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АРТЕРИАЛЬНАЯ ГИПЕРТЕНЗИЯ У ДЕТЕЙ

Учебное пособие

L. I. Krasnova

ARTERIAL HYPERTENSION IN CHILDREN

Manual

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Р е ц е н з е н т ы :

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Представлена информация об артериальной гипертензии у детей. Отражены проблемы этиологии, эпидемиологии, клинической картины, диагностики и новых методов лечения. Пособие соответствует программе госпитальной педиатрии для медицинских институтов и Федеральным клиническим рекомендациям и стандартам для высшего профессионального образования для специалитета.

Издание подготовлено на кафедре педиатрии Медицинского института ПГУ и предназначено для обучающихся по специальностям 31.05.01 «Лечебное дело», 31.05.02 «Педиатрия», а также может быть использовано для обучения и внеклассной работы для студентов медицинских институтов и практикующих врачей.

This manual covers information about arterial hypertension in children, reflects issues of etiology, epidemiology, clinical picture, diagnosis and modern methods of therapy. The textbook complies with the program in hospital pediatrics for medical specialties of universities and the Federal State Educational Standards for Higher Professional Education in medical specialties.

The publication was prepared at the Department of Pediatrics of the Medical Institute of PSU and is intended for students majoring in 31.05.01 "General medicine", 31.05.02 "Pediatrics" and can be used for classroom and extracurricular work by university medical students and practicing pediatric doctors.

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Arterial hypertension in children and adolescents diagnosis

Normal blood pressure is the average SBP (systolic blood pressure) and DBP (diastolic blood pressure) levels at three visits that are less than the 90th percentile for a given age, sex and height or less than 120/80 mmHg. Art. for children under 16 years of age and less than 130/85 mmHg. Art. for teenagers over 16 years old.

High normal (synonymous with elevated) BP – average levels of SBP and / or DBP at three visits equal to or greater than the 90th percentile, but less than the 95th percentile for a given age, sex and height.

Arterial hypertension – mean SBP and/or DBP levels at three visits equal to or greater than the 95th percentile for age, sex and height, for children from 1 to 16 years. In children over 16 years of age, uniform criteria can be used to diagnose hypertension ≥140/90 mmHg. Art.

Classification of arterial hypertension

Category	0–15 years SBP and/or DBP percentiles mmHg	16 years and older SBP and/or DBP mmHg
Normal	<90th percentile	<130/85
Hight normal	290th to <95th percentile	130–139/85–89
Hypertension	>=95th percentile	140/90
1st degree of hypertension	95th to 99th percentile and 5 mmHg Art.	140–159/90–99
2nd degree of hypertension	>99th percentile + 5 mmHg Art.	>160/100
ISH (isolated systolic hypertension)	SPB 295th percentile and < SPB 90th percentile	>=140/<90

Arterial hypertension is divided into 2 degrees

The blood pressure level for the 1st degree of hypertension varies from the 95th to the 99th percentile + 5 mmHg. Art. for children under 16 years old and 140–159/90–99 mmHg for teenagers over 16 years old. The blood pressure level for 2nd degree of hypertension is more than the 99th percentile + + 5 mmHg Art. for children less than 16 years old and ≥160/100 mmHg. Art. for teenagers over 16 years old.

Features of coding a disease or condition (group of diseases or conditions) according to the International Statistical Classification of Diseases and Related Health Problems

I10 – Essential [primary] arterial hypertension.
I11 – Hypertensive heart disease [hypertension primarily affecting the heart].
I11.0 – Hypertensive heart disease [hypertensive] disease predominantly affecting the heart with (congestive) heart failure.
I11.9 – Hypertensive heart disease [hypertensive] disease predominantly affecting the heart without (congestive) heart failure.
I12 – Hypertensive [hypertensive] disease with predominant kidney damage

Rules for measuring blood pressure in newborns

1. 1.5 hours after feeding or medical intervention.
2. The newborn lies on his stomach or back.
3. A cuff corresponding to the circumference of the shoulder is used.
4. Measurement on the right upper limb.
5. After applying the cuff, the baby is left alone for 15 min (the child is sleeping or quietly awake);
6. 3 consecutive BP readings are performed at 2-minute intervals; if an automated device is used, the first result is usually discarded.

High-risk conditions for which ABPM is indicated

States	Rationale
Secondary hypertension	Detection of severe or nocturnal hypertension, indicating a high probability of a secondary origin of hypertension
Chronic kidney disease (CKD) or ructural kidney malformations	Detection of masked hypertension or nocturnal hypertension on order to correct blood pressure levels and slow progression kidney pathologies
Diabetes mellitus type 1 or 2	Assessment or abnormal circadian rhythm HELL Controlling blood pressure reduces the risk of developing microalbuminuria

Organ transplantation	Detection of masked hypertension or nocturnal hypertension for better BP
Obesity	control Detection of white coat and masked hypertension
Obstructive nocturnal syndrome Definition of “non-dipping” and an increase	
Apnea	in the amplitude and speed of the morning rise in blood pressure
Coarctation of the aorta (after operations)	Diagnosis of persistent and masked Hypertension
Genetic syndromes and congenital malformation associated with hypertension (neurofibromatosis, Shereshevsky – Turner syndrome, Williams syndrome, coarctation of the aorta, Van Hipel-Lindau syndrome, multiple endocrine neoplasia syndrome)	Hypertension associated with increased arterial wall density is detected only using ABPM
Treatment of hypertension	Confirmation of effectiveness therapy during the day
History of prematurity	Identification of non-dipping >
Scientific developments, clinical trials	BP Allows you to reduce sample sizes

Indications for ABPM in children and adolescents

– To confirm hypertension (and determine its form) in children and adolescents with persistent high blood pressure for at least 1 year.

– With blood pressure values according to office measurements corresponding to the 1st degree of hypertension (at three visits) to exclude “white coat hypertension” and prescribe unnecessary antihypertensive treatment.

