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V. N. Karazin Kharkiv National University

METHODS OF EXAMINATION AND PECULIARITIES OF BONE AND MUSCULAR SYSTEM IN CHILDREN

Methodical recommendations
for students of 3rd course of the medical faculty
in discipline «Propaedeutics of Pediatrics»

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МЕТОДИ ОБСТЕЖЕННЯ ТА ОСОБЛИВОСТІ КІСТКОВО-М`ЯЗОВОЇ СИСТЕМИ У ДІТЕЙ

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INTRODUCTION

The musculoskeletal system plays the role of the locomotive system and determines biological maturity of the child's body. The knowledge of the basic anatomical and functional features of the musculoskeletal system in children is important due to the diversity and peculiarities of clinical manifestations of these organs diseases in children.

ANATOMICAL AND PHYSIOLOGICAL FEATURES OF THE SKELETAL SYSTEM IN CHILDREN AT DIFFERENT PERIODS OF LIFE

Bone tissue is formed from the mesoderm at the 5th week of intrauterine development. There are two types of osteogenesis: dermal (connective tissue) and chondral (cartilaginous). Dermal osteogenesis forms the bones of the cranial vault, mandible, face, and the diaphysis of the clavicle. Chondral osteogenesis contributes to the development of other parts of the skeleton. At first, cartilage is formed, and then cartilage is gradually substituted for bone. The osteoid calcification is mediated by the osteoclast phosphatase enzyme.

Features of the skeletal system in newborns

The bone tissue of newborns has a coarse fibrous mesh structure. The diaphyses of tubular bones consist of bone tissue, and the major part of the epiphyses, bones of the hands and feet are made of cartilaginous tissue. The main indicator of bone tissue development is timely ossification. The bones of newborns contain a lot of water and little compact tissue. The bones of ewborns are soft, elastic, less brittle, but can bend and deform.

Newborn's skull: At birth, the newborn's head is 1/4 of the body length. The cerebral part of the skull predominates over the frontal part, which is especially pronounced in premature infants. The skull sutures are still not formed. They are wide and non-united. Their closure takes up to 2-3 months, and complete fusion of bones – up to 3-4 years. There is connective tissue between the bones.

Child's fontanels. A large fontanel (frontal or anterior fontanel) – boneless, between the frontal and parietal bones, a small (posterior or occipital) – between the parietal and occipital bones and two lateral – between the temporal, parietal and frontal bones on the right and left.

The large fontanel is diamond-shaped. In a healthy child, its dimensions are determined by palpation, on average 2-2.5 x 3 cm. This fontanel closes at the age

of 12-18 months. In healthy newborns, the fontanel should not protrude or pulsate. The small fontanel in 20-25% of healthy newborns can be open and closes in 2-3 months after birth. Lateral fontanelles are rarely open after birth and usually close at 1-2 months of life. The small fontanel and lateral fontanelles are more frequently palpable in premature infants.

The ribs of a newborn are placed almost horizontally. The chest is wide, short, its anterior-posterior and transverse dimensions are the same. It takes the form of maximal inspiration.

Skeletal system peculiarities in children of early and school age

The most pronounced bone changes are observed in the first two years of life, at a primary school age and during puberty. Up to the age of 12, the bones of a child practically do not differ from the bones of adults. The bones

condition is maintained at a normal level only with a sufficient amount of calcium in the blood serum – 2.25-2.5 mmol / l, as well as vitamin D, which performs one of the main functions in the osteogenesis process. Limiting muscle work and the mobility of the child can lead to a violation of the bone mineralization process and osteoporosis.

A characteristic feature of the skeleton maturation in children is a gradual change in growth process and body proportions. The younger the child, the larger the head size is. If in newborns the head is 1/4 of the body, then in 2-3 years – 1/5; at 6 years old – 1/6; at a senior school age – 1/7 and in adults – 1/8 of the total length of the human body. The length of the body increases 3 times, and the length of the lower limbs – 5 times.

Teeth: A child is usually born without teeth. The lower central incisors usually appear first, between the 4th and 6th months of the child's life; the upper incisors appear a bit later – between the 5th and 7th months. The eruption of the central and lateral incisors on the upper and lower jaws is most often completed within the 1st year of the child's life.

On average, the eruption of milk teeth occurs in the following terms:

- central and lateral incisors – from the 3rd to the 12th month;
- first molars – from the 12th to the 19th month;
- fangs – from the 18th to the 24th month;
- second molars – from the 24th to the 32nd month.

Permanent teeth in the number of 32 begin to erupt at the age of about 6 with the appearance of the lower molar. The eruption process of permanent teeth is long and can last 18-20 years, ending with the eruption of the third molar, better known as the wisdom tooth.

