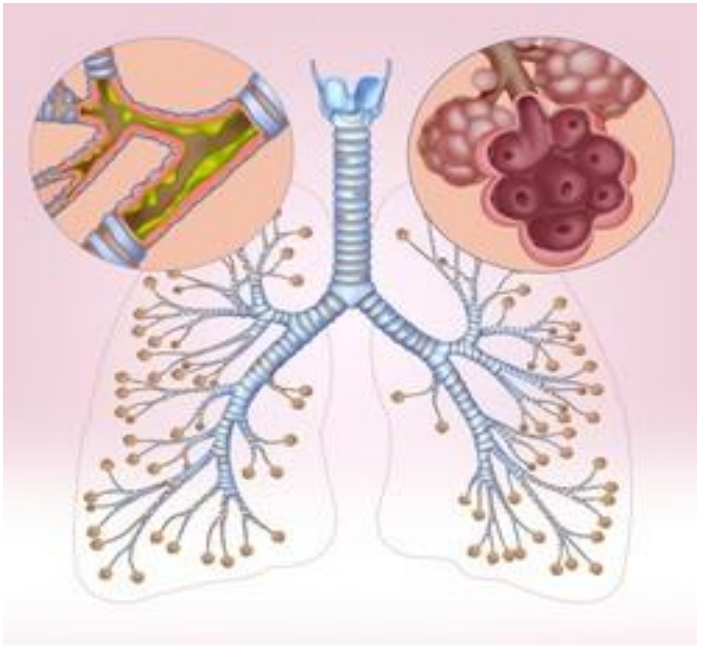
Pathophysiology
College of pharmacy 3rd stage



Cellular adaptation

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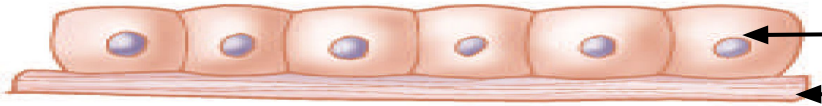
Adaptations

- **Adaptations are reversible functional and structural responses to more severe physiologic stresses and some pathologic stimuli,**
- **During, which new but altered steady states are achieved, allowing the cell to survive and continue to function.**

Types of Adaptations

- **Hypertrophy is an increase in the size of cells and functional activity.**
- **Hyperplasia is an increase in the number of cells.**
- **Atrophy is a decrease in the size and metabolic activity of cells.**
- **Metaplasia is a change in the phenotype of cells.**
- **Dysplasia is characterized by deranged cell growth of a specific tissue that results in cells that vary in size, shape, and organization**