– To confirm hypertension in case of significant fluctuations in blood pressure during one or more visits to the doctor.

– Hypertension resistant to ongoing drug treatment; assessment of blood pressure control in children with target organ damage.

– Exclusion of “masked hypertension” in case of target organ damage (left ventricular hypertrophy, microalbuminuria) and normal office / clinical blood pressure levels.

– In patients at risk for the development of hypertension with diabetes mellitus type 1 and 2, with chronic kidney disease, with severe obesity, with sleep-disordered breathing, operated on for coarctation of the aorta, with kidney, liver, or heart transplantation.

– With normal level of office / clinical blood pressure, but with a hypertensive response to physical activity.

– Before starting drug therapy with antihypertensive drugs and during treatment to assess its effectiveness.

– When conducting scientific research.

In addition to the average values of systolic and diastolic blood pressure, the following are assessed:

– maximum and minimum blood pressure values at different periods of the day;

– "pressure load" indicators (hypertension time index, hypertension area index) per day, day and night;

– blood pressure variability;

– daily index (degree of nocturnal decrease in blood pressure);

– morning rise in blood pressure (the magnitude and speed of the morning rise in blood pressure);

– duration of hypotensive episodes (time index and hypotension area index).

Criteria for establishing a diagnosis, principles for formulating a diagnosis

– It is recommended to measure blood pressure in children starting at the age of 3 years. The frequency of blood pressure measurements at doctor visits is once a year.

– It is recommended to measure blood pressure at every visit to the pediatrician if a child or adolescent is classified as at risk for the development of hypertension.

– It is recommended to measure blood pressure in children from birth to 3 years of age if the child is classified as at risk for the development of hypertension.

Indications for classifying a child as a risk group for the development of hypertension

– Prematurity with a gestational age of less than 32 weeks, low birth weight.

– The presence of neonatal pathology requiring resuscitation measures.

– The presence of congenital heart defects, including those undergoing surgery.

– History of repeated episodes of urinary tract infection, persistent hematuria and (or) proteinuria.

– Presence of chronic kidney disease (chronic renal failure) or urological abnormalities.

– Presence of congenital kidney disease in a family history.

– Organ or bone marrow transplantation performed.

– The presence of a malignant disease.

– Use of drugs that increase blood pressure.

– The child has systemic diseases that can manifest as hypertension (neurofibromatosis, tuberous sclerosis, sickle cell anemia, etc.).

– Cases of proven intracranial hypertension.

In all patients with hypertension, objective testing should include:

– With coarctation of the aorta, blood pressure in the legs is lower compared to blood pressure in the arms;

– Inspection of the skin – you should pay attention to: “nigricans” acanthosis (acanthosis nigricans), café-au-lait spots, livedo reticularis;

– Striae;

– Neurofibromatous nodes;

– Axillary freckles;

– Increased skin moisture;

– Pallor;

– Cold palms,

– Feet.

In all patients with hypertension, objective testing should also include:

– examination of the eyes and fundus: cataract, spasm and narrowing of the arteries, hemorrhages, exudation, hyperthyroidism, swelling of the optic nerve nipple;

– examination of the neck area: noise over the carotid artery during auscultation, swelling of the jugular veins, enlargement of the thyroid gland.

Sexual development according to Tanner

Girls	
Pubic hair	**Breast development**
Prepubertal, vellus hair only	Prepubertal: Enlargement of Nipple ONLY
Rare, slightly pigmented hair in the labial majora area	Enlargement of the mammary glands, determined visually or by palpation, increase in areole diameter
Hair that is darker, coarser, curly, extending into the pubic area	Further enlargement of the mammary glands and areolas without highlighting their contour
Adult type of hair growth without spreading to the inner thighs	Protrusion of the areola and nipple above the surface of the breast
Adult type of hair growth extending to the inner thighs in the shape of an inverted triangle, but without transition to linea alba	Adult conburs of the breast with only the nipple protruding above its surface

Boys	
Pubic hair	**Development of genital organs**
Prepubertal, vellus hair only	Prepubertal genitalia: testicular length <2.5 cm
Rare, slightly pigmented hair at the base of the penis	Thickening and redness of the scrotum; increase in testicular size: from 2.5 to 3.2 cm
Hair that is darker, coarser, curly, extending into the pubic area	Enlargement of the penis, especially in length; further increase in testicular size: 3.3 to 4.0 cm
Adult type of hair growth without spreading to the inner thighs	Further increase in penis length and thickness; testicular enlargement: from 4.1 to 4.5 cm; scrotal pigmentation
Adult type of hair growth extending to the inner thighs in the shape of an inverted triangle, but without transition to linea alba	Genital organs of an adult in shape and size; testicle size >4.5cm

Laboratory diagnostic tests

I. General clinical blood test.

– Blood chemistry determination of blood lipid spectrum: cholesterol, triglycerides; high and low density lipoprotein cholesterol.

– Determination of the level of catecholamines in the blood and / or daily urine (adrenaline, norepinephrine or metanephrines, vanillylmandelic acid) according to indications for suspected pheochromocytoma, during a crisis of hypertension.

– It is recommended to determine the level of plasma renin and aldosterone in patients in order to assess the activity of the renin-angiotensin-aldosterone system.

II. General urine analysis.

– Determination of elevated serum uric acid levels is more often associated with excess body weight.

– quantitative assessment of albuminuria in daily urine and / or morning urine (albumin/creatinine ratio or daily urine protein) to assess kidney damage as a target organ.

– Urinalysis according to Nechiporenko, Zimnitsky test, protein level in daily urine, urine albumin level are performed for patients with suspected renal genesis of hypertension.

– Determination of the level of TSH, T3 (free), T4 (free) in blood serum; Antibodies to thyroid peroxidase and thyroglobulin are performed in patients with suspected thyroid pathology.

