



Introduction. Adaptation

Pathological anatomy

Lecture 1

Mavlikeev M.O.

Pathological anatomy: definition

- **Pathological anatomy (syn. - pathomorphology) (Greek pathos - painful) - medical science on the structural bases of diseases and pathological conditions, the totality of which is the essence of a disease.**
- **Pathology - a science about laws of the genesis and development of diseases, individual pathological processes and conditions.**

Disease: definition

- **the disturbance of the vital activity of the organism, accompanied by the inability to function fully in its habitual framework**
- **Doctor's point of view: all that serves or may serve as an cause for seeking medical help (excluding visits to a medical institution with a preventive purpose or purpose monitoring of the state of health)**
- **Demographic point of view: any objectively existing structural and / or functional disturbances in the human body that interfere with his work activity and / or activities for his own life-support**
- **Legal point of view: sick persons are considered to have on hand a sheet of incapacity for work or an appropriate medical certificate.**
- **Biological point of view: decrease in the ability of the organism to compete in the process of natural selection.**

Pathological condition: definition

- **the objectively existing deviation of the structure, functions and chemical composition of the tissues and organs of the organism, beyond the extreme limits of the normal rate**

Disease is the complex of pathological conditions, which, considered in dynamics, represent a chain of events, sometimes closing in one or several vicious circles

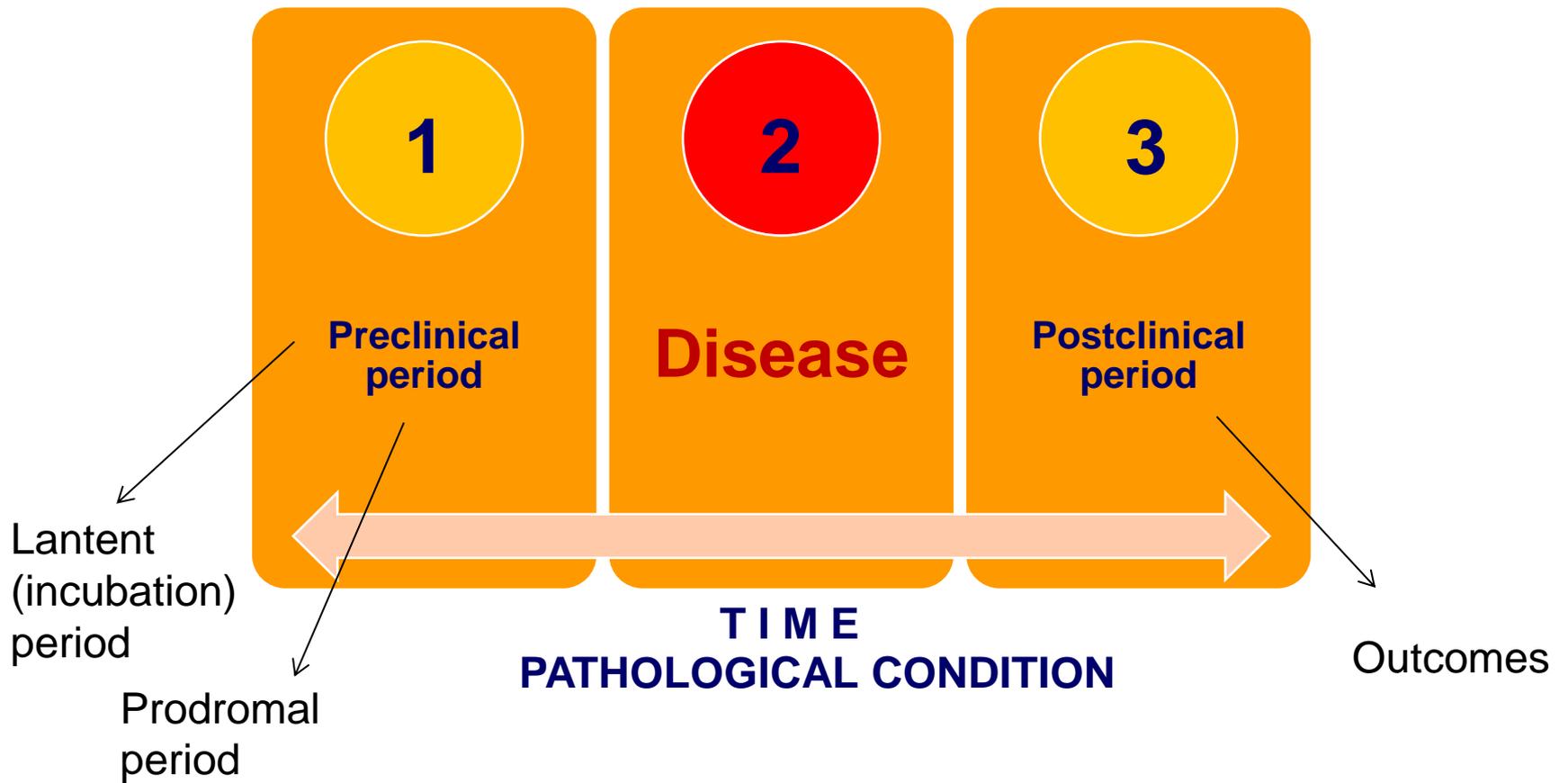
Disease is always common (general), pathological condition can be common and local.

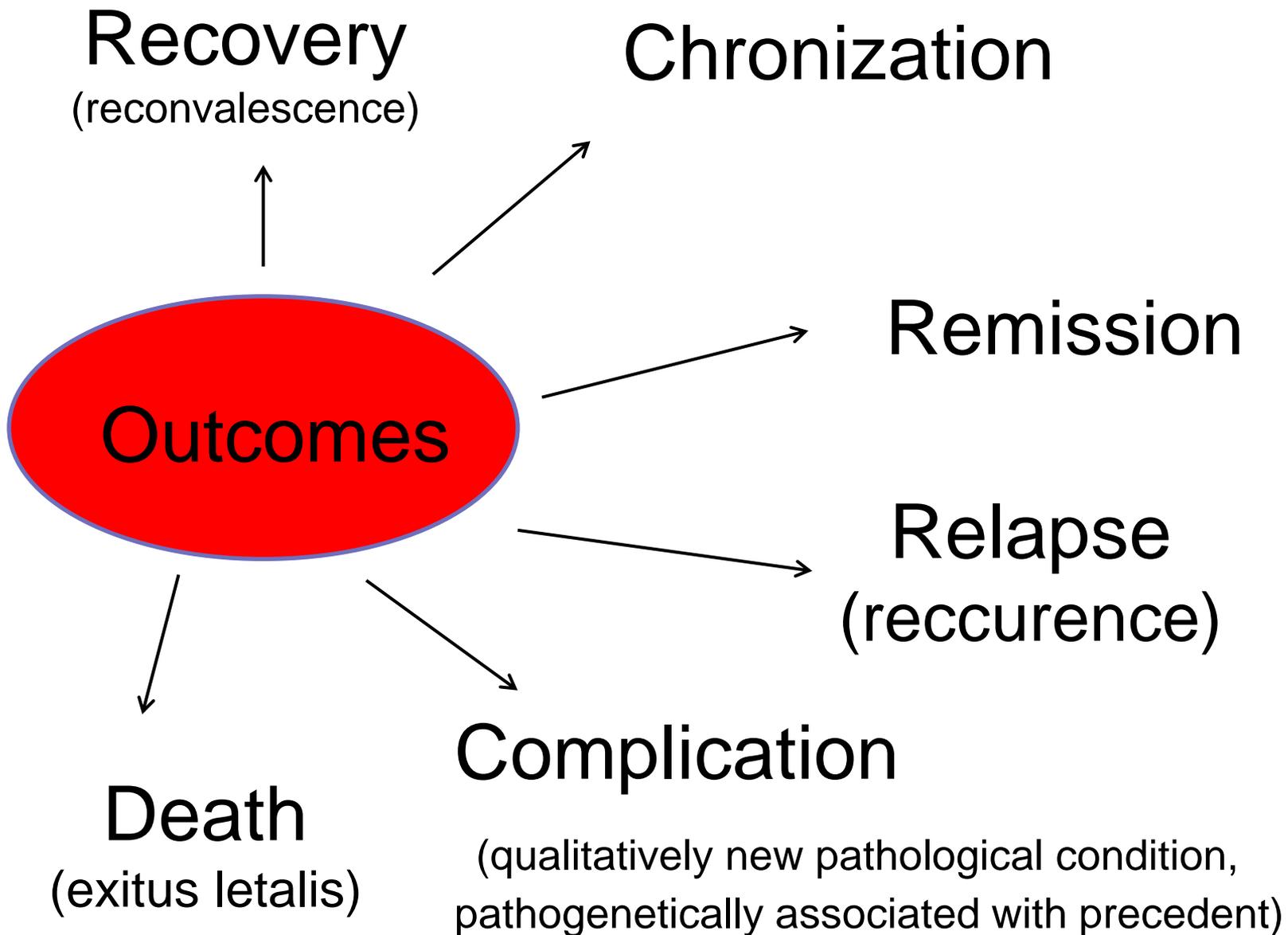
Pathological condition is stereotyped, can only vary its quantitative characteristics, disease is individual, but characterized by common features, caused by adaptation and compensatory capacities of individual organism.

