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Review Article

The Role of Pathology of The Cardiovascular, Respiratory and Digestive Systems in Embryogenesis and Early Postnatal Ontogenesis

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Abstract

The most common form of cardiovascular pathology in childhood are heart defects - congenital and acquired. Congenital heart defects occur as a result of the impact of ertain factors on the embryo during the formation of the cardiovascular system -hypoxia caused by heart or respiratory failure in a pregnant woman, placental abruption, hypovitaminosis A, E, B2, the action of ionizing radiation, taking medications such as methylthiouracil, cytostatic drugs, endocrinopathies, viral diseases of the maternal body, etc.The possibility of intrauterine endocarditis is currently being questioned. The pathology of the respiratory system of young children is largely determined by the peculiarities of the structure and function of their respiratory apparatus. The chest of young children is always in a state of maximum inhalation, the ribs are located at right angles to the spine, so compensation by deepening breathing is impossible. Babies' breathing is frequent, shallow, and mostly diaphragmatic. Of a small child's stomach has a small capacity (it reaches 250-300 ml only by the age of 6 months). The glands of the stomach floor are few in number. The acidity and enzymatic activity of gastric juice are low. In young children, the liver is the largest organ with a well-developed left half. The right half of the liver is larger in size and weight than the left by the age of 6. In the liver of a newborn child, a number of enzyme systems have not yet been formed, which leaves its mark on the pathology of early age. Insufficient enzymatic activity of the liver is associated with a low level of protein synthesis in children, since half of the protein produced by the liver is spent on building enzymes.

Keywords: ontogenesis; morphophysiological transformations; developing organism

Introduction

The most common form of cardiovascular pathology in childhood are heart defects - congenital and acquired. Congenital heart defects occur as a result of the impact of certain factors on the embryo during the formation of the cardiovascular system -hypoxia caused by heart or respiratory failure in a pregnant woman, placental abruption, hypovitaminosis A, E, B2, the action of ionizing radiation, taking medications such as methylthiouracil, cytostatic drugs, endocrinopathies, viral diseases of the maternal body, etc.The possibility of intrauterine endocarditis is currently being questioned.

During embryogenesis, the heart is formed by dividing the arterial trunk into the right and left atria and ventricles, the aorta and the pulmonary artery. The separation of the cavity begins on the 32nd and ends on the 46th day. The effect of pathogenic factors on the embryo during this period may cause an incorrect separation of the arterial trunk; part of it, from which the pulmonary artery develops, may be narrower, and this leads to congenital artery stenosis. The development of the septa between the ventricles and atria may not reach the end, which will lead to the formation of defects in them. Some defects occur in the postnatal period. After birth, with the first breaths of the child, the entire circulatory system is rebuilt. The umbilical vein, venous arantium duct and arterial Botall duct are obliterated, and the oval opening in the atrial septum is closed. In some cases, obliteration of the duct of Bothall does not occur, and the oval opening does not close.[1]

The most common congenital malformations include: non-narrowing of the duct of Bothall, pulmonary artery stenosis, non-narrowing of the interventricular and atrial septa, narrowing of the isthmus of the aorta, and aortic divergence from both ventricles simultaneously. In cases where, as a result of the defect, the connection between the right and left ventricles remains according to the embryonic type, or blood arterialization is difficult, cyanosis develops as an indicator of hypoxemia. In these cases,

the defect is compensated by increasing the mass of red blood cells, and polycythemia occurs. In early childhood, with a lack of oxygen in the blood and tissues, the erythroblastic reaction develops more intensively than in adults. Cases have been described when the number of red blood cells in 1 m3 reaches 14 million [2]. An increase in the volume of circulating red blood cells increases oxygen delivery to tissues, but the increase in blood viscosity increases the load on the heart.

Children with congenital malformations of the right heart are usually born physically mature, with normal height and weight, but in postnatal life, physical development gradually begins to lag. This is due to the fact that the small circle of blood circulation plays an insignificant role in fetal blood circulation and therefore its disorders do not significantly affect the development of the fetus. In postnatal life, with its high rate of growth and development, active metabolism, a small circle of blood circulation becomes vital in providing the body with oxygen, and a violation of its function dramatically affects the subsequent development of the child, causing a delay in growth by 3-12 cm and weight by 1.6—10 kg (5-32% of body weight) during preschool age.Acquired heart defects in children in the vast majority of cases are rheumatic in nature. They appear in children over 3 years of age and are most often observed in early school age. After puberty, their frequency decreases significantly. In a higher percentage of cases, people who have suffered a rheumatic attack develop a heart defect, and the rarer the older the first attack was.[3]

In childhood, heart defects are well compensated if they are not complicated by intoxication during the development of rheumocarditis. Good compensation is due to the anatomical and physiological characteristics of the child's heart. These include a high regenerative capacity of the myocardium, better blood supply to the heart muscle. In childhood, the coronary arteries branch in a loose type, i.e. they do not have a terminal type of branching, as in adults, but a large number of anastomoses. Their lumen is large, and the nervous system is more closely connected to the coronary vessels than in adults. At the same time, in the case of decompensation of cardiac activity, the child's body is much more difficult to remove from it. This is due to the weakness and insufficient stability of the regulatory function of the central nervous system, which leads to imperfect coordination of the functions of the circulatory, respiratory and blood systems.Great care and careful monitoring is necessary when training the cardiovascular system of a child with rheumatic heart disease. Physical activity should be strictly dosed and carried out under the control of the activity of the cardiovascular system.[4] Severe heart damage can occur with diphtheria. Diphtheria myocarditis, in which the nervous system of the heart, the conducting system, is affected, leads to heart failure. Dystrophic changes in the myocardium in diphtheria myocarditis exclude the possibility of a basic compensatory reaction — hypertrophy of the heart.In severe infectious diseases, a child may develop a collaptoid condition caused either by vascular paresis or excessive tachycardia, in which the diastolic filling becomes insufficient and the minute volume of the heart drops sharply.Due to the loose type of branching of the coronary vessels, there are no myocardial infarctions in early age periods, but premature infants of the first months of life, who are underweight, and even fetuses sometimes have focal myocardial necrosis., They are often mistakenly regarded as myocardial infarctions.The development of such foci is caused by morphological and functional imperfections of the vascular system. Their appearance is facilitated by the pathological conditions of the maternal body before and during pregnancy, as well as pathological childbirth, which causes asphyxia of the fetus and newborn.According to the materials of the X International Congress of the Society for Cardiovascular Diseases (Moscow, 1971), extensive operations to correct heart defects in children do not achieve the goal. Insufficiency of the regulatory, integrative, and compensatory functions of the central nervous system and the endocrine system do not allow for the full development of adaptive reactions in the postoperative period. Children do not tolerate artificial blood circulation well. With extensive operations, their reactivity decreases sharply, which contributes to the development of severe infectious complications. The immunological reactivity of the child is in a state of formation, the formation of the lymphoid system ends only by puberty. The mechanisms of cellular and humoral immunity in the fight against staphylococci, gram-negative bacillus and other microorganisms are insufficient. Modern surgery, which has developed surgical approaches for the correction of various heart defects, does not have the asepsis and antisepsis necessary for such extensive surgical interventions in children.Children tolerate blood loss much worse than adults, and the smaller the child, the more severe its consequences. It is important to note that after significant blood loss, a newborn may initially have no alarming symptoms, and after a few hours, death is possible with progressive shock.

