

SNS COLLEGE OF ALLIED HEALTH SCIENCE
Affiliated to The Tamil Nadu Dr MGR Medical University, Chennai



DEPARTMENT OF CARDIAC TECHNOLOGY

COURSE NAME: PATHOLOGY

UNIT : 1

TOPIC : CELLULAR ADAPTATIONS

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Cellular Adaptation

Definition:

Cellular adaptation is a **reversible change** in the size, number, phenotype, metabolic activity, or function of cells in response to **changes in their environment**.

It helps the cell **survive and maintain function** under stress.

If the stress persists or becomes severe, it may lead to **cell injury or death**.

Hypertrophy

Definition: (Define)

Increase in the **size of cells**, leading to enlargement of the organ.

Mechanism:

Increased synthesis of proteins and organelles

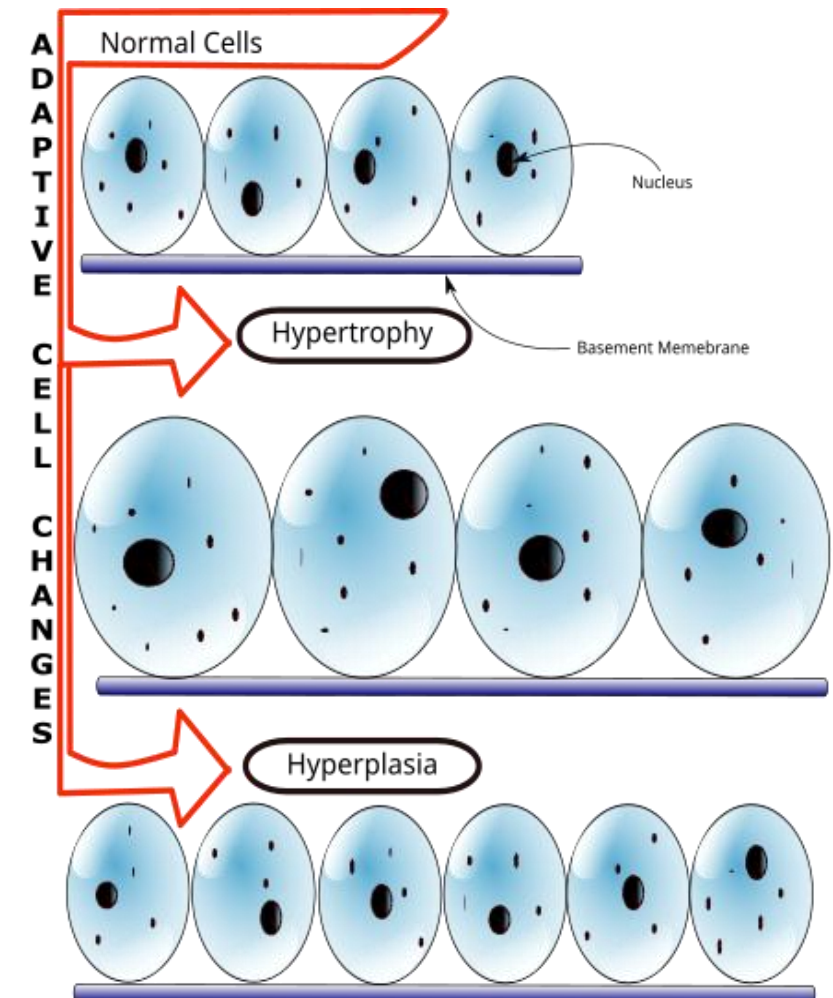
Often in tissues that **cannot divide** (e.g., cardiac muscle)

Causes: Increased workload

Conditions : (empathy)

Physiologic: Exercise-induced skeletal muscle hypertrophy

Pathologic: Left ventricular hypertrophy due to hypertension



Hyperplasia

Definition: (define)

Increase in the **number of cells** due to cell proliferation.

Mechanism:

Triggered by growth factors or hormones

Occurs in tissues capable of division

Causes: Hormonal & Compensatory

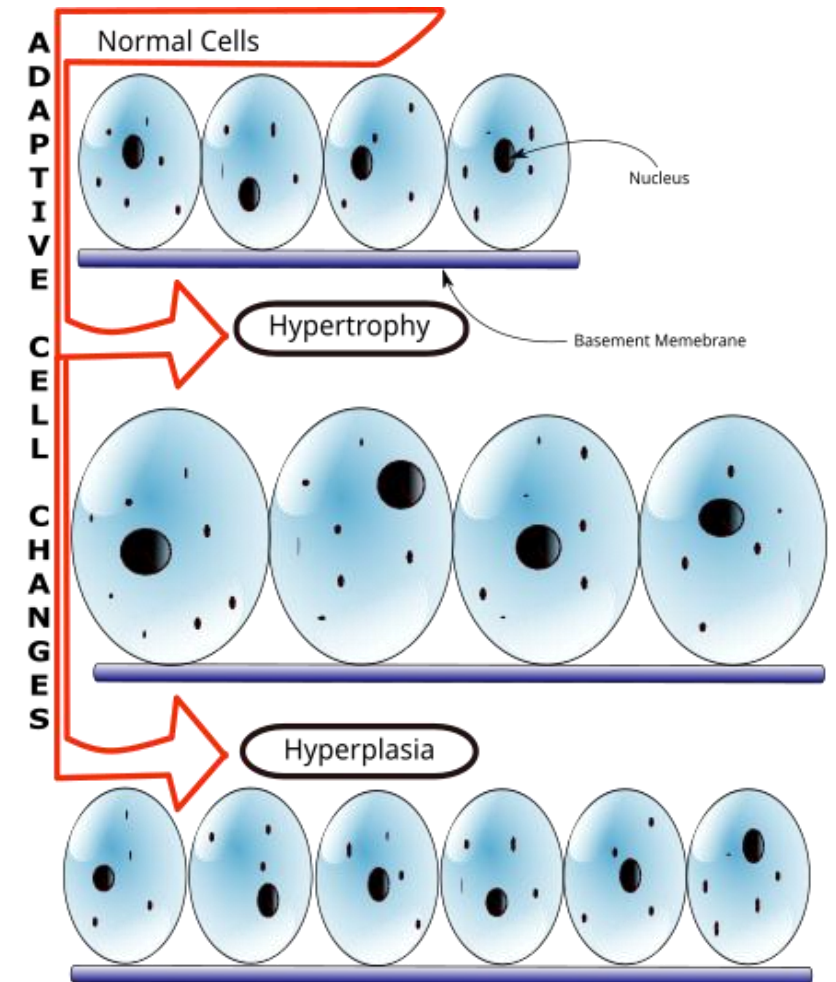
Conditions (empathy)