Spine: in newborns and babies during the first months of life there are no physiological curves. In infancy, a gradual forward curvature begins - lordosis and back curvature - kyphosis. Cervical lordosis is formed at the age of 2 months, when the child begins to hold his head. Thoracic kyphosis is formed at the age of 6-7 months, when the child can sits on his own. At the end of the first year of life, lumbar lordosis appears when the child begins to stand and walk. The end of the formation process of thoracic kyphosis occurs at the age of 6-7 years, and lumbar lordosis – during the school age period.

Chest. The anteroposterior size gradually decreases in comparison with the transverse size of the chest. In the pubertal period, the length of the chest gradually increases, the ribs go down, forming an acute angle relative to the spine. At the age of 12-13, the chest takes the form of a maximal expiration.

The criteria that characterize the child's biological maturity in the pre-pubertal period are the ossification indicators of the hand bones (bone age), the number of deciduous and permanent teeth (tooth age), body length and proportions, annual increase in growth. In adolescents, the assessment of puberty is added to the above mentioned indicators. The objective assessment

of the musculoskeletal system condition can be supplemented by data from X-ray examination and study of mineral metabolism (the amount of calcium, phosphorus, magnesium in serum, urine).

EXAMINATION METHODS OF THE SKELETAL SYSTEM IN CHILDREN

The following clinical methods are used in the objective study of the musculoskeletal system: examination, palpation, percussion, measurement. To get a holistic view of the musculoskeletal system condition of a child of any age, it is necessary to assess its motor activity, conduct an examination in different positions (lying, sitting, standing) and in motion.

Complaints: Bone and joint pains are possible. It is necessary to determine their location, intensity, irradiation and duration. It is essential to pay attention to stiffness in the joints, restriction of movements, various injuries and deformities of the skeletal system. The examination of the skeleton shall start with the head.

Head examination: It includes the condition of the skull (size, shape, condition of the fontanels in children under one year), the condition of the teeth. The palpation of the skull is best done with both hands, holding the head slightly: put your thumbs on the forehead, palms – on the temples, while examining the parietal bones, nape, sutures and fontanels with your middle and index fingers.

Spine: determine the shape of the line formed by the spinous processes of the vertebrae (should be straight), the shoulders level, the scapula symmetry and the location of the waist triangles formed on each side by the inner surface of the hand and the waist line. In case of the back muscles weakness, pathological curvatures in the form of pathological kyphosis, lordosis, scoliosis (distortion in the lateral direction) are formed. Rachitic kyphosis has an arcuate shape. It disappears when the child is lying on his stomach with his legs raised. Pathological lordosis is detected in case of congenital dysplasia of the hip joints. The spine motion range is estimated by tilting the head and torso in different planes. Stiffness is manifested in case of deforming polyarthritis.

When examining the chest in direct and lateral projections, its shape is determined. Congenital deformities of the chest (funnel-shaped, keel shaped) are possible, and are caused by dysplasia of the sternum bones, less often by hypovitaminosis D. Garrison's groove – a boat shaped depression of the chest at the place of the diaphragm attachment as a result of osteomalacia of the rib bones and hypotension of the intercostal muscles. Cardiac hypertrophy in case of congenital and acquired valvular disease causes deformation of the chest in the form of a "cardiac hump".

Palpation of the chest determines its resistance (pliability): the palms are placed on the symmetrical areas on both sides and apply pressure from front to

back on the sides. "Rachitic rosary" (significant club-shaped thickenings due to the osteoid tissue expansion) are distributed at the junction of the bone tissue of the ribs to the cartilage tissue. Palpation is performed along the ribs from the anterior axillary line to the sternum and perpendicular to the ribs (from top to bottom, without removing the hands). In healthy children, these thickenings are barely noticeable.

When examining the upper limbs, their length (fingertips should be in the middle of the thigh; shortening – in case of chondrodystrophy), shape (deformities – in case of congenital fragility of bones, rickets), the state of the epiphyses of tubular bones are determined. The palpation of the epiphyses shall be carried out with the arm slightly bent at the elbow along the dorsal surface of the wrist joint. A roll shaped thickening of the radius bones epiphyses - "rachitic bracelets" - is due to the expansion of the osteoid tissue. The diaphysis thickening of the fingers phalanges is called "strings of pearls." "Drum sticks" - the thickening of the terminal fingers phalanges - occur in case of congenital heart defects and chronic pneumonia.