In experiments on 1-3-day-old puppies with blood loss in the amount of 0.8—1% of body weight, the restoration of circulating blood volume is extremely slow. Within an hour after blood loss, no more than 40% of the lost blood is compensated due to the fluid entering the vascular bed from the tissues. In animals, the volume of circulating red blood cells drops sharply. In older puppies (3-10 days old), during the first hour after blood loss, the flow of fluid into the bloodstream is so intense that it is 1.5 times the volume of blood lost. At the same time, the mass of circulating red blood cells increases significantly. 3-day—old puppies represent an intermediate group, as it were. In some of them, the flow of fluid into the vascular bed from the tissues was slowed down, as in the younger ones, and in others, the hydroremic reaction developed vigorously, not differing in intensity from the reaction in 4-10—day-old puppies. This is probably due to the individual properties of the animals, their greater or lesser maturity. The pressor reaction, which maintains blood pressure and promotes the entry of deposited red blood cells into the bloodstream, was also better expressed in older puppies.The high intensity of the hydroremic reaction in puppies can be explained by the high mobility of tissue fluid in the early stages of ontogenesis. It is known from the observations of obstetricians that blood loss in newborns is accompanied by rapidly developing anemia, in the pathogenesis of which the flow of tissue fluid into the vascular bed is important.A mild pressor reaction after blood loss in 1-3-day-old puppies may be due to their lack of pressor reflex from the sinocarotid and aortic zones.Newborn babies and animals born immature. They have toned centers of the sympathetic, feather bed system, while depressive reactions appear in puppies only at the 3rd week after birth, which is caused by toning of the vagus nerve centers, which occurs during a period of changing the nature of the animal's diet, and with a decrease in energy expenditure. Therefore, newborns and animals have a high heart rate (in children 100-160 beats per minute), and with blood loss, tachycardia as a compensatory mechanism can be used by the child's body to a lesser extent.[5]We have included some materials on traumatic shock in the section of pathophysiology of the cardiovascular system, since hemodynamic changes are most pronounced during shock.It is still not completely clear whether traumatic shock develops in young children or not. According to some authors, young children are more sensitive to injury. Other authors believe that there is no traumatic shock in the early age period, as children are less sensitive to pain. According to V. I. Semkin (1967), newborn children, at least in most cases, respond with an atypical reaction to trauma, and therefore their traumatic shock remains unrecognized. E. I. Arshavskaya and I. A. Arshavsky (1948-1955) in a series of works showed that while pain irritation causes traumatic shock in adult dogs, in 1-week-old puppies it leads only to a short-term increase in blood pressure, increased breathing and general motor reaction. In the future, despite the continued irritation, blood pressure stabilizes and shock phenomena do not occur. Only 3–4-week-old puppies experience shock with erectile and torpid phases in response to injury.Traumatic shock cannot develop in a typical form in newborns due to the undifferentiation of their nervous system. Until the age of 4 weeks, the pain centers in the hypothalamus and in the cerebral cortex are not yet functioning, and the lower phylogenetically older parts of the brain are less excited.E. I. Arshavskaya (1952) believes that the leading role in the pathogenesis of vascular disorders in shock belongs to the inhibition

that develops in the centers of the sympathetic nervous system and in the spinal ganglia, the main mechanisms of regulation of vascular tone.[6]

Respiratory System

The pathology of the respiratory system of young children is largely determined by the peculiarities of the structure and function of their respiratory apparatus. The chest of young children is always in a state of maximum inhalation, the ribs are located at right angles to the spine, so compensation by deepening breathing is impossible. Babies' breathing is frequent, shallow, and mostly diaphragmatic. Their bronchi are narrow and long and have relatively few branches. So, in adults and adolescents over the age of 16, the bronchi have up to 25 branches, in young children the number of branches is always less. The lumen of their airways is narrow; the mucous membrane is rich in blood vessels and swells easily. The elastic properties of the lungs are less pronounced, since the elastic skeleton of the lungs in children is poorly developed. The respiratory muscles are weak. The abdominal muscles are involved in the breathing act from the very first hours after birth.In an experiment on kittens, it was shown that the reflex to stretch the rectus and oblique abdominal muscles is not stable enough, has a high horn and a low amplitude. Within a month, the reflex characteristic approaches that of adult animals. [7] The centers of the brainstem, including the respiratory center, have a low excitability in a small child, and under any stress, even a small one, exhaustion occurs, as a result of which the function of the respiratory center changes, returning to a phylogenetically lower level.In newborns, arousal of the respiratory center can lead to its inhibition, which will cause a lack of breathing.; This is especially common in premature babies.It should be borne in mind that the respiratory center is not an anatomical, but a functional concept, according to which the center is a whole constellation of centers united by performing a single functional act. In the process of ontogenesis, there is a gradual development and inclusion of all departments of the respiratory center. Arshavsky (1967) believes that in the antenatal period, only the lower part of the respiratory center functions, and only as fetal respiration begins, higher levels of the respiratory center, apneistic and pnneumotactic, gradually turn on. If the respiratory center is damaged as a result of birth trauma, or the excitability of the respiratory center decreases as a result of anesthesia to the maternal body, convulsive breathing may persist for a long time, with "grasping" respiratory movements, breathing characteristic of the functioning of the lower parts of the respiratory center.[8]

Induction influences spread from the respiratory center to the vasomotor center. In the case of a decrease in the tone of the respiratory center, for example, with severe acute hypoxia, induction is weakened and as a result, a certain degree of circulatory insufficiency may develop, which causes developmental delay.Respiratory disorders caused by damage to the upper respiratory tract, in particular, the shutdown of nasal breathing, are of great importance in the pathology of childhood. Impulses from the upper respiratory tract stimulate the respiratory and vasomotor centers, affect the central nervous system, enhancing arousal processes in it, increasing the reactivity of the body. It is no coincidence that substances that irritate the receptors of the nasal mucosa have long been used to bring a person out of fainting. There is a close connection between the lymphatic system of the nose and the subarachnoid space. connection. During nasal breathing, with pressure drops in the nasal passages, pressure changes periodically in the vessels of the brain in accordance with the rhythm of breathing. The shutdown of nasal breathing, and consequently, the cessation of air circulation in the nasal passages leads to impaired lymph circulation, to the development of congestion in the vessels of the brain. Therefore, prolonged shutdown of nasal breathing in childhood disrupts the development of the central nervous system, inhibits the function of its higher divisions.The absence of irritation of the ends of the trigeminal and olfactory nerves by a passing stream of air and a pressure drop during inhalation and exhalation deprives the respiratory center of reflex stimulating effects and may be one of the pathogenetic mechanisms of weakening the respiratory process. This mechanism makes clear the positive therapeutic effect of being outdoors in children suffering from pneumonia. M, S. Maslov believed that the temperature difference of moving air currents, acting on the nerve endings of the nasal mucosa ("air passes"), has an excitatory effect and reflexively increases the excitatory process in the central nervous system, which contributes to the activation of vital functions of the body. Narrowness of the nasal passages, slight swelling of their mucous membranes with rhinitis, adenoids lead to the shutdown of nasal breathing. With adenoids, for this reason, the airflow is less resistant when inhaling, since the child is forced to breathe through his mouth, as a result, there are no physiological stimuli for the normal development of respiratory muscles, and such children have poorly developed respiratory muscles. The cessation of nasal breathing in infants is a serious problem, since by switching to mouth breathing, the child loses the ability to suck, i.e. eat.Young children often aspirate various objects that, when they enter the respiratory tract, can clog the larynx, bronchus, or the branching of the bronchial tree. An aspirated object in the bronchial lumen can act as a valve: during inhalation, air passes into the alveoli, and during exhalation, the bronchus closes. As a result, emphysema develops in the area of the lung drained by a blocked bronchus. If both inhalation and exhalation are disrupted during bronchial blockage, atelectasis occurs.[9]

