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**ARTERIAL HYPERTENSION: DIAGNOSIS AND TREATMENT
(EDUCATIONAL MANUAL)**

**For master's students in the specialty "Therapy" of medical higher educational
institutions**

Field of knowledge: 900000 - Healthcare and Social Affairs

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The educational manual is intended for master's students in the specialty "Internal Medicine" ("Therapy") of medical universities.

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This educational manual is intended for master's students in the specialty "Therapy" and is based on the curriculum for master's students. Taking into account the features of the course, classification, clinical presentation, treatment, and prevention of arterial hypertension, it will be useful for master's students, clinical residents, as well as senior students of medical universities. The preparation of this manual has utilized the latest and modern data from medical literature.

Scientific Secretary of the University: G.A. Ismailova.

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GLOSSARY

AH - arterial hypertension

BP - blood pressure

ADH - antidiuretic hormone

CCBs - calcium channel blockers

ACEIs - angiotensin-converting enzyme inhibitors

β -blockers - beta-blockers

BUN - blood urea nitrogen

WHO - World Health Organization

HTN - hypertension

HC - hypertensive crisis

CCD - city cardiological dispensary

LVH - left ventricular hypertrophy

DBP - diastolic blood pressure

ESC - European Society of Cardiology

BMI - body mass index

ISH - isolated systolic hypertension

KKS - kallikrein-kinin system

LDL - low-density lipoprotein

HDL - high-density lipoprotein

MAU - microalbuminuria

ICD - International Classification of Diseases

ISH - International Society of Hypertension

CBC - complete blood count

UA - urinalysis

TPR - total peripheral resistance

BV - blood volume

RAAS - renin-angiotensin-aldosterone system

SAH - symptomatic arterial hypertension

SBP - systolic blood pressure
SAS - sympathetic-adrenal system
RAC - rural ambulatory clinic
DM - diabetes mellitus
ABPM - ambulatory blood pressure monitoring
PHC - primary health care
ESR - erythrocyte sedimentation rate
US - ultrasonography
SV - stroke volume
TG - triglycerides
EF - ejection fraction
RF - risk factors
FC - functional class
PCC - pheochromocytoma
CKD - chronic kidney disease
CHF - chronic heart failure
COPD - chronic obstructive pulmonary disease
CCB - central city hospital
HR - heart rate
ECG - electrocardiogram
EchoCG - echocardiography

"This triad: arterial hypertension, atherosclerosis, and ischemic heart disease takes the best hearts of humanity."

A. Myasnikov

INTRODUCTION

In his work "Together We Will Build a Free, Democratic, and Prosperous State of Uzbekistan", President of the Republic of Uzbekistan Shavkat Mirziyoyev wrote: "We will consistently and resolutely continue the state youth policy. And not only will we continue it, but we will also raise it to an even higher level in accordance with the demands of today. We will mobilize all the forces and capabilities of our state and society to ensure that our youth possess independent thinking, high intellectual and spiritual potential, do not lag behind their peers from other countries in any sphere, and are happy and confident in their future." To fulfill these tasks, numerous decrees and resolutions are issued in our country.

In particular, in the Decree of the President of the Republic of Uzbekistan dated April 20, 2017, No. PP-2909 "On Measures for Further Development of the Higher Education System," it is stated: "In order to fundamentally improve the system of higher education, to radically revise the content of personnel training in accordance with the priority tasks of socio-economic development of the country, to provide necessary conditions for the preparation of specialists with higher education at the level of international standards: consider it as one of the most important tasks of further improvement and comprehensive development of the higher education system, wide introduction of educational and methodological materials based on international educational standards into the educational process, creation and wide implementation of next-generation textbooks in the higher education system, provision of higher educational institutions with modern educational, educational and methodological and scientific literature, including on the basis of acquisition and translation of the latest foreign literature, regular updating of the funds of information and resource centers".

Over the past 20-30 years, significant progress has been made in the field of cardiology. Additionally, cardiovascular pathology is one of the leading causes of morbidity and mortality in the population. Hypertensive disease and ischemic heart disease occupy an important place in the social sphere among cardiovascular diseases.

Currently, arterial hypertension (AH) is the cause of over 17 million deaths worldwide annually, and it reduces life expectancy by an average of 5 years. According to the World Health Organization (WHO), in the coming decades,

elevated blood pressure ($\geq 140/90$ mmHg) will be recorded in almost one-third of the population, and the problem of overweight and obesity will become a global issue. In the world, one-fifth of the population aged 40-64 is at risk of developing cardiovascular diseases over the next ten years. In 2015 alone, non-communicable diseases claimed the lives of 40 million people, accounting for 70% of all deaths worldwide. In Uzbekistan, 78% of all deaths are caused by non-communicable diseases. In 2017, in the overall structure of standardized mortality rates by gender and age, diseases of the circulatory system took the first place (69%), including ischemic heart disease, arterial hypertension, and its complications (myocardial infarction, cerebral hemorrhage).

It is for this reason that the aim of treating AH is not only to normalize blood pressure but also to prevent cardiovascular complications and reduce mortality.

All of this has led to the adoption of a special Presidential Decree of the Republic of Uzbekistan No. PP-103 dated January 22, 2022, "On Measures to Improve the Prevention and Treatment of Cardiovascular Diseases," which specifies the need to expand prevention, early detection, and effective treatment of cardiovascular diseases in the regions, create comfortable conditions for patients, provide them with necessary services, and address the tasks set for healthcare institutions and medical workers in various directions.

Arterial pressure is one of the main indicators of the body's vital functions. The resistance of blood vessel walls to the flow of blood creates normal blood pressure. Arterial pressure is determined by the inflow of blood from the heart through the arteries to the veins. Blood vessels in a healthy person have the property of expanding and contracting, which is why the surrounding environment is balanced and moderately stable. In some families, each member may have a tendency to low blood pressure, while in others, the pressure may be higher. If the balance of vessel dilation or constriction is disrupted as a result of various influences, symptoms of illness may appear over time. Despite a person's calm and peaceful life, blood pressure fluctuates throughout the day. Usually, in the first half of the day, blood pressure is close to normal, it slightly increases in the second half, and at night, it returns close to normal.

ICD-10 Code:

Disease with elevated arterial pressure (arterial hypertension) **I10-I15**

Relevance of the Topic: ARTERIAL HYPERTENSION SYNDROME

Arterial hypertension syndrome is a condition in which systolic blood pressure is 140 mmHg or higher, and diastolic blood pressure is 90 mmHg or higher in individuals taking antihypertensive medications.

Symptomatic (secondary arterial hypertension) (SAH) is arterial hypertension syndrome that develops against the background of an underlying condition for known reasons. There is also so-called "white coat hypertension" or "office hypertension," which often occurs during the first visit to the doctor for susceptible individuals. This is a temporary condition, and after some time, blood pressure normalizes.

Interdisciplinary and Intradisciplinary Connections

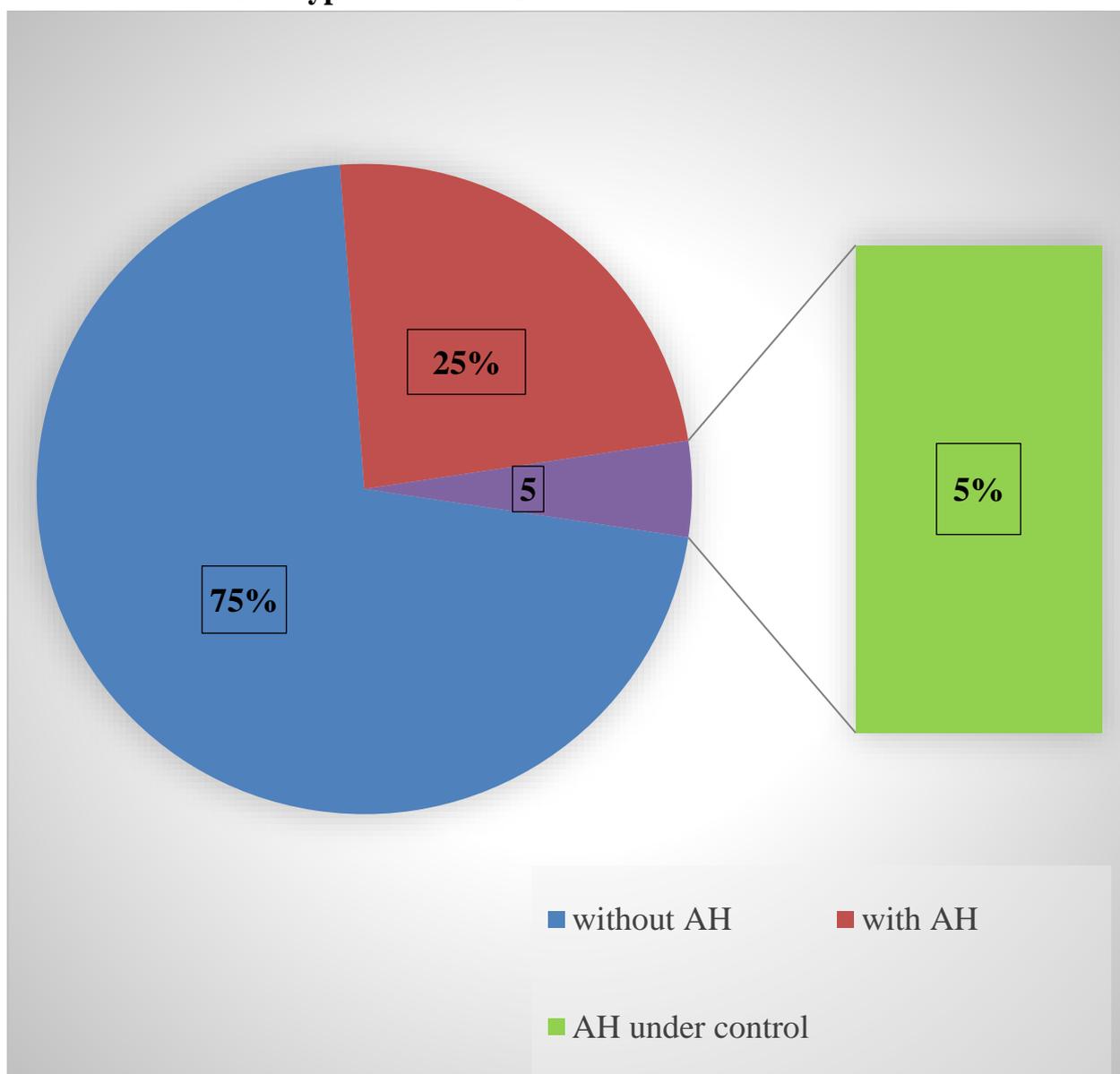
Teaching this subject is based on students' knowledge of normal physiology, pathological anatomy, propaedeutics of internal diseases, faculty therapy, pharmacology, and clinical pharmacology. The knowledge acquired during education will be useful in general practice, cardiology, and other clinical fields, as well as in the study of antihypertensive drugs in pharmacology.

Epidemiology

According to the World Health Organization (WHO), in 2014, the prevalence of arterial hypertension worldwide was 29.2% in men and 24.8% in women, and in 2015, the prevalence of arterial hypertension worldwide was 1.13 billion cases. By 2025, the number of cases is estimated to increase by 15-20%, reaching 1.5 billion. The prevalence of arterial hypertension in the general population of various European countries is 30-45%, sharply increasing with age. According to scientific studies, arterial hypertension accounts for 30% among the elderly population (over 18 years old) in our country. There is an inseparable connection between the prevalence of arterial hypertension and mortality rates resulting from increased blood pressure, which includes various cardiovascular diseases (stroke, myocardial infarction, sudden death, heart failure, and peripheral artery disease), as well as the development of kidney diseases. The relationship between cardiovascular disease and mortality varies depending on additional cardiovascular risk factors. In Uzbekistan, 25% of the population, or every fourth resident, suffers from arterial hypertension, and only one in five patients is treated regularly. According to our scientists, only 23.23% of women and 15.38% of men regularly take antihypertensive drugs among the population of the Republic of Uzbekistan. 30-40% of elderly people suffer from hypertension. With

increasing age, the prevalence of the disease increases, reaching 60-70% at the age of 65, with isolated systolic hypertension being more common in elderly patients, accounting for 5% of the population under 50 years of age. Hypertension predominantly affects men under 50 years of age, while after 50 years of age, the disease mostly begins to manifest in women. Among all types of arterial hypertension, mild to moderate hypertension accounts for 70-80%, with the rest corresponding to severe hypertension. Some individuals may be predisposed to high blood pressure, while others may experience high blood pressure due to negative factors in their lives. Increased blood pressure is particularly observed in diseases of the brain and some diseases of internal organs. Hypertension, i.e., blood pressure above normal, in several family members may indicate a congenital predisposition to the disease. Most of these family members have similarly elevated blood pressure levels.

The statistics of hypertension in Uzbekistan



CLASSIFICATION OF THE DEGREE AND STAGES OF ARTERIAL HYPERTENSION

Table №1

**Levels of arterial pressure and degrees of arterial hypertension
(ESC/ESH 2013, 2018, ASS/ANA 2017)**

Category	Systolic BP (mmHg)	Diastolic BP (mmHg)
Optimal	<120	<80
Normal	<130	<85
High-normal	130-139	85-89
Hypertension		
Borderline	140-149	90-94
Stage 1	140-159	90-99
Stage 2	160-179	100-109
Stage 3	>180	>110
Isolated systolic hypertension	>140	<90

Stratification of Patients by Risk Level

In patients with hypertension, the prognosis depends not only on the level of blood pressure. The presence of accompanying risk factors, the degree of involvement of target organs in the process, as well as associated clinical conditions, are no less important than the degree of blood pressure elevation. Therefore, modern classification introduces stratification of patients based on the risk level.

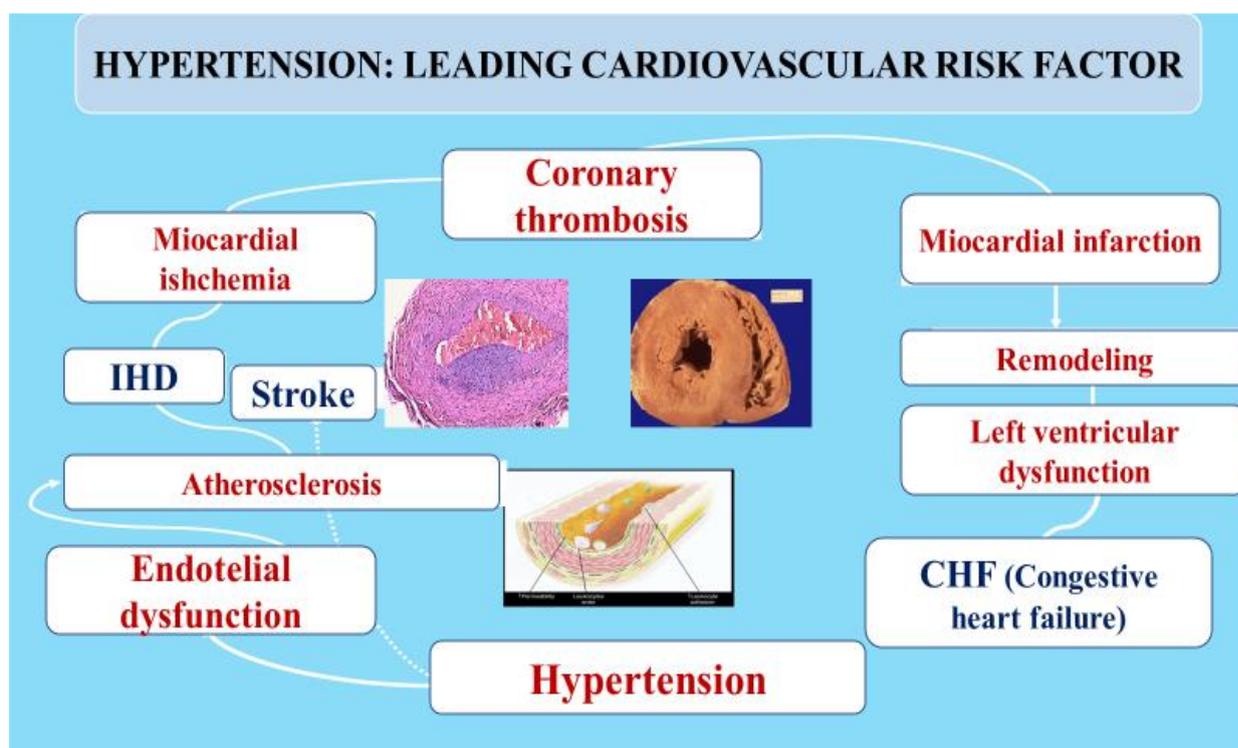
It is advisable to abandon the term "stage" as for many patients, it is not possible to determine the "staging" of the disease. Thus, instead of disease stage determined by the severity of organ damage, patients are divided based on the degree of risk. This allows considering a significantly larger number of objective parameters, facilitates the assessment of individual prognosis, and simplifies the choice of treatment tactics.

Table № 2

Risk Stratification for Assessing the Prognosis of Patients with Arterial Hypertension

Other Risk Factors (besides hypertension) Target organ damage, associated diseases	Grade 1 SBP 140-159 DBP 90-99	Grade 2 SBP 160-179 DBP 100-109	Grade 3 SBP 180 and above DBP 110 and above
No risk factors, target			

organ damage, associated diseases	Low risk	Moderate risk	High risk
1-2 risk factors	Moderate risk	Moderate risk	Very high risk
3 or more risk factors and/or target organ damage and/or diabetes mellitus	High risk	High risk	Very high risk
Associated clinical conditions	Very high risk	Very high risk	Very high risk



RISK FACTORS:

When studying arterial hypertension, it is appropriate to focus on risk factors, as the role of these factors in the onset of arterial hypertension, the acceleration of the pathological process, and the appearance of dangerous symptoms is significant.

Table №3

(ASS/ANA, ESC/ESH 2018)

Risk Factors	Characteristics
Gender	Men > Women
Patient's age	Men ≥ 55 years old; Women ≥ 65 years old
Smoking	Yes (currently or in history)

<p>Lipid Metabolism Total Cholesterol (TC) > 4.9 mmol/L (190 mg/dL) and/or Low-Density Lipoprotein Cholesterol (LDL-C) > 3.0 mmol/L (115 mg/dL) Triglycerides (TG)</p>	<p>Dyslipidemia (pay attention to each lipid parameter):</p> <p>Total cholesterol (TC) > 4.9 mmol/L (190 mg/dL) and/or Low-Density Lipoprotein Cholesterol (LDL-C) > 3.0 mmol/L (115 mg/dL) and/or</p> <p>For men - High-Density Lipoprotein Cholesterol (HDL-C) < 1.0 mmol/L (40 mg/dL) For women - High-Density Lipoprotein Cholesterol (HDL-C) < 1.2 mmol/L (46 mg/dL)</p> <p>Triglycerides (TG) > 1.7 mmol/L (150 mg/dL)</p>
Uric acid	For men - >420 μ mol/L; For women - >150–350 μ mol/L.
Fasting blood sugar level	5.6–6.9 mmol/L (101–125 mg/dL)
Glucose tolerance test (GTT) results	7.8–11.0 mmol/L
Obesity excessive weight	BMI \geq 30 kg/m ²
Abdominal obesity	Men – \geq 102 cm, Women – \geq 88 cm (in individuals of European descent)
Genetic predisposition to the disease	Men - <55 years old, Women - <65 years old
Early menopause (<45 years)	Yes
HR >80 per minute (Heart Rate >80 bpm)	
Subclinical (symptomatic) signs of target organ damage	
Pulse pressure (in elderly individuals)	The conduction is 60 mm higher.
Symptoms of left ventricular hypertrophy (LVH)	Sokolow-Lyon index (SV1 + RV5-6) >35 mm Cornell voltage index (RaVL + SV3):
	For men - \geq 28 mm For women - \geq 20 mm, (RAVL+SV3) Cornell (RAVL+SV3) mm \times QRS ms > 2440 mm \times ms

Markers of left ventricular hypertrophy	Left ventricular mass index (ASE formula): For men - $>50 \text{ g/m}^{2.7}$ For women - $>47 \text{ g/m}^{2.7}$ Indexing can be obtained by BMI. For men - $>115 \text{ g/m}^2$, and for women - $>95 \text{ g/m}^2$.
Pulse wave velocity (carotid-femoral)	$>10 \text{ m/s}$
Brachial-ankle pulse wave velocity	<0.9
Chronic kidney disease (CKD)	The average estimated glomerular filtration rate (eGFR) was calculated.
Microalbuminuria (MAU)	eGFR $30\text{--}59 \text{ mL/min/1.73 m}^2$ or calculated eGFR $<30 \text{ mL/min/1.73 m}^2$
Severe retinopathy	Albumin-to-creatinine ratio (ACR) $30\text{--}300 \text{ mg/g}$;
Diabetes mellitus (DM)	
Serum glucose fasting and/or Blood sugar level after loading	$\geq 7.0 \text{ mmol/L}$ (126 mg/dL) on 2 separate occasions and/or $>7\%$ (53 mmol/mol) $\geq 11.1 \text{ mmol/L}$ (198 mg/dL)
Cardiovascular diseases, cerebrovascular diseases, or kidney diseases	
Cerebrovascular diseases	Ischemic stroke, intracerebral hemorrhage, transient ischemic attack (TIA)
Cardiovascular diseases	Myocardial infarction, angina pectoris, percutaneous coronary intervention, or coronary artery bypass grafting
Heart failure	Left ventricular ejection fraction (LVEF) status is also included in the process
Has clinical significance	Atherosclerotic plaques
Rhythm disturbance	Atrial fibrillation (AF)

CHAPTER I

HYPERTENSIVE DISEASE

Depending on the etiology, arterial hypertension is divided into 2 groups:

- 1. Primary (essential or idiopathic) hypertension (hypertensive disease - HD).**
- 2. Secondary (symptomatic) hypertension.**

According to the proposal of G.F. Lang, the terms "essential arterial hypertension" and "hypertensive disease" have the same meaning. In 1962, on the recommendation of Professor A.L. Myasnikov, the expert council of the WHO recommended that the terms "essential arterial hypertension" and "hypertensive disease" be synonymous. According to Podzolkova (2000), it is appropriate to use the term "hypertensive disease."

Hypertensive disease (HD) or essential hypertensive disease is a chronic condition characterized primarily by elevated blood pressure, triggered by a disruption in the regulation of a complex "cascade" of interacting mechanisms (neurohumoral, hemodynamic, metabolic, etc.), with damage to target organs.

