ZAPORIZHZHIAN STATE MEDICAL UNIVERSITY

The department of pathological anatomy and forensic medicine with basis of law

Atherosclerosis (AS)
Hypertension disease (HD)
Symptomatic arterial hypertension (SAH)

Lecture on pathological anatomy
for the 3-rd year students

Atherosclerosis is a chronic disease, that is stereotyped response to injury featuring the accumulation of cholesterol-rich fat in the intimae of the large and medium-sized arteries of the body.

These masses form plaques

Risk factors of atherosclerosis:

1. High levels of LDL cholesterol and HDL.
2. Micro-trauma of intimae by: cytokines, toxins (exo- and endo-genous), immune complexes...
3. High blood pressure.
4. Pathology of lipid exchange at diabetes mellitus, thyroxin lack.
5. Law level of muscle activity (lack of exercise).
6. Biochemical lesions that promote thrombosis.
7. Some heredity stations:
   - Familial combined hyper-lipidemia

Stages of pathogenesis

1. The development of focal areas of chronic endothelial injury, with resulting increased endothelial permeability or other evidence of endothelial dysfunction.
2. Increased insudation of lipoprotein, mainly LDL with its high content of cholesterol, and also VLDL.
3. Cellular interactions in foci of injury involving endothelial cells, monocytes/macrophages, T-lymphocytes, and smooth muscle cells of intimal or medial origin.
4. Proliferation of smooth muscle cells in the intima with the formation of connective tissue

Morphogenesis

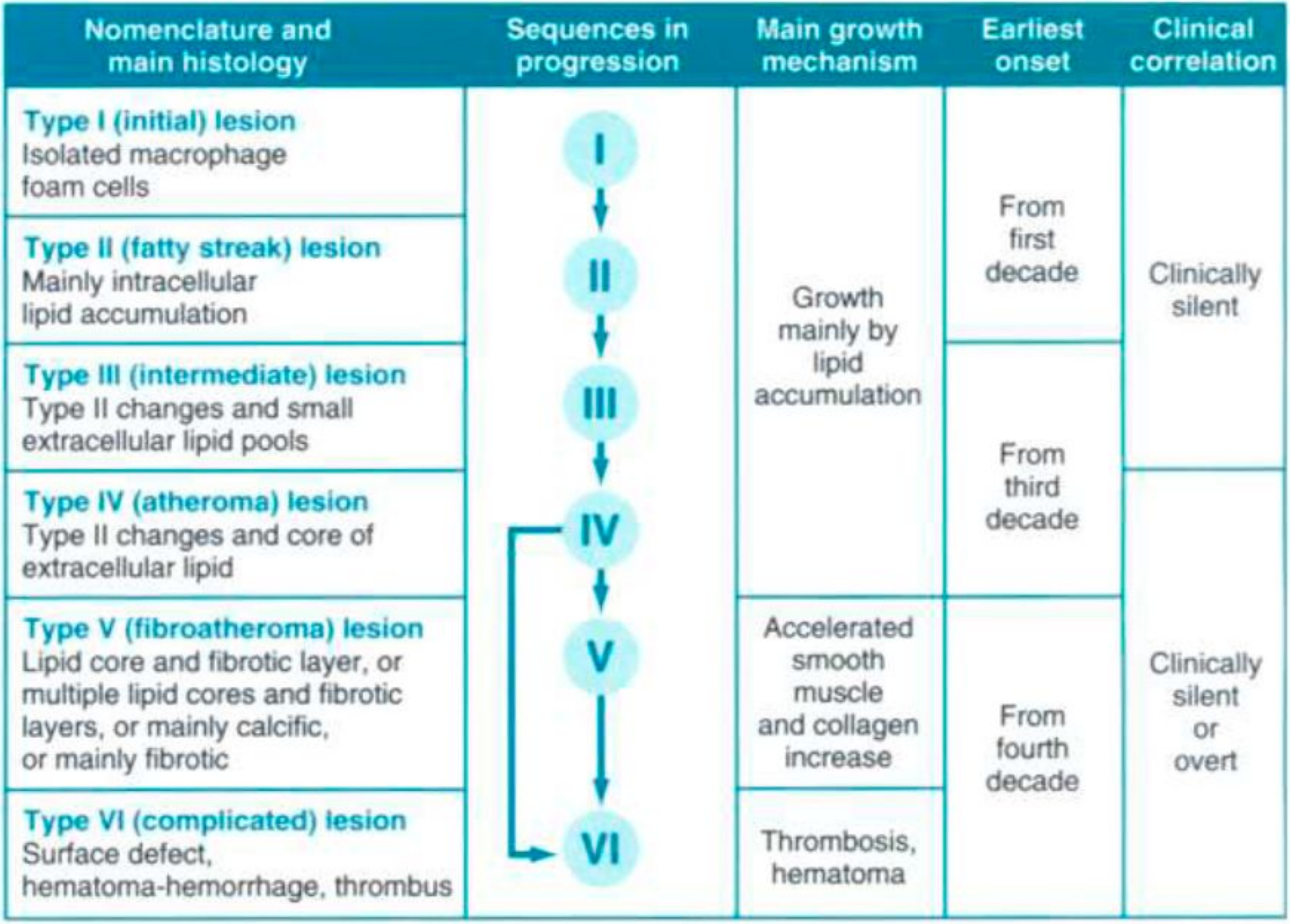
1. Pre-lipidosis stage. In intimae occurs an accumulation of plasma proteins, and glycosaminoglycanes. It causes development of edema and fixation of lipoproteins, cholesterol and proteins in intimae. There occurs the destruction of endothelium, elastic and collagen fibres of intima's basal membrane.
2. Stage of fatty stripes (lipidosis). Fatty stripes appear on intimae due to its lipid infiltration, lipoproteins and proteins fixation. Lipids impregnate intimae and are accumulated in macrophages (foam cell). Elastic membranes become swollen.
3. Stage of liposclerosis. In the areas of lipidosis, a young connective tissue grows and forms fibrous cap. Macroscopically dense, oval, white formations are observed there.