Hyaline membranes are a special form of respiratory system disease characteristic of newborn infants and mainly premature infants. A. F. Tour (1961) cites data from a number of authors, according to which hyaline membranes may be the cause of death in premature infants in the first two days of life. Out of 100 premature babies, 16 dice, and 40-60% of them, i.e. 5-9 children, die from hyaline membranes.In the section, films of acidophilic substance rich in protein are found in the small bronchi, alveolar passages and in the alveoli adjacent to the walls. The same substance is found in the lumen of the alveoli and bronchioles in the form of small lumps. Blocking of the alveoli disrupts gas exchange and causes progressive shortness of breath, hypoxemia, cyanosis. Death occurs as a result of increasing hypoxia. The pathogenesis of the disease is unclear. Hyaline membranes have never been observed in stillbirths, therefore, for their formation it is necessary that the child be born alive and breathe for a while. Some suggest that hyaline membranes are formed as a result of transudation of blood plasma from pulmonary capillaries, others suggest that the material for the formation of hyaline membranes is decayed bronchial epithelium, etc. Hyaline membranes are more common in children born to mothers with a burdened obstetric history: nephropathy, diabetes, rhesus conflict. They are often formed in children born by cesarean section.Due to the structural features of the bronchial tree (see above), bronchitis and bronchiolitis in infants are quite common and dangerous diseases. Inflammatory edema of the bronchial mucosa, filling of their lumen with a viscous secretion, spasm of the annular muscles lead to the development of atelectasis in some areas of the lung, and emphysema in others. Naturally, exhaling is more difficult than inhaling, as a result, the lungs swell, breathing becomes shallow, and therefore frequent. The more air circulation in the lungs is disrupted, the more severe the hypoxia and the more pronounced the hypoxemia, which causes cyanosis. Cyanosis occurs when the amount of reduced hemoglobin increases and the capillary blood contains 6-7 vol% oxygen instead of 20 vol%.One of the frequent and serious causes of respiratory disorders in early postnatal ontogenesis is pneumonia. The abundant development of interstitial tissue in the lungs of children in the first years of life, rich in blood and lymph vessels, promotes the development of a pathological process that diffusely spreads along the lung interstitium. More than 80% of pneumonia in children are interstitial and its disseminated form is most common. Damage to the bronchial mucosa, connective tissue, and alveoli is destructive.In recent years, the incidence of staphylococcal pneumonia has increased, often leading to the disintegration of lung tissue, the formation of abscesses and pyemic metastases.

In the early stages of ontogenesis, a sick child does not remove secretions from the respiratory tract, as he cannot clear his throat, which further

complicates gas exchange. Violation of the drainage function of the bronchial tree, especially pronounced in weakened children, contributes to the spread of infection. The diffuse nature of pneumonia, in addition to the abundance of connective tissue, is facilitated by the low severity of the vascular component of the inflammatory reaction — the late development and insufficiency of the proliferative and macrophage reactions, which do not allow the lesion to be delimited and localized. Weak production of antibodies during the newborn period is also important.Incomplete development of the functions of the central nervous system, incomplete formation of enzyme systems, protein and glycogen deficiency in the liver contribute to a more severe course of the disease.Characteristic of the course of pneumonia in newborns and especially in premature infants is the absence or low severity of shortness of breath, which is explained by the low excitability of the respiratory center. Pneumonia becomes especially severe in premature infants. Damage and blockage of bronchioles cause the development of widespread atelectasis. The high frequency of atelectatic pneumonia in premature infants is also due to the lack of formation of the system of surfactants in the lung tissue. In this regard, works devoted to the study of surfactant, a protein—lipid substance with surface-active properties located on the walls of the alveoli and preventing them from falling off during exhalation, are of interest.The normal respiratory function of the newborn is provided by a certain amount of surfactant in the alveoli. The main role is played by lecithin, which is part of the surfactant, which stabilizes the alveoli during exhalation by reducing high surface tension. In the absence or low concentration of lecithin, the surface tension increases and the volume of the alveoli decreases until it completely subsides. The older the fetus, the higher the concentration of surfactant.Since the fluid inside the bronchial tree is involved in the formation of amniotic fluid, the concentration of lecithin in the amniotic fluid corresponds to the amount of surfactant in the alveoli of the fetus and allows us to judge the degree of maturity of its lungs.[10] A low concentration of lecithin in the amniotic fluid indicates the possibility of respiratory disorders and, subsequently, hyaline membrane diseases. In this case, it is necessary to delay the development of labor, which may be vital for the child.

It is unknown which cells produce surfactant — second-order alveolar epithelial cells or bronchiolar epithelial cells. The surfactant is detected by luminescent microscopy, while the surface-active film is detected as a yellow-green stripe.High mortality in interstitial pneumonia of newborns and especially premature infants is caused by a violation of blood arterialization. Their blood oxygen saturation drops to levels incompatible with adult life. Hypoxia in pneumonia in children has a complex pathogenesis; along with hypoxic hypoxia caused by impaired gas exchange in the lungs, circulatory hypoxia develops, caused by compression of the pulmonary capillaries. Later, tissue hypoxia is added due to the insufficiency of enzyme systems in the tissues.Croup pneumonia in the first year of life in children is rare, since an allergic component plays a role in its pathogenesis, and young children are not able to give pronounced allergic reactions (see the section "Allergy"). Only as the body is sensitized does the possibility of developing lobular pneumonia become more frequent, which occurs no earlier than the second year of life.Pneumonia often develops in children born by caesarean section. During normal labor, the child's chest is subjected to concentric compression by the birth canal, while the child's airways are cleared of ingested mucus and amniotic fluid. The respiratory tract becomes free for the passage of air. When exiting the birth canal, compression is released, and the chest and lungs expand. Reflexes from the proprioceptors of the respiratory muscles are an important factor in irritation of the respiratory center.Release from compression promotes deep breathing, which is a stimulus for the respiratory center, and it begins to function actively, inducing arousal in the vasomotor center.Thus, acute pressure drops on the chest are necessary for the beginning of active activity of the newborn's respiratory system. By caesarean section, children are born with a lack of respiratory function due to the low excitability of the respiratory center, which persists for several days. The low excitability of the respiratory center is confirmed by encephalographic studies. The use of painkillers, drugs that enhance the contractility of the uterus, anesthesia during childbirth also have a depressing effect on the respiratory center of the fetus and newborn, which contributes to the occurrence of pneumonia in newborns.Recently, there has been a tendency towards a prolonged course of pneumonia and the transition of the disease to a chronic form, which is observed in all age groups of children. Undoubtedly, both the altered properties of the pathogen and the reactivity of the child play a role in the pathogenesis of this process. The microorganisms that cause pneumonia, as a result of the previous and not always justified use of antibiotics and other pharmacological drugs, lose their sensitivity to them. In a healthy body, the lower respiratory tract is sterile. This is ensured by the high resorptive capacity and function of the ciliated epithelium of the bronchial tree.

