

## METHODICAL RECOMMENDATIONS FOR PRACTICAL CLASSES

### **Topic 1 Subject and place of pediatrics, main stages of development. Organization medical and preventive care for children in Ukraine. Periods of childhood, them characteristics and features.**

**Aim:** to know how to evaluate the general state of a child on the basis of knowledge of the peculiarities of development of a child in different age groups, to learn to conduct anthropometric measurements in children of different ages, to evaluate the physical development of a child by different methods for discovering disorders of different origin, to know the methods of загартовування of children.

**Professional motivation of students:** one of the peculiarities of the development of a child is the non stop growth, development, and improvement of structures and functions of organ and systems. Because of the this every period of the life of a child has its own specific peculiarities. The knowledge of these peculiarities allows one to evaluate physical development of a child, and at the same time diagnose and correctly treat different age related pathologies in children, and to make specific prophylaxis and rehabilitation.

#### **After self-training**

the student must know the following:

1. Different childhood periods chronology, critical periods.
2. Peculiarities of all critical childhood periods.
3. Peculiarities of the newborn's organism and transitory states of the newborn period.
4. Morbidity peculiarities at different childhood periods.

#### **Having covered the topic, the student must be able to:**

1. Define the periods of children's age.
2. Single out critical periods in children's development.
3. Define maturity and ripeness of newborns, transitory states of the newborn period, estimate the state of a newborn child.

#### **Students should know how to:**

1. friendly facial expression and smile.
2. gentle tone of speech
3. greeting and introducing.
3. by means of game playing find a contact with a child.
5. tactful and calm conversation with the parents of sick child.
6. explanation of future steps concerning the child (hospitalization, some methods of examination, etc)
7. conversation accomplishment.

#### **Materials which might be helpful:**

- Childhood periods.
- Critical periods.
- Newborn period.

- Transitional states of the newborn period.
- Infant period.
- Early childhood period.
- Pre-school period.
- School period.
- Children's morbidity scheme depending on age.

### **Childhood Periods**

The pre-natal and extrauterine stages of childhood are distinguished. The pre-natal stage includes the phase of embryonal development (up to 2 months of pregnancy) and the phase of placental development (from 3 up to 10 months). Each period finishes with a new quality level of functional ripeness of definite organs and systems.

#### **The extrauterine stage covers the following periods:**

1. Newborn period (0-28 days):
  - a) early newborn (0—6 weeks);
  - b) late newborn (7—28 weeks).
2. Infant period (28 days - 12 months).
3. Early children's period (calf's teeth period) (1-3 years).
4. Pre-school period (4-6 (7) years).
5. Primary school period (6 (7)-11 (12) years).
6. Secondary school period (11 (12)-14 (15) years).

#### **Critical childhood periods are the time when:**

- a child grows very quickly, or his/her functional systems ripe quickly, and is very susceptible to external factors influence;
- there is a switch from one change to another, or there is a switch from one type of feeding to another.

A critical period has to be finished with higher level of adaptation. The following critical periods are distinguished:

1. Newborn - the period of extra adaptation.
2. Infant - higher enlargement and development of functions.
3. 3 years old - higher nervous activity (HNA) formation.
4. 6-7 years - school maturity mechanism ripening.
5. Teenager period - endocrine rebuilding of organism.

#### **Newborn Period**

- A very high speed of cardiovascular system functional state rebuilding, rebuilding of respiratory and other systems while adapting to the environment.
- The first 30 min. of lungs breathing switching - intensive hemodynamic and respiratory adaptation.
- Intensive metabolic adaptation - just after delivery the "hunger stress", catabolic energetic exchange, during which a child uses its own reserve, and the loss of body weight takes place; then the exchange becomes anabolic, a child starts to put on weight, metabolic rebuilding finishes.
- The establishment of sleep and food intake rhythm (the central nervous system rebuilding).

**Fetal maturity** — the state characterized by the readiness of organs and systems to provide a child's extrauterine existence — is determined on the basis of external features:

- skin is elastic and pink;
- head hair length is not less than 2 cm;
- nails reach finger-tips;
- lanugo is preserved on shoulders and back upper regions;

- auricular cartilages (cartilago auriculae) are thick enough;
- boys' testicles are in the gate, girls' large lips of pudendum (labia majora pudendi) cover small lips of pudendum (labia minora pudendi);
- umbilicus ring is located at precisely equal distance from thoracic and xiphoid processes;
- crown of head (vertex) is closed.

**Full-term state** - a child is born in the 38—40 weeks term weighing not less than 2500 gr. and being not less than 45 cm long.

An immature child is a premature child or a full-term child developed in inconvenient conditions.

**A premature child** is born between the 28<sup>th</sup> and 38<sup>th</sup> weeks of gestation, weighing from 1000 to 2500 gr. and being 35—45 cm long (according to World Public Health Organization's data, since 1995, the fetus of 500 gr. and more and from the 25<sup>th</sup> week of gestation is considered to be alive).

### **Infant Period**

- Intensive growth takes place (body length enlarges by 50%), child puts on weight intensively. That is why it needs a great quantity of plastic material, protein especially.
- Intensive movement development (after the 6<sup>th</sup> month growth intensity slows down, but nervous activity and movement activity enlarge).
- Alimentary canal development finishes (a child may eat different food from the 6<sup>th</sup>-8<sup>th</sup> months).
- Gradual ripening of respiratory tract and cardiovascular system.
- The organism is mostly under the sympathetic nervous system's influence.
- Intensive development of brain tissue: brain mass enlarges three times as much, I and II signal systems are developing (a child walks, speaks several words).

#### **Early Childhood**

- The speed of growth is still high but slows down in this period.
- Intensive development of higher nervous activity (HNA), personality is formed.
- Qualitative changes, central nervous system differentiation, development of conditioned reflexes on stereotypes, stimulation complexes.
- The visible-real type of thinking is prevailing (a child remembers what it sees, the development of memory is in process, "impressions reflection").
- There is a "mother's worship" in this period.

### **3 years old - "3 years old crisis"**

- A child realizes its own "I", studies itself with a mirror.
- At this time a child begins its contacts with the world around it, shows general interest in everything around, experiences inability to do everything it wants to (as a result, there are neuroses, neuropathies, neurotic retching).
- A child may play a lot and for a long time due to the fact that vagus prevailing influences cardiovascular and respiratory systems (24—26 breaths per minute - economic breathing).

### **Pre-School Period**

- Up to 3-5 years the development of higher nervous activity is still in process, habits are fastening.
- The vision-image type of thinking is forming (to construct, to draw, to sculpture).
- Bronchopulmonary system is improving, and its development is practically finished (as a result, respiratory morbidity lowers).
- The mechanisms of school maturity start their formation and are to be formed at 6—7 years old.

### **6- 7 years old, the school maturity formation .**

This is the first period of extension. Physiological mechanisms of school maturity:

- the level of internal inhibition must rise, it provides concentration during the lesson (a child must correctly react to words, intonation, listen attentively, etc.);
  - the mechanisms responsible for writing ability must become fully ripe (movement mechanisms of the right (left) hand);
  - a child must be able to copy, re-write a phrase consisting of 3-5 words, to draw a man etc.; it must pass the word-associative test;
- must be able to repeat after a teacher (in the way a child understands him/her), to pass the power test, motivation test (to understand the necessity of going to school and obtaining knowledge).

### **School Period**

- A child's morphological organs and organism systems development finishes.
- Movement qualities are improving and are in the process of development - speed, power, stamina.
- Sex ripening starts in this period - teenager (pubertal) period.
- The second period of extension (6-8 cm per year), child's harmony disappears.
- Muscular power and capacity for work increase a lot in this period.
- The lack of correspondence between the speeds of biological and social ripening is often observed.
- The endocrine rebuilding of organism takes place, especially of sexual glands function and hypothalamic-pituitary system.
- Cardiovascular, nervous, and other systems finish their development.

### **Children's Morbidity Scheme in Accordance with Age**

0-1 year old: diseases are not frequent, but serious.

1-3 years old: serious and frequent.

3-6 years old: frequent, less serious.

From 6 years old: chronic pathology increases with age.

#### **Contemporary morbidity tendencies**

- Acute respiratory virus diseases frequency increase.
- Allergic pathology increase.
- Immunologic reactivity lowering (lack of immune response).
- Fatiguability increasing, especially of a sensory one.
- Infections frequency increase, including controlled ones.

#### **0-1 year old**

Deficiency diseases (rickets, (iron-deficiency) anemia, hypotrophy, immunity dysfunction) because of the reserve shortage obtained from the mother.

Toxicoses (generalized infections, neurotoxicosis, intestinal toxicosis).

Diatheses manifestation.

#### **Early childhood**

Neuroses, neuropathies, ordinary retching.

Respiratory infections increase, a group of frequently ill children is formed.

Enteric infections.

Allergy manifestations, obstructive bronchitis.

Chronic nasopharynx pathology is formed, adenotonsillitis.

Children's infections (measles, whooping cough, chicken pox).

Poisoning and traumata.

Shortsightedness (myopia) is detected.

#### **Preschool period**

Respiratory morbidity decreases (the number of frequently ill children falls).  
Chronic pathology is developing (of alimentary canal, urogenital system (systema urogenitale), central nervous system, and support-motor apparatus) on the basis of diatheses and environmental impact.

### **Schooland teenager period**

Vegetative dysfunctions (myalgias, arthralgia, and cardiodynia are detected).

Neuroses, psychoneuroses, loss of consciousness.

Endocrine diseases (thyrotoxicosis, pancreatic diabetes, hypo-thalamic-pituitary system disturbances, pubertal exhaustion, and adiposity).

Tuberculosis, collagenoses appear for the first time.

### **Practical situational tasks**

.A five year old child has a moist cough that continues throughout the day, rapid breathing, and has a depressed appetite.

History of disease: onset was acute, began 3 days ago. the mother thinks the child caught a cold during a walk outside. she used at home methods of treating the child like mustard paper on the chest, she also administered a tea made with medicinal plant, but the symptoms got worse, the cough got stronger, and rapid breathing appeared. finally the mother contacted a pediatrician

From the life history we know that the child was bottle feed from 1 month, once every 2-3 months the child catches a cold. she has previously had measles scarlet fever chickenpox and enterocolitis

**Task-** To determine the period of development of the child

### **Literature:**

1. Nelson Textbook of Pediatrics / edited by Richard E. Behrman, Robert M. Kliegman, Ann M. Arvin; senior editor, Waldo E. Nelson. – 18<sup>th</sup> ed. – W. B. Saunders Company, 2012. – 2200 p.
2. Kapitan T. Propaedeutics of children's diseases and nursing of the child : textbook for students of higher medical educational institutions ; / T. Kapitan. – 4th ed. updated and translated in English Vinnitsa: The State Cartographical Factory, 2010. – 808 p.
3. Manual of Propaedeutic Pediatrics / S. O. Nykytyuk, N. I. Balatska, N. B. Galyash, N. O. Lishchenko, O. Y. Nykytyuk. – Ternopil : TSMU, 2005. – 468 p.

### **Topic 2 History collection. Clinical examination of the child. Criteria for assessing the general condition of children.**

**Aim:** To be able to prepare the child for Clinical methods of examination.

**Professional motivation :** The doctors of different specialty should be able to teach to examine the patients, to take care about them, know how to use medical technical apparatus and instruments, to analyze this information ; to organize daily regime and correct feeding; to know basic deontology principals during communication with children and their parents.

#### **Basic level**

1. Anatomy-physiological peculiarities of heart and respiratory system ,digestive system, urinary system and its peculiarities in children of different age (normal anatomy and physiology).

2. To know morphological knowledge on structure and pathology changes of different system (histology).
3. To Know anatomic and pathophysiological of pathological states of different system of child organism (pathoanatomy, pathophysiology)
4. Peculiarities of clinical examination .
5. To interpret the result of clinical and laboratory-instrumental examination (physics and normal and pathological physiology, propaedeutics of child illnesses, propaedeutics of internal diseases).

### **Student's practical activity.**

Names of practical skills:

- Determination of fontanel sizes and assessment of their edges .
- Determination of clinical signs of rickets: craniotables, „rachitic rosary”, „rachitic bracelets”, frontal and parietal prominents, bolding of occiput, O- and X-shaped deformities of legs, deformation of the chest .
- Determination of spinal cord deformations in children .
- Assessment of muscle tonus in children of different age .
- Calculation of anthropometrical indexes, evaluation of child's physical development .
- Auscultation of lungs in children of different age .
- Auscultation of a heart in children of different age .
- Taking of blood pressure in children of different age .
- Performance of Shalkov's test in children .
- Inspection of a tongue in children .
- Composition of a menu for infants on different types of feeding .
- Performance of control weighing of infants .

### **Students independent study program:**

- a) to use the knowledge of the anatomical and physiological peculiarities of the children's organism for objective examination of patients;
- b) to take anamnesis of children of different age
- c) to analyze the additional data;
- d) to organize correct care for the children of different age;
- e) to underline basic clinical syndromes.

### **Situate task**

The girl 11, was admitted with complains of high temperature, frequent and painful urination, pain in lumbar area. The disease began acutely, temperature increased to 38,0, cold appeared, general weakness, twice vomiting, frequent and painful urination.

Observed: the skin and mucous are pale, temperature is 37,5. PS-82 per minute, AP 90/60 mm.hg.st., heart tone-bright. rhythmically. in lungs-vesicular breathing. Pasternatsky symptom is positive from right side. Urination is frequent you 10-15 times daily, painful. Urine is muddy.

Task

1. What instrumental investigation must be carried .
2. Give indication for it.

Answer;

1. Excretory urogram.
2. Acute pyelonephritis.

### **Materials which might be helpful.**

### **Communication skills**

#### 1. Communication with the patient and/or family:

Establish rapport with the patient and family.

Identify the primary concerns of the patient and/or family.

Recognize the triangular relationship between the physician, patient and parent and be able to communicate information to both the patient and parent, making sure both understand the diagnosis and treatment plan and have the opportunity to ask questions; be aware that the relationship changes with increasing age of the child.

Provide anticipatory guidance during health maintenance visits, including the newborn nursery visit.

Recognize the important role of the patient's education in management of acute and chronic illnesses.

#### 2. Written communication skills:

Write a complete summary of the history and physical examination in a timely manner which is suitable to place in the patient's chart.

Outline the different formats for documenting the history and physical examination which may be used in different clinical settings.

Write admission orders for a hospitalized patient.

Write a prescription.

#### 3. Oral communication skills:

Present a complete, well organized summary of the findings of the patient's history and physical examination, modifying the presentation to fit the situation.

Communicate effectively with other health care workers, including consultants, nurses and social workers.

Explain the thought process that led to the diagnostic and therapeutic plan.

Use precise descriptions of physical findings and avoid vague terms and jargon, such as "clear" and "ARD".

### **Interviewing**

1. Patient interviews occur in a variety of clinical settings, including initial history for a hospital admission or first ambulatory visit, health maintenance visit, acute care visit, interim visit for a child with an acute or chronic health condition. The doctor should develop an awareness that in conducting a medical interview in a variety of settings, it is sometimes appropriate to obtain a complete medical history, while at other times a more limited, focused or interval history is appropriate. Initially, the emphasis should be on obtaining complete medical histories. Opportunities to do more focused work-ups should be available as the doctor builds competence.

2. Obtain a medical history from the second party (usually the parent), as well as from the patient, noting the increased reliability of obtaining information directly from the patient as the patient

matures. The doctor must be aware of issues of appropriate privacy at all ages and confidentiality in older children and adolescents.

3. Obtain a relevant history that is unique to paediatrics in addition to the standard medical history.

### **Chief complaint**

The chief complaint represents the specific reason for the child's visit to the clinic, office, or hospital. The chief complaint may be viewed as the theme, with the present illness as the setting of this problem. Six guidelines determine appropriate recording of the chief complaint: (1) it consists of a brief statement, (2) it is restricted to one or two symptoms, (3) it refers to a concrete complaint, (4) it is recorded in the child's or parent's own words, (5) it avoids the use of diagnostic terms or translations, and (6) it states the duration of the symptoms.

The doctor elicits the chief complaint by asking open-ended neutral questions such as, "Tell me what seems to be the matter?", "How may I help you?" or "What brings you here?". Labeling-type questions such as, "How are you sick?" should be avoided, since it is possible that the reason for the visit is not because of illness. For example, the visit may be for a routine health assessment, or the chief complaint may be of a nonphysical nature.

Examples of properly recorded chief complaints for a variety of situations may be: (1) ambulatory clinic – "My child has had a runny nose and sore throat for 4 days, but today it is worse", (2) hospital admission – "I need to have my tonsils fixed", sore throat and repeated earaches for 5 years, and (3) health center – "We are here for a routine checkup", last visit 1 year ago.

If the visit is for a well-child examination, one can ask, "Before we begin, is there anything of particular concern that you would like to discuss?". This type of statement encourages the parent (or child) to bring up an issue that may not surface during routine interviewing.

Occasionally it is difficult to isolate one symptom or problem as the chief complaint because the parent may identify many. In this situation it is important to be as specific as possible when asking questions. For example, asking informants to state which one problem or symptom caused them to seek help now may help them to focus on the most immediate concern.

### **Present illness**

The history of the present illness is a narrative of the chief complaint from its earliest onset through its progression to the present. Its four major components are (1) details of onset, (2) complete interval history, (3) present status, and (4) reason for seeking help now. The focus of the present illness is on all those factors that are relevant to the main problem, even if they have disappeared or changed during the onset, interval, and present.

Analyzing a symptom. Since pain is often the most characteristic symptom denoting onset of a physical problem, it is used as a prototype for analysis of a symptom. The nurse should assess pain for (1) type, (2) location, (3) severity, (4) duration, and (5) influencing factors. The type or character of pain should be as specific as possible. However, with young children, it is almost always impossible for them to describe the pain. Asking the parents how they know the child is in pain may help to describe its type, location, and severity. For example, a mother stated, "My child must have a severe earache because she pulls at her ears, rolls her head on the floor, and screams. Nothing seems to help".

The doctor can help older children to describe the pain by asking them if it is sharp, throbbing, dull, aching, stabbing, and so on. Whatever words they use should be recorded in quotes.

The location of the pain also must be specific. "Stomach pains" is too general description. Older children can better localize the pain if the doctor asks them to "point with one finger to where it



hurts". The doctor can also determine if the pain radiates by asking, "Does the pain stay there or move? Show me where it goes with your finger".

The severity of pain is best determined by finding out how it affects the child's usual behavior. Pain that prevents a child from playing, interacting with others, sleeping, and eating is most often severe. It is preferable to record pain in terms of interference with activity, rather than to quote the parent's or child's adjectives.

Duration of pain should include the duration, onset, and frequency of attacks. It may be necessary to describe this in terms of activity and behavior, such as "pain lasted all night because child refused to sleep and cried intermittently".

Influencing factors are anything that causes a change in the type, location, severity, or duration of the pain. These include (1) precipitating events (those that cause or increase the pain), (2) relieving events (those that lessen the pain, such as medications), (3) temporal events (times when the pain is relieved or increased), (4) positional events (standing, sitting, lying down, and so on), and (5) associated events (meals, stress, coughing, and so on).

A standard method of analyzing a symptom is listed in the following outline. These three categories - onset, characteristics, and course since onset - comprise the essential data for the present illness. Although the analysis of a symptom has concentrated on discussion of physical complaints, the same process of description and investigation can be used for emotional or psychosocial problems.

### **Analysis of a symptom**

#### **Onset**

Date of onset,

Manner of onset (gradual or sudden),

Precipitating and predisposing factors related to onset (emotional disturbance, physical exertion, fatigue, bodily function, pregnancy, environment, injury, infection, toxins and allergens, therapeutic agents, and so on).

#### **Characteristics**

Character (quality, quantity, consistency, or others),

Location and radiation (of pain),

Intensity or severity,

Timing (continuous or intermittent, duration of each, temporal relationship to other events),

Aggravating and relieving factors,

Associated symptoms.

#### **Course since onset**

##### **Incidence**

Single acute attack.

Recurrent acute attacks.

Daily occurrences.

Periodic occurrences.

Continuous chronic episode.

Progress (better, worse, unchanged),

Effect of therapy.

### **Past History:**

Neonatal history, including birth weight; approximate gestational age; maternal complications, such as extent of prenatal care, infections, exposure to drugs, alcohol or medications; and problems in the newborn period, such as prematurity, respiratory distress, jaundice and infections.

#### Immunizations

Development, noting the importance of assessing developmental milestones in evaluating the health of the child.

Diet, noting the importance of assessing the amount, type, and method of infant feeding.

Family History: number and ages of siblings; consanguinity, known genetic disorders, early childhood deaths, cardiovascular disease, depression and alcohol abuse.

Social History: assessment of the home environment, school and peer relationships.

**Review of Systems:** the relevant items are limited, but expand as the patient's age increases.

Modify the medical history depending on the age of the child, with particular attention given to the following age groups: neonate, infant, toddler/preschool aged child, school aged child, adolescence.

### **The Physical Examination**

I. Establish rapport with children of various ages in order to perform the physical examination.

II. Recognize that the age of the child influences the areas included in the exam, as well as the order of the examination, and the approach to the patient.

III. Recognize the important role of observation as a method of obtaining data in the assessment of the child.

IV. Perform complete physical examinations on an infant, child and adolescent, including the observation and documentation of normal physical findings.

V. Demonstrate the appropriate use of the limited or focused examination, particularly in the ambulatory setting.

VI. Use developmental assessment as part of the physical examination for all ages.

Observe how normal behaviours, such as stranger anxiety, affect the ability of the examiner to perform the examination, and develop strategies for improving rapport.

Perform the Denver Developmental Screening Test, and know how it is used to assess motor, language and social development.

Identify the physical changes of puberty and be able to conduct Tanner staging.

VII. Observe and demonstrate physical exam findings unique to the pediatric age group, and understand how findings have different clinical significance depending on the age of the child.

Some examples are:

#### Appearance

Recognize signs of acute illness in an infant, toddler and child by evaluating skin colour, respiration, hydration, mental status, cry and social interaction.

Recognize the importance of observing the psychosocial condition of the child, including behaviour, development, body habits (height, weight, body fat), relationship to parent and examiner, and general condition.

#### Vital signs

Measure heart rate, respiratory rate, blood pressure and temperature in an infant and child, demonstrating knowledge of the appropriate sized blood pressure cuff, interval to count respirations, and normal variation in temperature depending on the route of measurement (oral, rectal, axillary or tympanic).

Understand that normal values of the heart rate, the respiratory rate and the blood pressure change with age.

Recognize the importance of assessing vital signs in the evaluation of acute illness.

#### Measurements

Accurately measure height, weight and head circumference.

Plot the data on an appropriate growth chart.

Understand the normal relationships between height, weight and head circumference.

Recognize the usefulness of longitudinal data.

#### Head

Identify the anterior and posterior fontanelles and assess them.

Recognize the need for careful observation of the head size and shape, symmetry, facial features, ear size and hair whorls as a part of the examination for dysmorphic features.

Recognize the red reflex and strabismus.

Assess hydration of the mucous membranes.

Examine the tympanic membranes using pneumatic otoscopy.

#### Neck

Palpate the lymph nodes, know what anatomic areas they drain;

Know that the lymph nodes are more prominent during childhood

Recognize and demonstrate maneuvers that test for nuchal rigidity.

#### Chest

Remember how the rate and pattern of respirations change with age, and that abdominal respirations are normal in infants.

Observe the rate and effort of breathing as a measure of respiratory distress.

Recognize stridor, wheezing and rales and be able to distinguish between the inspiratory and expiratory obstruction.

Interpret less serious respiratory sounds such as transmitted upper airway sounds.

#### Cardiovascular

Palpate pulses in the upper and lower extremities and auscultate the heart for rhythm, rate, quality of the heart sounds and murmurs.

#### Abdomen

Understand that the liver edge, spleen tip and kidneys may be palpable in the normal newborn.

Examine the umbilical cord for signs of infection.

Examine the abdomen for distention, tenderness, rebound and mass lesions in an infant or young child with lethargy, irritability or signs of acute illness, noting the inability of the patient to communicate symptoms of abdominal complaints.

Be able to do a rectal examination and recognize when it is indicated.

#### Genitalia

Recognize the appearance of normal male and female genitalia in the newborn.

Recognize abnormalities, including cryptorchidism, hypospadias, testicular mass in the male.

Be able to examine the external genitalia of a female patient.

Recognize the need for privacy at all ages.

#### Extremities

Examine the hips of a newborn for dysplasia.

Recognize arthritis.

Evaluate gait and limp.

#### Back

Know how to test for scoliosis.

Neurologic examination

Elicit primitive reflexes.

Assess tone, gait, strength and reflexes, recognizing the importance of symmetry.

Assess developmental milestones; recognize that much of the neurologic examination of infants and children is accomplished through observation alone.

Skin

Recognize jaundice, petechiae, purpura, common birth marks (such as nevus flammeus and Mongolian spots), vesicles, urticaria and common rashes, such as erythema toxicum, impetigo, eczema, diaper dermatitis and viral exanthems.

Recognize common skin findings associated with child abuse.

Assess skin turgor.

### **Inspection**

The method of observation is used during physical examinations. Inspection, or "looking at the patient," is the first step in examining a patient or a body part.

### **Palpation**

The method of "feeling" with the hands is used during physical examinations. The examiner touches and feels the patient's body part with his hands to examine the size, consistency, texture, location, and tenderness of an organ or body part.

### **Auscultation**

This method used to "listen" to the sounds of the body during a physical examination can be performed by listening with the ear but is usually done by listening through a stethoscope. Health care providers routinely auscultate a patient's lungs, heart, and intestines to evaluate the frequency, intensity, duration, number, and quality of sounds. Health care providers also use auscultation to listen to the heart sounds of unborn infants.

Percussion

A method of "tapping" of the body parts during [physical examination](#) with fingers, hands, or small instruments to evaluate the size, consistency, borders and presence or absence of fluid in body organs. Percussion of a body part produces a sound (like playing a drum) that indicates the type of tissue within the organ. Lungs "sound" hollow on percussion because they are filled with air. Bones and joints "sound" solid. The abdomen "sounds" like a hollow organ filled with air, fluid, or solids.

### **Literature:**

1. Nelson Textbook of Pediatrics / edited by Richard E. Behrman, Robert M. Kliegman, Ann M. Arvin; senior editor, Waldo E. Nelson. – 18<sup>th</sup> ed. – W. B. Saunders Company, 2012.– 2200 p.
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## Topic 3 Features of the neonatal period

### Practical lessons 3-4

**Current relevance of the research.** Child's organism is constantly changing in the process of individual development, and different systems and organs formation takes place at definite time. Childhood periodization is the chronological basis for studying and understanding the regularities of child's growing up and developing, as well as the peculiarities of their morbidity depending on their age.

**The aim of the lesson:** to study the chronological structure of child's age, to study the peculiarities of children's growing, development and morbidity at different age.

#### After self-training

##### the student must know the following:

1. Peculiarities of Newborn period.
3. Peculiarities of the newborn's organism and transitory states of the newborn period.
4. Morbidity peculiarities at Newborn period.

##### Having covered the topic, the student must be able to:

1. Define the periods of children's age.
2. Single out critical periods in children's development.
3. Define maturity and ripeness of newborns, transitory states of the newborn period, estimate the state of a newborn child.

#### Materials which might be helpful.

##### *Newborn Period*

- A very high speed of cardiovascular system functional state rebuilding, rebuilding of respiratory and other systems while adapting to the environment.

- The first 30 min. of lungs breathing switching - intensive hemodynamic and respiratory adaptation.

- Intensive metabolic adaptation - just after delivery the "hunger stress", catabolic energetic exchange, during which a child uses its own reserve, and the loss of body weight takes place; then the exchange becomes anabolic, a child starts to put on weight, metabolic rebuilding finishes.

- The establishment of sleep and food intake rhythm (the central nervous system rebuilding).

**Fetal maturity** — the state characterized by the readiness of organs and systems to provide a child's extrauterine existence — is determined on the basis of external features:

- skin is elastic and pink;
- head hair length is not less than 2 cm;
- nails reach finger-tips;
- lanugo is preserved on shoulders and back upper regions;
- auricular cartilages (cartilago auriculae) are thick enough;
  
- boys' testicles are in the scrotum, girls' large lips of pudendum (labia majora pudendi) cover small lips of pudendum (labia minora pudendi);
- umbilicus ring is located at precisely equal distance from thoracic and xiphoid processes;
- crown of head (vertex) is closed.

**Full-term state** - a child is born in the 38—40 weeks term weighing not less than 2500 gr. and being not less than 45 cm long.

An immature child is a premature child or a full-term child developed in inconvenient conditions.

A **premature child** is born between the 28<sup>th</sup> and 38<sup>th</sup> weeks of gestation, weighing from 1000 to 2500 gr. and being 35—45 cm long (according to World Public Health Organization's data, since 1995, the fetus of 500 gr. and more and from the 25<sup>th</sup> week of gestation is considered to be alive).

*THE FOLLOWING SCALES ARE USED*

*FOR NEWBORNS STATE EVALUATION:*

*Apgar* - for a child's state evaluation after delivery.

*Silverman-Anderson's* - for diagnostics and heavy aspiratory disorders evaluation of newly-borns.

*Dubovitch's* - for post-natal evaluation of the gestation age.

Evaluation by Apgar scale is done on the 1<sup>st</sup> and 5<sup>th</sup> minute after delivery.

<i>Symptoms</i>	<i>Evaluation in points</i>		
	<i>0</i>	<i>1</i>	<i>2</i>
<b>Frequency of palpitation / per minute</b>	<b>Absent</b>	<b>Less than 100</b>	<b>More than 100</b>
<b>Breathing</b>	<b>Absent</b>	<b>Bradypnous irregular</b>	<b>Normal, loud cry</b>
<b>Muscular tonus</b>	<b>Absent</b>	<b>Light flexion of extremities</b>	<b>Active movements</b>
<b>Reflex excitability (reaction to mucus suction from the upper aspiratory tracts, plantar stimulation)</b>	<b>Absent</b>	<b>Grimace</b>	<b>Coughing, sneezing</b>
<b>Skin colour</b>	<b>General paleness or cyanosis</b>	<b>Pink colouring of body and blue extremities colouring (acrocyanosis)</b>	<b>Pink</b>

### *Transitional States of the Newborn Period*

**1. Transitional loss of initial weight** is usually not more than 6%. Pathogenesis is connected with the feeling of hunger, liquid loss, and perspiration.

Body weight renovation takes place on the 6<sup>th</sup>- 7<sup>th</sup> day among 60-70% of newly-borns, up to 2 weeks among all healthy full-term children.

### **2. Transitional changes of skin:**

- *simple erythema* - reactive skin reddening which appears after primary lubrication removal and first bath. It is connected with capillaries widening, disappears till the end of the first week of life;

- *physiological seed-like skin peeling* (rarely, scaled desquamation), appears on the 3<sup>rd</sup>-5<sup>th</sup> day of life, more often on abdomen or thorax regions;

- *labor tumor* - edema of the front lying part as a result of passive (venous) hyperemia, disappears during the 1<sup>st</sup>-2<sup>nd</sup> day;

- *toxic erythema* is found among 20-30% of newly-borns on the 2<sup>nd</sup>-5<sup>th</sup> day of life: erythematic, a bit thick spots, often with greyyellow bubbles in the centre, which are usually located near joints, on buttocks, thorax, rarely on face and stomach. They disappear during the 2<sup>nd</sup>—3<sup>rd</sup> day. It is an allergic reaction.

### 3. **Transitional hyperbilirubinemia.**

Develops among all newborns on the first days of life. At the same time, the yellow color of skin is found among 60-70% of children. The bilirubin increase is the result of indirect fraction. The yellow tint of skin appears as a result of transitory newly-born jaundice on the 2<sup>nd</sup>-3<sup>rd</sup> day of life and disappears on the 7<sup>th</sup>-10<sup>th</sup> day among a greater part of full-term children, among premature children it disappears much later.

Pathogenesis:

a) increased creation of bilirubin takes place because of red corpuscles short life term; it is explained by the predominance of red corpuscles with fetal hemoglobin;

b) liver functional ability is lowered, glucuronid transferring systems in particular.

### 4. **Transitional heat exchange violations:**

- *hypothermia* - within the first 30 min. of life the skin temperature may fall down to 35.8°C, then body temperature rises, and up to the 5<sup>th</sup>-6<sup>th</sup> hour of life homothermy establishes;

- *hyperthermia* appears on the 3<sup>rd</sup>-5<sup>th</sup> day of life among 1% of newborns, coincides with the maximum loss of weight. Pathogenesis: dehydration, catabolic direction of exchange, hypernatremia. Hyperthermia lasts for 1-4 hours.

5. **Sex crisis** is determined by the mother's estrogen influence. Its features:

- *mammary glands swelling* (physiological mastopathy). Starts on the 3<sup>rd</sup>—4<sup>th</sup> day of life, reaches its maximum on the 7<sup>th</sup>-8<sup>th</sup> day. At first grey then white contents come out of mammary glands. This process is found among girls and boys;

- *desquamatory vulvovaginitis* - significant mucus ejecta of grey-white color from the girls' pudendal fissure (rima pudenda);

- *vaginal bleeding* on the 5<sup>th</sup>-8<sup>th</sup> day of life;

- *milias* - white-yellow neps, 1-2 mm in size, often located on nose wings and nose bridge, on forehead and chin. They are oil glands with significant secretion and corked output duct;

-\* *arborization of nose mucus* - when the dried mucus is examined with a microscope one may find characteristic pattern looking like a fern leaf;

- *skin hyperpigmentation* around the nipples and gates (among boys);

- *edema of external genitals.*

Sex crisis is rarely observed among pre-mature children and degree of its intensity is not significant.

### 6. **Transitional peculiarities of kidneys functioning:**

- *oliguria* during the first 3 days of life;

—*proteinuria* (albuminuria);

—*kidneys uric acid infarct.* Sediment of uric acid in the form of crystals in the lumen of colligation tubules and in ductus papillary. Urine which comes out during the first week of life is

of yellow-brick color, nebulous, there may be hyaline and grainy cylinders in sediment, leukocytes, and epithelium. All these changes disappear during the first week of life.

7. **Transitional** dysbacteriosis. Fetus is sterilized, but in the process of delivery skin and mucous tunics of a child are occupied by mother's vaginal flora from the labor tract. Besides, the primary bacterial flora of bowels, skin, and mucous tunics is presented not only by such bacteria as Bifidobacterium, saprophytic staphylococcus, but also by conditioned pathogenic flora and fungi. Mother's milk is the source of Bifidobacterium flora which replaces pathogenic flora.

8. **Transitional gastric catarrh.** Excrements disorder, which is found among all newborns in the middle of the first week of life. Primary feces (meconium) is a thick, sticky mass of dark-green (olive) color, which comes out on the 1<sup>st</sup>-3<sup>rd</sup> day. Later excrements become more frequent, non-homogeneous as for consistence (nubbins, mucus, liquid), color (become more

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## Topic 4 Physical development of children, anthropometry. Assessment methods

### Practical lessons 5-6

**Current relevance of the research.** Physical development is one of integral indices of a child's state of health, of biological ripeness of all the organism's systems. The main methods of physical development investigation are easy for children of any age, which presupposes their wide application in pediatrics practice.

**The aim of the lesson:** to master the methods of main anthropometric measurements of children of different age, to be able to estimate a child's physical development by means of different methods, to point out reasons for deviation.

#### After self-training

##### the student must know the following:

1. The methods of main anthropometric measurements and necessary equipment.
2. Indexes of the physical development of a newly-born child.
3. The regularities of the enlargement of body weight and length, of thorax and head circumference at different age.
4. Factors which influence children's physical development.
5. Semiotics of physical development deviations.
6. Notions of acceleration and de-acceleration.

##### Having covered the topic, the student must be able to:

1. Measure the enlargement of body weight and length, of thorax and head circumference.
2. Make approximate calculation of main anthropometrical indexes for a child of any age.
3. Estimate the physical development of a child using centil and sigmal standards schemes.

##### Materials which might be helpful:

- Definition and essence of physical development.



- Regularities of main children's anthropometric indexes enlargement.
- Methods of children's physical development evaluation.
- The scale for children's physical development evaluation by means of different methods.
- Semiotics, of physical development deviations.

### *Definition and Essence of Physical Development Evaluation*

Physical development is a complex of morphological and functional indexes which characterize processes of child's growth and biological ripening, the storage of physical power.

Complex evaluation of physical development includes:

- evaluation of the results of anthropometry and somatoscopy. Anthropometry is a unified methodology of a human being's body or its parts measuring. Somatoscopy includes examination and description of body proportions and outward appearance indexes;

- evaluation of the functional state of different systems of organism. Dynamometry (hand muscular power measurement), spirometry (functional investigation of respiratory system), and functional tests of cardiovascular system are traditional procedures;

- definition of a child's biological age (most often the bone age is established by means of X-ray photograph of a hand).

Such complex evaluation is made in case of a significant deviation of child's physical development or if a child is suspected to have an endocrine, genetic or other diseases, or in children's groups on a special task. A district pediatrician usually deals with anthropometric data evaluation only.

### *Regularities of Main Children's Anthropometric Indexes Enlargement*

*Regularities of body length.* The average body length of a full-term newly-born child is 51-54 cm. During the first year of life the speed of child's growth changes every 4 months: during the first 4 months a child grows 3 cm per month, during the second 4 months a child grows 2.5 cm per month, during the third 4 months - 2 cm per month, during the fourth 4 months - 1 cm per month. Within 2-4 years body length enlarges by 8 cm per year, and up to the end of the 4<sup>th</sup> year makes 100 cm. From the 5<sup>th</sup> year and up to the period of sex ripening body length enlarges approximately by 6 cm, and during the pubertal period it enlarges by 8-12 cm per year.

*Regularities of body weight enlargement.* The average weight of a full-term newly-born child is 3100-3500gr. During the first half of the first year of life the average weight enlargement makes 800 gr per month, as for the second half of the first year of life, the average weight enlargement makes 400 gr per month. Up to the end of the first year of life a child's body weight makes 10 kg. Its enlargement during the second year of life makes 3-3.5 kg, and beginning from the third up to the 10<sup>th</sup> year of life it enlarges by 2 kg per year. Thus, a child's weight must be 20 kg at the age of 5, and 30 kg at the age of 10. At pubertal period weight enlarges by 4-5 kg annually.

*Regularities of thorax circumference enlargement.* Thorax circumference of a full-term newly-born child is 32-34 cm. During the first 6 months it enlarges by 2 cm per month, and during the second 6 months it enlarges by 0.5 cm per month. At the age of 2-10 thorax circumference enlarges by 1.5 cm annually, at pubertal period it enlarges by 3 cm per year. Thus, the average thorax circumference makes: 6 months old - 45 cm, 1 year old - 48 cm, 5 years old - 55 cm, 10 years old - 63 cm.