When examining the lower limbs, their length, the shape of the tubular bones (X- and O-shaped curvatures), feet, symmetry of the ischial folds, the number of folds on the inner surfaces of the thighs are evaluated. For children of the first year of life, a flat foot is typical. For its detection, it is necessary to examine the arch of the foot and do plantography (obtaining footprints). Direct percussion of tubular and flat bones of the lower leg is used to determine the pain syndrome (with leukemia, tumors, osteomyelitis, etc.).

Examination of the joints is carried out simultaneously with the study of the musculoskeletal systems by inspection, palpation, measurement, assessment of the range and nature of motions. During the examination, the shape and range of movements are revealed. The size of the joints is measured with a centimeter measuring tape at the level of symmetrical joints. The palpation of the skin above the joint determines sensitivity, thickness, mobility, the presence of swelling, localization of tender points.

SEMIOTICS OF MAJOR LESIONS AND DISEASES OF SKELETAL SYSTEM

Rickets is most often the disease of infants, where the main symptoms is bone damage. It is often the case that the timely closure of a large fontanel does not occur on time. There is a deformation of the skull size: caput quadratum, stretching of the frontal bone forward ("Olympic forehead"), protrusion of the parietal hills and indentation of the seam between them (caput natiforme), flat occiput, softening and compaction of the occipital bone (craniotabes) in the areas of a large fontanelle, elongated head (tower), softening of the skull bones (macrocephaly).

Chest deformities: chicken breast in the form of a keel (pectus carinatum), shoemaker's chest or funnel chest (bootmaker or funnel-shaped or pectus fusiforme). Garrison's sulcus – chest retraction, the costal arches turned forward. Rachitic "rosary" (rosary, beads) – pathological tubercles on palpation of the ribs at the attachment of bone tissue to the cartilage one. There may be some changes in the limbs: thickening of the radial bones epiphyses of the "bracelet" (bracelet, bangle), thickening of the phalangeal bone diaphysis – "strings of pearls" (pearl).

In the first or second year of life – O-shaped legs or X-shaped legs in the area of lower legs and feet. Delayed teeth eruption.

Diagnosis: Determination of serum calcium value (norm 2-2.5 mmol/l); Sulkovich's test (determination of calcium in urine: normal – slightly milky-white urine turbidity with the addition of 2.5 ml of the reagent; with an increased concentration of calcium – more intense turbidity – the test is positive, from + to ++++); with a low calcium concentration in urine, turbidity does not occur and the test is negative. The normal urine calcium level is 2.5-7.5 mmol / day.

Scoliosis – a lateral spine curvature. It can be right-handed and left-handed, S-shaped; can occur in the upper, middle and lower part of the spine. At the same time, asymmetry of the chest is observed. It is determined by palpation applied along the spinous processes from the VII cervical vertebra to the sacrum. The waist triangle formed in a standing position between the torso and the lowered arm is examined. On the concave side of the body this triangle gets bigger, and on the curved side, it becomes smaller.

Adams test: (Fig. 1) The Adams test is a screening test for scoliosis. The test is most reliable for thoracic scoliosis. Before you perform the Adams test, you should check for any length difference in the lower limbs. The patient leans forward (starting at the waist) until the upper torso is parallel to the floor. At the same time, the legs should be joined, the knees are unbent, the arms hang freely. The doctor stands behind the patient and examines the spine (along the horizontal plane) for abnormalities (eg, increased or decreased lordosis/kyphosis) and trunk asymmetry. These include different position levels of shoulder and hip joints, shoulder blades asymmetry, the location of the head off the pelvis line, costal tubercle.

Fig. 1. Adam's test

Lordosis: In children, lordosis is associated with weakness of the back muscles. Hollow-back lordosis can be congenital or acquired. Here we observe an intense forward bending of the spine.

The main clinical symptoms: pain in the cervical and lumbar spine, especially when tilting, turning. Pain irradiation in the arm, chest, numbness in he upper and lower limbs, fatigue.

Lordosis diagnosis: the buttocks and abdomen bulge back; open position of the legs; inability to sleep on the stomach when the spinal column is aligned; constant tension of the lower back muscles; problems with leaning forward; if the child lies on the floor, the distance between the floor and his lower back will be very large.

Kyphosis is a violation of the spine position with a bend to the back. Factors – continuous loads, injuries, forced postures, congenital anomalies, Bechterew's disease and others. Thoracic kyphosis is the most common.

1st degree kyphosis: fatigue, mild muscle pain at the end of the day, stoop (round back).

2nd degree kyphosis: compensatory lordosis is added, stoop intensifies, the head and shoulders go down.

3rd degree kyphosis: limited mobility of the spine, there are disturbances in the work of internal organs due to compression and deformation of the chest.