In a sensitized child's body, sensitivity to microorganisms is increased and the protective properties of the bronchial mucosa are weakened. Increasing the sensitivity of the child's respiratory system to microorganisms contributes to the sluggish course of the inflammatory process and the tendency to spread the process.There is an opinion that pneumotoxins play a certain role in the pathogenesis of pneumonia, i.e. autoantibodies against lung tissue.The consequences of chronic nonspecific pneumonia are bronchiectasis, lung abscesses, pneumosclerosis, and severe forms of bronchial asthma.As mentioned above, elastic and reticular fibers are poorly expressed in the lungs of a small child. Smooth muscles in the alveolar passages are not developed, and lung tone is low. This causes the low strength of the lung tissue. Causes of increased pressure in the alveoli, such as coughing (whooping cough attacks), strong and prolonged screaming, can lead to the development of pulmonary emphysema, which reduces the respiratory surface of the lungs. A sudden and sharp increase in intraalveolar pressure in a child can cause rupture of the delicate lung tissue and pneumothorax. In this case, air enters the pleural cavity or into the intervertebral tissue, into the mediastinum. There are known cases of emphysema in newborns (interstitial, bullous) as a result of artificial respiration performed for the purpose of revival, but without controlling the pressure of the injected air.In young children, and especially in premature infants, periodic breathing is often observed. At an early age, periodic breathing appears during sleep in healthy children. The weakness of the concentrating process in the central nervous system in young children leads to the irradiation of carotid inhibition from the cortex and subcortical centers to the underlying structures, capturing the area of the respiratory center and reducing its excitability. In pathological conditions, hypoxia and metabolic changes are important in the mechanism of periodic respiration, which affects the respiratory center and causes low mobility of the main nervous processes and their stagnation. The excitability of the respiratory center decreases. The normal level of carbon dioxide in the child's blood is insufficient to excite him and begin to inhale. There is a long pause. Hypercapnia, which develops during a pause, stimulates the respiratory center and causes respiratory movements. The release of excess carbon dioxide again leads to a pause.[11]In diabetic coma, with toxicosis, infants develop large Kussmaul breathing, characterized by deep and frequent breathing movements. As a result, the minute respiratory volume increases. Due to this, more carbon dioxide is removed from the body and thus metabolic acidosis is compensated. In very severe cases, the arousal of the respiratory center is replaced by its depression, breathing becomes shallow, although frequent. The respiratory minute volume decreases, and uncompensated metabolic acidosis occurs with a pH shift to 7-6.8. In the early stages of ontogenesis, the respiratory center has low excitability. The low lability of the respiratory center favors the easy occurrence of parabiotic inhibition in it. A little extra excitement can cause him to become exhausted. First of all, the pneumotactic part of the respiratory center associated with the reticular formation of the midbrain becomes insufficient, and then respiration is carried out due to the functioning of the apneistic and lower half of the medulla oblongata — the gasping center, which normally operates only in the antenatal period. In older children, this functional breakdown of the respiratory center develops in

severe diseases (tuberculosis meningitis, pneumonia, etc.). The activity of the gasping center in the fetus at birth is replaced by the functioning of the apneistic mechanism associated with the upper half of the medulla oblongata and the lower part of the varolian bridge. The pnneumotactic part of the respiratory center, located in the reticular formation of the midbrain, begins to act only after the lungs are fully expanded.

The restructuring of blood circulation that occurs at birth is associated with the onset of respiration. In the fetus, the branches of the pulmonary artery have a narrow lumen, and the younger the fetus, the narrower the branches of the pulmonary artery. In premature infants, this is due to underdevelopment of the vascular wall, and in full-term infants it is caused by a spasm that develops as a result of hypoxemia. The narrow branches of the pulmonary artery have a high resistance to fetal blood flow, so the pressure in the trunk of the pulmonary artery exceeds the pressure in the thoracic aorta and blood bypasses the lungs into a large circle through the Arantium duct. Little blood flows through the pulmonary artery into the left half of the heart and the pressure in the right atrium is higher than in the left, which determines the direction of blood flow through the oval opening from right to left.The beginning of active breathing of a newborn leads to the straightening of the respiratory tract and the entry of air into them, the oxygen content in the blood of the pulmonary artery increases, and this relieves spasm from its branches. The expansion of the lumen of the branches of the pulmonary artery leads to a decrease in resistance to blood flow, and blood begins to flow into the pulmonary artery, while the umbilical vessels and ductus arteriosus spasmodically close under the influence of increased oxygen content in the blood. The expansion of the branches of the pulmonary artery and the final expansion of the lungs do not occur immediately, but gradually. In newly born full-term infants, the average arterial lumen of the bronchioles is 10 microns, and by the 5th-7th day it reaches 25-27 microns. The drop in resistance to blood flow in the branches of the pulmonary artery runs parallel to the expansion of the lungs. Complete expansion of the lungs occurs within 48 hours. Studies by I. K. Esipova and O. Ya. Kaufman (1968) showed that the expansion of the small muscular arteries in a newborn and the expansion of the respiratory sections of the lung occur by the 4th-5th day. In premature infants, only 25% of the alveolar passages are straightened out in the first 48 hours of life due to the underdevelopment of the alveoli. If a premature baby spreads less than 7b of the lungs, which happens in children weighing less than 1,500 g, asphyxia is observed. In premature infants, atelectasis can last 5-7 days; if the child has suffered an intracranial injury, 5-10 days. I. K. Esipova and O. Ya. Kaufman (1968) established 2 types of disorders of postnatal vascular remodeling of the small circle:1) slowing down the expansion of the small muscular arteries of the small circulatory system, which is associated with insufficient aeration of the lungs (preservation of atelectasis); 2) premature and excessive expansion of the branches of the pulmonary artery; it occurs with artificial respiration performed without pressure control, under which air is pumped into the respiratory tract. In this case, the process of adaptation of the left ventricular myocardium to changes in hemodynamics is disrupted.Of great interest is the issue of sensitivity to hypoxia in the early age period. The laboratory of N. N. Sirotinin (1949-1951) established that at a certain stage of development, the respiratory center and the heart have a high degree of resistance to hypoxia. N. V. Lauer (1959) believes that the adaptation of newborn animals to a hypoxic environment occurs by lowering the level of oxidative processes and the associated reduced oxygen consumption. Oxidative metabolism switches to a more primitive and less efficient anaerobic glycolysis. The validity of the above position is proved by experience: if the anaerobic glycolysis of a newborn is pre-suppressed with monoiodacetic acid at the stage of the transition of glucose-6-monophosphate to triose phosphate, its death under conditions of hypoxic hypoxia occurs at the same time as in adult animals.A. 3. Kolchinskaya (1964), placing adult dogs and puppies in a pressure chamber, observed the death of adult dogs when they reached a "height" of 11,000-12,000 m. One-month-old and one-and-a-half-month-old puppies died at an "altitude" of 12,000 m, two-week-old puppies survived a 1.5-hour stay at an "altitude" of 12,000 m, and newborn puppies remained alive after 4 hours at an "altitude" of 10,000 m and 1 hour -12,000 m. N. V. Lauer (1959) showed It is shown that in conditions of severe hypoxia, the respiratory center in newborns is more resistant to hypoxia than in adults, and retains its automatic activity for a longer time.Adaptive responses at this stage of development are of little importance. As it develops and differentiates, tissue resistance to hypoxia decreases and adaptive mechanisms are formed. Children under 1 year of age do not respond to hypoxia by increasing their breathing and pulse rate. These reactions appear only after 1 year and then not constantly, only at the age of 6-7 years the same adaptive mechanisms as in adults act. Arshavsky believes that the long-life expectancy of children and animals of early age in conditions of hypoxia is due to prolonged collapse (delayed collapse) and depends on the pronounced automatism of the heart and respiratory center.[12] Only newborns born immature, such as puppies, kittens, baby rats, and baby mice, are resistant to hypoxia. Mature animals (guinea pigs, goats) have the same sensitivity to hypoxia as adults. Based on this, it can be concluded that resistance to hypoxia is mainly determined by the level of development of the central nervous system and its functional state. I. R. Petrov (1949) showed in animal experiments that an increase in the excitability of the central nervous system caused by any method dramatically reduces the body's resistance to hypoxia, while decortication significantly increases the body's resistance to reduced oxygen content in the inhaled air.