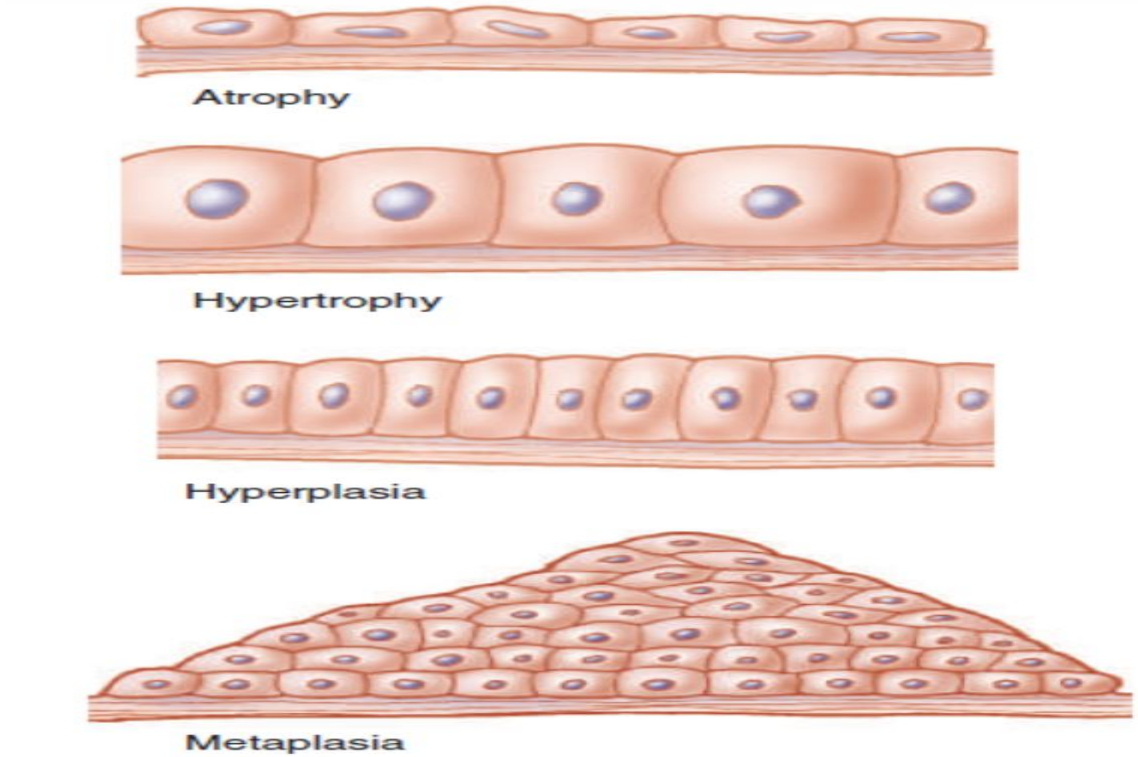
Adaptations

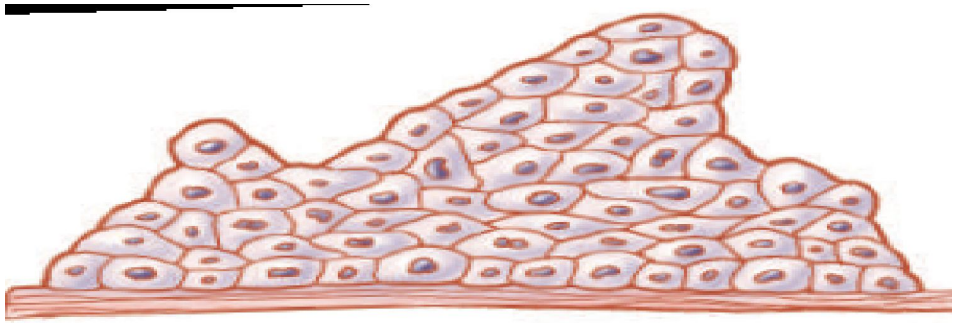


Nucleus

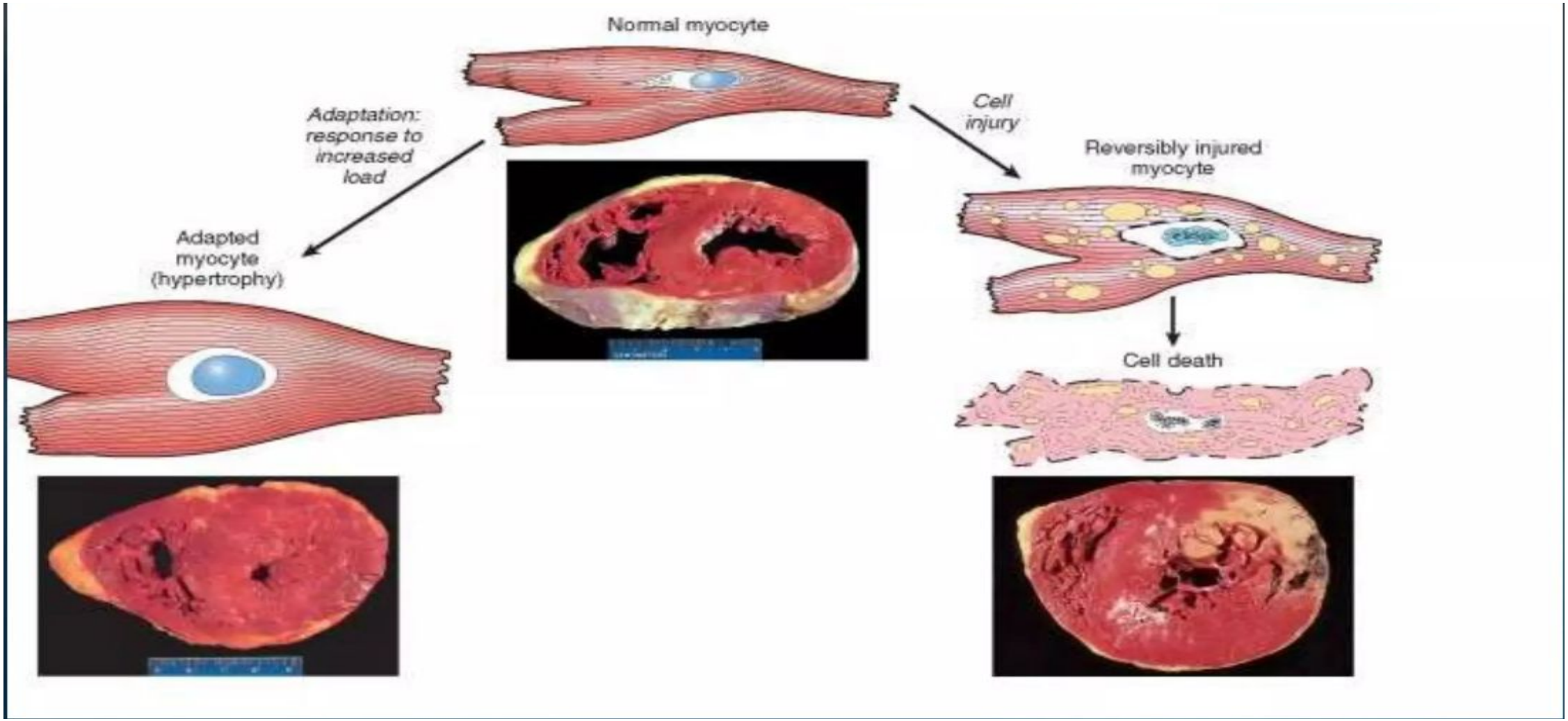
Basement membrane

Normal





Dysplasia


Normal myocyte
Adaptation: response to increased load
Cell injury
Adapted myocyte (hypertrophy)
Reversibly injured myocyte
Cell death