Etiology

The development of the disease is caused by prolonged stress and depression, frequent psychological stress. They are often caused by work requiring constant emotional stress. In addition, patients with concussion are also at higher risk of developing the disease. Genetic predisposition is also one of the reasons: if a person's offspring has scoliosis, the risk of developing scoliosis increases several times.

The main factor influencing the development of the disease is a sedentary lifestyle. With age, people may develop atherosclerosis, and an increase in blood pressure against the background of this change exacerbates the situation. This is extremely dangerous for life, as blood does not reach the brain, heart, or part of the kidneys through narrowed vessels. If clots and cholesterol deposits accumulate on the vessel walls, they can detach under high pressure, block capillary vessels, and disrupt blood flow. In this case, a heart attack or stroke occurs.

Hormonal changes during menopause may be a cause of high blood pressure in women. Salt, specifically the sodium it contains, as well as smoking, alcohol consumption, and obesity also put pressure on the cardiovascular system.

Factors, influencing **the development** of arterial hypertension include the following:

- Excessive physical exertion, metabolic diseases, endocrine diseases, sedentary lifestyle;
- Regular emotional stress, depression, experiencing tragic events, loss of loved ones;

- Due to problems in business, work;
- Head injuries (car accident, fall, hypothermia);
- Chronic diseases that have a negative impact on the cardiovascular system (diabetes mellitus, gout, rheumatoid arthritis);
- Genetic predisposition;
- Viral infections (meningitis, sinusitis, frontal sinusitis);
- Age-related changes in blood vessels;
- High cholesterol levels in the blood, resulting in accumulations in the vessel walls;
- Harmful habits (smoking, alcohol consumption, excessive coffee consumption);
- Daily consumption of large amounts of water;
- Increased adrenaline levels in the blood;
- Long hours of work on the computer;
- Less walking outdoors, etc.

Depending on the clinical course of arterial hypertension, two types are distinguished:

1. "silent," prolonged;
2. severe, rapidly developing form, leading to cerebral and renal insufficiency and a sudden decrease in blood pressure over a short period of time.

Classification of hypertensive disease by stages:

In the development of hypertensive disease, various target organs are affected – target organs.

Stage 1. No target organ damage (only blood pressure)

Stage 2. Registration of damage to at least one target organ is required:

- Left ventricular hypertrophy;
- Widespread or localized retinal damage;
- Proteinuria or moderate elevation of creatinine levels in the blood;
- Registration of an atherosclerotic plaque by ultrasound or radiological diagnostics (in the aorta, carotid, iliac, femoral arteries);

Stage 3. Complex damage to target organs:

- Heart. Angina pectoris, myocardial infarction, circulatory insufficiency.
- Brain. Transient ischemic attacks, stroke, hypertensive encephalopathy.
- Kidneys. Plasma creatinine level over 2 mg%, renal insufficiency.
- Fundus. Hemorrhages and edema of the optic disc or without edema.

- Blood vessels. Dissecting aneurysm, occlusive lesions of the heart.

Associated (associated) clinical conditions:

1. Cerebrovascular diseases:

- Ischemic and hemorrhagic stroke
- Transient ischemic attacks

2. Heart diseases:

- Myocardial infarction
- Angina pectoris
- Coronary artery revascularization
- Congestive heart failure

3. Kidney diseases:

- Diabetic nephropathy
- Renal insufficiency (plasma creatinine level above 177 $\mu\text{mol/L}$)

4. Vascular diseases:

- Dissecting aneurysm
- Peripheral arterial disease with clinical manifestations

5. Severe hypertensive retinopathy:

- Retinal hemorrhages or exudates
- Optic disc edema

Table №4

Risk stratification for assessing the prognosis of patients with arterial hypertension

Other risk factors (besides hypertension) Organ damage, associated diseases	Stage 1 SBP 140-159 mmHg DBP 90-99 mmHg	Stage 2 SBP 160-179 mmHg DBP 100-109 mmHg	Stage 3 SBP 180 and above DBP 110 and above
No risk factors, organ damage, associated diseases	Low risk	Moderate risk	High risk
1-2 risk factors	Moderate risk	Moderate risk	Very high risk
3 or more risk factors and/or organ damage and/or diabetes	High risk	High risk	Very high risk

Risk Stratification of Essential Hypertension

Risk Stratification Criteria:

- **Low-risk group:** This group includes men and women under the age of 55 who have hypertension but do not have risk factors, organ damage, or associated cardiovascular diseases. The risk of death from complications is less than 15%.
- **Moderate-risk group:** This group includes patients with hypertension and risk factors (men over 55, women over 65, smoking, cholesterol levels above 6.5 mmol/L, family history of early cardiovascular diseases). Organ damage and/or associated diseases are absent. In other words, this group includes patients with hypertension and several risk factors. The risk of dying from cardiovascular complications in the next 10 years is 15-20%.
- **High-risk group:** This group includes patients with organ damage, such as left ventricular hypertrophy according to ECG, echocardiography, proteinuria, or a creatinine concentration in the blood of up to 175 $\mu\text{mol/L}$, diffuse and focal narrowing of retinal arteries. The risk of death from cardiovascular complications in the next 10 years exceeds 20%.
- **Very high-risk group:** This group includes patients with associated diseases (angina pectoris, myocardial infarction, heart failure, acute and transient cerebral ischemia, nephropathy, chronic kidney disease, peripheral vascular disease, retinopathy III-IV degree) regardless of the degree of hypertension, as well as patients with diabetes mellitus with a high normal blood pressure level. The risk of death from cardiovascular complications in the next 10 years exceeds 30%.

Assessment of Overall Cardiovascular Risk:

Framingham Model - Risk of developing cardiovascular complications in the next 10 years:

- Low risk - 15%;
- Moderate - 20%;
- High - 20-30%;
- Very high - >30%.

SCORE Model - Risk of death from atherosclerosis-related diseases over 10 years:

- Low risk - <4%;
- Moderate - 4-5%;
- High - 5-8%;
- Very high - >8%.

Assessment of overall cardiovascular risk

Other risk factors, damage to target organs (DTO) or associated clinical conditions (ACC)	Normal blood pressure (BP) SBP 120-129 or DBP 80-84	High normal blood pressure SBP 130-139 or DBP 85-89	Stage 1 (mild hypertension) SBP 140-159 or DBP 90-99	Stage 2 (moderate hypertension) SBP 160-179 or DBP 100-109	Stage 3 (severe hypertension) SBP ≥180 or DBP ≥110
No risk factors	The usual risk	The usual risk	Low added risk	Moderate additional risk	High additional risk
1-2 risk factors	Low added risk	Low added risk	Moderate additional risk	Moderate additional risk	Very high additional risk
3 risk factors and more or metabolic syndrome or DTO or diabetes	Moderate additional risk	High additional risk	High additional risk	High additional risk	Very high additional risk
ACC	Very high additional risk	Very high additional risk	Very high additional risk	Very high additional risk	Very high additional risk

Recommendations for formulating the diagnosis by Makolkina V.I., in 2000:

1. Disease name - "hypertensive disease" or "essential hypertension." It is considered incorrect to use the term "arterial hypertension" without specifying its origin.

2. Stage of progression - I, II, III according to the WHO classification.

3. Specific indication of target organ damage (left ventricular hypertrophy, retinal angiopathy, cerebral vascular damage, kidney damage).

4. Indication of associated risk factors (hyperlipidemia, hyperuricemia, obesity, hyperinsulinism).

5. Degree of blood pressure elevation.

The degree of blood pressure elevation is indicated for patients with newly diagnosed hypertension, while for others, the achieved level of blood pressure is written.

For hospitalized patients, the degree of blood pressure is indicated at the time of admission.

Examples of diagnoses:

1. **Stage I hypertensive disease.** Blood pressure level 2. Dyslipidemia. Risk level 2 (moderate).

2. **Stage II hypertensive disease.** Blood pressure level 3. Dyslipidemia. Left ventricular hypertrophy. Risk level 4 (very high).

3. **Stage III hypertensive disease.** Achieved blood pressure Level 1. Occlusive atherosclerosis of lower limb vessels. Intermittent claudication. Risk level 4 (very high).

Recommendations of the ESC/ESH for assessing cardiovascular risk in arterial hypertension (2018)

Table №5

Risk of cardiovascular diseases	Presence of Signs
Very high	<ul style="list-style-type: none"> • Coronary Artery Disease (CAD): Acute coronary syndrome, acute myocardial infarction (MI), post-myocardial infarction condition, revascularization of coronary and other vessels. • Ischemic Cerebral Stroke and Transient Ischemic Attack (TIA). • Aortic Aneurysm. • Peripheral Artery Disease. • Angiography or ultrasound detection of significant plaques in coronary and/or carotid arteries ($\geq 50\%$ stenosis) over the next 10 years. SCORE risk $\geq 10\%$ over the next 10 years.
High	<ul style="list-style-type: none"> • Major risk factors (e.g., total cholesterol ≥ 8 mmol/L or blood pressure $\geq 180/110$ mmHg). • Most patients with Type 1 Diabetes, who have a moderate risk (CHQG). • Stage 3 Chronic Kidney Disease (CKD) (glomerular filtration rate 30–59 mL/min/1.73 m²). • 10-Year Risk of Fatal Cardiovascular Events (SCORE): $\geq 5\%$ but $< 10\%$
Moderate	<ul style="list-style-type: none"> • 10-Year Risk of Fatal Cardiovascular Events (SCORE): $\geq 1\%$ but $< 5\%$ • Lower risk; includes Stage 2 Hypertension (HTN). • Many middle-aged patients fall into this category.
Low	<ul style="list-style-type: none"> • 10-Year Risk of Fatal Cardiovascular Events (SCORE): $< 1\%$

PATHOGENESIS

It is known that **blood pressure level** is determined by three **main hemodynamic parameters**:

Cardiac output (CO), which in turn depends on the contractile ability of the left ventricular myocardium, heart rate, the volume of load on the heart, and other factors.

1. Total peripheral vascular resistance (TPVR) - this parameter is closely related to: the tone of smooth muscle vessels (arterioles), the degree of structural changes in their walls, the condition of elastic vessels (large and medium caliber arteries, aorta), arterial pressure, and other parameters.

2. Circulating blood volume (CBV).

An increase in any of these three parameters leads to an increase in blood pressure.

An important pathogenetic link in the development and progression of essential hypertension (EH) is as follows:

- Sympathetic adrenergic system (manifested by α 1-adrenoceptors in the vessels);

- Activation of the renin-angiotensin-aldosterone system (RAAS) (at the level of renal tissue);

- Increased production of mineralocorticoids due to hyperactivation of RAAS in the kidneys (aldosterone, etc.);

- Disruption of ion transport across the membrane (Na^+ , Ca^{2+} , K^+ , N^+);

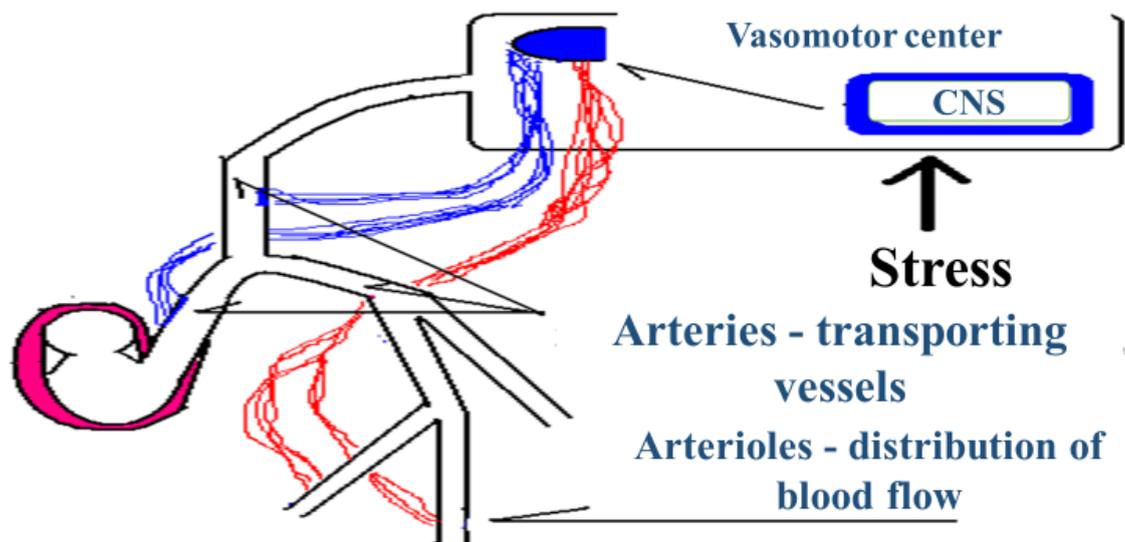
- Renal sodium excretion;

- Endothelial dysfunction: increase in the production of vasoconstrictive substances (tissue angiotensin II, endothelin), decrease in the production of vegetative depressor compounds (bradykinin, NO, EGPF, PGI₂, etc.);

- Structural changes in small and medium-sized arteries (hypertrophy, hyalinosis, etc.);

- Baroreceptors of the central control block regulating blood pressure level.

Neurogenic theory of hypertension formation: under the influence of prolonged psychological trauma, stress in the cerebral cortex and hypothalamic centers, a state of "neurosis" is formed, leading to central circulatory disorders. Also, significant changes in the afferent and efferent links of central regulation, i.e., the influence of pressor and depressor baroreceptors in the area of the aorta and carotid sinus, play an important role in increasing sympathetic activity.



**Pathological changes: - vascular remodeling;
- dilation.**

Figure 1. Neurogenic Theory of Hypertension Formation

Role of Sympatho-Adrenal System (SAS). Arterial hypertension, especially in the early stages of the disease, is often accompanied by pronounced hyperactivation of the SAS - sympathetic hyperactivity, which manifests not only as "cardiovascular neurosis" of the center controlling vascular tone but also as a maladaptation of the circulatory system to normal physiological loads (physical and psychological).

Clear sympathicotonia leads to a series of regulatory disturbances, which in any case affect blood pressure indicators:

- The process involves increased contractility of the left ventricle and increased systolic arterial pressure followed by an increase in cardiac output (systolic arterial pressure).

- Stimulation of noradrenaline α 1-adrenoceptors on arteriolar smooth muscle cells formed in presynaptic clefts leads to increased total peripheral vascular resistance (TPVR) and vascular tone.

- Stimulation of the suprarenal apparatus of the adrenal glands (through β -adrenoceptors) leads to activation of the renin-angiotensin-aldosterone system (RAAS): angiotensin II increases the tone of arterial vessels, and aldosterone retains sodium in the body, leading to an increase in circulating blood volume (CBV).

- Venous constriction occurs under the influence of noradrenaline and increases venous return to the heart, resulting in increased cardiac workload and cardiac output.

Thus, against the background of SAS hyperactivation, the activity of a number of pressor mechanisms controlled by blood pressure increases, namely: cardiac

output, total peripheral vascular resistance, and circulating blood volume.

Activation of the Renin-Angiotensin-Aldosterone System (RAAS).

Activation of RAAS plays a leading role in the development of hypertension (HTN) and its complications, with one of the main influencing factors being hypertrophy of the smooth muscles of the left ventricle and vessel wall. Increased renin secretion in the juxtaglomerular apparatus of the kidneys is due to increased sympathetic impulses and decreased perfusion pressure in the renal vessels. Angiotensin I (AI) is formed from angiotensinogen under the influence of circulating renin, and angiotensin I is converted to angiotensin II (AII), the main component of RAAS, under the influence of ACE (mainly in the lungs, plasma, and kidneys).

Angiotensin's effects include:

- Systemic elevation of total peripheral vascular resistance and muscle artery tone;

- Venomotor activity, venous return to the heart;

- Heart rate increase due to positive inotropic effect;

- Stimulates aldosterone production and retains sodium and water in the body, leading to increased circulating blood volume;

- Stimulates proliferation of cardiomyocytes and smooth muscle. The action of angiotensin II on cardiomyocyte and smooth muscle cells is mediated through angiotensin receptors - AT1 and AT2. As a result of angiotensin II's action on AT1 receptors, its vasoconstrictive property is manifested, and through its action on AT2 receptors, stimulation of cell proliferation occurs via alternative pathways - tissue chymase and some other compounds. It is worth noting that the RAAS system, influenced by circulating AII in the blood, operates as an "endocrine-humoral" system.

RAAS activation in hypertension includes:

- General and renal vasoconstriction;

- Secretion of aldosterone and renal Na⁺ reabsorption;

- Myocardial gamma wave, chronotropic, inotropic effects.

In the development of essential arterial hypertension, the involvement of the tissue renin-angiotensin-endothelial mechanism, regulating regional blood circulation in various vessels, also plays a significant role. Under the influence of angiotensin II, produced in tissues (vascular endothelium), organs, and cells, there is prolonged control of RAAS:

- Local vasoconstriction, resulting in increased total peripheral vascular resistance;

- Thickening of the left ventricular walls;

- Activation of fibroplastic processes in the vascular wall;

- Platelet activation;

- Increased reabsorption in renal tubules. Tissue RAAS is interconnected with other endothelium-dependent pressor and depressor factors and significantly influences the secretion of endothelial bradykinin, NO, and endothelin.

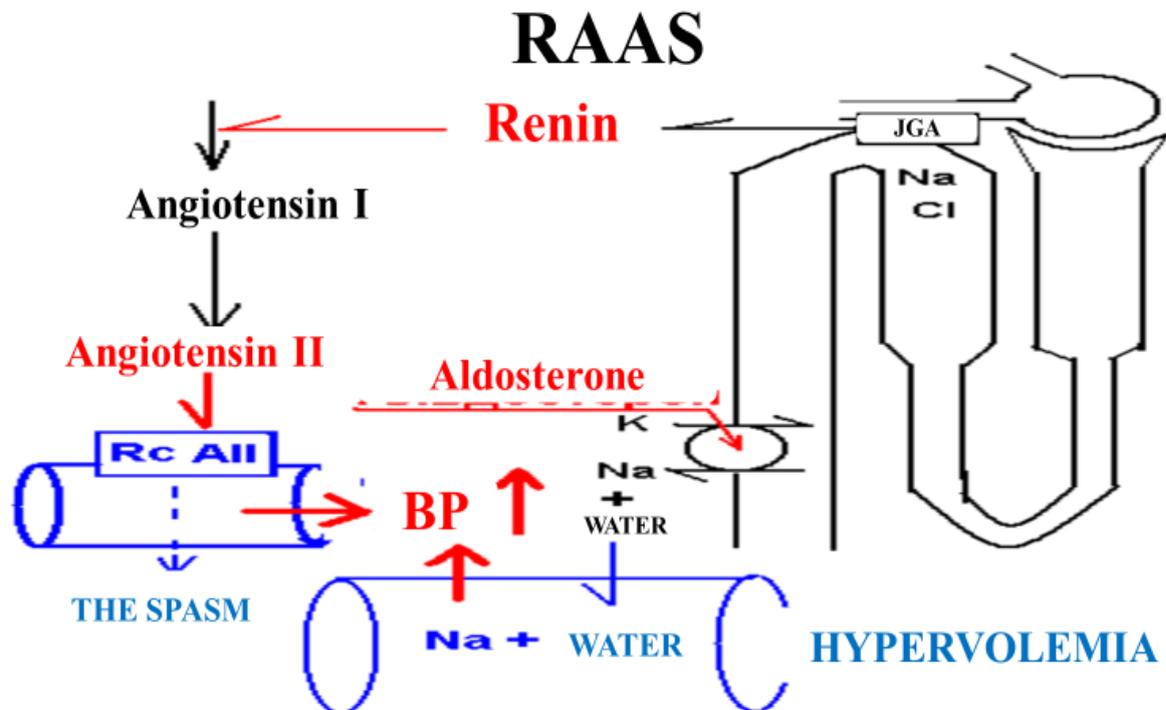


Figure 2. Activation of RAAS in Hypertension.

Role of Mineralocorticoids: Under the influence of aldosterone and other mineralocorticoids (deoxycorticosterone - DOC and corticosterone), produced by the adrenal cortex, Na^+ is reabsorbed through renal tubules and retained in the body. The excess Na^+ in the body leads to increased secretion of vasopressin - antidiuretic hormone (ADH), resulting in reduced diuresis and water retention. Due to sodium and water retention under the influence of hormones:

- Blood pressure increases due to increased circulating blood volume;
- Along with the increase in Na^+ concentration (via the Na^+ - Ca^{2+} exchange mechanism), the amount of Ca^{2+} ions inside the cells increases, leading to a sharp increase in the sensitivity of the vascular wall to normal physiological pressor stimuli (catecholamines and angiotensin II);
- Increased intracellular Na^+ concentration leads to edema and decreased elasticity of the vascular wall, resulting in reduced ability of arteries to dilate upon pulse wave arrival.

Role of Partial Natriuretic Factor: The partial natriuretic factor participates in maintaining the normal extracellular fluid volume by stimulating natriuresis. When sodium excretion through the kidneys is impaired, the activity of the partial natriuretic factor increases, enhancing natriuresis. This mechanism usually occurs

through inhibition of cellular Na⁺-K⁺-ATPase by the natriuretic factor, leading to increased intracellular Na⁺ and, consequently, Ca²⁺ concentration, which in turn increases vascular wall tone and reactivity.

Impairment of renal excretory function may be associated with primary inherited defects in intrarenal hemodynamics and sodium and water retention through the kidneys. Impairment of renal excretory function occurs due to increased tone of afferent arterioles of renal glomeruli (renal hemodynamics is disrupted). As a result, intraglomerular hypertension and hyperfunction of nephrons develop, and to compensate for this process, reabsorption in proximal tubules increases. Therefore, the leading mechanism at all stages of essential hypertension (EH) formation is considered to be impaired Na⁺ and water reabsorption in the kidneys. In the early stages of arterial hypertension, the kidneys are aimed at providing adequate natriuresis and diuresis and perform important compensatory functions aimed at reducing vascular wall tone by activating renal depressor factors (kallikrein-kinin system and prostaglandins).

Over time, pathogenetic mechanisms develop, and the action of these depressor mechanisms becomes insufficient to maintain a normal blood pressure level. Significant structural and functional changes also occur in the kidneys, as a result of which adequate filtration and excretion of sodium and water are provided only at high arterial pressure. Thus, the kidneys become participants in maintaining high blood pressure.

Obesity and Hyperinsulinemia: It is known that adipocytes lose sensitivity to normal physiological stimuli (catecholamines, angiotensin, insulin, sympathetic nervous system effects, etc.) and alter their metabolism. Hyperinsulinemia is accompanied by the following conditions:

- Increased activity of RAAS;
- Activation of RAAS and retention of sodium and water in the body;
- Stimulation of vascular wall proliferation.