Disease is associated with existing dysadaptation, pathological condition – with existing and potential dysadaptation.

What does it study?

- Structural bases of pathological conditions at the subcellular, cellular, tissue, organ and organism levels.
- Molecular bases, etiology, pathogenesis, pathomorphogenesis of pathological processes and disease.
- Thanatogenesis.
- Pathomorphosis of diseases.
- Pathological embryogenesis.





Types of pathological conditions (from the pathologist's point of view)

Structural abnormalities

Genetically
determined

Dysembryogen
etic

Injuries

Exogenic

Endogenic

Compensatory-adaptive changes

Effective

With lost
efficiency

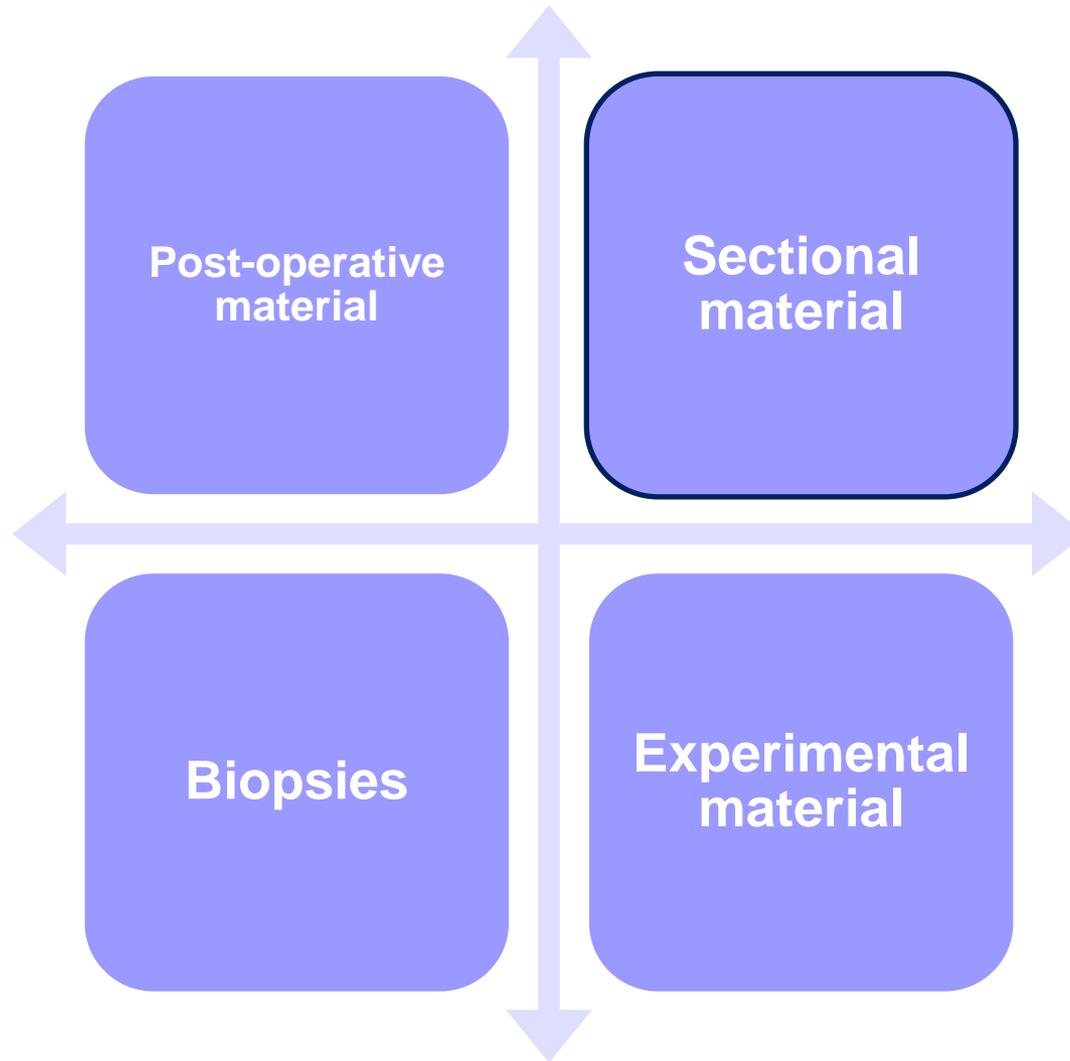
Conditions, related to
malnutrition

TUMORS

The study of the structural basis of the disease is carried out at different levels: organismic, systemic, organ, tissue, cellular, subcellular, molecular

Level	Optimum	Disorder	Death	After death
Organism	health	disease	death	corpse
Organ	-	Blood supply disorder; inflammation; immunopathological process	Infarction; gangrene	Inflammation Demarcation Organisation
Tissue	-	Degeneration; dysplasia	necrosis	Adaptation Compensation
Cell	-	Disorder of intracellular process	Apoptosis/necrosis etc.	Lysis, fagocytosis, desquamation

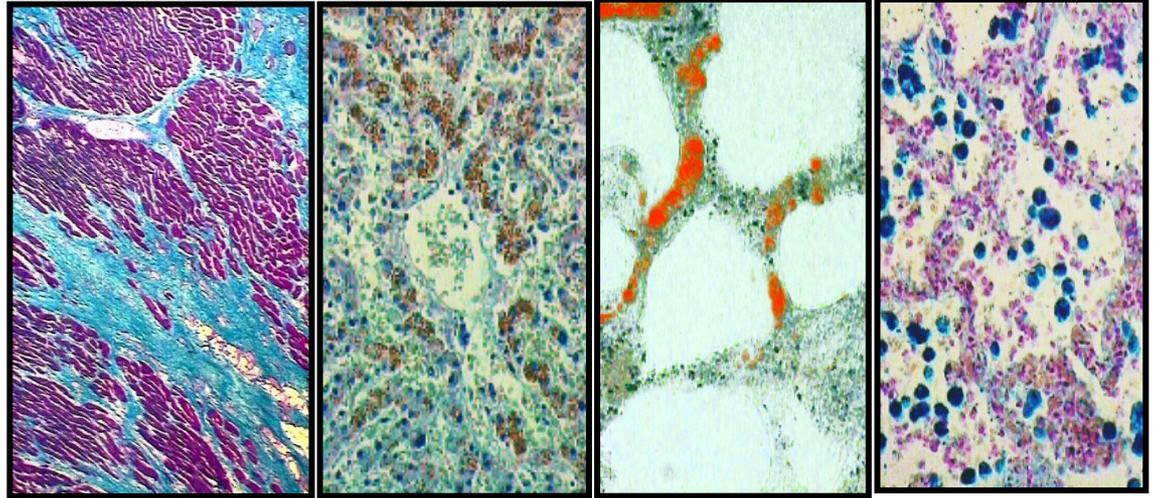
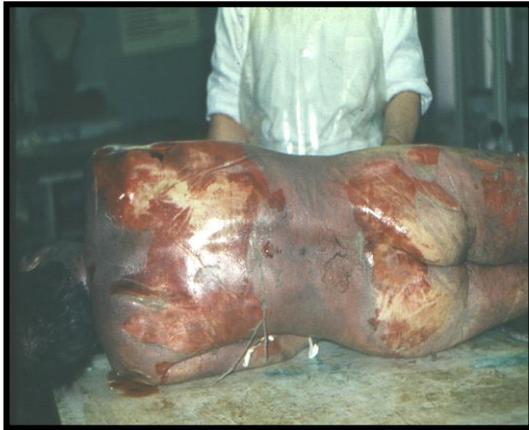
The material for pathological studies