*The regularities of head circumference enlargement.* The average head circumference of a fully-term newly-born child is 34-36 cm. During the first 6 months it enlarges by 1.5 cm per month, and during the second 6 months it enlarges by 0.5 cm per month. At the age of 1-10 years thorax circumference enlarges by 1 cm annually. Thus, the average head circumference makes: 6 months old - 43 cm, 1 year old - 46 cm, 5 years old - 50 cm, 10 years old - 55 cm.

### *Methods of Children's Physical Development Evaluation*

Physical development evaluation is made by means of comparing individual child's indexes with normative. Basic and mostly the only physical development evaluation method is conducting anthropometric investigation and evaluating the obtained data. Two main methods used are: approximate calculations and anthropometric standards.

The method of approximate calculations is based on the knowledge of basic regularities of body length, body weight, thorax and head circumference enlargement. Corresponding normative indexes can be calculated for a child of any age. The admissible interval of deviation of factual data from calculated data is  $\pm 7\%$  for average physical development indexes.

This method gives precise idea of child's physical development and is used by pediatricians when providing home medical aid to children.

The method of anthropometric standards is more accurate, because individual anthropometric features are compared with normative in accordance with age and sex of a child. Regional schemes of standards are of two types: sigmal and centil.

If a scheme made on the basis of sigmal standards is used, factual indexes are compared with arithmetical mean (M) for the same index of the same age and sex group the examined child belongs to. The obtained difference is expressed in sigma (8 is the average square deviation), thus, the degree of individual indexes deviation from the average value is determined (see scheme 1).

If a scheme made on the basis of centil standards is used, it is necessary to find out the centil interval to which the factual value of index corresponds, taking into account the patient's sex and age. After that a pediatrician may give his evaluation (see scheme 1). This method is not purely mathematical, therefore it characterizes variation rows in biology and medicine better. It is easy to use, it does not require calculations, and it allows evaluating the interconnection between different anthropometric indexes - all this explains its wide usage.

**Scheme 1. The Scale for Children's Physical Development Evaluation by Means of Different Methods**

<i>Evaluation</i>	<i>Sigmal method standards</i>	<i>Centil method standards</i>
Very high	-	From the 97 <sup>th</sup> centil
High	From M + 2.18 and higher	From 90 up to 97 centils
Higher than	From M + 1.18 up to M+28	From 75 up to 90 centils
Middle	M ± 1 8	From 25 up to 75 centils
Lower than	From M - 1.18 up to M - 2 8	From 10 up to 25 centils
Low	From M - 2.18 and lower	From 3 up to 10 centils
Very low	-	Up to the 3 <sup>rd</sup> centil

*Semiotics of Physical Development Deviation*

*Body length deviations:* growth delay or tallness. Significant growth delays are called nanism, as for tallness, its significant deviations are called giantism. The main reasons for growth deviations (in the order of lowering of pathology frequency) are the following: constitutional, cerebro-endocrine and somatogenic (chronic diseases of different organism systems accompanied by function deviations of this or that organ), hereditary diseases, social and everyday reasons.

*Body weight deviations:* body weight lowering or enlargement. Among children of young age body weight deviations that constitute about 10% from the normal index, accompanied by other characteristic factors, are called hypotrophy and paratrophy. As for other age groups, body weight enlargement by more than 14% because of extra lipopexia is called adiposity. The main reasons for such deviations are alimentary, constitutional, somatogenic, cerebro-endocrinal etc.

*Head circumference deviations:* head diminution (**microcephaly**) or head enlargement (the most frequent variant is hydrocephaly). The main reasons for such deviations are pre-natal brain development deviations, traumas, and brain hypoxia during delivery, traumas, infectious diseases, and children's brain tumor after birth.

*Thorax circumference deviations* may be of diminution and enlargement character. The reasons for such deviations are the anomalies of thorax and lungs development, aspiratory organs diseases, the state of physical training and muscular development, constitutional peculiarities.

**Tests**

1. Physical development is a complex of morphological and functional indexes which characterize:
  - 1.1. Length, weight, and form of a child's body.
  - 1.2. Functions of separate organs and systems.
  - 1.3. Processes of growth and biological ripening of a child.
2. Admissible interval of average indexes of physical development for the method of precise calculation makes:
  - 2.1. 3%.
  - 2.2. 7%.
  - 2.3. 10 %.

3. Average value of the monthly enlargement of child's body length during the first 4 months of life makes:
  - 3.1. 1 cm.
  - 3.2. 2 cm.
  - 3.3. 3 cm.
  - 3.4. 4 cm.
4. Which of the variants of physical development evaluation is the correct one?
  - 4.1. Corresponding to a child's age.
  - 4.2. Average.
  - 4.3. Within the norm.
5. During the second six months of life the weight of a child enlarges by... per month:
  - 5.1. 700 gr.
  - 5.2. 300gr.
  - 5.3. 400 gr.
6. The weight of a child at the age of 2-10 enlarges annually by:
  - 6.1. 4 kg.
  - 6.2. 3 kg.
  - 6.3. 2 kg.
  - 6.4. 1 kg.
7. How to evaluate a child's physical development if the indexes value of anthropometric examination lie in the interval of 25-10 centils?
  - 7.1. As average.
  - 7.2. As higher than average.
  - 7.3. As lower than average.
  - 7.4. As high.
  - 7.5. As low.
8. What interval must anthropometric examination indexes lie in if physical development is Considered to be low?
  - 8.1. 75-50 centils.
  - 8.2. 50-25 centils.
  - 8.3. 75-97 centils.
  - 8.4. 10-3 centils.
  - 8.5. 25-10 centils.
9. How many variants of physical development evaluation can be used if it is the method of sigmal standards?
  - 9.1. 3.
  - 9.2. 5.
  - 9.3. 7.
  - 9.4. 9.
10. How many variants of physical development evaluation can be used if it is the method of percentile standards?
  - 10.1.-3.
  - 10.2.-5.
  - 10.3.-7.
  - 10.4.-9.
11. Point out the average values of a newly-born child's body weight.
  - 11.1. 3100-3400 gr.
  - 11.2. 2900-3600 gr.
  - 11.3. 2700-4000 gr.
12. The average child's body enlargement during the first year of life makes:
  - 12.1. 15-20 cm.
  - 12.2. 20-25 cm.
  - 12.3. 30-35 cm.

**Correct answers:** 1.3; 2.2; 3.3; 4.2; 5.3; 6.3; 7.3; 8.4; 9.2; 10.3; 11.1; 12.2.

#### **Literature:**

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## **Topic 5 Anatomical and physiological features, methods of examination, and semiotics of nervous system diseases in children. Psychomotor development of children and its assessment**

### **Practical lessons 7-8**

#### **AIM:**

1. To know how to evaluate development of the child in different periods (in children by one year - on months), to exhibit a deviations of various etiology.
2. To know a mode of a day and elements of education of children of different age.

#### **PROFESSIONAL MOTIVATION:**

The general level of psychological development shows maturing of central nervous system (CNS) of the child. Healthy throughout, rigorous child, that is in rational conditions of a leaving should near to good physical development have also development, appropriate to age and mentality. It is necessary to the practical doctor to know dynamics of development of the child with the purpose of diagnostics of its deviation.

#### **Basic level:**

1. To collect history taking.
2. To evaluate development of the child behind the certain criterions (sight, hearing, emotion, intellect development, development of language, habit).
3. To exhibit main kinds of violations of development.

#### **Student's Practical Activities.**

#### **Student must know:**

1. Main periods of psychomotor development of children.
2. Main criteria of psychomotor development evaluation.
3. Main indexes of psycho-motor development of newborn children.
4. Main indexes of psycho-motor development of preschoolers.
5. Main indexes of psycho-motor development of school-age children.
6. Main indexes of psycho-motor development of teenagers .

#### **Student's will be able to know**

1. To evaluate development of the child of the 1-st year of life on months.
2. To evaluate development of children of preschool age.
3. To evaluate development of junior and higher school age.
4. To exhibit in anamnesis the factors, which influence modifications in development.
5. To determine a timetable of a day to children of various century to know elements of education of children of different age and skill.

#### **Main Periods of psychomotor development of children:**

- I. **Thalamopallidar** – from the moment of birth till 4-6 month.
- II. **Striopallidar** – from 4-6 month till 10-11 month, appearance of anti-gravitation mechanisms ( sitting, standing) , decreasing of muscle tone, movement development on the base of inborn reflexes,

### III. **Maturation of brain cortex functions** – development of the conditioned reflexes, second signal system.

Main criterions of an evaluation of development of the child of the 1-st year eyes- rough responses; - hearing rough responses; -emotions and social behaviour; -movements by hands and operation with subjects; - general movements(traffic); - preparatory stages of a reason of language; - preparatory stages of development of active language; - habit and skill in processes.

2. Main parameters of psychological development of children of the 2-nd year of life: - development of a reason of language and active speech; - sensory development; - game and operations with subjects; - further intellect activity, skills and habits

3. Main parameters of psychological development of children preschool and school age: - active speech; - sensory development; - participation in game; - design and representational activity; - intellect activity.

4. Evaluation of psychological development of children of preschool century: - motor development; - visual coordination; - development of speech; -social-culture development.

5. The features of development newborns: - physiological afraid of light, nistagm, absence of fixing of a sight; -reaction on sounds by shudders, modification of breathing, blinking, - physiological hypertonus, - loud shout; - availability of unconditional reflexes, automatism, rudimentary reflexes, constituent automatism).

6. Feature of development of children of the 2-nd year of life: - improvement of coordination of movements(traffic); - understanding of language; - extension of stocks of clear words; - improving of active language; - stock of words 200-400; - beginning of sensory development; - improvement of game and operation with subjects; - beginning of subject game; - independent eat period; - partial service itself for want of clothing.

7. Feature of development of children of the 3-rd year of life: -improvement of sensory development; - subject games; - design activity; - improvement of habits, self-service; - neatness for want of fulfilment of an operation; - improvement of movements; the extension of an emotional (feeling to a regret, bashfulness, self-love and so forth).

8. Feature in development of children of preschool century: - shaping of a character; - draft to independence; - improvement of language (sound culture of language, grammatically correct language, knowledge of verses and so forth); - beginning of aesthetic submissions; - easy shaping of complicated conditional reflexes; - complication of a behaviour (associative communications, own judgments, comprehension own “ I ”); - orientation in space; - mental activity (knowledge of the alphabet, figures, amount and account magnitude, orientation in space and time); - beginning of possession of habits of the letter; - good development of visual coordination (equilibrium for want of course, statistical equilibrium, jump and so forth)..

9. Features in development of children of junior school century: - maximal of game activity; - development of main intellect qualities; - restraint in manifestations emotion; - monitoring of a behavior; - increase of volume and stability of attention; - independent creative activities; - increase of intelligence.

10. Feature in development of teenagers: - emotional increasing; - decrease of work capacity and endurance; - fast fatigue; -discoordination of hormonal processes; - decrease of tonus; - functional modifications of internal organs; - violation of vegetative regulation; - the physical development advances nervous mental ,acceleration.

11. Reason of violations of development: - pathology of pregnancy ; - disease of the mother; - chronic intoxication by alcohol, nicotine, drugs; - acute and chronic diseases of the child; - burdened heredity; - influence of an environment, leaving(maintenance), education.

12. Violation of development, which have taken place during pregnancy or per the first 3 years of life: oligofrenia, - impossibility to generalizations and reproduction.

13. Bought delay of mental development after the 3-rd years and in the following periods: dementia.

Parameters of an evaluation of psychological development:

1. "Answers age".
2. "Lags behind".
3. "Advances century".

Norms of development:

- On 1 year of life of mastering of habits in the boundaries + 15 days from passport century;
- On 2 year of life - shaping of habits in the boundaries of a quarter;
- The 3 year of life - shaping of habits in the boundaries of half-year.
- The monitoring behind psychological development of children of early age is carried out in the following terms: the 1-st year of life - 1 time in a month;  
The 2-nd year of life - 1 time per one quarter;  
The 3-rd year of life - 1 time per one year.

**Main criteria of evaluation psychomotor development:**

- 1/ Visual – finding reactions,
- 2/ Hearing – finding reactions,
- 3/ Social behavior,
- 4/ Emotions,
- 5/ Movements of arms and fingers and operation with the objects,
- 6/ General movements,
- 7/ preparing stages of speech & speech understanding,
- 8/ Habits & practical skills

**Main indexes of psycho-motor development of newborn children:**

- 1/ Physiological hyper tonus of *flexor* skeletal muscles,
- 2/ Movements of the extremities are atetos – like, have chaotic character,
- 3/ Physiological photophobia, nystagmus,
- 4/ Reaction on the sounds by shudder, increasing of breathing movements,
- 5/ Loud shout,
- 6/ The presence of unconditional reflexes( for example, all-life automatisms)

**Main indexes of psycho-motor development of children second year of life:**

- 1/ Understanding of speech & active speech,
- 2/ Sensor development ( hearing, vision),
- 3/ Games and actions with the different objects,
- 4/ further development of movements ( running, jumping, climbing)

**Main indexes of psycho-motor development of children 3 – 4 years of life:**

- 1/ Active speech,
- 2/ Better sensor development,

- 3/ Taking part in different games,
- 4/ Graphic, decorative arts : ability to draw, colorate pictures, inventiveness
- 5/ Movement activity.

**Main indexes of psycho-motor development of preschoolers:**

- 1/ Social & culture development,
- 2/ Creative activities,
- 3/ Motor development,
- 4/ Vision coordination,
- 5/ Further speech development,
- 6/ Investigative activities.

**Peculiarities of psycho-motor development of children second year of life:**

- 1/ Improvement of movement coordination,
- 2/ Understanding speech,
- 3/ Increasing vocabulary stock,
- 4/ Improvement active speech,
- 5/ Vocabulary consists of 200-400 words,
- 6/ Initiation of sensor development,
- 7/ Improvement of game and actions with the objects,
- 8/ Development of acting games,
- 9/ Eating by themselves, using plate and spoon,
- 10/ Trying to self-service during dressing.

**Peculiarities of psycho-motor development of children third year of life:**

- 1/ Improvement of sensor development,
- 2/ Different acting games,
- 3/ Creating activities,
- 4/ Improvement of self – service habits,
- 5/ Tidiness during eating, washing,
- 6/ Improvement of movements,
- 7/ Emotional sphere becomes wide: development of feelings of pity, sorry others.

**Peculiarities of development preschooler children:**

- 1/ Development of personality,
- 2/ Feeling of independence,
- 3/ Language improvement (Speech becomes grammatically right, Knowledge by heart poems, tails)
- 4/ Development of aesthetic senses (feeling of beautiful),
- 5/ Development of the conditioned reflexes, second signal system,
- 6/ Behavior becomes more developed, the child have his own opinions and judgements, comprehend himself, what is the meaning of “I”.
- 7/ Good orientation in surrounded world,
- 8/ Learning ability (knowledge of alphabet, numbers, quantity, time orientation), appeared abstract thinking
- 9/ ability to wright,

10/ further development of motor movements and their visual coordination and control .

In this period one can find behavior differentiation between boys & girls.

Quickly developed intellectual ability by increasing analyze-synthetic function of the brain, the child need to speak and play with another children.

### **Peculiarities of development children of young school age:**

- 1/ Maximum of game activity,
- 2/ development of main movement activities
- 3/ development of behavior self-control,
- 4/ emotional restraint,
- 5/ increasing of attention,
- 6/ kindness, consideration,
- 7/ self-made creating activity,
- 8/ increasing intellectual abilities.

One can see motor abilities – speed, strength, dexterity.

### **Peculiarities of development children – teenagers:**

- 1/ Emotional instability,
- 2/ They quickly tired,
- 3/ dyscoordination of hormone-related processes,
- 4/ decreasing of muscle tone,
- 5/ functional changers of internal organs,
- 6/ formation of personality, individuality
- 7/ one can see pride, self-importance, self-determination in this group of children
- 8/ physical development is higher than psychological.

### **Evaluation of the level neuropsychological development**

**The level of neuropsychological development can be calculate as coefficient of development ( QD) and can be find by the formula**

**QD = APD \* 100: CA ( APD – age of psychological development, CA – calendar age)**

### **Possible causes of impairment of children psycho-motor development:**

- pathology of the pregnancy and labor,
- somatic diseases of the mother,
- chronic intoxications by alcohol, cigarettes, smoking, narcotic drugs,
- acute and chronic diseases of the child,
- bad hereditary,
- influence of surroundment, care, behavior

### **Impairment of psycho-motor development which appeared intrauterine or first 3 years of life**

- oligophrenia ( mental retardation)
- inability to make conclusions
- affective- will disturbances
- immaturity of thinking.



Criteria of evaluation of psychomotor development:

1. "Adequate to age"
2. "Retardation"
3. "Surpass"

### **Students Independent Study Programmer.**

**I. Objectives for Students independent study.** Great attention should be paid to the following items:

1. Main Periods of psychomotor development of children.
2. Main criteria of psychomotor development evaluation.
3. Main indexes of psycho-motor development of newborn children.
4. Main indexes of psycho-motor development of preschoolers.
5. Main indexes of psycho-motor development of school-age children.
6. Main indexes of psycho-motor development of teenagers .

### **II. Tests and Tasks for Independent Study.**

Select the right statements:

#### **1. Main indexes of psycho-motor development of newborn child:**

- 1/ hyper tonus of flexor muscles,
- 2/ hyper tonus of extensor muscles,
- 3/ atetos – like movements,
- 4/ photophobia,
- 5/ unconditional reflexes
- 6/ conditional reflexes.

#### **2. Main indexes of psycho-motor development of children second year of life:**

- 1/ Understanding of speech,
- 2/ ability to hear,
- 3/ vision,
- 4/ nystagmus
- 5/ sitting,
- 6/ running,
- 7/ jumping.

#### **3. Peculiarities of development children of young school age:**

- 1/ development of main movement activities
- 2/ development of behavior self-control,
- 3/ dyscoordination of hormone-related processes,
- 4/ decreasing of muscle tone
- 5/ increasing of attention,

Practical situation to be solved.

Child has 7 months. From 1<sup>st</sup> pregnancy and pathologic labor, was born mature, but in asphyxia. Was on breast-feeding 3 weeks, all the time – on cow's milk type of feeding. Become to hold his

head in 4 months, sit himself in 7 months, knows the voice of mother, don't know the name of simple objects.

Please, evaluate the level of psycho-motor development of child.  
show the possible causes.

### **III. Test and Task Keys for Self-Assessment Study.**

Tests: 1)-1,3,4,5, 2)-1,2,3,6,7, 3)-except 3.

Problem situation: retarded development. The causes are asphyxia and bad inadequate nutrition.

### **Literature:**

7. Nelson Textbook of Pediatrics / edited by Richard E. Behrman, Robert M. Kliegman, Ann M. Arvin; senior editor, Waldo E. Nelson. – 18<sup>th</sup> ed. – W. B. Saunders Company, 2012.– 2200 p.
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### **Topic 6 Anatomical and physiological features, methods of examination, semiotics of skin diseases, subcutaneous tissue Practical lessons 9-10**

**The aim of the lesson:** to study the anatomic and physiological peculiarities of skin and subcutaneous fat of children of different age, with symptoms of affection.

**Current relevance of the research.** Due to its anatomic and physiological peculiarities children's subcutaneous and skin fat takes an active part in all exchange and immune processes, it is treated as tissue characterized by fast development in childhood. That is why skin and subcutaneous fat affections may be the evidences of an affected organism.

#### **After self-training**

#### **the student must know the following:**

1. Anatomic and physiological peculiarities of skin and subcutaneous fat.
2. Skin and subcutaneous fat functions in age aspect.
3. Peculiarities of skin and subcutaneous fat of newborns, physiological and transitory states of skin and subcutaneous fat with-in the new-born period.
4. Methods of skin and subcutaneous fat investigation.
5. Skin and subcutaneous fat affection semiotics.

#### **Heaving covered the topic, the student must be able to:**

1. Collect anamnesis, analyze the complaints typical of skin and subcutaneous fat affections.
2. Evaluate the skin color, its humidity, temperature, skin fold thickness, skin elasticity, dermatographia, the state of capillaries; in case of eruption presence one must be able to find out its nature.
3. Evaluate the state of skin and subcutaneous fat (turgor, edema, infiltration, the state of development).

#### **Materials which might be helpful.**

The skin is a complex and important part of the body which plays a large role in the life and health of a child. It has a close physiological connection with the activity of some organs and the organism as a whole. Therefore the skin is the original screen that displays the pathological

changes in the organism. A careful examination and an adequate estimation of the condition of the skin has an important role in making a diagnosis of a child's disease.

As you remember the skin consists of 3 layers:

I. *Epidermis* which consists of

- a) corneal layer,
- b) glassy layer,
- c) granular layer,
- d) spinous layer,
- e) basal layer.

Basal membrane separates epidermis from the dermis.

II. Dermis.

III. Subcutaneous tissue.

### **Physiologicoanatomical features of the skin in children**

The skin in a newborn is velvety smooth, puffy and friable, especially around the eyes, the legs, the dorsal aspect of the hands and feet, and the scrotum or labia.

There are some peculiarities of the epidermis in the newborn and young children:

In the newborn the epidermis is thinner than in adults.

The basal layer is well developed and has 2 kinds of cells - basal and melanocytes. The last ones do not produce melanin until the infant is 6 months. That is why the skin in the newborn is lighter in the first days of life.

The granular layer is thinner, consists of 2-3 lines of cells. It is poorly developed except soles and palms. The absence of keratoglyadin protein makes the skin transparent considerably, because keratoglyadin protein gives the skin a white hue.

The glassy layer is absent.

The corneal layer is poorly developed, thin, it has only 2-3 lines of flattened corneal cells. The structure of the corneal layer is friable and puffy.

*The clinical significance.* In newborn and younger children the skin is susceptible to superficial bacterial infection, candidosis (oral moniliasis) and intertrigo with maceration, weeping and erosion.

The dermis comprises the major portion of the skin. It is firm, fibrous, and elastic connective tissue network containing an elaborate system of blood and lymphatics vessels, nerves. It varies throughout the body from 1 to 4 mm in thickness. It is invaded by the epidermal downgrowth of hair follicles, sweat and sebaceous glands. The dermis consists of papillary and reticular layers.

There are some peculiarities of the dermis in the newborn and young (little) children:

In the newborn the papillary layer is poorly developed. In the premature infant it is absent.

The dermis has an embryonic structure - it has a lot of cellular elements and a little amount of fibrous structures. Elastic fibres are absent. They first appear in 5-6 months of life.

Leucocytes (mast cells) have a high biological activity.

In the newborn the quantity of water is higher than in an adult (80 % and 6-8 % respectively) in the dermis.

The basal membrane is poorly developed. It leads to easy separation of the epidermis from the dermis, it results in epidermolysis.

Morphological maturity of the derma occurs by 6 years.

*The clinical significance.* A newborn and an infant more often show blistering (bullous) reactions caused by the poor adherence between the epidermis and the dermis and frequently affected by chronic atopic dermatitis (eczema).

### **Basic physiological functions of the skin**

The protective function is an immature function, it occurs because of thin epidermis and dermis, immature basal membrane, a little amount of fibrous structures and a good developing of blood vessels network.

The bactericidal function is an immature function, it is due to pH of the newborn skin (6.1-6.7) in an adult pH is acidic (4.2-5.6). This pH medium is favourable for developing microbes.

The thermoregulation is immature function as the result of high emission heat process and immature heat production. The high emission heat processes occur because of a thin skin, a later beginning of sweat glands functioning, a well developed superficial vessel network, the vessels are in physiological vasodilatation. Muscles of the hair bulbs are poor developed, so gooseflesh does not appear.

The respiratory function is well developed. It helps immature lungs to perform the respiratory function. The intensity of the respiratory function is more intensive by 8 times in a newborn than in an adult. Well developed respiratory functions are caused by puffy and thin skin, a well developed superficial vessel network, physiological vasodilatation of vessels.

The deposition function is well developed. The skin is the depot of blood and water.

The reception (receptor) function is well developed. There are a lot of nerves in the skin, so the skin is a peripheral analyzer that grasps endo- and exogenous stimuli.

The excretion function is provided by sweat glands. The skin excretes some products of metabolism of fat and carbohydrate and different medicaments. The excretion function of the skin begins with the beginning of functioning sweat and sebaceous glands (3-4 months).

The resorption is well developed. It is caused by puffy and thin skin, well developed superficial vessel network, a great number of sebaceous glands and hair follicles. But resorption depends on the chemical structure of the substance: liposoluble substances are well absorbed, water-soluble substances are nonabsorptive.

The buffer function is poor developed, because in newborn and young children pH of the skin is nearly neutral (pH 6.1-6.7) therefore the skin can't neutralize acids and alkaline.

The pigmentation function is immature.

The synthesis of vitamins. The skin synthesizes vitamin D and other biologically active substances.

The secretion function. The skin secretes keratin, squalen, calcium and phosphorus. In a newborn the secretion of keratin and squalen is decreased, the secretion of calcium and phosphorus is increased.

The metabolic function is well developed, therefore newborns and young children have a high regeneration of the epidermis and the dermis.

### **Physiologicoanatomical features of appendages of the skin in children**

Appendages of the skin are sebaceous gland, sweat gland, hair.

**Sebaceous glands** are well developed, begin to function since 7-months of the intrauterine life. The quantity of sebaceous glands in 1 cm<sup>2</sup> is relatively large in a newborn.

Millia is often seen in the newborn. That is the obstruction of the excretory duct of sebaceous glands. Millia localizes on the nose and cheeks, have yellow-roseate color, its size is 1x1 mm. Millia disappears by 2-3 month.

**Sweat glands** are poorly developed.

There are two types of sweat glands: eccrine and apocrine. In a newborn eccrine sweat glands are well formed, but their excretory ducts are feebly developed and obstructed. Eccrine sweat glands begin secretory function by 2 months.

Morphological and physiological maturity of eccrine sweat glands occurs by 5-7 years.

The formation of apocrine sweat glands finishes by one year but they begin to function only in the puberty period.

**Hair.** The hair covering the skin in a newborn falls gradually during the first year of life instead of permanent hair appearance. With age the hair becomes thicker.

**Subcutaneous fat.** In a newborn the thickness of subcutaneous fat is relatively larger than in an adult (12 % and 8 % in an adult). Distribution of the fat is not regular in a newborn. They have good subcutaneous fat all over the body except the abdomen where there is insensitive deposition during the first 6 months.

The subcutaneous fat has an embryonic structure; it gives the possibility to deposit fat and to perform the hemopoietic function.

If we look at the chemical structure of the subcutaneous fat we will see the predomination of saturated fatty acids. This gives a good turgor to the skin.

The next peculiarity of the subcutaneous fat in the newborn is the presence of a brown adipose tissue. It localizes in the back neck part, in the axillary area, around the thyroid gland and the kidneys, in the intrascapular space and around great vessels. The main function of the brown fat is heat production without muscle contraction. In 5-6 months the brown fat disappears. The subcutaneous fat is absent in the abdomen, peritoneal and thoracic cavities, therefore the inner organs are movable.

### **The peculiarity of the skin in newborn**

At birth the skin is covered with grayish-white, cheese-like substance called *vernix caseosa*. If it is not removed during the first bath, it will dry and disappear in 24 or 48 hours. It is thought to have insulating and bacteriostatic properties. A fine, downy hair called lanugo is present on the skin, especially on the forehead, cheeks, shoulders and back. It usually disappears spontaneously in a few weeks.

### **The technique of the examining of the skin**

The skin is assessed for color, texture, temperature, moisture, and turgor. Hair is also inspected for color, texture, quality, distribution, and elasticity. The examination of the skin and its accessory organs primarily involves inspection and palpation.

#### ***Skin Glands in Age Aspect .***

*Oil glands* may be found on all skin surface, except for palms, feet, and dorsal side of feet. Their ducts open to hair follicles, except for lips skin, preputial bags and small lips of pudendum, where they open directly to the surface. Oil glands activity depends on androgenic stimulation (mother's androgen stimulation of fetus).

*Apocrine glands* are located in axillary creases, perianal and genitals districts, near umbilicus. They produce milk-like odourless secret. It is pushed out by androgen stimulators action to the surface. Under the influence of bacteria it becomes smelly, this smell is associated with perspiration. These glands are "sleeping" till the pubertal period.

*Eccrine (merocrine) glands* are spread over the body surface. They respond to the temperature on hair districts and regulate body temperature by means of water transportation to the skin surface where it is turned into vapour. Their ducts are opened to the skin surface. The glands are provided with sympathetic nerve endings.

### **Skin Eruption Elements**

**Primary:** appear on visually unchanged skin.

*Spot (makula):* primary non-cavernous skin eruption element which changes skin colour only, disappears when pressed. May be of inflammation and non-inflammation genesis. According to its size is divided into roseolas (less than 5 mm in size), proper spots and erythema (more than 20 mm in size). Among the spots of non-inflammation genesis hemorrhagic ones are the most frequent; they are divided into petechia, purpura (2-5 mm in size), linear (vibries), ecchymosis ("bruises">5 mm), big formless spots - soggillation, hematoma. The spots can be dyspigmented (vitiligo, albinism), hyperpigmented (freckles, chloasma, birthmarks). Typhoid maculopapular rash is present in case of typhoid, syphilis, measles, and German measles. Punctate (finely papular) rash is typical of scarlet fever and measles. Telangiectasia (vessels units having a star form) are also treated as spots. They are the evidence of liver affection.

*Papule (papula):* a vessel knot, non-cavernous element which changes skin consistence and relief. Appears as a result of different pathological processes taking place in epidermis and upper skin layers (infiltrate skin accumulation, skin tissues hypertrophy, protein products precipitations). Depending on size the following types are distinguished: miliary, lenticular (up to 0.5 cm), numular (1-2 cm). They may be of inflammation and non-inflammation (warts) genesis. Papule is most frequent in case of scab, lichen pilaris, measles, German measles, and purpura rheumatica.

*Hunch (tuberculum):* a non-cavernous element located in the reticular layer of derma, up to 1 cm in diameter, prominent on the skin surface. May be of inflammation and non-inflammation nature. Appears in case of syphilis, wolfish herpes, leprosy, and leishmaniasis.

*Nodule (nodulus):* a non-cavernous element located in derma. Maybe of non-inflammation (atheroma, lipoma) and inflammation (strophulus, leprosy, furuncle, carbuncle, erythema nodosum) genesis.

*Vesicle (vesicula):* a primary non-cavernous element having a bottom, cover, and content. If it is less than 1 cm in diameter, it is vial; if more than 1 cm in diameter, it is bulb (bulla). The content may be serum, hemorrhagic, and purulent. May be located either in epidermis or below epidermis. It is typical of eczema, chicken pox, shingles. The bulb is typical of burns.

*Pustule (pustula):* a non-cavity element with purulent content located in epidermis, derma or subcutaneous layer. Maybe connected (osteofolliculitis, folliculitis, acne, and hydradenitis) and disconnected (impetigo) with skin appendages; deep and superficial.

*Bulb (urtica):* a non-cavernous element (stands between cavernous and non-cavernous ones), forms as a result of temporary surface blood vessels widening and liquid blood components release. Examples: nettle rash, insects bites, nettle burns, allergic dermatosis.

**Secondary:** a stage of primary and secondary elements development.

*Secondary pigmentation:* skin colour change on the place of a previously existing element.

*Peel (squama):* an element consisting of surface epidermis layers, skin fat, dust, and bacteria.

*Erosion (erosio):* a defect in epithelium boundaries.

*Ulcer (ulcus) is &* deep defect of skin which reaches the cellular layer, is formed of deep primary elements.

*Excoriation (excoriatio):* *scratch, abrasion.* It is a linear skin defect caused in a mechanic way.

*Crack (rhagades):* a linear skin defect formed as a result of skin wholeness and elasticity damage.

*Crust (crustae):* dry exudation; appears on places of all cavernous elements or on the places of secondary elements accompanied by skin wholeness affection.

*Cicatrice (cicatrix):* conjunctive tissue replaces skin.

*Atrophy:* all skin layers get thinner.

*Lichenification (lichenificatio):* all skin layers get thicker, the skin has a clear, intensive pattern (neurodermatitis, eczema). The skin is whole, coarse, the picture is enforced, there is a lot of furrows, practically cannot be folded.

The ambiguity of skin eruption elements is called *polymorphism*. The real (true) polymorphism is represented by several different primary elements, while the false one is represented by one primary element on different stages of its development.

### **Literature:**

10. Nelson Textbook of Pediatrics / edited by Richard E. Behrman, Robert M. Kliegman, Ann M. Arvin; senior editor, Waldo E. Nelson. – 18<sup>th</sup> ed. – W. B. Saunders Company, 2012.– 2200 p.
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## **Topic 7 Anatomical and physiological features, examination methods, semiotics of the bone system in children.**

### **Practical lessons 11-12**

Aim: The state of bone system in children of different age on the basic knowledge's of anatomy-physiological peculiarities, to identify pathological syndromes of osseous system, to organize correct treatment for sick children.

Professional motivation:

Bones system in children permanently changes and perfects, and that's why knowledge of it peculiarities are the central aspect to take care in order to prevent many diseases. That's why doctors are ought to be skilled in diagnostic these states, and to organize inspection and medical care for patients.

Basic level

To Know:

1. Development Peculiarities and functioning of bone system in children (normal anatomy, physiology, microbiology, propaedeutics therapy, propaedeutics of child diseases).
2. Methods of clinical inspection of system bone system in children (propaedeutics therapy, propaedeutics of child diseases).
3. Rates of general blood test, biochemical blood test, system (physics, normal and pathologic physiology, propaedeutic therapy, immunology, x-ray test, propaedeutics of child diseases).
4. Main syndromal diagnosis (pathological physiology, propaedeutics of child illnesses).
5. Semiotics of lesion of bone system in children (normal and pathological physiology, microbiology, propaedeutic therapy).
6. Medical care for sick children.

Student independent study program:

1. Anatomy-physiological peculiarities of bones system.
2. Research Methods of bones system
3. Clinical features of painful syndrome
4. Objective inspection
5. Laboratory methods AND. Biochemical blood test: determination of calcium level, phosphorus, alkaline phosphatase in blood .

Instrumental research methods:

- a) roentgenologic bone research in projections straight and lateral;
- b) tomography bone and receipt joint (of photos ;on layer)
- c) radionuclid bone research and joint ;
- d) artrography
- g) arthroscopy
- e) joint puncture

6. Semiotic of bones and muscular system

Student's practical activities

1. Determination of fontanel sizes and assessment of their edges

2. Determination of clinical signs of rickets: craniotables, „rachitic rosary”, „rachitic bracelets”, frontal and parietal prominents, bolding of occiput, O- and X-shaped deformities of legs, deformation of the chest
3. Determination of spinal cord deformations in children
4. Assessment of muscle tonus in children of different age

Student must know

1. Anatomico-physiological peculiarities of the bone and muscle system .
2. Research methods of the bone and muscle system
3. Clinical features of painful syndrome
4. Objective inspection (normal closing process of fontanelles), palpation of bones and muscular system
5. Laboratory methods
6. Semiotics of the bone and muscle system , basic syndromes
  - painful,
  - hyperplasia of bones system (microcephaly, , rachitis)
  - osteomalacy (rachitis)
  - osteoporosis
7. Medical care for children
  - movement of hygienic recommendations;
  - rational feeding accordingly child age;
  - anthropometry
  - medical physical training and massage
  - examination, palpation of bones and muscular system.

Student should be able to

1. Determination of fontanelles sizes and assessment of their edges
2. Determination of clinical signs of rickets: craniotables, „rachitic rosary”, „rachitic bracelets”, frontal and parietal prominent, bolding of occiput, O- and X-shaped deformities of legs, deformation of the chest
3. Determination of spinal cord deformations in children
4. Assessment of muscle tonus in children of different age

Materials which might be helpful.

**Peculiarity of the chest in newborn** The newborn's chest is almost circular because the anteroposterior and lateral diameters are equal. The ribs are very flexible, and slight intercostal retractions are normally seen on inspiration. The xiphoid process is commonly visible as a small protrusion at the end of the sternum. The sternum is generally raised and slightly curved.

**Physiologicoanatomical peculiarities of the head in the newborn**

General observation of the contour of the head is important, since molding occurs in almost all vaginal deliveries. In a vertex delivery the head is usually flattened at the forehead, with the apex rising and forming a point at the end of the parietal bones and the posterior skull or occiput dropping abruptly. The usual more oval contour of the head is apparent by 1 to 2 days after birth. The change in shape occurs because the bones of the cranium are not fused, allowing for overlapping of the edges of these bones to accommodate to the size of the birth canal during delivery. Such molding does not occur in infants born by cesarean section.

Six bones - the frontal, occipital, two parietals, and two temporals - comprise the cranium.

Between the junctions of these bones are bands of connective tissue called sutures. At the junction of the sutures are wider spaces of unossified membranous tissue called fontanelles. The two most prominent fontanelles in infants are the anterior fontanel formed by the junction of the sagittal, coronal, and frontal sutures, and the posterior fontanel, formed by the junction of the sagittal and lambdoidal sutures (Fig. 7.3). One can easily remember the location of the sutures because the coronal suture "crowns" the head and the sagittal suture "separates" the head.



Two other fontanelles - the sphenoidal and mastoid - are normally present but are not usually palpable. An additional fontanelle located between the anterior and posterior fontanelles along the sagittal suture is found in some normal neonates but is also found in some infants with Down's syndrome.

The presence of this sagittal or parietal fontanelle is always recorded.

The doctor palpates the skull for all patent sutures and fontanelles, noting size, shape, molding, or abnormal closure. The sutures are felt as cracks between the skull bones, and the fontanelles are felt as wider "soft spots" at the junction of the sutures. These are palpated by using the tip of the index finger and running it along the ends of the bones. The anterior fontanelle is diamond-shaped, measuring 2.5 cm (1 inch) by 3 cm (about 1.5 inches). The posterior fontanelle is triangular-shaped, measuring between 0.5 and 1 cm (less than 1/2 inch) at its widest part. It is easily located by following the sagittal suture toward the occiput.

The fontanelles should feel flat, firm, and well-demarcated against the bony edges of the skull. Frequently pulsations are visible at the anterior fontanelle. Coughing, crying, or lying down may temporarily cause the fontanelles to bulge and become more taut. However, a widened, tense, bulging fontanelle is a sign of increased intracranial pressure. A markedly sunken, depressed fontanelle is an indication of dehydration. Such findings are recorded and reported to the physician.

The doctor also palpates the skull for any unusual masses or prominences, particularly those resulting from birth trauma, such as caput succedaneum or cephalhematoma. Because of the pliability of the skull, exerting pressure at the margin of the parietal and occipital bones along the lambdoid suture may produce a snapping sensation similar to the indentation of a Ping-Pong ball. This phenomenon is known as physiologic craniotabes and, although usually a normal finding, can be indicative of hydrocephalus, syphilis and ricket.