Endothelial Dysfunction: Normally, a decrease in blood pressure increases the secretion of suppressor factors (NO, prostacyclin, bradykinin, EGF, etc.), thereby maintaining local satisfaction through compensatory dilation of resistive vessels at the required level. At the same time, the pressor system (central AQP control apparatus, SAS, RAAS) also operates and does not allow blood pressure to drop below normal values.

In pathologies, in response to an increase in systemic arterial pressure, the production of endothelial pressor compounds (endothelin, tissue AII, thromboxane A₂) increases, and, in turn, the secretion of depressor substances (NO, prostacyclin, bradykinin) decreases. As a result, due to local vasoconstriction of resistive vessels and active restriction of local blood flow, the process of adequate blood supply to

vital organs is disrupted.

Accordingly, forms of hypervolemia (volume hypertension) and hypersympathicotonia (increased vascular tone) can be distinguished.

1. For hypervolemic AH:

- Bradycardia, low systolic blood pressure, and high diastolic blood pressure, edema;
- Complaints often correspond to weather changes;
- Intolerance to vasodilators (nitrates, alpha-blockers);
- Due to NSAIDs intake;
- Hypertensive crisis of type II.

2. For hypersympathicotonic AH:

- The onset of the disease (initial AH symptoms correspond to the adolescent period);
- Tachycardia with high SQ;
- Symptoms typical of the autonomic nervous system;
- Excitement due to stress.

Pathogenesis of essential arterial hypertension:

➤ **Inherited factors:**

- Pathology associated with RAAS;
- Endothelin-1 gene polymorphism;
- Na⁺ and Ca⁺⁺ ion transport through membranes disruption;
- Insulin resistance;
- Number of nephrons decrease;
- Sodium excretion decrease.

➤ **External factors:**

- Salt consumption;
- Sa and Mg in the diet;
- Smoking;
- Alcohol abuse;
- Obesity;
- Psycho-emotional stress;
- Hypodynamia.

Target Organ Damage:

1. Changes in the heart caused by hypertension:

Considering the accuracy and high frequency of heart changes observed in hypertension (in 50% of patients), medical parlance includes terms such as "hypertensive heart disease" and "hypertensive heart," encompassing all morphological and functional changes in the heart.

E.D. Frolich (1987) categorized these changes into 4 stages:

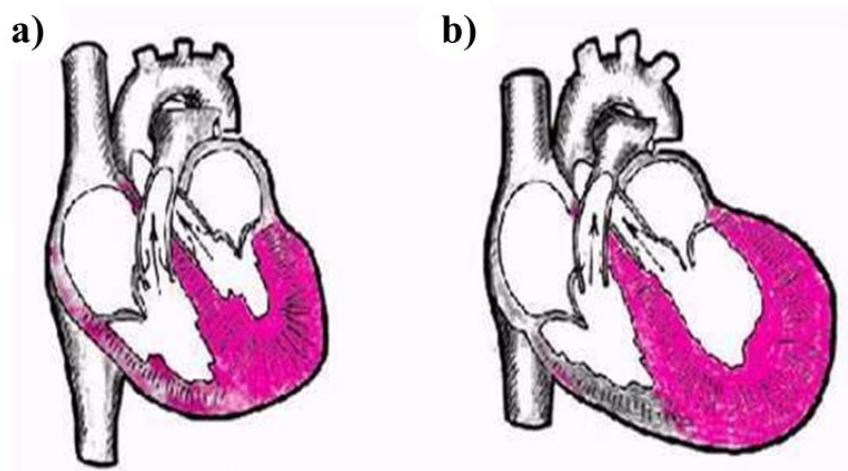
Stage I - No pronounced changes in the heart, but diastolic dysfunction is observed during echocardiography (EchoCG). Diastolic dysfunction of the left ventricle develops earlier than systolic dysfunction and is an independent risk factor for the development of heart failure.

Stage II - Left ventricular enlargement (based on changes in EchoCG and ECG).

Stage III - Left ventricular hypertrophy (ECG, EchoCG, X-ray). Left ventricular hypertrophy is one of the most common changes in the heart with hypertension, and this cardiac lesion is a sign of negative consequences, i.e., dangerous complications in the vascular system (myocardial infarction) compared to patients with hypertension without left ventricular hypertrophy. Ventricular hypertrophy increases the risk of myocardial infarction and stroke by 4 times, and the risk of death from cardiovascular diseases triples. In untreated patients with pronounced hypertension and left ventricular hypertrophy, the risk of death in the next two years is 20%.

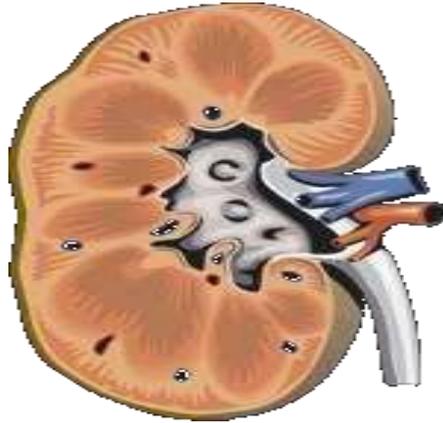
- EchoCG is one of the effective methods for detecting left ventricular hypertrophy. According to EchoCG data, left ventricular hypertrophy is observed in more than 50% of patients with hypertension.
- Radiological examination cannot provide sufficient information; only obvious left ventricular hypertrophy and cavity dilation can be determined.

Stage IV - Development of heart failure, sometimes characterized by the appearance of coronary artery disease. Heart failure is the "classic" consequence of hypertension, inevitable and even fatal. Therefore, it is important to know the clinical manifestations of heart failure and methods for its early detection. Coronary artery disease can occur not only as a result of coronary artery involvement but also due to microvascular pathology.



Concentric (a) and eccentric (b) left ventricular hypertrophy in hypertension.

2. Renal involvement in hypertensive disease:



Treatment of hypertension involves the kidneys playing one of the primary roles, as vasoactive substances are synthesized through them. The renal function can be assessed in arterial hypertension based on the glomerular filtration rate (GFR). In uncomplicated hypertension, the GFR is usually normal. However, in overt and dangerous hypertension, the glomerular filtration rate significantly decreases. Persistent high pressure in the glomerular vessels leads to changes in the glomerular membrane. Additionally, due to prolonged maintenance of blood pressure at a high level, there is narrowing of the renal arteries, resulting in ischemia of the proximal convoluted tubules and their dysfunction, eventually leading to damage to the entire nephron.

Hypertensive nephrosclerosis is one of the complications characteristic of hypertension, manifested by a decrease in renal excretory function. The main predisposing factors leading to the development of nephrosclerosis include:

- Aging
- Male gender
- Glucose intolerance

In arterial hypertension, one of the main indicators indicating renal involvement in the pathological process is an increase in the level of creatinine in the blood and the amount of protein in the urine. The increase in creatinine concentration in the blood is directly proportional to the level of blood pressure and the subsequent risk of developing cardiovascular diseases. High creatinine clearance indicates glomerular hyperfiltration and serves as a clinical marker for the early stages of hypertensive kidney damage. Microalbuminuria, where the amount of protein excreted in the urine is 300 mg per day (proteinuria), is also significant.

3. Changes in blood vessels in arterial hypertension

Elevated peripheral vascular resistance plays a leading role in maintaining high blood pressure. Blood vessels are one of the target organs in arterial hypertension. Damage to small-caliber arteries of the brain (occlusion and

microaneurysms) leads to stroke, while damage to renal arteries leads to kidney function loss. The detection of hypertensive retinopathy in the eye (in ophthalmoscopy) is more important than determining the prognosis of the disease. Four stages of hypertensive retinopathy are distinguished:

- Stage I: slight arteriolar dilatation, angiosclerosis
- Stage II: marked arteriolar constriction, absence of retinopathy
- Stage III: angiospastic retinopathy ("cotton wool" spots), coagulation, and hemorrhage
- Stage IV: optic nerve edema and significant nerve constriction.

In ophthalmoscopy, retinal arteries and arterioles have a more straight-line orientation and usually appear as arteriovenous connections. In retinopathy, the walls of the arteries thicken, pressing on adjacent veins at crossing points, narrowing their space. In many cases, especially in elderly individuals, arterioles become pale (silver-wire symptom), while veins become tortuous and dilated (Gunn sign). The widening of veins at distal arteriovenous junctions indicates the development of hypertension. In the advanced stages of retinopathy, blood leaks onto the fundus and exudates appear. Sudden elevation of diastolic blood pressure can lead to retinal infarctions, manifested in ophthalmoscopy as small cotton wool-like spots (cotton wool exudates), and neovascularization of the optic nerve and retina can also be observed. In dangerous arterial hypertension, a hard star-shaped exudate develops in the macular area, accompanied by optic nerve edema.

DIAGNOSIS

To make an accurate diagnosis for the patient, the doctor will need to conduct several laboratory tests and diagnostic procedures. The goal of diagnosis is to determine the stage of the disease and the degree of hypertensive illness. With this information, the doctor can select an effective treatment method. Since the initial stages of the disease are often hidden, most patients seek medical attention late. Completely curing the disease is very difficult, so patients need to be patient, as the disease may accompany them for the rest of their lives. Therefore, it is necessary to prevent the disease in time and undergo examination by a doctor when suspicious symptoms appear. Diagnosis is nonspecific and depends on the degree of target organ damage. When examining a patient with arterial hypertension, it is necessary to rely on clinical diagnostic principles applied in any disease, i.e., starting from simple to complex diagnostic methods. In arterial hypertension, diagnostic measures are carried out with the following objectives:

- determination of possible causes of hypertension (correct diagnosis determines the further treatment tactics for the patient).
- diagnosis of concomitant diseases (medications used in the treatment of hypertension may affect the course of comorbidity, or comorbidity itself may affect

the course of hypertension).

- identification of additional risk factors for ischemic heart disease. Hypertension itself is considered a risk factor for cardiovascular diseases, and identifying additional risk factors increases the likelihood of disease. Moreover, the prescribed treatment can have a significant impact on risk factors (for example, the use of diuretics and β -blockers against the background of insulin resistance and dyslipidemia can further exacerbate these disorders).

- determination of whether the pathological process has spread to target organs, as their involvement worsens the course and prognosis of hypertension. When assessing the clinical picture of primary arterial hypertension, the doctor should carefully analyze the following conditions:

- anamnestic data and subjective manifestations of the disease;
- objective examination results;
- results of instrumental studies;
- determination of the presence of risk factors for cardiovascular diseases;
- determination of the level of damage to target organs;
- determination of the risk group
- exclusion of secondary arterial hypertension.

Clinical Picture

Complaints: headache, dizziness, fainting when walking, nausea, appearance of "stars" before the eyes, darkening in the eyes, sharp pains in the heart area, palpitations, blurred vision, rapid fatigue, ringing in the ears or tinnitus, nasal bleeding irritates. In some patients, despite high blood pressure, patients may not complain.

Headaches usually start in the morning after waking up and can occur throughout the day or at the end of the day due to emotional and physical stress. The location of the headache also varies - neck (predominantly), temples, forehead, crown; sometimes patients cannot determine the exact localization of the headache. many patients associate headaches with adverse climatic conditions. The intensity of the headache also varies, i.e., it can range from mild headaches like heaviness in the head (typical for most patients) to relatively severe pains. Some patients complain of severe pressing or pressing pains in different areas of the head.

Approximately 40-50% of patients with primary arterial hypertension have neurotic disorders - emotional lability (unstable mood), irritability, tearfulness, depression, rapid fatigue, often - asthenic and hypochondriacal syndrome, depression, and cardiophobia. 17-20% of patients complain of chest pain. usually, these pains have moderate intensity, are predominantly localized in the area of the apex of the heart, and are associated with emotional rather than physical stress.

13-18% of patients complain of palpitations (sinus tachycardia, less often paroxysmal tachycardia), irregular heartbeats (extrasystolic arrhythmia).

Some patients complain of visual disturbances (flashes of particles before the eyes, circles, spots, and haze), and with a severe course of the disease, vision gradually disappears. the above visual complaints are explained by retinopathy and hypertensive retinopathy.

In addition, most patients are concerned about nonspecific symptoms such as general weakness, rapid fatigue, decreased mental and physical performance.

Patient interviews should focus on clarifying the following important points:

- Family history associated with hypertension, diabetes mellitus, lipid metabolism disorders, cvd, stroke, kidney disease;
- Detailed information on the duration of hypertension, previous blood pressure levels, results, and side effects of antihypertensive drugs used so far, antihypertensive drugs - oral contraceptives, nonsteroidal anti-inflammatory drugs (nsaids), amphetamines, erythropoietin, cyclosporine, information on glucocorticosteroids;
- This patient has been diagnosed with chd, heart failure, stroke, and other pathological processes (gout, dyslipidemia, erectile dysfunction, kidney pathology, bronchospastic syndrome);
- Identification of secondary hypertension symptoms;
- Lifestyle assessment (salt, fat, alcohol intake, quantity, smoking, lack of mobility), personal, psychosocial factors, and environmental factors affecting blood pressure.

Objective examination of patients:

Examination. In patients with uncomplicated primary arterial hypertension, there are no other characteristic changes besides excess body weight (in 30-40% of patients).



Figure 3. Signs of Visceral Obesity

Waist circumference (in the standing position) >102 for men, >88 for women. In patients with uncomplicated primary arterial hypertension, other characteristic changes besides excess body weight (in 30-40% of patients) are usually absent. With evident hypertrophy of the left ventricle and left ventricular dysfunction, signs of insufficiency may develop: acrocyanosis, edema in the heel and calf area, shortness of breath, severe heart failure - ascites may even be observed.

During examination of patients with arterial hypertension, palpation of peripheral arteries is of great importance, on the one hand, for the diagnosis or prediction of the onset of atherosclerotic processes in the arteries, and on the other hand, it informs about the possibility of arterial hypertension being associated with arterial damage. In the area of the inner edge of the scapular muscle, and the bifurcation of the common carotid artery is palpated at the intersection of the line from the upper edge of the thyroid gland to the edge of the scapular muscle. The temporal artery is palpated in the temple area. With atherosclerotic lesions or inflammation of the arteries, they become rough, nodular, and pink. Clear decrease in pulsation in the area of the carotid artery indicates their damage. The brachial artery is palpated in the antecubital and subclavian grooves, the brachial artery - on the inner part of the elbow bend. The brachial artery is easily palpable. Not only the quantity but also the rhythm, size, and condition of the artery walls (in both arteries simultaneously) can be determined. Tense and hard pulse is characteristic of arterial hypertension.

It is desirable to auscultate the abdominal aorta, carotid, subclavian, renal, and iliac arteries. The abdominal aorta can be auscultated along the midline of the abdomen or from the costal arch slightly below the navel to the navel. Renal arteries can be auscultated along the outer edge of the rectus abdominis muscle at a distance from the costal arch to the navel. Auscultation of the common iliac arteries is performed along a line drawn from the navel to the inner edge of the middle 1/3 of the inguinal ligament. Normally, two tones are heard above the aortic arch, common carotid, and subclavian arteries. Only one tone is heard above the abdominal aorta, common iliac, and femoral arteries. Stenotic murmurs are heard during auscultation with arterial stenosis. In hypertensive and antihypertensive hypertension resistant to treatment, a systolic murmur heard on auscultation in the projection of the renal arteries is an important diagnostic sign indicating the obvious development of the atherosclerotic process in the renal arteries.

Heart examination. The development of left ventricular hypertrophy is characteristic of arterial hypertension. It is manifested by the expansion of the left half of the heart when dilation of the left ventricular cavity is accompanied by peak cardiac output. On auscultation over the aorta (with prolonged course of the disease), a systolic murmur and accentuation of the II tone are heard. A systolic murmur

between the II ribs is observed during hypertensive crisis and atherosclerotic lesions of the aorta.

Pathological IV tone appears with pronounced hypertrophy of the left ventricular myocardium. Its appearance is explained by active contraction of the left ventricle against the background of high diastolic pressure in the left ventricular cavity and impairment of the myocardial relaxation process during diastole. Usually, the IV tone is low, so it is rarely heard on auscultation; it is often detected during phonocardiography. With evident dilation of the left ventricle and impairment of its contractile function at the apex of the heart, III and IV tones (simultaneously) and a systolic murmur associated with mitral regurgitation are heard.

For the malignant syndrome of arterial hypertension, the following are characteristic:

- Paleness of the skin;
- Blood pressure 240/130-300/170 mm Hg and higher;
- Retinopathy of III-IV degree (hemorrhagic retinopathy);
- Rapid deterioration of the patient's general condition, rapid development of organic changes in the arteries of the brain, heart, and kidneys;
- In the blood, neutrophilic leukocytosis, increased ESR, moderate thrombocytopenia, severe anemia;
- Progressive renal failure;
- In the urine analysis, proteinuria, hematuria, cylindruria, isostenuria, increased levels of residual nitrogen, creatinine, and indican in the blood.

Measurement of arterial pressure (BP):

One of the most important symptoms of arterial hypertension is undoubtedly the elevation of arterial pressure. Measuring BP is the main method for studying arterial hypertension.



Figure 4. Measurement of Blood Pressure

Conditions and rules for measuring blood pressure:

- The examination should be conducted after the patient has arrived for the appointment with the doctor and has fully relaxed (a walking patient should rest for at least 5 minutes). For 30 minutes before the examination, the patient should not eat, drink coffee, alcohol, smoke, or engage in sports. During the examination, support for the arms is necessary, i.e., the examined arm rests on the table, legs are not crossed, both feet touch the floor, the patient leans on the back of the chair, and the bladder should be emptied before the examination. Failure to comply with these rules may lead to elevated blood pressure readings.

1. Blood pressure should be measured at rest, after 5 minutes of rest (after 15-30 minutes if there was previous physical or mental stress).

2. During the measurement, the subject should be in a comfortable position, with arms extended on the table or lying on the bed with palms up.

3. Before measuring the pressure, the pointer of the sphygmomanometer should be at the 0 mark.

4. The cuff of the sphygmomanometer should be wrapped 2 cm above the bare elbow joint to the level of the heart; clothing should not compress the area above the cuff.

5. Before inflating the cuff of the sphygmomanometer, it is necessary to determine the pulse in the axillary area and apply the stethoscope to this area.

6. It is necessary to tightly close the airbag valve, squeeze the bag several times in a row, direct air into the manometer, and continue this process until the pressure rises to 30 mmHg after the pulse disappears in the elbow joint.

7. After that, the air in the cuff is slowly released to the level of 20 mmHg within 1 second, and at the same time, using the stethoscope, the tones of the brachial artery above the elbow pit are listened to.

8. The appearance of the first murmuring sound (tones) above the brachial artery (1st stage) indicates elevated arterial pressure (systolic).

9. The disappearance of the last pulsating sound (tones) in the wrist of the brachial artery (2nd stage) indicates a decrease in the level of arterial pressure (diastolic).

10. Blood pressure should be measured at least 2 times with a break of 1-2 minutes, and more if the indicators significantly differ from each other; they should be measured 3 or 4 times and the "average" recorded in the observation book.

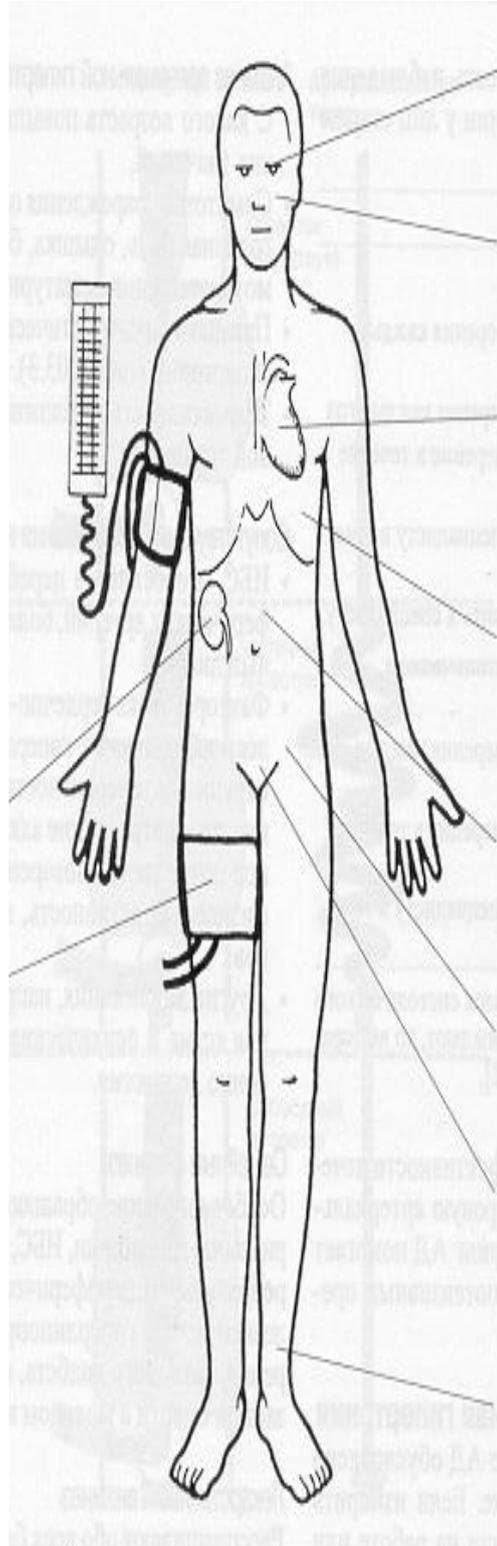
During the initial examination, blood pressure is measured on both arms, then it is measured again on the same arm where it is higher. In the norm, the difference in blood pressure between the right and left arms does not exceed 5 mmHg. A greater difference may indicate pathology in the arterial vessels of the arms. Repeat measurement is also carried out in the same order and conditions. In elderly

individuals, patients with diabetes mellitus, and those receiving peripheral vasodilators, it is advisable to measure blood pressure in two different positions (lying down and sitting) (to determine the presence of orthostatic arterial hypotension).