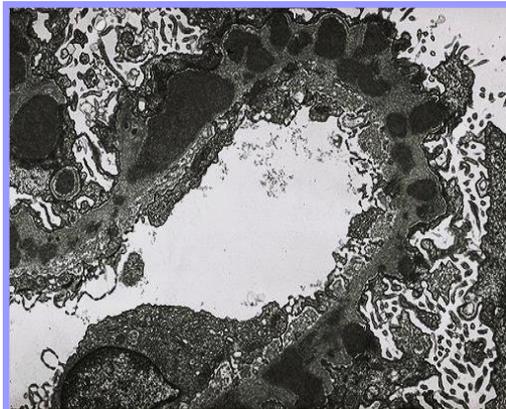
Methods of morphological studies

Light microscopy

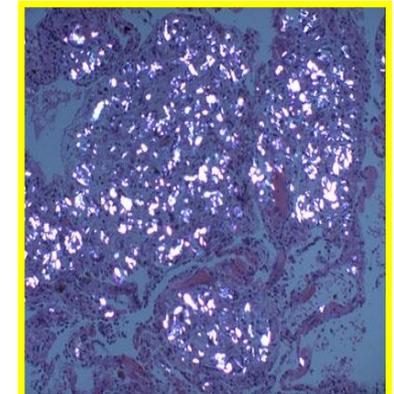
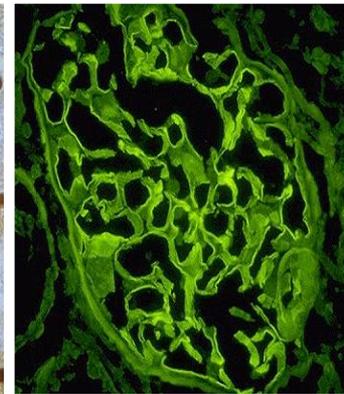
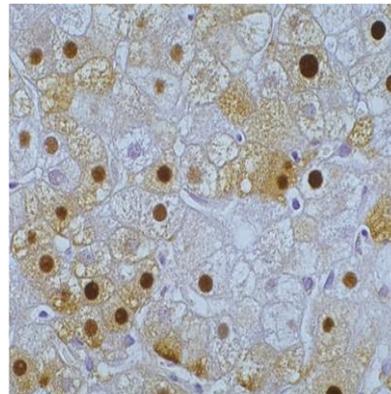
Autopsy



Electronic microscopy



Immunohistochemistry/ immunofluorescence



The main manifestations of cell life

Growth

Proliferation

Differentiation

SPECIFIC FUNCTIONS
(specialization)

Death

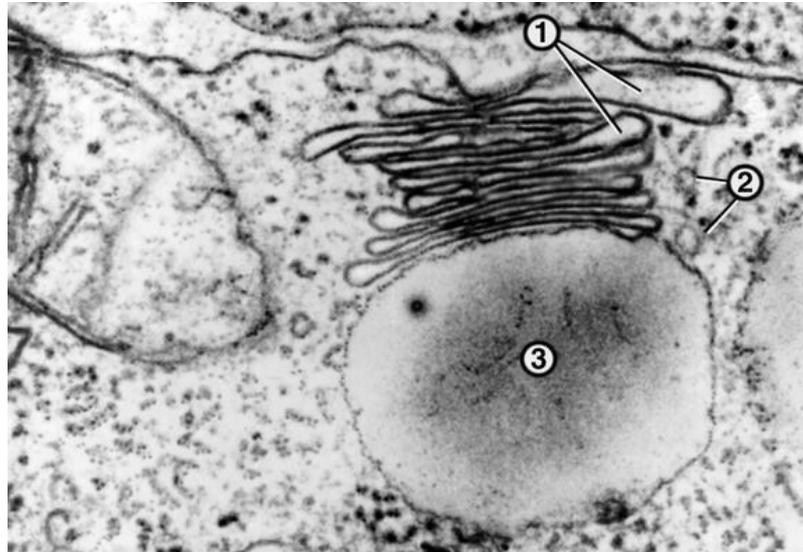
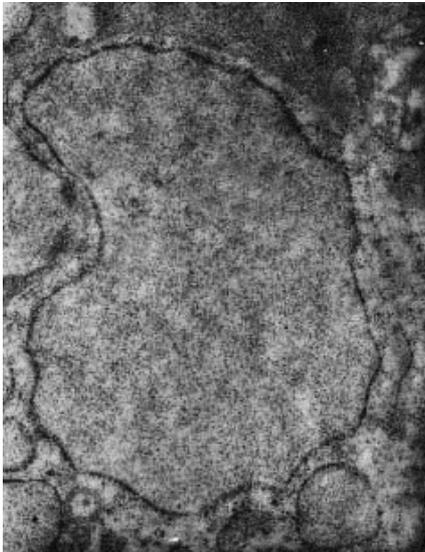
IRRITABILITY

REACTIVITY

REGENERATION

REACTIVITY

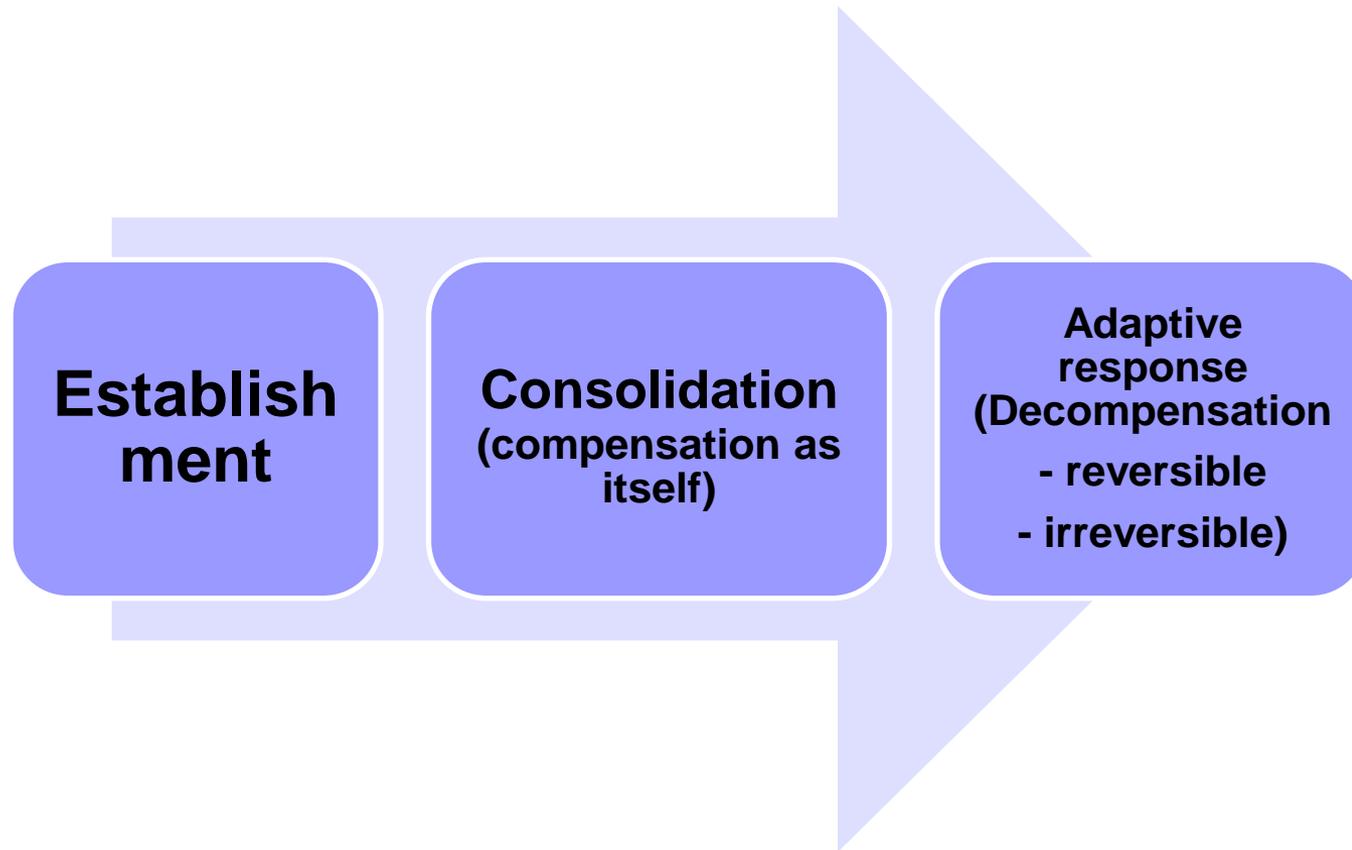
- **Reactivity of cells and tissues - morphofunctional transformations in response to external (in relation to the cell or tissue) factors.**
- **To reactivity belong changes in the main regular aspects of tissue development - proliferation, differentiation, cell integration, intercellular interactions, and other regular processes of histogenesis.**



Adaptation and compensation

- **Adaptation** - general biological concept that brings together all the vital processes that underlie the body's interaction with the environment and to preserve the species.
- **Compensation** - a set of reactions of the body that arise from injuries or illnesses and aimed at restoring impaired functions.
- **Adaptation to changing conditions** takes place by compensation, i.e. balancing the insufficiency of the function of structures that have changed under the influence of certain factors, with the more active or altered functioning of other, undamaged structures.

Stages of adaptive-compensatory process



Establishment

**Consolidation
(compensation as
itself)**

**Adaptive
response
(Decompensation
- reversible
- irreversible)**

Adaptation and compensation

- Adaptation may appear by different pathological processes:
 - Atrophy
 - Adaptive hypertrophy (hyperplasia)
 - Organization
 - Metaplasia,
 - Dysplasia.
- Compensation may appear by compensatory hypertrophy

Atrophy

- **Atrophy - lifetime decrease in the volume of cells, tissues, organs, accompanied by a decrease or cessation of their functions.**
- **In atrophy mechanisms, usually accompanied by a decrease in the number of cells, apoptosis plays a leading role.**

Variants of atrophy

■ The following types of atrophy:

- Physiological atrophy (General (senescence) and local (involution)),
- Pathological atrophy,
 - General atrophy (wasting, cachexia)
 - Local atrophy

■ Pathological atrophy - a reversible process.