– Determination of the level of adrenocorticotropic hormone (ACTH) and cortisol in blood serum, ACTH free cortisol in daily urine; a test with dexamethasone is performed in patients with suspected Cushing's disease.

List of laboratory testing methods in patients with hypertension, suspected secondary hypertension:

Name of pathology	Laboratory procedure
Kidney diseases	General urine analysis, urine analysis according to Nechiporenko, daily urine for protein, urine microalbumin, level of creatinine, urea, electrolytes in blood serum, estimated glomerular filtration rate, level of renin in blood serum

Name of pathology	Laboratory procedure
Thyroid diseases	Level of TSH, T3 (free), T4 (free) in blood serum; antibodies to thyroid peroxidase and thyroglobulin
Pheochromocytoma	The level of metanephrine or catecholamines in the blood and daily urine
Itsenko-Cushing syndrome	Level of adrenocorticotropic hormone (ACTH) and cortisol in the blood serum, free cortisol in daily urine; test with Dexamethasone
Primary hyperaldosteronism	Serum potassium, plasma renin and aldosterone levels; separate study of renin and aldosterone in blood from the right and left renal and adrenal veins; dexamethasone test
Hyperparathyroidism	Serum calcium and parathyroid hormone levels; radiography of the hand bones

Instrumental diagnostic studies

1. 24-hour blood pressure monitoring (ABPM) is recommended for all patients with hypertension, starting from 6 years of age.
2. Echocardiography is recommended for all patients with hypertension.
3. It is recommended to repeat echocardiography in patients with hypertension to assess the dynamics of the myocardium at intervals of 6–12 months.
4. ECG registration is recommended for all patients with hypertension.
5. Examination of the fundus vessels (fundoscopy) is performed in all patients with hypertension.
6. Renal ultrasound is performed in all patients with hypertension to exclude renal masses, congenital anomalies, and polycystic disease.
7. Dopplerography of the renal vessels is performed in patients with hypertension if renal artery stenosis is suspected.
8. Renal scintigraphy (static / dynamic scintigraphy) is performed in patients with suspected renal / vasorenal hypertension to assess renal perfusion and function.

Treatment of arterial hypertension

Non-drug treatment includes the following components:

– reduction of excess body weight;
– optimization of physical activity;
– quitting smoking, drinking alcohol and energy drinks;
– rationalization of nutrition;
– reduction of psycho-emotional stress.

Optimizing physical activity to maintain good health, children (over 5 years old) need to spend 30–60 min daily on moderate (mainly aerobic) exercise and 30 min 3–4 times a week on intense dynamic physical activity.

Characteristics of sports depending on the severity of the dynamic component:

Low dynamic component	Moderate dynamic component	High dynamic component
Bobsled Various types of throwing shells Gymnastics Karate, judo Luge Climbing Water skiing Weightlifting Windsurfing	Bodybuilding Wrestling Skiing	Boxing (not recommended) Bicycle Decathlon Skates Dam

Examples of moderate physical activity:

– Walking at a brisk pace (3 km in 30 min).
– Cycling (8 km in 30 min).
– Dancing at a fast pace (duration 30 min).
– Playing basketball (for 15–20 min)
– Volleyball game (for 45 min).

Drug antihypertensive therapy

Treatment begins with a minimal dose and only one drug to reduce possible side effects. If there is an insufficient hypotensive effect with good

tolerability of the drug, it is advisable to increase the dosage of this drug. The dose is increased every 4 weeks, preferably under the control of ABPM results.

Two classes of antihypertensive drugs are used as initial therapy in children and adolescents: ACE inhibitors and angiotensin receptor blockers (ARBs).

It is advisable to use long-acting drugs that provide blood pressure control for 24 hours with a single dose.

The effectiveness of antihypertensive treatment is assessed after 8–12 weeks from the start of treatment.

The optimal duration of drug therapy is determined individually in each specific case. The minimum duration of drug treatment is 3 months, preferably 6–12 months.

With adequately selected therapy, after 3 months of continuous treatment, it is possible to gradually reduce the dose of the drug until it is completely discontinued with the continuation of non-drug treatment with stable normal blood pressure. The effectiveness of non-drug treatment is monitored once every 3 months.

Currently, antihypertensive drugs of 5 main groups are recommended for the treatment of hypertension in children and adolescents:

1) ACE inhibitors;
2) angiotensin receptor blockers;
3) calcium channel blockers (dihydropyridine);
4) thiazide diuretics;
5) beta blockers.

ACE inhibitors

ACE inhibitors are recommended as first-choice drugs in the treatment of hypertension in childhood and adolescence.

Special indications: diabetes mellitus, metabolic syndrome, LVH, chronic kidney disease, proteinuria.

Special notes: control of potassium, blood creatinine, control of the leukocyte count every 8 weeks of treatment, when treating teenage girls, a pregnancy test every 8 weeks of treatment.

ACE inhibitor drugs used: captopril, enalapril, fosinopril, lisinopril, ramipril, benazepril, quinapril.

Angiotensin II receptor blocker drugs used: losartan, irbesartan, candesartan, olmesartan, valsartan.

Calcium channel blocker drugs used: amlodipine, felodipine, isradipin, nifedipine sustained release.

Drugs used: hydrochlorothiazide, chlorothiazide, chlorthalidone, indapamide sustained release.

Features of treatment of nephrogenic arterial hypertension

Children with nephrogenic hypertension (excluding patients with salt-wasting forms of kidney disease), especially against the background of hypervolemia, must follow a low-salt diet: avoid adding salt to food during preparation and while eating, use products with a salt content of <0.5 g/100 g of product (indicated in the product composition).

For patients ≥16 years of age with proteinuric types of kidney pathology, the level of average daily blood pressure (according to ABPM) can be reduced to 125/75 mm Hg. Art. It must be remembered that patients should not have episodes of hypotension recorded both during single measurements and according to ABPM data.