The degree of the head control in the neonate is also assessed. Although the head lag is normal in the newborn, the degree of the ability to control the head in certain positions should be recognized. If the supine infant is pulled from the arms into a semi-Fowler's position, a marked head lag and hyperextension are noted. However, as one continues to bring the infant forward into a sitting position, the infant attempts to control the head in an upright position. As the head falls forward onto the chest, many infants attempt to right it into the erect position. If the infant is held in ventral suspension, that is, held prone above and parallel to the examining surface, the infant holds his head in a straight line with the spinal column. When lying on the abdomen, the newborn has the ability to lift the head slightly, turning it from side to side. A marked head lag is seen in Down's syndrome, hypoxic infants, and newborns with brain damage.

Examination of the spine

While the child is prone, the spine, extremities, joints, and muscles are inspected. However, they are also observed with the child sitting and standing.

The general curvature of the spine is noted. Normally the back of a newborn is rounded or C-shaped from the thoracic and pelvic curves. The development of the cervical and lumbar curves approximates the development of various motor skills, such as cervical curvature with the head control, and gives the older child the typical double-S curve.

Marked curvatures in posture are noted. Scoliosis, lateral curvature of the spine, is an important childhood problem, especially in females. Although scoliosis may be palpated as one feels along the spine and notes a sideways displacement, more objective tests include some aspects.

1. With the child standing erect, clothed only in underpants (and bra if an older girl), he is observed from behind, noting asymmetry of the shoulders and hips.
2. With the child bending forward so that the back is parallel to the floor, he is observed from the side, noting asymmetry or prominence of the rib cage.

A slight limp, a crooked hemline, or complaints of a sore back are other signs and symptoms of scoliosis.

The back, especially along the spine, is inspected for any tufts of hair, dimples, or discoloration. A small dimple usually with a tuft of hair called a pilonidal cyst may indicate an underlying

spina bifida occulta. The nurse palpates the spine to identify each spiny process of the vertebrae or lack of them. Any masses, which may be meningoceles, evidence of tenderness, and swelling are noted.

Mobility of the vertebral column is easily assessed in most children because of their propensity for constant motion during the examination. However, mobility can be specifically tested for by asking the child to sit up from a prone position or to do a modified sit-up exercise. Maintaining a rigid straightness when performing these maneuvers is considered abnormal and may indicate central nervous system infection or irritation. However, some individuals who are unable to relax, despite normal skeletal function, may also retain a rigid posture.

Movement of the cervical spine is an important diagnostic sign for neurologic problems, such as meningitis. Normally movement of the head in all directions is effortless. Hyperextension of the neck and spine, called opisthotonos, which is accompanied by pain if the nurse attempts to flex the head, is always referred for immediate medical evaluation.

Examination of extremities. Each extremity is inspected for symmetry of length and size; any deviation is referred for orthopedic evaluation. The fingers and toes are counted to be certain of the normal number. This is so often taken for granted that an extra digit (polydactyly) or fusion of digits (syndactyly).

The extremities are examined for symmetry, range of motion, and signs of malformation or trauma. The fingers and toes are counted, and supernumerary digits (polydactyly) or fusion of digits (syndactyly) is noted. A partial syndactyly between the second and third toes is a common variation seen in otherwise normal infants.

Range of motion of the extremities should be observed throughout the entire examination.

Hyperflexibility of joints is characteristic of Down's syndrome. Eliciting the scarf sign may be helpful in identifying abnormal flexion of joints.

The fingernails are examined, and the nail beds should be pink, although slight blueness is evident in acrocyanosis. Persistent cyanosis of the nail beds indicates anoxia or vasoconstriction. Yellowing of the nail beds may indicate intrauterine distress, postmaturity, or hemolytic disease. Short or absent nails are seen in premature infants, whereas long nails, extending over the ends of the fingers, are characteristic of postmature newborns.

The palms of the hands should have the usual creases. A transverse palmar crease, called a simian crease, may suggest Down's syndrome. The full-term newborn usually has creases on the anterior two thirds of the sole of the foot. In postmature infants the sole is covered with deep creases, and in premature infants the creases are absent. The soles of the feet are flat with prominent fat pads.

The extremities are inspected for evidence of fractures from birth trauma. The clavicle, humerus, and femur are most commonly involved. Limitation of movement, visible deformity, asymmetry of reflexes, and malposition of the site are signs suggestive of a fracture. The hips are rotated to identify a congenital dislocation.

Semiotics of the bone and muscle system lesions. Care for children with the diseases of bones and muscles

.

### RICKETS (RACHITIS)

It is one of the most frequent deficiency diseases in infants, the main clinical symptoms of which are changes of the skeleton.

Etiology of rickets: the deficiency of vitamin D (D2-ergocalciferol, D3-cholecalciferol).

Clinical symptom.

#### Head

- a) delayed closure of fontanelles;
- b) deformed shape of the head:
  1. the skull is flat and depressed toward middle;
  2. a prominence of frontal bones = "Olympic forehead";
  3. a prominence to the sides of the parietal bones = "caput quadratum";

4. prominence of parietal bones and depression toward middle the suture between these bones = caput natiforme;
5. craniotabes (softening of cranial bones);
6. softening of cranial bones may lead to enlarging all the sizes of the head that is called macrocephalia).

Chest:

- a) rachitic rosary (enlargement of costochondral junction of ribs);
- b) Harrison's groove (horizontal depression in the lower portion of the rib cage);
- c) pigeon chest (depression to the middle of lower part of sternum);

Spine:

kyphosis, scoliosis, lordosis.

Extremities:

- a) bowing of the arms and legs;
- b) knock-knee (X-shaped legs) (see fig. 7.4-5);
- c) saber shins;
- d) instability of hip joints;
- e) pelvic deformity;
- f) enlargement of epiphysis at the ends of the long bones.

Teeth:

- a) delayed calcification, especially of permanent teeth;
- b) maleruption of teeth.

Abdomen: potbelly, constipation.

Rachitis tetany: seizures.

Symptoms of rickets are usually found in children less than 2 years of age, some of them in an reduced form can persist for the whole life.

Laboratory diagnostics

1. Quantity of Ca<sup>2+</sup> in the blood serum (normally: 2.25 – 2.5 mM/l).
2. Sulkovich test (test for founding calcium in urine).

Nursing care plan

1. Encourage foods rich in vitamin D, especially fortified cow's milk
2. In breast-fed infants is encourage use of vitamin D supplements if maternal diet inadequate or infant exposed to minimal sunlight.
3. Emphasize the importance of exposure to the sun as the source of vit. D.
4. In caring for the child with rickets:
  - a) maintain a good body alignment;
  - b) reposition frequently to prevent decubiti and respiratory infection;
  - c) handle the child very gently and minimally;
  - d) instate seizure precautions;
  - e) have 10 % calcium gluconate available in case of tetany;
  - f) if prescribed, supervise proper use of orthopedic splints or braces.

SCOLIOSIS

A lateral curvature of the is spine usually associated with a rotary deformity.

Tests for scoliosis:

1. Have the child stand erect, observe from behind and note asymmetry of the shoulders and hips. (Normally shoulders, scapula, and iliac crests are symmetric).
2. Have the child bend forward at the waist until the back is parallel to the floor, observe from side and note asymmetry or prominence of rib cage.

Other signs of scoliosis include a slight limp, a crooked hem or a waistline, complaint of backache.

Congenital dislocation of the femur (hip)

Malformations of the hip with various degrees of deformity are present at birth.

Congenital dysplasia of the hip joint (acetabular dysplasia) – the mildest form, in which there is neither subluxation nor dislocation. The femoral head remains in the acetabulum.

In congenital hip subluxation the femoral head loses contact with the acetabulum and is displaced posteriorly and superiorly over the fibrocartilaginous rim. The femoral head remains in contact with the acetabulum, but stretched capsule and ligamentum teres cause the head of the femur to be partially displaced.

In dislocation the femoral head loses contact with the acetabulum and is displaced posteriorly and superiorly over the fibrocartilaginous rim.

Clinical symptom

I. Dislocated or subluxated hip.

- a) Limitation in hip abduction;
- b) Unequal gluteal or leg folds;
- c) Unequal knee height (Allis or Galeazzi sign);
- d) Audible click on abduction (Ortolani sign) – if infant is under 4 weeks of age).

II. In older children.

- a) Affected leg shorter than the other.
- b) Telescoping or piston mobility of the joint (the head of the femur can be felt to move up and down in the buttock when the extended thigh is pushed first toward the child's head and then pulled distally).
- c) Trendelenburg's sign (when the child stands first on one foot and then on the other (holding onto a chair or someone's hands) bearing weight on the affected hip, the pelvis tilts downward on the normal side instead of upward as it would with normal stability).
- d) Greater trochanter is prominent and appears above a line from the anterior superior iliac spine to the tuberosity of the ischium.
- e) Marked lordosis (bilateral dislocation).
- f) Waddling gait (bilateral dislocation).

Paraclinic diagnostic procedures

- Radiography.
- Sonography.

Child caring plan.

1. Improve the means of transportation of the child.
2. Devise the self-mobilization equipment.
3. If prescribed, supervise a proper use of orthopedic splints or braces.

Congenital clubfoot

A common deformity in which the foot is twisted out of its normal shape or position.

It must be described according to position of the ankle and foot:

- a) talipes varus is an inversion or a bending inward;
- b) talipes valgus is an eversion or bending outward;
- c) talipes equines is a plantar flexion, in which toes are lower than the heel;
- d) talipes calcaneus is a dorsiflexion, in which toes are higher than the heel;
- e) talipes equinovarus is a composite deformity, in which the foot is pointed downward and inward in varying degrees of severity.

It is important to determine if the deformity can be passively corrected or is fixed.

Osteomyelitis

Infection of the bone.

## Manifestations of acute osteomyelitis

### I. General:

- a) History of the trauma to the affected bone (frequent).
- b) Child appears very ill.
- c) Irritability.
- d) Restlessness.
- e) Elevated temperature.
- f) Rapid pulse.
- g) Dehydration.

### II. Local:

- a) Tenderness.
- b) Increased warmth.
- c) Diffuse swelling over the involved bone.
- d) Involved extremity is painful, especially on movement.
- e) Involved extremity is held in semiflexion.
- f) Surrounding muscles are tense and resist to passive movement.

### Paraclinic diagnostic procedures:

Radiography, tomography, scintigraphy, blood culture, WBC (white blood count), erythrocyte sedimentation rate.

### Child care plan

1. To administer antibiotics as prescribed, wound care, to maintain asepsis.
2. To cleanse the area as ordered, including irrigation if prescribed.
3. To apply appropriate medication and dress wound according to instructions.
4. To maintain immobilization with positioning or devices such as casts, splints, traction.
5. To ensure a nutrition diet.
6. To maintain integrity and sterility of venous access.

### Literature:

1. Nelson Textbook of Pediatrics / edited by Richard E. Behrman, Robert M. Kliegman, Ann M. Arvin; senior editor, Waldo E. Nelson. – 18th ed. – W. B. Saunders Company, 2012. – 2200 p.
2. Kapitan T. Propaedeutics of children's diseases and nursing of the child : textbook for students of higher medical educational institutions ; / T. Kapitan. – 4th ed. updated and translated in English Vinnitsa: The State Cartographical Factory, 2010. – 808 p.
3. Manual of Propaedeutic Pediatrics / S. O. Nykytyuk, N. I. Balatska, N. B. Galyash, N. O. Lishchenko, O. Y. Nykytyuk. – Ternopil : TSMU, 2005. – 468 p.

## **Topic 8 Anatomical and physiological features, examination methods, semiotics of lesions of the muscular system in children.**

### **Practical lessons 13-14**

Aim: The state of muscle system in children of different age on the basic knowledges of anatomy- physiological peculiarities, to identify pathological syndromes of system, to organize correct treatment for sick children.

### Professional motivation:

Muscle system in children permanently changes and perfects, and that's why knowledge of it peculiarities are the central aspect to take care in order to prevent many diseases. That's why doctors are ought to be skilled in diagnostic these states, and to organize inspection and medical care for patients.

## Basic level

### To Know:

1. Development Peculiarities and functioning of muscle system in children (normal anatomy, physiology, microbiology, propaedeutic therapy, propaedeutic of child diseases).
2. Methods of clinical inspection of system muscle system in children (propaedeutic therapy, propaedeutic of child diseases).
3. Rates of general blood test, biochemical blood test, system (physics, normal and pathologic physiology, propaedeutic therapy, immunology, x-ray test, propaedeutic of child diseases).
4. Main syndrome diagnosis (pathological physiology, propaedeutic of child illnesses).
5. Semiotics of lesion of bone and muscle system in children (normal and pathological physiology, microbiology, propaedeutic therapy).
6. Medical care for sick children.

### Student independent study program:

1. Anatomy-physiological peculiarities of muscular system.
2. Research methods muscular system
3. Clinical features of painful syndrome
4. Objective inspection
5. Laboratory methods AND. Biochemical blood test: determination of calcium level, phosphorus, alkaline phosphatase in blood.
6. Semiotic of muscular system

### Student s practical activities

Assessment of muscle tonus in children of different age

### Student must know

1. Anatomico-physiological peculiarities of the muscle system.
2. Research methods of the muscle system
3. Clinical features of painful syndrome
4. Objective inspection (normal closing process of fontanelles), palpation of muscular system
5. Laboratory methods
6. Semiotics of the muscle system, basic syndromes
7. Medical care for children
  - movement of hygienic recommendations;
  - rational feeding accordingly child age;
  - anthropometry
  - medical physical training and massage
  - examination, palpation of bones and muscular system.

Having covered the topic, the student must be able to:

1. Point out complaints typical of musculoskeletal system affection; collect the family and individual anamnesis.
2. Conduct an objective muscles investigation of children of different age.
3. Evaluate the data obtained as a result of objective investigation of the given system.
4. Work out the plan for laboratory and instrumental musculoskeletal system investigation and evaluate the data obtained.

### Materials which might be helpful.

During the examination of children it is necessary to examine the anamnesis data which have any importance for the musculoskeletal system, static and motility development (mother's state of health during the pregnancy period, the character of her feeding, the child's state of health, feeding and bringing up regime); as well as typical complaints (pain in bones, muscles and joints; joints configuration change and mobility limitation).

During the examination one must pay attention to the following aspects: head's form and size changes (microcephalia, macrocephaly, acrocephaly, buttocks-like, saddle-like, scaphocephaly, steeple (tower) skull, flat occiput); upper and lower jaws development, peculiarities of occlusion, teeth quantity, their type (milk teeth, permanent teeth); chest form (conical, cylindrical, flat, Harrison's trench, keeled chest, funnel breast, barrel (emphysematous) chest, cardiac hump, one side flattening or one side outpouching); backbone form (pathological kyphosis, lordosis, scoliotic angulation) and pelvis form (planorachitic, Otto's pelvis); extremities configuration (acromegalia, bradydactylia, adactylia, aphalangia, etc.); joints form (edema, deformation), their mobility, skin and surrounding tissues state (eruption, knots and other formations); muscles trophism (weak, middle and best state of development, atrophy, hypertrophy, hypotrophy); the state of muscles tonus (hypotonus and hypertonus).

By means of musculoskeletal system palpation the wholeness of skull bones, sutures and crown state are detected (craniotabes, crown sides pliability, crown size); breaks and deformation presence; osteoid tissue hyperplasia signs (rickety thickening of wrists and ankles, rachitic rosaries, "beads"); skin temperature over the joints, pain in bones, muscles, and joints; muscles power and tonus; infiltration presence.

#### Muscles Trophism and Power Estimation

Muscles trophism which characterizes the level of metabolism processes is detected by the degree and symmetry of the development of certain muscles groups. The evaluation is made in the state of calm and in the state of physical activity. The following development states are distinguished: low, average, and good. In case of low body and extremities muscles development they are not well-exposed in the state of calm, in case of physical activity their volume is not significantly changed, the lower part of stomach is drooping, the shoulder-blades lower corners are separated from the chest.

In case of average development body muscles mass is moderately exposed in the state of calm, the same of extremities is well-exposed, their volume and form are changed when physically loaded. In case of good state of development body and extremities muscles are well-developed, their relief enlargement is visually noticeable when physically loaded.

Muscles power evaluation is made according to a special scale by 5 points' system: 0 points - movements are absent; 1 point - active movements are absent but muscular tension is detected by means of palpation; 2 points - passive movements are possible in case of slight resistance overcoming; 4 points - passive movements are possible in case of moderate resistance overcoming; 5 points - muscles power is within normal indexes.

Additional methods of investigation: a) calcium, phosphorus, alkaline phosphatase content detecting in blood serum; b) X-ray examination of cells; c) electromyography; d) chronaxia; e) for older children - dynamometry; f) muscles biopsy; g) densitometry.

#### Osteoid Tissue Hyperplasia Signs

Rickety thickening of wrists and ankles, rachitic rosaries, "beads", frontal tubers enlargement.

#### OSTEOMALACIA SIGNS

Craniotabes (occipital bone softening), back of the head flattening, Harrison's trench, X-like and O-like shanks (genu varum).

THE NORMAL RATE OF Ca AND P IN BLOOD SERUM (DOSKIN VA., 1997) Usual calcium - 2.5-2.87 millimoles per liter. Ionized calcium - 1.25-1.37 millimoles per liter.

Phosphorus inorganic - 0.65-1.62 millimoles per liter.

#### ARTHRITIS SYMPTOMS

Skin edema, skin ache, edemas of the tissues surrounding joints, mobility is limited in joints, active movements are also limited.

#### MUSCLES TONUS VIOLATION TYPES

Hypotonia - muscles tonus lowering (as a result of rachits, hypotrophy, chorea, congenital acromicria, hypothyroidism, Hoffmann's muscular atrophy, peripheral paralysis).

Hypertension - muscles tonus increasing (it is typical of healthy children of the first 3-4 months of life, central paralysis, meningitis).

## MUSCLES TROPHISM VIOLATION TYPES

Atrophy - extreme degree of low muscles development or undevelopment (simple form), or degeneration (degenerative form).

Simple form is met in cases of cerebral palsy, muscles diseases (muscles progressive dystrophy, inborn myodystrophy), and joints diseases (juvenile rheumatoid arthritis, tuberculous coxitis).

Degenerative form is a result of peripheral paralysis, poliomyelitis, etc.

Hypertrophy - the process of muscles thickening and mass enlargement. Most frequently is found among children going in for sports or practicing physical activity. In case of pseudohypertrophy fat accumulation simulates well-exposed muscles.

Duchenne muscular dystrophy

Inherited disorder is characterized by gradual degeneration of muscle fibers.

### I. Manifestations of Duchenne muscular dystrophy

1. Waddling gait.
2. Marked lordosis.
3. Frequent falls.
4. Gower sign (the child turns onto side and abdomen, flexes knees to assume a kneeling position, then with knees extended gradually pushes torso to an upright position by “walking” the hands up the legs).
5. Enlarged muscles (especially thighs and upper arms).
6. It is felt feel unusually firm or woody on palpation.

### II. Later signs

1. Profound muscular atrophy.
2. Mental deficiency (common), usually mild.
3. Complications (contracture deformities of hips, knees and ankles, diffuse atrophy, obesity).

Para clinic diagnostic procedures

4. Serum enzyme measurements (creatine phosphokinase, aldolase, glutaminoxaloacetic transaminase).
5. Electromyography.
6. Muscle biopsy.

Nursing care plan:

1. To help the child to develop self-help skills; to modify clothing for wheelchair wear, to fit over the contracted limbs; to help the family to modify the environment to facilitate self-help.
2. To carry out physical therapy program.
3. To help the family to acquire the necessary equipment to promote mobility.

Literature:

13. Nelson Textbook of Pediatrics / edited by Richard E. Behrman, Robert M. Kliegman, Ann M. Arvin; senior editor, Waldo E. Nelson. – 18<sup>th</sup> ed. – W. B. Saunders Company, 2012.–2200 p.
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## **Topic 9. Anatomical and physiological features, methods of examination of the respiratory system in children.**

### **Practical lessons 15-20**

**Current relevance of the research.** The respiratory system is one of those which are intensively developed morphologically and functionally in the post-natal period. Anatomic and physiological peculiarities of children's respiratory organs determine the peculiarities of respiratory pathology which takes one of the leading positions in the list of children's morbidity structure. .

**The aim of the lesson:** to study anatomic and physiological peculiarities of all the sections of the respiratory system, to master the methods of children examination, to study affection semiotics.

#### **After self-training the student must know the following:**

1. Anatomic and physiological peculiarities of the respiratory system and gaseous exchange of children.
2. Additional methods of children's respiratory organs examination:
  - functional (spirometry, pneumotachometry, peakflowmetry, oxymetry);
  - laboratory (general and biochemical blood analysis, nose and throat secretion investigation, phlegm, pleural fluid, biopsy materials);
  - instrumental (X-ray methods of chest organs investigations, computer and unenhanced (baseline) magnetic resonance imaging, thermography, bronchoscopy and bronchography, scanning);
    - methods of allergy diagnostics.
3. Respiratory system affection semiotics of children

#### **Having covered the topic; the student must be able to:**

1. Denote complaints typical of respiratory organs affection, collect anamnesis.
2. Conduct objective investigation of respiratory organs and evaluate the obtained results for children of different age.
3. Define and interpret symptoms and syndromes of the children's respiratory system affection.
4. Make up a plan of investigation of a child with affected respiratory system.

#### **Materials which might be helpful.**

##### **Anatomic and Physiological Peculiarities of the Respiratory Organs of Children**

Respiratory organs are divided into three sections: upper (nose, gullet), middle (larynx, trachea, bronchi), and low (bronchioles, teethridge). Before the moment of birth their morphological composition is not perfect, functional peculiarities of respiration are connected with it. The respiratory organs formation finishes till the age of 7, at older age their size is the only thing which changes. All the respiratory organs have noticeably smaller size and thinner lumen in comparison with those of adults. Mucous tunic is delicate, thin and easily damaged. Glands are not well-developed, production of IgA and surfactant is not sufficient. The submucous layer is soft, contains insufficient quantity of elastic and connective tissue elements, and is multi-vascularized. Cartilaginous frame of respiratory tracts is soft and pliable. It leads to the lowering of the mucous

barrier function, easier infectious and atopic penetration into blood vessels, to the appearing of reasons for aspiratory tracts narrowing as a result of edemas.

Nose and nasopharynx cavities of children of early age are of small size, nasal meatus is narrow, turbinate (concha nasalis) is thick (lower ones develop up to 4 years), that is why even insignificant hyperemia and mucous edema make nasal meatus impassable, lead to asphyxia, make sucking difficult.

To the moment of birth maxillary sinuses are the only developed ones of the accessory sinuses of nose (develop up to 7 years). One ethmoidal, one sphenoidal and two coronal sinuses finish their development up to the age of 12, 15, and 20 years accordingly.

Nasolacrimal canal is short, situated by the angle of eye; at the same time, its valves are not well-developed, which allows infection to move easily from nose to conjunctival sac (saccus conjunctivae).

Pharynx is relatively broad and small. Auditory (otopharyngeal, eustachian) tubes, which connect epipharynx and tympanic cavity are short, broad, straight, and located horizontally. It allows infection to penetrate from nose to middle ear (auris media). Lymphoid ring of Woldader-Pyrohov set in pharynx contains six tonsils: two palatine tonsils, two tonsils of torus tubaris, one lingual (glossal) tonsil, and one nasopharynx tonsil. During the oropharyngeal surface investigation the term "fauces" is used. Higher stands for the anatomic unit surrounded by the root of the tongue from below palatine tonsils and arches from left and right, by the soft palate and uvula from above, by the back side of oropharynx from the rear and by the mouth cavity from the front. Epiglottis of newborns is relatively short and broad and may be the reason for the pharynx entrance functional constriction and glottic spasms appearance.

The larynx of children is located higher and is longer than that of adults, and has a watering-can form with distinct constriction in the subglottic zone (4 mm for newborns), which gradually spreads (1 cm long at the age of 14). Glottis is narrow; its muscles get tired quickly. Vocal cords are thick, short; mucous tunic is very delicate and much vascularized, rich in lymphoid tissue; all mentioned above leads to subglottis edema in case of respiratory infection and croup syndrome.

Trachea is broad of relatively big length, watering-can form, contains 15—20 cartilaginous rings and is very movable. Trachea's walls are soft. Mucous tunic is delicate, dry, and well-vascularized.

Bronchial tree (arbor bronchialis) is formed before the child's birth. Bronchi size enlarges intensively during the first year of life and in teenage period. Cartilaginous rings are their base; they do not have covering laminae joined by a fibrous septum. Bronchi cartilages are very elastic, soft and are easily moved. Children's bronchi are relatively broad; the right main bronchus is the continuation of trachea, that is why foreign bodies are found here. Absolute narrow shape is typical of small bronchi; it is the reason for obstructive syndrome at this age. Mucous tunic of big bronchi is covered by epithelium which performs the bronchi clearing function (mucociliary clearance). The vagus nerve (nervus vagus) incomplete myelinization and respiratory muscles undeveloped state result in the absence of cough reflex among small children or very weak coughs. The slime accumulated in small bronchi easily corks them and leads to pulmonary collapses and pulmonary tissue contagion.

The children's lungs have segmental composition as well as those of adults. The segments are divided by thin connective tissue septa. The main structural lungs unit is acinus, but its terminal bronchiole finishes with alveolar saccules which are different from adults'; new alveoli are formed gradually from these saccules, the quantity of alveoli is three times less than that of adults. The

diameter of each alveolar increases with the age of a child. At the same time the vital volume of lungs enlarges. Interstitial tissue of lungs is fluffy, rich in vessels, cellular tissue, contains a small quantity of connective tissues and elastic fibers. As a result of it, the pulmonary tissue of children of the first years of life is more saturated by blood, and is less air conductive. Undeveloped elastic skeleton leads to emphysema and pulmonary collapse. Inclination to pulmonary collapses is also a result of the lack of surfactant, a substance which regulates alveolar surface tension and stabilizes air carrying terminal spaces, i.e., alveoli. Surfactant is synthesized by alveolocytes of second type and appears when the fetus weight is not less than 500—1000 gr. The smaller the gestational age of a child is, the greater the lack of surfactant is. It is the lack of surfactant which is the cause of incomplete lungs spread among prematurely born children and the respiratory distress syndrome appearance.

The main functional physiological peculiarities of respiratory organs of children are the following: breathing is frequent (compensates the lungs small volume) and superficial. The younger a child is, the more frequent breathing is (physiological shortness of breath). Newborn breath 40—50 times per minute, 1-year-old children - 35—30 times per minute, 3-year-old children - 30—25 times per minute, 7-year-old children - 20—25 times per minute, 12-year-old children - 20-18 times per minute, and adults - 12-14 times per minute. Speeding-up and slowing-down of breathing is noted if deviation makes 30—40 and more percent from the normal rate. Newborns' breathing is characterized by arrhythmic character with short stops (apnoea). Diaphragmatic character of breathing is prevailing one, beginning with the age of 1—2 it becomes a mixed one, at the age of 7—8 it becomes a breast one among girls and a stomach one among boys. The younger a child is, the less the lungs breathing volume (LBV) is. Breathing volume per minute (BVM) increases in accordance with a child's age. Thus, infants' BVM is 2-3 times bigger than that of adults. The lungs vital volume (LV) of children is significantly lower than that of adults. The gas exchange of children is more intensive due to the significant lungs vascularization, blood circulation speed, and high diffusion possibilities.

### **Methodic of clinical investigation of respiratory organs. (Inspection, palpation,).**

Current relevance of the research. **The respiratory system is one of those which are intensively developed morphologically and functionally in the post-natal period. Anatomic and physiological peculiarities of children's respiratory organs determine the peculiarities of respiratory pathology which takes one of the leading positions in the list of children's morbidity structure.**

The aim of the lesson: **to study anatomic and physiological peculiarities of all the sections of the respiratory system, to master the methods of children examination, to study affection semiotics.**

After self-training  
the student must know the following:

- 3. Anatomic and physiological peculiarities of the respiratory system and gaseous exchange of children.**
- 4. Additional methods of children's respiratory organs examination:**

- functional (spirometry, pneumotachometry, peakflowmetry, oxymetry);
- laboratory (general and biochemical blood analysis, nose and throat secretion investigation, phlegm, pleural fluid, biopsy materials);
- instrumental (X-ray methods of chest organs investigations, computer and unenhanced (baseline) magnetic resonance imaging, thermography, bronchoscopy and bronchography, scanning);
- methods of allergy diagnostics.

#### **3. Respiratory system affection semiotics of children**

Having covered the topic, the student must be able to:

- 5. Denote complaints typical of respiratory organs affection, collect anamnesis.**

6. Conduct objective investigation of respiratory organs and evaluate the obtained results for children of different age.

7. Define and interpret symptoms and syndromes of the children's respiratory system affection.

8. Make up a plan of investigation of a child with affected respiratory system.

Materials which might be helpful.

#### *Methods of Children's Respiratory Organs Examination*

While examining child's respiratory organs one must focus attention on the following:

1) During the process of anamnesis collection it is necessary to find out how the disease began; first pathological symptoms onset, development and sequence (coryza, shortness of breath, cough, humidity secretion, weakness, pain in throat and chest, body temperature rising, headache, appetite lowering, etc.), to make a detailed analysis of complaints, to evaluate the disease and life anamnesis.

2) During the examination - to evaluate the state of a sick child, the state of skin and pharynx, cyanosis presence, the form of chest (tubby, flattened on one side, flatness of intercostal spaces, etc.), breathing (type, frequency, rhythm, and deepness), shortness of breath presence and character (inspiratory (Traube's) dyspnea, exhalation, mixed), voice quality (husky, hoarse, nasal, aphonia), cough (character, pathognomonic, frequency, depth, rhythm, prevailing time of day, etc.).

3) During palpation - pain, voice trembling character, chest deformation, skin wrinkle thickness symmetry, edema and explosions of intercostal spaces, pleura rubbing noise presence.

4) During percussion - the character of lungs sound and its changes (shortening, atrophy, absolute dullness, tympanic), pathological symptoms (Corani, Philosofov's bowl, Arkavin, Filatov, Maslov, El-lis-Damuazo-Sokolov line, Garlyand triangles, Grocco-Rahfus), lungs boundaries changes.

5) During auscultation - the type of respiration (vesicular, puerility, bronchial), pathologic respiration types (firm, weak, bronchial, amorphous), the presence and character of additional pathological noises (crepitation, pleura rubbing, bronchophony).

6) On the basis of the additional methods of investigation one must evaluate clinical, biochemical, bacteriological, immunological, cytological data of blood investigation, phlegm, pleural fluid, X-ray examination results, spirometry, peakflowmetria, bronchoscopy, bronchography, computer, and magnetic resonance tomography.

#### **Tests**

1. Which of the given below is not peculiar of the nose mucous tunic of children?

1.1. Covered with delicate epithelium.

1.2. Thin, tender, dry.

1.3. Submucosal layer is well-vascularized.

1.4. Cavernous tissue is well-developed.

1.5. Dry.

2. When do all the paranasal sinuses finish their formation?

2.1. During the 3<sup>rd</sup>-6<sup>th</sup> months of pre-natal development.

2.2. They are formed when a child is born.

2.3. Till the 3<sup>rd</sup> year of life.

2.4. Up to 10 years.

2.5. Up to 15-20 years.

3. What peculiarities are not typical of the larynx of early age children?

3.1. Watering-can-like form.

3.2. The fissure of glottis is broad with developed vocal folds.

3.3. Cartilages are pliable and soft.

3.4. Short and narrow.

3.5. Well-vascularized submucous layer.

4. What peculiarities does trachea of children of early age have?

4.1. Short and narrow.

4.2. Mucous tunic is delicate, thin, dry, and much vascularized.

4.3. The quantity of semi-rings enlarges with age.

4.4. Is located lower than that of adults.

4.5. The bifurcation place is located on the level of the VII cervical vertebra.

5. What is the newborn's respiratory frequency per minute?
    - 5.1. 16-18.
    - 5.2. 25-30.
    - 5.3. 35-40.
    - 5.4. 40-60.
    - 5.5. 50-70.
  6. When does children respiratory organs formation finish?
    - 6.1. Up to 1 year.
    - 6.2. Up to 3 years.
    - 6.3. Up to 7 years.
    - 6.4. Up to 10 years.
    - 6.5. Up to 15 years.
  7. Voice trembling is enforced during:
    - 7.1. Pneumonia.
    - 7.2. Exudative pleurisy.
    - 7.3. Bronchial asthma.
    - 7.4. Pneumothorax.
    - 7.5. Emphysema.
  8. Local weakening of percutory sound may be found:
    - 8.1. If child is healthy.
    - 8.2. If a child is ill with pneumonia.
    - 8.3. If a child is ill with bronchitis.
    - 8.4. If a child is ill with emphysema.
    - 8.5. If a child is ill with bronchiolitis.
  9. Crepitation appears as a result of:
    - 9.1. Bronchitis.
    - 9.2. Pneumonia.
    - 9.3. Pulmonary collapse.
    - 9.4. Bronchial asthma.
    - 9.5. Dry pleurisy.
  10. When can the puerile respiration be heard?
    - 10.1. When a child is newborn.
    - 10.2. When a child is of early age.
    - 10.3. At the age of 7-8 years.
    - 10.4. At the age of 10-14 years.
- Correct answers:** 1.4; 2.4; 3.1; 3.2; 4.2; 5.4; 6.3; 7.1; 7.2; 8.4; 8.5; 9.2; 10.3.

### **Methodic of clinical investigation of respiratory organs (percussion, auscultation).**

**Current relevance of the research.** The respiratory system is one of those which are intensively developed morphologically and functionally in the post-natal period. Anatomic and physiological peculiarities of children's respiratory organs determine the peculiarities of respiratory pathology which takes one of the leading positions in the list of children's morbidity structure. .

**The aim of the lesson:** to study anatomic and physiological peculiarities of all the sections of the respiratory system, to master the methods of children examination, to study affection semiotics.

#### **After self-training the student must know the following:**

5. Anatomic and physiological peculiarities of the respiratory system and gaseous exchange of children.
6. Additional methods of children's respiratory organs examination:
  - functional (spirometry, pneumotachometry, peakflowmetry, oxymetry);
  - laboratory (general and biochemical blood analysis, nose and throat secretion investigation, phlegm, pleural fluid, biopsy materials);
  - instrumental (X-ray methods of chest organs investigations, computer and unenhanced (baseline) magnetic resonance imaging, thermography, bronchoscopy and bronchography,

scanning);

- methods of allergy diagnostics.

3. Respiratory system affection semiotics of children

**Having covered the topic; the student must be able to:**

9. Denote complaints typical of respiratory organs affection, collect anamnesis.

10. Conduct objective investigation of respiratory organs and evaluate the obtained results for children of different age.

11. Define and interpret symptoms and syndromes of the children's respiratory system affection.

12. Make up a plan of investigation of a child with affected respiratory system.

**Basic level:**

To know anatomy-physiological features of a system of breathing (anatomy, normal physiology, histology).

To know stages of the embryogenesis of a respiratory organ (histology, anatomy).

To know functional capabilities of respiratory organs (normal physiology).

### **Materials which might be helpful.**

### **Methods of Children's Respiratory Organs Examination**

While examining child's respiratory organs one must focus attention on the following:

7) During the process of anamnesis collection it is necessary to find out how the disease began; first pathological symptoms onset, development and sequence (coryza, shortness of breath, cough, humidity secretion, weakness, pain in throat and chest, body temperature rising, headache, appetite lowering, etc.), to make a detailed analysis of complaints, to evaluate the disease and life anamnesis.

8) During the examination - to evaluate the state of a sick child, the state of skin and pharynx, cyanosis presence, the form of chest (tubby, flattened on one side, flatness of intercostal spaces, etc.), breathing (type, frequency, rhythm, and deepness), shortness of breath presence and character (inspiratory (Traube's) dyspnea, exhalation, mixed), voice quality (husky, hoarse, nasal, aphonia), cough (character, pathognomonic, frequency, depth, rhythm, prevailing time of day, etc.).

9) During palpation - pain, voice trembling character, chest deformation, skin wrinkle thickness symmetry, edema and explosions of intercostal spaces, pleura rubbing noise presence.

10) During percussion - the character of lungs sound and its changes (shortening, atrophy, absolute dullness, tympanic), pathological symptoms (Corani, Philosofov's bowl, Arkavin, Filatov, Maslov, El-lis-Damuazo-Sokolov line, Garlyand triangles, Grocco-Rahfus), lungs boundaries changes.

11) During auscultation - the type of respiration (vesicular, pu-erilistic, bronchial), pathologic respiration types (firm, weak, bronchial, amorphous), the presence and character of additional pathological noises (crepitation, pleura rubbing, bronchophony).

12) On the basis of the additional methods of investigation one must evaluate clinical, biochemical, bacteriological, immunological, cytological data of blood investigation, phlegm, pleural fluid, X-ray examination results, spirometry, peakflowmetria, bronchoscopy, bronchography, computer, and magnetic resonance tomography.

### **Additional methods of inspection of respiratory system. Spirometry, spirometry, peakflowmetria in peadiatrics.**

**Aim:** To know how to conduct indispensable measures on children nursery with illnesses of a respiratory organs, to afford the indispensable help at pressing condition, compliance with a pathology of a respiratory organs.

**Professional motivation:**

The system of respiratory organs from the moment of birth of the child has the features of operation, which one predetermine nature of a symptomatology of lesions. With growth (increase) of the child the morphological constitution of the breathing system will be improved not only, but also the functional capabilities increase. A pathology of respiratory organs one with widespread,

that is why demands legible knowledge of microsymptoms of the lesion to begin treatments in time.

- Basic level:**
1. To know a history taking in children (propedeutics of children's illnesses).
  2. To know anatomy-physiological features of a system of breathing (anatomy, normal physiology, histology).
  3. To know stages of the embryogenesis of a respiratory organs (histology, anatomy).
  4. To know functional capabilities of respiratory organs (normal physiology).

### **Students Independent Study Program**

Objectives for Students Independent Studies

1. To collect an anamnesis in ill with illnesses of a respiratory organs.
2. To give an estimation to the obtained findings of investigation
3. To secure the main syndromes of a lesion of a respiratory organs.
4. To learn semiotics of a respiratory organs lesions:
  - kinds of tissues;
  - kinds of the dyspnea;
  - innate stridor;
  - a syndrome of respiratory failure, degree;
  - a syndrome of respiratory dissonances.

### **Key words and phrases:**

Respiratory organ, respiratory tract, morphogenesis, bronchology, interrogation, palpation, percussion, auscultation, lesion, dyspnea, innate stridor, respiratory failure, radiography, bronchoscopy, bronchography, tomography, spirometry,

II.

Problem of a software Scientific Research Work of Students:

To perform the abstract on the subject of: «Maintenance (drift) for children with acute stenosis laryngitis volume».