General atrophy (cachexia)

■ Alimentary:

- Esophageal stenosis
- Malabsorption and maldigestion due to alimentary tract diseases (chronic enterocolitis, celiac disease, short enteron after surgical excision etc)
- Psychogenic (anorexia nervosa)

■ Cancer cachexia

■ Pituitry/cerebral

- Shihan syndrom
- Disorders of metabolism in endocrine diseases, especially in panhypopituitarism (hypothalamic-pituitary insufficiency);
- Adrenal insufficiency;
- Insufficiency of the thyroid gland;

■ In other diseases:

- Exhausting diffuse diseases of connective tissue;
- Prolonged intoxication with chronic infectious diseases such as brucellosis, tuberculosis, etc. and purulent processes (abscesses, osteomyelitis);
- Acquired immune deficiency syndrome

General atrophy (cachexia): morphology

- Sharply reduced (disappeared) amount of adipose tissue depots.
- The internal organs are reduced (liver, heart, skeletal muscle) and take on a brown color due to the accumulation of a golden-brown pigment - lipofuscin (brown atrophy bodies).

General pathologic atrophy (cancer cachexia)



Brown atrophy of liver

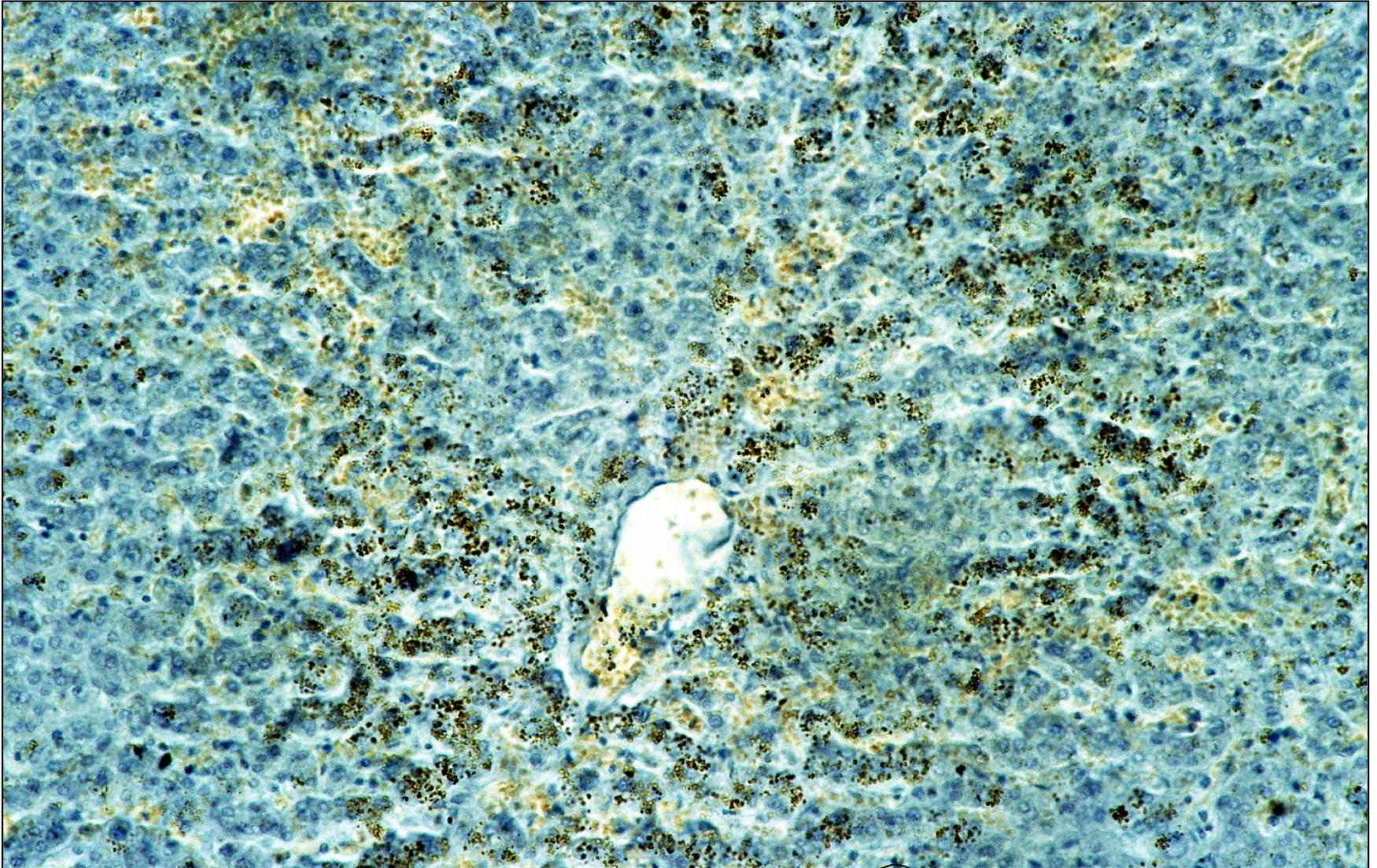
■ **Macroscopic picture:**

- Liver size reduced
- Capsule wrinkled,
- The front edge is pointed, leathery as a result of the replacement of the parenchyma by connective tissue,
- In the section - liver tissue is brown.

■ **Microscopic picture:**

- Hepatocytes and their nuclei reduced
- A large number of small beads of brown color (lipofuscin) in the cytoplasm of hepatocytes in the center of lobules
- The spaces between the thinned hepatocytes are expanded.

