $O_2 \Rightarrow \downarrow$  ATP.

## Causes of hypoxia.

- Ischemia.
- hypoxemia.

### Ischemia.

• decreased blood flow through an organ.



- 1 atherosclerosis of artery.
- 2 venous obstruction.  
eg: Budd-Chiari Syndrome.