Treatment of monogenic forms of arterial hypertension

Monogenic forms of hypertension	Gene / inheritance	Treatment
False mineralocorticoid excess syndrome	HSD11B2AP	Amiloride Spironolactone Eplerenone
Glucocorticoid – mediated hyperaldosteronism	CYP11B2I / CYP11B1AD	Low dose glucocorticoids (dexamethasone) Amiloride Triamterene
Pseudoldosteronism, Liddle's syndrome	SCNN1B / SCNNIG AD	Amiloride Triamterene Salt restriction
Pseudohypoaldosteronism type 2, Gordon's syndrome	KLHL3, CUL3 WNK1, WNK4 AD	Hypothiazide
Congenital adrenal hyperplasia	CYP21A21 / CYP11B1 AD	Spironolactone Eplerenone Dexamethasone

Rehabilitation

Conducting the Arterial Hypertension School is recommended for adolescents with primary (essential) hypertension: performed on all patients; an individual rehabilitation program is developed; the goals and objectives of carrying out rehabilitation activities are formulated based on the rehabilitation diagnosis and rehabilitation potential; motor mode is determined; rehabilitation methods are determined: medications, physiotherapy, information technology, psychological correction; forms of medical rehabilitation are selected at various stages of its application, during various periods of the course of the disease (individual, group lessons); legal representatives of children in need of medical rehabilitation are consulted

Methods of rehabilitation of children and adolescents with hypertension in sanatorium-resort organizations include:

1) climatic regime according to the season of the year and the clinical and functional state of the patient;

2) medical nutrition;

3) adequate physical activity, taking into account tolerance to physical activity in the form of a course of small group or individual classes;

4) therapeutic massage of the collar area and scalp;

5) physical methods of treating children and adolescents with hypertension: sedative, hypotonic, vasodilating, cardiotonic, vegetative-corrective methods (prescribed according to generally accepted methods);

6) psychocorrection, psychotherapy if indicated (individual or small group sessions).

Methods of rehabilitation of children and adolescents with hypertension in sanatorium and resort organizations

The motor mode includes:

– Morning hygienic exercises with self-monitoring of heart rate, therapeutic exercises.

– Walks in the fresh air along the sea and in the park area.

– Therapeutic dosed walking is prescribed adequately to the patient's condition at a pace of 70–80 steps per minute according to mode I and 80–90 steps per minute according to mode II with a short rest (3–5 min) on a bench. Before and after therapeutic walking, heart rate is measured to monitor exercise tolerance.

– Terrenkur – alternating walking on flat terrain with inclines from 3 to 15°. Walking pace is slow (60–80 steps per minute).

Centrally acting drugs

Clonidine is a central α1-adrenergic receptor agonist. Reduces the excitability of the vasomotor center and causes expansion of peripheral vessels and a slight decrease in cardiac output. It also has a sedative effect. Side effects: dry mouth, weakness and drowsiness. With long-term continuous use it is addictive. To relieve a crisis, 2–5 mg/kg per dose is prescribed orally or sublingually, up to a maximum of 10 mg/kg per dose every 6–8 hours.

Clinical case

A male patient D., aged 15, was admitted to the cardiology department of the State Medical University named after N. F. Filatov with complaints of periodic increase in blood pressure (up to 170/80 mmHg), headache, palpitations. When studying the medical history of the disease, it was revealed that the patient has been registered with a cardiologist since April 2023 with the diagnosis: "Secondary symptomatic arterial hypertension (I15.2). Concentric LV remodeling (I51.5). The threat of HCMP. Constitutionally exogenous obesity of the 2nd degree (E66.0). The transient Wolf-Parkinson-White phenomenon (I45.6)". The last inpatient treatment was completed in August 2023 (the patient's age at the time of hospitalization was 14 years). He constantly receives medications: atenolol 50 mg, moxonidine ("Physiotens") 0.2 mg in the morning. He was sent to the hospital for routine examination and treatment.

When studying the life history of a child patient, it was revealed: the child was born from 2 pregnancies, which proceeded without pathology, screamed immediately. The birth weight was 3900 g, length 51 cm. Vaccinated according to the calendar in the maternity hospital (BCG, against hepatitis B). It is applied to the chest for 1 day. He was discharged from the hospital for 3 days. The patient was breastfed for up to one year, complementary foods were introduced from 6 months. There were no allergic reactions. Heredity is burdened: the maternal grandmother has type 2 diabetes mellitus. Vaccination was carried out according to the schedule of the National Vaccination Calendar. He has not been vaccinated against influenza and COVID 19. Previous diseases: SARS rarely (2–3 times a year), chickenpox. He denies injuries and operations. He is registered at the dispensary with an ophthalmologist with a diagnosis of "Myopia".

Anamnesis of the disease revealed the presence of headache for several years. Since December 2022, the teenager has noticed an increase in blood

pressure. I applied for an appointment with a neurologist at my place of residence. He received outpatient medications – Enalapril ("Enap") constantly, magnesium B6 courses. There was a short-term positive trend during treatment. In January 2023, the headaches intensified, had a pressing character, dizziness, nausea, vomiting at the height of the headache joined, blood pressure increased to 170/80 mmHg (maximum value). He was examined by a cardiologist, therapy was supplemented by taking Enalapril "Enap" 10 mg in the morning and 5 mg in the evening. Due to the lack of positive dynamics (persistent increase in blood pressure to 170/80 mmHg, dizziness), in April 2023, he was hospitalized for the first time in the cardiology department of the N. F. Filatov Medical Center. He was hospitalized for 15 days from 04/19/2023 to 05/03/2023 in accordance with the procedure for providing medical care.