Brown atrophy of liver

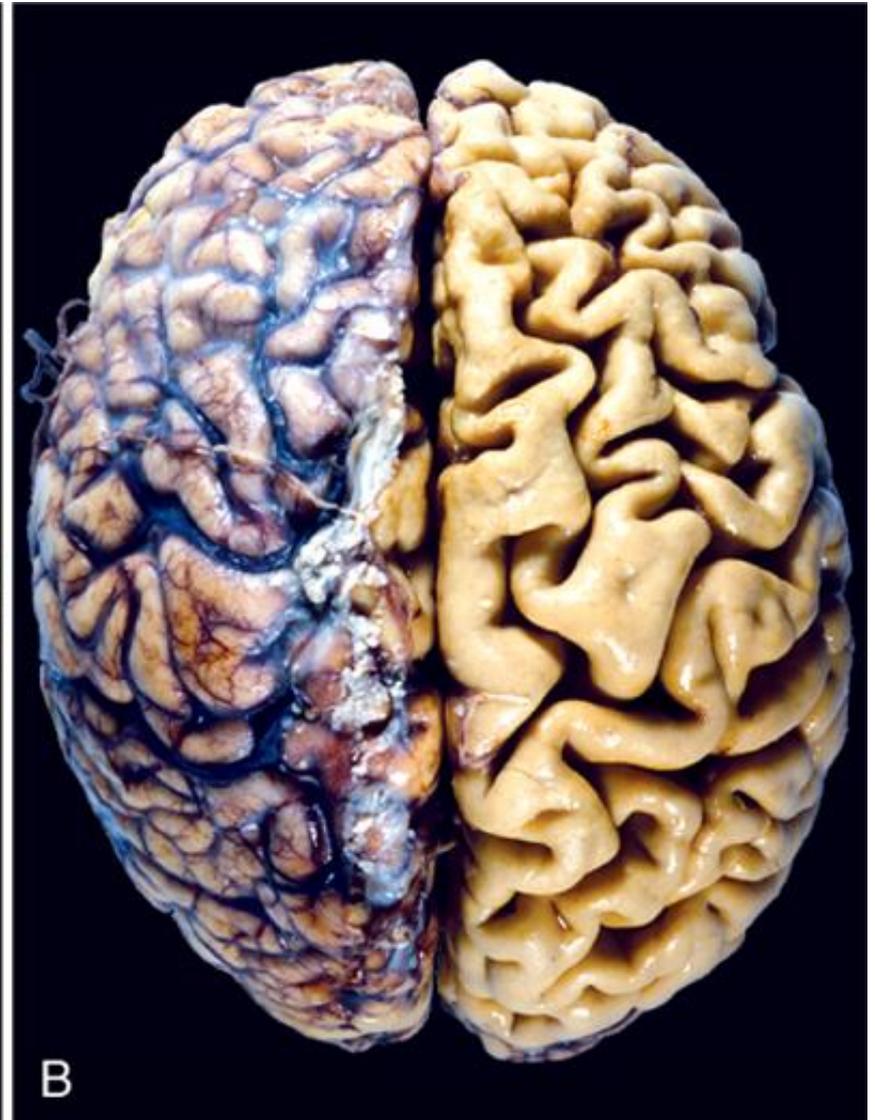


Local pathologic atrophy

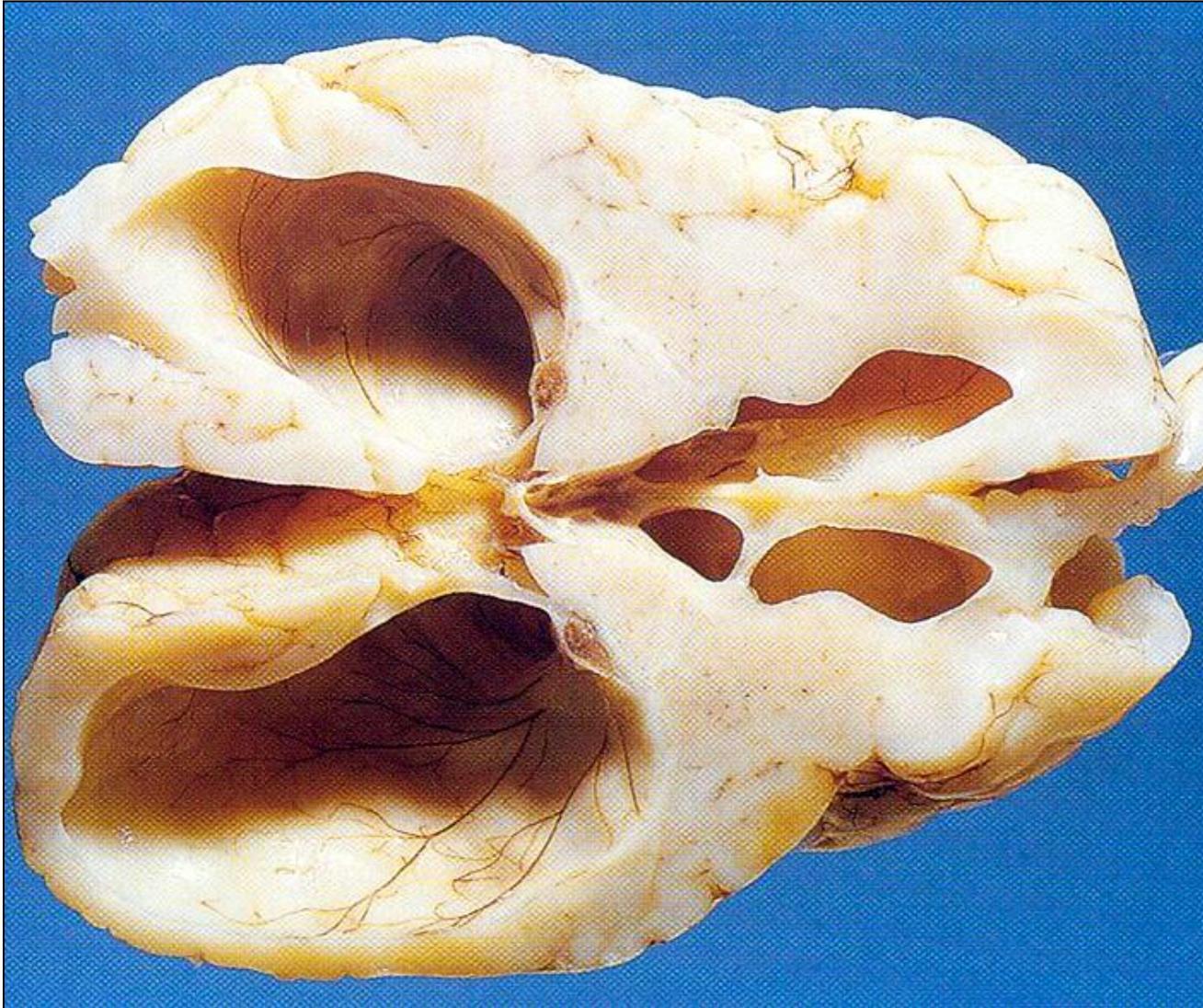
■ There are kinds of local atrophy:

- Dysfunctional (atrophy from inactivity)
- Atrophy from chronic lack of blood supply
- Atrophy of the pressure:
 - Kidney atrophy with a loss of urine outflow (stone, tumor, stricture) with the development of hydronephrosis,
 - Atrophy of the brain tissue in difficulty outflow of cerebrospinal fluid (tumor, aqueduct stenosis, congenital atresia Lyushka and Magendie holes by the syndrome of Dandy - Walker) with the development of hydrocephalus,
- Neurotrophic atrophy:
 - Skeletal muscle atrophy in peripheral paralysis.
- Atrophy under the influence of physical and chemical factors.

Brain atrophy from chronic ischemia



Hydrocephaly



Hydronephrosis

■ **Macroscopic picture:**

- The kidney is greatly increased,
- Cortical and medullary layers are thinned, the border is poorly distinguishable,
- Pelvis and calyx stretched,
- In the cavity of the pelvis and ureter stones are visible.

■ **Microscopic picture:**

- Cortex and medulla dramatically thinned,
- Most glomeruli are atrophied and replaced by connective tissue,
- Tubules are atrophied, some - cystic dilated and filled with pink homogeneous mass (protein cylinders), their epithelium flattened,
- Between the tubules, glomeruli and vessels outgrowths of fibrous connective tissue are seen .

Hydronephrosis



Hypertrophy

- **Hypertrophy - an increase in body volume, tissue due to increased functioning structures.**
 - Hypertrophy - a reversible process.
 - Mechanisms of hypertrophy:
 - Increased volume of functional structures of specialized cells (tissue hypertrophy).
 - Increased number of specialized cells (cell hyperplasia).
 - The increase in both the number and volume of specialized intracellular structures (hypertrophy and hyperplasia of cell structures).

Adaptive hypertrophy

- **There are 2 types of adaptive hypertrophy:**
 - Neurohumoral (hormonal) hypertrophy (hyperplasia)
 - Physiological
 - Pathological
 - Hypertrophic growths.

Neurohumoral hypertrophy

- Occurs by violation of the functions of the endocrine glands (hormonal hypertrophy).
- An example of neurohumoral hypertrophy - glandular hyperplasia of the endometrium.
 - Reason - ovarian dysfunction.
 - Clinically it is manifested by acyclic uterine bleeding.
 - Associated with severe epithelial dysplasia and proliferation (atypical hyperplasia) process is precancerous.

Glandular endometrial hyperplasia

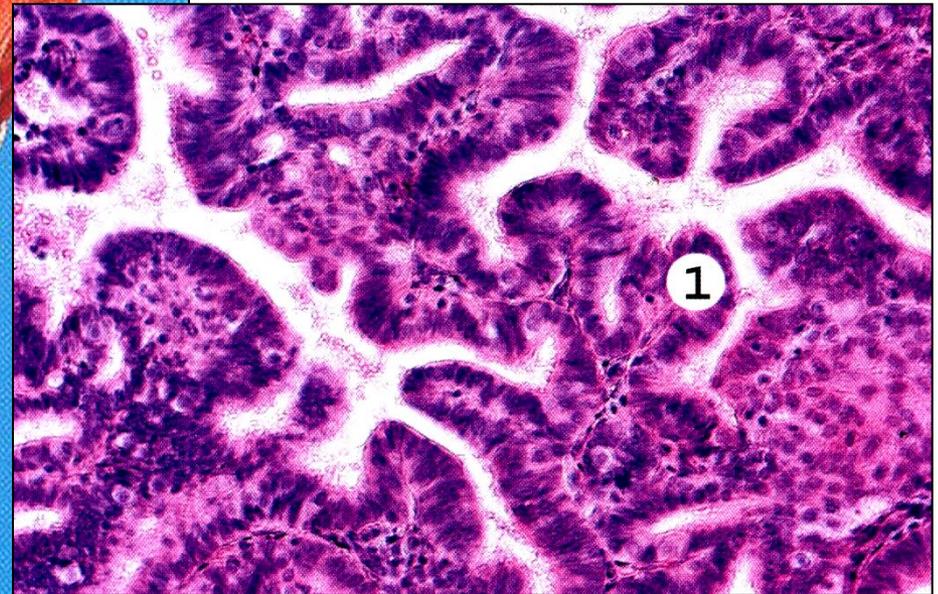
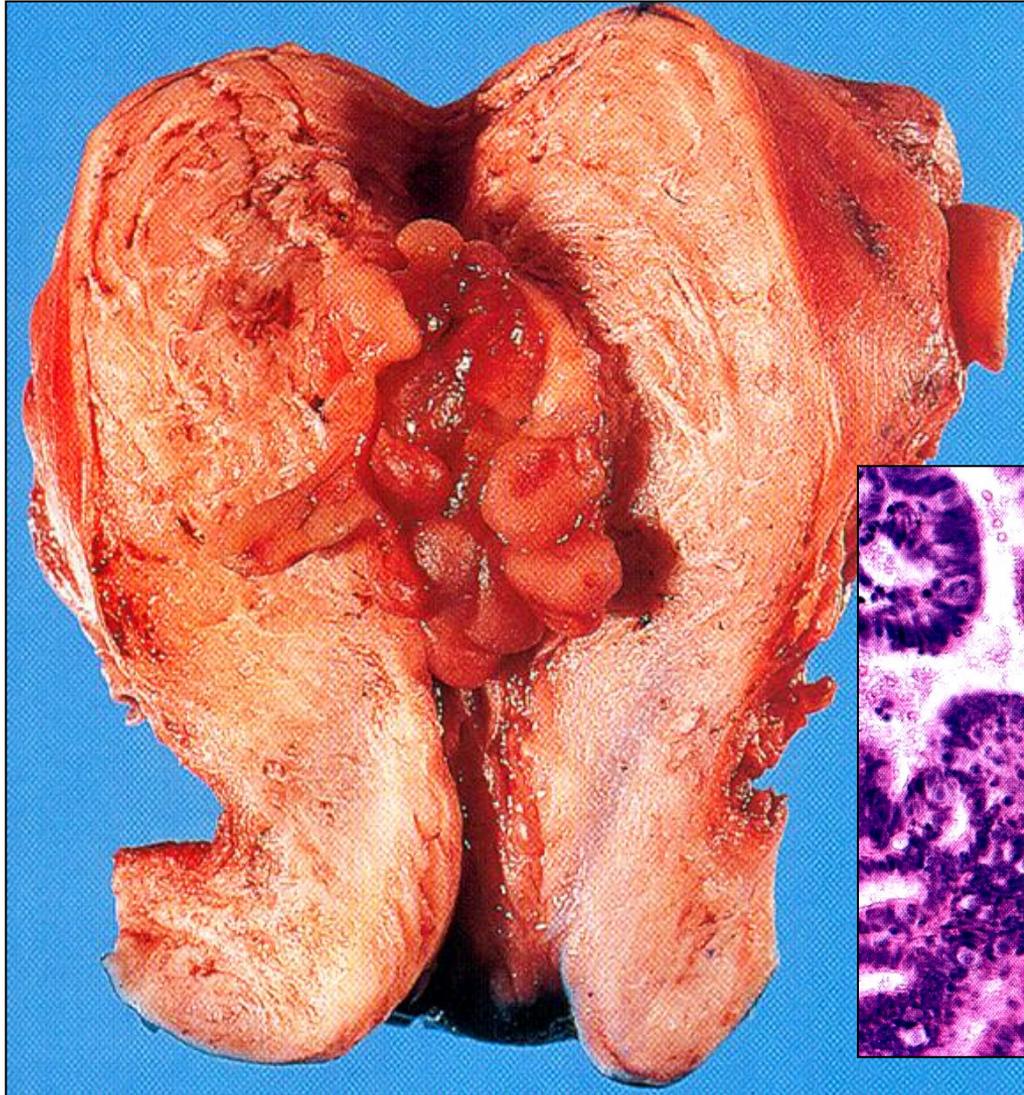
■ **Macroscopic picture:**