Congenital dislocation (dysplasia) of the pelvis joint is an underdevelopment of the acetabulum, the decrease in its depth, and some discrepancy in the size of the femoral head. Clinical and diagnostic signs: visually – certain asymmetry of skin folds on the thighs, limbs shortening; Galeazzi test: if the child is put on his back, legs are bent and brought to the stomach, then in case of dysplasia, the knee joints will be at different levels, because the hips are of different sizes (Fig. 2)

Fig. 2. Galeazzi test

Ortolani test: (click symptom) is the sensation of clicking. Bend the limb at the knee and hip joints, putting your thumb on the inside of the thigh, and keep the remaining fingers on its outer surface, then bring the leg and turn it inward a little – this is the first moment. The second moment – after that, it is necessary to turn the legs outward and abducting simultaneously, and at the moment of abduction a clunk is felt. This symptom is objective only during 1-2 months of life, during the 3rd month it gradually disappears (Fig. 3).

Fig. 3. Ortolani test

Late sign of congenital hip dislocation: (Trendelenburg symptom):

If the patient stands on a healthy leg and lifts the diseased leg up, the buttock on

the side of the diseased leg will rise – this is good. In case of pathology – if the child stands on the leg of the affected side, and the second healthy leg, bends at the knee and raises it slightly, then the pelvis will tilt to the healthy side and the buttock of the same side will fall. At the same time, the child will lean to the affected side to keep the body in a vertical position.

Barlow test:

The essence of the Barlow test is that when the legs are adducted, the femoral head is dislocated from the acetabulum. This maneuver is accompanied by a click. The Barlow test should be performed with the child lying on his back. The legs are bent at an angle of 90 °, then carefully directed and pressed on the knee along the axis of the thigh. When the head of the femur comes out of the acetabulum, a characteristic click is felt. This is a positive Barlow's sign (Figure 4).

Fig. 4. Barlow test

Also, one of the late signs of congenital hip dysplasia is "duck gait" ("wadding" or "goose gait"), that is, lameness. The final diagnosis is confirmed by the results of X-ray examination.

Flat feet: is one of the most common diseases of the musculoskeletal system in children. This is a deformity of the foot, in which its arch is compacted, and the flat sole comes in contact with the floor with its entire surface. Signs of flat feet:

- when walking, the child is "clubfoot": the feet are turned inward, while the feet should be parallel to the child during walking;
- the child steps on the inner edges of the feet when walking;
- the child complains about fatigue when walking, pain in the back and legs, he refuses to walk for a long time; the severity of complaints increases with the age of the child;
- uneven wear out of shoe heels (more on the inside) in children after 5 years.

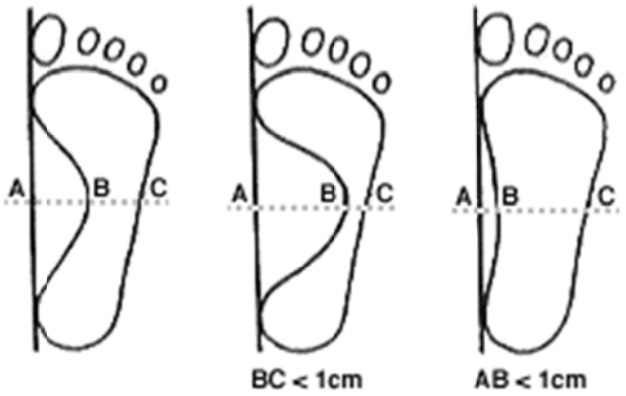

Fig. 5. Flat feet

If any of these manifestations are found in a child, an orthopedist should be consulted. If the width of the instep raiser (AB) in its widest part is less than 1 cm, the foot is considered flat (right). If the imprint width at its narrowest part (BC) is less than 1 cm, the arch is considered to be high (centered). All other footprints are considered "normal" (left) (Fig. 5).

ANATOMY - PHYSIOLOGICAL FEATURES OF THE MUSCULAR SYSTEM IN CHILDREN AT DIFFERENT LIFE PERIODS

Muscle tissue begins to develop with mesoderm at 3-4 weeks of embryogenesis. The formation of muscle fibers in different muscle groups does not occurs simultaneously: first, the muscles of the tongue, lips, diaphragm, intercostal and dorsal muscles differentiate. The differentiation of the upper limbs muscles occurs before the lower ones. In newborns and children of the first months of life, pronounced muscle hypertension is observed, which disappears at the age of 2-2.5 months in the upper and 3-4 months in the lower limbs. The movements of a healthy full-term newborn are erratic, almost continuous. Good coordination of movements while walking is established at the age of 1.5-2 years. From the age of 8-9 years, the volume of muscles increases significantly. During puberty, there is an increase in the muscles of the back, thoracic girdle. By the end of school age, small muscles develop intensively, contributing to the accuracy and coordination of graceful movements. The ratio of muscle mass to body weight in children is much lower than in adults – (23% in newborns, 44% in adults). In children, muscle fibers are much thinner than in adults. Muscle tissue grows more after birth.