HYPERTROPHY

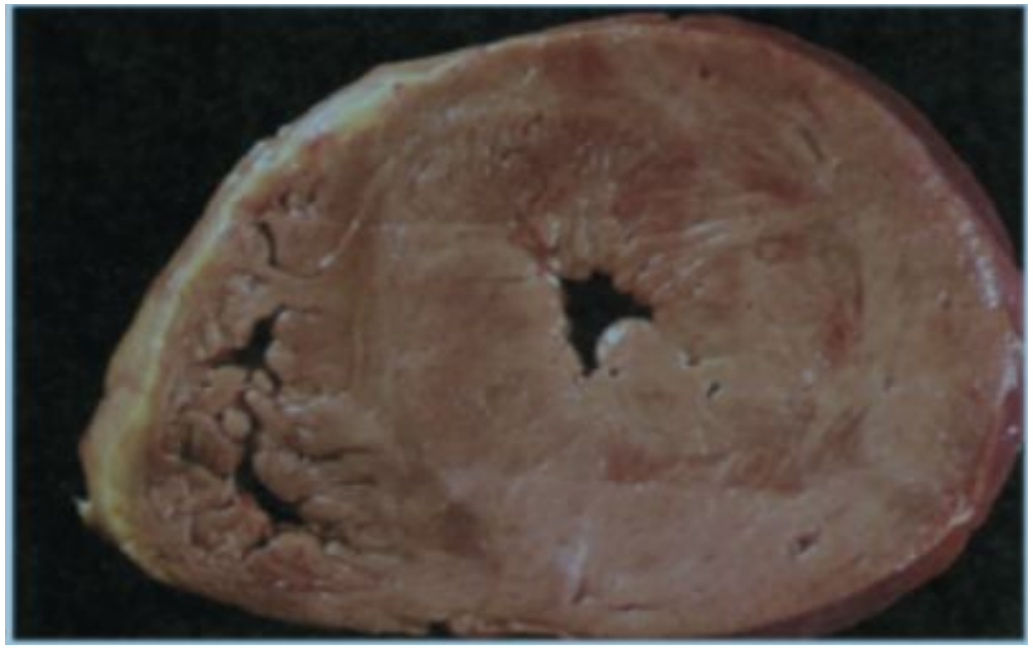
- Hypertrophy refers to an increase in the size of cells, resulting in an increase in the size of the organ.
- The hypertrophied organ has no new cells, just larger cells.
- Cells capable of division may respond to stress by undergoing both hyperplasia and hypertrophy, whereas in non-dividing cells (e.g., myocardial fibers) increased tissue mass is due to hypertrophy.
- In many organs, hypertrophy and hyperplasia may coexist and contribute to increased size.
- Hypertrophy can be physiologic or pathologic and is caused by increased functional demand or by stimulation by hormones and growth factors.
- The striated muscle cells in the heart and skeletal muscles have only a limited capacity for division and respond to increased metabolic demands mainly by undergoing hypertrophy.

HYPERTROPHY

- Hypertrophy may occur as the result of normal physiologic
- or abnormal pathologic conditions.
- The increase in muscle mass associated with exercise is an example of
- physiologic hypertrophy.
- Pathologic hypertrophy occurs as the result of disease conditions and may be adaptive or compensatory.
- Examples of adaptive hypertrophy are the thickening of the urinary bladder from long-continued obstruction of urinary outflow and myocardial hypertrophy from valvular heart disease or hypertension.

HYPERTROPHY

- Compensatory hypertrophy is the enlargement of a remaining organ or tissue after a portion has been surgically removed or rendered inactive. For instance, if one kidney is removed, the remaining kidney enlarges to compensate for the loss.



Myocardial hypertrophy. Cross-section of the heart in a patient with long-standing hypertension.