Visual Aids and Material Tools:

Ill children's histories.

### **Students' Practical Activities:**

#### **Students must know:**

- Semiotics of lesions of children's respiratory organs.
- Features of maintenance at respiratory organs pathology.
- Padding survey methods at respiratory organs pathology.
- Opening-up and technique of realization of separate diagnostic manipulations.
- Processing of the before doctor's help at acute respiratory failure.

#### **Students should be able to:**

1. Evaluate of the data of laboratory-tools and objective survey methods of a breathing system.
2. Draw the conclusion about a condition of a respiratory system for the child under examination, point of the possible cause of detected deviations on the part of respiratory organs and acts of nursery.
3. Execute of a maintenance for the ill with a lesion of a respiratory system.

### **Tests and Tasks for Independent Study.**

Select the right statements:

1. **What main clinical features are useful in the diagnosis of bronchiolitis?**
  - a) paroxysmal cough,

- b) wheezing,
- c) tachypnea,
- d) dyspnea
- e) flaring of the alae nasal
- f) cyanosis.

**Test and Task Keys for Self-Assessment Study.**

Tests: 1-b, 2-f, 3-a,b,c.

Problem situation: c.

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**Topic 10 APF (anatomical and physiological features) of the cardiovascular system in children. Methods of clinical examination of CVC (cardiovascular system) organs in children  
Practical lessons.21-26**

**Current relevance of the research.** The cardiovascular system is one of the vitally important in a child's organism. The cardiovascular system provides oxygen and nutritive material supply to all organs and tissues, carbonic acid and other products of metabolism evacuation, thus taking part in internal environment continuity maintaining. The cardiovascular system of children of different age has a lot of peculiarities which influence its functioning. It determines the necessity of anatomic and physiological peculiarities of children's cardiovascular system studying by students of medical departments.



**The aim of the lesson:** to study anatomic and physiological peculiarities of the children's cardiovascular system characteristic of different stages of ontogenetic development, to be able to investigate the cardiovascular system of children of different age, to know the most important symptoms of cardiovascular disorders among children.

**After self-training the student must know the following:**

1. Peculiarities of fetus' and newborn's circulation of blood.
2. Anatomic peculiarities of heart among children of different age.
3. Peculiarities of heart tomography in age respect.
4. Histological peculiarities of child's myocardium.
5. Peculiarities of child's heart intervals and rhythm.
6. Morphological peculiarities of vessels (arteries, veins, capillaries).
7. The frequency of heart contractions among children of different age.
8. Children's arterial pressure at different age.
9. Differential diagnostics of functional and organic systolic murmur, physiological and pathological splitting of the II tone on the children's lung artery.
10. Positive features of physiological peculiarities of the children's cardiovascular system.
11. Negative features of physiological peculiarities of the children's cardiovascular system.

**Having covered the topic, the student must be able to:**

1. Investigate the cardiovascular system of children.
2. Collect anamnesis among children of different age, taking into account typical complaints about the cardiovascular system of young and older patients.
3. Conduct the children's heart percussion, estimating age dictated heart boundaries.
4. Conduct heart auscultation among children using the knowledge of age peculiarities.
5. Evaluate the results of the main instrumental methods of cardiovascular system investigation among children.

**Materials which might be helpful.**

**Transitional circulation in the newborn.**

The mechanism of transition of the cardiovascular system to the extrauterine functioning is as follows.

1. The infant's first breath raises  $pO_2$ , which causes dilatation of the pulmonary arterial blood vessels and allow blood to flow freely to the lungs. Now the pulmonary blood pressure is decreased.
2. The umbilical arteries constrict in response to higher  $pO_2$  levels, and the cord is cut. The umbilical arteries turn into the lateral umbilical ligaments.
3. Circulation through the umbilical vein ends. Later, the umbilical vein becomes the round ligament.
4. As the venous duct closes, the systemic blood pressure rises. Later the venous duct turns into the venous ligament.
5. These changes in pressures cause blood flow through the arterial duct to reverse its direction, thus changing one of the "right-to-left" shunts. The arterial duct then constricts (also in response to

higher  $pC_{O_2}$  levels), preventing blood flow through it by the end of the first day. It will later become the arterial ligament.

6. Since there is now an increased blood flow to the lungs, there must be an increased flow from the lungs through the pulmonary veins and to the left atrium.

7. The increased pressure of this blood against the oval foramen forces it to close against the interatrial septum. This reverses the other "right-to-left" shunt (the site of the old oval foramen will later become the oval fossa).

8. The above changes make it possible for blood to flow to the newborn lungs for gas exchange and return to the heart for distribution to the body. All foetal vessels (umbilical arteries and veins, venous and arterial ducts) first functionally and then anatomically adapt to adult circulation by obliteration.

The results of the normal transition are as follows.

1. Decrease in pulmonary blood pressure with
2. Resultant increase in pulmonary blood flow.
3. Closure of the oval foramen.
4. Constriction of the arterial duct.
5. End of flow through the umbilical vein.

Failures of this transition are such life-threatening disorders as persistent foetal circulation or persistent pulmonary hypertension.

The heart and blood vessels in children have certain anatomic features that are reflected in the functional activity of the heart and its pathology.

The heart. The mass of the heart is relatively greater in children than in adults. In the newborn the weight of the heart is 0.9 % of the body weight, while in adults it is only 0.5 %.

The initial weight of the heart (17-24 g) doubles to 6-7 months, triples between one and two years, increases fourfold in the fifth year of life, six fold in the tenth year, and eleven fold by 16 years of age.

As we see, an increase in the heart weight lags behind an increase in the body weight. The energy of cardiac growth is higher in the first year of life, between 7 and 14 years it slows down, and again increases at puberty, it means, cardiac growth keeps to the general laws of the bodily growth.

The mass of heart is bigger in boys than in girls.

The right and left ventricles have approximately the equal size in newborn, thickness of their wall is about 5 mm. The atria and main vessels have a relatively larger size in comparison with the ventricles than those in adults.

The growth of the left part of the heart, especially the left ventricle, is more intensive after birth, than the right part. It is caused by an increase of vascular resistance and arterial pressure.

The growth of the heart is accompanied with tissue differentiation.

The histological features of the cardiac muscle of children are as follows.

1. Slenderness of muscular fibres, their closer congregation.
2. Poor development of connective tissue.
3. Muscular cells in newborns and infants are shorter and much thinner than those of adults.
4. Muscle cell nuclei have an elongated oval configuration.
5. The total amount of nuclei is greater than in adults.
6. The elastic tissue is poorly developed, abundant.

Blood vessels. The arteries of the child are relatively wider than in adults. The capillaries are particularly wide in infancy. Contrarily, the veins of young children are relatively narrow. (In adults the diameter of the veins are twice as wide as the diameter of the arteries.

### **DIAGNOSTIC EVALUATION**

Diagnosis of congenital or acquired heart disease is aided by a comprehensive history and physical examination. A variety of specific diagnostic procedures help confirm the diagnosis. This discussion is an overview of each of these techniques. Specific positive findings are included, under the discussion of the heart defect.

#### **Diagnostic criteria**

##### *Anamnestic:*

- A complete history is essential regardless of the type of heart defect. The major categories to investigate include a history of:
  - Poor weight gain, poor feeding habits, and fatigue during feeding
  - Frequent respiratory infections and difficulties
  - Cyanosis with or without clubbing of fingers
  - Evidence of exercise intolerance in addition,
  - a history of previous defects in a sibling,
- maternal rubella infection during pregnancy, or associated chromosomal abnormalities, such as Turner's or Down's syndrome
- In rheumatic fever a history of a previous streptococcal infection is of primary importance.

##### *Physical examination*

Examination of the heart involves the skills of inspection, palpation, percussion, and auscultation, although the latter is the most significant. Overall assessment of cardiac function involves a comprehensive evaluation of pulse, blood pressure, respiratory function, and general physical growth and development. The doctor must be familiar with the anatomy and physiology of the normal heart in order to properly evaluate the findings.

The apex is located at the left midclavicular line and fifth intercostal space or mitral area. The heart of the infant is more horizontally positioned; therefore, the apex is higher (third to fourth intercostal space) and to the left of the midclavicular line. The apical impulse, or point of maximum impulse, is normally located at the apex.

**Inspection.** While examining the chest, any obvious bulging is noted, especially on the left side, which may indicate cardiac enlargement. This is best done by observing the child sitting and looking at the anterior chest wall from an angle, comparing both sides of the rib cage to each other. Normally they should be symmetric. In children with thin chest walls, the point of maximum impulse, or apical pulse, is sometimes apparent as a pulsation. Noting the location of the impulse may give some indication of the size and positioning of the heart, especially if it deviates from the expected apical site.

Since comprehensive evaluation of cardiac function is not limited to the heart, the doctor also considers other findings, such as presence of all pulses (especially the femoral pulses), distended neck veins, peripheral cyanosis, edema, blood pressure, and respiratory status.

**Palpation.** Palpation is useful in determine the size of the heart by feeling for the point of maximum impulse, which ordinarily corresponds to the apex. The apex is usually at a lower interspace and more lateral in a child with cardiac enlargement. The apex is felt by placing the fingertips or the palmar aspect of the fingers and hand at the fifth intercostal space and left midclavicular line.

While feeling for the point of maximum impulse, the doctor notes the presence of *vibratory thrills* and *pericardial friction rubs*. *Thrills* are palpable vibrations most commonly produced by the flow of blood from one chamber of the heart to another through a narrowed or abnormal opening, such as a stenotic valve or a septal defect. They are best felt with the ball of the hand (palmar surface at the base of the fingers) and during expiration. Thrills feel similar to the placing

of one's hand on a purring cat.

*Pericardial friction rubs* are scratchy, high-pitched grating sounds, similar to pleural friction rubs, except that they are not affected by changes in respiration. This is a useful clue in differentiating the two rubs, because the pleural rub will cease if the child holds his breath, but the pericardial rub will not. Both thrills and rubs are abnormal and must be reported for further evaluation.

*Assessing the quality and symmetry of all pulses.* Pulse-altering, large, swift, dicrotic, intermittent, labile, small, slow, soft, tense, rhythmic, rapid, pulse deficit, pulse flutter, tension of the pulse, full (weak) pulse, pulse rhythm, beatings of the pulse, pulse rate.

**Average pulse rates at rest (per minute)**

Newborn	140-160
6 months	130-135
1 year	120-125
2 years	110
3 years	105
4 years	100
5 years	98-100
6-7 years	90-85
10 years	78-85
12 years	70-75

The normal rate is not more than 10 % of average

*Determine blood pressure.*

**Blood pressure, mmHg**

<b>Upper extremity</b>	
<b>Newborn</b> systolic: diastolic:	70-76 35
<b>For children younger 12 months</b> systolic: diastolic:	$76 + 2 \times n$ (n is months) 1/2-1/3 of systolic
<b>1 year</b> systolic: diastolic:	90-100 60
<b>For children older 1 year</b> systolic: diastolic:	min. $90 + 2 \times n$ (n is years) max. $100 + 2 \times N$ 1/2-1/3 of systolic
<b>Lower extremity</b>	
<b>Newborn</b> systolic: diastolic:	70-76 35
<b>For children younger 9 months</b> systolic: diastolic:	$76 + 2 \times n$ (n is months) 1/2-1/3 of systolic
<b>In children older 9-10 months</b>	the blood pressure is 5-20 mm Hg more than upper extremity

While investigating a child's cardiovascular system it is necessary to pay attention to complaints: pain in the heart region, heart beat, intermissions, short wind, cyanosis, edema, headache, loss of consciousness, weakness, fatigability; examination data - cardiac hump, pulsation in the heart region, changes in heart tremor, skin colour (paleness, cyanosis), physical development; palpation data: heart tremor, "meowing"; percussion data - heart size enlargement; auscultation data - the change of tone loudness, rhythm and frequency of heart contractions, presence of functional or organic systolic noise, diastolic noise, accents and splitting of tones at the heart base, additional auscultation phenomena; changes in arterial pressure, frequency and character of pulse.

One also has to evaluate the data of instrumental methods of the children's cardiovascular system examination (electrocardiogram, exercise electrocardiogram, X-ray photograph of the heart, ultrasound investigation).

**Percussion.** Percussion is used mainly to determine the size of the heart by outlining its borders. Dullness is normally heard over the left area of the heart and partially over the right.

#### Border's of hearts relative dullness

Border	age of child			
	until 2 years	2-7 years	7-12 years	older 12 years
Right	right parasternal line	right parasternal line or something inward from right parasternal line	Between the right parasternal line and the right sternal line	the right sternal line
upper	the II rib	the II intercostal space	the III rib	the III intercostal space
Left	2 cm outward from left midclavicular line	1 cm outward from left midclavicular line	0,5 cm outward from left midclavicular line	0,5 cm medialy from left midclavicular line
transversal size	6-9 cm	8-12 cm	9-14 cm	9-14 cm

#### Border's of hearts absolute dullness

Border	age of child			
	until 2 years	2-7 years	7-12 years	older 12 years
Right	left sternal line	left sternal line	left sternal line	left sternal line
upper	the II intercostal space	the III rib	the III intercostal space	the IV rib
Left	1.0-0.5 cm outward from left mid-clavicular line	left midclavicular line	Between the left midclavicular line and left parasternal line	left parasternal line
transversal size	2-3 cm	4 cm	5-5.5 cm	5-5.5 cm

Deviation from the expected finding may indicate cardiac enlargement or displacement and warrants further study.

**Auscultation.** Auscultation involves listening for heart sounds with the stethoscope, similar to the procedure used in assessing breath sounds.

Origin of heart sounds. The heart sounds are produced by the opening and closing of the valves and the vibration of blood against the walls of the heart and vessels. Normally two sounds – S<sub>1</sub> and S<sub>2</sub> - are heard, which correspond respectively to the familiar "lub dub" often used to describe the sounds. S<sub>1</sub> is caused by the closure of the tricuspid and mitral valves (sometimes called the atrioventricular valves). Right ventricular contraction follows tricuspid valve closure, and left ventricular contraction follows mitral valve closure. The contractions (systole) occur almost simultaneously, although the mitral valve (left side) closes slightly before the tricuspid valve (right side). Normally this split of the sounds is so close that it is not audible, except occasionally at the apex of the heart.

S<sub>2</sub> is the result of the closure of the pulmonic and aortic valves (sometimes called semilunar valves). Aortic valve closing (left side) occurs slightly before pulmonic valve closing (right side). The flow of blood into the aorta and pulmonary artery occurs following closure of their respective valves. The interval between S<sub>2</sub> and S<sub>1</sub> is diastole, or relaxation, of the heart. Normally the split of the two sounds in S<sub>2</sub> is distinguishable and widens during inspiration,

since inspiration prolongs right ventricular filling and delays pulmonic valve closure. "Physiologic splitting" is a significant normal finding that should be elicited. "Fixed splitting", in which the split in S<sub>2</sub> does not change during inspiration, is an important diagnostic sign of atrial septal defect.

#### *Boundaries of Relative Heart Dullness on Percussion for Children of Different Age*

Boundary	Age groups		
	Up to 2 years	2-7 years	7-12 years
Upper	II rib	II intercostal	Upper edge of the III rib
Right	2 cm out of lin. sternalis dextra	1 cm out of lin. sternalis dextra	0.5 cm out of lin. sternalis dextra
Left	2 cm out of lin. medioclavicularis sin.	1cm out of lin. medioclavicularis sin.	0.5 cm out of lin. medioclavicularis sin.

#### *Differential Diagnostics of Functional and Organic Systolic*

<i>Functional systolic-murmur</i>	<i>Organic systolic murmur</i>
As a rule, it is low, non-steady, short (occupies a part of the systole)	As a rule, it is loud, steady, long (occupies the whole systole)
Is not connected with the I tone	Is connected with the I tone
Is not conducted behind the heart boundaries	Is conducted behind the heart boundaries
Disappears (is muffled) in the vertical position, after physical load, while breathing	Constant in horizontal and vertical positions, after physical load and in calm state, while breathing in and out
Phonocardiogram is short, of low height, irregular uncertain shape as a rule, is not connected with the I tone, is registered on low frequencies	Phonocardiogram is of high height as a rule, occupies the greater part of the systole, is of regular certain form, connected with the I tone, is registered on high frequencies

#### *Differential Diagnostics of Physiological and Pathological Splitting of the II Tone on the Left Pulmonary Artery*

<i>Physiological splitting of the II tone on the left pulmonary artery</i>	<i>Pathological splitting of the II tone on the left pulmonary artery</i>
Variable, is heard on some beats, disappears on breath, in the vertical position, after physical load	Fixed, is heard on breathing, in horizontal and vertical positions, after physical load and in calm state

Murmurs may be systolic, diastolic or continuous throughout systole; diastolic murmurs are either pansystolic, as in mitral or tricuspid regurgitation and ventricular septal defects, or ejection ones, when they arise either from the pulmonary or aortic outflow tracts. Pansystolic murmurs start immediately with the first heart sound and continue through to the second one. Typically they have uniform intensity. By contrast, ejection systolic murmurs have a diamond-shaped configuration building to a peak in mid-systole. Ejection murmurs typically diminish before the second heart sound.

Diastolic murmurs are of two types: early diastolic murmurs start at the second heart sound and occur as a result of aortic or pulmonary regurgitation, while mid-diastolic murmurs, in which there is a short gap after the second heart sound before the beginning of the murmur, arise from the mitral or tricuspid valve. The maximum intensity point and direction of selective propagation must be noted.

The character of a murmur is now considered an unreliable guide to its origin. Rough murmurs are associated with obstruction to flow through a narrowed valve; blowing murmurs are more typical of an incompetent valve.

#### **Main signs of cardiovascular system diseases in children. General clinical symptoms.**

**Current relevance of the research.** The cardiovascular system is one of the vitally important in a child's organism. The cardiovascular system provides oxygen and nutritive material supply to all organs and tissues, carbonic acid and other products of metabolism evacuation, thus taking part in internal environment continuity maintaining. The cardiovascular system of children of different age has a lot of peculiarities which influence its functioning. It determines the necessity of anatomic and physiological peculiarities of children's cardiovascular system studying by students of medical departments.

**The aim of the lesson:** to study anatomic and physiological peculiarities of the children's cardiovascular system characteristic of different stages of ontogenetic development, to be able to investigate the cardiovascular system of children of different age, to know the most important symptoms of cardiovascular disorders among children.

**After self-training the student must know the following:**

1. Peculiarities of fetus' and newborn's circulation of blood.
2. Anatomic peculiarities of heart among children of different age.
3. Peculiarities of heart tomography in age respect.
4. Histological peculiarities of child's myocardium.
5. Peculiarities of child's heart intervals and rhythm.
6. Morphological peculiarities of vessels (arteries, veins, capillaries).
7. The frequency of heart contractions among children of different age.
8. Children's arterial pressure at different age.
9. Differential diagnostics of functional and organic systolic murmur, physiological and pathological splitting of the II tone on the children's lung artery.
10. Positive features of physiological peculiarities of the children's cardiovascular system.
11. Negative features of physiological peculiarities of the children's cardiovascular system.

**Having covered the topic, the student must be able to:**

1. Investigate the cardiovascular system of children.
2. Collect anamnesis among children of different age, taking into account typical complaints about the cardiovascular system of young and older patients.
3. Conduct the children's heart percussion, estimating age dictated heart boundaries.
4. Conduct heart auscultation among children using the knowledge of age peculiarities.
5. Evaluate the results of the main instrumental methods of cardiovascular system investigation among children.

**Materials which might be helpful.**

Syndrome of arterial pressure disorders includes arterial hypotonia and hypertension. Recurrent arterial hypotonia includes such symptoms as general weakness, fatigue, irritability, sleep disorder, paleness. Arterial hypertension in children is often symptomatic, headache and tachycardia being its clinical symptoms.

The cardiovascular system pathology includes anomalies of development in the heart (congenital cardiac lesions) and vessels, inflammatory diseases (endocarditis, myocarditis, pericarditis), rheumatic fever, infective endocarditis, etc.

Ventricular septal defects involving the membranous portion of the septum are the commonest congenital cardiac malformation. It may be found as an isolated lesion, the defect is also often associated with abnormalities of the conotruncal region. Tetralogy of Fallot is the most frequently occurring abnormality of the conotruncal region. The defect is due to an unequal division of the conus, resulting from an anterior displacement of the conotruncal septum. Displacement of the septum produces four cardiovascular alterations: (a) pulmonary infundibular stenosis in a narrow right ventricular outflow region; (b) a large defect of the atrioventricular septum; (c) an overriding aorta that arises directly above the septal defect; and (d) hypertrophy of the right ventricular wall due to a resultant higher pressure on the right side.

Persistent arterial trunk results when the conotruncal ridges fail to fuse and to descend toward the ventricles. The persistent trunk is always accompanied by a defective interventricular septum. Transposition of the major vessels occurs when the conotruncal septum fails to follow its normal spiral course and

descends straight downward. As a consequence, the aorta originates from the right ventricle, and the pulmonary artery originates from the left ventricle.

Valvular stenosis of the pulmonary artery or aorta occurs when the semilunar valves are fused for a variable distance.

Dextracardia is caused by formation of the cardiac loop to the left rather than to the right. In this condition, the heart is located in the right side of the thorax; the abnormality is usually associated with a total or partial visceral inversion (transposition of the viscera). Heart ectopia is a rare anomaly in which the heart is located on the surface of the chest. This malformation is caused by failure of the embryo to close the ventral body wall.

Children with cardiovascular diseases need proper regimen of nutrition, treatment according to the therapeutic plan, bed regimen, control of diuresis, checking of the child's weight for control of oedema. Patients with cardiovascular insufficiency need strict bed regimen, an elevated position in the bed, fluid limitation, oxygen therapy, cardiovascular monitoring.

### **Test and Assignments for Self-assessments.**

#### **Tests**

1. What is the term of formation of the 4-chamber heart in the foetus?
  - a) At 3 weeks of gestation;
  - b) at 5 weeks of gestation;
  - c) at 7 weeks of gestation;
  - d) at 10 weeks of gestation;
  - e) at 18 weeks of gestation.
2. In which of the following foetal vascular structures is oxygen content the lowest?
  - a) The umbilical vein;
  - b) the inferior vena cava;
  - c) the left atrium;
    - b) the umbilical arteries; e) the arterial duct;
  3. The change from the foetal to newborn circulation is primarily accomplished by:
    - a) clamping the umbilical cord;
    - b) closure of the arterial duct;
    - c) expansion of the lungs;
      - e) closure of the umbilical arteries;
    4. The heart's position in the chest and its relative dullness borders can be influenced by the following factors, except for:
      - a) shape of the chest;
      - b) level of the diaphragm;
      - c) size of the spleen;
      - d) size of the liver;
      - e) meteorism;
      5. Tachycardia can be noticed in all the conditions below, but:
        - a) intoxication;
        - b) hyperthermia;
        - c) diseases of the cardiovascular system;
        - d) hyperthyroidism;
        - e) hypothyroidism.
      6. For which age is autonomovascular dysfunction typical?
        - a) newborn period;
        - b) infant period;
        - c) preschool period;
        - d) puberty age.
      7. At the examination of a 1-year-old child the heart rate of 150 beats per minute was found. The apex beat was determined in the 5<sup>th</sup> intercostal space, the left border of the relative heart



dullness is located at 1.5 cm to the left from left midclavicular line. Cardiac sounds are clean, their rhythm is correct.

Task: What are the pathological symptoms and what are their causes?

8. The borders of relative heart dullness of a 2-month-old child are as follows: the upper one - the 2<sup>nd</sup> rib, the left one - at 2 cm to the left from the left midclavicular line, the right one - the right parasternal line.

Task: Assess the borders of relative heart dullness. Explain the cause of the difference of heart dullness borders in this child versus heart dullness in a 13-year-old child.

9. It was marked during inspection and examination of a healthy 8-year-old child that borders of his heart dullness were displaced to the right. Heart sounds are auscultated not in their typical points of projection, but in the right side of the chest.

Tasks: What is the cause of these changes? What kind of instrumental methods of investigation can be used for diagnosis?

10. It was marked during auscultation of the heart of a 14-year-old child that in the second intercostal space on the left side splitting of the 2<sup>nd</sup> heart sound appeared in a horizontal position. Cardiac complaints are absent. Response to physical exercises is normal.

Tasks: What is the cause of such a heart rhythm? What should the physician do in order to make a diagnosis?

11. The mother of a 1-month-old infant complains of small increases of weight - 450 g during one month, perioral cyanosis during breast feeding. The "machine"-type systolic-diastolic murmur over the whole heart region is marked during auscultation, it spreads on heart vessels and on the child's back.

Tasks: What pathology of the heart can be supposed? Which paraclinical methods of investigation must be used?

**Answers:** 1 - a; 2 - d; 3 - c; 4 - c; 5 - e; 6 - d, 7 - The increased heart rate can be caused by heart disease or restlessness of the child. It is necessary to repeat assessment of heart rate in calm conditions or during sleep. If tachycardia disappears it is caused by excitement of the child. If tachycardia does not disappear the child must be examined by paraclinical methods of investigation (ECG, PCG, ultrasound investigation for diagnosis);

8 - The borders of relative heart dullness of a 2-month-old child are normal. The difference of borders of heart dullness is caused by a comparatively big mass of the heart and a high level of the diaphragm in young children; the heart position is more horizontal in young children. This difference is more marked if the child is younger;

9 - Dextracardia. ECG with a reverse fixation of electrodes, X-ray picture of the chest, ultrasound investigation of the heart;

10 - Dextracardia. ECG with a reverse fixation of electrodes, X-ray picture of the chest, ultrasound investigation of the heart;

11 - Congenital heart defect: patent arterial duct. ECG, PCG, ultrasound investigation of the heart, X-ray picture of the chest for determination of hypervolaemia of the lungs.

### **Additional methods of inspection. Functional tests.**

**Aim.** To learn a value state of cardio-vascular system in children of different age, to take hold of heart inspection methods and vessels, to can identify stinging signs, to league them in syndromes, to organize correcting departure for children of different age with diseases of cardio-vascular system, to give pressing help attached to sharp vascular and cardiac insufficiency, sudden stopped of cardiac activity.

**Professional motivation.** To learn a value state of cardio-vascular system in children of different age, to take hold of heart inspection methods and vessels, to can identify clinical signs, to put them in syndromes, to organize correcting care for children of different age with diseases of cardiac-vascular system, to give pressing help attached to sharp vascular and cardiac insufficiency, sudden stopped of cardiac activity. A doctor of any speciality can give emergency care for sharp vascular and cardiac insufficiency.

### **Basic level.**

1. Anatomy-physiological heart peculiarities and vessels in children of different age (normal and topographic anatomy, normal physiology, propaedeutics of internal illnesses, propaedeutics of child diseases).
2. Complaints collection Peculiarity, anamnesis with receipt of information about functional state of cardiac-vascular system (propaedeutics of internal illnesses, propaedeutics of child diseases).
3. To See out an objective inspection of cardiac-vascular system with taking account of century peculiarities (propaedeutics of child illnesses, propaedeutics of internal diseases).
4. To Interpret the results of clinical and laboratory research, to decipher EKG and FKG (physics, normal and patho-physiology, propaedeutics of child illnesses, propaedeutics of internal diseases).
5. To Support by charity for children of different age with stinging of cardiac-vascular system, to assign feeding (propaedeutics of child diseases, propaedeutics of internal diseases).

### **Student's practical activity:**

1. For inspection of cardiac-vascular system in children of different age.
2. To Agglomerate complaints, anamnesis data into children with heart pathology and vessels.
3. To See out an objective child inspection.
4. On complaints base, anamnesis, objective data, got attached to inspection of sick, to pick out the stinging syndromes of cardiac-vascular system.
5. Semiotics of congenital and acquired diseases
6. To Appoint microclimate for workplace, impellent mode, medical feeding, dynamic supervision.
7. Medical care for children .Cardiovascular arrest, emergency care for children with cardiac insufficiency, sudden stop of cardiac activity, cardiac shock.

### **Students independent study Program**

To learn the basic clinical signs of cardiac-vascular system in children of different age:

- a) complaints peculiarities;
- b) discolouration skin;
- c) oedemata presence, pulsations;
- d) changes with sides of osseous system;
- e) displacement of boundary paths of cardiac stupidity;
- f) heart tones sounding change;
- g) noises presence;

APchange;

To learn the medical care for sick children: a) microclimate; b) impellent mode; c) medical feeding; d) dynamic supervision; e) personal hygiene.

1. To take hold of assignment regulations prehospital help attached to pressing states to children with stinging of cardiac-vascular system attached to: a) to sharp vascular insufficiency; b) to sharp cardiac insufficiency; c) cardiac shock; d) sudden stop of cardiac activity.

### **Student should be able to:**

1. Auscultation and percussion of a heart in children of different age
2. Taking of blood pressure in children of different age
3. Performance of Shalkov's test in children
4. Medical care for children .Cardiovascular arrest, emergency care for children

### **Materials which might be helpful.**

#### **Laboratory test**

*Common blood analysis*-increased ESR, leucocytosis; increases in the erythrocyte count, hemoglobin level, and hematocrit.

*Biochemical blood analysis*-elevated level of glycoproteins, seromucoid, protein's fractions ( $\alpha$ -1 and  $\alpha$ -2-globulins), kreatininephosphokinase, fibrinogen, mucoproteins.

*Serological-elevation* of antistreptolysin O (AS-O, antidesoxyribonuclease B, antihyaluronidase).

*Bacteriological* - culture of group A streptococcus is the gold standard evidence of the previous infection. In children with cyanosis, blood gas analysis and laboratory tests for hemostasis.

In children with cyanotic heart disease, a number of hemostatic abnormalities are common, including thrombocytopenia and low levels of prothrombin and factors V, VII, and IX.

### Main clinical symptoms in patient with cardiovascular disorders

1. Cardialgies,
2. tachycardia,
3. dispnea, abdominal pains, heart enlargement,
4. decrease of tones' sonority,
5. rigidity of cardiac rhythm,
6. rhythm of gallop,
7. apical systolic murmur,
8. considerable cardiomegaly,
9. substantial decrease of myocardial contractile ability,
10. blood circulation's insufficiency ,
11. stability or slow progress of heart disturbances,
12. combined ECG-disorders , ,
13. echocardiographic disorders (the disorders of automatism, conductivity, excitability, processes of de-and repolarization);
14. decreased of myocardium contractive ability, objectively confirmed by the instrumental investigations,
15. mitral or aortic configuration of the heart at X-ray of the chest.

### Degree of heart failure

Degree	clinical symptoms						
	failure of right ventricle				failure o left ventricle		
	breath rates	pulse rates	cough and rales in the lungs	the colour of the skin	Hepato-megaly	Spleno-megaly	edema, oliguria
I	The clinical manifestation appears during physical activity (dyspnea, tachycardia, acrocyanosis)						
II A	> 30-50 %	> 15-30 %	-	-	+ 3 cm	-	(-)-(+)
II B	> 50-70 %	> 30-50 %	+	+	+ 3-5 cm	-	+
III	> 70 %	> 50 %	++, oedema of lung	++	> 5 cm	+	++

### Clinical manifestations

Despite compensatory mechanisms, the heart may be unable to maintain an adequate cardiac output. Decreased blood flow to the kidneys continues to stimulate sodium and water reabsorption, leading to hypervolemia, increased workload on the heart, and congestion in the pulmonary and systemic circulations. Because these hemodynamic changes occur at different times, the signs and symptoms can vary.

**Impaired myocardial function.** One of the earliest signs of compensation and

decompensation is *tachycardia* (sleeping heart rate above 160 beats/minute in infants), as a direct result of sympathetic stimulation. It is elevated even during rest but becomes markedly rapid during the slightest exertion.

Increased blood volume causes the ventricles to dilate, stretching the myocardial fibers until they are no longer as contractile. Ventricular dilation results in extra heart sounds, S<sub>3</sub> and/or S<sub>4</sub>. The addition of these extra sounds to S<sub>1</sub>S<sub>2</sub> produces a *gallop rhythm*. S<sub>3</sub> is believed to be caused by vibrations against the ventricle walls as blood flow is abruptly stopped when the dilated ventricles can no longer accommodate the volume. It is heard immediately after the second heart sound (ventricular diastolic gallop). S<sub>4</sub> is believed to be caused by atrial contraction in response to ventricular resistance during filling of the ventricles. It occurs just before the first heard sound (atrial presystolic gallop). The presence of S<sub>3</sub> and S<sub>4</sub> is called a summation gallop. Each is best heard at the apex.

Variations in the strength of ventricular contraction result in *pulsus alternans*, regular alternation of one strong beat and one weak one. It is best detected by palpating the pulse while taking the blood pressure. The increased pressure from the inflated cuff occludes the weak beats, so that only the stronger beats are counted. As a result, the pulse is half the actual rate.

*Cardiomegaly* results from dilation of the ventricle to accommodate increasing volumes of blood and from hypertrophy, as a result of persistent lengthening and thickening of the myocardial fibers. Although hypertrophy decreases the contractility of the fibers, it is partially compensated by an increase in muscle mass.

Decreased cardiac output results in poor peripheral perfusion, which is manifest by cold extremities, weak pulses, low blood pressure, mottled skin, and eventually growth retardation.

**Pulmonary congestion.** As the left ventricle fails, blood volume and pressure increase in the left atrium, pulmonary veins, and lungs. Eventually the pulmonary capillary pressure exceeds the plasma osmotic pressure, forcing fluid into tissues, causing pulmonary edema. The increased pressure also decreases the compliance (expansion) of the lungs.

*Dyspnea* is the earliest signs of failure and is thought to be caused by a decrease in the distensibility of the lungs. As a result, additional muscles must be used for respiration, causing *costal retractions*. Initially dyspnea may only be evident on exertion but may progress to the point that even slight activity results in labored breathing. In infants dyspnea at rest is a prominent sign and may be accompanied by flaring nares.

*Tachypnea* (respiratory rate above 60 breaths/minute in infants) occurs in response to decreased lung compliance. Inability to feed with resultant weight loss is primarily a result of tachypnea and dyspnea on exertion.

*Orthopnea* (dyspnea in the recumbent position) is caused by increased blood flow to the heart and lungs from the extremities. It is relieved by sitting up, because blood pools in the lower extremities, decreasing venous return. In addition, this position decreases pressure from the abdominal organs on the diaphragm. In infants orthopnea may be evident in their inability to lie supine and their desire to be held upright.

*Paroxysmal nocturnal dyspnea (PND)* is a severe shortness of breath that occurs shortly after falling asleep. It is a result of reabsorption of fluid (from dependent edema), which increases blood volume, producing more severe pulmonary congestion.

Edema of the bronchial mucosa may produce *cardiac wheezing* from obstruction to airflow. Mucosal swelling and irritation result in a persistent, dry, hacking *cough*. As pulmonary edema increases, the cough may be productive from increased secretions. Pressure on the laryngeal nerve results in *hoarseness*. A late sign of heart failure is *gasping* and *grunting respirations*. An uncommon sign in infants is rales.

*Cyanosis* may occur without a right-to-left shunt and is the result of impaired respiratory gas exchange. On exertion, such as crying or feeding, the infant may experience mottling of the skin or generalized transient duskiness. Extreme pallor or persistent duskiness is an ominous sign of CHF.

**Systemic congestion.** Systemic congestion is a primary consequence of right-sided failure

from inability of the right ventricle to eject blood into the pulmonary circulation, resulting in increased pressure and pooling of blood in the venous circulation. As was explained earlier, it can result as a late consequence of left-sided failure.

*Hepatomegaly* is usually the earliest sign of failure and occurs from pooling of blood in the portal circulation and transudation of fluid into the hepatic tissues. The liver may be tender on palpation and its size is an indication of the course of heart failure.

*Edema* forms as the sodium and water retention cause systemic vascular pressure to rise. The earliest sign is *weight gain*. However, as additional fluid accumulates, it leads to swelling of soft tissue that is dependent and favors the flow of gravity, such as the sacrum and scrotum when recumbent and loose periorbital tissues. In infants edema is usually generalized and difficult to detect. Gross fluid accumulation may produce *ascites* and *pleural effusions*.

*Distended neck* and *peripheral veins*, which are uncommon in infants, result from a consistently elevated central venous pressure. Normally neck and hand veins collapse when the head or hands are raised above the level of the heart, since the blood drains by gravity back to the heart.

However, when the venous pressure is high, it prevents the back flow of blood, causing the veins to remain distended.

### **Diagnostic evaluation**

Diagnosis is made on clinical symptoms such as dyspnea (especially when at rest), flaring nares, moist grunting respirations, subcostal retractions, tachycardia, activity intolerance (particularly during feeding), excessive sweating, and unexplained weight gain from edema. Since the signs of pulmonary congestion from heart failure resemble respiratory infections, it is imperative to differentiate between the two. Signs selectively indicative of CHF are cardiac enlargement, edema, sweating, hepatomegaly, and auscultatory findings such as tachycardia, gallop rhythm, and pulsus alternans.

### **Care for children**

The objectives of nursing care are to (1) assist in measures to improve cardiac function, (2) decrease cardiac demands, (3) reduce respiratory distress, (4) maintain nutritional status, (5) assist in measures to promote fluid loss, and (6) provide emotional support. Although the objectives are the same, the interventions differ depending on the child's age, especially with infants as compared to older children.

**Assist in measures to Improve cardiac function.** The nurse's responsibility in administering digitalis includes observing for signs of toxicity, calculating the correct dosage, and instituting parental teaching regarding drug administration at home.

### **Cardiac arrest**

#### Clinical manifestation

Apnoea, absence of pulse, loss of consciousness, dilatation of pupils, areflexia, cyanosis. The duration of the clinical death depends on the time, during which the brain is without blood supply, and the body temperature. When the body temperature is normal –effective resuscitation is possible during 5 min; at the body temperature 36-32° C- the resuscitation will be effective during 8 min, 32-28° C - 15 min, 28-18° C - 45 min.

#### Emergency Aid

I. To provide upper respiratory tract passage.

1. Put the child on the back on the hard surface.
2. Put the pillow under the neck to get the maximal extension of the head.
3. Put mandibulla forward
4. Clean the upper respiratory tract by the pump.

II. Artificial ventilation of the lungs is carried out either by mouth to mouth respiration, or by mouth to nose, with the help of breathing pump.

After making deep breath and through the cotton mask, putted on the mouth, inhale the air to the mouth of the child. Nose must be closed.

The rate of inhalation is 40 per min for newborn, for infants – 30; for children over 5 years

– 25; 6-14 years – 20 and for elder - 16-18 per 1 min.

Artificial ventilation of the lungs is connected with indirect massage of the heart.

In the children of the first 3 month of life-massage is done by thumb. In the children from 3 months till 3 years-by 3 fingers ,in children over 5 years-by two hands which are put in cross position on the lower part of the sternum. Press on the sternum to compress the heart between the sternum and vertebral column...In newborns sternum should be pressed down on 1-1.5cm, in children 2month-3 years-on 2.5 cm, in children 5-15 years-on 3-4 cm.