- **Murmur over the carotid arteries**
- **Jugular vein distension**
- **Blood Pressure in the Arms:**

Should be measured at least twice while seated (on both arms) and while standing

- **Kidneys:**
Murmur over the renal arteries (heard during epigastric auscultation)
Kidney enlargement
- **Blood Pressure in the Legs**
- **Height and Weight:**
Obesity (calculate body mass index)



Ophthalmoscopy (Fundus of the Eye):

- Hemorrhages
- Exudation
- Arteriovenous crossing
- Optic disc edema

Face:

- Redness
- Puffiness
- Signs of alcohol abuse

Heart:

- Diffuse, increased apical impulse
- Arrhythmias
- Third and fourth heart sounds

Lungs:

- Rales in left ventricular failure
- Wheezing in bronchospasm

Abdomen:

- Enlargement and pulsation of the abdominal aorta
- Murmur over the abdominal aorta
- Hepatomegaly

Femoral Artery

Pulsation:

- Asynchronous pulse between the femoral and radial arteries

Urinalysis:

- Glucosuria
- Proteinuria
- Hematuria
- Leukocyturia
- Cylindruria

Figure 5. Scheme of physical examination for arterial hypertension.

LABORATORY INVESTIGATIONS:

To distinguish uncomplicated arterial hypertension from symptomatic arterial hypertension, identify risk factors, and changes in target organs, the following laboratory investigations are conducted:

- Complete blood count: anemia, erythrocytosis, leukocytosis, accelerated ESR - secondary symptoms of AH.

- Urinalysis is performed to determine the presence of leukocyturia, erythrocyturia, proteinuria (symptomatic arterial hypertension), glucosuria (diabetes mellitus).

- In the biochemical analysis of blood, potassium, creatinine, glucose, cholesterol level, lipid profile (HDL, LDL, triglycerides), uric acid concentration, hormones (catecholamines in urine, aldosterone content) are determined to exclude secondary arterial hypertension and identify risk factors. It should be remembered that in a patient with long-standing AH (regardless of etiology), a decrease in blood pressure leads to an increase in the level of creatinine in the blood.

Instrumental diagnostic methods:

Electrocardiography (ECG)

On the ECG, left ventricular hypertrophy, rhythm and conduction disturbances, signs of heart failure, and electrolyte disturbances can be detected.

ECG signs of left ventricular hypertrophy in arterial hypertension:

- 1) Increase in the amplitude of the R wave in the left chest leads (V5, V6) and in the right chest leads (V1, V2) by the amplitude of the R wave. Here $RV_4 < RV_5$ or $RV_4 < RV_6$; $RV_{5,6} > 25$ mm or $RV_{5,6} + SV_{1,2} \geq 35$ mm (40 in elderly patients, on ECG) and ≥ 45 mm (in young patients, on ECG) or $RaVL + SV_3 > 28$ mm in men and > 20 mm in women.

Sokolow-Lyon index: $RV_{5,6} + SV_{1,2} \geq 35$ mm (in patients over 40 years old) and ≥ 45 mm (in patients under 40 years old). The specificity of the Sokolow-Lyon index is 100%, but the sensitivity does not exceed 22%.

Cornell voltage index: $RaVL + SV_3 > 28$ mm in men and $RaVL + SV_3 > 20$ mm in women. The sensitivity of this index is higher than that of the Sokolow-Lyon index (42%), and the specificity is 96%.

- 2) Leftward deviation of the electrical axis:

- a) Transition zone to the right - V2 is displaced;

- b) High R wave in V5, V6;

- c) In the left chest leads (V5, V6). Sudden decrease or loss of S wave amplitude.

- 3) Leftward shift of the electrocardiogram, where $RI \geq 15$ mm, $RaVL \geq 11$ mm, or $RI + R_{III} \geq 25$ mm.

- 4) ST segment depression below the isoelectric line in leads V5, V6, I, aVL or formation of a negative or biphasic (—+) T wave in leads I, aVL, V5, V6.

5) Prolongation of the QRS interval in the left chest leads (V5, V6).
Lengthening (more than 0.05 s).

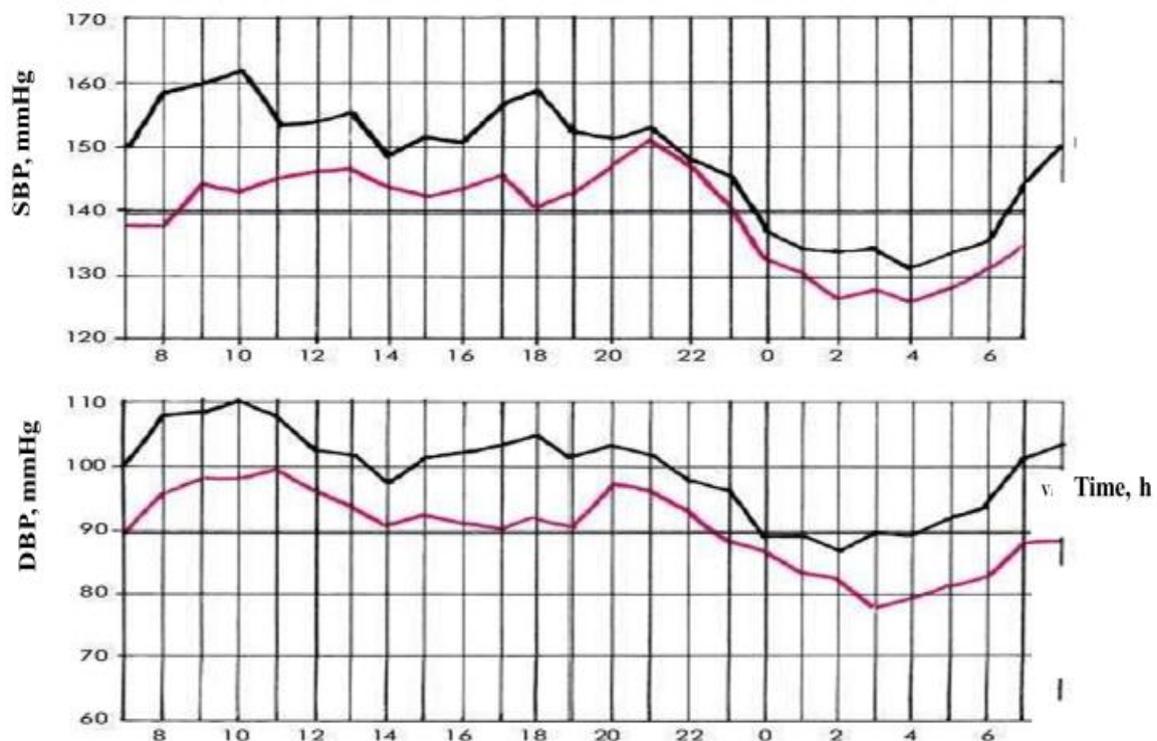
24-hour blood pressure monitoring (24h BPM)

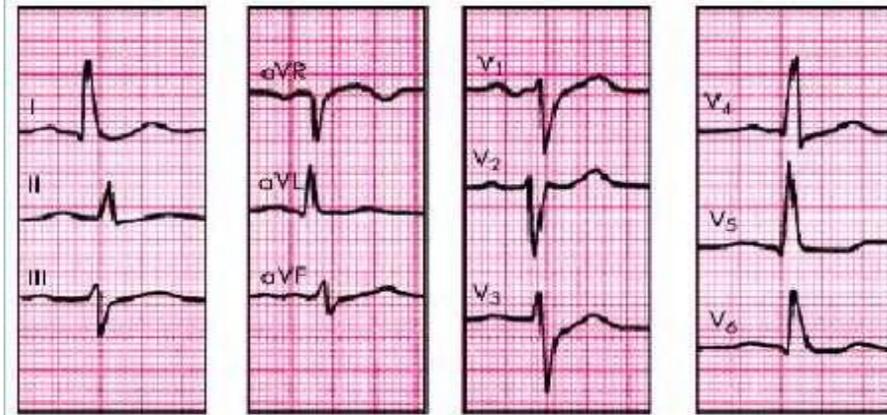
Concepts:

1. System of automatic blood pressure monitoring to determine the dynamics of pressure changes over a prolonged period of time;
2. Determination of the etiology and pathogenesis of arterial hypertension;
3. Assessment of key hemodynamic parameters in emergency situations;
4. Used for selecting individual medications for patients with arterial hypertension.

Daily blood pressure performance is assessed based on several quantitative indicators:

- Mean daily systolic blood pressure (MSBP);
- Mean daily diastolic blood pressure (MDBP);
- Daily maximum SBP (Max SBP);
- Daily maximum DBP (Max DBP);
- During daytime and evening hours;
- The "daily pressure load" is 140/90 mmHg relative to the total number of measurements, expressed as a percentage.



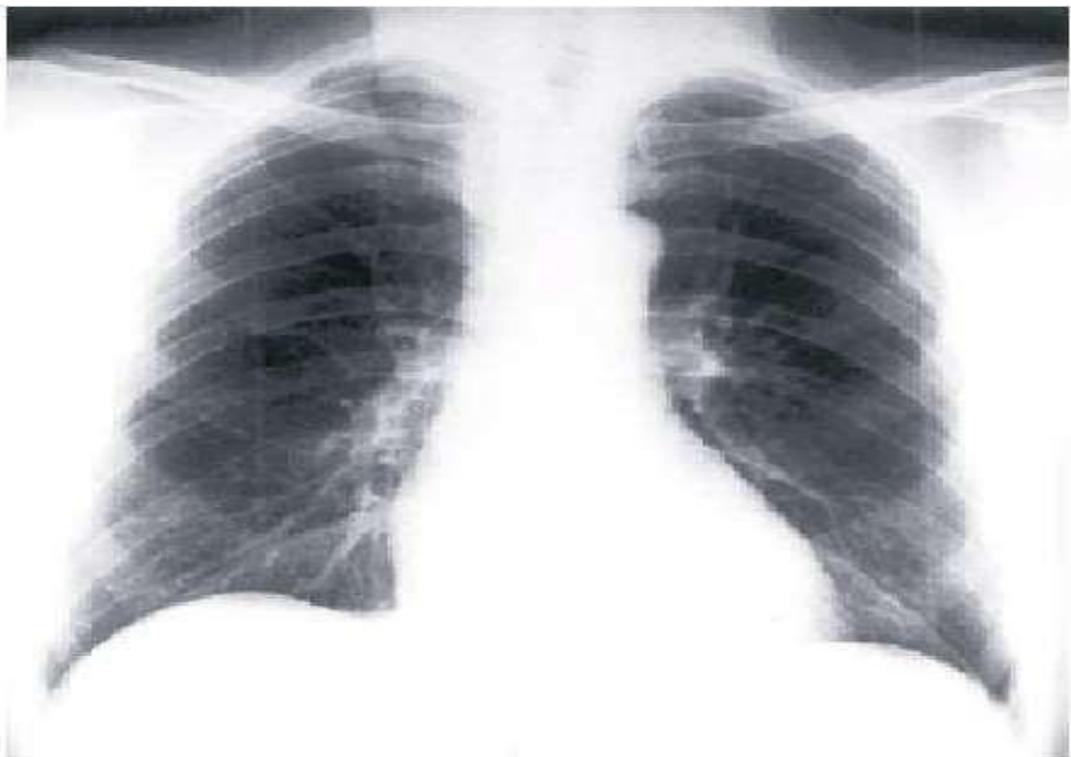


ECG signs of left ventricular hypertrophy

Echocardiography (EchoCG)

Echocardiography is performed to assess myocardial contractility, detect left ventricular hypertrophy, valve defects causing arterial hypertension.

X-ray examination - radiographic examination in patients with hypertension allows evaluating the degree of left ventricular hypertrophy, and in patients with chronic heart failure - identifying signs of pulmonary arterial hypertension and attenuation in the pulmonary circulation.



Hypertrophy and dilatation of the left ventricle

Ultrasonic examination: To identify secondary arterial hypertension, ultrasound examination of the veins, kidneys, adrenal glands, and renal arteries should be performed.

Ophthalmoscopy of the fundus of the eye is the most informative method for determining the degree of retinal vessel changes. In patients with hypertension, the following changes are usually detected:

1. Constriction of retinal arterioles
2. Dilation of retinal veins.
3. Specific changes at the intersections of veins with arteries.
4. Hypertensive retinopathy

Changes in the fundus of the eye in hypertension:

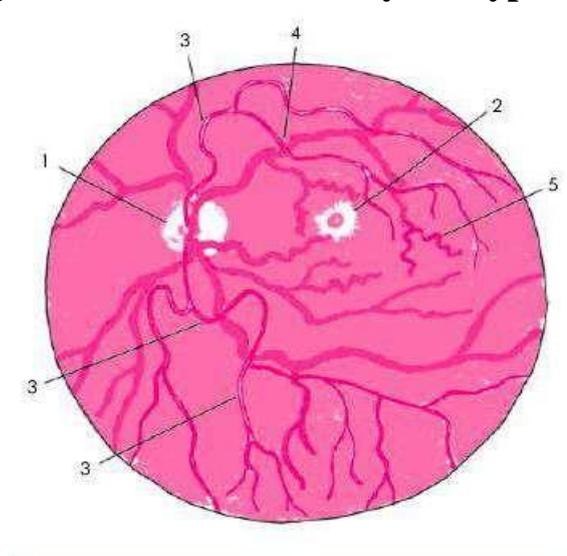


Figure 6. 1. Optic nerve disc; 2. Macula; 3. "Copper wire" symptom; 4. Arteriovenous crossing sign (Salus II); 5. Tortuous veins in the macular area (Gustav's sign).

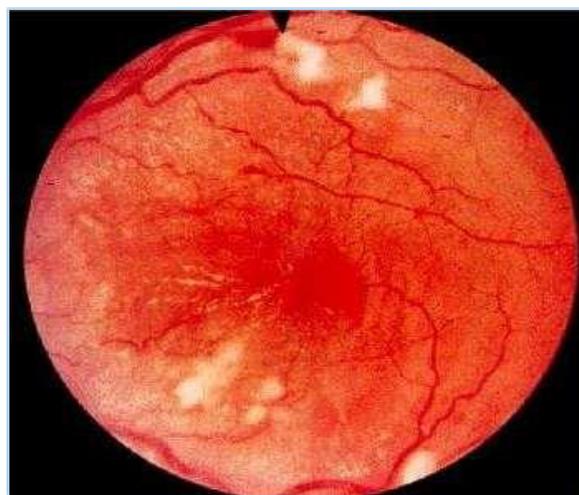


Figure 7. Hypertensive retinopathy: "cotton wool spots" on the retina, narrowed arteries

PRACTICAL PART

Table No. 6

Order processing	Activity Algorithm		Signs and Symptoms
	Sequence of operations	Action	
1.	Identification of passport data	Inquiry	Age, nationality, occupation, place of residence
2.	Identification of complaints for characteristic of the disease.	Inquiry	Headache, dizziness, chest pain, ringing in the ears, nausea, vomiting.
3.	Inquiry and collection of medical history	Inquiry	Risk factors - hypercholesterolemia, diabetes mellitus, obesity.
4.	Inquiry and collection of life history	Inquiry	Association with stress. Genetic predisposition. Consumption of large amounts of salty and fatty foods. Sedentary lifestyle. Harmful habits.
5.	Assessment of general condition	Examination	General condition is severe, paleness of the skin, obesity.
6.	Objective examination	Physical examination methods	On palpation: apex beat of the heart is displaced 1 cm to the left. On percussion: relative boundaries of the heart are displaced 1 cm to the left. On auscultation: heart sounds are muffled, second heart sound is accentuated in the aorta. Systolic murmur, not associated with the first heart sound during auscultation. Bradycardia. Blood pressure - 220/115 mmHg.
7.	Examination plan	Clinical reasoning	Complete blood count and urinalysis are normal. ECG: Sinus rhythm, heart rate - 59, left axis deviation, signs of left ventricular

			hypertrophy.
8.	Formulation of diagnosis	Clinical reasoning	Clinical Diagnosis Rationale
9.	Differential diagnosis	Clinical reasoning	Symptomatic arterial hypertension.
10.	Treatment	Clinical reasoning	<ol style="list-style-type: none"> 1. Diet (restriction of salt). 2. Healthy lifestyle. 3. ACE inhibitors. 4. Diuretics. 5. Beta-blockers. 6. Calcium antagonists. 7. Angiotensin receptor blockers.

Control Questions:

1. Etiology of hypertension.
2. Risk factors for hypertension.
3. Risk stratification.
4. Classification of hypertension.
5. Pathogenesis of hypertension.
6. Clinical manifestations of hypertension.
7. Objective examination of a patient with hypertension.
8. Laboratory diagnostics of hypertension.
9. Instrumental diagnostics of hypertension.
10. ECG signs of left ventricular hypertrophy.

"White coat" hypertension and "masked" hypertension

Diagnosis of "white coat" hypertension is established for a patient who is not receiving treatment and who shows an increase in blood pressure during visits to the doctor, but normal blood pressure values according to ambulatory blood pressure monitoring (ABPM) or home blood pressure monitoring (HBPM), or both of these methods. According to research results, "white coat" hypertension is found in 30-40% of patients (and in >50% of the elderly) with high office blood pressure. Its frequency increases with age, it is more common among women, as well as among non-smoking patients. In "white coat" hypertension, the difference between the

maximum office blood pressure value and the minimum value obtained during out-of-office measurements is called the "white coat effect," which is presumably due to the pressor effect associated with the presence of a doctor or nurse during office blood pressure measurement, but other factors may also influence it. There is evidence that the "white coat effect" may be observed in patients with any degree of hypertension (including resistant hypertension), but the prevalence of "white coat" hypertension is highest in the group of patients with grade 1 hypertension. Organ damage in hypertension is less common in patients with "white coat" hypertension than in those with sustained hypertension, which indicates that the cardiovascular risk associated with "white coat" hypertension is also lower than that with sustained hypertension.

"Masked hypertension" is diagnosed in a patient not receiving treatment, who has normal office blood pressure readings, but elevated readings according to ABPM or HBPM. It differs from "true normotension" and "sustained hypertension." The term "true normotension" is considered when both office and out-of-office blood pressure values are normal, while "sustained hypertension" is when all values are elevated. Although the terms "white coat" hypertension and "masked" hypertension were originally proposed for patients not receiving antihypertensive therapy, they are now used to describe the discrepancy between office and out-of-office blood pressure values.

CHAPTER II

HYPERTENSIVE CRISIS

Complications of arterial hypertension include hypertensive crisis, acute cerebrovascular accident (hemorrhagic or ischemic), myocardial infarction, nephrosclerosis (primary renal enlargement), heart failure, collapsing aortic aneurysm, etc.

A hypertensive crisis (HC) is a sudden increase in systolic and/or diastolic blood pressure to individually high levels, accompanied by the appearance or worsening of cerebrovascular, coronary, and renal circulation disorders, as well as pronounced autonomic nervous system dysfunction.

MAIN KEY POINTS:

1. Lack of strict quantitative blood pressure parameters (the degree of relative increase in blood pressure in a given patient)
2. Symptomatic increase in blood pressure - a circle of symptoms of target organ damage is clearly outlined and determines the management tactics for patients
3. Controlled blood pressure reduction is not necessarily to normal levels. A differentiated approach to blood pressure reduction depending on the specific clinical situation, taking into account the potential risk of hypotension and hypoperfusion with overly aggressive therapy.

EPIDEMIOLOGY

Before the era of antihypertensive treatment, hypertensive crises developed in approximately 7% of patients. In the United States, up to 500,000 cases of hypertensive crisis are registered annually. In Italy, 25% of all intensive care unit admissions are due to hypertensive crisis. In Russia, 20% of cases were diagnosed with hypertensive crisis per year.

Predisposing factors:

1. Psychoemotional situations;
2. Intensive physical stress;
3. Prolonged stressful work without rest, associated with great responsibility;
4. Intake of a large amount of fluid and salty food the day before;
5. Significant changes in meteorological conditions. An increase in hypertensive crises has been noted with an increase in UV solar radiation, magnetic storms are important;
6. Exposure to acoustic and light stresses (loud noise, light, noise), leading to sensory overload;
7. Alcohol abuse, excessive consumption of coffee, intense smoking;
8. Consumption of varieties of cheese containing tyramine;

9. Excessive mental stress accompanied by lack of sleep and not alternating with active rest;
10. Sudden withdrawal of beta-blockers;
11. Treatment with glucocorticosteroids, tricyclic antidepressants (amitriptyline), sympathomimetics, NSAIDs;
12. Dysfunction of the hypothalamus, decreased adaptive capabilities of the CNS in young people and in women during menopause.

In some cases, it is possible to identify the direct causes of hypertensive crisis:

1. Acute psychoemotional trauma;
2. Acute physical stress;
3. Acute alcohol load;
4. Intensive sun exposure;
5. Acute allergic reaction;
6. Acute intercurrent respiratory tract infection;
7. Acute urinary retention;
8. Severe head injury;
9. Extensive burns;
10. Surgical stress;
11. Repeated episodes of cerebral ischemia in the elderly, for example, morning hypertensive crises with an uncomfortable head position during sleep.

PATHOGENESIS

1. Hyperactivation of the sympathetic nervous system and consequent increase in norepinephrine concentration at sympathetic nerve endings innervating resistance vessels, leading to increased arteriolar tone.
2. Increased production of thromboxane and endothelin by the endothelium, decreased production of nitric oxide and prostacyclin.
3. Increased secretion of vasopressin by the hypothalamus.
4. Acute or chronic retention of sodium and water in the body, including in the arteriolar wall.
5. Activation of the calcium mechanism in smooth muscle cells.
6. Activation of the renin-angiotensin-aldosterone system (RAAS).
7. Direct toxic effect of angiotensin II on the endothelium, mediated by the proinflammatory cytokine IL-6 and cell adhesion molecules, endothelial damage, development of fibrinoid necrosis of arterioles.
8. Activation of platelets and blood clotting factors.

Conditions mimicking hypertensive crisis: systemic lupus erythematosus,

systemic vasculitis, brain tumor, head injury, post-seizure state, encephalitis, use of sympathomimetics - cocaine, ephedrine, acute porphyria, hypercalcemia, acute excitement during hyperventilation.

DIAGNOSTIC CRITERIA:

1. Relatively sudden onset - 5-6 times more common in women, more often in the afternoon.

2. Individually high blood pressure level, DBP >120-130 mmHg, SBP >200-230 mmHg, individual blood pressure level with a threshold of encephalopathy, depending on the mechanism of cerebral blood flow regulation.

3. Systolic hypertensive crisis - SBP 220-230 mmHg, with DBP of 60-90 mmHg, more common in elderly patients with severe atherosclerosis of the aorta, aortic coarctation, aortic valve insufficiency.

4. Systolic-diastolic hypertensive crisis - more common, increase in DBP and SBP.

5. Various degrees of cardiac dysfunction - ischemic heart disease, arrhythmias, left ventricular hypertrophy, pulmonary edema.