HYPERPLASIA

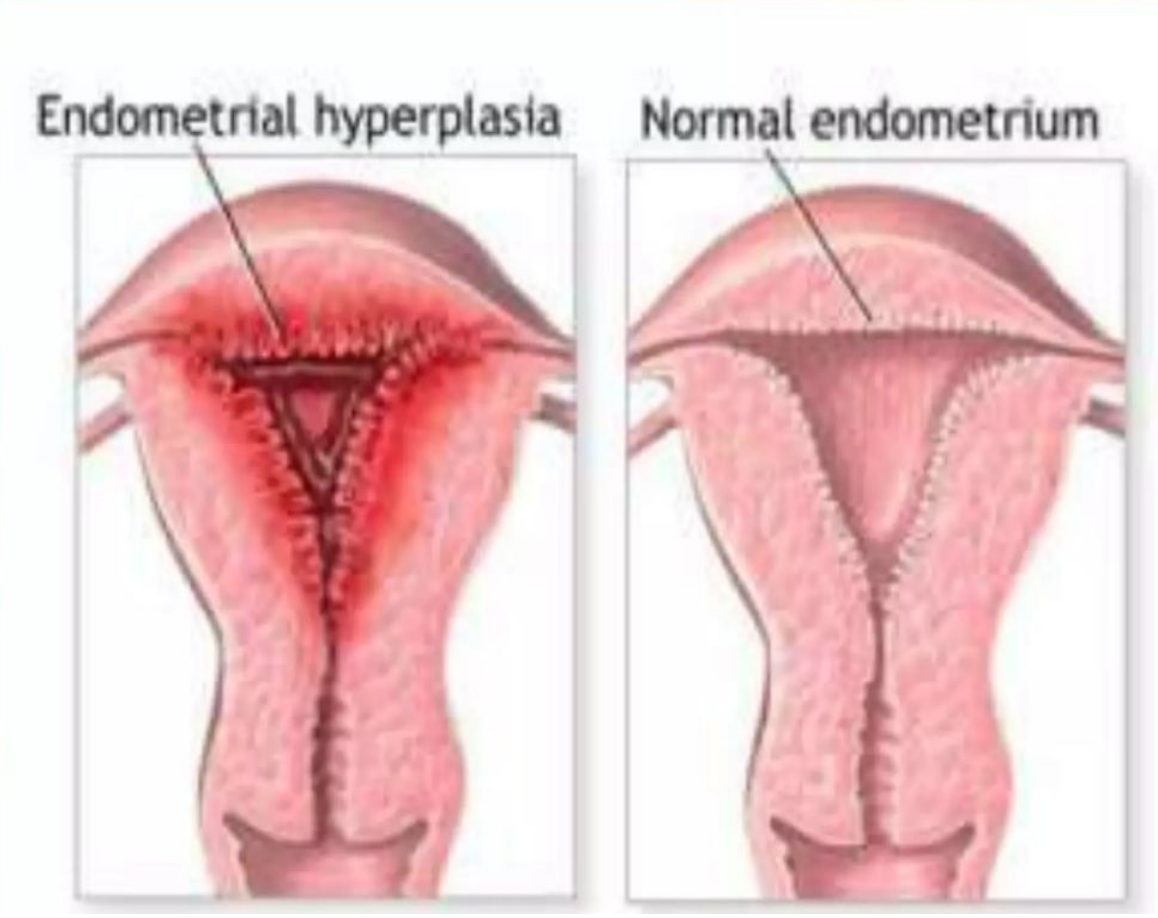
- Hyperplasia is an increase in the number of cells in an organ or tissue, usually resulting in increased mass of the organ or tissue.
- Hyperplasia takes place if the cell population is capable of dividing, thus increasing the number of cells.
- Hyperplasia can be physiologic or pathologic, Occurring together with hypertrophy.
- **Physiologic Hyperplasia**
- 1. hormonal hyperplasia, which increases the functional capacity of tissue when needed.
- Hormonal hyperplasia is well illustrated by the proliferation of the glandular epithelium of the female breast at puberty and during pregnancy, usually accompanied by enlargement (hypertrophy) of the glandular epithelial cells.