As a result of a comprehensive examination, the patient was diagnosed with Secondary symptomatic arterial hypertension (I15.2). Concentric LV remodeling. (I51.5) Threatened by the GKMP. Myopia. (H51.1). A child patient received treatment: Elanapril "Enap" 5 mg 2 times a day. Positive dynamics was noted against the background of treatment. Upon discharge, the following recommendations were given: a gentle regime, fractional nutrition with the exception of sweet and carbonated drinks, restriction of fast carbohydrates, exclusion of fried and fatty foods from the diet, exemption from physical education lessons until the end of the school year, daily keeping a diary of blood pressure and heart rate control. It is recommended to re-examine the cardiologist after 2 months with the results of UAC, OAM. The child was first prescribed atenolol 50 mg once a day orally in the morning for a long time and hospitalization was recommended after 3 months.

On re-hospitalization in the cardiology department, the child was in the N. F. Filatov Hospital from 08/02/2013 to 08/15/2023 (13 days). The patient complained of a continued increase in blood pressure to 170/80 mmHg, attacks of palpitations. During the clinical, laboratory and instrumental examination, Moxonidine ("Physiotens") was added to the therapy regimen 0.2 mg once a day in the morning orally. Positive dynamics was noted against the background of treatment. The real hospitalization of the teenager was carried out six months later from 10.01.2024 to 21.01.2024 as planned for examination and dynamic monitoring of the child's condition.

Upon objective examination at admission, the patient's condition was noted as closer to satisfactory, the child did not complain. Consciousness was clear, body temperature 36.6 °C. Height was 175 cm, weight 85 kg, BMI = 27.6 kg / m2, SDS BMI = 2.7. Physical development is disharmonious (due to overweight), above average. The physique is correct, the diet is excessive.

The musculoskeletal system is without visible disorders, gait is not impaired. The skin is physiologically colored. The subcutaneous fat layer is excessively developed. The thyroid gland is not palpable. Nasal breathing is not difficult. There is no shortness of breath at rest. The frequency of respiratory movements (BPD) is 18 per minute.

Vesicular breathing was heard auscultatively in all fields, there were no wheezes. The heart area is not visually changed, the apical shock is localized in the V intercostal space, heart tones are clear, the rhythm is correct, heart rate 92 beats per minute, blood pressure 110/70 mmHg, pulse of satisfactory filling. Pulsation on the femoral arteries is preserved on both sides. No edema was detected on palpation. The belly is soft, painless. The liver is not enlarged. The stool is daily, decorated. Genitourinary system without visible disorders. In the department, a laboratory and instrumental examination was performed on a child patient, consisting of the following:

The general clinical blood test revealed relative erythrocytosis (5.88 * 109 g/l), hyperhemoglobinemia (178 g/l). Bacteriuria (++) was found in the general clinical analysis of urine. A blood test for thyroid hormones (TSH, T4 sv.), a study of the level of glycated hemoglobin (HbA1c) in the blood showed no pathological abnormalities. The biochemical blood test revealed a high level of triglycerides (2.76 mmol/l), other indicators did not go beyond the reference values. A sinus rhythm, the normal position of the electrical axis of the heart, violations of intraventricular conduction along the right leg of the Gis bundle, metabolic disorders in the myocardium were recorded on the resting ECG in 12 leads. Ultrasound examination of the abdominal organs revealed signs of biliary dyskinesia (JVP), splenomegaly. Ultrasound examination of the thyroid gland and kidneys revealed no structural pathology. Ultrasound examination of the heart (ECHO-KG) revealed concentric LV remodeling, a tendency to LV myocardial hypertrophy. Daily monitoring of blood pressure revealed transient borderline systolic arterial hypertension during the daytime, episodes of increased systolic blood pressure (SAD) at night, episodes of increased diastolic blood pressure (DAD) during the day. Holter heart rate monitoring revealed: sinus rhythm with episodes of sinus arrhythmia, migration of the rhythm driver, atrial rhythm against the background of the transient WPW phenomenon. The average heart rate during the study was 80 beats in min. The minimum heart rate is 58 beats per minute. The maximum heart rate is 149 beats per minute. The circadian index is 1.18, which indicates an insufficient decrease in heart rate at night. Registered: 1 pause after the blockade of the II art. Pauses of more than 1500 ms (by age), no significant dynamics of the ST segment was

revealed. Based on the obtained clinical data, the results of laboratory and instrumental studies, the patient was given a final clinical diagnosis.

Underlying disease: hypertension secondary to endocrine disorders (I15.2). Complications of the underlying disease: Concentric LV remodeling (I51.5). Threatened by HCMP. Concomitant diseases: Constitutionally exogenous obesity of the 2nd degree (E66.0). The transient Wolf-Parkinson-White phenomenon (WPW) (I45.6). Myopia (H51.1). Psoriasis vulgaris (L40.0). In the hospital, the sick child was treated as follows: Atenolol 50 mg 1 time a day in the morning, 30 minutes after meals, Moxonidine 0.2 mg 1 time a day. The child was discharged with improvement in satisfactory condition on the 11th day from the moment of hospitalization under the supervision of a pediatrician and a cardiologist at the place of residence. It is recommended to continue drug therapy with Atenolol 50 mg once a day for a long time, Moxonidine 0.2 mg once a day for a long time, do not cancel on your own, continue to monitor heart rate, blood pressure (keep a diary), re-hospitalization is recommended after 6 months.

Clinical tasks

Task 1.

A 15-year-old boy is being examined by a paediatrician with complaints of recurrent headaches associated with an increase in blood pressure to 145/90 mmHg Art., weather dependence, increased fatigue, emotional lability. Considers himself sick for about 2 years; increased blood pressure is often associated with emotional and physical overload. The hereditary history is aggravated by hypertension in the mother and maternal grandmother. An objective examination reveals increased nutrition (height 162 cm, weight 82 kg),

the limits of relative cardiac dullness are normal, a short systolic murmur of a functional nature at the apex and at the 5th point. Pulse – 100 per minute, blood pressure – 140/85 mmHg. Art., ECG shows sinus rhythm, signs of overload of the right parts, sinus tachycardia, heart rate – 102 per minute. CIG: initial autonomic tone – normotension. VR – sympathicotonia. On echocardiography: the dimensions correspond to the age norm, the chord is abnormally located in the cavity of the right ventricle.