- The endometrium is significantly thickened,
- Loose, easily rejected.

■ **Microscopic picture:**

- Very thickened endometrium with numerous glands,
- The glands are elongated, have a tortuous course, sometimes cystic dilated, epithelium of glands proliferates,
- endometrial stroma is also rich in cells (cell hyperplasia).

Glandular endometrial hyperplasia



Hypertrophic growths

- Accompanied by an increase of organs and tissues.
- The most common causes:
 - Inflammation (the formation of hyperplastic polyps and genital condylomas)
 - Violation of lymph circulation (elephantiasis of the lower limbs)
 - Atrophied tissue replacement by fat or connective tissue with development of pseudohypertrophy.

Compensatory hypertrophy

- **There are 3 types of compensatory hypertrophy:**
 - Working hypertrophy
 - Vicar (replacement) hypertrophy
 - Regenerative

Work hypertrophy

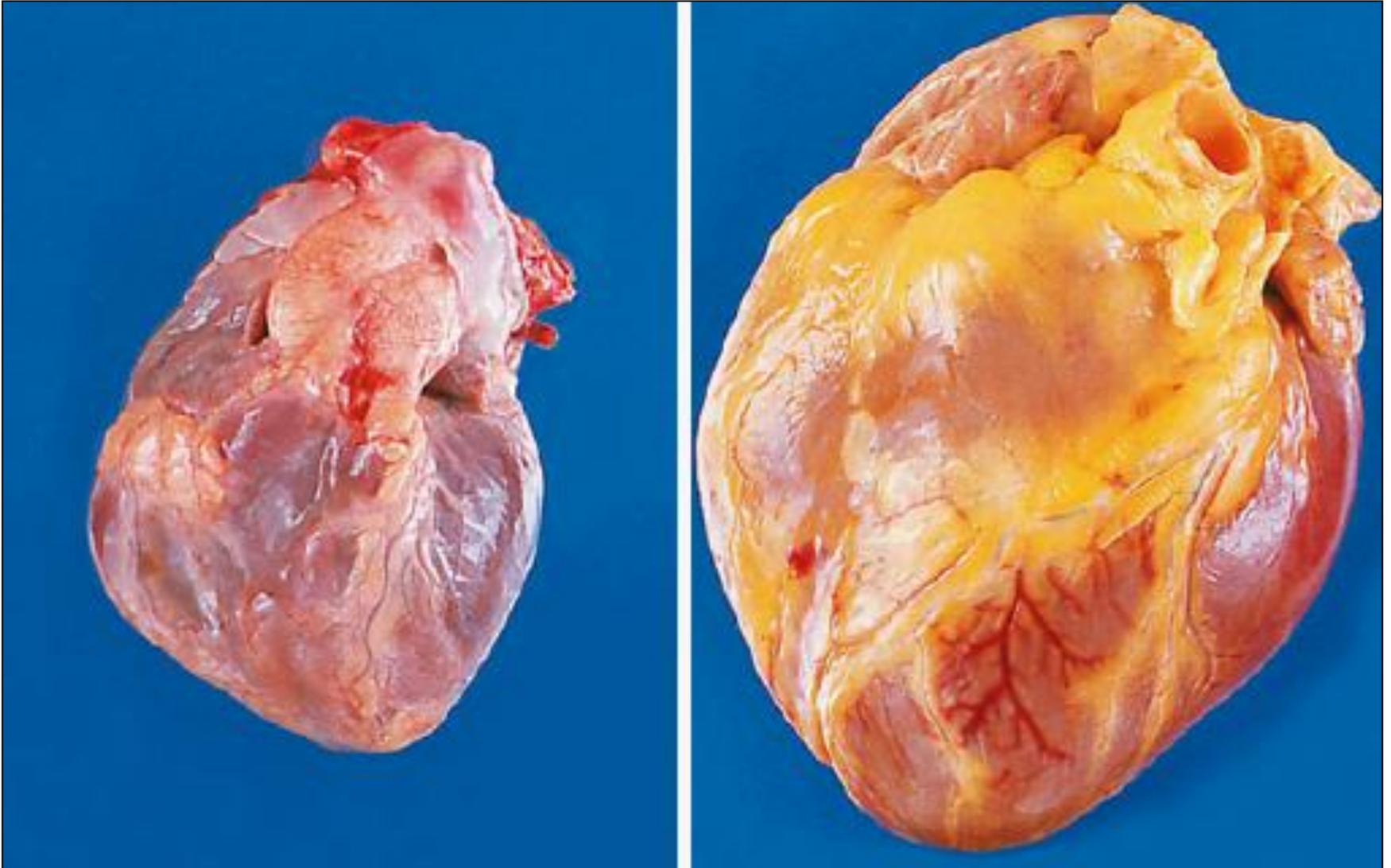
- It occurs due to excessive load on the organ, requiring enhanced function.
- The most common work hypertrophy is cardiac hypertrophy in hypertensive disease.
- Work myocardial hypertrophy mechanisms:
 - Hyperplasia and hypertrophy of cardiomyocytes intracellular structures,
 - Number of cardiomyocytes is not increased.