Muscle classification

- Skeletal muscles (cross-striated) – move the skeleton, expression, gait; produces heat through aerobic energy production; helps return blood to the heart.
- Smooth muscles – (without striped and voluntary) helps maintain blood pressure by regulating the size of the arteries. They supports peristalsis, helping to push food through the intestines, they are responsible for the movement of the urinary tract, dilating the pupils of the eyes.
- Cardiac (striped) muscles pump blood with the help of contractions.

The main criteria for the muscular system assessment in children are:

- degree of muscle mass development;
- muscle strength;
- muscle tone;
- movement coordination;
- motor activity;
- density and the presence of muscle pain.

Degree of the muscle mass development

Poor development – all the muscles are small. The changes in the muscle volume are barely visible, on the abdomen area they are reduced. The lower corners of the scapula are protruded and the distance between them is increased.

Average muscle development - the muscles of the trunk are moderately developed, the limbs are well developed, visible changes in the shape and volume of the muscle are observed.

Good muscle development of the whole body is clearly visible during external examination. The muscle contraction is ideal. The symmetry of the limbs muscle bulk is observed. The allowable difference is not more than 1 cm.

Assessment of Muscle Strength

It is defined as the amount of effort a child needs to exert to resist a movement. In school-age children, it is measured with a dynamometer. The average strength of the right hand muscles in children (Table 1) is measured using special standard indicators.

Table1

Muscles strength in children

Age (years)	Boys (muscle strength, kg)	Girls (muscle strength, kg)
7-9	11-12,5	9-13
10-11	16	14-14,5
12-14	21,5-31	18,5-27

Muscle strength can be also determined by using some clinical techniques:

- by the force of the handshake;
- by the ability to lift some load;
- by the ability to resist that the patient can exercise when the doctor is bending and unbending his limbs.

When examining a young child, one should try to take away from him an object by force, especially if the child likes it. Muscle strength is measured with a dynamometer in school-age children. You must carry out 3 measurements, and choose the highest parameter.

Muscle strength is often rated on a scale of 0/5 to 5/5 as follows:

- 0/5: no contraction - 1/5: muscles tremble but there is no movement
- 2/5: the movement is possible, but there is no counteraction to gravity (check the connection in the horizontal plane)
- 3/5: the movement is possible against gravity, but not against the resistance of the doctor-examiner
- 4/5: the movement is possible with some resistance from the doctor-examiner (sometimes this category is divided into 4-/5, 4/5 and 4+/5)
- 5/5: the normal strength

The strength of the fingers – the patient joins the 1st and 2nd fingers, forming a ring around the 1st and 2nd fingers of the doctor. The doctor is actively trying to open the ring, assessing the strength of the child's resistance.

The strength assessment of the muscles of the upper part of the shoulder is determined by the resistance that occurs when bending or unbending the

forearm. *The assessment of the strength of the extensor and flexor muscles of the forearm* - the doctor tries to bend the child's arms and determines the resistance in this action and vice versa.

The evaluation of the strength of the extensor and flexor muscles of the arm – is set by the degree of resistance that occurs when the doctor bends or unbends the forearm at the elbow joint, respectively. The doctor pushes down the entire arm (extensor muscle strength and vice versa).

Assessment of muscle tone

Muscle tone is the result of the skeletal muscle tension.

At an early age – the child lies on his back, the doctor takes him by the wrist and tries to move him into an upright position. The child's response to a satisfactory muscle tone consists of two phases: in the first phase, the child abducts his arms, in the second one he flexes them and the entire body moves towards the doctor. The absence of phase 1 shows that the child has muscle hypertonicity. The absence of phase 2 shows that the child has muscle hypotonia.

In older children: the doctor feels some tension in the child's muscles during passive extension and flexion of the child's limbs. Flexion occurs only in the elbow and knee joints. It is necessary to take into account the consistency of the limbs muscles during palpation.

Assessment of movement coordination

To assess the condition of movements coordination (in 5-7-year old children), the most objective methods are:

Romberg position:

The child stands with his arms down. The heels and toes of both feet are put together. Ask the child to stretch their hands forward to get more precise information. Then ask the child to close his eyes and place one foot in front of the other, heel to toes. The first position of the child is similar to the above, then ask the child to raise one leg vertically. You can ask the child to stand on tiptoe. In a normal state, the child is stable in all these positions.