1. Your expected diagnosis.
2. What is the cause of this disease?
3. Principles of emergency care for hypertensive crisis.
4. Algorithm for examining a child with hypertension.
5. Name the basic principles of non-drug treatment of hypertension in adolescence.

Task 2.

A preventive examination revealed persistent arterial hypertension of 140/90 mmHg in a 15-year-old boy. Art. He makes no complaints. Sent for examination. The family history is aggravated by hypertension on the father's and mother's side.

The condition upon examination is satisfactory. Weight 47 kg, height 170 cm. Correct physique. The skin is clean, mucous membranes are pink. Lymph nodes are not enlarged. Borders of relative cardiac dullness: right – along the right parasternal line, upper – 3rd rib, left along the midclavicular line, on auscultation, heart sounds are muffled, systolic murmur at the apex and at the 5th point. Vesicular breathing over the lungs. The abdomen is soft, painless, the liver and spleen are not enlarged. There is no swelling. The symptom of effleurage in the lumbar region is negative. Diuresis – 800 ml, urination is free, genitals are formed correctly. Stool – every day.

General blood test: Er. – 5.3 x1012/l, Hb – 140 g/l, leukocytes – 6.1x109/l, e-2, p-2, p-54, lymph. – 28, m-10, ESR – 5 mm/hour.

General urinalysis – straw-colored urine, specific gravity – 1022, protein – 0.033 g/l, erythrocytes – 2–1–2 in the field of view, leukocytes – 2–4 – in the field of view, single oxalates.

Ultrasound of the kidneys: both kidneys are located paravertebral. The right kidney is oval in shape, the contours are clear, even, dimensions are 125x55 cm (age norm is 110x55), the echogenicity of the parenchyma is normal, the pyelocaliceal system is not dilated, mobility during breathing is preserved, cortico-medullary differentiation is preserved. The left kidney is reduced in size – 80x45 cm, the echogenicity of the parenchyma is increased, the corticomedullary differentiation is unclear, the expansion of the

pyelocaliceal system is not determined. The echostructures of the renal sinuses are homogeneous. The adrenal glands are not visualized. The child was sent to hospital with a diagnosis...

1. Your expected diagnosis.
2. In which department is this patient examined?
3. What examination methods are necessary to confirm the diagnosis?
4. What is the cause of arterial hypertension?
5. Prognosis of arterial hypertension based on the presumed diagnosis.

Test tasks

1. Blood pressure increases due to an increase in total peripheral vascular resistance in the following diseases and conditions:

1) hyperaldosteronism;
2) aortic coarctation;
3) renal artery stenosis;
4) thyrotoxicosis;
5) pheochromocytoma.

2. Blood pressure increases due to an increase in cardiac output in the following diseases and conditions:

1) hyperinsulinism;
2) aortic coarctation;
3) thyrotoxicosis;
4) renal artery thrombosis;
5) pheochromocytoma.

3. Arterial hypertension can be:

1) the "white coat";
2) secondary;
3) benign familial;
4) primary;
5) subacute;
6) tertiary.

4. Arterial hypertension in children may occur:

1) at the age of not earlier than ten years;
2) at the age of not earlier than five years;
3) at any age;
4) only in adolescence;

5) only for drug poisoning;
6) only if there is a family history of hypertension.

5. Arterial hypertension in children – most often:
1) alimentary;
2) asymptomatic;
3) innate;
4) secondary;
5) spontaneous;
6) essential.

6. Arterial hypertension is a condition:
1) in which there is regular use of two or more antihypertensive drugs;
2) in which there is regular use of one or more antihypertensive drugs;
3) in which there is regular use of sedatives;
4) in which the average level of systolic blood pressure and / or diastolic blood pressure, calculated according to three separate measurements, is constantly equal to or exceeds the 75th percentile of the blood pressure distribution curve in the population for the appropriate age, gender and height;
5) in which the average level of systolic blood pressure and / or diastolic blood pressure, calculated according to three separate measurements, is constantly equal to or exceeds the 95th percentile of the blood pressure distribution curve in the population for the appropriate age, gender and height;
6) in which the average level of systolic blood pressure and / or diastolic blood pressure, calculated according to three separate measurements, is constantly equal to or exceeds the 95th percentile of the blood pressure distribution curve in the population for the appropriate age, gender and height in the presence of complaints.

7. Arterial hypertension is:
1) a disease of adults characterized by a persistent increase in systolic blood pressure above 120 mmHg and / or diastolic blood pressure above 80 mmHg.;
2) a condition when using daily blood pressure monitoring, the average of all blood pressure values for 24 hours exceeds 95 percentile;
3) a condition when using daily blood pressure monitoring, the average of all blood pressure values for 24 hours exceeds 95 percentile in the presence of complaints;

4) a condition in which there is regular use of one or more antihypertensive drugs;

5) persistent increase in blood pressure in a school-age child.

8. In what cases is the development of arterial hypertension possible?

1) uncontrolled use of external glucocorticoids in atopic dermatitis in young children;

2) uncontrolled use of dexpanthenol-containing products in atopic dermatitis in young children;

3) inadequate antibacterial therapy for acute pyelonephritis;

4) overdose of ambroxol;

5) overdose of expectorant medicine with althea;

6) overdose of licorice root syrup.

9. The pathogenesis of renovascular hypertension includes:

1) activation of the renin-angiotensin-aldosterone system;

2) irritation of renal baroreceptors and chemoreceptors;

3) increasing the volume of circulating blood;

4) increased blood flow to the kidney and increased perfusion pressure on the affected side;

5) a decrease in blood flow to the kidney and a decrease in perfusion pressure on the affected side.