The Digestive System

Of a small child's stomach has a small capacity (it reaches 250-300 ml only by the age of 6 months). The glands of the stomach floor are few in number. The acidity and enzymatic activity of gastric juice are low. Thus, according to M. S. Maslov (1946), in a one—month-old child, the total acidity is 3.6-10 ml, and in a one-year-old it is 12-21 ml (the acidity of gastric juice is expressed in the number of milliliters of decinormal caustic soda used to neutralize 100 ml of gastric juice). Only after 9 months, the actual acidity reaches the value necessary for the digestion of animal proteins.In early childhood, a child has a high level of metabolic processes. The energy obtained from the food he eats is spent by him on maintaining life, on muscular activity, on plastic processes. During this period, the most intensive growth occurs. Previously, by the age of 5-6 months, the child doubled his body weight, and by the age of 12 months, he tripled. Currently, body weight doubles by 4.5—5 months, and triples by 11-11.5 months. The acceleration of growth is explained by the acceleration that is taking place. In accordance with a high metabolism, a child needs food, the caloric content of which would satisfy his needs. In the first 3 months after birth, 120-125 kcal / kg is needed, at the age of 3 to 6 months — 100-110 kcal / kg, and in the period from 1 to 3 years — 80-90 kcal / kg. Thus, in early childhood, the child's digestive system is heavily burdened, while his gastrointestinal tract has limited adaptability to food substances and food that does not meet the functional capabilities of the child's digestive system causes severe disorders.Therefore, gastrointestinal diseases in young children are very common. They can be caused by the food itself or substances that come with it, disorders of the digestive organs, or develop a second time, as a reflection of the pathological process that has arisen in the body. It was mentioned above that a feature of a young child's reactivity is the ability to respond to any irritation with a general reaction.: from the nervous system — convulsions, from the digestive system — dyspeptic phenomena. Therefore, a variety of diseases and changes in the environment can be accompanied by digestive disorders (flu, pneumonia, inflammatory diseases of the upper respiratory tract, otitis media, pyelitis, etc., as well as malnutrition, overheating).[13] In an adult organism, food is digested through oral and parietal digestion. In the intestinal cavity, the initial stage of hydrolysis of proteins, fats, carbohydrates, and nucleic acids is underway, i.e., the preparation of a substrate for parietal digestion. Intermediate and final hydrolysis of food takes place on the surface of the intestinal mucosa. The surface of the intestinal epithelium has microvilli (brush border), up to 3,000 on each cell, which increases the surface of

the mucosa by 35 times. Being sorbed on microvilli, enzymes increase their activity. The surface of the intestinal epithelium becomes like a catalyst. The end products of hydrolysis formed in the brush border under the influence of enzymes are inaccessible to microorganisms, since the gaps between the microvilli (100-200 A) are smaller than microbial bodies.In newborns and infants who are not yet receiving complementary foods, oral digestion is almost not developed. Milk is a highly dispersed food. It does not require oral digestion. With the transition to a mixed diet, the set of digestive system enzymes changes, their activity increases, and the specific gravity of oral digestion increases. The activity of maltase, which breaks down disaccharides, increases first, followed by lactase and other intestinal enzymes. Sometimes there is a slight delay in the synthesis of enzymes, and then the presence of substances in the child's food that do not yet have enzymes for digestion leads to diarrhea. Thus, the absence of lactase leads to severe dystrophy, since all milk sugar, without hydrolyzing, becomes the property of microorganisms. The intestinal microflora multiplies, a large number of metabolic products of microorganisms are formed, which have a toxic effect, cause diarrhea and lead to exhaustion.[14] A.M. Ugolev et al. (1967) showed in an experiment that there may be a temporary deficiency of invertase. This is often the case in children and is explained by the delay in the development of the invertase synthesizing system. In addition to the delay in the synthesis of an enzyme, its absence may be genotypic or secondary, due to impaired enzyme production by the intestinal epithelium or a decrease in its adsorption by the intestinal mucosa from the chyme, resulting in decreased enzyme activity. As the child grows, the set of enzymes of not only oral, but also parietal digestion changes. This is facilitated by a change in the nature of food — the parietal and abdominal digestion adapts to the quality of nutrition. In addition, genetically determined nervous and humoral stimuli act. The mechanism of regulation of parietal digestion is poorly understood, but it is known that hormones of the pituitary gland, adrenal cortex, and thyroid gland stimulate the production of certain enzymes.[3] Violation of parietal digestion underlies the pathogenesis of a number of diseases of the digestive system, such as celiac disease. In celiac disease, there is an intolerance to the gluten protein of cereals — gliadin. This nonspecific intolerance to a particular protein is caused by enzymatic insufficiency of the intestinal epithelium. The products of gluten hydrolysis are adsorbed by the microvilli of the intestinal epithelium and damage them. The number of microvilli decreases, sometimes almost to complete disappearance, and therefore contact digestion suffers. The appointment of a gluten-free diet leads to the restoration of the normal structure of the brush border and the gradual restoration of enzyme systems.[15]