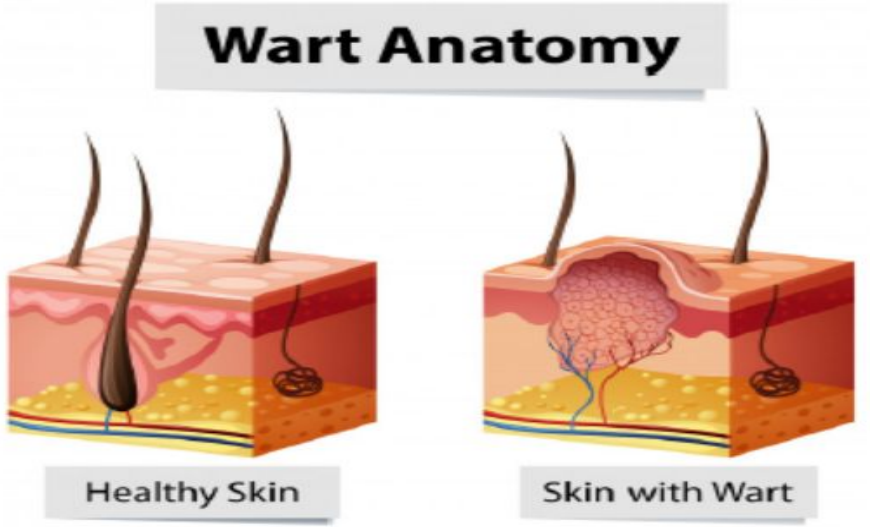
HYPERPLASIA

- 2. Compensatory hyperplasia, which increases tissue mass after damage or partial resection, in individuals who donate one lobe of the liver for transplantation, the remaining cells proliferate so that the organ soon grows back to its original size.

- **Pathologic Hyperplasia**
- Most forms of nonphysiologic hyperplasia are due to excessive hormonal stimulation or the effects of growth factors on target tissues.
- Excessive estrogen production can cause endometrial hyperplasia and abnormal menstrual bleeding.
- Benign prostatic hyperplasia, which is a common disorder of men older than 50 years of age, is thought to be related to the action of androgens.