Finger-to-nose test

Ask the child to stretch his arms outward from the sides of the body. Then ask him to slowly move his index finger and touch the tip of his nose. The child must do this with the right and left hand alternately and first with his open eyes, then with closed ones. With dystaxia, the child misses the tip of the nose.

Heel-to-shin test

Ask the child to raise one leg in a horizontal position and touch the knee of the other leg with the heel. Then, with the same heel, move along the ridge of the lower leg from the joint to the ankle. The child should move the right and left legs alternately and first with open eyes, then with closed eyes. With

dystaxia, the child cannot touch the knee with the heel, or the heel slips to the right or left when moving along the tibia.

Motion activity

Older children. Ask him/her to walk on heels and tiptoes, put his hands on his head or behind his neck for a few minutes. To detect hidden hyperkinesis, you can ask the child to write a few words with his eyes closed, copy the movements of the doctor.

SEMIOTICS OF MAJOR LESIONS OF MUSCULAR SYSTEM IN CHILDREN

Muscular dystonia

These include: muscle hypotension, muscle hypertension, cerebellar damage.

Muscular hypotonia is a decrease in muscle tone. It may be detected in newborns (lying on the back, arms and legs extended along the body). At school age, it can be observed in case of rheumatic fever, in the presence of a brain tumor, thyroid diseases, rickets, Down syndrome, in case of muscles hypotension of the pelvic girdle and lower limbs (duck gait). Also, the presence of muscle hypotonia can be detected in children with Gowers syndrome (rising from a lying position, the child first rests on his knees and elbows, and then rises on his palms, then on his feet, at the end he rests his hands on his knee joints and raises his torso). At any age, a decrease in the potassium amount in the blood serum (vomiting, diarrhea, dehydration, toxicosis) leads to the muscle tone weakening.

Muscular hypertension is an increase in muscle tone. It happens physiologically in newborns (the hand is slightly curved, and the fingers are in tension and spread apart, excessive clenching of the fingers into a fist, athetosis - when the fingers are straightened, tense and are in different planes). Also, muscle hypertonia can be a sign of cerebral palsy.

Opisthotonus. Its presence is possible at any age, when the trunk takes on the appearance of a bridge – stretched tense limbs, the head is sharply thrown back. The tone of the posterior muscles of the body predominates.

Atrophy and muscle weakness

This disease is characterized by a violation of muscle trophism, muscle thickness and degeneration of muscle fibers, as well as a significant decrease in muscle mass with a decrease or disappearance of their contractility.

Muscular dystrophy refers to a group of genetic diseases characterized by progressive damage and weakness of the facial, respiratory, cardiac and limb muscles. This is due to the lack of a key protein necessary to maintain the integrity and proper functioning of muscles. The main clinical symptoms: weakness, stiffness in the joints, problems with coordination and mobility

including frequent falls. Shoulders and arms are unstable when walking (thrown back). Weak gluteal muscles. The knees can bend back to support the weight. The calf muscles are thick ("the muscles are predominantly thick and not strong"). Tight heels (contractures) and the child can walk on tiptoe. The child does not squat well. The thighs are thin and weak. The balance is poor, the child often falls. Clumsiness when walking. "Foot drop", contractures on tiptoe.

Duchenne muscular dystrophy. The child can use his hands to get up off the floor and help himself stand up. There may be frequent falls, a staggering gait, limited range of motions, and facial pain. These symptoms appear early, usually between 1 and 6 years of age. The condition progresses rapidly, and by the age of 12, many children need a wheelchair.

Becker muscular dystrophy. It usually begins at around the age of 12. The symptoms include the above mentioned, plus heart diseases, curvature of the spine, weakness, thinking problems, breathing difficulties.

Symptoms of fascio-scapular-brachial muscular dystrophy (also called Landouzy-Dejerine muscular dystrophy) begin between the ages of 10 and 26. It affects mainly the upper body. This disease includes: weakness of the face and shoulders muscles, difficulty in raising arms; whistling and closing eyes; hearing loss; speech problems and heart rate changes.

Muscular dystrophies of the limbs and lower back cause weakness in the hips or shoulders. The symptoms usually begin in childhood or early adulthood. Muscle weakness begins in the pelvis and moves to the shoulders.

Emery-Dreyfus muscular dystrophy causes muscle wasting of the lower limbs as well as the forearms. It can also affect other areas such as shoulders, chest, and face. Usually, muscle contractures (muscle contraction) are detected before the onset of muscle weakness.

Laboratory studies: blood test at the level of creatine phosphokinase (CPK); muscle biopsy (changes in the structure of muscle cells and other characteristics of different forms of muscular dystrophy can be detected); electromyography (this is a test that measures the response of a muscle to stimulation of nerve supply (nerve conduction test) and electrical activity in the muscle (needle electrode test)).