After gastric resection in children, amylase adsorption by the intestinal epithelium is disrupted. Damage to the structure of the small intestine wall and thus to contact Digestion occurs in a number of viral diseases, for example, hepatitis, measles, and adenovirus infection.[4] Dyspepsia, especially its toxic form, is of great importance in the pathology of early childhood. Dyspepsia is an acute digestive disorder caused by malnutrition or infection (dysentery, salmonellosis, enteritis of various etiologies, pneumonia, otitis media, respiratory viral infections). The main clinical manifestations of toxicosis are disorders of the central nervous system, cardiovascular disorders and metabolic disorders, mainly water-salt.The study of the pathogenesis of toxic dyspepsia has shown that it should be considered not as an independent nosological unit, but as a peculiar syndrome that can be caused by various causes.In the clinical picture of toxic dyspepsia, there are 3 groups of disorders: disorders of the central nervous system, circulatory disorders and metabolic disorders (dehydration and metabolic acidosis). As a rule, the disease is accompanied by vomiting and diarrhea. In the pathogenesis of the syndrome, initial intoxication, dehydration and collapse are distinguished.When infected food or food that does not correspond to the age of the child enters the intestine, toxic substances are formed that penetrate through the intestinal, hepatic, and blood-brain barriers. However, in the pathogenesis of the disease, especially at the beginning of it, the main role is played not by intoxication, but by a violation of water-salt metabolism — dehydration of the body. Accelerated intestinal motility makes it impossible to absorb water, salts, nutrients, and digestive juices. The build-up of organic acids in the blood, as well as the loss of bases with vomit and loose stools, causes acidosis. Starvation of a child worsens it, contributing to the accumulation of ketone bodies in the blood. In the same direction, impaired kidney function is affected, which loses the ability to release acidic valences. As a result of metabolic acidosis, the release of potassium from cells increases, while sodium takes its place. Dehydration with hyposalemia leads to potassium deficiency in the body. Clinical manifestations of hypokalemic syndrome are: general weakness, decreased muscle tone, dilation of the heart, tachycardia, ECG changes, paralytic ileus, resulting in flatulence and vomiting.[16] Yu. E. Veltischev (1967), examining children with toxicosis, found hypokalemia in */w patients, while clinical signs of hypokalemic syndrome were present in almost half of the children. This is due to the fact that potassium is an intracellular ion and its normal plasma content can be combined with a significant deficiency inside cells.Intoxication with substances absorbed from the intestine, impaired water-salt metabolism, metabolic acidosis, and hypotrophy, which increase during the disease, affect the central nervous system. Initially, the excitability of the cerebral cortex increases, manifested by motor arousal.In the future, progressive dehydration and metabolic changes lead to the suppression of all regulatory functions of the body. Consciousness is depressed (soporotic-adynamic phase). A decrease in the immunological reactivity of a child leads to the development of a septic condition. Dehydration and, as a result, impaired function of the cardiovascular system, microcirculation disorders cause tissue hypoxia and rapid onset of collapse.If an infant suffering from dyspepsia receives milk, i.e. water, salts, protein, fat, then the water-salt balance may not be disturbed or slightly disturbed. If, as a result of loss of appetite, food intake is sharply reduced, dehydration is inevitable.[17] In the case of addition of water loss to toxicosis by perspiration, hyperventilation, which is observed at high ambient temperatures, dehydration becomes threatening. Thus, at normal room temperature, a healthy infant loses up to 20 ml/kg of water per day, and at a room temperature of 33.8 ° C, water loss increases to 75 ml/kg/day. In the late 19th and early 20th centuries, the mortality rate from toxic dyspepsia in children, especially in the summer months, reached 90%. Currently, due to the early use of pathogenetic therapy (rehydration, i.e. the introduction of water and salts, antibacterial drugs — antibiotics, sulfamide preparations), mortality has decreased to 2-5%. Incomplete starvation or malnutrition occurs in infants with hypolactia, with tight nipples of the mother, with a runny nose in the child, which makes the act of sucking impossible. In children receiving complementary foods, the content of all necessary ingredients in food (complete protein, fats, vitamins, carbohydrates) and their ratio are important. In economically underdeveloped countries, children often do not receive adequate nutrition, which leads to stunted growth, impaired memory, perception, and diarrhea (Report of the Food and Agriculture Organization of the United Nations —FAO/WHO, 1969). Diarrhea, which develops with malnutrition, has a complex pathogenesis. Prolonged fasting reduces the excitability of the food center, which causes a decrease in the secretion of digestive juices. The bactericidal activity of intestinal juice decreases, and microorganisms from the colon penetrate into the upper intestine. A decrease in the enzymatic activity of digestive juices disrupts the digestion of food, as a result of which, under the influence of microflora, products of fermentation and putrefaction of food substances are formed, among them toxic, irritating the intestinal mucosa and causing rapid peristalsis.With a decrease in the reactivity of the body, the inflammatory process in the intestine can also be caused by saprophytes, which acquire pathogenicity in these conditions. The high permeability of the intestinal barrier in the early age period is of great importance.Eating disorders in children, leading to starvation, are often the cause of impaired appetite. Conditioned reflexes play a huge role in appetite regulation, and the older the child, the more important they become. Under the influence of conditioned reflexes, secretory activity of the digestive glands begins. Conditioned reflexes begin to form at the end of the first month or at the

beginning of the second month and reach a fairly high differentiation in the 3rd or 4th month.[18] Allergic diseases of the gastrointestinal tract are common in young children. Sensitization can occur during the prenatal period in a transplacental manner. After birth, sensitization occurs enterally, due to the high permeability of the intestinal wall, which increases even more during and after diarrhea. The main allergen for infants is cow's milk — its p-lactoglobulin, contained in amounts from 7 to 12%. At an early age, typical allergic reactions do not develop. Allergy manifests itself in the form of digestive disorders, loss of appetite, and dystrophic changes. At an older age, there may be eczema, asthmatic bronchitis, and there are no digestive system disorders.

Liver

In young children, the liver is the largest organ with a well-developed left half. The right half of the liver is larger in size and weight than the left by the age of 6. In the liver of a newborn child, a number of enzyme systems have not yet been formed, which leaves its mark on the pathology of early age. Insufficient enzymatic activity of the liver is associated with a low level of protein synthesis in children, since half of the protein produced by the liver is spent on building enzymes.Hypoproteinemia and hypoalbuminemia are even more common in premature infants. A manifestation of functional immaturity of the liver is the delayed destruction of hormones. Thus, 17-ketosteroids are not formed in the homogenate of the newborn's liver, aldosterone, antidiuretic hormone, etc. are not inactivated. With cirrhosis of the liver, which develops in childhood or adolescence, there is insufficient cleavage of sex hormones, which leads to inhibition of the secretion of gonadotropic hormones. In such children, the development of the testes and ovaries is delayed, and as a result, sexual development slows down.The liver has a high regenerative capacity. In adult healthy animals, after 3/4 of the liver is removed, the original weight of the organ is restored after 4 to 8 weeks. In a developing organism, regeneration occurs faster. However, with liver diseases in childhood, deep functional disorders are more often observed, a tendency to necrosis, and repair is more prolonged; this is facilitated by both the anatomical and physiological features of the child's liver and increased demands on liver functions from the growing organism.[19] The liver plays a major role in the metabolism of bilirubin. Indirect bilirubin, formed from hemoglobin in reticuloendothelial cells (from 1 g of hemoglobin it forms 34 mg of bilirubin), enters the liver with blood, is captured by liver cells and, under the action of the enzyme glucuronyltransferase, combines with glucuronic acid, bilirubin diglucuronide or direct bilirubin is formed, secreted by liver cells in bile.In newborns, the conjugatory function of the liver is less pronounced, the formation of direct bilirubin in the liver almost does not occur, which is explained by the lower activity of glu- the curonyltransferase system in microsomes, resulting in a deficiency of uridine diphosphate, glucose dehydrogenase, under the influence of which uridine diphosphate glucose and uridine phosphate glucuronic acid are formed. It is also possible that hypoxia, which develops in the liver when fetal blood circulation switches to postnatal blood circulation, reduces the activity of liver enzymes. In the fetus, the liver receives purely arterial blood, and after birth, only 1/ ml of blood flows through the hepatic arteries, and the remaining 2/ ml flowing to the liver through the portal vein is venous.Many newborns have jaundice on the 1st-3rd day after birth, which reaches a maximum on the 3rd-4th day and disappears on the 11th-21st day (physiological jaundice). The rapid rise of bilirubin in the blood is one of the most constant physiological manifestations of the newborn period. In premature babies, jaundice develops more often, is more pronounced and lasts longer.[20] For a long time, the origin of neonatal jaundice was explained by the destruction of red blood cells that occurs after the birth of a child due to an increase in oxygen content in his blood after switching to pulmonary respiration. However, it was later found that all children are born with hyperbilirubinemia, although only a part of them turn out to be jaundiced, and that there is no correspondence between the intensity of hemolysis and the severity of jaundice. Jaundice appears in the first days of life, and the maximum decrease in the number of red blood cells occurs in the second week, when jaundice most often disappears. It was found that the content of indirect bilirubin in the fetal blood is always increased compared to the blood of the maternal body. After the birth of a child, the amount of bilirubin increases during the first 3-10 days, and then gradually begins to decrease to the usual level. The tendency to hemolysis and the development of jaundice is partly explained by the fact that the child's blood has low levels of lipids, especially cholesterol, which contributes to the hemolysis of red blood cells.[21] During intrauterine development, the main route of bilirubin release from the fetal body is the placenta and, to a much lesser extent, the liver. The placenta is impassable to bilirubinoglucuronate and easily permeable to indirect bilirubin, which is due to its solubility in the lipid components of the placenta. After birth, the placental route of bilirubin removal becomes impossible, and bilirubin excretion in the first days is only 1-2% compared to adult excretion. Due to the immaturity of liver enzymes, the conversion of bilirubin to bilirubindiglucuronate is carried out only to a small extent. Therefore, after birth, indirect bilirubin begins to increase in the blood of the child, and only after the inclusion of liver enzymes — glucuronyltransferase, its level decreases. According to V. A. Tabolin (1967), bilirubin ranges from 1.43 to 2.4 mg% in the blood of healthy newborn infants. On day 3-4, when maximum hyperbilirubinemia occurs, its content reaches 10-14 mg%. In premature infants, the level of bilirubin in the blood is even higher and to a greater extent, the lower the child's weight. V. A. Tabolin cites data from Osh (1954), But 1 shap (1958), according to which 39-59% of all children born prematurely have bilirubin levels in the blood in the first week of life may exceed 18-20 mg%.In newborns, there is no direct relationship between the bilirubin content in the blood and the presence and intensity of jaundice staining. The latter depends mainly on the bilirubin content in the tissues, which in turn is determined by the content of lipids in which bilirubin is highly soluble. The penetration of bilirubin from the blood into the tissues depends on the amount of free bilirubin in the blood. Indirect bilirubin entering the blood immediately binds to plasma albumin (1 g of albumin binds 14 mg of bilirubin). If the amount of bilirubin in the blood exceeds the binding capacity of plasma albumin, then the remaining free bilirubin easily diffuses into the tissues, into the cerebrospinal fluid. Thus, the level of albumin in the blood determines the amount of free bilirubin and the degree of its penetration into tissues. Newborns always have hypoalbuminemia. In addition, the degree of tissue affinity for bilirubin is important.[22] Bilirubinophilic and bilirubinophobic tissues are distinguished. The first include the mucous membrane of the soft palate, conjunctiva, vascular intima, the second — the cornea of the eye, cartilage, muscles. It is possible that the ability of the tissue to retain bilirubin is determined by the content of elastin in it, which intensively binds bilirubin. Bilirubin is retained in lipids (in fatty and nervous tissues) due to its good solubility in them. Therefore, in premature infants who do not have developed adipose tissue, the concentration of bilirubin in the blood and in other tissues increases.In case of incompatibility of the blood of the maternal organism and the fetus (hemolytic disease of newborns or eri- fetal troblastosis) in the fetal body, increased hemolysis of red blood cells occurs and, accordingly, a large amount of bilirubin is formed.Hemolytic disease of newborns can also occur with incompatibility of blood group factors (according to the ABO system, etc.), but much less frequently, and its course in these cases is less severe.With hemolytic disease of newborns, the formation of albumin in the liver is disrupted, and therefore a greater or lesser degree of hypoalbuminemia develops (VA Tabolin, 1967), which leads to an increase in free bilirubin, which easily diffuses into tissues and mainly into tissues rich in lipoids, i.e. into nervous tissue, adrenal cortex and adipose tissue.Penetrating into the brain cells, bilirubin stains its nuclei, which are mostly actively functioning. As a result, a number of neurological symptoms occur (apathy, drowsiness, oculomotor disorders, seizures), and death often occurs. The above-described syndrome is called nuclear jaundice, and it occurs when indirect bilirubin in the blood increases to 18-20 mg% or higher. • Indirect bilirubin has a toxic effect, uncoupling the processes of oxidation and phosphorylation, binding NAD and cytochrome C. As a result of the toxic effect of bilirubin, in addition