The frequency of compression is 60-100 times per 1 minute ,depending on age. During I inspiration should be made 4 compression on sternum.

The manifestations of effective resuscitation are appearance of pulse on carotids, renewal of breathing, constrictions of pupils and decreasing of cyanosis.

Putting ice or bags with cold water around the head helps to prolong time of effective resuscitation. If it's possible you can make intubation of trachea.

### Cardiovascular syndromes

1. Atrial septal defect.
2. Patent ductus arteriosus.
3. Triad of Fallot.
4. Tetralogy of Fallot.
5. Coarctation of aorta.
6. Tricuspid insufficiency syndrome.
7. Tricuspid stenosis syndrome.
8. Mitral insufficiency syndrome.
9. Mitral stenosis syndrome.
10. Pulmonary valvular insufficiency syndrome.
11. Pulmonary valvular stenosis syndrome.
12. Aortic insufficiency syndrome.
13. Aortic stenosis syndrome.
14. Myocarditis syndrome.
15. Pericarditis syndrome.
16. Syndrome of damage.
17. Syndrome of pancarditis.
18. Intoxication syndrome.
19. Physical development delay.

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## **Topic 11. Anatomical and physiological features of the digestive system, examination methods**

### **Practical lessons 27-28**

**Aim;** To research anatomo-physiological features of gastroduodenal organs in children, and to learn methods of clinical investigation. To research digestion organs in children, to identify pathological signs, to determine causes of their beginning and to make diagnosis, to teach skills of manipulation with children of this pathology.

**Professional motivation :** Knowledge of anatomy-physiological peculiarities of gastroduodenal part of digestive system and methods of clinical examination ,give as a possibility to recognize basic symptoms of pathological states, to organize a rational food mode and baby-minding.

#### **Basic level**

1. To Agglomerate anamnesis (propaedeutic therapy, of child diseases).
2. To examine mouth cavity examination, stomach, organs palpation of abdominal cavity (propaedeutic therapy).
3. To Estimate disposition of evacuation and coprogramme, to research results of gastric contents, duodenal contents (physiology, biochemistry, propaedeutic therapy). To Agglomerate anamnesis (propaedeutic therapy, of child diseases).

#### **Student's practical activity**

1. For inspection of gastro-duodenal and hepatobiliary system in children of different age.
2. To Agglomerate complaints, anamnesis data into children with gastro-duodenal and hepatobiliary .
3. To See out an objective child inspection.
4. On complaints base, anamnesis, objective data, got attached to inspection of sick, to pick out the stinging syndromes of gastro-duodenal and hepatobiliary .

After self-training the student must know the following:

1. **Anatomic and physiological peculiarities of the children's mouth cavity (the reasons for sucking process, peculiarities of children's salivation).**
2. **Anatomic peculiarities of esophagus, ventriculus, sphincter of ventriculus, bowels, mucous membrane of digestive apparatus, liver, gallbladder, and abdominal salivary gland.**
3. **Peculiarities of the secretory function of the digestive system:**
  - a) **acidity, enzymatic activity of gastric (appetite) juice;**
  - b) **external and internal secretory functions of the abdominal salivary gland;**
  - c) **quantitative and qualitative composition of bile;**
  - d) **secretory function of bowels;**
  - e) **the interdependence between the secretory activity, the character of feeding, and the child's age.**
4. **Peculiarities of alimentary ingredients (proteins, fats, carbohydrates, mineral salts, and water absorption) through different sections of the nutrient canal (canalis nutricius).**
5. **Peculiarities of the evacuation function of the nutrient canal of children of early age:**

- a) evacuation of food from the stomach depending on feeding;
  - b) the frequency of defecation (bowel movement) and its dependence on feeding.
6. Variants of defecation most frequently found among children:
- a) newborns and infants during natural and artificial feeding;
  - b) gastric indigestional;
  - c) during enteritis and colitis.
7. Bowels microflora and its role in the child's organism:
- a) the large intestine (intestinum crassum) microflora character;
  - b) the dependence of microflora on feeding;
  - c) physiological role of microflora;
  - d) pathological role of microflora, the notion of dysbacteriosis.

**Having covered the topic, the student must be able to:**

1. Collect anamnesis of a child and its parents, paying attention to the way of feeding, composition and regime of feeding, preference given to different dishes, the state of appetite, hereditary inclination for digestive organs diseases; complaints typical of this system affections.
2. Conduct objective investigation of digestion organs of children of different age (examination, percussion, palpation, auscultation).

**Materials which might be helpful.**

**Anatomic and Physiological Peculiarities of the Children's Digestive System**

During the embryonic period the histiotrophic feeding of the embryo is the main one (by endometrium (tunica mucosa uteri) secretion and gall-bladder material). Beginning from 2-3 months the hemotrophic feeding begins due to the diaplacental transportation of nutritive materials. Beginning from 16—20 weeks own digestive organs start functioning, that is the beginning of aminotrophic alimentation. Depending on the enzyme systems of feeding formation the fetus starts to get protein, glucose, water, mineral salts, and other materials in enteral way. The speed of differentiation and digestive organs' ripening increases, but relative unripeness of this system remains till the time of birth. Lactotrophic feeding is the most important stage of the newly-born's adaptation, it allows to find the balance between relatively great needs of quick growth of the organism and the low stage of functional development of the distant digestive system.

All the sections of the infants' digestive system are adapted to the natural feeding by mother's milk. The mouth cavity of a child is relatively small, the tongue is relatively big, and the palate is flattened during the first year of life. Well-exposed adipose bodies of cheeks, roller-like bulges on gums, and cross tucks on the lips mucous tunic have a great importance for sucking. The mucous tunic of the mouth cavity is a bit dry, rich in blood vessels, and very sensitive. Saliva secretion is provided by the submandibular gland (glandula submandibularis), sublingual gland (glandula sublingualis), parotid gland (glandula parotidea), and numerous small glands. Within the first 3 months saliva secretion is not significant, but besides it the carbohydrates digestion and milk casein coagulation in the mouth cavity start. The esophagus has a watering-can-like form, its length makes a half of the newly-born's body (10 cm), and it has the length of 25 cm among teenagers. The newly-born's stomach is round, its capacity makes 30—35 ml, at the age of 7—11 its form is similar to that of adults', its capacity enlarges up to 1020 ml. The movable function of the stomach lies in peristaltic movements with periodic clonuses and funnel openings.



Acidity and enzymes activity of stomach glands is low, but 1/3 of fat (emulsified by milk lipase) is hydrolysed in stomach under the influence of stomach lipase. Protein is partially hydrolysed in stomach due to such proteolytic enzymes as renin (chemosin), gas-tricsin, an insignificant quantity of salt, water, and glucose is absorbed. Stomach histological differentiation lasts up to the end of the second year of life. Abdominal salivary gland is the main gland of alimentary canal; its secretion grows up quickly after adding a lure and reaches an adult's level of secretion up to the age of 5. The main enzymes of pancreatic juice are the following: tripsin, chemo-trypsin, diastase, amylase, lipase, phospholipase, incretory insulin secretion. The newly-born's liver is relatively big, makes 4-4.4% of body weight, is much vascularized, conjunctive tissue is not well-developed and parts are badly separated, is immature in functional aspect. The function of glycogen forming is well-exposed, while the function of disintoxication is poor. Liver takes part in the processes of alimentation, blood forming, blood circulation and metabolism.

During the first months of a child's life bile is produced in small quantity, contains a small quantity of bile acids which sometimes leads to steatorrhea among newly-borns; at the same time it contains a lot of water, mucin, and pigments; the newly-born's bile contains urine. It also contains more taurocholine acid than gluco-choline one which increases its bactericidal properties, stimulates abdominal salivary gland secretion and enforces the large intestine's peristalsis. Infant's bowels are relatively long in comparison with those of an adult, they are 6 times longer its body. The tunica mucosa is delicate, rich in fibres, blood vessels, and cellular elements. The glands are well-developed. The blind gut and appendix are movable; the descending section of the large intestine is longer than the ascending one. The rectum is relatively long, has slightly fixed mucous and submucous tunics. Child's bowels perform alimentary, movable, and absorption functions. Intestinal juice is less active in comparison with that of an adult, it has a weak acid or neutral reaction, and soon it possesses an alkaline reaction. It contains the following enzymes: enterocynase, alkaline phosphatase, amylase, maltase, invertase, and soon lipase. Hydrolysis products which are formed as a result of cavernous (distant) and membranous (periwall) alimentation are absorbed in the small intestine by all its sections, which is absent among adults. Intracellular digestion with an easy transition of milk lactoglobulin into blood in unchanged condition has a great importance for children. Water is absorbed, fecal masses are formed, and mucus secretion takes place in the large intestine. The peculiar feature of children's bowels is relatively weak but long frill which provides favourable conditions for intussusception development.

### **Infants' Stomach Juice Composition**

	1 month			1 year		
General acidity	3.6-10ml	0.8-4.5ml	1.5-3.0	12-21ml	4-10 ml	1.0-2.0 16-
Free hydrochloric acid	2-8 units	32 units	4.2-10.2	33 units	256-512 units	0-40
pH	units			units		
Pepsin						
Labenzyme						
Lipase						

### **Peculiarities of Children's Gut Organisms**

The normal gut flora performs the following functions: protective, immune, metabolic, contributes to the final gastrointestinal digestion, vitamin and enzymes synthesis. Its composition

depends on the child's age and the type of alimentation. A newly-born child has sterilized bowels, but within the first day of life they are inhabited by colon bacillus (*Escherichia coli*), enterococcus, yeast flora, and rarely streptococcus. If natural alimentation is used, *B.bifidus* and *B.laktis aerogenes* are prevailing in the bowels. If artificial alimentation is used, *B.colli* is prevailing.

Disorder in the normal state of gut microbiocoenosis leads to bowel dysbacteriosis development, which is considered to be the borderline state of infectious process. The degree of dysbacteriosis is evaluated on the basis of balance between esheryhias and conditioned-pathogenic microbes. If dysbacteriosis is considered to be weak, conditioned-pathogenic microbes make 25%; if dysbacteriosis is considered to be temperate, conditioned-pathogenic microbes make 50%; if dysbacteriosis is considered to be significant, conditioned-pathogenic microbes make 75%; if dysbacteriosis is considered to be sharp, conditioned-pathogenic microbes make 100%.

### Gut Microbiocoenosis Characteristics

Microorganisms	Children of the 1-year of life		Adults	
	Microorganisms' quantity in onegr. of excrements			
	min—max	M±m log 10	min—max	M+m log 10
Bifidobacterium	10 <sup>8</sup> -10 <sup>10</sup>	8.6±0.6	10 <sup>9</sup> -10 <sup>10</sup>	9.810.19
Bacteroids	10 <sup>9</sup> -10 <sup>10</sup>	9.2±0.1	10 <sup>8</sup>	—
Lactobacillus Lactate	10 <sup>8</sup> -10 <sup>7</sup>	6.9±0.2	10 <sup>6</sup> -10 <sup>8</sup>	7.510.1
Staphylococcus	10 <sup>6</sup> -10 <sup>7</sup>	6.6±0.1	10 <sup>7</sup> -10 <sup>8</sup>	7.410.36
Enterococcus	10 <sup>5</sup> -10 <sup>6</sup>	5.2±0.1	10 <sup>5</sup> -10 <sup>6</sup>	6.410.2
Enterobacterium with normal enzyme activity	10 <sup>7</sup> -10 <sup>8</sup>	7.7±0.3	10 <sup>7</sup> -10 <sup>8</sup>	7.810.24
Enterobacterium with lowered enzyme activity	10 <sup>6</sup> -10 <sup>7</sup>	6.7±0.3	10 <sup>6</sup> -10 <sup>7</sup>	6.810.24
Lactose negative	10 <sup>6</sup> -10 <sup>7</sup>	6.4±0.2	10 <sup>6</sup> -10 <sup>7</sup>	6.510.2
Organisms of Proteus genus	<10 <sup>4</sup>	3.410.1	10 <sup>3</sup>	—
Other conditioned-pathogenic enterobacterium	< 10 <sup>5</sup>	-	10 <sup>4</sup>	-
Staphylococcus (saprofitic, epidermal)	<10 <sup>4</sup>	-	10 <sup>4</sup> -10 <sup>6</sup>	5.310.4
Yeast-like fungi	<10 <sup>4</sup>	-	< 10 <sup>4</sup>	
Spore carrier anaerobic bacilli (clostridias)	< 10 <sup>5</sup>	-	-----	-

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### Main Methods of Investigation

#### STOMACH FRACTIONAL INVESTIGATION

Investigation is done in the morning, after 12-14 hours of starvation.

Basal secretion: the sum of 4 portions of stomach secretion obtained every 15 min.. It reflects the state of gland activity of stomach apparatus and its regulation. After entering of irritator (7%

dry cabbage decoction, meat decoction, more frequently 0.1% histamine solution - 0.01 mg/kg of body weight in parenteral way) the contents of the stomach are obtained, according to the quantity of the contents the evacuation function of the stomach is estimated. Then, within an hour, the stomach contents are sucked off with a syringe every 15 min. in order to get the index of the so-called stimulated or consecutive secretion. Estimating the absolute quantity of hydrochloric acid per unit of time (debit HCL) is the most objective index of the acid-forming function of the stomach, in comparison with clinical (titrimetric) units. Debit-hour HCL is determined with the help of the formula:

$$D = 0.0365 \cdot N \cdot E_1 + 0.0365 \cdot N_2 \cdot E_2 + \dots,$$

where N — the quantity of stomach juice, E — acidity (in clinical (titrimetric) units), 0.0365 - quantity of HCL in 1 ml of juice with its concentration in 1 clinical (titrimetric) unit.

The quantity of stomach contents of a healthy child of school age makes 0—30 ml, the quantity of basal secretion - 30—100 ml, and 40—110 ml of the consecutive one. The debit-hour of the free acid in basal secretion is 0.55-2.74 milli gram-molecules (20—100 mg) and 1-4.93 milli gram-molecules (40-180 mg) in the consecutive one. The intragastric pH measuring which is made with a pH sensor probe or with a radio capsule with the pH radiometric system is used together with the titration of the stomach contents extract.

Ultrasound investigation gives a possibility to define the size and structure of liver, gallbladder, pancreas, and spleen at any age. It is used for the revelation of inflammatory processes, salts and stones in gallbladder, and gallbladder dyskinesia. It is an informative method and a child does not suffer of it.

Esophagogastroduodenoscopy gives a possibility to estimate the character and location of pathological processes in the gullet, stomach, and duodenum. It may be combined with biopsy and microscopic investigation of mucous tunic. The patient must be specially prepared for it, sometimes narcosis is used.

### **Methods of Child's Examination**

During the child's digestive system examination special attention must be paid to the following:

- while collecting anamnesis it is necessary to find out the peculiarities of heredity concerning digestive system diseases, of perinatal anamnesis (pregnancy toxicosis, breakdown of pregnancy, pregnant person's and newly-born's diseases, etc.), child's feeding (natural, artificial, mixed, bait, regime), dyspeptic phenomena presence (regurgitation, vomiting, pains in the abdomen, the state of appetite, frequency, and character of defecation);

- while examining a child it is necessary to find out the peculiarities of tongue (dry, with<sup>4</sup> thin coating, sonorous, "geographical", big), mouth cavity mucous tunic (pale, enanthema presence, hemorrhage presence, Filatov's spots), teeth, tonsils, skin colour, abdomen size and form, peristalsis, the state of umbilicus (wet, presence of pus), the state of anus (yawning);

- while conducting surface palpation it is necessary to estimate the tension, lowered or increased anterior wall of the stomach (paries anterior) tonus, the pain zones of Zakharyin-Ged (chole-dochoduodenal, erigastric, Shoffar's zone, pancreatic, appendicular, sigmal), Shchotkin-Blumberg's symptom;

- while conducting deep palpation by Obratsov-Strazheska's method one is able to find out the peculiarities of the stomach cavity organs (bowels, liver, gallbladder, spleen, pancreas, mesenteric glands). To find out the pathology of stomach cavity organs it is necessary to denote some pain "dots" and symptoms. If liver or gallbladder are influenced, the following "dots" and symptoms will indicate it: the Ker's "dot" and symptom, Lepine, Ortner, Horhievsky-Mussi, and

Murphy symptoms. If the stomach or duodenum is influenced, the Mendel's symptoms and the dots of Boas and Openkhovsky will indicate it. The dots and symptom of Mayo-Robson indicate affection of the pancreas, the dots of De Zharden and Pasternatsky syndrome indicate the kidneys affection, and the Shchotkin-Blumberg symptom indicates peritonitis;

- with the help of percussion the presence of liquid in the stomach cavity, the liver size by the method of Kurlov (11-9-7 cm) among children of 5-7 (4-4 cm for the 1<sup>st</sup> year, 5-5 cm for the 2<sup>nd</sup>-3<sup>rd</sup> years, 6-6 cm for the 6<sup>th</sup>-7<sup>th</sup> years, and soon 6-7 cm as an adult has). In case of children of early age the upper level of the liver is determined between the 5<sup>th</sup> and 6<sup>th</sup> ribs, and the low level of the liver is determined by means of palpation (up to the age of 5—7 it is located 1—2 cm lower than the costal margin);

- one must evaluate the results of laboratory-instrumental investigation: fraction investigation of digestive juices, duodenal intubation, endoscopic investigation of upper and low sections of the esophagus, ultrasound methods of parenchymatous organs investigation, co-program, bacteriogram, X-ray, and radiological investigations, biochemical and immunological methods of investigation.

### **Main semiotics of diseases of the gastrointestinal tract.**

**Current relevance of the research.** The children's digestive organs have certain anatomical and physiological peculiarities which presuppose peculiarities of alimentation as well as pathology peculiarities of this system; moreover, this system takes one of the leading positions in infants' and older age children's morbidity. A doctor has to know these peculiarities as well as the peculiarities of gradual ripening of the digestive system for working out the ration, diagnostics, treatment and prevention of morbidity connected with organs of digestion of children of different age.

**The aim of the lesson:** to study age-related anatomic and physiological peculiarities of all the parts of the digestive system, to master the methods of children's examination, to study the semiotics of this system's diseases.

#### **After self-training the student must know the following:**

1. Symptoms and syndromes most frequently observed during digestive organs diseases: the painful syndrome, its peculiarities and manifestations among children; the syndrome of dyspepsia (gastric indigestion) in stomach and bowel forms; reduction or absence of appetite; regurgitation and vomiting; dysfunction of excrements; hepatosplenomegaly (Banti's (hepatorenal) syndrome), etc.
2. The reasons for digestive organs diseases.

#### **Having covered the topic, the student must be able**

**to:**

3. Denote the most frequent symptoms and syndromes of digestive system's affections among children.

### **Materials which might be helpful.**

#### *The Main Syndromes of Children's Digestive System Affections*

1. **The syndrome of "acute stomach".** It appears because of affection or acute diseases of stomach cavity organs and out-of-sto-mach space, which needs immediate medical aid. Symptoms: pain in the stomach which sometimes leads to the state of shock, the Shchotkin-Blumberg positive symptom, vomiting, defecation gas

evacuation delay, diarrhea, melena, Hippocratic face, the syndrome of intoxication. The most frequent reasons for it: empty organs perforation, acute inflammatory processes accompanied by peritonitis (acute appendicitis, acute cholecystitis etc.), hemorrhage to the stomach cavity, invagination.

2. The syndrome of stomach and bowel *dyspepsia*. Stomach dyspepsia appears as a result of rude alimentary disorders, as well as a result of worsening of chronic inflammatory processes, mostly among older children. Symptoms: vomiting, heartburn, eructation, sickness, and sometimes diarrhea. In case of younger children special attention must be paid to the vomiting symptom which may be connected with the vomiting centre stimulation as a result of the toxicosis syndrome. The bowel dyspepsia appears as a result of bowel infection or rude feeding violation. Symptoms: vomiting, liquid feces or constipation, pain in the stomach, wind and collywobbles. In case of enteritis or gastroenteritis multiple vomiting, pain in epigastria, and multiple feces without admixtures are prevailing, the syndrome of exicosis appears. In case of colitis the syndrome of toxicosis prevails, feces are liquid, contain a lot of slime and blood substances.

3. The *malabsorption* syndrome. It is a clinical complex of symptoms connected with the final feeding product absorption disorder in the small intestine. It may be determined by inborn fermentopathy (the lack of lactose, sucrose, etc.), intolerance to gluten (celiac disease (Heubner-Herter disease)), milk protein. It also may appear as a result of the resection of a part of the small intestine, of a long-term taking of antibiotics, chronic diseases of the digestive system, lambliaiasis, and other simplest forms invasion. Symptoms: chronic diarrhea with polyfecalia and steatorrhea, hypotrophy, atrophy, sharp stomach upthrusting because of wind and chyme accumulation, anemia, polyhypoavitaminosis, immunodeficiency, and disorder of water-electrolytic exchange.

4. The *jaundice* syndrome. In case of this syndrome mucous tunics, skin, and tissues are of yellow colour. It appears when there is hyperbilirubinemia in a child's blood, in other words, when the level of bilirubine is more than 20.5-34.0 milli gram-molecules per liter.

*Hepatocellular jaundice* appears as a result of hepatocyte cyto-lysis. The fraction of direct bilirubine in blood increases, skin acquires lemon colour with a red tint, feces are allochiral, urine is of dark colour, and liver is enlarged. This syndrome appears as a result of viral, aggressive chronic and toxic hepatitis, and cirrhosis.

*Mechanic hepatocellular jaundice*. Appears when the bile outflow is disordered, bile-excreting routes obturation as a result of the inborn anomaly, calculous cholecystitis, regional glands increasing, and bile-excreting routes atresia. Skin colour may have a green tint, there may be itching, feces are allochic, and urine is of yellow colour; liver is enlarged and there is a significant increase of the level of direct bilirubine in blood.

*Hemolytic hepatocellular jaundice*. Bilirubine hyperproduction appears as a result of red corpuscles hemolysis during hemolytic anemias, newly-borns' hemolytic disease and other erythropathies. The colour of skin is pale or lemon, feces are dark, urobilin is detected in urine. The fraction of indirect bilirubine in blood increases, liver may have a tendency to enlargement, but spleen enlarges naturally.

*Physiological jaundice, (transitory jaundice)* appears on the second day of life among the greater part of newly-borns, increases up to the 4<sup>th</sup>-5<sup>th</sup> days of life and disappears up to the 7<sup>th</sup>-10<sup>th</sup> days of life. It is connected with high destruction of red corpuscles and age unripeness of glucuroniltransferase system which leads to the accumulation of indirect bilirubine in blood, its level reaches the concentration of 68.4-85.5 milli gram-molecules per liter.

*Exogenic jaundice* must be distinguished from the endogenic one. The first appears when a child consumes a large quantity of products which have a colouring liquid in their composition (carrot, tangerine, pumpkin). In such case feces have natural coloring. Bilirubine concentration does not increase (carrot jaundice).

#### Tests

1. The suction act is promoted by:
  - 1.1. A relatively large mouth cavity.
  - 1.2. Well-exposed cheeks adipose body.
  - 1.3. A large tongue.
  - 1.4. Cylinder-like bulges on gums.
  - 1.5. Well-developed muscles of mouth and cheeks.
2. The newly-born's stomach capacity makes:
  - 2.1. 30-35 ml.
  - 2.2. 50-60 ml.
  - 2.3. 100-150 ml.

- 2.4. 200-250 ml.
3. The main active enzyme in the newly-borns' stomach liquid is:
  - 3.1. Pepsin.
  - 3.2. Chymosin (labenzyme, rennet).
  - 3.3. Lipase.
  - 3.4. Amylase.
  - 3.5. Entrokinase.
4. The liver boundaries of a 1-year-old child are:
  - 4.1. Upper - 5<sup>th</sup>-6<sup>th</sup> rib, lower - 1-2 cm lower than the costal margin.
  - 4.2. Upper - 6<sup>th</sup> rib, lower - 3-4 cm lower than the costal margin.
  - 4.3. Upper - 4<sup>th</sup> rib, lower - 5 cm lower than the costal margin.
5. The infants' bowels length must be longer in comparison with the body length by:
  - 5.1. 2 times.
  - 5.2. 6 times.
  - 5.3. 4 times.
  - 5.4. 10 times.
  - 5.5. 3 times.
6. Which of the given below is not typical of the normal bowels microflora?
  - 6.1. Creates an immunologic barrier.
  - 6.2. Promotes final gastrointestinal digestion.
  - 6.3. Promotes vitamin and enzymes synthesis.
  - 6.4. Provokes bowels mucous tunics inflammation.
7. What do naturally fed infants' feces look like?
  - 7.1. Semi-liquid, of yellow colour.
  - 7.2. Perfect.
  - 7.3. With white masses.
  - 7.4. Of green colour, liquid.
  - 7.5. With blood and slime.
8. Which bowels microflora is the dominant one among children who are naturally fed?
  - 8.1. Bifidoflora.
  - 8.2. Colon bacillus.
  - 8.3. Staphylococcus.
  - 8.4. Enterococcus.
  - 8.5. Yeast-like fungus.
9. Pain in the left low part of the stomach usually appears during:
  - 9.1. Stomach diseases.
  - 9.2. Appendicitis.
  - 9.3. Gallbladder diseases.
  - 9.4. Dysentery
  - 9.5. Hepatitis.
10. Which symptom is not characteristic of gallbladder and bile-duct affection?
  - 10.1. Ortner's.
  - 10.2. Pasternatsky's.
  - 10.3. Ker's.
  - 10.4. Heorhievsky-Mussi.
  - 10.5. Murphy's.

Correct answers: 1.1; 2.1; 3.2; 4.1; 5.2; 6.4; 7.1; 8.1; 9.4; 10.2.

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## Topic 12. Anatomical and physiological features, methods of examination of the excretory system in children

### Practical lessons 29-30

**The current relevance of the research.** The qualitative changes in the work of the urinary system take place after the birth of a child. Even an embryo has functioning kidneys, and its urine is of great importance for keeping the amniotic fluid volume. The excretion of fetus's substances is provided by placenta. Kidneys get the leading role in the provision of organism homeostasis from the moment of birth. Their function lies in keeping the right volume of blood and inner environment liquid, in the provision of constant concentration of the osmotic active substances and separate ions, pH, the final exchange products excretion, foreign substances. The knowledge of the peculiarities of the children's urinary system composition and functioning is the must for exact diagnosis and appropriate treatment.

**The aim of the lesson:** to study the peculiarities of the children's urinary system composition and functions, to find out the most important features of urine tracts affection, to learn how to investigate and estimate the state of the urinary system of children of different age.

#### After self-training the student must know the following:

1. Anatomic and physiological peculiarities of children's kid-neys, urinary tracts, urinary bladder.
2. Peculiarities of kidneys functional state.
3. Symptoms and syndromes appearing as a result of transitory and residual loss of kidneys homeostatic functions.
4. Quantitative and qualitative indexes of urinary excretion of different age periods.
5. Disease semiotics of urinary organs: edema syndrome, nephrotic syndrome, nephritic syndrome, arterial hypertension syndrome, urinary syndrome.
6. The methods of the children's urinary system investigation.

**Having covered the topic, the student must be able to:**

1. Define and estimate complaints which are characteristic of the urinary system affection, collect family and individual anamnesis (history).
2. Be able to conduct the kidney palpation by Obraztsov-Strazheska's method in horizontal state and by Botkin method.
3. Be able to detect evident and hidden edemas.
4. Be able to estimate the general urine analysis, urine analysis by Nechyporenko, Addis-Kakovsky, Ambourge; estimate the results of bacteriological urine investigation.
5. Know how to interpret indexes of biochemical blood investigation used in nephrology: creatinine, urine acid, general protein and its fractions, cholesterol, and electrolytes.
6. Know how to interpret indexes of the main laboratory functional kidneys investigations: Zymnitsky's test, Ruberg's test, loading tests (the test on concentration, the water loading test).
7. Know how to evaluate the roentgenogram: examination X-ray picture of stomach organs, excretory urography, voiding (micturating) cystography.

### **Materials which might be helpful.**

#### *Anatomic and Physiological Peculiarities of the Children's Urinary System*

Relatively large kidneys size and shorter back girdle's part determine the kidneys topographical location during the first years of life. The kidneys upper pole is located on the level of XI-XII thoracic (dorsal) vertebrae, while the lower pole is located on the level of the IV lumbar vertebra, in other words lower than the glomerular bone's crest. Kidneys are more movable among children of early age which is explained by the weak development of adipose body of the kidney. Kidneys have a lobular composition during the first years of life. Kidneys jutting out parts are relatively broader; urinary tracts are splinted at a sharp angle. Urinary tracts are wavy, a bit hypotonic and have a relatively large diameter. The infant's urinary bladder is located above the symphysis; later on it goes down to the small pelvis. The girls' urethra is shorter and broader than that of boys' in all age periods.

The children's urinary system anatomic peculiarities mentioned above are the reasons for possible microbial-inflammatory diseases development, and thus, they influence the interpretation of definite instrumental investigations and the methods of diagnostics investigation conducting.

Urine secretion with its pouring to alantoic and aminotic liquids is detected even throughout the prenatal period. Urine is hypotonic to blood plasma and contains little urine acid, urea, and chloride at this stage. After birth kidneys become the main organs responsible for providing the vitally necessary permanency of the organism inner environment. The kidneys concentration function is limited among the children of early age. Urine low density is connected with the glomerule low diameter, antidiuretic hormone lowered production, osmoregulators underdevelopment, functional inferiority of distal convoluted renal tubules' epithelium, etc.

The infants' general diuresis is 2-3 times higher than that of the children of older age. It makes 80-90 ml per kg of body weight during the first months of life and about 50 ml per kg of body weight among children of 8-10. Taking these peculiarities into account, it is recommended to prescribe about 200 ml of liquid per 1 kg of body weight to infants. At the same time, besides the increased diuresis, the child's organism is not able to compensate the superfluous liquid injection quickly, which may lead to anxiety, retching, diarrhea, polyuria, and convulsions. The high tubular (canalicular) absorption (99.4-100%) determines the low tempo of chloride release which leads to sodium chloride deposition in tissues, lowering of filtration, diuresis. That is why the superfluous



sodium chloride injection may be accompanied by significant diuresis dysfunction, even anuria, hypostases, the so-called salt fever.

The imperfection of water and sodium reabsorption mechanisms in distal straight renal tubules is enforced by functional unripeness of processes connected with hydrogen ions and ammonia synthesis in this particular district of tubule apparatus; as a result of it conditions for serious metabolic acidosis may appear. Urine approaches adults' indexes by its functional indexes during the final differentiation and ripening of kidneys morphological structures (5-7 years).

### ***Methods of Children's Urinary System***

#### ***Organs Examination***

While examining the children's urinary system organs one must pay attention to the presence of pain in the waist district, above pubis, character of urine secretion (painfulness, frequency, urinary incontinence, enuresis, and other urine secretion act violations), "unreasonable" jumps of body temperature.

While collecting anamnesis it is necessary to specify the risk factors of inborn and hereditary pathology, possible reasons for acquired diseases (mother's nephropathy during the pregnancy period, serious infections the children had experienced, chronic niduses of infection, overcooling, previous vaccinations, etc.).

During examination the presence of paste, hypostases, pale skin, skin dampness, and the state of genitals are registered.

Kidney palpation must be done if hidden hypostases are suspected by the McKlur-Oldridge test, the quantity of drunk and secreted liquid per day, the colour and clarity of urine are evaluated.

#### ***Methods of Clinical Investigation Used for the Examination of Children with Urinary System Organs Diseases***

- Questions put to a child or parents.
- General clinical investigation: examination, urinary system organs palpation.
- Laboratory investigation of urine, blood; the main biochemical indexes important for nephrology.
  - Kidneys and urinary bladder echography.
  - X-ray-radiological methods of investigation: excretory (intravenous) urography, voiding (micturating) cystourethrography, retrograde pyelography, renal angiography etc.
- Kidneys thermography.
- Kidneys biopsy.

#### ***Urinary System Affections Semiotics***

**Toxic syndrome** - weakness, decrease of appetite, possible rise of body temperature.

**Pain syndrome** - pain in stomach, waist, and suprapubic zones.

**Nephrotic syndrome** - a complex of symptoms among which the following can be found: proteinuria is more than 3 gr. per day, hy-poproteinemia, hypercholesterolemia, edemata. These are characteristic features of nephrosis and nephritis.

**Nephritic syndrome** - a complex of symptoms among which the following can be found: moderate oedemata, hematuria, hypertension. Is characteristic feature of nephritis.

**Dysuric syndrome** - complex of symptoms which testify the pathological character of urination act.

- **Incontinence** — urination without preliminary vesical tenesmus.
- **Enuresis** - urination without preliminary vesical tenesmus at night time.
- **Incontinence** - urination after imperative preliminary vesical tenesmus.
  - **Strangulation** - pain during urination.
  - **Ischuria (delay in urination)** - absence of urine after vesical tenesmus while urine is present in urinary bladder.
- **Polakiuria** - increase of urination frequency.
- **Oliguria** - lowering of the daily urine quantity to 20—30% .
- **Anuria** - lowering of the daily urine quantity to 6—7% .
- **Polyuria** - increase of the daily urine quantity by 1.5 times compared to the normal range.
- **Nocturia** - prevailing of night time urination over that of the daytime.

**Urine syndrome** - any changes of quantitative and qualitative urine composition detected during the laboratory examination of urine. Is represented by *macrohematuria, microhematuria, le'ukocyturia, bacteriuria, proteinuria, cylinderuria, crystaluria, glucosoria, cetoneria, changes in urine pH, and other symptoms.*

### **Additional methods of inspection. Functional tests. Semiotics of microscopic changers of urine (protein-, erythrocyte-, leucocyt, cylinderuria) .**

The current relevance of the research. **The qualitative changes in the work of the urinary system take place after the birth of a child. Even an embryo has functioning kidneys, and its urine is of great importance for keeping the amniotic fluid volume. The excretion of fetus's substances is provided by placenta. Kidneys get the leading role in the provision of organism homeostasis from the moment of birth. Their function lies in keeping the right volume of blood and inner environment liquid, in the provision of constant concentration of the osmotic active substances and separate ions, pH, the final exchange products excretion, foreign substances. The knowledge of the peculiarities of the children's urinary system composition and functioning is the must for exact diagnosis and appropriate treatment.**

The aim of the lesson: **to study the peculiarities of the children's urinary system composition and functions, to find out the most important features of urine tracts affection, to learn how to investigate and estimate the state of the urinary system of children of different age.**

After self-training the student must know the following:

1. **Anatomic and physiological peculiarities of children's kid-neys, urinary tracts, urinary bladder.**
2. **Peculiarities of kidneys functional state.**
6. **Symptoms and syndromes appearing as a result of transitory and residual loss of kidneys homeostatic functions.**
7. **Quantitative and qualitative indexes of urinary excretion of different age periods.**
8. **Disease semiotics of urinary organs: edema syndrome, nephrotic syndrome, nephritic syndrome, arterial hypertension syndrome, urinary syndrome.**
6. **The methods of the children's urinary system investigation.**

Having covered the topic, the student must be able to:

3. **Define and estimate complaints which are characteristic of the urinary system affection, collect family and individual anamnesis (history).**

4. Be able to conduct the kidney palpation by Obratzov-Strazheska's method in horizontal state and by Botkin method.

3. Be able to detect evident and hidden edemas.

8. Be able to estimate the general urine analysis, urine analysis by Nechiporenko, Addis-Kakovsky, Amburge; estimate the results of bacteriological urine investigation.

9. Know how to interpret indexes of biochemical blood investigation used in nephrology: creatinine, urine acid, general protein and its fractions, cholesterol, and electrolytes.

10. Know how to interpret indexes of the main laboratory functional kidneys investigations: Zimnitsky's test, Reberg's test, loading tests (the test on concentration, the water loading test).

11. Know how to evaluate the roentgenogram: examination X-ray picture of stomach organs, excretory urography, voiding (micturating) cystography.

### Materials which might be helpful.

#### Complex of laboratory investigation:

1. Urine analysis once per 7-10 days.
2. Nechiporenko (Amburgeau, Kakovskiy-Addis) test.
3. Revealing of the so-called "active leukocytes" in the urine sediment has some auxiliary significance.
4. Urine inoculation (not less than 3 times) with definition of microbe sensitivity to antibiotics.
5. Determination of bacteriuria degree. It is considered significant if there are 100000 of microbes in 1 ml of urine.
6. Determination of renal function condition with Zimnitsky's test (takes 8 urine portion once per 3 hours)
7. Rebergs test
8. Determination of secretory renal function and renal blood flow. Function of distal nephrons (ammonia, filtrated acidity of urine), proximal tubules ( $\alpha$ 2-microglobulin in urine, proteinuria, calciuria, phosphaturia), Henle's loop (osmotic concentration of the urine).
9. Biochemical analyses of blood: total protein, cholesterol, residual nitrogen, creatine, blood urea, dysproteinemia (with elevated levels of  $\alpha$ -and  $\gamma$ -globulins), rise of ciliac acids, mucoproteis, positive C-reactive protein reaction.
10. Ultrasonography of kidneys and urinary bladder.
11. Urography, excretory urography, cystography and cystoscopy.

#### General analyses of the urine:

Collect the morning urine, middle portion; investigate physical properties, and lead microscopy.

Urine physical properties:

- clearness, pH, specific gravity,
- methods chemical properties: protein, glucose, sugar, ketone bodies, biliary pigments
- microscopy of sediment: leukocytes, erythrocytes, cylinders, endotelial cells

Changes from the side of general analysis of urine:

Low or high specific gravity of urine, proteinuria, ketonuria, glucosuria, leucocyturia, casts in urine, bacteria's in urine.

Common rules of urine collection:

The first portion of urine have to be taking after slipping in the morning.

Before taking the analysis, the patient must be washed and he have to collect the urine in the clear bottle, then send it to laboratory.

Bacteriological investigation:  
10 ml of urine in the sterile test-tube.

### Quantities method:

#### Method by Kakovsky-Addis:

In the clear bottle collect urine, which was excreted of urine while 10 night's hours (from 22 to 8). Count formed, elements of daily urine:

Leucocytes/ erythrocytes as  $2 \times 10^6 / 1 \times 10^6$

#### Ambyrze's method

Use for investigate "minute leukocyturia" formed elements which excreted of urine while one-minute leucocytes / erythrocytes as  $2 \times 10^6 / 1 \times 10^6$

#### Nechepurenko's method

Taking middle portion of urine, near 2-3 ml.

Count number formed elements in the 1 ml of urinary sediment.

leucocytes / erythrocytes as  $2 \times 10^6 / 1 \times 10^6$

#### Zymnyckiy's test

Collect 8-portion urine while 24 hours; from 6 o'clock (this portion do not take). While every 3 hours to the 6 of other day.