6. Marked ophthalmological signs (subjective signs of fundus changes) - fog, haze, floaters, arteriolar spasm, venule dilation, optic nerve head edema, hemorrhages, sometimes retinal detachment.

7. Newly occurring or aggravated renal dysfunction, azotemia.

The two main diagnostic criteria for hypertensive crisis are a sudden increase in blood pressure and CNS dysfunction - probable crisis, plus other criteria - definite crisis.

Classification according to J. Laragh 2001 (USA):

1. Renin-angiotensin crises.

2. Sodium-volume-dependent crises with high RAAS activity of more than 0.65 ng/mL/h.

Koch-Vezer classification (JNC6-1997-2003, WHO-MOG 1999; DAG1 2000):

Type I crisis - complicated ("critical hypertension"), urgent, life-threatening crisis:

- significant increase in blood pressure (DBP over 130 mmHg), severe target organ damage, life-threatening for the patient.

Immediate blood pressure reduction - hospitalization in an intensive care unit and parenteral administration of drugs, reduce by 15-20% within 1-2 hours, achieve 160/100 mmHg in the next 2-6 hours.

Type II crisis - non-life-threatening hypertensive crisis, uncomplicated -

blood pressure reduction within a day - oral medication.

Uncomplicated hypertensive crisis.

Uncomplicated hypertensive crisis is often observed in the early stages of the disease (stages I-II of hypertension), despite the sudden and very high increase in blood pressure, there is no obvious target organ damage, such as acute hypertensive encephalopathy or myocardial infarction. ischemia.

In the clinic of this type of crisis, vegetative disorders often dominate, especially symptoms of sympathotonia, as well as symptoms characteristic of sudden increases in blood pressure. So far, this type of crisis has been called "sympathoadrenal crises" (A.L. Myasnikov and N.A. Ratner, based on the classification, 1968) or "hyperkinetic crises" (A.P. Golikov et al., 1976). Uncomplicated crises are mainly due to a significant increase in sympathetic-adrenal activity and a large release of catecholamines into the blood, especially adrenaline. This type of crisis usually develops quickly but lasts a short time (no more than 2-3 hours) and is easily eliminated with antihypertensive drugs.

In the clinic, in addition to elevated blood pressure, symptoms such as agitation, "internal tremor," anxiety, fear, tachycardia, and shortness of breath are observed. Upon examination of the patient, cold sweat, "goosebumps" on the skin, trembling hands, and facial flushing are detected. Local circulatory disturbances in the brain include headaches, dizziness, nausea, vomiting (occasionally), which becomes unnoticeable upon resolution. In most cases, predominantly systolic blood pressure increases. Clinical blood tests may reveal neutrophil leukocytosis and hyperglycemia for a short period. Polyuria is often observed upon resolution of uncomplicated hypertensive crisis.

Complicated hypertensive crisis. Complicated hypertensive crisis develops in the late stages of the disease (stages II-III of hypertension) and is characterized by the development of hypertensive encephalopathy or other cardiovascular complications in addition to elevated blood pressure. The following pathological conditions develop during complicated crises against the background of sudden elevation of blood pressure:

- hypertensive encephalopathy;
- hemorrhagic ischemic stroke;
- subarachnoid hemorrhage;
- myasthenia;
- aortic dissection;
- acute left ventricular failure (pulmonary edema);
- myocardial infarction and angina pectoris;
- eclampsia;

- acute renal failure;
- hematuria;
- severe retinopathy.

Complicated crises with hypertensive encephalopathy intensify.

Complicated hypertensive crises correspond to the terms "hypertensive crises type II" (according to A.L. Myasnikov and N.A. Ratner) or "hypokinetic crises" (A.P. Golikov and co-authors) in the literature.

Complicated attacks gradually intensify in intensity and last for several days (even after blood pressure normalization). Symptoms such as severe headaches, dizziness, nausea and vomiting, consciousness disorders (slowed thinking, numbness, loss of consciousness, etc.) prevail in the clinic. Focal neurological disorders such as weakness and paresthesia in the limbs, lip and tongue movement disorders, speech disorders often accompany the above symptoms. Bradycardia is observed. In severe cases, symptoms of left ventricular failure (shortness of breath, orthopnea, moist rales in the lungs), unstable angina (chest pain, ECG changes, and other cardiovascular complications mentioned above) develop. Signs of grade II-III hypertensive retinopathy - retinal edema, "cotton wool" exudate, optic disc edema are detected upon fundus examination.

It should be noted that recurrent development of hypertensive crises in patients with arterial hypertension indicates the inadequacy of antihypertensive treatment.

Investigation plan for a patient with hypertension:

1. Blood pressure measurement every 15-30 minutes, blood pressure monitoring;
2. Electrocardiogram (ECG);
3. Central hemodynamics assessment;
4. Complete blood count (CBC), urinalysis (UA);
5. Blood biochemistry;
6. Ophthalmoscopy;
7. Neurological examination;
8. Rheoencephalography and determination of cerebral hemodynamics type.

Indication for specialist consultations:

A. Neurologist:

1. Acute cerebrovascular disorders:
 - Stroke (ischemic, hemorrhagic);
 - Transient ischemic attacks.
2. Chronic cerebrovascular pathology:
 - Developmental brain defects;
 - Discirculatory encephalopathy.

B. Ophthalmologist:

- Fundus blood vessels;

- Optic nerve;
- Clear migration;
- Visual acuity.

C. Nephrologist:

- To exclude symptomatic nephrogenic hypertension stages IV-V of chronic kidney disease (CKD).

D. Endocrinologist:

- Diabetes mellitus (DM), to prevent symptomatic endocrine hypertension.

Outcomes of hypertensive crisis: myocardial infarction, acute coronary syndrome (ACS), pulmonary edema, encephalopathy.

Control questions:

1. Concepts of hypertensive crisis.
2. Etiology of hypertensive crisis.
3. Risk factors for hypertensive crisis.
4. Pathogenesis of hypertensive crisis.
5. Classification of hypertensive crisis.
6. Clinic of uncomplicated hypertensive crisis.
7. Clinic of complicated hypertensive crisis.
8. Investigation plan.
9. Laboratory diagnostics.
10. Instrumental diagnostics of hypertension.
11. Outcome of hypertensive crisis.

CHAPTER III

SYMPTOMATIC (SECONDARY) ARTERIAL HYPERTENSION

Symptomatic arterial hypertension (SAH) belongs to a group of various diseases, the only common feature of which is elevated arterial blood pressure (pathological, elevated arterial pressure).

SAH accounts for 15-20% of all cases of hypertension. However, the results of comprehensive studies of patients with high and stable blood pressure (clinical, laboratory-instrumental, special examination methods) show that this condition accounts for 25-30%. Various pathological conditions belonging to this group have a unique clinical picture. Therefore, in addition to elevated blood pressure, it is necessary to study these conditions from the point of view of their different symptoms, since most patients experience elevated blood pressure or complications associated with it (headache, chest pain, exhaustion), which should prompt them to seek medical attention.

It is important to timely identify patients with SAH, as some of them (kidney vessel lesions, pheochromocytoma, etc.) can be treated surgically.

In 13-30% of cases, symptomatic AH progresses malignantly, whereas such progression is observed in only 1.9% of cases of essential hypertension.

There are several signs that may indicate the presence of symptomatic AH:

- Age < 40 years;
- Ineffectiveness of antihypertensive therapy;
- Malignant or progressive nature of AH;
- Good tolerance of hypertension, few complaints;
- Stability of blood pressure, preferential elevation of diastolic blood pressure.
- Alarm anamnesis:
 - Nephropathy, cystitis, edema, renal colic.
- "Off-program" disturbances:
 - Muscle weakness, vascular murmurs, paroxysms of blood pressure elevation;
 - Paradoxical reaction to certain medications.

Classification of symptomatic arterial hypertension:

I - Renal

1. Acute and chronic glomerulonephritis
2. Chronic pyelonephritis
3. Interstitial nephritis
4. Polycystic kidney disease
5. Obstructive nephropathy
6. Hydronephrosis

7. Congenital kidney anomalies (hypogenesis, dystopia, polycystosis, "horseshoe kidney").
8. Diabetic nephropathy (Kimmelstiel-Wilson glomerulosclerosis)
9. Atherosclerosis of renal arteries
10. Atherosclerotic stenosis of the renal artery, fibromuscular dysplasia, nonspecific aortoarteritis, thrombosis and embolism of renal arteries and their extrinsic pressure (tumor, scar).

II - Endocrine

1. Cushing's syndrome
2. Pheochromocytoma
3. Conn's syndrome
4. Acromegaly
5. Hypothyroidism
6. Hyperparathyroidism
7. Thyrotoxicosis

III - Hemodynamic, due to lesions of the heart, aorta, major branches:

1. Atherosclerosis, bradycardia, aortic valve insufficiency - systolic hypertension.
2. Ischemic hypertension, coronary heart disease, hypertension, mitral valve disease.
3. Coarctation of the aorta.
4. Erythremia due to hematological insufficiency, hypertension.
5. Due to hyperkinetic circulation syndrome - hyperthyroidism, arteriovenous aneurysm, anemia.

IV - Secondary neurogenic hypertension due to development of organic changes and diseases of the central nervous system (cns):

1. Disorders of cerebral circulation, vascular diseases and brain tumors, cysts.
2. CNS: encephalitis, meningitis, and infectious diseases resulting from poliomyelitis, diphtheria.
3. Head injuries.
4. Polyneuritis, porphyria, beriberi, chronic thallium poisoning.

V - Conditional exogenous hypertension.

1. "Salty" hypertension (due to excessive consumption of table salt).
2. Due to acute stress.
3. Due to psychogenic hypoventilation.
4. Hyperglycemia.
5. After burns.

6. After surgery and resuscitation.
7. Due to sudden cessation of alcohol intake.

VI - Hypertension induced by medications:

- Oral contraceptives
- MAO inhibitors (phenelzine, tranylcypromine, isocarboxazid)
- Tricyclic antidepressants (amitriptyline, desipramine, nortriptyline, imipramine, doxepin)
- Cocaine
- Corticosteroids
- Thyroid hormone preparations
- Cyclosporine, erythropoietin alfa

Prevalence and typical causes of secondary hypertension in different age groups:

Table №7

Age Group	Percentage %	Typical causes
Children (<12 years)	70-85 %	Renoparenchymal diseases - Aortic coarctation - Monogenic diseases
Adolescents (12–18 years)	10-15%	Renoparenchymal diseases Fibromuscular dysplasia Undiagnosed monogenic diseases
Young Adults (19–40 years)	5-10%	Renoparenchymal diseases Fibromuscular dysplasia Undiagnosed monogenic diseases
Middle-aged Adults (40–65 years)	5-15%	Primary aldosteronism Obstructive sleep apnea Cushing's syndrome Pheochromocytoma Renoparenchymal diseases Atherosclerosis of renal arteries
Elderly (>65 years)	5-10%	Atherosclerosis of renal arteries Renoparenchymal diseases Thyroid diseases

RENAL HYPERTENSIONS

Renal (nephrogenic) hypertension accounts for 18% or 70-80% of symptomatic AH. Renal hypertension is widely prevalent within SAH and is characterized by damage to the renal parenchyma (renoparenchymatosis) and renal vasculature (renovascularism).

Renoparenchymatous arterial hypertension is observed in acute and chronic glomerulonephritis, chronic pyelonephritis, urolithiasis, kidney developmental anomalies, and pregnancy nephropathy.

Pathogenesis of renal hypertension:

- Damage to the renal parenchyma and increased activity of the renin-angiotensin-aldosterone system

- Decreased depressor function of the kidneys

- Increased systemic vascular resistance

Clinical and laboratory signs of renoparenchymatous AH:

- History of pyelonephritis, glomerulonephritis, pregnancy nephropathy, kidney stone disease, etc.;

- Characteristic changes in urine sediment, laboratory, instrumental, and morphological study findings indicating the presence of primary kidney disease;

- Positive hypotensive effect from specific therapy of kidney disease.

Renoparenchymatous hypertensions

Chronic pyelonephritis ranks first among this group. Pyelonephritis is more often observed in patients under 40 years of age with arterial hypertension. In this disease, elevated blood pressure is accompanied by urinary-urologic edema and pustules, with no change in body temperature or convulsions. Hypertension caused by pyelonephritis gradually resolves over time and is characterized by high diastolic pressure. Despite the increase in blood pressure during this disease, atherosclerotic changes in the vessels and left ventricular hypertrophy develop insignificantly.

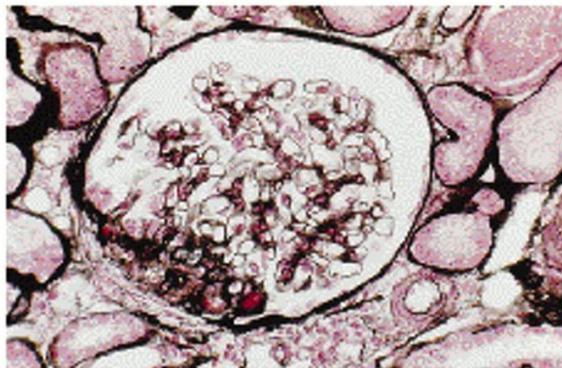
Instrumental methods such as X-rays, ultrasound, radionuclide studies are important for confirming the diagnosis. Chronic pyelonephritis is characterized by asymmetric anatomical and functional changes in the right and left kidney. If both kidneys are affected, one kidney undergoes more changes than the other. Thus, arterial hypertension is a diagnostic sign of chronic pyelonephritis, with urine analysis less frequently showing: proteinuria (up to 1%), true bacteriuria, leukocyturia, changes in kidney volume and functional asymmetry on ultrasound, deformation of the kidney calyx and cups on excretory urograms.

Chronic diffuse glomerulonephritis is the cause of arterial hypertension in most cases, with "malignant" arterial hypertension observed in 20% of cases. Elevated blood pressure is noted in various forms of glomerulonephritis, but distinguishing such essential hypertension from hypertensive disease with glomerulonephritis is

somewhat difficult. In most cases of chronic diffuse glomerulonephritis, there is a slight urinary syndrome (proteinuria up to 1%, less commonly hematuria and cylindruria). Chronic diffuse glomerulonephritis in hypertensive form differs from hypertensive disease in several respects: hypertensive crises are rare, diastolic blood pressure is high (120-140 mmHg), and most patients develop cerebral and coronary atherosclerosis late.

Chronic diffuse glomerulonephritis is comparatively less effectively diagnosed with urological and radionuclide studies, young age of the patient, frequent anginal pain in the history, acute glomerulonephritis from the outset, even if there are no changes in urine - all of these are the basis of chronic glomerulonephritis diagnosis. In the absence of contraindications, a kidney biopsy is performed in case of diagnostic uncertainty.

Thus, chronic diffuse glomerulonephritis is characterized by the following features: young age of the patient, elevated diastolic pressure, proteinuria, hematuria, absence of bacteria, unchanged excretory urography, morphological changes corresponding to biopsy material.



Renoparenchymal Hypertension: Clinical Features

1. Patient is younger than 40 years old.
2. Presence of specific clinical symptoms (edema, dysuric manifestations, urinary syndrome):
 - Nephropathy, cystitis, edema, renal colic.
3. **Diastolic blood pressure (DBP) >120 mmHg.**
4. Presence of specific findings in laboratory and instrumental examinations.
5. Absence of hypertensive crises, chronic kidney disease (CKD) symptoms, or complications of acute and chronic renal failure.

Renovascular Hypertension

Atherosclerotic renal artery disease is the most common cause of renovascular hypertension, accounting for approximately 70% of cases. It typically develops in men over 50 years old.

Fibromuscular dysplasia (FMD) of the renal arteries occurs in 10–20% of patients with renovascular hypertension. It is 4–5 times more common in women than in men and usually develops at a young age (before 40 years). This condition is often congenital. Diagnosis is performed using the same methods and criteria as for atherosclerotic hypertension. However, in angiographic studies, renal artery stenoses appear as a “string of beads” or “pearl necklace.”

Key Features of Renovascular Hypertension:

1. **Consistently high blood pressure from onset.**
2. **Predominant increase in diastolic blood pressure (DBP).**
3. **Systolic murmur** over the projection of the renal arteries:
 - In unilateral disease, a murmur is heard in 50–70% of cases.
 - In bilateral disease, it is heard in almost all patients.
4. **Resistance to standard antihypertensive therapy.**
5. **Frequent malignant course of hypertension:**
 - Occurs in **30%** of cases with unilateral involvement.
 - Occurs in **50–60%** of cases with bilateral involvement.
6. **Associated damage to other arterial systems.**
7. **Pulse and blood pressure asymmetry.**

Urinary abnormalities are not typical for renovascular hypertension, though mild **proteinuria** may be observed in rare cases. Impairment of nitrogen excretion occurs in late stages and is usually associated with either **bilateral occlusive disease** or **significant damage to the contralateral kidney** due to prolonged function under high blood pressure.

Diagnostic Methods:

- **Seldinger’s Aortography** – the gold standard for diagnosing renovascular hypertension.
- **Radionuclide Renography** – has low sensitivity; even a **2–3 times decrease** in blood flow may not show significant deviations.
- **Intravenous Urography** – in 60–80% of cases, indirect signs include:
 - Delayed excretion of contrast by the affected kidney.
 - Paradoxical enhancement of contrast in the renal pelvis-calyx system.
 - Reduction in kidney size on the affected side by **≥1 cm**.

- **Selective urine analysis via ureteral catheterization** – the affected kidney:
 - Reabsorbs water and sodium more intensively.
 - Produces less urine with a **15% lower sodium concentration** than the healthy kidney.
 - A **50% difference in urine volume** and a **15% difference in sodium levels** are considered diagnostic for renovascular hypertension.
- **Percutaneous Renal Biopsy** – used in specific cases.

Fibromuscular Dysplasia (FMD)

Fibromuscular dysplasia (FMD) is a **dystrophic-sclerotic** disease primarily affecting the **mid and distal segments** of the renal arteries. It accounts for **15–20%** of all cases of renovascular hypertension. Literature also describes FMD affecting the **carotid, iliac, and coronary arteries**.

In the **hereditary form**, the **middle muscular layer** of blood vessels is affected. However, there is evidence that FMD has an **autoimmune** component and is related to **Takayasu arteritis** (localized form).

Morphological Features of FMD:

- **Hypertrophy of connective tissue.**
- **Atrophy of muscle fibers.**
- **Unilateral involvement in 2/3 of cases**, though bilateral disease can occur.
- **More common in young adults.**

Abdominal **aortography** is the most accurate diagnostic method for FMD. It reveals:

- **Tortuous renal arteries.**
- **Aneurysmal dilations in some segments**, followed by **concentric narrowing**.

Treatment:

The most effective approach is **reconstructive vascular surgery**.



FIBROMUSCULAR DYSPLASIA

Nonspecific Aortoarteritis (Takayasu's disease, "pulseless disease," "intermittent claudication syndrome"). In addition to affecting the aortic arch and brachiocephalic arteries, vascular pulsation in the arms becomes asymmetrical. The abdominal aorta and its branches are damaged, and later the renal arteries also become involved.

The disease begins with signs of active inflammation (increased body temperature, a shift in leukocyte count to the left, elevated erythrocyte sedimentation rate (ESR), and hypergammaglobulinemia). The acute phase subsides, but hypergammaglobulinemia remains at high levels. Leukocyte blast transformation and other autoimmune signs appear. Usually, the proximal segments of the renal arteries are symmetrically affected, indicating a severe hypertensive syndrome. In most cases, early thrombosis of the renal artery leads to acute renal failure. The only treatment option is **surgical intervention**, but since the process is systemic, surgery does not fully resolve the issue.

A distinct sign of renovascular hypertension is the development of **systolic murmurs** in the abdominal vessels. In hypertensive patients, renal artery murmurs should be auscultated from both the abdomen and back. The occurrence of systolic murmurs is associated not only with arterial stenosis and turbulent blood flow but also with the development of collateral circulation.

For **primary diagnosis**, excretory urography, radionuclide renography, and renal scintigraphy should be performed. In unilateral renal artery involvement, kidney size is reduced in **32% of cases (excretory urography)** and **75% (radionuclide renography)** due to decreased function and stenosis. For an accurate **final diagnosis**, **abdominal aortography** is required to determine the nature, location, and extent of the damage and assess indications for surgery.

HEMODYNAMIC HYPERTENSION

Unlike other types of secondary hypertension, hemodynamic hypertension is **directly linked to heart and large vessel diseases**, causing changes in blood flow. This type of arterial hypertension is primarily characterized by **increased systolic pressure**.

Coarctation of the Aorta (a vascular anomaly) is the most common congenital heart defect, accounting for **6-13%** of cases. The disease's severity depends on the **length of the narrowed segment, the branching of large arteries, and the position relative to the aortic arch**. The development of hypertension due to aortic coarctation is caused by **mechanical obstruction to blood flow and narrowing of the aorta's elastic chamber**. However, the **increase in total**

peripheral vascular resistance and the gradual normalization of blood pressure after distal aortic surgery remains unexplained.

Narrowing of the **thoracic aorta** creates different circulatory conditions in the upper and lower body, leading to **distinct clinical manifestations**:

- **Upper body symptoms:** Hypertension, hypercirculation, and hypervolemia, causing **headaches, dizziness, prominent pulsation of head and neck veins, tinnitus, nosebleeds, fatigue, and chest pain due to rib compression by collateral vessels.**
- **Lower body symptoms:** Hypotension, hypoperfusion, and hypovolemia, leading to **leg pain, weakness, muscle cramps, and cold feet, resembling intermittent claudication.**

Upon examination:

- **Blood pressure is elevated in the arms and reduced in the legs.**
- **Upper body:** Well-developed shoulder muscles, strong carotid artery pulses.
- **Lower body:** Hypotrophy, pallor, cold extremities, weak or absent femoral artery pulses.
- **Oscillography and rheography** reveal decreased mineral supply to the legs.

Surgical Treatment

Surgical correction is the only treatment, but its effectiveness varies. Without surgery, **life expectancy averages 33 years.** The main causes of death are:

- **Congestive heart failure (26%)**
- **Aortic rupture or dissection (21%)**
- **Infectious endocarditis or endarteritis (12%)**

ENDOCRINE HYPERTENSION

Pheochromocytoma (PCC) – a tumor derived from **chromaffin cells**, producing excessive **adrenaline and noradrenaline** (noradrenaline accounts for **50–90% of total secretion**). The high hormone levels contribute to hypertension and other symptoms.