This test will confirm that the muscle weakness is caused by a muscular system disease and not by nervous system diseases; the genetic test (many muscular dystrophies can be accurately diagnosed by testing mutated genes). Gene tests can help to avoid muscle biopsy for these muscular dystrophies, including Duchenne's, Beckers', myotonic dystrophy, Emery-Dreyfus', and others).

Spinal muscular atrophy is characterized by the loss of nerve cells in the spinal cord, called motor neurons. It is classified as a motor neuron disease. The reason is genetic. The most common form of SMA (types 1-4) is caused by a defect (mutation) in the SMN1 gene on chromosome 5. (People have two SMN1 genes, one in each chromosome 5). The mutation in the SMN1 gene results in

a deficiency in a motor neuron protein called SMN (a protein highly required fo normal motor neuron function). Less common is the mutation in the X chromosome gene called UBE1 that causes X-linked SMA. The UBE1 gene carries instructions for the ubiquitin-activating enzyme 1, which normally helps to attach a molecular tag to proteins in order to mark them for destruction by the cell.

Werdnig-Hoffmann disease is the most severe form of spinal muscular dystrophy. The muscular hypotonia is highly expressed; "sluggish child" syndrome; the child does not hold his head; does not achieve the ability to sit and roll over; the body is saggy when held suspended on the stomach; cough, sucking and swallowing reflexes are weakened; there is some choking; respiratory disorders.

Motor activity violation

Hypokinesia: Decreased range of motion. The reasons are injuries, intoxication, damage to the neuromuscular system.

Hyperkinesia: This is a sharp spontaneous movement of the face, trunk, limbs muscles. Most occurrences of hyperkinesis are in the distal muscles area; they are less often in the proximal one. Also, the process can be generalized.

Types of hyperkinesia:

Tic (spasm): spontaneous blinking of the eyelids, twitching of the nose, twitching of the shoulder.

Tremor: spontaneous contraction and relaxation of a muscle group, resulting in rapid rhythmic movements of a small amplitude in different parts of the body (fingers, hands, head, jaw).

Athetosis: slow, constant, tonic forced movement of the distal parts of the upper limbs, lower limbs and facial muscles. Sometimes athetosis of the trunk muscles occure (torsion spasm), rheumatic chorea.

Myoclonus: This is a spasm of various muscles that occurs at rest and during different movements, with different amplitude and duration, single and multiple spasms.

Paralysis and paresis

This is a condition in which muscle movement is absent or limited. Paralysis can be central or peripheral.

Central (spastic) paralysis and paresis: characterized by muscle hypertonicity, clonus, hyperkinesia (prolonged twitching), spontaneous, uncontrolled contractions of the face, trunk and limbs muscles.

Peripheral (flaccid) paralysis and paresis: characterized by reduced strength and weak muscle tone, muscle atrophy.

Polio

It is an acute and sometimes devastating viral illness. The virus enters the mouth and multiplies in the lymphoid tissues of the pharynx and intestines. A small amount of the virus enters the blood and other places where it multiplies more widely. Another round of viremia (viruses in the blood) leads to the invasion of the central nervous system (CNS), the spinal cord.

Mild poliomyelitis is registered in 80-90% of clinical infections, mainly in young children, without CNS damage. Symptoms: slight fever, malaise, headaches, sore throat and vomiting 3-5 days after infection. Recovery occurs within 24-72 hours. This is called the abortive type of polio and brain

Severe polio: Paralysis may occur. Symptoms usually appear without prior illness, especially in older children and adults, 7 to 14 days after the infection. The symptoms include fever, severe headache, neck and back stiffness, deep muscle pain, and sometimes areas of hyperesthesia (increased sensation) and paresthesia (change in sensation). This picture resembles viral meningitis, may not progress, or there may be loss of tendon reflexes and weakness or paralysis of certain muscle groups.

Major symptoms: Fever, headache, nausea and vomiting, diarrhea, stiffness and neck pain. Severe muscle pain, muscle spasm, muscle weakness, paralysis. Usually the damage is asymmetrical (affecting each side differently or affecting only one side). Muscles become sluggish (plump, flexible). Legs are affected more often than arms. Paralysis of the respiratory muscles and urinary retention are possible.

Post-polio syndrome. In paralytic polio, about 50% of patients recover without residual paralysis, about 25% are left with mild disability, and the rest of the patients have severe permanent disability. Decades later, previously stable muscle weakness may worsen due to post-polio syndrome. The biggest part of muscle function recovery occurs in the first 6 months and lasts up to 2 years.