Work myocardial hypertrophy

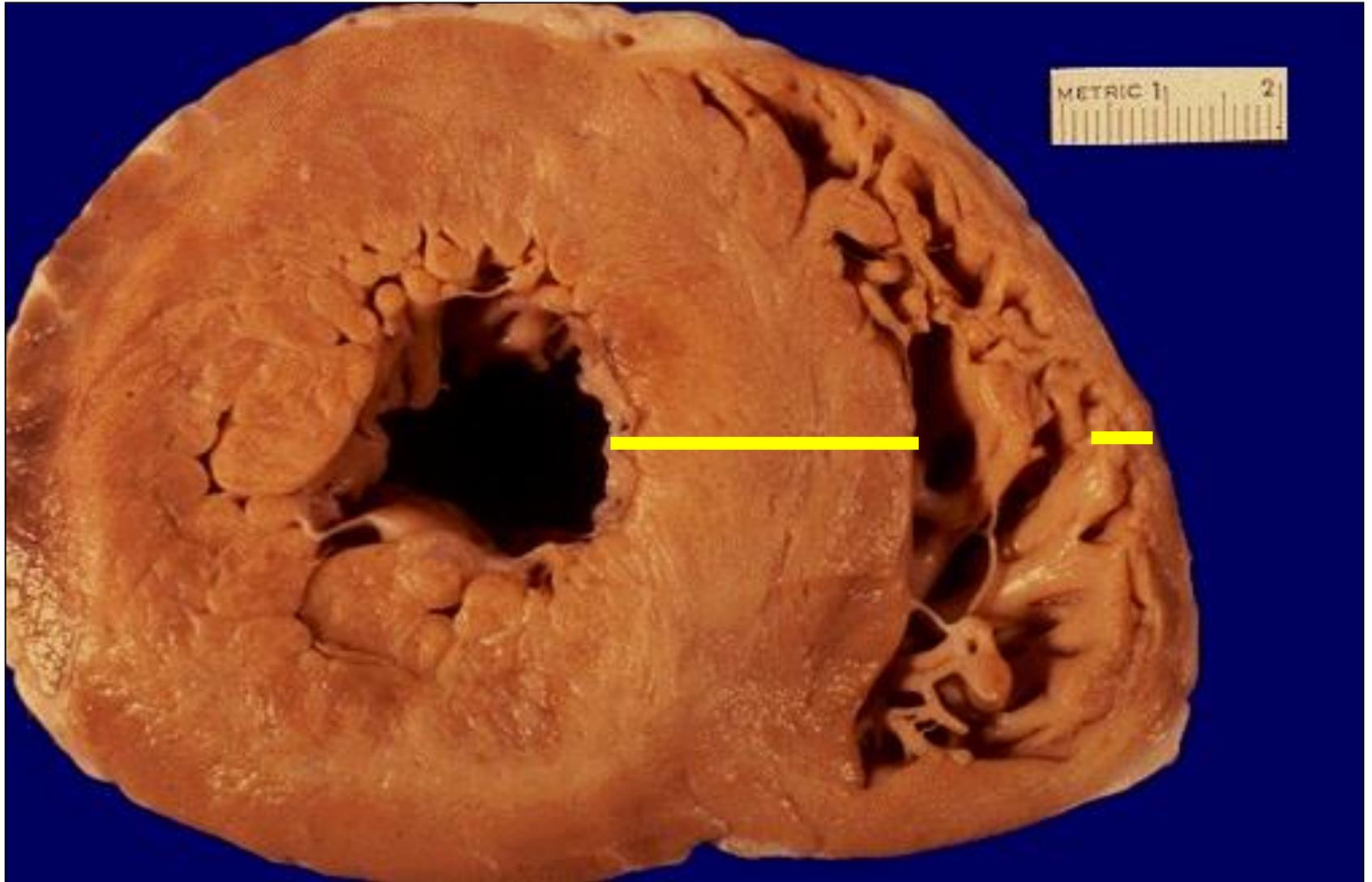
■ Macroscopic picture:

- The dimensions of the heart and its weight are increased,
- Significantly thickened left ventricular wall,
- Increased trabecular and left ventricular papillary muscles volume,
- The cavities of the heart are narrowed (concentric hypertrophy) - in consolidation stage (compensating)
- The cavities of the heart extended (eccentric hypertrophy), myocardium flabby, clay type (fatty degeneration) - in the decompensation.

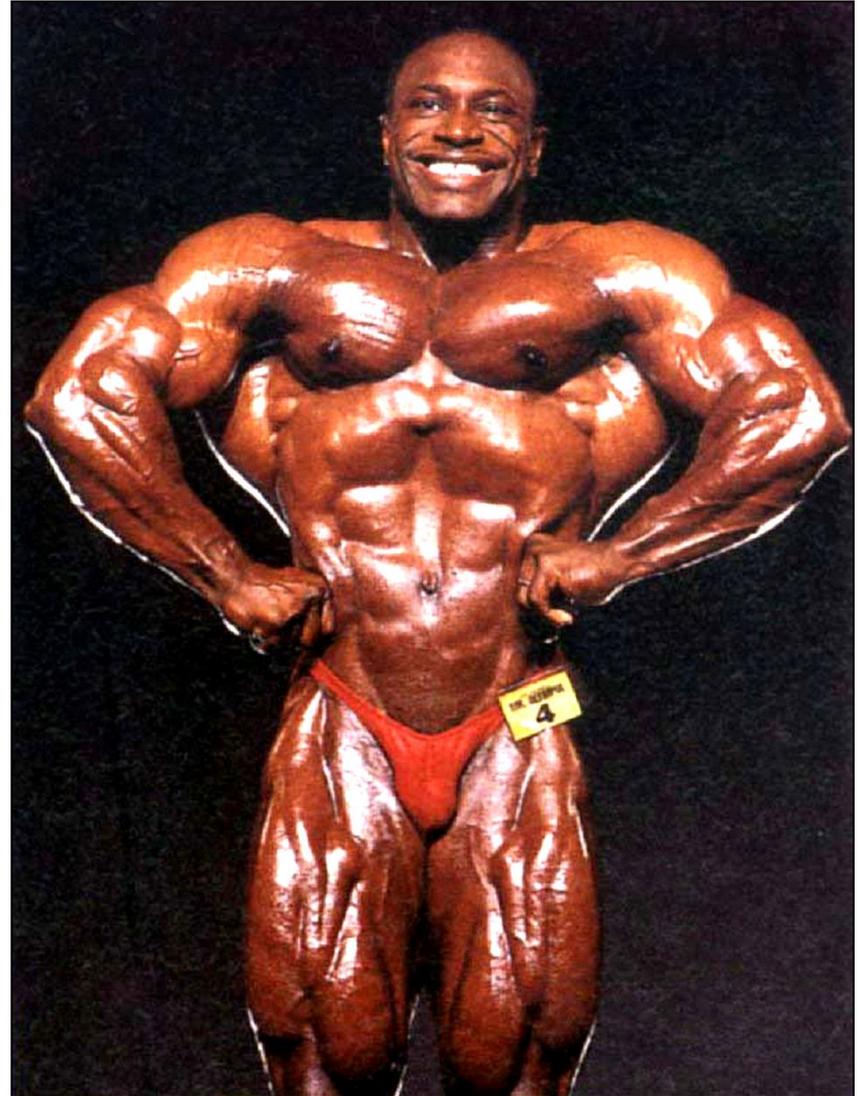
Work myocardial hypertrophy



Work myocardial hypertrophy



Work muscle hypertrophy



Vicar hypertrophy

■ Vicar (replacement) hypertrophy:

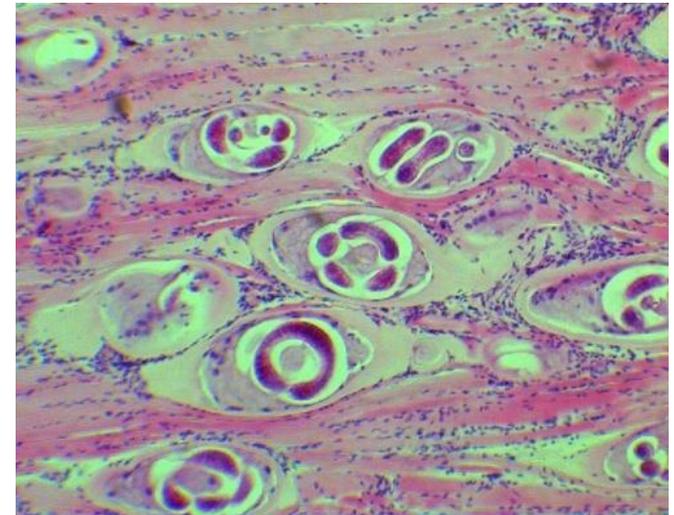
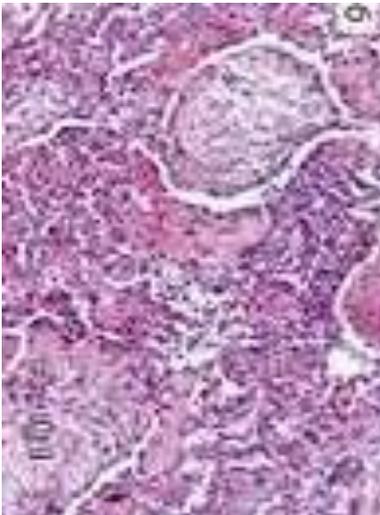
- Occurs as a result of the death of one of the paired organs (kidney, lung).
- Preserved organ hypertrophies and compensates the loss of enhanced performance.