Chromaffin cells are found in the **adrenal medulla and sympathetic paraganglia.**

- **90% of PCCs** occur in the **adrenal medulla.**
- **10% occur outside the adrenal glands (paragangliomas),** found in the **thoracic and abdominal cavities, aorta, and kidney cortex.**
- **Less than 10% of tumors are malignant** and are termed **pheochromoblastomas.**
- Due to its variable presentation, PCC is sometimes called **“The Chameleon Disease.”**

Hypertension in Pheochromocytoma

PCC-related hypertension results from massive catecholamine release, leading to increased **peripheral resistance**. In some cases, **paroxysmal hypertension** occurs, suggesting involvement of the **renin-angiotensin-aldosterone system** in **persistent hypertension**.

Forms of PCC Hypertension

1. **Paroxysmal** – Normal BP between crises, but severe hypertensive episodes occur.
2. **Mixed** – BP rises to **280/150 or 300/180 mmHg** in later disease stages.
3. **Persistent** – Continuous hypertension without crises.
4. **Asymptomatic** – Sudden fatal hypertensive crisis; PCC is discovered post-mortem.

Hypertensive Crises in PCC

- Sudden BP surge (**250-300/150-130 mmHg**)
- **Severe tachycardia (120-150 bpm)**
- **Pallor, cold sweat, visual disturbances**
- **Headache, dizziness, anxiety, nausea, vomiting**
- **Hyperglycemia, leukocytosis**
- **ECG changes (arrhythmias)**
- Crises last **seconds to hours**, occurring **up to 5-10 times daily** in early stages.

Primary Pheochromocytoma Symptoms

- **Transient hypertension with autonomic symptoms (tremors, fever, agitation)**
- **Hypertensive crises**
- **Throbbing headaches**
- **Facial flushing and edema**
- **Palpitations, chest pain (mimicking angina)**
- **Weight loss, diarrhea**

Diagnosis:

Crises can be triggered by:

- **Cold exposure, deep abdominal palpation, leg flexion, or certain drugs (methyldopa, reserpine, clonidine).**
- **Clonidine suppression test:** In non-PCC patients, catecholamine levels drop within **2-3 hours**; in PCC patients, levels **remain high**.
- **24-hour urine test** detects increased:

- **Adrenaline (>50 µg), Noradrenaline (>100-150 µg), Vanillylmandelic acid (>6 µg), especially within 3 hours after a crisis.**

Imaging for Diagnosis

- **Ultrasound, CT scan**
- **Scintigraphy with ¹³¹I-labeled guanethidine** selectively targets tumors.

Pathogenesis of Crises

Tumors gradually accumulate vasoactive substances, but their **release into circulation is irregular**, leading to sudden crises. Triggers include:

- **Vasodilators (aminophylline, papaverine, magnesium sulfate)**
- **Sympatholytic drugs (reserpine, clonidine, methyldopa)**

Without timely diagnosis and treatment, **pheochromocytoma crises can be fatal.**

The onset of the disease occurs suddenly: blood pressure rises abruptly and, within seconds, reaches 250/130–300/150 mmHg. The patient experiences extreme panic, body tremors, rapid heartbeat, dizziness, a sensation of cold, nausea, vomiting, and dilation of the pupils. The pulse rate increases to 120–150 beats per minute, body temperature is usually normal, and laboratory tests show leukocytosis and hyperglycemia, with elevated catecholamine levels in the blood and urine. ECG recordings reveal various rhythm disturbances. The duration of an episode varies among patients, ranging from a few seconds to several hours. In the early stages, episodes are intermittent, may persist for an extended period, and sometimes recur up to 5–10 times a day.

Primary Pheochromocytoma

During an episode:

- Transient hypertension accompanied by autonomic symptoms (agitation, tremors, fever)
- Hypertensive crises
- Throbbing headache
- Facial swelling and flushing
- Palpitations
- Skin hyperemia
- Pressing chest and throat pain (sometimes resembling angina attacks)
- Weight loss and diarrhea

After an episode:

- Elevated levels of catecholamines and their metabolite, vanillylmandelic acid, in blood and urine (urine should be tested in the first days following an episode)
- Detection of adrenal gland enlargement via ultrasound and CT scan

- Leukocytosis in blood tests

Diagnosis

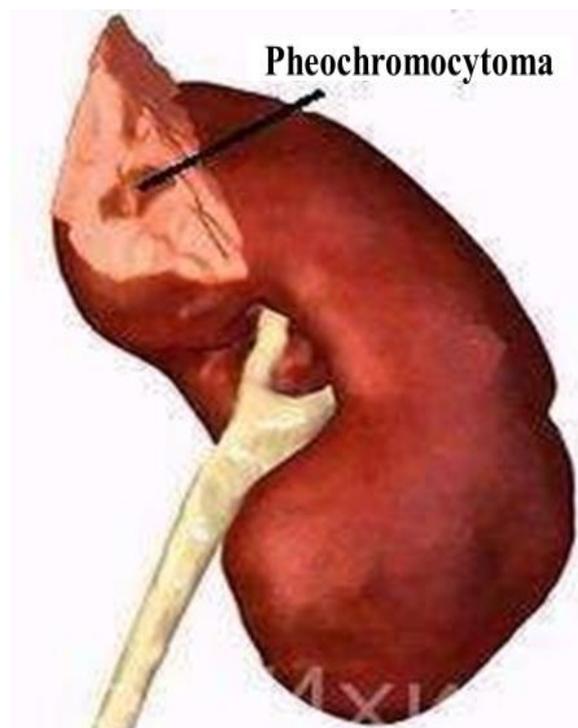
Episodes can be triggered by cold exposure, deep abdominal palpation, bringing the lower limbs to the abdomen, or administration of certain drugs (e.g., methyldopa, reserpine, clonidine). Clonidine can be used for differential diagnosis: in patients without pheochromocytoma, a 0.3 mg dose significantly reduces catecholamine levels in blood (within 2–3 hours) and urine (collected overnight from 9 PM to 7 AM). In contrast, patients with pheochromocytoma show no change in catecholamine levels.

A diagnosis of pheochromocytoma is confirmed by detecting increased excretion of catecholamines and their metabolites in 24-hour urine samples:

- Adrenaline (>50 mcg)
- Noradrenaline (>100–150 mcg)
- Vanillylmandelic acid (>6 mcg)
- Elevated levels within 3 hours after a hypertensive crisis

Imaging Studies

Radiographic examination of the adrenal glands (X-ray and targeted multi-positional tomography) is performed using retroperitoneal pneumography, revealing the tumor in the upper part of the kidney or outside the adrenal gland. Extra-adrenal pheochromocytomas are more challenging to diagnose. Confirmation is achieved through CT scans and ultrasound. Recently, scintigraphy with radiolabeled ¹³¹I-labeled **guanethidine analogs**, selectively absorbed by the tumor, has been increasingly used for diagnosis.



HYPERALDOSTERONISM

Adrenal cortex damage is a rare and difficult-to-diagnose disease.

1. Primary aldosteronism – Aldosteroma (solitary adrenal adenoma – Conn’s syndrome)

These conditions account for **70–80%** of adrenal cortex damage.

2. Bilateral idiopathic adrenal cortical hyperplasia (20–30%)

Adrenal hyperplasia can be bilateral and is four times less common than aldosteroma. Unlike Conn’s syndrome, it does not normalize blood pressure even after bilateral adrenalectomy.

In addition to primary aldosteronism, there is **secondary or nephrogenic aldosteronism**, which is characterized by a high level of renin-angiotensin system activity.

Clinical Signs of Conn’s Syndrome:

- **Arterial hypertension**
- **Hypokalemia** due to increased aldosterone secretion
- **Muscle spasms and nephropathy**

Hypokalemia is persistent and below **3 mmol/L**, with the potassium-sodium ratio increasing **332 times**. Other common findings include **magnesium deficiency** and **metabolic alkalosis**. Hypokalemia leads to **muscle relaxation**, a key distinguishing feature, since **asthenic syndrome** is not typical for hypertensive patients or those with other secondary arterial hypertension (SAH).

Other symptoms include:

- **Periodic muscle paresthesia**
- **Twitching and temporary weakness** in certain muscle groups

This process affects both **skeletal muscles** and the **heart muscle**. Despite stable hypertension, the **left ventricular wall** is only slightly hypertrophied, but there are **high dystrophic changes in the myocardium**, along with **cardiomegaly**. Heart sounds are muffled, and **arrhythmia** is present.

Urinary changes in Conn’s syndrome appear early:

- **Moderate proteinuria**
- **Hypothenuria**
- **Nocturia**
- **Polyuria (3–5 liters per day)**
- **Polydipsia**

These changes are associated with hypertension-induced nephrosclerosis and potassium-wasting nephropathy, leading to **reduced sensitivity to thiazide diuretics**, even in small doses. This results in an **acute state due to exaggerated hypokalemia**.

Conn's Syndrome Has Four Key Symptoms:

1. Hypertension
2. Hypokalemia
3. Hyperaldosteronuria
4. Hyporeninemia

Diagnosis

Laboratory tests play a crucial role in diagnosing the disease.

Instrumental diagnostics include:

- Radionuclide **scintigraphy**
- **Ultrasound examination**
- **Computed tomography (CT scan)**

Treatment

Surgical treatment is **not recommended** for **bilateral adrenal hyperplasia**. Patients are prescribed **Verospiron** (Spironolactone) at **300–400 mg per day** for at least a month, then the dose is gradually reduced to **100–200 mg per day**.

Conn's Syndrome Symptoms:

- Muscle weakness, neuromuscular disorders (paresthesia), tendency to seizures (transient para- and tetraplegia)
- Hyponatremia, hypocalcemia, alkalosis, hypokalemia
- Polyuria, polydipsia, nocturia
- Increased aldosterone levels in serum (up to 100 mg/mL) and urine (up to 150 mg/day)
- Changes in urine composition
- Increased plasma adrenaline levels
- Reduced glucose tolerance
- High blood pressure
- Detection of adrenal tumors using instrumental methods

Cushing's Syndrome (Itsenko-Cushing Syndrome)

Cushing's syndrome occurs **3–4 times more often in women** than in men and is accompanied by arterial hypertension in **80–90% of cases**. In **one-third of**

patients, the syndrome is associated with a **primary adrenal adenoma** or **adrenal carcinoma**.

In **two-thirds** of cases, the disease results from **excessive production of adrenocorticotrophic hormone (ACTH)** by the adrenal cortex, which is considered **secondary hyperfunction**.

Early diagnosis is crucial, **as** untreated patients have a life expectancy of less than 5 years.

Clinical Features

- Gradual development of symptoms
- Characteristic changes in appearance:
 - Round, "moon-shaped" face
 - Pink-red cheeks
 - Central obesity (**fat accumulation in the neck, trunk, thighs, and abdomen**)
 - Thin extremities
 - Purple-red stretch marks (striae) on the chest, thighs, and shoulders
 - Petechiae and telangiectasias **on the wrist and elbow joints**
- Hormonal and metabolic disturbances:
 - Oligomenorrhea or amenorrhea in women
 - Impotence and gynecomastia in men
- **Psychological changes:**
 - Loss of interest in surroundings
 - Memory impairment
 - Insomnia, irritability, and fatigue
- **Osteoporosis and pathological fractures**

Laboratory and Diagnostic Findings show:

- Increased red blood cell count (erythrocytosis > 6 million)
- Thrombocytosis
- Leukocytosis with eosinophilia and lymphopenia
- Biochemical findings:
 - Hypercortisolemia
 - Metabolic alkalosis
 - Hyperglycemia
 - Hypercholesterolemia
 - Triglyceridemia
 - Elevated aldosterone, 17-OHCS, and 17-KS levels

Instrumental Diagnostics include:

- Retroperitoneal pneumography
- Chest X-ray
- Computed tomography (CT scan)

Arterial Hypertension Due to Adrenergic Agonists

This group includes **drugs that stimulate adrenergic receptors**. Based on their effects, they are classified into:

- **Alpha-adrenergic agonists**
- **Beta-adrenergic agonists**
- **Alpha-beta adrenergic agonists**

Their effects may cause:

- **Vasoconstriction**
- **Hypertensive crisis**
- **Acute heart failure**
- **Stroke**
- **Pulmonary edema**

Commonly associated medications include **phenylephrine (Mesaton) and norepinephrine (Noradrenaline)**, which may lead to **severe arrhythmias**. **High blood pressure is a contraindication** for using alpha- and beta-adrenergic agonists.

GLUCOCORTICOIDS AND HYPERTENSION

Depending on the **dose and duration** of glucocorticoid therapy, these medications can cause a **sharp increase in blood pressure**. **Severe hypertension occurs in 6–11% of patients** taking these drugs. The mechanism involves **potassium chloride and water retention**, leading to **volume overload** and increased blood pressure.

ANALGESICS AND HYPERTENSION

Phenacetin was widely used in the past, but due to its **numerous side effects**, its use has been restricted. **Long-term use** of this drug was associated with **persistent arterial hypertension**.

Tabel №8.

Medications	Mechanisms of Hypertension (HTN)
NSAIDs (Non-Steroidal Anti-Inflammatory Drugs)	Sodium retention, inhibition of prostaglandin synthesis

Glucocorticoids	Sodium retention, increased angiotensin II and norepinephrine levels in the blood
Cyclosporines	Increased reactivity of the sympathetic-adrenal system, sodium retention
Liquiriton, Carbenox	Increased synthesis and release (unspecified mechanism)
Erythropoietin	Sodium retention (unknown mechanism)
Monoamine Oxidase Inhibitors (MAOIs)	Stimulation of the sympathetic-adrenal system
Sympathomimetics: nasal drops, bronchodilators, catecholamines	Stimulation of the sympathetic-adrenal system
Tricyclic Antidepressants (Imipramine, etc.)	Inhibition of norepinephrine uptake by sympathetic nerve endings
Thyroid Hormones	Effect of thyroxine
Oral Contraceptives	Sodium retention, activation of the renin-angiotensin system

Features of Arterial Hypertension in Pregnant Women:

- More severe course, increased fetal mortality, and proteinuria (within 24 hours).
- Characterized by eclampsia, with mild and severe forms.
- **Mild preeclampsia:** Slight increase in blood pressure (140-159/90-109 mmHg) with moderate proteinuria.
- **Severe preeclampsia:** Consideration of high blood pressure, significant proteinuria (>5 g/day), brain and kidney involvement (creatinine >2 mg/L), liver dysfunction (hemolysis and thrombocytopenia <100,000/mm³).

Features of Arterial Hypertension in the Elderly:

- **Chronic hypertension in older adults** is characterized by:
 - Age ≥60 years
 - Aortic and branch involvement
 - Changes in systolic volume
 - Good tolerance of high blood pressure
 - Systolic BP >160 mmHg, diastolic BP <90 mmHg
 - Accentuated second heart sound and coarse systolic murmur over the aorta

Arterial Hypertension in Sleep Apnea Syndrome:

- Sleep apnea syndrome (SAS): **Breathing cessation for ≥ 10 seconds during sleep.**
- Diagnosis if ≥ 5 -6 episodes per hour.
- **Types of apnea:**
 - **Central:** Reduced central activity of respiratory muscles.
 - **Obstructive:** Inspiratory airway obstruction due to muscle relaxation.
 - **Mixed:** Combination of both; affects 4% of men and 2% of women.
- **Blood pressure during sleep:** Normally 5-14% lower than wakefulness.
- **In SAS, BP increases, reaching 200-300 mmHg in some cases.**
- **Persistent nocturnal hypertension** is seen in 30-50% of SAS patients.
- **Diagnosis:**
 - **Polysomnography** (EEG, EOG, EMG during sleep)
 - **Assessments include:**
 - Sleep structure
 - Breathing (via thermistor)
 - Respiratory muscle activity
 - Blood oxygen saturation
 - ECG monitoring

Pseudoresistant Hypertension

- **Resistant hypertension** is linked to:
 - Age > 75 years
 - Male sex
 - African descent
 - High baseline BP
 - Frequent doctor visits
 - Obesity, diabetes, atherosclerosis, chronic kidney disease (CKD)
 - High 10-year coronary risk ($> 20\%$ by Framingham scale)
- **Before diagnosing resistant hypertension, consider pseudoresistance causes:**
 1. **Poor adherence** to therapy (seen in $\leq 50\%$ of monitored patients).
 2. **White coat effect** (elevated office BP but normal ambulatory/home BP).
 3. **Improper BP measurement** (wrong cuff size).
 4. **Severe arterial calcification** (especially in elderly patients).
 5. **Clinical inertia**, leading to inadequate drug dosing or suboptimal combinations.
 6. **Other causes of resistant hypertension are:**
 - Obesity, rapid weight gain

- High alcohol or salt intake
- Use of vasopressors, sodium-retaining drugs, herbal/narcotic substances (e.g., cocaine, anabolic steroids)
- **Obstructive sleep apnea syndrome (OSAS)** (often but not always linked to obesity)
- **Severe organ damage** due to hypertension, especially CKD and arterial stiffness

Further evaluation is necessary to differentiate true resistant hypertension from secondary or pseudoresistant causes.

Differential Diagnosis

Tabel №9

Causes	Clinical indicators			Diagnosis	
	History	Examination	Laboratory tests	Main investigations	Additional investigations
Renal parenchymal damage	Obstruction, urinary tract infection, hematuria, polycystic kidney disease, family history, prolonged use of NSAIDs	Abdominal mass, detection of a formation (polycystic kidney disease)	Urinalysis (UA): Proteinuria, detection of leukocytes, erythrocytes, decreased glomerular filtration rate (GFR)	Kidney ultrasound	Study of kidney condition
Renal artery stenosis	Fibromuscular dysplasia, hypertension in young individuals (primarily women), Atherosclerotic stenosis; Sudden hypertension and uncontrolled response to treatment; Acute pulmonary edema	Systolic murmur on auscultation of the renal arteries;	Urinalysis (UA): Hematuria	Two-dimensional Doppler imaging of the kidneys	MRI, CT, angiography of renal arteries
Primary aldosteronism	In young individuals: muscle weakness, family history of hypertension, or cardiovascular complications in the family before the age of 40	Arrhythmia (extrasystole)	Hypokalemia, hyperreninemia, aldosteronuria Urinalysis (UA): Hematuria	Change in the renin-aldosterone ratio	Physiological and pharmacological tests, adrenal ultrasound, biopsy.
Pheochromocytoma	Paroxysms of hypertension, crises against the background of hypertension, headaches,	Neurofibromatosis manifestations on the skin (café-au-lait spots).	Detection of a mass in the adrenal gland.	In urine: Hematuria, detection of VMA	MRI, CT, adrenal ultrasound,

	sweating, palpitations, tremor.			(vanillylmandelic acid); Biochemical blood analysis (BAC): Hyperglycemia, increased catecholamines.	renal artery angiography.
Cushing's syndrome	Weight loss, polyuria, polydipsia, psychological disorders.	Typical appearance: moon-shaped face, striae on the abdominal skin.	Hyperglycemia	Impaired cortisol excretion through the kidneys.	Determination of 11-OCS, 17-OCS, and dexamethasone suppression test.

Control Questions:

1. Etiology of Symptomatic Arterial Hypertension.
2. Classification of Symptomatic Arterial Hypertension.
3. Characteristics of Renoparenchymal Arterial Hypertension.
4. Characteristics of Renovascular Arterial Hypertension.
5. Characteristics of Hemodynamic Arterial Hypertension.
6. Characteristics of Arterial Hypertension of Endocrine Etiology.
7. Characteristics of Conn's Syndrome.
8. Characteristics of Pheochromocytoma.
9. Clinical Features of Cushing's Syndrome.
10. Principles of Diagnosis of Symptomatic Arterial Hypertension.

CHAPTER IV

TREATMENT OF ARTERIAL HYPERTENSION

The **World Health Organization (WHO)** and the **International Society of Hypertension (ISH)** recommend maintaining **blood pressure (BP)** at **130/85 mmHg** for young and middle-aged patients, as well as for those with **diabetes mellitus**. In elderly individuals, BP should be maintained at **140/90 mmHg**. It is important to note that in cases of **severe and prolonged hypertension**, reducing BP below the target level may cause **hypoperfusion of vital organs**, including:

- **Brain** (hypoxia, stroke)
- **Heart** (angina, myocardial infarction)
- **Kidneys** (renal infarction)

Treatment Goals

The **primary goal** in treating hypertension (HTN) is to **minimize overall cardiovascular disease risk and mortality**. This involves not only **reducing BP** but also:

- **Protecting target organs**
- **Correcting all identified risk factors**

Medication therapy is determined **not by BP level alone**, but rather by **risk stratification**:

- **High-risk** patients should begin treatment **immediately**.
- **Low and moderate-risk** patients should first undergo **non-drug therapy** for **3 to 12 months** before starting medications.
- **Patients with heart/kidney failure or diabetes mellitus** should receive **medication treatment even if BP is at the high-normal range**.
 - **First-line drugs: ACE inhibitors** are preferred in such cases.

Non-Pharmacological Treatment

Non-drug therapy is recommended for **all patients with hypertension** and includes:

1. Smoking Cessation

- **Smoking cessation** is one of the **most significant lifestyle changes** for preventing cardiovascular and other organ diseases.

2. Weight Reduction

- **Especially recommended for individuals with** abdominal obesity.

- Benefits include improved **insulin sensitivity, reduced diabetes risk, lower lipid levels, and left ventricular hypertrophy regression.**
- **Every 5 kg of weight loss:**
 - **Systolic BP ↓ by 5.4 mmHg**
 - **Diastolic BP ↓ by 2.4 mmHg**
- Weight loss is more effective when combined with **increased physical activity, reduced alcohol intake, and sodium restriction.**

3. Sodium Restriction (Salt Reduction)

Limiting sodium intake to **2 grams per day**, which is equivalent to **5 grams of table salt per day**, is recommended. Patients who are **overweight and elderly individuals** are the most sensitive to a reduction in salt consumption.

Controlled clinical studies have shown that reducing salt intake from **10 grams to 4.5 grams per day** can lower **systolic blood pressure by 4–6 mmHg**. In elderly individuals, reducing salt intake to **2 grams per day** does not cause adverse effects and significantly **reduces the need for medication**, while also improving the effectiveness of **ACE inhibitors and diuretics**.

A **teaspoon contains approximately 5 grams of table salt**. People with **hypertension** tend to consume more salt due to a **reduced sensitivity to its taste**. When determining sodium content in food, it is recommended to use **special tables** rather than relying on general advice such as "do not add extra salt to your food."