SELF-CONTROL QUESTIONS

1. Peculiar features of the musculoskeletal system in newborns.
2. Characteristics of fontanelles in newborns.
3. Name the main types of thoracic deformity in children.
4. Basic tests to scoliosis detection.
5. What muscle groups do you know?
6. Technique for performing the Ortolani test.
7. The main criteria used to assess the muscular system.
8. Types of motor activity disorders of the muscular system.
9. Large criteria for polio.
10. Types of paralysis.

Control tests

1. At what week of pregnancy does the formation of the skeletal system occur?

a) in the first week b) by 3-4 weeks;
c) 5-6 weeks; d) 7-8 weeks; e) 12-15 weeks

2. At what week of pregnancy does the development of muscle tissue begin?

a) 1-2 weeks; b) 3-4 weeks;
c) 5-6 weeks; d) 8-9 weeks; e) 10-11 weeks.

3. What is the head-to-body ratio in a child aged 2-3 years?

a) 1/4; b) 1/5; c) 1/6;
d) 1/7; e) 1/8.

4. The closure of a large fontanel should occur:

a) at 1 month; b) at 3 months;
c) at 6 months; d) at 4 months; e) from 12 to 18 months.

5. The normal amount of calcium in the blood serum should correspond to:

a) 1-1.5 mmol/l; b) 3-3.5 mmol/l;
c) 2.25-2.5 mmol/l; d) 5-5.5 mmol/l; e) more than 5.5 mmol/l.

6. The main criteria for the muscular system assessment are:

a) muscle strength; c) muscle tone; c) coordination of movements;
d) motor activity; e) all of the above are correct.

7. During the examination, a congenital malformation of the hip (dysplasia) was found in the child. What symptoms will the doctor apply to evaluate dysplasia other than:

a) Ortolani symptom; b) Gazelazi symptom;
c) Adams test; d) Barlow test; e) Trendelenburg's symptom.

Standard test answers: 1 – c; 2 – в; 3 – в; 4 – e; 5 – c; 6 – e; 7 – c.

Situational task 1. Child, 11 months old. Has 2 upper front incisors. Large fontanel 3 x 2.5 cm, soft bones. The skull is caput natiforme, flat back, craniotabes when pressed. The head circumference 48.5 cm. There is Harrison's groove in the thoracic region, "Rachitic rosary" is palpated on the V-VII ribs. "Bracelets" are expressed on the upper limbs. The abdomen is enlarged in size, especially on the sides. Your preliminary diagnosis.

Answer: Rickets.

Situational test 2. Mother turned to the pediatrician with a one-month child. The baby was born prematurely at 32 weeks of gestation. Objectively: there is some weakness of the upper and lower limbs stretchers. Your preliminary diagnosis.

Answer: Muscular hypotension

LITERATURE

Major information sources

1. Pediatrics. Textbook / O. V. Tiazhka, T. V. Pochinok, A. N. Antoshkinaey al. / edided by O. Tiazhka – Vinnytsia: Nova Knyha Publishers, 2011. – 584 p.

2. Emily Schaeffer, John Lubickly, Kishore Mulpuri /Appropriate use criteria: the management of developmental dysplasia of the hip in infants up to 6 months of age: Intended for use by general pediatricians and referring physicians/ Journal of the American Academy of orthopedic surgeons: April 15, 2019. – Volume 27. – Issue 8. – P. 364 – 368.

3. Nelson textbook of Pediatrics 20 th ed. / Robert M. Kliegman, Bonita M. D. Stanton, Joseph St. Geme, Nina F Schor.//Philadelphia, Pa: Saunders Elsevier; 2017. – 3888 p.

4. Propaedeutic of pediatrics / V. A. Fjoklin, V. A. Klymenko et al. – Kharkiv, 2010. – 346 p.

Additional information sources

1. Capitan T. Propaedeutics / of children`s diseases and nursing of the child. – Vinnisa, 2010. – 807 p.

2. Oxford Handbook of Neonatology / Grenville Fox, Nicholas Hoque, Timothy Watts. – 2 th ed. – Oxford University Press 2017. – 575 p.

3. Goodman CA, Homberger TA, Roblin AG. Bone and skeletal muscle: Key players in mechanotransduction and potential over lapping mechanisms. Bone. 20155 Nov; 80 : 24 – 36 [PMC free article] [Pub Med].

4. Danning C (2019) Structure and function of the musculoskeletal system. In: Banasik jand Copstead LED (eds) Pathophysiology: 6 th Edition. London. Elsevier.

5. http://www.emedicine, com/MED/topic
6. http://ru.wikipedia.org (articles.skin.nails.hear)
7. http://www.shop.aap.org/publications/books/
8. https: doi.org/10.3390/cells10123322
9. https: doi.org/10.1002/wsbm.1462