Morphologenesis

4. Stage of atheromatosis is characterized by necrosis of the central part of fibrous cap with formation of amorphous substance (atheromatous detritus).
5. Stage of ulceration is characterized by the break of the atheromatosis cap cover and forming of ulcer with small hemorrhage into the plaque.
6. Stage of atherocalcinosis. Dense and fragile cap is formed due to the cap connective tissue infiltration with calcium.

Evolution of arterial wall changes in the response to injury hypothesis.

1. Normal.
2. Endothelial injury with adhesion of monocytes and platelets.
3. Migration of monocytes (from the lumen) and smooth muscle cells (from the media) into the intimae.
4. Smooth muscle cell proliferation in the intimae.
5. Well-developed plaque.


Nomenclature and main histology
Sequences in progression
Main growth mechanism
Earliest onset
Clinical correlation
Type I (initial) lesion
Isolated macrophage foam cells
Type II (fatty streak) lesion
Mainly intracellular lipid accumulation
Type III (intermediate) lesion
Type II changes and small extracellular lipid pools
Type IV (atheroma) lesion
Type II changes and core of extracellular lipid
Type V (fibroatheroma) lesion
Lipid core and fibrotic layer, or multiple lipid cores and fibrotic layers, or mainly calcific, or mainly fibrotic
Type VI (complicated) lesion
Surface defect, hematoma-hemorrhage, thrombus
I
II
III
IV
V
VI
Growth mainly by lipid accumulation
Accelerated smooth muscle and collagen increase
Thrombosis, hematoma
From first decade
From third decade
From fourth decade
Clinically silent
Clinically silent or overt

Results of atherosclerosis

Abnormal blood circulation

Microscopically, the aortic atheromatous plaque is thicker than the remaining media. The plaque contains amorphous pink material with slit-like "cholesterol clefts" of lipid material. There is overlying recent hemorrhage. Thrombus may form on top of such a plaque

Clinic-anatomic forms of atherosclerosis

1. Atherosclerosis of aorta - the most frequent form. Usually it is not complicated by the thrombosis, thromboembolism and embolism of lower extremities. Development of aortal aneurysm is possible.
2. Atherosclerosis of coronary arteries of heart - ischemic heart disease (IHD).
3. Atherosclerosis of renal arteries leads to atrophy of parenchyma, or infarction. Outcome is atherosclerotic nefro-cirrhosis.
4. Atherosclerosis of arteries of an intestine is complicated by the thrombosis, leading to gangrene or infarction of bowel.