- Skin warts are an example of hyperplasia caused by growth factors

HYPERPLASIA





ATROPHY

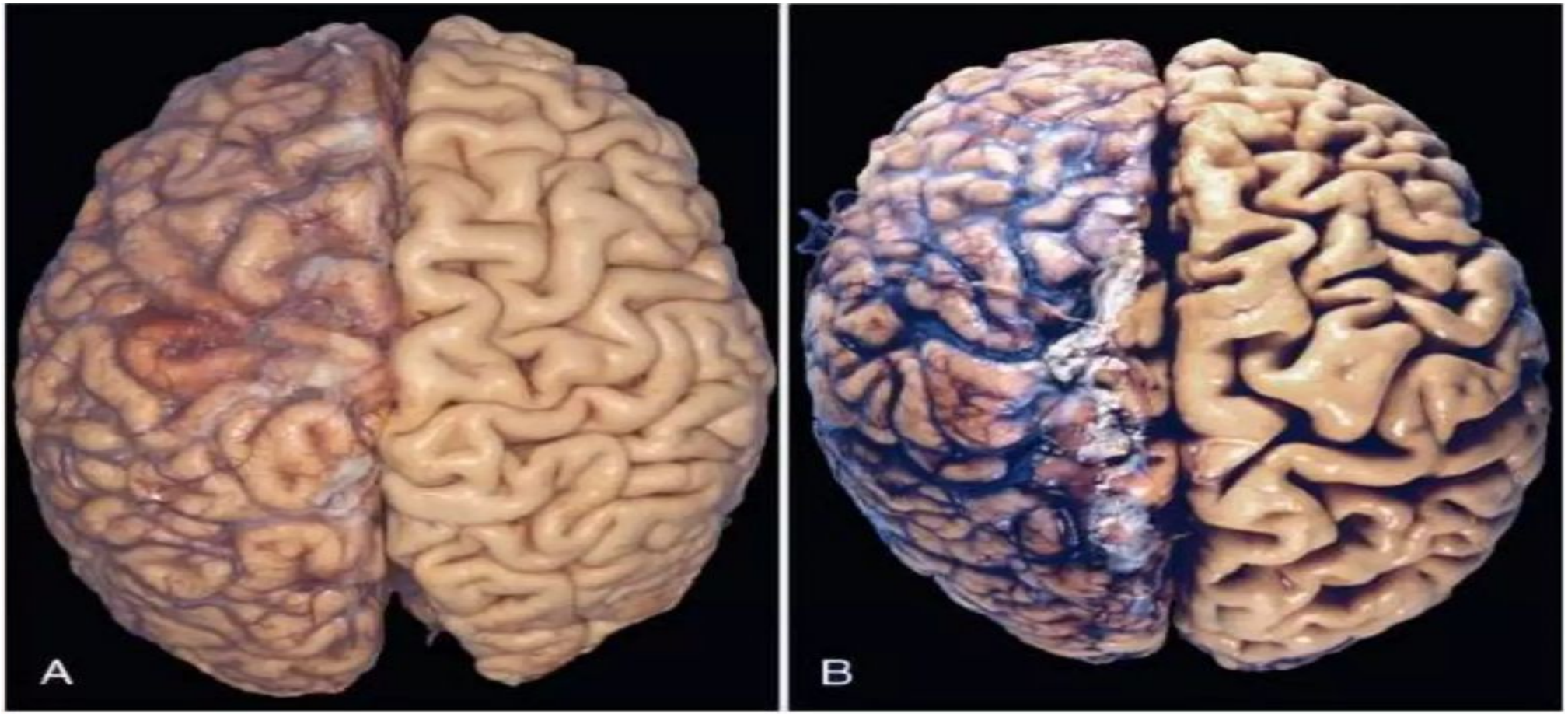
- Atrophy is the reduced size of an organ or tissue resulting from a decrease in cell size and number.
- When confronted with a decrease in work demands or adverse environmental conditions, most cells are able to revert to a smaller size and a lower and more efficient level of functioning that is compatible with survival.
- Cells that are atrophied reduce oxygen consumption and other cellular functions by decreasing the number and size of their organelles and other structures.
- There are fewer mitochondria, myofilaments, and endoplasmic reticulum structures.
- When a sufficient number of cells are involved, the entire tissue atrophies.