Vicar lung emphysema



Organization (fibrosis) - replacement by dense irregular connective tissue

1. Organization of detritus - dead (necrotic) tissues
2. Thrombus organization
3. Fibrinous exudate organization
4. Incapsulation – fouling (encrustation) of detritus, foreign bodies or dead parasites by fibrous tissue with the formation of a connective tissue capsule



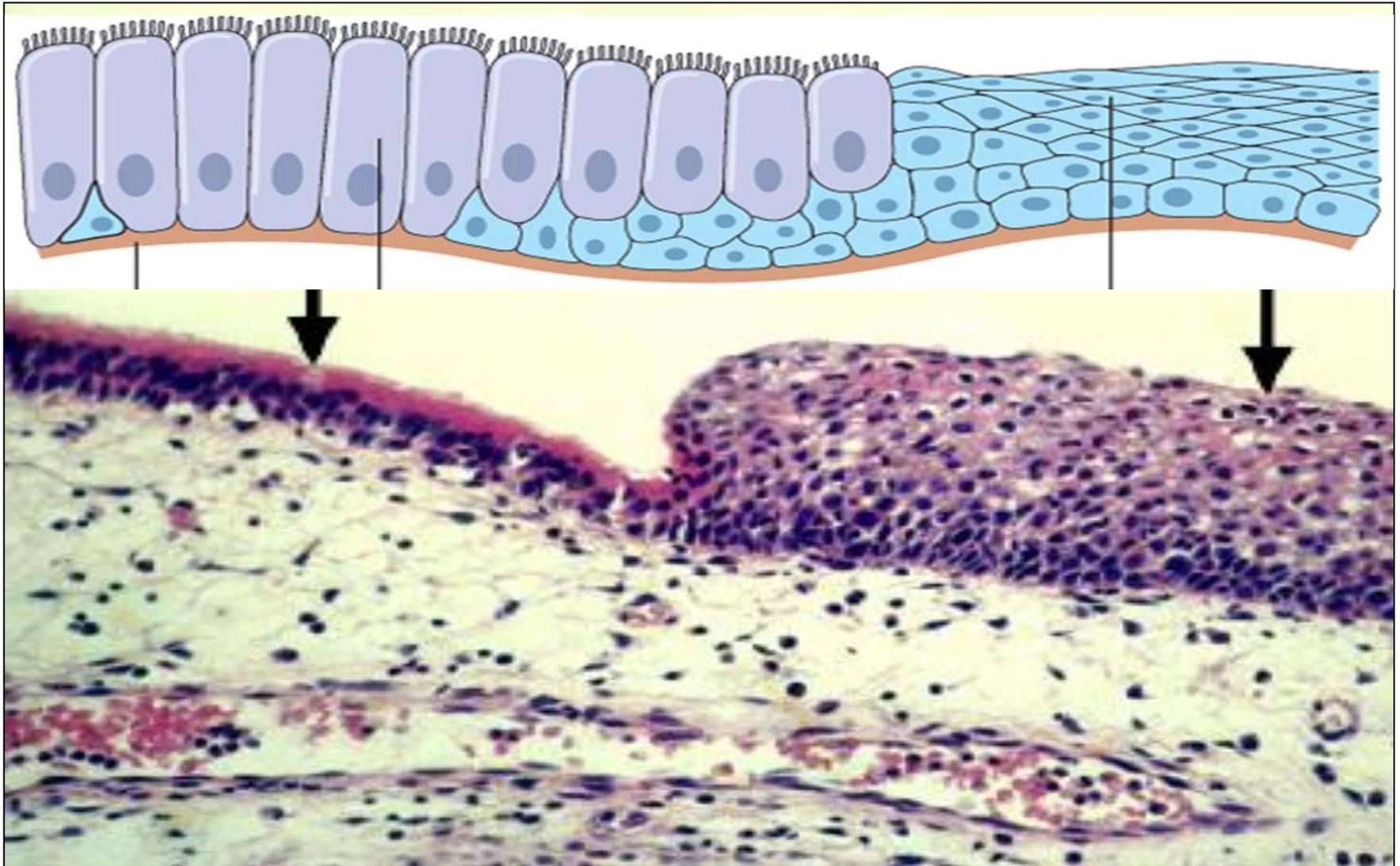
Metaplasia

- **Metaplasia - the replacement (probably not direct transformation) of one type of tissue by another related to it on tissue origin.**
- **Most often it occurs in the epithelium of the mucous membranes:**
 - Intestinal metaplasia of the gastric epithelium;
 - Gastric metaplasia of intestinal epithelium;
 - Squamous metaplasia of prismatic epithelium into stratified squamous epithelium.

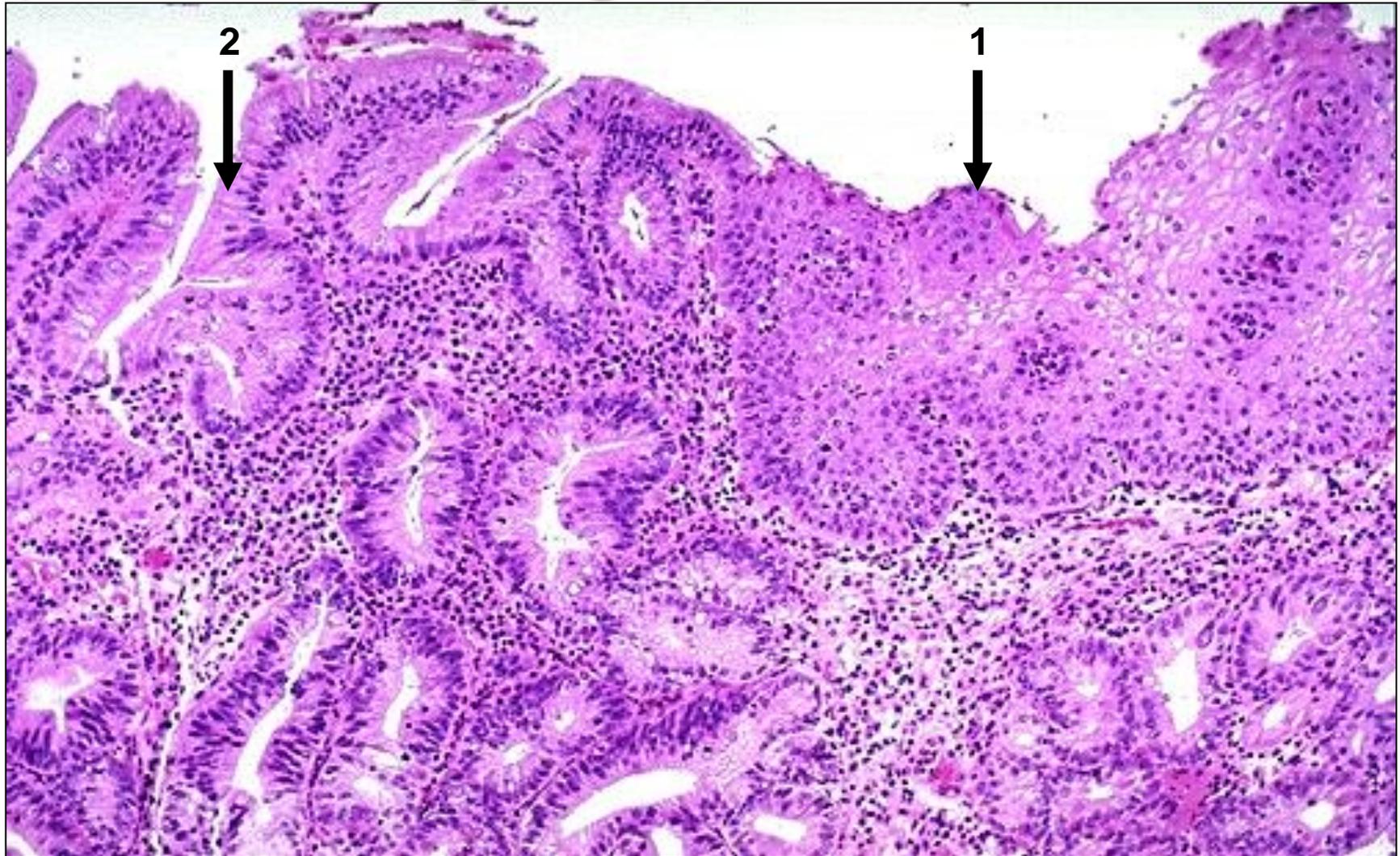
Metaplasia

- Squamous metaplasia may be reversible, but when the permanent stimulus (eg, smoking) persists on its background may develop dysplasia and cancer.
- Metaplasia of connective tissue leads to its conversion into cartilage or bone.
- Nerve and muscle tissue metaplasia is not peculiar.

Squamous metaplasia of the bronchus



Glandular metaplasia of the esophagus (Barrett's esophagus)



Dysplasia

- **Dysplasia is characterized by impaired proliferation and differentiation of the tissues and cells with development of:**
- **cellular atypia:**
 - Different size and shape of the cells,
 - Increased nuclei and their hyperchromia,
 - The increase in the number of mitoses and atypic mitoses.
- **histoarchitectonic violations:**
 - Loss of epithelial polarity
 - Loss of histological and organ specificity
 - Violation of tissue components ratio
 - Formation of abnormal tissue elements

Dysplasia

- **There are 3 degrees of dysplasia:**
 - Low-grade,
 - Moderate-grade,
 - Severe
- **Severe dysplasia - precancerous process.**
- **Severe-grade dysplasia is difficult to distinguish from carcinoma in situ.**

Dysplasia of liver