Clinic-anatomic forms of atherosclerosis

1. Atherosclerosis of arteries of cerebrum.

The results are ischemic infarctions of brain or brain haemorrhage. Atherosclerosis of carotides leads to acute local ischemia and cerebral softening (infarction)

2. Atherosclerosis of arteries of extremities, very often this process is located in femoral arteries. The thrombosis with gangrene of lower extremity is possible.

Classification of aneurysms

1. True aneurysms
2. False aneurysms

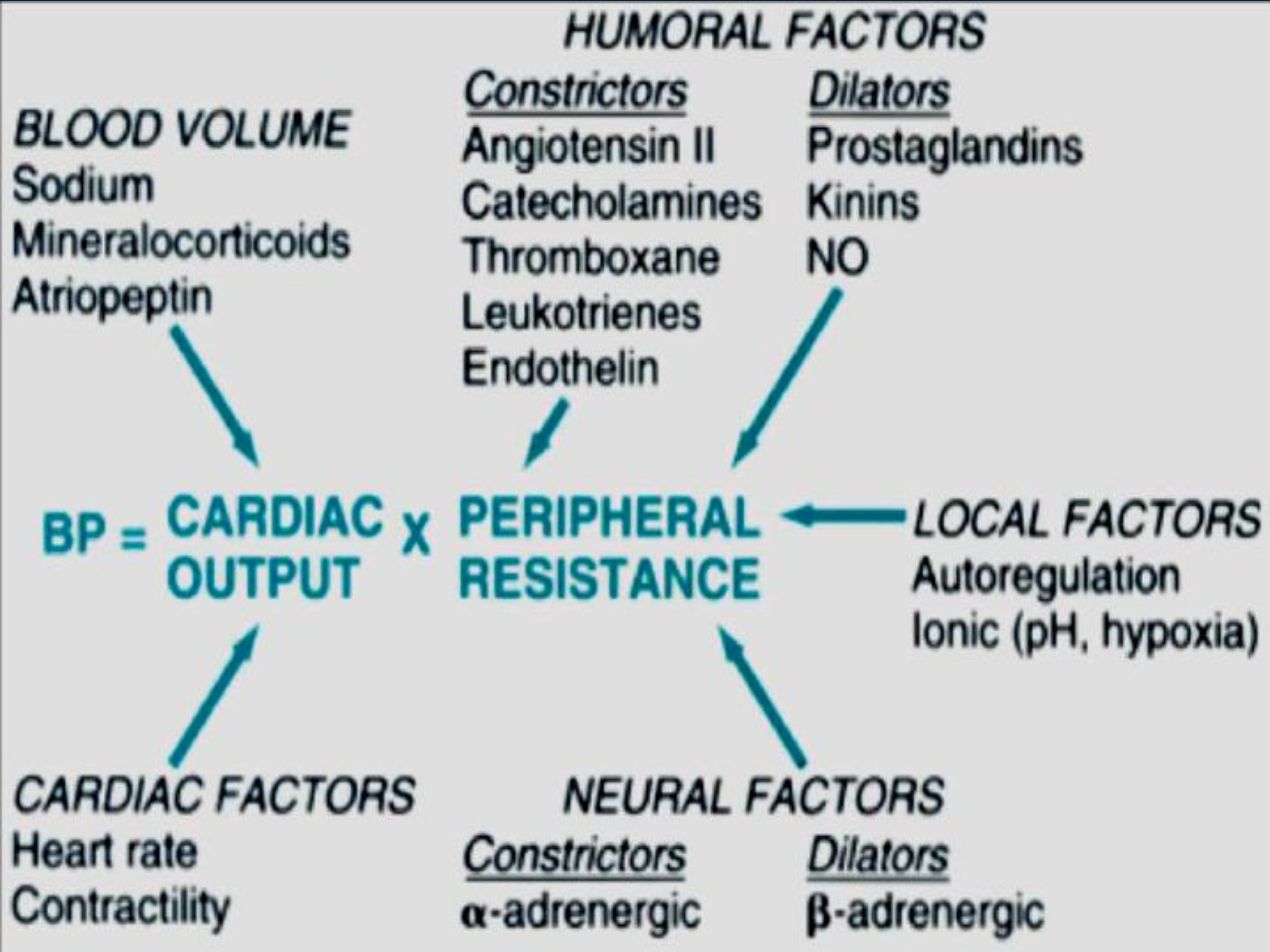
1. Type A (proximal) involves the ascending aorta
2. Type B (distal) does not involves the ascending aorta

Hypertension

Hypertension is a chronic disease that is characterized by increased blood pressure with progression and presence of crisis. There is damage of elastic type arteries and secondary changers in organs.