Foods naturally low in salt include:

- **Fruits, vegetables, grains, milk, cottage cheese, fresh-frozen fish, and fresh meat.**

However, processed foods contain significantly higher amounts of salt:

- **Sausages contain 10–15 times more salt than fresh meat**, and standard **bakery bread** is also high in salt.

Special **dietary products** typically contain lower amounts of salt.

Individuals with **salt-sensitive hypertension** are particularly responsive to dietary sodium restriction. For these individuals, it is recommended to **not only reduce salt intake but also limit fluid intake to 1.2–1.5 liters per day**.

Additionally, **Sanasol** may be used at a dosage of **1.5–3 grams per day**.

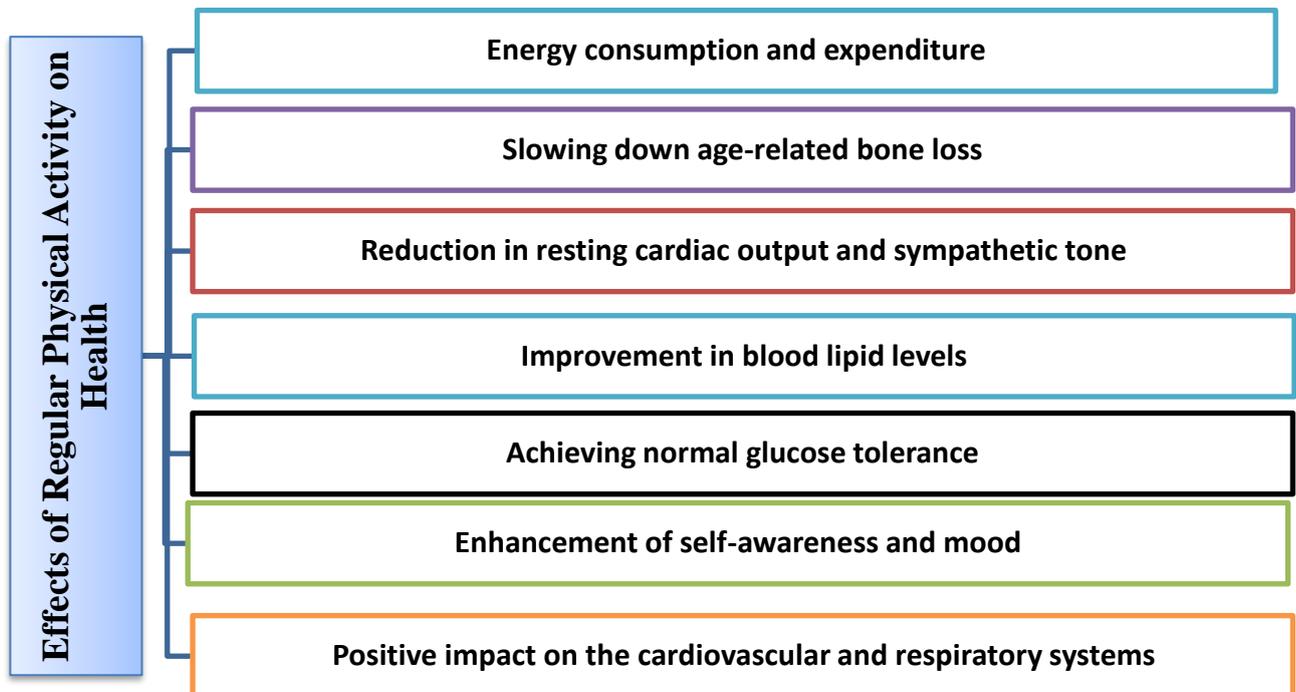
4. Alcohol Reduction

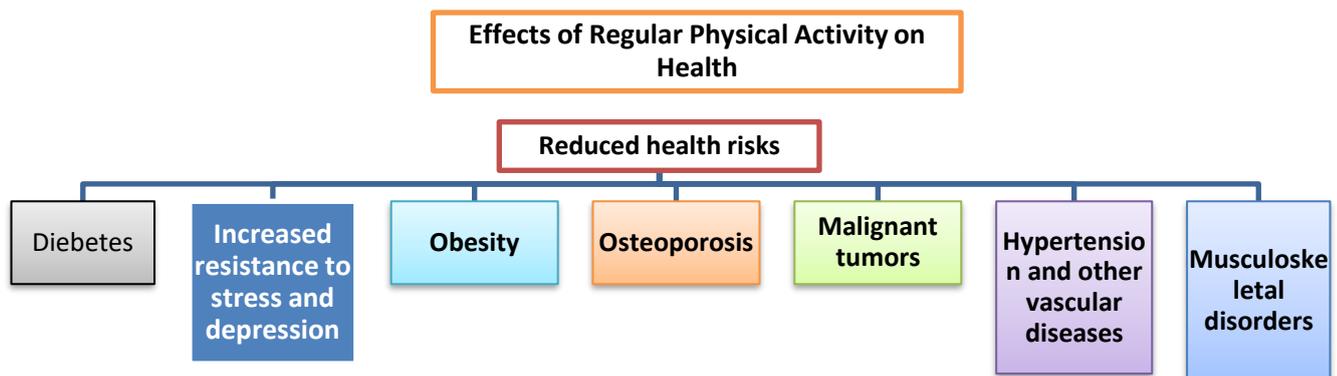
- **Linear relationship** between alcohol intake, **BP levels**, and **hypertension prevalence**.
- **Alcohol also reduces the effectiveness of antihypertensive drugs.**
- **Recommended limits:**
 - **Men: 23-30g of pure ethanol per day** (\approx 50-60ml vodka, 200-250ml wine, 500-600ml beer).

- **Women: 10-20g of pure ethanol per day.**
- **Weekly maximum:**
 - **Men: 168ml of pure ethanol**
 - **Women: 112ml of pure ethanol**

5. Increased Physical Activity

- **Recommended:**
 - **Aerobic exercise (outdoor activities) 30-60 minutes, 3-4 times per week (e.g., walking, swimming).**
- **More intense exercise (e.g., running) has a weaker antihypertensive effect.**
- **Isometric exercises (e.g., weightlifting) can increase BP and should be avoided by hypertensive patients.**





Pharmacological Treatment of Arterial Hypertension

Principles of Pharmacological Treatment

The general principles of pharmacological treatment of **arterial hypertension (AH)** include:

1. Starting treatment with the lowest dose of a single drug.
2. Switching to another class of medication if treatment is ineffective (**after increasing the dose of the initial drug**) or if there is **poor tolerance**.
3. Using long-acting medications **to achieve a 24-hour effect** with a single dose, **ensuring** stable blood pressure control, better organ protection, **and** higher patient adherence.
4. Optimizing drug combinations **to maximize antihypertensive efficacy while minimizing side effects**.

Physicians must explain to **hypertensive patients**:

- **The** goals and long-term benefits **of treatment**.
- **The** need for lifelong therapy.
- **The importance of** proper lifestyle management, diet, and work-rest balance.

Main Classes of Antihypertensive Drugs

I. Diuretics

Diuretics are one of the **main groups** of antihypertensive drugs. Their action:

- Increases sodium excretion, restoring sodium balance in plasma.
- After 6-8 weeks, their effect gradually diminishes, and cardiac output returns to normal.

- Diuretics also have a non-diuretic vasodilatory effect, particularly when used in low doses.

Types of Diuretics:

- Thiazide and Thiazide-like Diuretics (most commonly used for AH)
- Moderately effective: reduce sodium reabsorption by 5-10%.

Examples: Hydrochlorothiazide, Chlorthalidone, Indapamide, Clopamide.

- **Loop Diuretics**
 - Act rapidly (especially when administered parenterally).
 - Strong diuretics: reduce sodium reabsorption by 15-25%.
 - Examples: Furosemide, Bumetanide.
- Potassium-Sparing Diuretics
 - Weak diuretics: reduce sodium reabsorption by 5%.
 - Examples: Spironolactone, Triamterene.

Clinical Benefits of Diuretics:

- Long-term use **has been shown to** reduce cardiovascular complications.
- Low-dose therapy **is well tolerated and** preserves organ function (e.g., **reduces left ventricular hypertrophy**).
- Best combined with ACE inhibitors and calcium channel blockers.

Side Effects of Diuretics:

- Dizziness, fatigue, nausea, depression
- Electrolyte imbalances (hypokalemia, hyponatremia)
- Decreased libido

II. Beta-Adrenergic Blockers (β -Blockers, BABs)

β -Blockers are classified into:

1. **Selective β 1-blockers** (targeting only **β 1-receptors**)
2. **Non-selective β 1/ β 2-blockers**

Mechanism of Action:

- Reduce **cardiac output** (negative **inotropic** effect)
- Decrease **heart rate** (negative **chronotropic** effect)
- Lower **vascular resistance and blood pressure**
- Inhibit **renin secretion**, reducing **angiotensin and aldosterone** levels
- Increase **baroreceptor sensitivity**, reducing **norepinephrine release**

Side Effects of β -Blockers:

- Worsening of heart failure symptoms

- Atrioventricular conduction disturbances
- Raynaud's syndrome (cold extremities, vasospasms)
- Bronchospasm (caution in asthma patients)
- Fatigue, drowsiness, depression.

Tabel №10

Drug Name:	Dose, mg/ (number of recommended daily doses)
• Propranolol (oral)	20-80(2-3)
• Bisoprolol	10 (1)
• Metoprolol (Lopressor)	100 (1)
• Pindolol (Visken)	10 (1)
• Nadolol (Corgard)	80-240(1-2)
• Oxprenolol	80-480(2-3)
• Betaxolol	5- 20(1)
• Atenolol (Tenormin)	50-100 (1)

Contraindications:

- Atrioventricular (AV) block (**2nd-3rd degree**)
- Bradycardia
- Bronchial obstructive syndrome
- Sick sinus syndrome (SSS)
- Decompensated heart failure
- Raynaud's syndrome
- Diabetes mellitus

III. Calcium Channel Blockers (CCBs)

For over 30 years, calcium channel blockers (CCBs) **have been effectively used to treat** arterial hypertension (AH). **Unlike** diuretics and β -blockers, CCBs reduce the risk of stroke and myocardial infarction **with** long-term use.

Pharmacological Classification of CCBs:

First-generation CCBs:

- Nifedipine, Verapamil, Diltiazem
- Disadvantages:

- Increased neurohumoral activity
- Frequent hospitalizations due to short duration of action
- Low tissue selectivity
- High metabolism
- Significant fluctuations between peak and trough plasma concentrations
- Higher incidence of side effects

Second-generation CCBs:

- Felodipine, long-acting forms of Verapamil and Diltiazem, Nimodipine, Nisoldipine

Third-generation CCBs:

- Amlodipine, Lercanidipine

Mechanism of Action:

- Blocks **calcium ion influx** into **vascular smooth muscle**
- Has **vasodilatory properties**

Indications for Use:

- Atrioventricular block (II-III degree) → **(use Verapamil and Diltiazem)**

Clinical Efficacy of CCBs:

1. Systolic and diastolic blood pressure (SBP/DBP) decreases with long-acting CCBs.
 - Long-acting CCBs **are especially beneficial in elderly patients with systolic hypertension and coexisting angina, reducing the risk of cerebrovascular complications and vascular dementia (Neal B et al., 2000).**
2. CCBs have renoprotective effects, **eliminating the need for** dose adjustment **of Amlodipine and Lercanidipine in** chronic kidney disease (CKD).
3. Reduction in left ventricular mass **(helps reverse left ventricular hypertrophy).**

Side Effects:

- Headache, dizziness, peripheral edema, facial flushing
- Cardiodepressive effects (Verapamil and Diltiazem may worsen heart failure, cause bradycardia, and AV block)
- Rarely, constipation

Tabel №11

Use of Calcium Antagonist Drugs (Calcium Channel Blockers)

Drug Name	Daily Dose (mg)	Frequency (times per day)
Verapamil (Finoptin, Isoptin)	240–480 mg	3–4 times/day
Diltiazem (Cardil, Dilzem)	180–360 mg	3 times/day
Nifedipine (Corinfar, Cordafen)	40–80 mg	3–4 times/day
Nifedipine (JusticeSL)	20 mg	1–2 times/day
Amlodipine (Norvasc)	5–10 mg	1 time/day
Isradipine (Lomir)	5–10 mg	1 time/day
Lacidipine (Lacipil)	2–4 mg	1 time/day
Felodipine (Ilendil)	5–10 mg	1 time/day
Nitrendipine (Baypress)	20 mg	1 time/day

Dosages may vary depending on individual patient needs, medical conditions, and formulation type (immediate or extended release). Always refer to specific prescribing guidelines.

IV. Angiotensin-Converting Enzyme Inhibitors (ACE Inhibitors)

ACE inhibitors **prevent** the conversion of **angiotensin I (AG I)** to **angiotensin II (AG II)** and **increase bradykinin activity**, which leads to **vasodilation**.

Hormonal Changes Under ACE Inhibitor Influence:

- Increased renin secretion
- Increased angiotensin I levels
- Decreased angiotensin II levels
- Reduced aldosterone levels
- Increased bradykinin levels

Classification of ACE Inhibitors:

Class I (Lipophilic Drugs):

- Captopril, Alacepril, Fentiapril

Class II (Lipophilic Drugs):

- IIA – Renal-Excreted Drugs:
 - Quinapril (Lotensin), Perindopril (Prestarium), Cilazapril (Inhibace), Enalapril (Renitec)

- **IIB – Drugs Eliminated by the Liver and Kidneys:**
 - Moexipril (Moex), Ramipril (Tritace), Spirapril (Renpress), Trandolapril (Ropten), Fosinopril (Monopril)

Class III (Hydrophilic Drugs):

- Lisinopril (Zestril), Cilazapril

Effects of ACE Inhibitors:

- Arterial vasodilation → **reduces** total peripheral vascular resistance, **decreasing** afterload
- Venodilation → **reduces** left ventricular pressure
- Cardioprotective effect
- Coronary vasodilation
- Improved blood circulation **in** kidneys, brain, skeletal muscles, and other organs
- Reduced sympathetic-adrenal activity
- Increased vagal tone
- Enhanced kallikrein-kinin system activity
- Increased prostaglandins E2 and J2
- Increased levels of natriuretics in blood and myocardium
- Antithrombotic effect
- Antioxidant effect
- Reduced aldosterone levels
- Increased bradykinin levels

Tabel №12

Indications for Use:

Drug Name	Dosage mg/ (Daily Amount and Frequency)
Captopril (Capoten)	25–150 mg (2–3 times/day)
Quinapril	5–80 mg (1 time/day)
Lisinopril	2.5–40 mg (1 time/day)
Enalapril (Berlipril, Enap, Enam)	5–40 mg (2 times/day)
Perindopril (Prestarium, Coverex)	2–4 mg (1–2 times/day)
Ramipril (Tritace)	2.5–5 mg (1–2 times/day)
Fosinopril	10–40 mg (1 time/day)

Cilazapril (Inhibace)	2.5–5 mg (1–2 times/day)
Angiotensin II Receptor Antagonists (ARBs)	
Drug Name	Dosage mg/ (Daily Amount and Frequency)
Losartan (Cozaar)	50–100 mg (1 time/day)
Valsartan (Diovan)	80–160 mg (1 time/day)
Irbesartan (Aprovel)	150–300 mg (1 time/day)
Candesartan (Atacand)	8–16 mg (1 time/day)

V. Angiotensin II Receptor Antagonists

Angiotensin II receptor antagonists are recommended for use when a dry cough develops as a side effect of ACE inhibitors. The contraindications for this group of drugs are the same as those for ACE inhibitors.

Side effects: headache, dizziness, nausea, loss of appetite, fatigue, cough.

Tabel №13

Groups	Drugs
Biphenyltetrazoles	Losartan, Irbesartan, Candesartan
Non-heterocyclic blockers	Eprosartan, Valsartan

VI. Alpha-Adrenoceptor Blockers (AABs)

- AABs are considered peripheral vasodilators.
- **Mechanism of action:** Alpha-1 and alpha-2 blockade eliminate adrenergic receptor stimulation.

They are classified as follows:

- **Selective:** Prazosin, Terazosin, Doxazosin
- **Non-selective:** Phentolamine, Tropicafen

By effect:

- **Short-acting agents:** Prazosin, Trimazosin
- **Long-acting agents:** Bunazosin, Doxazosin

They possess **vasodilatory (Prazosin, Doxazosin) and anti-atherogenic properties.**

Side effects:

- Particularly upon first use, AABs can cause a rapid decrease in blood pressure, leading to symptoms of **orthostatic collapse**.

Tabel №14

Uses of Alpha-Adrenoceptor Blockers

Drug Name	Dosage mg/ (Daily Amount and Frequency)
Doxazosin	1–16 mg (1 time/day)
Prazosin	0.5–20 mg (2–3 times/day)
Terazosin	8–80 mg (1 time/day)
Carvedilol (Alpha- and Beta-Adrenoceptor Blocker)	12.5–50 mg (2 times/day)

COMBINATION THERAPY

According to international studies, **54–70% of patients** require combination therapy.

Indications for Combination Therapy:

- **If monotherapy is ineffective:**
 - Monotherapy is effective in **50% of patients**, and while increasing the dose may enhance results, it also raises the risk of side effects.
 - The remaining **50% of patients** require **two or more** antihypertensive drugs.
- **To provide additional protection for target organs, particularly the heart and brain.**

Drug Combinations:

- ✓ **Diuretic + ACE inhibitor** – The most effective combination (e.g., **enalapril + hydrochlorothiazide**).
- ✓ **Diuretic + β -blocker** – This combination has a similar effect to **diuretics + ACE inhibitors**, but is less successful because both diuretics and beta-blockers can negatively impact glucose and lipid metabolism.
- ✓ **Diuretic + Angiotensin II receptor antagonists**
- ✓ **Diuretic + Calcium channel blockers**
- ✓ **ACE inhibitor + Potassium channel blockers**
- ✓ **β -blocker + Calcium channel blockers** (*Dihydropyridines*)
- ✓ **β -blocker + α -blocker**
- ✓ **Angiotensin II receptor antagonists + Calcium channel blockers**
- ✓ **Verapamil (or Diltiazem) + Amlodipine (or Felodipine)** – The use of this combination has been **controversial**.

Tabel № 15

**Plan for Dispensary Monitoring of Hypertensive Patients in
Primary Healthcare Settings**

Diagnosis and Treatment Data	SVA/SP 1		CRH 2	CCH 3
	Consultation/Diagnostic Procedures			
Cardiologist Consultation	-		+	+
Neurologist Consultation	-		+	+
Ophthalmologist Consultation	-		+	C/O
Hematologist Consultation	-		C/O	C/O
Endocrinologist Consultation	-		+	+
Nephrologist Consultation	-		C/O	C/O
Cardiologist Consultation	-		+	+
Blood Pressure Monitoring	+		+	+
Fundus Examination (Ophthalmoscopy)	+		+	C/O
	Laboratory and Instrumental Examination Methods			
Complete Blood Count (CBC)	+		+	+
Urinalysis (OAM)	+		+	+
Blood Glucose Measurement	+		+	+
Coagulogram	-		C/O	+
Chest X-ray	-		C/O	C/O
ECG	+		+	+
Stress ECG (Bicycle Ergometry)	-		C/O	+
	Echocardiography (Doppler Echocardiography)			
Abdominal Ultrasound	-		+	+
Holter ECG Monitoring	-		C/O	C/O
Daily Blood Pressure Monitoring	-		C/O	C/O
Coagulogram	+		C/O	+
Chest X-ray	-		C/O	+
ECG	-		C/O	C/O
Stress ECG (Bicycle Ergometry)	+		+	+
Complete Blood Count (CBC)	-		C/O	+

Legend:*CRH (ЦРБ) – Central Regional Hospital**CCH (ГКБ) – City Clinical Hospital**C/O (К/О) – Consultation/Optional*

Regional Cardiology Dispensary and Diagnostics at the Republic's Central Hospital Level

- 1. Medical History and Complaints Collection**
- 2. Clinical Examination**
- 3. Laboratory and Instrumental Examination**
- 4. Additional Tests:**
 - Determination of microalbuminuria, glomerular filtration rate, and A/C ratio
 - Electrolyte analysis
 - Sensitivity threshold for asthma
 - Ultrasound examination of major arteries (Doppler imaging of main arteries)
 - Determination of central blood pressure and pulse wave velocity
 - Identification of resistant forms of hypertension
 - Diagnostic methods for symptomatic hypertension:
 - Adrenal gland examination (renin, aldosterone, cortisol, catecholamines), pituitary gland (ACTH, TSH, GH), and thyroid hormones (T3, T4)
 - CT, MSCT, MRI of the brain, kidneys, aorta, and liver
 - Vascular Doppler imaging, angiography
 - Cognitive function assessment in cerebrovascular diseases

Dispensary Treatment and Rehabilitation

Low Risk (Less than 1%)

- Recommendations on diet, physical activity, smoking cessation, and alcohol avoidance.
- If risk is less than 1%, follow-up is scheduled in 12 months.
- Annual tests: Urine protein, blood glucose, blood pressure, ECG.
- Cholesterol testing every 2 years.

Moderate Risk (1% to 5%)

- Recommendations on diet, physical activity, smoking cessation, and alcohol avoidance.
- Monitoring every 3-6 months.
- If blood pressure $\geq 140/90$ mmHg, consider medication.
- Urine protein check every 6 months.
- Annual tests: Blood glucose, blood pressure, ECG.
- Cardiologist consultation once a year (including creatinine and cholesterol testing).