to nuclear jaundice, necrosis foci form in the adrenal glands, spleen, pancreas and other organs.E. N. Vorotyntseva and V. A. Tabolin (1965) found that administration of serum containing indirect bilirubin at a concentration of 12-15.9 mg% and even 3.38—4.5 mg% to rabbits caused a decrease in oxygen absorption by brain tissue, liver, and adrenal glands. When exposed to the tissue of adult rabbits, the bilirubin concentration of 12-15 mg%, on the contrary, caused increased oxygen uptake by the brain tissue. The different effect of indirect bilirubin on oxygen uptake at an early age and in adults is explained by the greater permeability of the hemato-encephalic barrier, which is higher the younger the body, the albumin content in the blood, which is lower at an early age, and the degree of tissue differentiation.The bilirubin-binding ability of albumin can be reduced by the presence of substances in the blood that easily combine with it. These substances include a number of drugs, such as sulfonamides, salicylates, caffeine, etc. These substances displace bilirubin from its junction with albumin and transfer it to a free state.The content of bilirubin in the cerebrospinal fluid correlates more with the level of blood albumin than with the concentration of bilirubin in the blood. Therefore, in the case when a pregnant woman took the above-mentioned drugs shortly before giving birth, or they were given to a newborn, the possibility of developing nuclear jaundice increases, even in the absence of hemolytic disease.

Jaundice can also develop under the influence of various factors that inhibit the enzymatic activity of the liver or form compounds with glucuronic acid and, thus, compete with bilirubin. These substances include some antibiotics (levomycetin, novobiocin), barbiturates, chloramphenecol, menthol, etc. An overdose of some vitamin K analogues increases the hemolysis of red blood cells and inhibits the connection of bilirubin with glucuronic acid. Children of the first month of life are not recommended to be given medicinal substances that are removed from the body in the form of compounds with glucuronic acid, as this contributes to hyperbilirubinemia. Hypoxia and infectious diseases, especially viral ones, in newborns reduce the ability of the liver to form bilirubin compounds with glucuronic acid and thereby cause high hyperbilirubinemia.Usually, hyperbilirubinemia decreases earlier than the activity of the conjugating system of the liver glucuronyl transferase is restored.In addition to hemolytic jaundice, mechanical and parenchymal jaundice are also observed in the early age period. Mechanical jaundice usually develops in the case of congenital atresia of the biliary tract. Parenchymal jaundice occurs as a result of hepatitis, cytomegaly, congenital toxoplasmosis, syphilis, umbilical sepsis, etc. When the liver is affected, direct and indirect bilirubin increases in the blood. The latter penetrates into the blood through the lymphatic vessels of the liver, bile capillaries, through sinusoids and through connective tissue. In recent years, evidence has been obtained that the combination of bilirubin with glucuronic acid can occur in the blood, due to the fact that in severe lesions of the liver parenchyma, glucuronyltransferase is detected in the blood.[23] The most common cause of liver failure in childhood is viral hepatitis (Botkin's disease). According to A. S. Martynkin (1967) and M. V. Malina (1967), viral hepatitis mainly affects children; they account for 70-80% of all sufferers of this disease. Therefore, this disease should be considered as a childhood infectious disease. The course of viral hepatitis in childhood is more severe, staphylococcal infection is very easy to join, there is a violation of bilirubin secretion, which contributes to the development of jaundice and is especially pronounced in infancy.Insufficiency of the enzymatic function of the liver is manifested in a decrease in the amount of diglucuronides and an increase in monoglucuronides.With epidemic hepatitis in children, water-salt metabolism is disrupted. Hyponatremia and hypokalemia develop, which are most pronounced in severe forms of the disease. The excretion of potassium and sodium by the kidneys after a short-term decrease increases significantly, 2-4 times higher than normal. In the acute period of the disease, the hydrophilicity of tissues increases, and a positive water balance occurs.Children under 3 years of age have a pronounced deficiency of vitamin B6, which develops with hepatitis, which leads to a disorder of protein metabolism, to a decrease in the activity of antitoxic liver function. The phagocytic function of Kupffer cells decreases, which is quite pronounced in healthy infants.In fetal hepatitis, the metabolism of bilirubin and 17-oxycorticosteroids is disrupted, which indicates damage to the liver parenchyma. The high regenerative capacity inherent in a healthy liver is significantly reduced when it is affected by a pathological process.Kidneys A child is born with kidneys that have not completed their development. The volume of filtration in the glomeruli per unit body surface area is almost two times less than that of an adult. This is due to the smaller size of the filtering surface of the kidneys in a child with smaller glomeruli. The visceral leaf of the Bowman—Shumlyansky capsule is lined with cubic and even cylindrical epithelium, which complicates the filtration process. It is only by the 3rd month that the cubic epithelium turns into a flat one. The reabsorption of water and salts also occurs in a smaller volume. Glucose reabsorption only approaches the volume of adult reabsorption by the beginning of the second year. At an early age, tubular excretion occurs to a much lesser extent than in adults. The ability of newborn kidneys to release H-ions, titrated acids, phosphates, and to synthesize ammonium salts is at a low level.[24]