Physiologic:

Hormonal: Breast tissue in pregnancy

Compensatory: Liver regeneration

Pathologic: Endometrial hyperplasia due to excess estrogen



Atrophy

Definition: (define)

Decrease in the **size and function** of a cell, tissue, or organ.

Mechanism:

Reduced protein synthesis

Increased protein degradation (via ubiquitin-proteasome pathway)

Changes (empathy)

Physiologic: Thymic atrophy in aging

Pathologic:

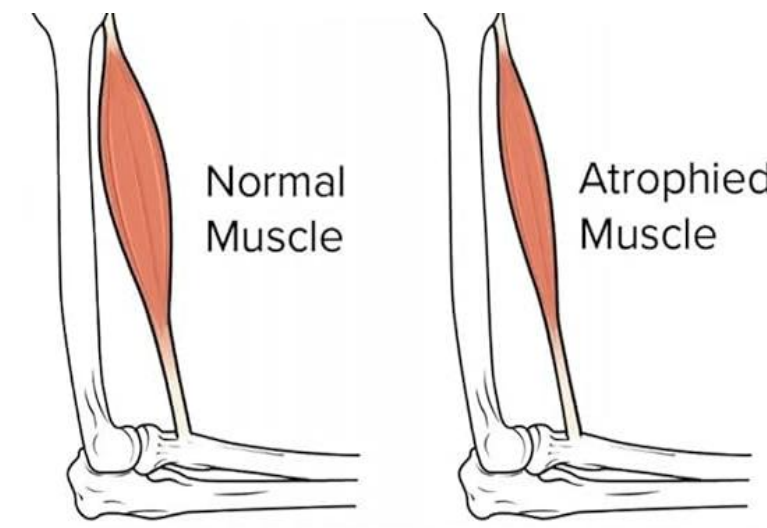
Disuse (immobilization)

Denervation

Ischemia

Malnutrition

Hormonal deficiency (e.g., menopause → endometrial atrophy)



Metaplasia

Definition:

Reversible replacement of one **differentiated cell type** by another, often less specialized type.

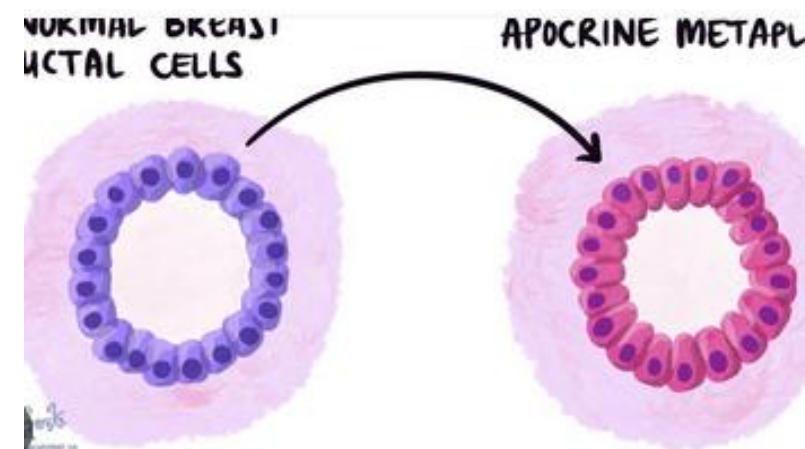
Mechanism:

Reprogramming of stem cells or undifferentiated mesenchymal cells
Adaptive but may predispose to malignancy

Conditions:(empathy)

Squamous metaplasia: Columnar epithelium of the respiratory tract replaced by squamous epithelium in smokers

Barrett's esophagus: Squamous epithelium replaced by intestinal-type columnar cells in chronic GERD



Dysplasia

A term used to describe the presence of abnormal Cells within a tissue or organ.

It is called as disordered cellular development

Dysplasia can also be considered as a transitional stage Linking neoplasia to hyperplasia or metaplasia

eg:- Dysplasia cells in intestine and cervix There is high change of malignancy development.

SUMMARY TABLE

Type	Change	Example
Hypertrophy	↑ Cell size	LV hypertrophy due to hypertension
Hyperplasia	↑ Cell number	Endometrial hyperplasia
Atrophy	↓ Cell size/function	Muscle wasting from disuse
Metaplasia	Change in cell type	Respiratory epithelium in smokers

REFERENCE

Harshmohan's book of pathology

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