#### Control edema

Weigh daily, measure abdominal girth at umbilicus

measure accurately intake and output

test urine for specific gravity, album

collect specimens for laboratory examination

take blood pressure

Prevent further edema formation

Provide salt-restricted diet

limit fluids if ordered

Establish good nutrition

administer high-protein, high-carbonate diet (restrict sodium during edema)

administer supplementary vitamins and iron as ordered.

Prevent skin breakdown

provide meticulous skin care

cleanse and powdre opposing skin surfaces several time daily

separate skin surfaces with soft cotton

support edematous organs, such as scrotum

cleanse edematous eyelids with warm saline wipes

changes position frequently, maintain good body alignment

#### Urinary tract infection (UTI)

UTI is a significant childhood problem, probably second only to infection of the respiratory tract. Although its exact incidence is not known, it is suggested that from 1% to 2% of school-age

children have UTI as demonstrated by significant bacteriuria. The peak incidence of UTI not caused by structural anomalies occurs between 2 and 6 years of age. Except for the neonatal period, females have a 10 to 30 times greater risk for developing UTI than males. It has been estimated that approximately 5% of school-age females will develop bacteriuria by 18 years of age. Such statistics attest to the importance of preventing, diagnosing, and treating this problem to prevent recurrent infections and possible renal damage in later years.

**Predisposing factors.** A number of factors predispose to the development of UTI. The major ones included here relate to anatomic, physical, and chemical causes.

*Anatomic and physical.* These factors seem to account for the increased incidence of bacteriuria in females. The short urethra, which measures about 2 cm in young females and 4 cm (1½ inches) in mature women, provides a ready pathway for invasion of organisms. The longer male urethra (as long as 20 cm [8 inches] in an adult) and the antibacterial properties of prostatic secretions inhibit the entry and growth of pathogens.

Introduction of bacteria can occur in females during tub baths. Soap or water softeners decrease the surface tension of the water, increasing the possibility of fluid entry into the short urethra. Tight clothing or diapers, poor hygiene, and local inflammation, such as from vaginitis or pinworm infestation, may also increase the risk of ascending infection.

Physical factors relating to the functioning of the bladder are of major importance in the occurrence and spread of infection. Ordinarily urine is sterile, but at 37° C it is an excellent culture medium. Under normal conditions the act of completely and repeatedly emptying the bladder flushes away any organisms before they have an opportunity to multiply and invade surrounding tissue. However, urine that remains in the bladder allows bacteria from the urethra to rapidly become established in the rich medium.

Incomplete bladder emptying may result from reflux, anatomic abnormalities, especially involving the ureters, or dysfunction of the voiding mechanism. Vesicoureteral reflux (VUR) refers to the retrograde flow of bladder urine into the ureters. Reflux increases the chance for and perpetuates infection, since with each void urine is swept up the ureters and then allowed to empty after voiding. Therefore, the residual urine in the ureters remains in the bladder until the next void.

Primary reflux results from the congenitally abnormal insertion of the ureters into the bladder and predisposes to development of infection. Secondary reflux occurs as a result of infection. Normally the ureters enter the bladder wall in such a manner that the accumulating urine compresses the submucosal segment of the ureter, preventing reflux. However, the edema caused by bladder infection renders this mechanism at the ureterovesicular junction incompetent. In addition, in infants and young children the shortness of the submucosal portion of the ureter decreases the effectiveness of this antireflux mechanism. Other causes of secondary reflux are neurogenic bladder from either chronic obstruction or neural dysfunction or as an iatrogenic result from progressive dilation of the ureters following surgical urinary diversion.

Reflux with infection can lead to kidney damage, since refluxed urine ascending into the collecting tubules of the nephrons allows the microorganisms to gain access to the renal parenchyma, initiating renal scarring.

Inflammation of the kidney and upper tract (may be acute or chronic).

Acute or chronic inflammatory disease resulting from infection may involve the kidneys and upper urinary tract (pyelonephritis) or the bladder and lower tract (cystitis).

### **Acute pyelonephritis**

Onset of disease based on the ground of acute bacterial and viral infections.

*Diagnostic clinical criteria*

1. Disuria - frequent and painful micturitions (urination).
  2. Painful syndrome – lumbar region pains are present in the majority of school age children.
  3. The temperature as a rule, febrile or subfebrile.
  4. Urinary syndrome consists of leucocyturia, normal or elevated diuresis, monotonous, decreased specific gravity of the urine in different portions. Urine inoculation - positive in 85% of cases.
  5. Edematic syndrome is absent.
  6. Hypertension is not typical.
  7. Syndrome of intoxication - weakness, indisposition, bad appetite, loss of weight, vomiting, toxicosis, exicosis.
- Main indices of renal function are normal. Morphologic changes of kidneys are primary lesion of interstitial renal tissue.

### Glomerulonephritis

Glomerulonephritis is an infectious allergic renal disease with primary lesions of glomerule.

*Diagnostic clinical criteria*

*Clinical:*

- I. Extrarenal symptoms:
  1. Edema.
  2. Arterial hypertension.
- II. Renal symptoms:
  - a) Oliguria and anuria are present in the initial period of acute glomerulonephritis, in this case urine has high specific gravity (1030-1040 and more),
  - b) hematuria of different degree - moderate (microhematuria – when the quantity of RBC is less then 50) and massive (macrohematuria - when the quantity of RBC is more then 50),
  - c) proteinuria:
    - moderate - up to 1000 mg/l (daily loss is up to 1 g);
    - significant - more than 1000 mg/l. up to 2500-3000 mg/l (daily loss is 2,5-3 g);
    - massive - more than 3000 mg/l (daily loss is more than 3 g),
  - d) leucocyturia - is not typical for glomerulonephritis; may be transitory leucocyturia of lymphoid character,
  - e) cylindruria - hyaline, epithelial, granular, waxy casts.

*Nephrotic syndrome:* massive proteinuria, hypoproteinemia, hyperlipidemia, hypersholesterinemia, edemas.

*Nephritic syndrome:* hypertension, hematuria, moderate proteinuria, edemas.

### Table

#### Prevention of urinary tract infection

Factors	Measures of prevention

Short female urethra close to vagina and anus	Perinea hygiene - wipe from front to back. Avoid tub baths, especially with bubble bath or water softener; use showers
	Avoid tight clothing or diapers: wear cotton panties rather than nylon. Check for vaginitis or pinworms, especially if child scratches between legs
Incomplete emptying (reflux) and overdistention of bladder	Avoid "holding" urine; encourage child to void frequently, especially before a long trip or other circumstances when toilet facilities are not available
	Empty bladder completely with each void
	Avoid straining at stool
Concentrated and alkaline urine	Encourage generous fluid intake Acidify urine with juices such as apple or cranberry and a diet high in animal protein

### Acute renal failure (ARF)

ARF is an acute impairment of renal function to exist when the kidneys suddenly are unable to regulate the volume and composition of urine appropriately in response to food and fluid intake and the needs of the organism.

*Diagnostic criteria:* There are prerenal, renal and postrenal (obstructive) ARF. The principal feature is oligoanuria associated with azotemia, acidosis, and diverse electrolyte disturbances. ARF is not common in childhood, but the outcome depends on the cause, associated findings, and prompt recognition and treatment.

The terms "azotemia" and "uremia" are often used in relation to renal failure. Azotemia is the accumulation of nitrogenous waste within the blood. Uremia is a more advanced condition in which retention of nitrogenous products produces toxic symptoms. Azotemia is not life threatening, whereas uremia is a serious condition that often involves other body systems.

#### *Important causes of ARF:*

#### I. Prerenal:(decreased perfusion).

1. Acute gastroenteritis (vomiting, diarrhea, nasogastric tubes).
2. Acute anemia (hemolytic crises, including sickle cell crisis).
3. Shock.
4. Congestive heart failure

#### II. Renal:

##### 1. Acute tubular necrosis:

- fluid loss, hemorrhage, shock,
- intravascular hemolysis,
- sepsis,
- nephrotoxic drugs, chemical, radiocontrast substances,
- major surgical procedures, road accidents, extensive burns,
- hepatic failure, congestive cardiac failure.

##### 2. Glomerular disease:

- acute glomerulonephritis,
- hemolytic uremic syndrome.

##### 3. Interstitial nephritis.

4. Acute bacterial pyelonephritis.

5. Miscellaneous:

- snakebite,
- renal vein thrombosis.

III. Post-renal (obstructive): Calculus, blood clots, crystals of uric acid, sulphonamides.

**Table**

**Laboratory findings associated with acute renal failure**

<b>Clinical problem</b>	<b>Mechanism</b>	<b>Clinical considerations</b>
Azotemia Elevated BUN levels	Ongoing protein catabolism. Significantly decreased excretion	Lower rate of production in neonates and persons with depleted protein stores. Increased in situations involving large amounts of necrotic tissue or extravasated blood.
Elevated plasma creatinine levels	Continued production. Significantly decreased excretion	Production less affected by other factors. More sensitive measure of intensity of azotemia. Low in neonate because of small muscle mass relative to size
Metabolic acidosis	Continued endogenous acid production. Significantly decreased excretion. Depletion of extracellular and intracellular fluid buffers.	Compensatory hyperventilation. Opisthotonos. Major threat to life.
Hyponatremia	Dilution of extracellular fluid. Decreased excretion of water.	May develop cerebral signs.
Hyperkalemia	Ongoing protein catabolism. Decreased excretion compounded by metabolic acidosis.	Most important electrolyte to be considered in acute renal failure. May contribute to cardiac arrhythmia. With ECG changes, major threat to life. Maybe lost from gastrointestinal tract.
Hypocalcemia	Associated with metabolic acidosis and hyperphosphatemia.	During alkali therapy, may cause tetany.

**Chronic renal failure (CRF)**



The kidneys are able to maintain the chemical composition of fluids within normal limits until more than 50% of functional renal capacity is destroyed by disease or injury. Chronic renal insufficiency or failure begins when the diseased kidneys can no longer maintain normal chemical structure of body fluids under normal conditions. Progressive deterioration over months or years produces a variety of clinical and biochemical disturbances that eventually culminate in the clinical syndrome known as uremia. The pattern of renal dysfunction is remarkably uniform no matter what disease process initiates the advanced disease. Renal vascular disorders such as hemolytic-uremic syndrome, vascular thrombosis, or cortical necrosis are less frequent causes.

### **Diagnostic criteria**

#### *I. Clinical:*

- tiredness, fatigue, headache, loss of appetite, vomiting,
- polyuria, nocturia, polydipsia, bone and joint pains, retardation of growth, dryness and itching of skin,
- muscular convulsions, paresthesias, signs of sensor or motor neuropathy,
- heart failure and hemodynamic disorders.

#### *II. Laboratory:*

- decrease of glomerular filtration rate,
- metabolic acidosis,
- anemia,
- decrease of thrombocytes' adhesion,
- hyperkalemia, hyperphosphatemia, hypocalcemia, hypoproteinemia, hyperuricemia,
- isostenuria,
- renal osteodystrophy,
- X-ray examination of the chest may reveal cardiomegaly, hypertrophy of the left ventricle, aortectasia, lung's edema, pleural exudates.

### **Cause of chronic renal failure**

#### 1. Glomerular diseases.

##### a) Glomerulonephritis:

- of unknown etiology,
- associated with systemic lupus erythematosus (SLE), polyarteritis nodosa,
- Henoch-Schonlein vasculitis.

##### b) Familial nephropathy:

- nephronophthisis,
- Alport's syndrome,

##### c) Hemolytic uremic syndrome,

##### d) Amyloidosis.

#### 2. Congenital anomalies:

##### a) bilateral renal dysplasia,

##### b) congenital nephrotic syndrome,

##### c) polycystic kidney.

### **Clinical manifestations**

The first evidence of difficulty is usually loss of normal energy and increased fatigue on exertion. For example, the child may prefer quiet, passive activities rather than participation in

more active games and outdoor play. The child is usually somewhat pale, but it is often so inconspicuous that the change may not be evident to parents or others. Sometimes the blood pressure is elevated. As the disease progresses, other manifestations may appear. The child eats less well (especially breakfast), shows less interest in normal activities, such as schoolwork or play, and has an increased urinary output and a compensatory intake of fluid. For example, a previously dry child may wet the bed at night. Pallor becomes more evident as the skin develops a characteristic sallow, muddy appearance as the result of anemia and deposition of urochrome pigment in the skin. The child may complain of headache, muscle cramps, and nausea. Other signs and symptoms include weight loss, facial puffiness, malaise, bone or joint pain, growth retardation, dryness or itching of the skin, bruised skin, and sometimes sensory or motor loss. Amenorrhea is common in adolescent girls.

The therapy is generally instigated before the appearance of the uremic syndrome, although there are occasions in which the symptoms may be observed. Manifestations of untreated uremia reflect the progressive nature of the homeostatic disturbances and general toxicity. Gastrointestinal symptoms include anorexia and nausea and vomiting. Bleeding tendencies are apparent in bruises, bloody diarrheal stools, stomatitis, and bleeding from lips and mouth. There is intractable itching, probably related to hyperparathyroidism, and deposits of urea crystals appear on the skin as “uremic frost”. There may be an unpleasant “uremic” odor to the breath. Respirations become deeper as a result of metabolic acidosis, and circulatory overload is manifest by hypertension, congestive heart failure, and pulmonary edema. Neurologic involvement is reflected by progressive confusion, dulling of sensorium, and, ultimately, coma. Other signs may include tremors, muscular twitching, and seizures.

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## **Topic 13. Features of the endocrine system**

### **Practical lessons 31-32**

#### **Anatomy-physiological peculiarities, methodic of investigation. semiotics of hypo-and hyper function syndromes of epiphysis, hypophysis, thyroid and parathyroid glands**

The knowledge of morphofunctional peculiarities of the endocrine system in children, symptoms and syndromes of hyper-and hypofunctions of some endocrine organs is necessary for understanding endocrine pathology.

#### **Concrete aims:**

- to fulfil subjective and objective examination of organs of the endocrine system with taking into consideration peculiarities of methods in children; to prescribe complex diagnostic methods for a patient with pathology of the endocrine system in order to reveal pathological changes;

- to interpret received data taking into consideration their morphofunctional peculiarities;
- to make an integrated syndromic diagnosis.

#### **Objectives student independent studies.**

1. To see out objective inspection of organs of endocrine system with methods peculiarities in children.

2. To appoint necessary complex for diagnostic arrangements for specification of pathogenetic changes.

3. To interpret the expressed changes in child inspection results on knowledge base of anatomy-physiological peculiarities.

4. To form a complex syndromal diagnosis.

5. To compose a baby-minding plan sick with pathology of endocrine system.

6. To Learn the anatomy-physiological peculiarities of basic organs of endocrine system in children:

- a) peculiarities embryogenetic;
- b) structural peculiarities into different century periods;
- c) functional peculiarities into different century periods.

7. To Learn an organs research methods of endocrine system:

a) general child examination is exposure of rough peculiarities of physical development, body frame, evident deformations to skeleton, to conduct peculiarity, to facial expression, voice, motions, body regulation;

b) growth estimation, thickness hypodermic-fatty to layer, development musculus, body proportion;

c) examination of external sexual organs, exposure of secondary sexual signs, formula of sexual development;

d) palpation and determination of augmentation degree of thyroid, consistence, determination of optic symptoms and symptoms of cramps readiness.

8. To Learn additional inspection methods:

- a) laboratory;
- b) instrumental;
- c) peculiarities of their interpretation in child endocrinology.

9. Complex choice Peculiarities of additional inspection methods attached to stinging of glands of incretion:

- a) taking account of gland function;

b) influence on other glands.

10. To Learn the symptoms and syndromes attached to pathologies of endocrine glands:

a) gland hyperfunction;

b) hypofunction glands.

11. To Learn the departure peculiarities for children with pathology of endocrine system, children preparations to taking of additional inspections, assignment order of pressing prehospital help attached to diseases of endocrine system.

### **Materials which might be helpful.**

#### Contents

The endocrine glands consist of:

- 1) the anterior hypothalamus;
- 2) the pituitary gland (hypophysis);
- 3) the epiphysis;
- 4) the thyroid gland;
- 5) the parathyroid glands;
- 6) the thymus;
- 7) the islands of Langerhans in the pancreas;
- 8) the adrenal glands;
- 9) the gonads (testes and ovaries).

Some organs, such as the kidney and placenta, secrete hormones too. The main functions of the endocrine system are:

- to take an active part in metabolism,
- influence on water-mineral metabolism,
- influence on growth and development of a child,
- regulation of differentiation of tissues,
- ensuring of adaptation of the organism to its environment.

All functions are carried out by secretion of biologically active substances, hormones.

Hormones are characterized by strong biologic activity and distant action.

Due to a close relationship between functions of the endocrine system and those of the hypothalamus, it is possible to consider these two systemic components as a common neuroendocrine system. The latter controls plastic processes of a child's organism during its development and maturation, especially physical development and puberty. The neuroendocrine system takes an active part in metabolic processes by action of various hormones.

Some glands of the endocrine system (pituitary, thyroid, adrenal and others) begin to function during the intrauterine period. The hypophysis is organized at 4 weeks of gestation; it starts to secrete ACTH at 9-10 weeks. The start of action of other endocrine glands in the postnatal period is various for different glands.

The hypothalamus and the hypophysis are regulating organs of the endocrine system and at the same time perform functions of endocrine glands too. The hypothalamus regulates activity of the hypophysis by producing neurohormones (releasing hormones). Some of them activate and others inhibit secretion of trophic hormones of the hypophysis. There is a reverse connection in the secretory function of these two glands. The hypophysis consists of three parts: the anterior and middle parts (adenohypophysis) and the posterior part (neurohypophysis).

Cells of the anterior part secrete 7 hormones:

- 1) adrenocorticotrophic hormone (ACTH);
- 2) somatotrophic hormone (STH);
- 3) thyroid-stimulating hormone (TSH);
- 4) follicle-stimulating hormone (FSH);
- 5) luteal hormone (LTH);
- 6) lactogenic hormone (LH);
- 7) gonadotropic hormones.

Cells of the middle part secrete the melanocyte-stimulating hormone.

Cells of the posterior part synthesize 2 hormones:

- 1) oxytocic hormone,
- 2) antidiuretic hormone, or vasopressine (ADH).

The weight of the hypophysis in newborns is 10-15 mg (in adults it is 50-65 mg). Adrenocorticotrophic hormone influences the adrenal cortex, stimulates synthesis and secretion of Cortisol, corticosterol and does not influence synthesis of aldosteron. Injection of ACTH causes increase of the adrenal cortex size, atrophy of the thymus, eosinopenia, hyperglycaemia.

Somatotropic hormone influences metabolism and growth through somatomedines. STH increases synthesis of proteins and decreases disintegration of amino acids, it favours the increase of protein reserve. At the same time STH causes accumulation of P, Na, K and Ca. Simultaneously fat disintegration increases, concentration of fatty acids in blood rises. All these mechanisms favour acceleration of growth.

The thyroid-stimulating hormone causes growth and functional activity of the thyroid gland, increases its secretion, iodine accumulation, synthesis and secretion of hormones.

Gonadotropic action of the hypophysis causes increase of the function of the gonads.

Concentrations of ACTH, CTH and TSH in the newborn period are high, later they decrease.

Concentrations of luteal and follicle-stimulating hormones increases during the late school period. Gonadotropin-releasing factor increases production of LTH and FSH.

So, influence of the hypophysis on metabolism and development processes is many-sided. The hypophysis function is connected with activity of the autonomic centres of the hypothalamus.

Functional disorders in the anterior part of the hypophysis and in the hypothalamus region of the brain are accompanied by growth disorders.

Hypofunction of the hypophysis (hypopituitarism) causes pituitary nanism (dwarfism); its hyperfunction (hyperpituitarism) causes pituitary gigantism and acromegaly. Pathology of the hypophysis and hypothalamus causes disturbances in lipid metabolism and puberty development. Hypofunction of the adrenehypophysis is accompanied by progressive exhaustion: hypophyseal cachexia, Sirmond's disease. Complete or partial insufficiency of the antidiuretic hormone, produced by the posterior part of the hypophysis, causes diabetes insipidus. The examination of patients with pathology of their hypophysis should include laboratory investigations of the level of hypophysis hormones and radiography of the cranial Turkish saddle, CT of the brain.

The epiphysis. Its main functions are: synthesis of melatonin (hormone), which slows down secretion of gonadotropic hormones in the anterior part of the hypophysis; the amount of melatonin decreases before child sexual maturity, which favours their action after; deceleration of sexual maturity. Semiotics of a decreased function of the epiphysis accompanies early sexual development, while its increased function slows down the sexual development. Melatonin normalizes pigment metabolism.

The thyroid gland. The thyroid rudiment in an embryo appears by the end of the 1<sup>st</sup> month of gestation. The thyroid gland becomes a structure, which is formed and functionally active by the 4<sup>th</sup> month of gestation. The thyroid function is regulated by the foetus hypophysis thyroid-stimulating hormone. The mass of the thyroid gland in newborns is 1-5 grammes. The thyroid gland enlarges vigorously at the age of 5-6 years and in the preadolescence period. The final histological structure of the thyroid gland forms after 15 years.

The main thyroid gland hormones are tyrosine and triiodothyronine (T4 and T3). These hormones increase oxygen consumption, stimulate protein synthesis and growth, as well as influence metabolism of carbohydrates, lipids and vitamins.

The thyroid gland produces one hormone more, thyreocalcitonin. The latter regulates phosphorus-surplus admission of calcium, decreasing calcium reabsorption in the kidney tubules, calcium absorption from the intestines and increasing calcium fixation in the bone tissue. The thyroid function activity is regulated by thyroid-stimulating hormone of the hypophysis, blood calcium level and gastrin secretion regulating the production of thyrocalcitonin. Disorders of the thyroid glands can have two types: hypothyroidism and hyperthyroidism. Clinical manifestations of hypothyroidism in neonates are as follows: a heavier birth weight, prolonged jaundice due to a delayed maturation of glucuronide conjugation, feeding problems, lethargy, respiratory difficulties due to a large tongue, hypothermia, cold and mottled skin, oedemata of the genitals and extremities, bradycardia, heart murmurs and cardiomegaly, anaemia and wide fontanelles. There is stunted growth of a child, normal or large head, wide fontanelles, wide spread eyes, a depressed nasal bridge, a thick tongue, a delayed dentition, dry and scaly skin, myxoedema, coarse brittle hair, retarded development and hypotonia.

Clinical manifestations of hyperthyroidism appear in the school period, the peak incidence being observed in female adolescents. Emotional lability, tremor, an increased appetite, loss of body weight, exophthalmos, eyelid lag, sweating and tachycardia are common features. Thyroid "crisis" produces an acute onset of hyperthermia, tachycardia and restlessness. In case of hypothyroidism, laboratory investigation includes newborns' screening for T4, TSH should be tested if T4 is abnormal. Roentgenograms reveal delayed bone development. ECG shows depressed P and T waves and QRS complex. ECG shows low voltage. In case of hyperthyroidism, there elevated levels of T4 and T3, roentgenograms of bones show osteoporosis and bone resorption.

The parathyroid glands take part in regulation of calcium homeostasis. The latter is regulated by parathyroid hormone, vitamin D and calcitonin. Low serum calcium stimulates PTH secretion. Disorders of the parathyroid glands are accompanied by hypoparathyroidism and hyperparathyroidism.

Clinical manifestations of hypoparathyroidism include muscle pains, cramps, numbness, tingling and convulsions. The teeth are soft and erupt late, there is dry and scaly skin, cataracts may occur. Laboratory findings include low calcium, elevated phosphorus, low vitamin D, low PTH. Roentgenograms show increased metaphyseal thickening. ECG shows a prolonged QT interval.

Clinical manifestations of hyperparathyroidism consist of weakness, constipation, polydipsia, polyuria, weight loss, fever, renal calculi, skeletal abnormalities and pancreatitis. Laboratory findings include high calcium, low phosphorus, high PTH and normal calcitonin after prolonged hypercalcaemia. Roentgenograms show resorption of subperiosteal bone.

## **Anatomy-physiological peculiarities, methodic of investigation. semiotics of hypo-and hyper function syndromes of adrenal, sexual and pancreas glands**

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### **Materials which might be helpful.**

The adrenal glands. The adrenal gland is composed of the medullary and cortical systems. During the foetal life the adrenal glands are comparatively large, with a "foetal cortex" that produces DHEA and DHEAS and then involutes after birth.

The adrenal cortex is composed of the fasciculated area (*zona fasciculata*), which secretes Cortisol and androgens under the control of ACTH, and the glomerular area (*zona glomerulosa*), which synthesizes aldosterone independently from ACTH. Aldosterone secretion is regulated by the rennin-angiotensin system; in rare cases ACTH affects aldosterone. Changes in sodium and blood volume stimulate the juxtaglomerular apparatus to alter rennin and aldosterone, which controls sodium and water reabsorption. Androgens promote the growth, secondary male sex characteristics and female axillary and pubic hair. Glucocorticoids affect tissue metabolism, increase protein and glucogen content in the liver and influence the immune and nervous systems. The adrenal medulla secretes catecholamines: dopamine, norepinephrine and epinephrine.

Disorders of the adrenal glands include pathological conditions, associated with adrenocortical insufficiency and adrenocortical hyperfunction. The etiology of adrenocortical insufficiency includes:

- corticotropin deficiency is caused by congenital hypoplasia/aplasia of the pituitary gland, craniopharyngioma;

- primary adrenal aplasia/hypoplasia;

- congenital defects of steroidogenesis-21 -hydroxylase; 3 (5-hydroxysteroid dehydrogenase);

- isolated deficiency of aldosterone; Addison's disease; adrenoleukodystrophy;

haemorrhage in the adrenal glands may be due to difficult delivery, asphyxia and Waterhouse-Friderichsen syndrome; abrupt cessation of corticotropin or corticosteroids may cause insufficiency; action of drugs (rifampin, ketonazole, phenytoin, phenobarbital, etc.). Clinical manifestations of the adrenal gland hypofunction in neonates and young children include: failure to thrive, vomiting, lethargy, anorexia, dehydration and possible shock. In older children there is a gradual onset of muscular weakness, anorexia, body weight loss, low blood pressure, increased skin pigmentation (in the genitals, navel, axillae, nipples and joints) and brown-bluish buccal mucosa. Laboratory findings: low sodium and chloride, elevated potassium and rennin levels, hypoglycaemia and ECG changes consistent with potassium level may be noted. ACTH stimulation test (measurement of Cortisol level before and after administration of ACTH) is made. If no Cortisol increase after ACTH occurs, there is likely some primary adrenal disorder. Adrenocortical hyperfunction: congenital adrenal hyperplasia (CAH) (autosomal recessive) - adrenogenital syndrome. Origin: 21-hydroxylase deficiency (95 % of cases); the majority have a salt-losing, virilized form. Female patients present with virilized genitalia, body weight loss, dehydration, vomiting and anorexia; male patients have normal genitalia but other manifestations are the same. Laboratory findings include: low sodium, high potassium, elevated 17-



hydroxyprogesterone (17-OHP) and rennin, and low aldosterone.

Cushing's syndrome. The etiology includes adrenocortical tumour, ACTH-dependent bilateral adrenal hyperplasia, pituitary adenoma or abnormal production of ACTH. Clinical manifestations include a moon face, a double chin, a buffalo hump, obesity, masculinization, hypertrichosis on the face and trunk, acne, clitoral enlargement, impaired growth and hypertension. Laboratory findings include polycythaemia, lymphopenia, eosinopenia, abnormal glucose tolerance, elevated urinary and serum Cortisol, osteoporosis, variable bone maturation, suppressed growth hormone.

The pancreas. This is a gland of the digestive system; its insular apparatus performs simultaneously 2 functions:

- exocrine, i.e. secretion of enzymes to the duodenum;

- endocrine, i.e. secretion of polypeptide hormones by some cells and their discharge to blood: glucagon ( $\alpha$ -cells) increases glucose concentration in blood and influences metabolic processes, insulin ( $\beta$ -cells) regulates carbohydrate metabolism and supports the optimum level of glucose by decreasing it (the action of insulin is contrary to that of glucagons); the main action of somatostatin ( $\delta$ -cells) consists in inhibition of the release of insulin, glucagons and gastrin and secretion of peptic acid by the stomach; pancreatic polypeptide (PP-cells) is an antagonist of cholecystokinin. Diabetes mellitus is the most frequent disease of this gland.

Sexual phenotype formation in children occurs during all stages of their development and maturation, but there are two quite short time periods, which are most important:

- the first period is that of sexual formation during the intrauterine development, it lasts about 4 months;

- the second period is that of sexual maturation during 2-3 years in girls and 4-5 years in boys.

Primary sexual cells in male and female embryos are histologically identical and able to be differentiated in 2 directions up to 7 weeks of gestation. The primary differentiation is based on the chromosome set of embryo. The sex of the embryo is determined by the presence or absence of Y chromosome. The latter contains a gene, which is responsible for testis determination factor (TDF). Testis determination factor triggers the production of protein that signals other genes to induce maleness in the embryo. In the absence of TDF, the embryo becomes a female. The testes or ovaries of the embryo are formed to the sixth or seventh week of gestation. Next stages of male differentiation are regulated by hormones produced by the testicles. There are two types of hormones, such as testosterone and dehydrotestosterone, and group hormones, which cause inhibition of the paramesoneal duct (the future female gonad). Disorders in the production of hormones can cause disorders of gonad formation.

Hormone preparation of the children's sexual maturation occurs gradually. Sex differentiation of the hypothalamus starts in the foetal period due to influence of androgenic hormones. There are two centres in the hypothalamus, which regulate the production of releasing factor for luteal hormone - tonic and cyclic. Only one centre, responsible for tonic luteal hormone, remains to act in boys. Next stage of preparation of sexual maturation consists of an increasing level of gonadotropic and sexual hormones during the first year of life and the peak in androgen production by the adrenal glands in the preschool period. Due to a high sensitivity of the hypothalamus centres to the minimum level of androgens in peripheral blood, the hypothalamus can control production of gonadotropic hormones and maturation of the child.

It is suspected that there are hypothetic "centres of childhood support", probably located in

the posterior hypothalamus and epiphysis. These centres inhibit the production of releasing-hormone in the hypothalamus for LH due to low blood concentrations of sexual steroids. It is suspected that the start of sexual maturation mechanism is connected by some way with general physical maturation of the child.

The sequence of appearance of sexual maturity signs is constant and is not connected with the term of its start.

Girls:

9-10 years - pelvis bones growth, buttock growth round, little breast nipple rise.

10-11 years - cupola-like rise of breast ("bud" stage), appearance of pubic hair.

11-12 years - enlargement of external genitals, vaginal epithelium change.

12-13 years - development of glandular tissue of breast, nipple pigmentation, appearance of menarche.

13-14 years - hair in axillary region, menarche is not regular.

14-15 years - change of pelvis and buttock shape.

15-16 years - appearance of blackhead, menarche is regular.

16-17 years - skeleton growth stopping.

Boys:

10-11 years - testis and penis growth start.

11-12 years - prostate enlargement, larynx growth.

12-13 years - extensive growth of testis and penis, nodules-like consolidation near nipple area, voice change start.

14-15 years - hair growth in axillary region, subsequent voice change, hair appearance on the face, scrotum pigmentation, first ejaculation. 15-16 years - maturity of spermatozoons.

16-17 years - male type hair-covering of pubic region, body hair growth, appearance of spermatozoons.

17-21 years - skeleton growth stopping.

Let us discuss some examples of endocrine pathology diagnosing in children.

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## **Topic 14. Blood system in children**

### **Practical lessons 33-34**

The knowledge about peculiarities of the immune and blood systems in children is necessary for estimating their condition and diagnosing pathology.

#### **Concrete aims:**

1. to study a case history and find data, which show changes of the immune and blood systems of a child;
2. to fulfil an objective examination of the immune and blood systems with taking into consideration age-specific peculiarities;
3. -to know clinical signs of immunodeficiency states and anaemia, to recognize the main syndromes;
4. -to interpret laboratory-instrumental methods of examination of the immune and blood systems in children.

#### **Objectives student independent studies.**

1. To Learn the anatomy-physiological peculiarities of basic organs of blood system in children:

- a) peculiarities embriogenetic;
- b) structural peculiarities into different age periods;
- c) functional peculiarities into different age periods.

2. To Learn an organs research methods of blood system:

a) general child examination is exposure of roagh peculiarities of physical development, body frame, evident deformations to skeleton, to conduct peculiarity, to facial expression, voice, motions, body regulation;

3. To Learn additional inspection methods:

- a) laboratory;
- b) instrumental;
- c) peculiarities of their interpretation in child endocrinology.

#### **Materials which might be helpful.**

Amount of blood. The total amount of blood of an adult is approximately 5-5.5 % of his body weight. The amount of blood in children is higher. In a newborn, the amount of blood makes 10.5-19.5 % of the body weight, in later infancy it is 9-12.5 %, in the school-age period it is approximately 7 % of the body weight.

There are many differences in morphofunctional characteristics of blood between children and adults.

#### Blood of the newborn infant.

Its red blood count is  $5.0-7.0 \cdot 10^{12}/l$  following birth, but by the 14<sup>th</sup> day, it usually drops down to  $4.0 \cdot 10^{12}/l$ . Haemoglobin level during the first two days may be as high as 170-220 g/l, falling to 165 g/l by the end of the 14<sup>th</sup> day. Anisocytosis (erythrocytes of unequal size) is typical for newborn infants. Anisocytosis *is* expressed by the presence of macrocytes (abnormally large

erythrocytes with high haemoglobin content).

The number of reticulocytes (immature or young erythrocytes) is from 50 to 100 per 1,000 mature erythrocytes during the first days; their number also drops rapidly down by 10-15 days of life and makes 5 to 10 per 1,000 mature erythrocytes.

Osmotic fragility. Blood of the newborn contains erythrocytes with elevated and reduced osmotic fragility.

Erythrocyte sedimentation rate (ESR) of the newborn is slower than in adult and is 2-3 mm/h; beginning with the age of 2 months ESR rises and reaches the level of 8-10 mm/h (the same as in adults).

The number of thrombocytes varies during the first days of life within  $100-200 \times 10^9/l$ .

The picture of their white blood in newborns is quite specific.

During the first 8-12 hours of life the number of leukocytes is as high as  $25-30 \times 10^9/l$ ; neutrophilic leukocytosis is marked, a regenerative deviation to the left is present; it means the presence of many immature neutrophils in peripheral blood. By the 10-15 day white blood count gradually drops to an average of  $10-12 \times 10^9/l$ ; immature cells, as a rule, disappear from the peripheral blood almost completely; primary neutrophilosis is replaced by lymphocytosis.

A gradual increase in the number of lymphocytes begins in the first days of life, attaining 50-60 % by the fifth day; this level is sustained throughout infancy; at the same time the number of neutrophils is gradually reduced to 30 %.

There are two intersections in numbers of neutrophils and lymphocytes: between the 4<sup>th</sup> and 6<sup>th</sup> days and between the 4<sup>th</sup> and 5<sup>th</sup> year.

The coagulation (clotting) and bleeding times in the newborn are the same as normal for adults: coagulation time is 5-5.5 minutes; bleeding time is 1-3 minutes. Clot retraction is normal.

According to the opinion of some authors, high haemoglobin and red and white cell levels in the newborn are caused by the maternal hormones; the hormones circulating in the body of the pregnant woman and stimulating her haematopoietic system penetrate into the body of the foetus and thus stimulate its haematopoietic organs. The delivery of these hormones into the infant's blood ceases after birth, and therefore a rapid drop of haemoglobin, erythrocytes and leukocytes occurs.

Blood in infancy has some characteristic features. Red blood count rates  $4-5 \times 10^{12}/l$ , haemoglobin level is 95-140 g/l, and it easily drops to 70.0-80.0 g/l, so that the colour index stays below norm. Anisocytosis is rather marked. Reticulocytes do not number more than 5-6 per 1,000 normal erythrocytes.

The maximum and minimum osmotic fragility of erythrocytes is slightly elevated in comparison with the newborn period.

Thrombocyte count varies between  $200-300 \times 10^9/L$

Coagulation, bleeding time, and clot retraction almost do not differ from what is normal in adults.

White count is usually  $10-12 \times 10^9/l$  in infants, lymphocytosis is marked (the level of lymphocytes is 50 %), neutrophil count during this period varies within the range of 35-40 %. It is possible to note the development of physiological anaemia at the age of 3-4 months as a result of iron deficit, because breast and cow's milk is low in iron.

Blood of children from 2 to 6 years. Between the ages of 2 and 6 years the level of haemoglobin is 105-140 g/l (averaging 120 g/l), red blood count is  $4.5 \times 10^{12}/l$ , with 2-3 % of reticulocytes, the colour index is lower than norm and is 0.85-0.95. Anisocytosis is marked.

White count gradually diminishes, becoming  $8-8.5 \times 10^9/l$  by the age of 6 years.

The number of lymphocytes gradually decreases, going down to 40-35 % by the age of 5-7 years. The number of neutrophils grows (the second intersection).

Blood of children between 6 and 14 years. The composition of blood at this period is approximately the same as in the preceding period. Anisocytosis gradually disappears. Leukocyte count continues to fall, and by 14 years is  $7-7.5 \times 10^9/L$

Differential white count is characterized by a further rise in the number of neutrophils and a drop of lymphocytes. By 14 years the count indicates 60-65 % of neutrophils and 25-30 % of lymphocytes.

Blood of adolescents. Red blood count is  $4.5-5 \times 10^9/L$  Haemoglobin is at a high level, averaging 140 g/l. White count is  $6-7.5 \times 10^9/l$ .

#### Methods of the clinical and paraclinical investigation

Clinical examination of the haematological system of children includes questioning, general examination, physical examination of the skin, lymph nodes, liver, spleen and bones.

The most typical complaints are: bleeding, haemorrhage, enlargement of lymphatic nodes, paleness of the skin and mucous membranes, ossalgia.

Complaints of the common character are: hyperthermia, headache, dizziness, weakness, exhaustion, memory disorders, poor appetite, exertional dyspnoea.

Case history taking:

- to establish the first day of appearance of symptoms, under which circumstances they appeared, especially bleeding and haemorrhage (spontaneously, under influence of some strong or superficial damaging);

- to ask about the dynamics of symptoms (when fresh elements appeared, simultaneously or subsequently);

-to ask about treatment, including the dose and duration of using the medicines, their effectiveness;

- to get acquainted with results of laboratory and other methods of examination before the patient's admission to the hospital

Life history is very important in cases of inheritable diseases (haemophilia) and possible tendency to pathology of the haemopoietic system and blood. The obstetric anamnesis is very important for infants.

The following signs must be assessed during examination:

- position of a patient (active, passive, forced);

- bleeding (its location, intensity, duration);

- colour of the skin: a) pallor, b) jaundice;

-rash (macula, petechia, purpura, bruise), papule, exanthema, haemorrhage, haematoma, haemarthrosis;

- enlargement of lymph nodes;

- distended abdomen;

- oedema;

- enlargement of the liver and spleen.