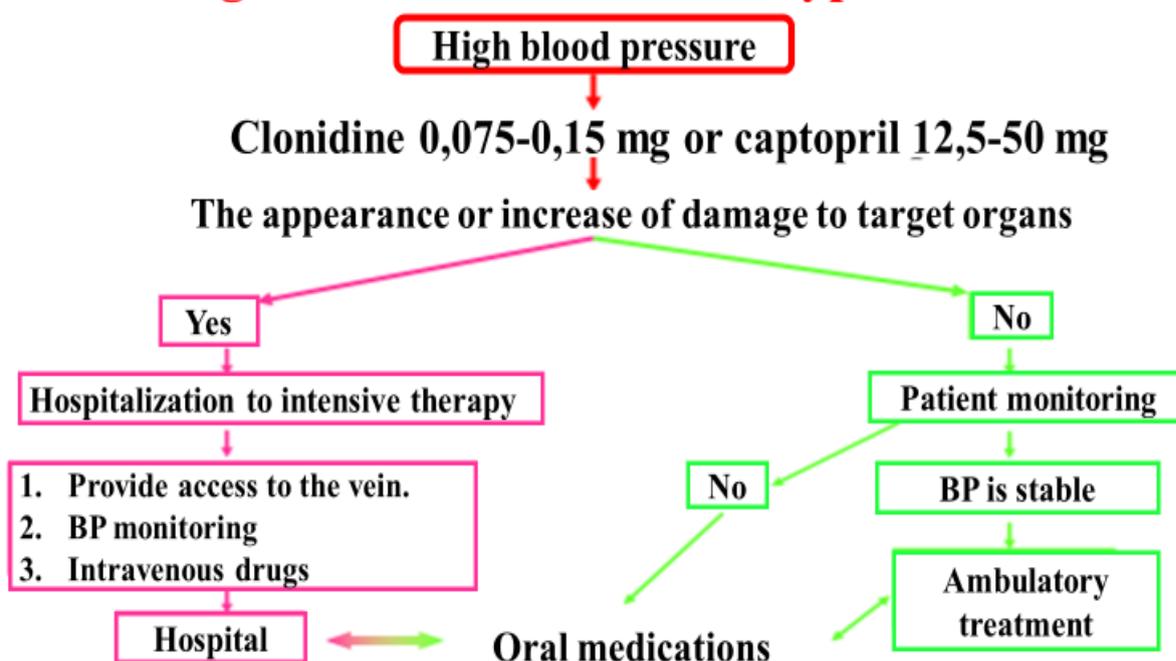
High Risk (5% to 10%) or Very High Risk (Above 10%)

- Recommendations on diet, physical activity, smoking cessation, and alcohol avoidance.
- If blood pressure $\geq 140/90$ mmHg, consider medication.
- Monitoring every 3 months. If cardiovascular complications persist for 6 months, hospitalization is recommended.
- Every 6 months: Urine protein, blood glucose, ECG.
- Annual eye examination.
- Cardiologist, endocrinologist, and neurologist consultations twice a year (including creatinine and cholesterol testing at the regional hospital).

Effectiveness of Hypertension Treatment

According to the American Committee for the Study and Control of Hypertension, regular and adequate treatment reduces stroke-related mortality by 54% and myocardial infarction mortality by 43%. As a result, the risk of death from cardiovascular diseases decreases by 20%, and overall mortality (including cancer and other diseases) drops by 13%.

The algorithm of treatment of hypertensive crisis



Goals of Hypertensive Crisis (HC) Therapy:

1. **Gradual Reduction of Blood Pressure (BP)** by 20-25% from baseline in the treatment of uncomplicated hypertensive crisis.
2. **Rapid Reduction of BP** by 20-30% from baseline in the treatment of complicated hypertensive crisis to prevent irreversible damage to the heart, brain, and potential patient mortality, as well as to manage existing complications.

Tabel № 16

Hospital Treatment Measures for Hypertensive Crisis Management

General Measures	Medication Therapy
Strict bed rest	For intravenous (IV) drip administration, the following are additionally prescribed:
Monitoring of blood pressure (BP) and dynamic assessment of the patient's condition	Pentamin 5% – 1 ml in 100 ml saline solution
Monitoring of BP and ECG; evaluation of the effectiveness of the therapy. Examination of the patient to rule out secondary hypertension	Methyldopa (Aldomet) – 250-500 mg in 100 ml saline solution Enalaprilat – 1 ml (1.25 mg) in 100 ml saline solution Isoket (Perlinganit) 0.1% – 10 ml in 100 ml saline solution
Main antihypertensive medications for intravenous drip administration	Arfonad (Trimetaphan) 5% – 5 ml in 200 ml saline solution
Selection of individualized therapy for long-term hypertension management	Sodium Nitroprusside (Nipride) – 50 mg dissolved in 400 ml saline solution Labetalol (Trandate) – 200 mg in 200 ml saline solution Adalat 0.01% – 50-100 ml Reserve mixture: Nipride and Arfonad in a 10:1 ratio (IV drip)

Tabel № 17

Pre-Hospital Treatment Measures for Hypertensive Crisis Management

General Measures	Medication Therapy
Strict bed rest; in case of a risk of pulmonary edema – sitting position.	<p>Sublingual medications:</p> <p>Capoten: 6.5–50 mg under the tongue</p> <p>Corinfar: 10–20 mg under the tongue</p> <p>Clonidine: 0.075–0.15 mg under the tongue</p> <p>Furosemide: 80–120 mg under the tongue</p> <p>Labetalol: 200–400 mg under the tongue</p>
Blood pressure monitoring and assessment of the patient's condition every 10-15 minutes.	<p>Injectable medications for intravenous bolus administration:</p> <p>Obsidan (Propranolol): 0.1% solution, 5 ml diluted in 10 ml of saline</p> <p>Clonidine: 0.01% solution, 1 ml diluted in 10 ml of saline</p> <p>Droperidol: 2 ml diluted in 20 ml of saline</p>
Continuous monitoring of blood pressure and ECG; evaluation of the effectiveness of the therapy; preparation and execution of evacuation to a hospital.	<p>Injectable medications for intravenous bolus administration:</p> <p>Clonidine: 0.01% solution, 1 ml diluted in 10 ml of saline</p> <p>Droperidol: 2 ml diluted in 20 ml of saline</p>

Emergency Care Standards for Hypertensive Crises

Hypertensive crises are acute, severe elevations in blood pressure (BP) that require immediate medical attention to prevent or limit target organ damage. The emergency management of hypertensive crises follows established protocols to ensure rapid BP reduction while minimizing risks.

1. Classification of Hypertensive Crises

A. Hypertensive Emergency

A life-threatening condition characterized by severe BP elevation ($\geq 180/120$ mmHg) with evidence of acute organ damage, such as:

- Hypertensive encephalopathy (severe headache, altered mental status, seizures)

- Acute left ventricular failure with pulmonary edema
- Acute myocardial infarction or unstable angina
- Aortic dissection
- Acute kidney injury
- Intracerebral hemorrhage or ischemic stroke
- Eclampsia or severe preeclampsia

B. Hypertensive Urgency

- Severe BP elevation ($\geq 180/120$ mmHg) **without** evidence of acute organ damage.
- Can often be managed with oral antihypertensives in an outpatient or observation setting.

2. General Emergency Measures

- **Patient Positioning:** Strict bed rest; sit upright if pulmonary edema is present.
- **Vital Signs Monitoring:** BP monitoring every 10-15 minutes, along with ECG and neurological assessment.
- **Oxygen Therapy:** Administer oxygen in cases of respiratory distress.
- **IV Access:** Establish venous access for medication administration.
- **Evacuation to Hospital:** If required, transport the patient on a stretcher with continuous monitoring by a physician or paramedic.

3. Pharmacologic Management

A. First-Line IV Medications for Hypertensive Emergencies

(Choice depends on the underlying condition and associated complications)

Medication	Indication	Dosage
Nitroprusside Sodium (Nipride)	Aortic dissection, acute heart failure	0.3-0.5 mcg/kg/min IV infusion
Labetalol	Stroke, eclampsia, aortic dissection	10-20 mg IV bolus, repeat as needed
Nicardipine	Stroke, hypertensive encephalopathy	5 mg/h IV infusion, increase by 2.5 mg/h every 5 min
Esmolol	Aortic dissection, perioperative hypertension	500 mcg/kg IV bolus over 1 min, followed by infusion
Fenoldopam	Acute renal failure, hypertensive encephalopathy	0.1 mcg/kg/min IV infusion
Hydralazine	Eclampsia, preeclampsia	5-10 mg IV every 20-30 min
Enalaprilat	Acute heart failure	1.25 mg IV every 6 hours
Furosemide	Pulmonary edema, volume overload	20-40 mg IV bolus
Clonidine	Hypertensive urgency (oral or IV)	0.1-0.2 mg PO every hour

4. Special Considerations for Specific Conditions

- **Acute Myocardial Infarction:** Labetalol or nitroglycerin preferred. Avoid drugs that cause reflex tachycardia (e.g., hydralazine).
- **Acute Stroke:** BP reduction is only indicated if BP exceeds 220/120 mmHg in ischemic stroke or 180/110 mmHg in hemorrhagic stroke. Nicardipine or labetalol preferred.
- **Aortic Dissection:** Rapid BP control with labetalol or esmolol to maintain systolic BP <120 mmHg and HR <60 bpm.
- **Eclampsia/Preeclampsia:** Magnesium sulfate, labetalol, or hydralazine preferred. Avoid ACE inhibitors.
- **Acute Pulmonary Edema:** IV nitroglycerin or furosemide preferred; avoid beta-blockers in acute heart failure.

5. Hypertensive Urgency Management

- Usually managed with **oral** antihypertensives (e.g., captopril, clonidine, amlodipine, labetalol).
- Gradual BP reduction over **24-48 hours** to avoid hypoperfusion complications.
- Patient education on lifestyle modification and medication adherence.

6. Post-Crisis Management & Long-Term Care

- **Identify and Treat Underlying Causes** (e.g., renovascular hypertension, pheochromocytoma, primary aldosteronism).
- **Lifestyle Modifications** (low-sodium diet, weight loss, smoking cessation, regular exercise).
- **Follow-Up** with a cardiologist or nephrologist if secondary causes are suspected.

Hypertensive crises require **rapid, individualized management** to prevent life-threatening complications. **Intravenous therapy is preferred in emergencies**, while **oral therapy suffices for urgency cases**. A **multidisciplinary approach** involving emergency physicians, cardiologists, and nephrologists ensures optimal patient outcomes.

Tabel №18

Treatment of Isolated Systolic Hypertension (ISH)

Clinical Situations	Medications
Left ventricular hypertrophy	ACE inhibitors (ACEi), Calcium channel blockers (CCB)

Asymptomatic atherosclerosis	ACE inhibitors (ACEi), Calcium channel blockers (CCB)
Cardiovascular diseases	
History of stroke	
History of myocardial infarction	Beta-blockers (BB), Alpha-adrenergic blockers (AAFi) or Angiotensin receptor blockers (ARB)
Angina pectoris	Beta-blockers (BB), Calcium antagonists (CA)
Heart failure	Diuretic, Beta-blockers (BB), ACE inhibitors (ACEi), Calcium channel blockers (CCB)
Aortic aneurysm	Beta-blockers (BB)
Atrial fibrillation (for prevention)	ACE inhibitors (ACEi) or ARB, Beta-blockers (BB) or mineralocorticoid receptor antagonists
Atrial fibrillation (ventricular rate control)	Beta-blockers (BB), Non-dihydropyridine calcium channel blockers
Proteinuria	ACE inhibitors (ACEi) or ARB
Peripheral artery disease	ACE inhibitors (ACEi) or Calcium channel blockers (CCB)
Others	
Isolated systolic arterial hypertension (in elderly patients)	Diuretic, Calcium antagonists (CA)
Metabolic syndrome	ACE inhibitors (ACEi) or ARB, Calcium antagonists (CA)
Diabetes	ACE inhibitors (ACEi) or ARB
Pregnancy	Methyldopa, Beta-blockers (BB), Calcium channel blockers (CCB)

Treatment of Conn's Syndrome

- **For Bilateral Adrenal Hyperplasia**, surgical treatment is not recommended.
- Patients are prescribed **Spironolactone (Verospiron)** at **300-400 mg/day** for one month or longer, then the dose is gradually reduced to **100-200 mg/day**.

Aspirin Therapy

- **Low-dose aspirin (75–150 mg/day)** is recommended for patients at **high or very high cardiovascular risk**, as well as those with **cardiovascular complications** and **chronic kidney disease (CKD)**.

Statin Therapy

- **Statins** are recommended for adults with **moderate, high, or very high cardiovascular risk**.
- The target **low-density lipoprotein (LDL) cholesterol** level:
 - **<3.0 mmol/L (115 mg/dL)**
 - **<1.8 mmol/L (70 mg/dL) for patients with coronary artery disease (CAD).**

Review Questions

1. Principles of Hypertension Treatment
2. Non-Pharmacological Treatment
3. Classification of Antihypertensive Drugs
4. Indications and Contraindications for Diuretics
5. Indications and Contraindications for Beta-Blockers
6. Indications and Contraindications for Calcium Channel Blockers
7. Indications and Contraindications for ACE Inhibitors
8. Treatment of Uncomplicated Hypertensive Crisis
9. Treatment of Complicated Hypertensive Crisis
10. Treatment of Secondary (Symptomatic) Hypertension
11. Disease Prevention
12. Patient Monitoring and Follow-Up (Dispensary Care)

CLINICAL CASE SCENARIOS

Case 1

Patient: 45-year-old male

Symptoms: Severe headaches, facial and neck flushing, hand tremors, palpitations, dizziness, sweating.

Findings: Moderate condition, vesicular breathing, muffled heart sounds, tachycardia, accentuated second heart sound over the aorta. BP **160/100 mmHg**, pulse **100 bpm**, ECG shows **sinus rhythm (HR 95 bpm)** and **left ventricular hypertrophy (LVH)**.

1. **Diagnosis?**
 - **Hypertensive crisis (uncomplicated) with LVH**
2. **Stage of Disease?**
 - **Stage II Hypertension**
3. **Treatment Plan?**
 - **Antihypertensive therapy, lifestyle modifications, and monitoring**

Case 2

Patient: 35-year-old woman

Symptoms: Moderate hypertension, muscle weakness, polyuria, paresthesia.

Findings: No edema, **urinary potassium loss increased**, **CT: localized encapsulated lesion in the left adrenal gland.**

1. **Most Likely Laboratory Findings?**
 - **Increased aldosterone, decreased renin, hypokalemia (Option 1 or 3)**
2. **Which Diagnostic Test Confirms the Diagnosis?**
 - **Spironolactone Test**

Likely Diagnosis: Primary Hyperaldosteronism (Conn's Syndrome)

Case 3

Patient: Young woman

Symptoms: Periodic headaches, BP 160/100 mmHg, normal urine tests.

History: 10 years of oral contraceptive (OC) use.

1. **Most Likely Cause of Hypertension?**
 - Oral contraceptive use
2. **Mechanism of Increased BP with OC Use?**
 - RAAS stimulation

Case 4

Patient: 67-year-old woman

Symptoms: Nausea, vomiting, loss of appetite, itching, history of chronic pyelonephritis (16 years, untreated).

Findings: Dry skin with excoriations, BP 180/100 mmHg, HR 100 bpm, laboratory results show anemia, increased urea (15 mmol/L), creatinine (0.34 mmol/L), and proteinuria.

1. **Preliminary Diagnosis?**
 - Chronic pyelonephritis (CPN) with chronic kidney disease (CKD)
2. **Additional Diagnostic Tests?**
 - Kidney ultrasound, isotope renography, Rehberg test, blood gas analysis, urine culture
3. **Treatment Plan?**
 - Low-protein diet, antibiotics, antihypertensive therapy (calcium channel blockers or beta-blockers instead of ACE inhibitors due to high creatinine levels).

Case 5

Patient: 48-year-old male

History: Hypertension (diagnosed 3 years ago)

Findings: Chronic glomerulonephritis with compensated CKD, BP 200/100 mmHg, dry pale skin, HR 60 bpm, accentuated second heart sound over the aorta.

Which Antihypertensive Drug is Most Suitable?

- Enalapril (ACE inhibitor)
- Reason: Improves intrarenal hemodynamics
- Beta-blockers and calcium channel blockers are not recommended due to bradycardia.

Case 6

Patient: 60-year-old male

Findings: Complete atrioventricular block, HR 32-44 bpm, BP 220/100 mmHg

1. **Pathogenesis and Type of Hypertension?**
 - **High cardiac output, hemodynamic hypertension**
2. **Best Treatment Approach?**
 - **Permanent pacemaker implantation**

Case 7

Patient: 33-year-old woman

Symptoms: Weight loss, tachycardia, sweating, irritability, emotional instability, diarrhea, HR 98 bpm, BP 150/80 mmHg, Moebius sign positive.

1. **Most Likely Diagnosis?**
 - **Thyrotoxicosis with secondary hypertension**
2. **Most Informative Diagnostic Test?**
 - **Thyroid hormone panel (T3, T4, TSH)**

These cases cover a broad range of hypertension-related disorders, including **primary hypertension, secondary hypertension (due to Conn's syndrome, CKD, oral contraceptives, thyrotoxicosis), hypertensive crisis, and treatment approaches for each condition.**

TEST QUESTIONS

1. **During Stage II Hypertension, an objective examination may reveal:**
 - Systolic murmur at the base of the heart
 - **Accentuation of the second heart sound over the aorta**
 - Narrowing of the heart borders
 - **Leftward displacement of the heart borders**
 - Rightward displacement of the heart borders
2. **Stage III Hypertension is characterized by:**
 - Left ventricular hypertrophy
 - Right ventricular hypertrophy
 - Persistently high blood pressure
 - **Target organ damage**
 - Unstable blood pressure
3. **Key ECG symptoms of left ventricular hypertrophy:**
 - Absence of T waves
 - Prolonged QT interval
 - High R wave amplitude in II, III, V1, V2
 - **High R wave amplitude in I, V5, V6, aVL**
 - Absence of P waves
4. **Non-drug treatment of hypertension does not include:**
 - **Limiting physical activity**
 - Sufficient physical activity
 - Weight loss
 - Reducing salt intake
 - Reducing fluid intake
5. **Which of the following is NOT an angiotensin II receptor blocker?**
 - Losartan
 - Valsartan
 - **Enalapril**
 - Irbesartan
 - Lisinopril
6. **Which drug combination is considered irrational for hypertension treatment?**
 - **Beta-blockers + Calcium channel blockers**
 - Beta-blockers + Diuretics

- ACE inhibitors + Calcium channel blockers
 - ACE inhibitors + Diuretics
 - ARBs + Diuretics
7. **The most effective method to detect left ventricular hypertrophy is:**
- Percussion
 - ECG
 - **Echocardiography**
 - X-ray
 - Phonocardiography
8. **The most common complication of hypertension is:**
- Renal artery thrombosis
 - Brain tumor
 - **Hypertensive crisis**
 - Primary renal failure
 - Retinal hemorrhages
9. **Causes of hypertensive crises do NOT include:**
- Abrupt withdrawal of clonidine
 - Stress
 - Physical inactivity
 - **Abrupt discontinuation of aspirin**
 - Sudden weather changes
10. **Which type of hypertensive crisis does NOT exist?**
- **Asthmatic**
 - Adrenal
 - Neurovegetative
 - Water-salt
 - With tremor syndrome
11. **Which medication is NOT used in the treatment of a hypertensive crisis?**
- Corinfar
 - Nifedipine
 - Sodium nitroprusside
 - **Triampur**
 - Lasix
12. **Which drug is NOT used to relieve a hypertensive crisis?**
- **Amlodipine**
 - Lasix
 - Corinfar
 - Magnesium sulfate
 - Sodium nitroprusside

13. A diuretic used for hypertensive crisis treatment is:

- **Furosemide**
- Uregit
- Voine
- Obman
- Triamterene

14. A feature distinguishing Stage II from Stage I hypertension according to WHO classification:

- **Left ventricular hypertrophy**
- Presence of complications
- Absence of treatment
- Presence of comorbidities

15. Key criteria for Stage III Hypertension:

- **Heart, kidney, and brain damage due to hypertension**
- Stable high blood pressure manageable with medication
- Periodic diastolic BP > 115 mmHg
- Left ventricular hypertrophy
- Frequent hypertensive crises

16. Which test is conducted for suspected pheochromocytoma?

- **Norepinephrine and its metabolites**
- 17-OH corticosteroids
- Thyroid hormones
- Aldosterone level
- Electrolytes in blood

17. A side effect of ACE inhibitors is:

- **Hyperkalemia**
- Bradycardia (HR < 50 bpm)
- Worsening heart failure
- Atrioventricular conduction disorders
- Hemorrhagic diathesis

18. A key feature of renovascular hypertension is:

- **Persistently high blood pressure**
- Gradual increase in BP
- Good response to antihypertensive therapy
- Increase in both systolic and diastolic BP

- Gradual progression

19.A characteristic clinical sign of pheochromocytoma:

- **Hyperglycemia associated with hypertension**
- Moon face, osteoporosis, skin atrophy
- Muscle relaxation, polyuria
- Hypoglycemia, hypokalemia
- Constantly high blood pressure

20.A characteristic clinical sign of primary hyperaldosteronism:

- **Severe hypokalemia**
- Hyperglycemia
- Generalized edema
- Exophthalmos
- Hyperkalemia

21.Two types of secondary hypertension with reduced renin levels:

- **Conn's syndrome**
- **Primary hyperaldosteronism**
- Renovascular hypertension
- Pheochromocytoma

22.Which two drugs are cardioselective beta-blockers?

- **Propranolol**
- **Nadolol**
- Metoprolol
- Propafenone

23.Beta-blockers are contraindicated in the following three conditions:

- **Sick sinus syndrome**
- **Sinus bradycardia**
- **Bronchial obstructive syndrome**
- Hypertension
- Symptomatic hypertension
- Tachyarrhythmia

24.Three mechanisms of ACE inhibitors:

- **Pre- and afterload reduction**
- **Reduction of myocardial oxygen demand**
- **Improvement of endothelial function**

- Increased coronary vessel stiffness
- Reduced diuresis
- Increased myocardial oxygen demand

25. Three symptoms characteristic of primary hyperaldosteronism:

- **Severe weakness**
- **Absent paresthesia and tremor**
- **Polyuria and nocturia**
- Increased blood sugar
- Increased cortisol levels

26. Three signs of systolic hypertension:

- **Develops in elderly patients**
- **Increased risk of stroke**
- **Increased risk of myocardial infarction**
- Occurs in young people
- Considered normal
- Hypertension is harmless

27. Beta-blockers are contraindicated in the following three conditions:

- **Sick sinus syndrome**
- **Sinus bradycardia**
- **Bronchial obstructive syndrome**
- Hypertension
- Symptomatic hypertension
- Tachyarrhythmia

28. Contraindications for ACE inhibitors:

- **Pregnancy**
- **Hyperkalemia (>5.5 mmol/L)**
- **Bilateral renal artery stenosis**
- Left ventricular hypertrophy with hypertension
- Post-infarction atherosclerosis
- Heart failure

29. Three urine markers suggesting hypertension due to pyelonephritis:

- **"True" bacteriuria**
- **Low proteinuria**
- **Hypoisothenuria**
- Massive proteinuria
- Uric acid crystals

- Oxaluria

30. Four side effects of ACE inhibitors:

- **Cough**
- **Angioedema**
- **Hyperkalemia**
- **Increased serum creatinine**
- Bronchospasm
- Raynaud's syndrome
- Myalgia
- Bradycardia

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