10. Secondary arterial hypertension may occur in the following diseases / conditions:

1) tumor of the adrenal glands (pheochromocytoma);

2) dehydration;

3) primary hyperaldosteronism;

4) overdose of adrenomimetics;

5) overdose of glucocorticoids;

6) Itsenko – Cushing syndrome.

11. Secondary arterial hypertension can occur in the following diseases:

1) aortic coarctation;

2) thymus gland tumor;

3) adrenal gland tumor;

4) thyroid tumor;

5) pylorospasm;

6) pyloric stenosis.

12. Secondary arterial hypertension is:

1) arterial hypertension, relieved by taking two or more antihypertensive drugs;

2) arterial hypertension, the cause of which has been established;

3) asymptomatic arterial hypertension;

4) congenital arterial hypertension;

5) uncupable arterial hypertension;

6) unstable arterial hypertension.

13. Hypertensive crisis is:

1) sudden deterioration due to a sharp increase in blood pressure;

2) an increase in blood pressure that is not stopped by medication;

3) an increase in blood pressure, which is accompanied by complaints of a deterioration in well-being;

4) a condition that is possible only in adults, and is characterized by a significant increase in blood pressure.

14. Drugs of the following groups can be used to relieve a hypertensive crisis:

1) antimetabolites;

2) diuretics;

3) antipyretic;

4) angiotensin converting enzyme inhibitors;

5) sedatives;

6) holinoblockers.

15. Normal blood pressure is:

1) systolic blood pressure ≤120 mmHg, diastolic blood pressure ≤80 mmHg.;

2) the level of blood pressure at which there are no complaints;

3) the level of systolic and diastolic blood pressure ≥ the 10th or 90th percentile of the distribution of blood pressure in the population for the appropriate age, gender and height;

4) the level of systolic and diastolic blood pressure ≥ the 25th or 75th percentile of the distribution of blood pressure in the population for the appropriate age, gender and height.

16. Is sedation therapy indicated for hypertensive crisis?

1) yes, because anxiety, emotional lability themselves contribute to tachycardia, increased cardiac output and increased blood pressure;

2) yes, because sedatives lower blood pressure due to the diuretic effect;
3) yes, because sedatives lower the overall peripheral resistance;
4) no, because sedatives increase blood pressure due to vasoconstriction;
5) no, because sedatives increase the strength of heart contractions and cardiac output.

17. Advantages of daily blood pressure monitoring:
1) reproducibility of results;
2) does not require special equipment;
3) the patient can keep a normal routine;
4) allows you to identify hypertension of the "white coat";
5) allows you to identify nocturnal hypertension;
6) allows continuous recording of blood pressure measurement results for a week.

18. When arterial hypertension is detected for the first time, it is necessary:
1) ECG;
2) ECHO-KG;
3) bronchoscopy;
4) consultation with a hematologist;
5) consultation with a cardiologist;
6) general urine analysis.

19. During the routine measurement of blood pressure in 11–year-old girl, the blood pressure figures 135/90–140/90 mmHg were determined 5 times within 6 months. Necessary studies:
1) biochemical blood test (urea, creatinine, potassium, total protein, albumin);
2) bronchoscopy;
3) consultation with an infectious disease specialist;
4) general urine analysis;
5) daily blood pressure monitoring;
6) esophagogastroduodenoscopy.

20. The child is in hospital treatment. Upon admission, his blood pressure was measured. For what symptoms does he need to measure blood pressure daily?
1) cough;
2) nosebleed;

3) edema;
4) subfebrility of unclear origin;
5) dark red urine.

21. Recommendations for the treatment of hypertension:
1) a sufficient amount of table salt;
2) animal fats;
3) ACE inhibitors;
4) easily digestible carbohydrates;
5) restriction of table salt;
6) daily routine and metered physical activity.

22. Daily blood pressure monitoring is carried out:
1) to patients within the framework of mandatory medical examination within the prescribed time limits;
2) patients after kidney transplantation;
3) patients receiving hemodialysis or peritoneal dialysis;
4) with arterial hypertension, relieved only by medication (and not relieved by other means);
5) with significant fluctuations in blood pressure during one or more visits;
6) only for adults with essential arterial hypertension.

23. Daily blood pressure monitoring is:
1) registration of the results of measurement of systolic and diastolic blood pressure (day, night, average daily) during the day with keeping a diary;
2) registration during the day of the results of measurement of systolic and diastolic blood pressure (day, night, average daily) with drug tests;
3) registration of the results of measurement of systolic and diastolic blood pressure during the day in case of complaints;
4) registration of the results of measuring systolic and diastolic blood pressure during exercise during the day;
5) registration of the measurement results of systolic and diastolic blood pressure during the waking period.

24. There are two criteria for the diagnosis of hypertension. One of them is enough for a diagnosis. Select these criteria:
1) the presence of arterial hypertension in the family history;
2) the presence of nephropathy in the mother during pregnancy;
3) a condition when using daily blood pressure monitoring, the average of all blood pressure values for 24 hours exceeds 95 percentile;

4) a condition in which the use of antihypertensive drugs for three years or more is required to normalize blood pressure;

5) a condition in which the use of two or more antihypertensive drugs is required to normalize blood pressure;

6) a condition in which there is regular use of one or more antihypertensive drugs.

25. Which of the foods can contribute to an increase in blood pressure in a healthy child?

1) dried apricots;
2) fresh apples;
3) salted nuts;
4) bread with bran;
5) tea, coffee.

26. In what cases does the plasma renin level increase against the background of essential arterial hypertension?

1) during the daytime;
2) as the elevated blood pressure level stabilizes;
3) during load tests;
4) at the initial stages of the formation of essential arterial hypertension.