Paraclinical investigation includes: blood count; coagulogram; puncture of the liver, spleen and bone marrow; study of myelogram; puncture of a lymph node; radiography, CT. The main methods of examination of the system of haemostasis are as follows: capillary resistance tests, thrombocyte count, tests of thrombocytic adhesion (aggregate functions), time of capillary

bleeding according to Duke, retraction of blood clots.

Myelogram gives information about the quality and quantity of bone marrow cells. In order to get some bone marrow, the breastbone is to be punctured. It is necessary to count not less than 500 cells and calculate percentage for every type of cells.

The main peculiarity in the bone marrow of children of the first 3 years of life consists in a large quantity of lymphocytes: infancy -10-18 %, at 3 years -7-14 %, after 3 years - 2-8%. There are no significant differences in other parameters of the bone marrow of healthy children and adults.

The main clinical symptoms of the blood system diseases are: pallor, jaundice, fatigue, irritability, seizures, enlargement of the liver, spleen, lymph nodes, petechia, ecchymosis, gastrointestinal haemorrhage, mucosal bleeding, bacteriaemia, cellulitis, pharyngitis, oral ulceration.

Combination of these symptoms may be various and depends on the nosological form of haemopathy.

#### Symptomatology of blood changes.

##### I. Quantitative changes in red blood.

###### 1. The increase in the number of erythrocytes (polyglobulia):

- a) true polyglobulia is associated with intensification of bone marrow activity (in newborns, congenital heart disease, in polycythaemia, etc.);
- b) false transient polyglobulia results from condensation of blood due to fluid losses (acute dyspepsia, dysentery, excessive perspiration).

2. Reduced red blood counts and lower haemoglobin levels, i.e. conditions corresponding to the clinical concept of anaemia:

- a) reduction of bone marrow function (starvation, infection, intoxication, tumours), congenital inferiority of the haematopoietic system (prematurity, tumours in the bone marrow);
- b) the number of erythrocytes may be reduced due to increased expenditure (chronic bleeding, erythrocytes disintegration during chronic infections, worms, malaria), haemolysis of erythrocytes (familial haemolytic jaundice).

##### II. Qualitative changes in red blood.

Changes in the quality of blood elements are connected with changes in the process of blood formation. These are characterized by the appearance of embryonal precursors:

- a) megaloblasts, megalocytes: these indicate return to the embryonal type of blood formation;
- b) erythroblasts, normoblasts: these demonstrate intensified bone marrow activity;
- c) increased reticulocytes counts: these display intensified bone marrow function;
- d) the appearance of macrocytes: this is a sign of healthy blood regeneration;
- e) hyperchromia indicates regeneration; this is a sign of functional deficiency of bone marrow;
- f) anisocytosis is inequality in the size of erythrocytes; this is a sign of normal regeneration; poikilocytosis means different shape of erythrocytes and signals about degeneration of erythrocytes.

#### White blood:

##### I. Quantitative changes in white blood.

Leukocytosis is an increase in the quantity of leukocytes more than  $10 \times 10^9/l$  (over  $20 \times 10^9/l$  is hyperleukocytosis). An increase in the number of white blood cells, leukocytosis, results from heightened activity of the bone marrow under the influence of some pathological and also

physiological stimuli.

The following forms of leukocytosis are distinguished:

1. Physiological leukocytosis:

- a) in the newborn (20,000-25,000),
- b) in infancy (10,000-12,000).

2. Pathological leukocytosis, associated with local and generalized infection processes and intoxications:

- a) pseudoleukocytosis results from condensation of blood, digestive leukocytosis is possible;
- b) neutrophilic leukocytosis is associated with infections: sepsis diseases, pneumonia, scarlet fever, dysentery, rheumatic fever, meningitis.

Leukaemia is characterized by a particularly high leukocytosis (100,000 and higher) and the appearance of numerous immature forms. There are many different forms of leukaemia, but myeloid (granulocytic) and lymphatic leukaemia are more often.

Besides determination of the total number of leukocytes, estimation of the nuclear shift of neutrophils is highly important. A deviation to the left (an increased number of young forms of leukocytes) is a sign of accelerated production of white blood cells. Presence of a deviation to the left and neutrophilosis is a favourable prognostic symptom. Prognosis is less favourable when a deviation to the left is **not** combined with an increase in the total white count.

Lymphocytosis is an absolute and relative increase of the number of lymphocytes in peripheral blood. It is a stable physiological condition throughout infancy and early childhood.

The number of lymphocytes increases in certain acute and chronic infections (pertussis, rubeolla, typhoid fever), during convalescence, certain forms of glandular fever, tonsillitis. Especially high lymphocyte counts are observed in lymphatic leukaemia and in cases of so-called lymphatic reactions in children, more often in whooping cough.

Monocytosis is a transient increase in the number of monocytes, it is typical for certain acute infections (malaria, measles, tuberculosis and infectious mononucleosis).

Eosinophilia is observed in numerous pathological conditions. Normally blood contains 2-4 % of eosinophils, in some pathological conditions the amount goes up to 20-30 %, or even higher. Eosinophilia occurs in bronchial asthma, serum sickness, anaphylactic status, scarlet fever, leukaemia, certain cases of lymphogranulomatosis, and in all types of worm diseases.

Basophilia. Normally basophil count does not exceed 0.5-1 %. A rise is observed in association with acute and chronic leukaemia, lymphogranulomatosis.

Leukopenia is diminution in the number of leukocytes, it is a characteristic sign of certain infections (typhoid fever, measles, rubella). In sepsis, pneumonia leukopenia is an indication of depression of the haematopoietic organs and an unfavourable prognostic sign.

Reduction of white blood count may result from the bone marrow hypofunction due to infections, chemical poisons (arsenic, benzene), ionizing radiation or lesion of the myeloid tissue (agranulocytosis).

Neutropenia is a sign of a severe form of infection or sepsis. Absolute neutropenia is characteristic of agranulocytosis.

Lymphopenia develops in certain infectious diseases in association with neutrophilic leukocytosis. Absolute lymphopenia is observed in lymphogranulomatosis, lymphosarcomatosis, and certain forms of myelosis.

Monocytopenia is seen in severe septic and infectious processes.

Eosinopenia is typical for typhoid fever, measles, pneumonia, septicaemia, aggravation of tuberculosis and rheumatic fever.

## II. Qualitative changes in white blood.

High leukocytosis is rather often accompanied by a marked deviation to the left and appearance of primary and immature elements of white blood in the circulating flow such as myeloblasts (the youngest of the precursor cells of granulocytic series) or next intermediate forms of granulocytes (promyelocytes, myelocytes and juvenile neutrophils). It is typical for a number of infections.

The deviation degree demonstrates activity with appearance of myelocytes; juvenile neutrophils are more typical for pyoseptic and infectious diseases, haemolysis, chronic leukosis, allergic reactions, bleeding.

An increased quantity of juvenile and band forms is a sign, which demonstrates an increase in haemopoiesis.

Hiatus leukemicus is such a type of content of all neutrophils when an increase in the quantity of immature forms (myelocytes, juvenile forms) and a small number of mature forms (segmental neutrophils) are present, but transitional forms (juvenile, band neutrophils) are absent. Hiatus leukemicus is a sign of acute leukosis.

A deviation of the differential count to the right means an increased amount of mature leukocytes (segmental neutrophils), practically without any immature (band) neutrophils. It can be very rare and displays a disorder in the bone marrow haemopoiesis.

Neutropenia is such a condition of the differential blood count when the quantity of neutrophils decreases more than by  $\frac{1}{3}$  versus the age norm. Pathogenesis of neutropenia (which may be leukopenia) can be caused by:

disorder in the haemopoietic function of the bone marrow and incomplete going out of mature neutrophils into peripheral blood;

acceleration of the destruction of formed elements;

increase in the removal of neutrophils from haemocirculation

Neutropenia is a rather rare condition and appears in:

- some infectious diseases (malaria, measles, typhoid fever, influenza, severe forms of bacterial infections with an increased duration);
- tuberculosis;
  - prolonged treatment by cytostatic medicines, sulfonamides, antibiotics;
- some type of anaemia (B<sub>12</sub>-folic-deficit, hypoplastic anaemia);
- increased irradiation;
- aplasia of the bone marrow.

Lymphocytosis is an increase in the quantity of lymphocytes which can cause leukocytosis. Its pathogenesis is based on an increased formation of a large number of lymphocytes from the lymphopoietic organs and their arrival in the circulating blood. The main causes are as follows:

- acute infectious diseases (whooping cough, viral hepatitis);
- chronic infectious diseases (tuberculosis, syphilis, brucellosis);
- chronic lympholeukosis.



Lymphopenia is a decrease in the quantity of lymphocytes, caused by some hypofunction of the lymphopoietic organs; lymphopenia can produce leukopenia. Lymphopenia can occur in:

- congenital immunodeficiency;
- acquired immunodeficiency syndrome;
- lymphogranulomatosis.

True leukaemia is differentiated from leukaemoid reaction on the basis of bone marrow studies.

Toxic granulation of leukocytes is a sign of infection.

Thrombocytes. The number of blood platelets is normally 200,000-300,000.

Thrombocytosis is typical for many infection diseases (pneumonia, rheumatic fever).

Thrombopenia is found in severe forms of anaemia, leukaemia, idiopathic thrombocytopenic purpura.

Erythrocyte sedimentation rate (ESR). The **normal erythrocyte** sedimentation rate is: in newborns - 0-2 mm/h, in **infants** -2-4 mm/h, later - 4-10 mm/h.

An increase of ESR is a sign of different **pathology: an** inflammatory process of any system (the higher ESR, the more acute pathological condition), infectious diseases, allergic reactions, malignant pathology.

Decreased ESR is rare; it may be found out in dehydration, anaphylactic shock, dystrophy, peptic ulcer, heart failure, acute viral hepatitis.

**Laboratory and instrumental methods of examination in children with blood diseases.**

**Their assessment and semiotics deviations.**

The knowledge of peculiarities of the blood system in children of different age groups, methods of clinical-laboratory examination of children with their blood system affection and semiotics of the main haematological syndromes (anaemic, haemolytic, haemorrhage and others) is necessary for diagnosing diseases of the blood system in children.

### **Contents**

Peculiarities of the blood system in children of different ages. Methods of clinical and laboratory examination of children with affection of the blood system. Clinical-haematological semiotics of the main syndromes (anaemic, haemolytic, haemorrhage and others) and diseases of the blood system in children.

### **The aim:**

1. to teach to examine the patients,
2. to take care about them,
3. know how to use medical technical apparatus and instruments,
4. to analyze this information ;
5. to organize daily regime and correct feeding;
6. to know basic deontology principals during communication with children and their parents.

### **Technique of realization of practical Work:**

1. To examine the patient with blood system disorders
2. To collect the anamnesis in child with the blood system disorder..
3. To prescribe laboratory examination for the child.
4. Examine a patient with blood pathology, to establish the main symptoms and syndromal diagnosis of the urinary pathology .
5. Make a syndromal diagnosis .

6. Administer the medical care for children of the pathology of blood .

**Objectives student independent studies.**

1. To see out objectiv inspection of organs of blood system with methods peculiarities in children.
2. To appoint necessary complex for diagnostic arrangements for specification of pathogenetic changes.
3. To interpret the expressed changes in child inspection results on knowledge base of anatomy-physiological peculiarities.
4. To form a complex syndromal diagnosis.
5. To compose a baby-minding plan sick with pathology of blood system.
6. To Learn the anatomy-physiological peculiarities of basic organs of blood system in children:
  - a) peculiarities embriogenetic;
  - b) structural peculiarities into different age periods;
  - c) functional peculiarities into different age periods.
7. To Learn an organs research methods of blood system:
  - a) general child examination is exposure of roagh peculiarities of physical development, body frame, evident deformations to skeleton, to conduct peculiarity, to facial expression, voice, motions, body regulation;
8. To Learn additional inspection methods:
  - a) laboratory;
  - b) instrumental;
  - c) peculiarities of their interpretation in child endocrinology.

**Materials which might be helpful.**

**Type and Crossmatch**

Blood typing determines the ABO and Rh blood groups of a blood sample. A crossmatch tests for agglutination reactions between donor and recipient blood.

**Complete Blood Count**

The complete blood count consists of the following: red blood cell count, hemoglobin measurement (grams of hemoglobin per 100 ml of blood), hematocrit measurement (percent volume of erythrocytes), and white blood cell count.

***White Blood Cell Differential Count***

The white blood cell differential count determines of. percentage of each type of leukocyte.

**Prepare child for laboratory tests** .Explain to older children need forrepeated venipunctures or fingersticks for blood analysis,particularly why a sequence of tests is required Allow children to play with laboratory equipment and/or participate with test Older children may enjoy looking at blood smears under a microscope or at pictures of blood cells

Observe for signs of shock and hypoxia from repeated blood samples Explain to parents reason for replacing withdrawn blood and necessity of performing tests.

**Decrease tissue oxygen needs**

**Minimize physical exertion.** Assess child's level of hysical tolerance

Anticipate and assist child in those activities of daily living that may be beyond his

tolerance Provide diversional play activities that promote rest and quiet but prevent boredom and withdrawal Choose an appropriate roommate of similar age and interests and one who requires restricted activity

**Minimize emotional stress** Anticipate child's irritability, short attention span, and fretfulness by offering to assist him in activities rather than waiting for him to ask. Assess parents' awareness of child's need for dependency to conserve strength Explain to older children and parents reason for behavioral changes caused by anemia. Encourage parents to remain with child

**Prevent and observe for infection** Place child in room with noninfectious children; restrict visitors with active illnesses Advise visitors (and hospital personnel) to practice good hand washing Report any temperature elevation to physician . Observe for leukocytosis Maintain adequate nutrition.

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Combination of these symptoms may be various and depends on the nosological form of haemopathy.

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Lymphocytosis is an absolute and relative increase of the number of lymphocytes in peripheral blood. It is a stable physiological condition throughout infancy and early childhood.

The number of lymphocytes increases in certain acute and chronic infections (pertussis, rubella, typhoid fever), during convalescence, certain forms of glandular fever, tonsillitis. Especially high lymphocyte counts are observed in lymphatic leukaemia and in cases of so-called lymphatic reactions in children, more often in whooping cough.

Monocytosis is a transient increase in the number of monocytes, it is typical for certain acute infections (malaria, measles, tuberculosis and infectious mononucleosis).

Eosinophilia is observed in numerous pathological conditions. Normally blood contains 2-4 % of eosinophils, in some pathological conditions the amount goes up to 20-30 %, or even higher. Eosinophilia occurs in bronchial asthma, serum sickness, anaphylactic status, scarlet fever, leukaemia, certain cases of lymphogranulomatosis, and in all types of worm diseases.

Basophilia. Normally basophil count does not exceed 0.5-1 %. A rise is observed in association with acute and chronic leukaemia, lymphogranulomatosis.

Leukopenia is diminution in the number of leukocytes, it is a characteristic sign of certain infections (typhoid fever, measles, rubella). In sepsis, pneumonia leukopenia is an indication of depression of the haematopoietic organs and an unfavourable prognostic sign.

Reduction of white blood count may result from the bone marrow hypofunction due to infections, chemical poisons (arsenic, benzene), ionizing radiation or lesion of the myeloid tissue (agranulocytosis).

Neutropenia is a sign of a severe form of infection or sepsis. Absolute neutropenia is characteristic of agranulocytosis.

Lymphopenia develops in certain infectious diseases in association with neutrophilic leukocytosis. Absolute lymphopenia is observed in lymphogranulomatosis, lymphosarcomatosis,



of the lymphopoietic organs; lymphopenia can produce leukopenia. Lymphopenia can occur in:

- congenital immunodeficiency;
- acquired immunodeficiency syndrome;
- lymphogranulomatosis.

True leukaemia is differentiated from leukaemoid reaction on the basis of bone marrow studies.

Toxic granulation of leukocytes is a sign of infection.

Thrombocytes. The number of blood platelets is normally 200,000-300,000.

Thrombocytosis is typical for many infection diseases (pneumonia, rheumatic fever).

Thrombopenia is found in severe forms of anaemia, leukaemia, idiopathic thrombocytopenic purpura.

Erythrocyte sedimentation rate (ESR). The **normal erythrocyte** sedimentation rate is: in newborns - 0-2 mm/h, in **infants -2-4** mm/h, later - 4-10 mm/h.

An increase of ESR is a sign of different **pathology: an** inflammatory process of any system (the higher ESR, the more acute pathological condition), infectious diseases, allergic reactions, malignant pathology.

Decreased ESR is rare; it may be found out in dehydration, anaphylactic shock, dystrophy, peptic ulcer, heart failure, acute viral hepatitis.

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## Topic 15. Immune system in children. Curation Practical lessons 35-36

The knowledge about the immune system and peculiarities of its function in children. The notion about immunodeficiency, classification and semiotics of immunodeficiency conditions is necessary for diagnosis of immunologic pathology in children. The opinion about

immunodeficiency of a child must be confirmed by results of laboratory-instrumental methods of examination.

### **Contents**

The immune system defends the individual from infections such as bacteria, viruses, fungi, protozoa and their virulence factors. The immune system also impedes the development of malignant diseases. The cost of this protection is allergy, autoimmune diseases and rejection of organ transplantations.

#### **The aim:**

7. to teach to examine the patients,
8. to take care about them,
9. know how to use medical technical apparatus and instruments,
10. to analyze this information ;
11. to organize daily regime and correct feeding;
12. to know basic deontology principals during communication with children and their parents.

#### **Technique of realization of practical Work:**

7. To examine the patient with immune system disorders
8. To collect the anamnesis in child with the immune system disorder..
9. To prescribe laboratory examination for the child.
10. Examine a patient with immune pathology, to establish the main symptoms and syndromal diagnosis of immune pathology .
11. Make a syndromal diagnosis .
12. Administer the medical care for children of the pathology of immune .

#### **Objectives student independent studies.**

1. To see out objectiv inspection of organs of immune system with methods peculiarities in children.

2. To appoint necessary complex for diagnostic arrangements for specification of pathogenetic changes.

3. To interpret the expressed changes in child inspection results on knowledge base of anatomy-physiological peculiarities.

4. To form a complex syndromal diagnosis.

5. To compose a baby-minding plan sick with pathology of immune system.

6. To Learn the anatomy-physiological peculiarities of basic organs of immune system in children:

a) peculiarities embriogenetic;

b) structural peculiarities into different age periods;

c) functional peculiarities into different age periods.

7. To Learn an organs research methods of immune system:

a) general child examination is exposure of roagh peculiarities of physical development, body frame, evident deformations to skeleton, to conduct peculiarity, to facial expression, voice, motions, body regulation;

8. To Learn additional inspection methods:

a) laboratory;

b) instrumental;

c) peculiarities of their interpretation in child endocrinology.

**Materials which might be helpful.**

## 1. Primary immunodeficient conditions Classification of primary immunodeficient conditions

### *1. Prevalence of antibodies deficiency:*

- a) sex-linked agammaglobulinemia;
- b) sex-linked agammaglobulinemia and growth hormone's deficiency;
- c) autosomal recessive agammaglobulinemia;
- d) selective immunoglobulin's deficiency:
  - with elevated level of IgM and IgD;
  - IgA deficiency.
- e) selective deficiency of other isotypes of Ig;
- f) kappa-chains deficiency;
- g) immunodeficiency on the background of thymoma;
- h) transitory hypogammaglobulinemia in children.

### *2. Combined immunodeficiency:*

- a) total variable immune deficiency:
  - with primary antibody deficiency;
  - with primary deficiency of cellular immunity.
- b) severe combined immunologic deficiency:
  - reticular dysgenesis;

#### *deficiency of T- and B-lymphocytes (earlier the Swiss type of /DC).*

- c) T-lymphocyte deficiency (earlier Nezelof syndrome);
- d) adenosindeaminase deficiency;
- e) purine-nucleotide-phosphorylase deficiency;
- f) absence of HLA-antigens of the  $^181$  class (syndrome of "naked" lymphocytes);
- g) absence of HLA-antigens of the 2<sup>nd</sup> class.

### *3. Immunodeficiency in combination with other congenital defects:*

- a) Wiscott-Aldrich syndrome;
- b) ataxia-telangiectasia (Louis-Bar syndrome);
- c) syndrome of 3<sup>^</sup>-4<sup>^</sup> pockets of branchial arch (Di George syndrome);
- d) transcobalamin-2 deficiency;
- e) immunodeficiency due to congenital anomalous reaction at Epstein-Barr virus.

## Diagnostic criteria

### *Clinical:*

#### A. Suggestive T-cell deficit:

- a) systemic illness following vaccination with any alive virus or BCG;
- b) unusual life-threatening complication following infection caused by ordinary benign viruses (e.g., giant rubella pneumonia; varicella pneumonia);
- c) chronic oral candidiasis after 6 months of life;
- d) chronic mucocutaneous candidiasis;
- e) fine, thin hair, short-limbed dwarfism with characteristic radiographic features of cartilage-hair hypoplasia (CHH);



f) intrauterine graft-versus-host disease - the most characteristic feature is scaly erythroderma and total alopecia {absence of eyebrows is quite striking);

g) graft-versus-host disease after blood transfusion;

h) hypocalcemia in newborn (Di George anomaly, especially with characteristic faces, ears and cardiac lesions);

i) small (less than 10 mm in diameter) lymphocytes count persistently less than  $1500/\text{mm}^3$ , must rule out gastrointestinal loss of them or loss from the lymphatic vessels.

#### B. Suggestive B-cell defect

a) recurrent proved bacterial pneumonia, sepsis or meningitis;

b) nodular lymphoid hyperplasia.

#### C. Suggestive B- and T-cell deficiency (combined immunodeficient disease - CID)

a) all the above mentioned features except chronic mucocutaneous candidiasis and nodular lymphoid hyperplasia;

b) features of Wiskott-Aldrich syndrome (draining ears, thrombocytopenia and eczema);

c) features of ataxia-telangiectasia. D. Suggestive immunodeficiency without clearly implicating T- or B-cell defect

a) Pneumocystis carinii pneumonia;

b) intractable eczema;

c) ulcerative colitis in infants less than 1 year old;

d) intractable diarrhea;

e) unexplained hematological deficiency (RBC, WBC, platelet);

f) severe generalized seborrheal dermatitis (Leiner's disease) suggests C5 deficiency; seborrhea is common in combined immunodeficient disease;

g) recurrent pyogenic infections seen in C3 deficiency. E. Suggestive biochemical defect

a) features of combined immunodeficiency with characteristic bony lesions (adenosine deaminase deficiency);

b) features of Blackfan-Diamond aplastic anemia (nucleoside phosphorylase deficiency).

#### F. Suggestive abnormality of polymorphonuclear leukocytes

a) primary skin infections (if associated with asthma, eczema and coarse faces, think of Buckley syndrome);

b) chronic osteomyelitis caused by Klebsiella or Serratia species, draining lymph nodes (chronic granulomatous disease).

#### G. Suggestive secondary deficiency

a) concomitant or preceding viral infection;

b) lymphoid malignancy (chronic lymphatic leukemia, Hodgkin's disease, myeloma).

//. Laboratory:

a) genealogical anamnesis;

b) common blood analysis (not only total but absolute quantity of different leukocytes);

c) investigation of numeral link of immunity:

- gammaglobulin concentration;

- immune serum globulins by Mancini;

- immunoelectrophoresis of serum proteins;

- titers of different antibodies, blood group, titer of

isoagglutinins;

- secretory immunoglobulins;
- surface immunoglobulins of antiserum lymphocytes, marked with fluorescein;
- EAC-rosellas.
- d) investigation of cellular link of immunity:
  - E-rosellas;
  - reaction of blast transformation (in unspecific stimulation with FHA, in stimulation with antigens, in mixed lymphocytes culture);
  - depression of macrophages migration;
  - reaction of hypersensitivity of a delayed type (intracutaneous tests with 2,4-dinitrochlorobenzol, streptokinase, odorinase, antigen; Shieck's reaction).
- e) special investigations:
  - functions of T-helpers and T-suppressors;
  - histochemical determination of adenosine-deaminase's activity;
  - transcobalamin's content.
- f) X-ray of the chest including side positions and tomogram of mediastinum for revealing the thymus;
- g) biopsy of the lymph nodes with the use of histological and histochemical methods;
- h) investigation of complement's system (total complement, its factors);
  - i) investigation of phagocytosis' function (opsonization, bacteria's killing, a test with blue tetrazolium, cytochrome C methods of determination of enzyme's activity etc.)

## 2. Acquired immunodeficiency syndrome

(AIDS) is caused by human immunodeficiency virus (HIV) of type 1 (HIV-1). HIV-1 infects CD4+ T-lymphocytes predominantly. Depletion of CD4+ lymphocytes results in immunodeficiency.

The clinical picture of AIDS is the final phase of HIV infection and its manifestation, with a wide spectrum of clinical disorders. The majority of them is nonspecific.

### Clinical manifestations of HIV infection in children

Manifestation	Criteria
Persisting generalized lymphadenopathy	One or more nodes have size more than 1 cm. and exist longer than 1 month (especially substantial is enlargement of auxiliary lymph nodes)
Persisting hepatomegaly	Enlargement of the liver, registered for 3 months and more

Persisting splenomegaly	Enlargement of the spleen, registered for 3 months and more
Persisting diarrhea	Stool is three times a day for more than 1 month
Fever	t = 38" C for 4 weeks and more, 2 and more episodes of fever of obscure nature
Persisting enlargement of salivary glands	For 3 months and more
Thrombocytopenia	Amount of thrombocytes is less than 100 000 per ml twice and more times
Serious bacterial infections	2 and more episodes of exacerbation or chronization of an infection (for more than 3 days in spite of the treatment)
Retardation of development	Progressing hypotrophy, encephalopathy
Persisting or recurring oral candidiasis	It lasts for 2 months and more or relapses after the course of treatment
Cardiomyopathy	Signs of heart insufficiency and/or pathology by USE
Nephropathy	Nephrotic syndrome (proteinuria, hypoalbuminemia)

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### **Investigation of the children for writing the case history.**

**Amount of hours:** 2 hours

**Aim:** To know how to write case history on the basis of knowledge of anatomy-physiological features, to show syndromes of a lesion of different system and organs.

**Professional motivation:**

The system of different organs from the moment of birth of the child has the features of operation, which one predetermine nature of a symptomatology of lesions. With growth (increase) of the child the morphological constitution of the breathing system will be improved not only, but also the functional capabilities increase. A pathology of different organs one with widespread, that is why demands legible knowledge of microsymptoms of the lesion to begin treatments in time.

The knowledge about the writing of a case history is necessary for the future professional activity of students. Concrete aims:

- to fulfil subjective and objective examinations of children;
- to diagnose clinical syndromes;
- to make syndromic diagnoses;
- to interpret results of laboratory-instrumental examinations.

Method of implementation of practical work.

1 practical employment

Work 1

To collect anamnesis at a child with the defeat of different system. To draw conclusion in relation to probability of reasons of origin of this state, character of motion of disease.

Work 2

To learn to conduct the inspection of organs of the different system at the children of different age (review, palpation, percussion, auscultation)

Theme 2 practical employment

Work 3

To select main syndromes at children with the defeat of the different system.

## Work 4

To discover and estimate the displays of different system and the diseases at the children of different age-dependent groups.

Theme 3 practical employment

A student must know:

1. Anatomic features of the system at the children of different age.

Functional features of the system at the children of different age.

Features of the system and anomaly them of development .

2. Method 'of objective 'inspection of the different system at the children of different age (review, palpation, percussion , auscultation).

Additional methods of research of the different system and their interpretation (laboratory and instrumental: sciagraphy, bronchoscopy and bronchography, tomography, spirometry, functional tests, analyses of bronchial maintenance).

3. Semiotics of defeat of the different system at children.

Syndrome of different insufficiency, its degrees. Syndrome of different disorders.

A student must be able: due to models of communication

Complaints and anamnesis taking

1. friendly facial expression and smile.

2. gentle tone of speech

3. greeting and introducing.

3 .by means of game playing find a contact with a child.

5 .tactful and calm conversation with the parents of sick child.

6 .explanation of future steps concerning the child (hospitalization ,some methods of examination ,etc)

7. conversation accomplishment.

Physical methods of examination

1.friendly facial expression and smile.

2. gentle tone of speech

3. greeting and introducing.

4.explain to the parents what examination should be performed and obtain there informed consent.

5.find a contact with a child, try to gain his/her confidence.

6.prepare for examination(clean and warm hands, warm phonendoscope, etc)

7.examination

8.explaining the results of examination to child s parents.

9.conversation accomplishment

Informing about the results of examination

1. friendly facial expression and smile.

2. gentle tone of speech

3. greeting and introducing

4.explain to a child and his/her parents what examinations should be performed and obtain their informed consent

5.involve adolescent and his/her relatives in to the conversation(compare present examination results with previous ones, clarify weather your expectations are clear for them or not)

6.conversation accomplishment.

Planning and prediction of conservative treatment results

1. friendly facial expression and smile.

2. gentle tone of speech
3. greeting and introducing
4. explain to child's parents the necessity of further treatment directions correctly and accessibly.
5. discuss with parents and their child the peculiarities of drug intake, duration of usage, side effects and find out whether they understand your explanations
6. conversation accomplishment

Informing about treatment prognosis

1. friendly facial expression and smile.
2. gentle tone of speech
3. greeting and introducing
4. correct and clear explanation of expected results of treatment.
5. discuss with the parents and their child the importance of continuous treatment, following the treatment scheme, make sure that your explanations are properly understood.
6. conversation accomplishment

1. To collect anamnesis and to select information which testify to the defeat of the different system of child?

2. To conduct 'the objective inspection of the different system at the children of different age.

To estimate the results 'of objective inspection of the different system taking into account age-old features.

To select the main syndromes of defeat of the different system.

To conduct the estimation of results of functional tests laboratory and instrumental researches of the different system at children.

3. To give urgent help to the child with the displays of different insufficiency at the different pathos's.

To organize the proper care of children with the defeat of breathing organs.

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## Topic 16. Breastfeeding

### Practical lessons 37-41

**Theme:** Natural feeding. Lactation

**Aim:** To learn and understand the necessity and techniques of breast-feeding, quantitative and qualitative composition of the human milk. To know methods of daily volume food calculation and regime of feeding. To gain knowledge of introduction of additional foods to infants (weaning) and physiological correction of diet.

**Professional necessity of the theme:** Some women don't feel comfortable with the idea of nursing. They don't want to handle their breasts, or they want to think of them as sexual, not functional. They may be concerned about modesty and the possibility of having to nurse in public. They may want a break from child care to let someone else feed the baby, especially in the wee hours of the morning. So, it is very important that medical health care providers should be knowledgeable persons, which can help the nursing mother to initiate and keep breast-feeding.

Technique of realization of practical work

1. To know peculiarities of digestive tract of infants (anatomy, propaedeutics of child's diseases).
2. To know transitional conditions of neonate period (propaedeutics of child's diseases).
3. To know peculiarities of physical and neurological examination of a newborn child (propaedeutics of child's diseases).
4. To know main rules and techniques of breast and formula feeding of infants (propaedeutics of child's diseases).

Programme of student's self-preparation.

#### RECOMMENDED BREASTFEEDING PRACTICES

Human milk is the preferred feeding for all infants, including premature and sick newborns, with rare exceptions. The ultimate decision on feeding of the infant is the mother's. Pediatricians should provide parents with complete, current information on the benefits and methods of breastfeeding to ensure that the feeding decision is a fully informed one. When direct breastfeeding is not possible, expressed human milk, fortified when necessary for the premature infant, should be provided. Before advising against breastfeeding or recommending premature weaning, the practitioner should weigh thoughtfully the benefits of breastfeeding against the risks of not receiving human milk.

Breastfeeding should begin as soon as possible after birth, usually within the first hour. Except under special circumstances, the newborn infant should remain with the mother throughout the recovery period. Procedures that may interfere with breastfeeding or traumatize the infant should be avoided or minimized.

Advantages of breast feeding:

Child	Mother	Family
Prophylactic of infectious and allergic illnesses	Prevention of post-pregnancy complications	Economic advantages

Prophylactic of illnesses of digestive and endocrine systems	Prevention of unwanted pregnancy during the 4-6 month after the birth of the child	Healthy child
Provision of physiologic development		Preservation of reproductive health
High index of intellectual development	Prophylactic of cancer illnesses	Psychoemotional unity
Healthy society		

Newborns should be nursed whenever they show signs of hunger, such as increased alertness or activity, mouthing, or rooting. Crying is a late indicator of hunger. Newborns should be nursed approximately 8 to 12 times every 24 hours until satiety, usually 10 to 15 minutes on each breast. In the early weeks after birth, non-demanding babies should be aroused to feed if 4 hours have elapsed since the last nursing. Appropriate initiation of breastfeeding is facilitated by continuous rooming-in. Formal evaluation of breastfeeding performance should be undertaken by trained observers and fully documented in the record during the first 24 to 48 hours after delivery and again at the early follow-up visit, which should occur 48 to 72 hours after discharge. Maternal recording of the time of each breastfeeding and its duration, as well as voiding and passing of stool during the early days of breastfeeding in the hospital and at home, greatly facilitates the evaluation process.

No supplements (water, glucose water, formula, and so forth) should be given to breastfeeding newborns unless a medical indication exists. With sound breastfeeding knowledge and practices, supplements rarely are needed. Supplements and pacifiers should be avoided whenever possible and, if used at all, only after breastfeeding is well established.

When discharged <48 hours after delivery, all breastfeeding mothers and their newborns should be seen by a pediatrician or other knowledgeable health care practitioner when the newborn is 2 to 4 days of age. In addition to determination of infant weight and general health assessment, breastfeeding should be observed and evaluated for evidence of successful breastfeeding behavior. The infant should be assessed for jaundice, adequate hydration, and age-appropriate elimination patterns (at least six urinations per day and three to four stools per day) by 5 to 7 days of age. All newborns should be seen by 1 month of age.

Exclusive breastfeeding is ideal nutrition and sufficient to support optimal growth and development for approximately the first 6 months after birth.<sup>100</sup> Infants weaned before 12 months of age should not receive cow's milk feedings but should receive iron-fortified infant formula. Gradual introduction of iron-enriched solid foods in the second half of the first year should complement the breast milk diet.<sup>102,103</sup> It is recommended that breastfeeding continue for at least 12 months, and thereafter for as long as mutually desired.

In the first 6 months, water, juice, and other foods are generally unnecessary for breastfed infants. Vitamin D and iron may need to be given before 6 months of age in selected groups of infants (vitamin D for infants whose mothers are vitamin D-deficient or those infants not exposed to adequate sunlight; iron for those who have low iron stores or anemia). Fluoride should not be administered to infants during the first 6 months after birth, whether they are breast- or formula-fed. During the period from 6 months to 3 years of age,



breastfed infants (and formula-fed infants) require fluoride supplementation only if the water supply is severely deficient in fluoride (<0.3 ppm).

Should hospitalization of the breastfeeding mother or infant be necessary, every effort should be made to maintain breastfeeding, preferably directly, or by pumping the breasts and feeding expressed breast milk, if necessary.

## ROLE OF PEDIATRICIANS IN PROMOTING AND PROTECTING BREASTFEEDING

To provide an optimal environment for breastfeeding, pediatricians should follow these recommendations:

1. Promote and support breastfeeding enthusiastically. In consideration of the extensive published evidence for improved outcomes in breastfed infants and their mothers, a strong position on behalf of breastfeeding is justified.

2. Become knowledgeable and skilled in both the physiology and the clinical management of breastfeeding.

3. Work collaboratively with the obstetric community to ensure that women receive adequate information throughout the perinatal period to make a fully informed decision about infant feeding. Pediatricians should also use opportunities to provide age-appropriate breastfeeding education to children and adults.

4. Promote hospital policies and procedures that facilitate breastfeeding. Electric breast pumps and private lactation areas should be available to all breastfeeding mothers in the hospital, both on ambulatory and inpatient services. Pediatricians are encouraged to work actively toward eliminating hospital practices that discourage breastfeeding (eg, infant formula discharge packs and separation of mother and infant).

5. Become familiar with local breastfeeding resources (eg, Special Supplemental Nutrition Program for Women, Infants, and Children clinics, lactation educators and consultants, lay support groups, and breast pump rental stations) so that patients can be referred appropriately. When specialized breastfeeding services are used, pediatricians need to clarify for patients their essential role as the infant's primary medical care taker. Effective communication among the various counsellors who advise breastfeeding women is essential.

6. Encourage routine insurance coverage for necessary breastfeeding services and supplies, including breast pump rental and the time required by pediatricians and other licensed health care professionals to assess and manage breastfeeding.

7. Promote breastfeeding as a normal part of daily life, and encourage family and societal support for breastfeeding.

8. Develop and maintain effective communications and collaboration with other health care providers to ensure optimal breastfeeding education, support, and counsel for mother and infant.

9. Advise mothers to return to their physician for a thorough breast examination when breastfeeding is terminated.

10. Promote breastfeeding education as a routine component of medical school and residency education.

11. Encourage the media to portray breastfeeding as positive and the norm.

12. Encourage employers to provide appropriate facilities and adequate time in the workplace for breast-pumping.

Composition of Mature Breastmilk

### Caloric of colostrum

1 day	150 ccal	B 100 ml
2 day	120 ccal	B 100 ml
3 day	80 ccal	B 100 ml
4 day	75 ccal	B 100 ml

- **Protein:** approximately 60% whey and 40% casein
- **Carbohydrate:** Lactose
- **Fat:** Human milkfat
- 20 calories per ounce and 1 gram protein per dL.

### Composition of Premature Breastmilk

- **Protein:** approximately 60% whey and 40% casein
- **Carbohydrate:** Lactose
- **Fat:** Human milkfat
- Higher electrolyte and protein content than term which decreases as gestational age increase. Energy and mineral content is similar between the mature and preterm milks.<sup>20, 21</sup>
- Higher content of medium-chain triglycerides than mature breastmilk<sup>20,21</sup>
- May contain insufficient protein, calcium, phosphorus, zinc, copper to achieve intrauterine growth rates in rapidly growing premature infants
- Requires the fortification of human milk fortifier to meet the nutritional requirements of the premature infant.
- 20 calories per ounce and 1.4-2.2 grams protein per dL.