ATROPHY

- The general causes of atrophy can be grouped into five categories: (1) disuse, (2) denervation, (3) loss of endocrine stimulation,
- (4) inadequate nutrition, and
- (5) ischemia or decreased blood flow.
- Disuse atrophy occurs when there is a reduction in skeletal muscle use. An extreme example of disuse atrophy is seen in the muscles of extremities that have been encased in casts. Because atrophy is adaptive and reversible, muscle size is restored after the cast is removed and muscle use is resumed.

ATROPHY

- Denervation atrophy is a form of disuse atrophy that occurs in the muscles of paralyzed limbs.
- Lack of endocrine stimulation produces a form of disuse atrophy. In women, the loss of estrogen stimulation during menopause results in atrophic changes in the reproductive organs.
- With malnutrition and decreased blood flow, cells decrease their size and energy requirements as a means of survival.

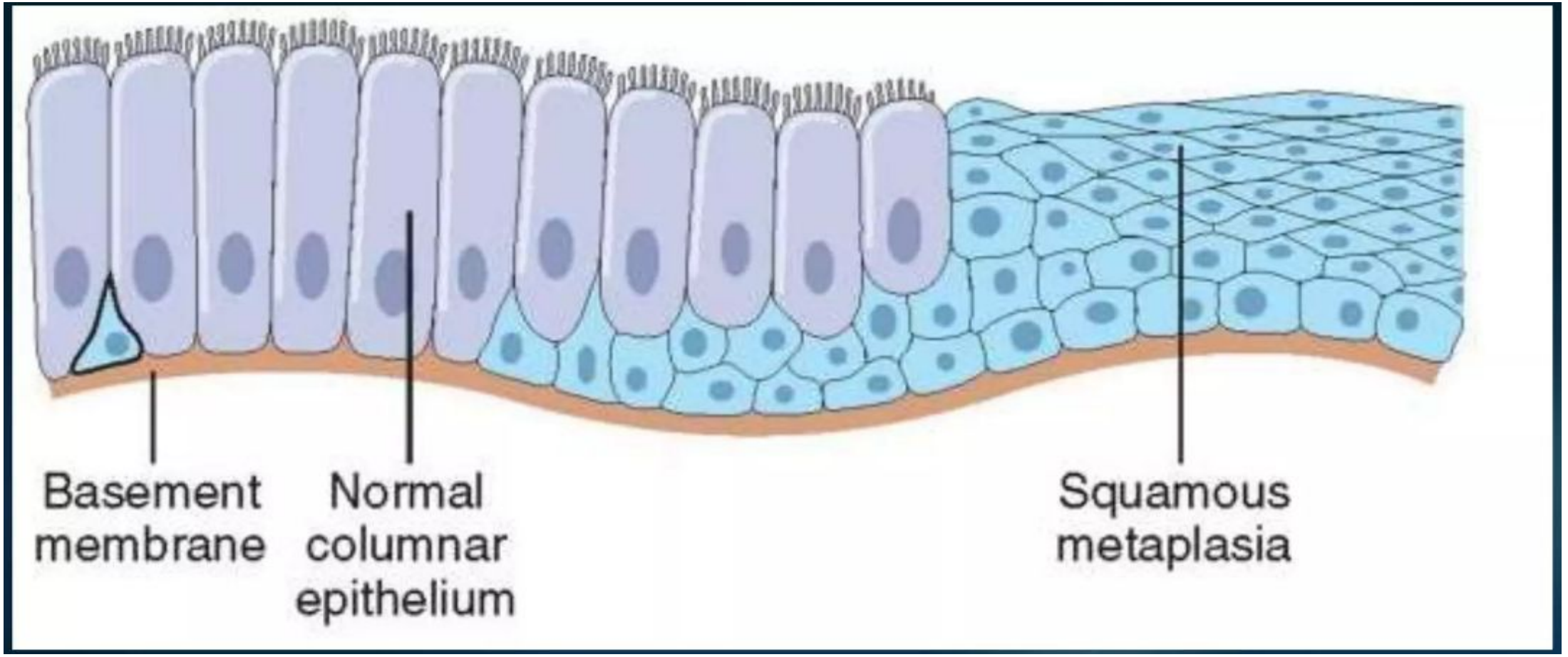


Atrophy. A, Normal brain of a young adult. B. Atrophy of the brain in an 82-year-old male with atherosclerotic cerebrovascular disease, resulting in reduced blood supply.

METAPLASIA

- Metaplasia is a reversible change in which one differentiated cell type (epithelial or mesenchymal) is replaced by another cell type.
- It may represent an adaptive substitution of cells that are sensitive to stress by cell types better able to withstand the adverse environment.
- The most common epithelial metaplasia is columnar to squamous, as occurs in the respiratory tract in response to chronic irritation. In the habitual cigarette smoker, the normal ciliated columnar epithelial cells of the trachea and bronchi are often replaced by stratified

METAPLASIA


Basement membrane
Normal columnar epithelium
Squamous metaplasia

METAPLASIA

- Stones in the excretory ducts of the salivary glands, pancreas, or bile ducts may also cause replacement of the normal secretary columnar epithelium by stratified squamous.
- Thus, epithelial metaplasia is a double-edged sword and, in most circumstances, represents an undesirable change. Moreover, the influences that predispose to metaplasia, if persistent, may initiate malignant transformation in the metaplastic epithelium. Thus, a common form of cancer in the respiratory tract is composed of squamous cells, which arise in areas of metaplasia of the normal columnar epithelium into squamous epithelium.

Dysplasia

- ***Dysplasia*** **is characterized by deranged cell growth of a specific tissue that results in cells that vary in size, shape, and organization.**
- **Minor degrees of dysplasia is associated with chronic irritation or inflammation.**
- **The pattern is most frequently encountered in areas of metaplastic squamous epithelium of the respiratory tract and uterine cervix.**

Dysplasia

- **Although dysplasia is abnormal, it is adaptive in that it is potentially reversible after the irritating cause has been removed.**
- **Dysplasia is strongly implicated as a precursor of cancer.**
- **In cancers of the respiratory tract and the uterine cervix, dysplastic changes have been found adjacent to the foci of cancerous transformation.**


THANK YOU
FOR YOUR
ATTENTION