Arterial hypertension is defined clinically as borderline when it riches 140/90 mm Hg.

Blood pressure depends of cardiac output and peripheral resistance (elasticity of the arterial system).


HUMORAL FACTORS
Constrictors
Angiotensin II
Catecholamines
Thromboxane
Leukotrienes
Endothelin
Dilators
Prostaglandins
Kinins
NO
BLOOD VOLUME
Sodium
Mineralocorticoids
Atriopeptin
BP = CARDIAC OUTPUT x PERIPHERAL RESISTANCE
LOCAL FACTORS
Autoregulation
Ionic (pH, hypoxia)
CARDIAC FACTORS
Heart rate
Contractility
NEURAL FACTORS
Constrictors
α-adrenergic
Dilators
β-adrenergic

In 90-95% of all cases of hypertension, no cause can been established – such cases are called essential or idiopathic or primary.

The increased peripheral resistance resulting in sustained hypertension may arise from:

- Increased sympathetic tone
- Increased release of renin and generation of angiotensin
- The presence of vaso-constrictive substances in the blood circulation
- Increased sodium load and extracellular fluid load
- A postulated excessive responsiveness to the other factors

In only 5-10% of all cases of hypertension is any disease, which may be associated with disturbance of detectable mechanisms – such cases are secondary hypertension. Examples:

- Kidney diseases
- Hyper-function of adrenal cortex. May be Cushing ‘s syndrome – corticosteroid excess
- Tumor of adrenal medulla (pheochromocytoma) – catecholamine excess.
- Hypertension occurs in toxemia of

Clinical-morphological stages

Subclinical stage is displayed by hypertrophy of muscular layer and elastic structures of arterioles and small-sized arteries, spasm of arterioles. At this stage the hypertrophy of the left ventricle of heart begins.

A stage of general changes of arteries begins as arterial pressure increases. Arteriolar walls permeability is increased, it results in plasmatic impregnation and hyalinosis. Elastic, muscular-elastic and musculary arteries walls undergo elastofibrosis and atherosclerosis.

Clinical-morphological stages

3. The stage of secondary changes of organs is developed in connection with changes of arteries and insufficiency of the intra-organic blood circulation.

Types of hypertension disease:

benign H. - changes develop slowly, that results in atrophy of parenchyma and sclerosis of organ

malignant H. - changes develop quickly (spasm, thrombosis, fibrinoid necrosis) and causing infarctions and hemorrhages.

This is a different kind of arterio- sclerosis. This is hyperplastic arteriolosclerosis, which most often appears in the kidney in patients with malignant hypertension. The arteriolar wall is markedly thickened and the lumen is narrowed

Sometimes the small arteries and arterioles can be damaged so severely in malignant hypertension that they demonstrate necrosis with a pink fibrin-like quality that gives this process its name--fibrinoid necrosis

Clinical-morphological forms of HD

(effects and complications in various organs)

Cardiac form. Hypertrophy of the myocardium occurs. Weight of heart reaches 1 kg, thickness of left ventricle walls is up to 3 cm. Heart is called "cor bovin". Atherosclerosis of coronary arteries of heart is a result of hypoxia of the myocardium, dystrophic and necrobiotic processes.

Cerebral form is characterized as impairment of cerebral blood circulation. Infarctions of the brain and hypooxygenous changes are possible. As the result of brain vessels rupture hemorrhage into tissue can be observed (Hematoma).

Clinical-morphological forms of HD
(effects and complications in various organs)

The renal form is characterized by chronic arteriolo-sclerotic nephrosclerosis. Kidney has a term primary shrunken kidney.

In case of malignant hypertension can develop as hypertonic crisis - acute increase of arterial pressure in connection with spasm of arterioles.

Morphological appearance of hypertonic crisis: plasmatic impregnation or fibrinoid necrosis of arteriolar walls.