27. Which substances are produced by endothelial cells that increase with endothelial dysfunction?

1) angioprotective factors;
2) vasodilating factors;
3) proliferative agents;
4) prothrombic agents.

28. Which substances are produced by endothelial cells that decrease with endothelial dysfunction?

1) angioprotective factors;
2) antiproliferative factors;
3) vasodilating factors;
4) vasoconstrictive agents.

29. How should blood pressure be measured when examining a child with suspected hypertension?

1) twice with an interval of 1 day;
2) twice with an interval of 2–3 min;

3) once;
4) three times with an interval of 2–3 min.

30. What pathology of the fundus can accompany hypertension?
1) hemorrhages;
2) megalopapilla;
3) spasm and narrowing of the arteries;
4) exudation.

31. What is the degree of increase in blood pressure in adolescents related to grade I hypertension?
1) 90–95 percentile or ≥120 mmHg, but <95 percentile;
2) 95 – (99 percentile + 5 mmHg);
3) <90 percentile;
4) >99 percentile + 5 mmHg.

32. What is the degree of increase in blood pressure in adolescents related to grade II hypertension?
1) 90–95 percentile or ≥120 mmHg, but <95 percentile;
2) 95 – (99 percentile + 5 mmHg);
3) <90 percentile;
4) >99 percentile + 5 mmHg.

33. What degree of elevated blood pressure in adolescents is considered high normal blood pressure?
1) 90–95 percentile or ≥120 mm Hg, but <95 percentile;
2) 95 – (99th percentile + 5 mmHg);
3) <90th percentile;
4) >99th percentile + 5 mmHg.

34. What is the normal degree of increase in blood pressure in adolescents?
1) 90–95 percentile or ≥ 120 mmHg, but <95 percentile;
2) 95 – (99 percentile + 5 mmHg);
3) <90 percentile;
4) >99 percentile + 5 mmHg.

35. What substances enhance vasoconstrictor and anti-natriuretic neurohumoral systems?
1) angiotensin II;
2) Dopamine ions;
3) naradrenaline;
4) Endothelin-1.

Standards of answers to the clinical tasks and to the test tasks

Clinical tasks

Task 1.

1. Diagnosis: VSD of the puberty period of a mixed type with a predominance of sympathicotonia, hypertensive stress reactions, cardiac syndrome (sinus tachycardia), cerebroasthenic syndrome, exacerbation period. Risk group for PAH sop: SDSTS, LV ACL.

2. The causes of this disease include the predominance of regulation of the sympathetic nervous system during the puberty period against the background of excess weight and hereditary predisposition.

3. To relieve a hypertensive crisis it is necessary:

1) creating the most relaxed environment possible;

2) use of antihypertensive drugs;

3) sedative therapy. In children over 6 years of age, immediate reduction of blood pressure before hospitalization is necessary. Nifedipine can be used at a dose of 0.5 mg/kg sublingually, repeated after 15 minutes if necessary. Replacement drugs are drotaverine and captopril. Drotaverine – for children from 1 to 6 years old, 40–120 mg in 2–3 doses, over 6 years old – at a dose of 80–200 mg in 2–5 doses. Apply clonidine orally at a dose of 3–5 mcg/kg 3 times a day subcutaneously, intramuscularly, intravenously or furosemide at a dose of 1–5 mg/kg intravenously.

4. List of laboratory and instrumental diagnostic examinations in children with hypertension: general blood test, general urine test, biochemical blood test (potassium, sodium, urea, creatinine, glucose levels), lipid profile. ECG, echocardiography, ultrasound of the kidneys. According to indications – consultations with a nephrologist, endocrinologist.

5. At any age, for the treatment of arterial hypertension, especially in adolescence, non-drug treatment is important for the effectiveness of treatment, including:

– restoration of psychological relationships in the family, at school;

– adherence to the daily routine, removal of physical overload, rest breaks, physical activity of children with uncomplicated hypertension is not limited, since regular exercise leads to a decrease in blood pressure;

– normalization of excess body weight, introduction of a sufficient amount of fiber into the daily diet (at least 300 g of vegetables or fruits);

– stopping smoking and drinking alcohol. Limiting alcohol consumption leads to a decrease in blood pressure by 2–4 mmHg Art.;

– table salt consumption no more than 5 g/day. Reducing sodium intake leads to a decrease in systolic pressure by 4–9 mmHg Art., and diastolic – by 2–6 mmHg Art.;

– control of other risk factors (hyperlipidemia, diabetes mellitus, male gender, family hypertension, cases of cardiovascular accidents in first-degree relatives);

– the use of such psychological techniques as creating positive motivation and positive feedback.

Task 2.

1. Anomaly in the development of the left kidney.
2. The boy is indicated for examination in the nephrology or urology department.
3. Biochemical blood test: urea level, creatinine, proteinogram, C-reactive protein. Zimnitsky's test. Test urine for sterility. Aortonephroangiography. Void cystography according to indications.
4. Activation of the RAAS system.
5. The prognosis is favorable after surgical treatment.

Test tasks

1	**2**	**3**	**4**	**5**	**6**	**7**
2, 3	3, 5	1, 2, 4	3	4	2, 5	2, 4

8	**9**	**10**	**11**	**12**	**13**	**14**
1, 3, 6	1, 2, 5	1, 2, 4, 5, 6	1, 3, 4	2	1	2, 4, 5

15	**16**	**17**	**18**	**19**	**20**	**21**
3	1	1, 3, 4, 5	1, 2, 5, 6	1, 4, 5	2, 3, 4, 5	3, 5, 6

22	**23**	**24**	**25**	**26**	**27**	**28**
2, 3, 5	1	3, 6	3, 5	1, 3, 4	3, 4	1, 2, 3

29	**30**	**31**	**32**	**33**	**34**	**35**
2, 3, 5	1	3, 6	3, 5	1, 3, 4	3, 4	1, 2, 3

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На английском языке

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