### GENERALLY CONTRAINDICATED

Atropine oral anticoagulants, especially phenindione antithyroid drugs antineoplastic agents cathartics (excluding senna) iodides mercurials radioactive agents bromides ergot tetracycline metronidazole

### NOT CONTRAINDICATED BUT REQUIRE CLOSE OBSERVATION

Corticosteroids, diuretics, oral contraceptives (low dose progesterone only), reserpine, diazepam, nalidixic acid, phenytoin, sulfonamides, barbiturates, lithium carbonate, salicylates, antibiotics, chlorpromazine

1. Breast milk characterized by:
  - a) great concentration of casein
  - b) low concentration of lipas

- c) presence of immunologic protective factors
- d) presence of alfa-lactose

2. Preferences of breast-feeding in comparing with cow-milk feeding are:

- a) include great quantity of casein
- b) include beta-lactose
- c) great concentration of albumin
- d) high concentration of lipase
- e) presence of immunologic protective factors

3. Main difference between mothers milk and cow-milk:

- a) more high concentration of protein
- b) more lower concentration of protein
- c) more lower concentration of fat
- d) more higher concentration of fat
- e) more lower concentration of carbohydrates

4. What form (fraction) has protein in the breast-milk?

- a) albumin
- b) globulin
- c) casein
- d) caseinogen

5. Main component of fats in the breast-milk is:

- a) glycerin
- b) fat acids
- c) cholesterol
- d) triglycerides
- e) stearine

6. What is the difference in Lactose concentration in breast milk and cow milk:

- a) higher
- b) lower
- c) equal

7. Concentration of P and Ca in the breast milk:

- a) 1:1
- b) 1:2
- c) 2:1
- d) 1:3
- e) 2:3

8. How long breast milk is staying in the newborn's stomach?

- a) 2-2,5 hours
- b) 3-3,5 hours
- c) 3,5 – 4 hours

d) 1,5 hour

9. How many times per day must be fed 6-month old child:

- a) 5 times
- b) 7 times
- c) 3 times
- d) 4 times
- e) 6 times

10. Daily requirement in protein for child in breast feeding before giving additional food in g/kg ?

- a) 1-2,0
- b) 2,0-2,5
- c) 3,0-3,5
- d) 4,0-4,5
- e) 4,5-5,0

Complaints and anamnesis taking

- 1. Friendly facial expression and smile.
- 2. Gentle tone of speech
- 3. Greeting and introducing.
- 3. By the means of game playing find a contact with a child.
- 5. Tactful and calm conversation with the parents of sick child.
- 6. Explanation of future steps concerning the child (hospitalization ,some methods of examination ,etc)
- 7. Conversation accomplishment.

Physical methods of examination

- 1. Friendly facial expression and smile.
- 2. Gentle tone of speech
- 3. Greeting and introducing.
- 4. Explain to the parents what examination should be performed and obtain there informed consent.
- 5. Find a contact with a child, try to gain his/her confidence.
- 6. Prepare for examination (clean and warm hands, warm stethoscope, etc)
- 7. Examination
- 8. Explaining the results of examination to child s parents.

#### **Additional food (complementary foods) and feeding correction.**

**Aim:** To learn and understand the necessity and techniques of breast-feeding, qquantitative and qualitative composition of the human milk. To know methods of daily volume food calculation and regime of feeding. To gain knowledge of introduction of additional foods to infants (weaning) and physiological correction of diet.

**Professional necessity of the theme:** Some women don't feel comfortable with the idea of nursing. They don't want to handle their breasts, or they want to think of them as sexual, not functional. They may be concerned about modesty and the possibility of having to nurse in public. They may want a break from child care to let someone else feed the baby, especially in the wee hours of the morning. So, it is very important that medical health care providers should be knowledgeable persons, which can help the nursing mother to initiate and keep breast-feeding.

Technique of realization of practical work

5. To know peculiarities of digestive tract of infants (anatomy, propaedeutics of child's diseases).
6. To know transitional conditions of neonate period (propaedeutics of child's diseases).
7. To know peculiarities of physical and neurological examination of a newborn child (propaedeutics of child's diseases).
8. To know main rules and techniques of breast and formula feeding of infants (propaedeutics of child's diseases).

### Materials which might be helpful.

#### Common Breastfeeding Difficulties

Difficulty or Condition	Prevention	Solutions
<b>Engorgement</b>	<ul style="list-style-type: none"> <li>• Correct positioning and attachment</li> <li>• Breastfeed immediately after birth</li> <li>• Breastfeed on demand (as often and as long as baby wants) day and night: 10 – 12 times per 24 hours</li> </ul> <p>Allow baby to finish first breast before switching to the second breast</p>	<ol style="list-style-type: none"> <li>1. Apply cold compresses to breasts to reduce swelling; apply warm compresses to “get milk flowing.”</li> <li>2. one breast at a time</li> <li>3. Breastfeed more frequently or longer</li> <li>4. Improve infant positioning and attachment</li> <li>5. Massage breasts</li> <li>6. Express some milk</li> </ol> <p>Apply a warm bottle (demonstrate use of warm bottle)</p>
<b>Sore or Cracked Nipples</b>	<ul style="list-style-type: none"> <li>• Correct positioning of baby</li> <li>• Correct latch-on</li> <li>• Do not use bottles, dummies or pacifiers</li> <li>• Do not use soap on nipples</li> <li>•</li> </ul>	<ol style="list-style-type: none"> <li>1. Make sure baby is positioned well at the breast</li> <li>2. Make sure baby latches on to the breast correctly</li> <li>3. Apply drops of breastmilk to nipples and allow to air dry</li> <li>4. Remove the baby from the breast by breaking suction first</li> <li>5. Begin to breastfeed on the side that hurts less</li> <li>6. Do not stop breastfeeding</li> <li>7. Do not use bottles, dummies or pacifiers</li> <li>8. Do not use soap or cream on nipples</li> </ol> <p>Do not wait until the breast is full to breastfeed. If full, express some milk first</p>
<b>Plugged Ducts and Mastitis</b>	<ul style="list-style-type: none"> <li>• Get support from the family to perform non-infant care chores</li> <li>• Ensure correct attachment</li> <li>• Breastfeed on demand</li> <li>• Avoid holding the breast in</li> </ul>	<ol style="list-style-type: none"> <li>1. Apply heat before the start of breastfeeding</li> <li>2. Massage the breasts before breastfeeding</li> <li>3. Increase maternal fluid intake</li> <li>4. Rest (mother)</li> <li>5. Breastfeed more frequently</li> </ol>

	scissors hold <ul style="list-style-type: none"> <li>• Avoid sleeping on stomach (mother)</li> <li>• Avoid tight clothing</li> <li>• Use a variety of positions to rotate pressure points on breasts</li> </ul>	6. Seek medical treatment; if mastitis antibiotics may be necessary 7. If mother is HIV-positive: express milk and heat treat or discard 8. Position baby properly
<b>Insufficient Breastmilk</b> <ul style="list-style-type: none"> <li>• Mother “thinking” she does not have enough milk</li> </ul>	<ul style="list-style-type: none"> <li>• Breastfeed more frequently</li> <li>• Exclusively breastfeed day and night</li> <li>• Breastfeed on demand</li> <li>• Correct positioning of baby</li> <li>• Breastfeed on demand at least every 3 hours</li> <li>• Encourage support from the family to perform non-infant care chores</li> <li>• Avoid bottles and pacifiers</li> </ul>	1. Withdraw any supplement, water, formulas, tea, or liquids 2. Feed baby on demand, day and night 3. Increase frequency of feeds 4. Wake the baby up if baby sleeps throughout the night or longer than 3 hours during the day 5. Make sure baby latches-on to the breast correctly 6. Reassure mother that she is able to produce sufficient milk 7. Explain growth spurts 8. Baby takes fore and hind milk
<b>Insufficient Breastmilk</b> <ul style="list-style-type: none"> <li>• Insufficient weight gain</li> <li>• Fewer than 6 wet diapers/day</li> <li>• Dissatisfied (frustrated and crying) baby</li> </ul>	<ul style="list-style-type: none"> <li>• Same as above</li> </ul>	<ul style="list-style-type: none"> <li>• Same as above</li> <li>• Refer mother and baby to nearest health centre</li> </ul>

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## Common Breastfeeding Difficulties

### Special Situations

Special Situation	Solutions
<b>Sick baby</b>	<ul style="list-style-type: none"> <li>• <b>Baby under 6 months:</b> If the baby has diarrhea or fever the mother should breastfeed exclusively and frequently to avoid dehydration or malnutrition.</li> <li>• Breastmilk contains water, sugar and salts in adequate quantities, which will help the baby recover quickly from diarrhea.</li> <li>• If the baby has severe diarrhea and shows any signs of dehydration, the mother should continue to breastfeed and provide ORS either with a spoon or cup.</li> <li>• <b>Baby older than 6 months:</b> If the baby has diarrhea or fever, the mother should breastfeed frequently to avoid dehydration or malnutrition. She should also offer the baby bland food (even if the baby is not hungry).</li> </ul>

Special Situation	Solutions
	<ul style="list-style-type: none"> <li>• If the baby has severe diarrhea and shows any signs of dehydration, the mother should continue to breastfeed and add ORS.</li> </ul>
<b>Sick mother</b>	<ul style="list-style-type: none"> <li>• When the mother is suffering from headaches, backaches, colds, diarrhea, or any other common illness, she <b>SHOULD CONTINUE TO BREASTFEED HER BABY</b>.</li> <li>• The mother needs to rest and drink a large amount of fluids to help her recover.</li> <li>• If mother does not get better, she should consult a doctor and say that she is breastfeeding.</li> </ul>
<b>Premature baby</b>	<ul style="list-style-type: none"> <li>• Mother needs support for correct latch-on.</li> <li>• Breastfeeding is advantageous for pre-term infants; supportive holds may be required.</li> <li>• Direct breastfeeding may not be possible for several weeks, but expressed breastmilk may be stored for use by infant.</li> <li>• If the baby sleeps for long periods of time, he/she should be unwrapped to encourage waking and held vertically to awaken.</li> <li>• Mother should watch baby's sleep and wake cycle and feed during quiet-alert states.</li> <li>• <i>Note:</i> Crying is the <u>last</u> sign of hunger. Cues of hunger include rooting, licking movements, flexing arms, clenching fists, tensing body, and kicking legs.</li> </ul>
<b>Malnourished mothers</b>	<ul style="list-style-type: none"> <li>• Mothers need to eat extra food ("feed the mothers, nurse the baby")</li> <li>• Mothers need to take micronutrients</li> </ul>
<b>Mother who is separated daily from her infant</b>	<ul style="list-style-type: none"> <li>• Mother should express or pump milk and store it for use while separated from the baby; the baby should be fed this milk at times when he/she would normally feed.</li> <li>• Mother should frequently feed her baby when she is at home.</li> <li>• Mother who is able to keep her infant with her at the work site should feed her infant frequently.</li> </ul>
<b>Twins</b>	<ul style="list-style-type: none"> <li>• The mother can exclusively breastfeed both babies.</li> <li>• <b>THE MORE THE BABY NURSES, THE MORE MILK IS PRODUCED.</b></li> </ul>
<b>Inverted nipples</b>	<ul style="list-style-type: none"> <li>• Detect during pregnancy</li> <li>• Try to pull nipple out and rotate (like turning the knob on a radio)</li> <li>• Make a hole in the nipple area of a bra. When pregnant woman wears this bra, the nipple protrudes through the opening</li> <li>• If acceptable, ask someone to suckle the nipple</li> </ul>
<b>Baby who refuses the breast</b>	<ul style="list-style-type: none"> <li>• Position the baby properly</li> <li>• Treat engorgement (if present)</li> <li>• Avoid giving the baby teats, bottles, pacifiers</li> <li>• Wait for the baby to be wide awake and hungry (but not crying) before offering the breast</li> <li>• Gently tease the baby's bottom lip with the nipple until he/she opens his/her mouth wide</li> <li>• Do not limit duration of feeds</li> </ul>

Special Situation	Solutions
	<ul style="list-style-type: none"> <li>• Do not insist more than a few minutes if baby refuses to suckle</li> <li>• Avoid pressure to potential sensitive spots (pain due to forceps, vacuum extractor, clavicle fracture)</li> <li>• Express breastmilk, and give by cup</li> </ul>
<b>Medications</b>	<ul style="list-style-type: none"> <li>• Three things are known about drugs and human milk:               <ol style="list-style-type: none"> <li>1. Most drugs pass into breastmilk.</li> <li>2. Almost all medication appears in only small amounts in human milk, usually less than 1% of the maternal dosage.</li> <li>3. Very few drugs are contraindicated for breastfeeding women.</li> </ol> </li> </ul>
<b>Mother who will be away from her infant for an extended period expresses her breastmilk. Caregiver feeds expressed breastmilk from a cup.</b>	<ul style="list-style-type: none"> <li>• Mother expresses breastmilk by following these steps:               <ol style="list-style-type: none"> <li>a. Washes hands</li> <li>b. Prepares a clean container</li> <li>c. Gently massages breasts in a circular motion</li> <li>d. Positions her thumb on the upper edge of the areola and the first two fingers on the underside of the breast behind the areola</li> <li>e. Pushes straight into the chest wall</li> <li>f. Avoids spreading the fingers apart</li> <li>g. For large breasts, first lifts and then pushes into the chest wall</li> <li>h. Rolls thumb and fingers forward as if making thumb and fingerprints</li> <li>i. Repeats rhythmically: position, push, roll; position, push, roll</li> <li>j. Rotates the thumb and finger positions</li> </ol> </li> <li>• Mother stores breastmilk in a clean, covered container. Milk can be stored 8–10 hours at room temperature in a cool place and 72 hours in the refrigerator.</li> <li>• Mother or caregiver gives infant expressed breastmilk from a cup. Bottles are unsafe to use because they are difficult to wash and can be easily contaminated.</li> </ul>
<b>Cleft lip and/or palate</b>	<ul style="list-style-type: none"> <li>• Let mother know how important breastmilk is for her baby.</li> <li>• Try to fill the space made by the cleft lip with the mother's finger or breast.</li> <li>• Breastfeed infant in a sitting position.</li> <li>• Express milk and give to the infant using a cup or a teaspoon.</li> </ul>
<b>HIV-positive mother who chooses to breastfeed</b>	<ul style="list-style-type: none"> <li>• Mother should practice exclusive breastfeeding for 6 months. If AFASS<sup>[1]</sup> criteria are met, mother should transition to replacement feeds. At 6 months mother should introduce appropriate complementary foods.</li> <li>• Mother who experiences breast difficulties such as mastitis, cracked nipples, or breast abscess should breastfeed with the unaffected breast and express and discard milk from the affected breast.</li> <li>• Mother should seek immediate care for a baby with thrush or oral lesions.</li> <li>• Mother who presents with AIDS-related conditions (prolonged fever, severe cough or diarrhea, or pneumonia) should visit a health centre immediately.</li> </ul>

<sup>[1]</sup> AFASS = Acceptable, Feasible, Affordable, Sustainable and Safe



Special Situation	Solutions
	<b>Note:</b> The lactating woman should use condoms to protect herself from exposure to infected semen.
<b>HIV-positive mother who chooses to replacement feed</b>	<ul style="list-style-type: none"> <li>• Mother should practice safe and appropriate use of infant formula or animal’s milk (with additional sugar) exclusively for the first 6 months.</li> <li>• Mother should use a cup, not a bottle.</li> <li>• Mother should NOT mix-feed – “give only breastmilk substitutes, do not breastfeed”.</li> </ul>

### Introducing Solids

When:

- 4-6 months - Rice cereal
- 6 months - vegetables and fruits
- 9 months - finger foods
- 1 year - eggs, citrus fruits, strawberries, peanut butter, whole milk
- 2 years - low fat milk
- MUCH, MUCH later - peanuts

How:

- Rice cereal - mix with breastmilk or formula to make a medium thickness soup/paste. (Water mixed with rice cereal TASTES like paste). Introduce from a bowl and spoon (do not put in bottle). Child will only take a few bites, thus, the need to continue same amount of formula as before. Try at mealtimes and before bed (socialized eating).
- Baby foods - Tell parents they do not need to buy expensive baby foods. If they eat well, their fruits and veggies mashed in a blender or baby food grinder will do just as well. Introduce one new item per week, so if the baby has an allergic reaction you will know which one it is to. Do not do citrus fruits or strawberries at this age, as they are potent allergens (wait until after one year). Again, baby will only take a few bites of these things, so feed formula first before offering baby foods (formula contains the essential fats and protein that the developing brain needs). Also, continue to offer at mealtimes to encourage socialized eating.
- Finger foods - Do not give until baby has good head control and pincer grasp. Then, make sure that pieces of food are not big enough to cause choking. Never give peanuts as they are huge choking hazards.
- Other foods - Potent allergens may be started after one year of age as less risk of causing allergies at that time.
- Start whole milk after one year of age, as fat in whole milk is necessary for myelin development in brain.
- After 2 years of age may change to low fat milk.

**Technique of formula feeding, criteria of its effectiveness. Child’s daily need in energy, proteins, fats and carbohydrates in formula feeding.**

## **Additional food and feeding correction in formula feeding**

**Aim:** To learn medical and social aspects of formula feeding, to know safety techniques and used formulas, to be able to assess formula feeding adequacy and to make necessary correction.

**Professional necessity of the theme:** although there is an agreement among healthcare professionals, infant food manufacturers and mothers that breastfeeding is the best choice for feeding infants during their first four to six months of life, but there are several reasons why a mother cannot breastfeed her baby. In such cases pediatrician or family doctor must give recommendations how to feed a baby to guarantee his proper physical and psychomotor development. Dietary treatment is the adequate nutrition of a sick child that answers main caloric and energetic requirements up to peculiarities of metabolism and functional stage of digestive organs and the organism in whole. Using different restrictions, we can regulate the patient's metabolism and thus improve his condition. That is why it is very important to know how to organize a sick child's feeding.

### **Technique of realization of practical work**

- 1 To know peculiarities of digestive tract of infants and children (anatomy, propaedeutics of child's diseases).
- 2 To know nutritional requirements of children of different age (course of nutrition, propaedeutics of child's diseases).
- 3 To know peculiarities of physical examination and assessment of nourishment of children (propaedeutics of child's diseases).
- 4 To know main types of inborn errors of metabolism (pathological physiology).
- 5 To know main types of metabolism (biochemistry).
6. To prescribe different menu for the children

### **Student must know**

1. To know peculiarities of digestive tract of infants
2. To know transitional conditions of neonate period
3. To know peculiarities of physical and neurological examination of a newborn child .
4. To know main rules and techniques of formula feeding of infants .

### **Student should be able to**

1.prescribe menu in formula feeding for the child of different age group

Complaints and anamnesis taking

1. Friendly facial expression and smile.
2. Gentle tone of speech
3. Greeting and introducing.
- 4 .By means of game playing find a contact with a child.
5. Tactful and calm conversation with the parents of sick child.
6. Explanation of future steps concerning the child (hospitalization ,some methods of examination ,etc)
7. Conversation accomplishment.

Physical methods of examination

1. Friendly facial expression and smile.
2. Gentle tone of speech
3. Greeting and introducing.
4. Explain to the parents what examination should be performed and obtain there informed consent.

5. Find a contact with a child; try to gain his/her confidence.
6. Prepare for examination (clean and warm hands, warm stethoscope, etc)
7. Examination
8. Explaining the results of examination to child s parents.
9. Conversation accomplishment

### **Informing about the results of examination**

1. Friendly facial expression and smile.
2. Gentle tone of speech
3. Greeting and introducing
4. Explain to a child and his/her parents what examinations should be performed and obtain their informed consent
5. Involve adolescent and his/her relatives in to the conversation (compare present examination results with previous ones, clarify weather your expectations are clear for them or not)
6. Conversation accomplishment.

### **Materials which might be helpful.**

#### **ROLE OF PEDIATRICIANS IN PROMOTING AND PROTECTING BREASTFEEDING**

**To provide an optimal environment for breastfeeding, pediatricians should follow these recommendations:**

13. Promote and support breastfeeding enthusiastically. In consideration of the extensive published evidence for improved outcomes in breastfed infants and their mothers, a strong position on behalf of breastfeeding is justified.

14. Become knowledgeable and skilled in both the physiology and the clinical management of breastfeeding.

15. Work collaboratively with the obstetric community to ensure that women receive adequate information throughout the perinatal period to make a fully informed decision about infant feeding. Pediatricians should also use opportunities to provide age-appropriate breastfeeding education to children and adults.

16. Promote hospital policies and procedures that facilitate breastfeeding. Electric breast pumps and private lactation areas should be available to all breastfeeding mothers in the hospital, both on ambulatory and inpatient services. Pediatricians are encouraged to work actively toward eliminating hospital practices that discourage breastfeeding (eg, infant formula discharge packs and separation of mother and infant).

17. Become familiar with local breastfeeding resources (eg, Special Supplemental Nutrition Program for Women, Infants, and Children clinics, lactation educators and consultants, lay support groups, and breast pump rental stations) so that patients can be referred appropriately.<sup>111</sup> When specialized breastfeeding services are used, pediatricians need to clarify for patients their essential role as the infant's primary medical care taker. Effective communication among the various counsellors who advise breastfeeding women is essential.

18. Encourage routine insurance coverage for necessary breastfeeding services and supplies, including breast pump rental and the time required by pediatricians and other licensed health care professionals to assess and manage breastfeeding.

19. Promote breastfeeding as a normal part of daily life, and encourage family and societal support for breastfeeding.

20. Develop and maintain effective communications and collaboration with other health care providers to ensure optimal breastfeeding education, support, and counsel for mother and infant.

21. Advise mothers to return to their physician for a thorough breast examination when breastfeeding is terminated.

22. Promote breastfeeding education as a routine component of medical school and residency education.

23. Encourage the media to portray breastfeeding as positive and the norm.

24. Encourage employers to provide appropriate facilities and adequate time in the workplace for breast-pumping.

**Composition of Commercially Available Human Milk Fortifiers:**

	(Ross) Similac Natural Care (per dl)	(Mead Johnson) Enfamil HMF Powder (per 3.8 gram packet)
Energy (kcal)	81	14
Protein (gm)	2.2	0.7
Fat (gm)	4.4	---
Carbohydrate (gm)	8.6	2.7
Sodium (meq)	1.5	0.3
Potassium (meq)	2.7	0.4
Calcium (mg)	171	90
Phosphorus (mg)	85	45
Magnesium (mg)	10	1
Zinc (mg)	12	0.31
Iron (mg)	0.3	0
Manganese (µg)	10	9
Copper (µg)	203	8
Iodine (µg)	5	---
Osmolality (mOsm/L)	280	380-440 (when mixed 4pkts/100ml)

**Drugs and Breastfeeding:**

Almost all drugs pass to breast milk to some extent; avoid any that are not essential. Advise new mother to take any medication immediately after breastfeeding so drug level in milk is low at time of next feeding.

**GENERALLY CONTRAINDICATED**

Atropine oral anticoagulants, especially phenindione antithyroid drugs antineoplastic agents cathartics (excluding senna) iodides mercurials radioactive agents bromides ergot tetracycline metronidazole

**NOT CONTRAINDICATED BUT REQUIRE CLOSE OBSERVATION**

Corticosteroids, diuretics, oral contraceptives (low dose progesterone only), reserpine, diazepam, nalidixic acid, phenytoin, sulfonamides, barbiturates, lithium carbonate, salicylates, antibiotics, chlorpromazine

**Schemes of mixed feeding children of the first year of life. The milk formulas which are used for additional feeding. Additional food and feeding correction in mixed feeding. Child needs in proteins, fats, carbohydrates and calories in mixed feeding.**

**Aim:** To know the principles of dietary treatment on mix-feeding

**Professional motivation:** Mix-feeding – the feeding of the babies of first 5-6 mo with human milk and formula in which the volume of formula is more than 1/5 of daily volume (or the daily volume of the human milk is less than 4/5).

Technique of realization of practical work

9. To know peculiarities of digestive tract of infants (anatomy, propaedeutics of child's diseases).
10. To know transitional conditions of neonate period (propaedeutics of child's diseases).
11. To know peculiarities of physical and neurological examination of a newborn child (propaedeutics of child's diseases).
12. To know main rules and techniques of breast and formula feeding of infants (propaedeutics of child's diseases).
13. To know main rules and techniques of formula feeding of infants (propaedeutics of child's diseases).
14. To know main rules and techniques of mixed feeding of infants (propaedeutics of child's diseases).
15. To know principals and methods of evaluation of children's physical development. To know methods of neurologic and psychological development of children evaluation.

**Programme of student's self-preparation.**

There are two kinds of mix feeding:

Mix-feeding closed to breast-feeding

Mix-feeding close to formula feeding

Mix-feeding closed to breast-feeding – the feeding of the babies with human milk and formula in which the ratio between them in daily volume are 2:1 (or 2/3:1/3).

Mix-feeding close to formula feeding - the feeding of the babies with human milk and formula in which the ratio between them in daily volume are 1:2 (or 1/3:2/3).

Mix-feeding indication:

In causes of mother's diseases:

1. hypogalactia (oligogalactia);
2. Some diseases in that mother must decreased the quantity of feeding:
  - a. mastitis;
  - b. anemia of severe degree;
  - c. using of medicine (medicament);
  - d. erythroderma.
3. Human milk inferiority (fat's, protein's or carbohydrate's inferiority).

In social and living conditions

1. Mother is working and can't nurse a baby for all feeding.
2. Closed children institution in which the amount of donor human milk is not in enough quantity.

In causes of baby's diseases:

Congenital malabsorption syndrome: hypolactasia.

### **Hypogalactia (oligogalactia)**

Hypogalactia (oligogalactia) – is decreasing human milk secretion.

Hypogalactia is divided into primary and secondary.

Primary hypogalactia – is very rarely diseases (only 1-3 %). It is connected with neuro-humoral disorders in mother's organism or undeveloped breast or carried mastitis during previous deliveries.

Secondary hypogalactia - can appear in case of

- a. not correct day regimen during pregnancy and delivery;
- b. not correct carrying for breasts (nipple crack, erosion, mastitis);
- c. incorrect mother's nutrition.

There are four degree of hypogalactia:

I<sup>st</sup> degree – deficiency of the human milk is less than 25 % of the daily requirements;

II<sup>nd</sup> degree – deficiency of the human milk is between 25 and 50 % of the daily requirements;

III<sup>d</sup> degree – deficiency of the human milk is between 50 and 75 % of the daily requirements;

IV<sup>th</sup> degree – deficiency of the human milk is more than 75 % of the daily requirements.

There are two methods of mix-feeding:

- classic
- Interchanging (rotate) method.

Classic method is used in babies younger than 3 mo. In this method for each feeding the formula is given.

For example: the child 2 mo is in mix-feeding closed to breast-feeding. The weight at birth was 3300 gm

The normal weight of the child is  $3300+600+800=4700$  gm

Daily volume is (will use volume method of calculations)

$$4700/6=783 \text{ ml}$$

Volume for one feeding is  $783/6=130$  ml

If the child is in mix-feeding closed to breast-feeding that the quantity of human milk must be  $2/3$  and formula  $1/3$ . So, the quantity of human milk will be  $130:3 \times 2=86$  ml and formula 44 ml.

Menu

6.00 o'clock	86 ml of human milk + 44 ml of Hipp 1
9.30 o'clock	86 ml of human milk+ 44 ml of Hipp 1
13.00 o'clock	86 ml of human milk+ 44 ml of Hipp 1
14.30 o'clock	86 ml of human milk+ 44 ml of Hipp 1
20.00 o'clock	86 ml of human milk+ 44 ml of Hipp 1
23.30 o'clock	86 ml of human milk+ 44 ml of Hipp 1

Interchanging method is used in babies older than 3 months. In this method the human milk is given for first and last feeding. In others feeding formula or human milk is given (it depend of kind of feeding).

For example: the child 3.5 mo is in mix-feeding closed to formula-feeding. The weight at birth was 3300 grams

The normal weight of the child is  $3300+600+800+800+375=5875$  g

Daily volume is (will use caloric method of calculations)

$$115\text{kcal} \times 5.875\text{kg} = 676 \text{ kcal/day}$$

700 kcal – 1000 ml of human milk

676 kcal – X ml of human milk

X=956 ml – that is the daily volume

Volume for one feeding is  $956/5 = 190$  ml

If the child is in the mix-feeding closed to formula-feeding, so the first and last feeding is human milk and other - formula

Menu

6.00 o'clock	190 ml of human milk
10.00 o'clock	190 Hipp 1 +20 ml apple juice
14.00 o'clock	190 ml of Hipp 2 +15 ml of apple juice
18.00 o'clock	185 ml of Hipp 1+5 ml of apple puree
22.00 o'clock	190 ml of human milk

## Test

### Mixed feeding

- Choose the term of giving fruit juices for the child on mixed feeding:
  - 2 weeks
  - 1 month
  - 3 month
  - 4 month
  - elder than 6 month
- Advisable term of giving egg yolk for the child on mixed feeding:
  - from 3 month
  - 4 month
  - 5 month
  - 6 month
  - 7 month
- What does it mean accessory feeding :
  - milk formula
  - vegetable puree
  - fruit juices
  - porridge
- Advisable term of giving fruit puree for the child on mixed feeding:
  - 1 month
  - 2 month
  - 3 month
  - 4 month
  - 5 month
- Most better formula for mixed feeding 2-month baby:
  - "NAN"
  - "Detolact"
  - Acidofile milk
  - "Krepish"
  - easy formule N3
- Clinical symptoms of fasting for child:
  - regurgitation
  - flat form of "weight curve"

- c) rare urination
- d) restlessness
- e) frequent stools

7. “Control weighting” must be prescribed in situation:

- a) hypogalactia in mother
- b) restlessness
- c) fasting stools
- d) flat form of “weight curve”

8. “Control weighting” – it means measurement the weight of the child:

- a) in the evening before sleeping
- b) before feeding in the morning
- c) 3 times during a day
- d) every time after feeding
- e) before and after feeding

9. What are the components of easy formula:

- a) milk+ rice-water
- b) sour- milk
- c) milk+ water
- d) sour- milk + water
- e) milk+ sour- milk

10. What quantity of breast milk in daily ration need the child on mixed feeding near breast-feeding?

- a) 2/3 of daily ration
- b) 1/2
- c) 1/3
- d) 1/4

Right answer 1a-2a3a4a5b6-C7a,8C,9a.10a

#### **Student must know**

1 To know peculiarities of digestive tract of infants and children (anatomy, propaedeutics of child’s diseases).

2 To know nutritional requirements of children of different age (course of nutrition, propaedeutics of child’s diseases).

3 To know peculiarities of physical examination and assessment of nourishment of children (propaedeutics of child’s diseases).

4 To know main types of inborn errors of metabolism (pathological physiology).

5 To know main types of metabolism (biochemistry).

6. To prescribe different menu for the children

#### **Student should be able to**

##### **Due to communicative skills**

##### **Complaints and anamnesis taking**

1. Friendly facial expression and smile.
2. Gentle tone of speech
3. Greeting and introducing.
3. By means of game playing find a contact with a child.
5. Tactful and calm conversation with the parents of sick child.



6. Explanation of future steps concerning the child (hospitalization ,some methods of examination ,etc)
7. Conversation accomplishment.

#### **Physical methods of examination**

1. Friendly facial expression and smile.
2. Gentle tone of speech
3. Greeting and introducing.
4. Explain to the parents what examination should be performed and obtain there informed consent.
5. Find a contact with a child; try to gain his/her confidence.
6. Prepare for examination (clean and warm hands, warm stethoscope, etc)
7. Examination
8. Explaining the results of examination to child s parents.
9. Conversation accomplishment

#### **Informing about the results of examination**

1. Friendly facial expression and smile.
2. Gentle tone of speech
3. Greeting and introducing
4. Explain to a child and his/her parents what examinations should be performed and obtain their informed consent
5. Involve adolescent and his/her relatives in to the conversation (compare present examination results with previous ones, clarify weather your expectations are clear for them or not)
6. Conversation accomplishment.

## **Topic 17. Metabolism in children**

### **Practical lesson 42**

The knowledge of age-specific peculiarities of energy, protein, carbohydrate, lipid, water-electrolyte and acid-base metabolism in children and their clinical manifestations by laboratory data is necessary for diagnosing metabolic disturbances. The knowledge about vitamins and their significance for development of the child is necessary for diagnosing hypo- and hypervitaminosis in children.

#### **Concrete aims:**

- to know peculiarities in energy, protein, carbohydrate, lipid, water, mineral and acid-base metabolism in children;
- to fulfil subjective and objective examinations of children with affection of metabolism;
- to recognize clinical signs of metabolic disturbances and diagnose their main syndromes;
- to interpret results of laboratory-instrumental methods of examination.

#### **Materials which might be helpful.**

Metabolism is one of the essential signs of life. The term "metabolism" means the ability of the organism to accept, digest and assimilate nourishment. Metabolic processes include assimilation (digestion of substances which are admitted from environment), synthesis (building of composite chemical compounds from more simple elements for creation of live matter) and dissimilation (disintegration of substances forming alive organisms).

Processes of synthesis of organic compounds (energy expending processes) are called anabolic (anabolism, constructive metabolism); processes of disintegration (energy forming processes) are called catabolic (catabolism, destructive metabolism). Life is possible if the constant ties between processes of disintegration and synthesis are present, due to this fact development and regeneration is possible.

Children have the predominance of anabolic processes over catabolic ones during all periods of childhood; the degree of prevalence is parallel to growth intensity.

Metabolic processes are integrated with the defined structure formation. The most part of metabolic processes (Krebs cycle, respiration chain, oxidize phosphorylation, etc.) occurs in cell's mitochondria, which are like power stations, supplying the rest of the cell with energy. Protein synthesis occurs in ribosomes, energy for this process is received from mitochondria. The main protoplasm substance, the hyaloplasm, takes part in the process of glycolysis and other enzyme reactions.

Cell structures are not constant; they undergo permanent formation and disintegration. It is known that erythrocytes live 80-120 days, neutrophils 1-3 days, thrombocytes 8-11 days. Half of plasma proteins renews during 2-4 days.

During growth and development not only self-renewal takes place, but also permanent accumulation and formation of new organism structures.

Processes of metabolism include 4 consecutive stages:

1. Digestion - processes in the gastrointestinal tract, preparing absorption of nutrients. It is disintegration (splitting) of nutrients in the gastrointestinal tract by energy and bacteria.
2. Resorption - processes of absorption through the intestinal mucous membrane.
3. Intermediary metabolism - enzyme-caused and neurohumoral!y regulated intracellular synthesis and disintegration (splitting) processes.
4. Excretion of final metabolism products.

Metabolic disturbances in children are very various and can be divided into 3 parts:

1. The first group - inherited, genetically determined diseases. These are caused by deficiency (different degree) of an enzyme or enzymes, taking part in metabolism of some substance (for example, amino acid metabolism - aminoacidopathy). At present, more than 400 inherited diseases of metabolism are known.
2. The second group - transient metabolic disorders, which are caused by retardation in maturity of some enzyme system in children during growth processes (for example, transient phenilalaninaemia in children of the first day and weeks, which disappears with growth).
3. The third group - syndromes of metabolic disorders occur during different diseases or remain some time after them (for example, malabsorption syndrome after intestinal infections). It is a very large group.

### **Tests**

1 A 4-month-old boy is admitted to hospital with complaints about vomiting and frequent watery stool. The boy has been ill for 3 days. On admission, his general condition is severe. His body weight loss is 12%. Results of biochemical investigation of blood are as follows: haematocrit 63 %, protein 65 g/l.

The initial diagnosis is:

- a) gastroenteritis, hypotrophy;
- b) gastroenteritis, dehydration syndrome;
- c) gastroenteritis, polycythaemia;
- d) galactosaemia;
- e) hypotrophy, hypoproteinaemia.

2. A 7-year-old-girl is admitted to hospital with complaints about thirst, vomiting, abdominal pain, restlessness. On admission, her general condition is very severe. The girl is unconscious. Loss of her body weight is 8 kg. The skin is pale. Decrease of turgor and elasticity is marked. Blood glucose is 12mmol/l, urine glucose is 2 %. Acetone ++++.

The initial diagnosis is:

- a) acute gastritis, hyperglycaemia;
- b) acute gastroenteritis, hyperglycaemia;
- c) diabetes mellitus, hypoglycaemic coma;
- d) gastritis, syndrome of acetonic vomiting;
- e) myocarditis, hyperglycaemia.

3. A 14-year-old boy has been ill with diabetes mellitus for 3 years. After an injection of 15 units of insulin the child did not take any food. Ten minutes later the child becomes very pale and convulsions are noticed. At the moment of admission to **the hospital** the child was unconscious, with paleness of his skin, a decreased muscle tone and marked convulsions. Blood glucose is 1.2 mmol/L The initial diagnosis is:

- a) diabetes mellitus, hyperglycaemic coma;
- b) diabetes mellitus, hypoglycaemic coma;
- c) epilepsy, hyperglycaemia;
- d) autonomic dysfunction, hyperglycaemia;
- e) meningoencephalitis, hypoglycaemia.

4. A 3-month-infant has the natural feeding. The child cannot keep up the head, does not smile. Periodical convulsions appeared 2 weeks ago. On admission to the hospital, a high level of phenylalanine was found in the child's blood.

The initial diagnosis is:

- a) meningitis, hyperphenylalaninaemia;
- b) meningitis, hypophenylalaninaemia;
- c) phenylketonuria;
- d) retardation of psychomotor development, hypophenylalaninaemia;
- e) epilepsy, hypophenylalaninaemia.

5. A 7-day-old newborn has vomiting, distention of the abdomen, watery stool 12 times a day after taking breast milk. On admission to the hospital, jaundice and enlargement of the liver were found (the liver border was palpated by 5 cm below the costal arch).

It is known from the case history that the infant's father does not drink milk due to dysfunction of stool after taking milk.

The initial diagnosis is:

- a) gastroenteritis, conjugation jaundice;
- b) gastroenteritis, dehydration syndrome;
- c) galactosaemia;
- d) hepatitis;
- e) hypotrophy, dehydration syndrome.

6. A 4-month-old infant has artificial feeding with diluted cow's milk in proportion 1:1. Its body weight deficit is 25 %. On admission to the hospital, the blood protein was 48 g/l.

The initial diagnosis is:

- a) hypotrophy degree II, hyperproteinaemia;
- b) hypotrophy degree II, hypoproteinaemia;
- c) hypotrophy degree I, hyperproteinaemia;
- d) hypotrophy degree III, hypoproteinaemia;
- e) hypotrophy degree III, hyperproteinaemia.

7. A 7-month-old infant starts to have a dysfunction of its intestines, distention of the abdomen, watery stool after introduction of semolina and bread. The infant lost 800 g of weight. On admission to the hospital the infant was examined, Ht was 62 %, protein = 42

The initial diagnosis is:

- a) hypotrophy degree II, gastroenteritis;
  - b) hypotrophy degree II, dehydration syndrome;
  - c) celiac disease;
  - d) gastroenteritis, hypovolemia;
  - e) hypotrophy degree II, hypoproteinaemia.
- Answer: 1 - b, 2 - c, 3 - d, 4 - c, 5 - c, 6 - b, 7 - c.

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**Prepared by Associate Professor, PhD - Romaniuk O.**