The main function of the kidneys is to maintain the consistency of the composition of the body's internal environment. Despite the limited functionality, the kidneys of a newborn provide homeostasis under physiological conditions. Thus, the urea content in a child's blood varies within the normal range, although a lower filtration volume determines a lower urea clearance. The absence of azotemia is explained by the fact that in the early age period children have a positive nitrogen balance and the bulk of dietary protein is used to build tissues, only a small part of the protein breakdown products is excreted. However, the slightest error in the diet, for example, an excess of protein in food, will cause azotemia of extrarenal origin, homeostasis is disrupted.The kidneys of a small child regulate the constancy of osmotic pressure only within narrow limits, since antidiuretic and antinatriuretic reflexes have not yet been formed. At an early age, the concentration function of the kidneys is not yet developed. The concentrating mechanism of the adult kidney consists, firstly, in the fact that, under the influence of succinic acid succine dehydrogenase, located in the epithelium of the ascending Henle loop, sodium is actively reabsorbed from the tubules into the interstitium and capillaries of the kidneys, thereby creating a hypertonic environment at the level of the peaks of the pyramids. Secondly, in the pyramid zone, the intercellular substance of the collecting tubes contains acidic mucopolysaccharides, and the epithelium of the collecting tubes responds to the action of ADH by secreting hyaluronidase. Under the influence of hyaluronidase, the intercellular substance of the collecting tubes becomes permeable to water, and due to the difference in osmotic pressures, water rushes from the collecting tubes into the kidney tissue. An antidiuretic reflex is performed.Enzyme systems have not been formed in the epithelium of the Henle loop of a newborn child, which prevents the creation of a hypertensive environment at the top of the pyramids and the formation of acidic mucopolysaccharides in the intercellular substance has not been completed, and the epithelium of the collecting tubes only gradually acquires the ability to respond with the secretion of hyaluronidase to the action of antidiuretic hormone. Therefore, the urine of a newborn child is always hypotensive in relation to blood plasma, and a child requires almost twice as much water as an adult to remove nitrogen metabolism products. This is the reason for the relative polyuria and hyposthenuria characteristic of young children.[25] During the newborn period, excess fluid is secreted by the kidneys exclusively by the glomerular apparatus. The tubular sections of the nephron do not change their activity under water stress. At an early age, the system of epithelioid cells of the juxtaglomerular apparatus synthesizing renin has not yet reached its final development and does not regulate filtration and natriuresis. As is known, the function of renin is not so much to influence filtration as to regulate natriuresis.In newborns of the first days of life (up to the 14th day), deposits of uric acid salts (ammonium uric acid) and calcium oxalate are found in the renal tubules and pelvis, which fall out in the form of sand or lumps. Small salt crystals are incorporated into

leukocytes, into the renal epithelium. With increased urination, salts are washed out, which occurs within 10-14 days. Urine rich in salts is intensely colored, cloudy, and red precipitate precipitates during centrifugation. This physiological phenomenon, called uric acid infarction, is caused by increased uric acid formation and insufficient excretory function of the newborn's kidneys. All children who died during the first day after birth have a uric acid infarction. The epithelium of the urinary tubules secretes a substance that forms hyaline cylinders, in which uric acid salts, urates, are deposited.In newborns, transient proteinuria (no more than 0.5%) is observed in the first days of life, apparently associated with the release of ballast protein substances trapped in the child's body during childbirth. Another form of physiological proteinuria, most often found in adolescence (7-16 years), is orthostatic proteinuria. Protein excretion in the urine (up to 5-10 g per day) occurs when the body is in an upright position. After puberty, this form of proteinuria disappears.[26] Some believe that it is caused by compression of the inferior vena cava between the spine and the liver, which makes it difficult for blood to flow out of the renal vein. A more likely explanation is proposed by E. M. Tareev (1958), according to which proteinuria develops as a result of the instability of the vasomotor apparatus characteristic of adolescence. A change in body position leads to a reflex narrowing of the renal vessels and, as a result, proteinuria.The mechanism of this phenomenon has not been definitively clarified. Palpation of the abdomen, excessive physical exertion and other stressful factors cause transient proteinuria in children much more easily than in adults.A number of kidney diseases are genotypic and manifest.already at an early age. The pathogenesis of these diseases is based on a violation of the tubule function (tubulopathy) associated with the absence of any enzyme. For example, in renal diabetes mellitus, tubule cells do not produce the enzyme necessary for glucose reabsorption. In this case, glucosuria occurs without hyperglycemia. It is believed that the disease is caused by a single dominant gene unrelated to gender.Tubular acidosis is a hereditary anomaly that consists in the low ability of the tubular epithelium to remove hydrogen ions and to ammoniogenesis. A low activity of NADP-diaphorase in the renal epithelium associated with isocitrate dehydrogenase of the Krebs cycle was found. The authors believe that as a result, insufficient energy is generated, which is necessary for the formation of a concentration gradient of hydrogen ions. The result is urinary excretion of large amounts of bicarbonates, loss of sodium, potassium, and calcium. The alkaline reserve in the blood decreases, hypokalcemia and hypophosphatemia develop. Retention of chlorine ions leads to hyperchloremic acidosis. The loss of sodium ions causes hyperaldosteronism. The deposition of calcium and phosphorus in osteoid tissue is disrupted, leading to the development of osteomalacia, and the high calcium content in urine contributes to nephrocalcinosis and the deposition of kidney stones. The disease manifests itself most often in the first year and a half of life.Aminoaciduria occurs in children with galactosemia, when there is a marked inability to completely convert galactose. As long as the child's diet contains galactose, amino acids are excreted in the urine. When galactose is excluded from the diet, aminoaciduria disappears. Galactose appears to block enzymes involved in the active reabsorption of amino acids by cells of the proximal tubules of the kidney. Wilson's disease also has aminoaciduria, but its pathogenesis is different.[27] At the age of 1-2 years, some children develop renal phosphate rickets, an anomaly of renal function that is familial and inherited in a dominant type. The disease is characterized by increased release of phosphates, despite their low levels in the blood. The consequence is an insufficient deposition of calcium in the bones, which leads to their rickety deformation and impaired growth. Absorption of calcium in the intestine decreases, as well as excretion, but despite this, the concentration of calcium in the blood remains normal. The therapeutic effect is provided by large doses of vitamin E. Diffuse glomerulonephritis, an infectious and allergic disease with a pronounced autoallergic component, occupies a central place in kidney pathology in children.The most common sensitizing agent is hemolytic streptococcus group XII, type A, localized in tonsils, carious teeth. The interaction of streptococcal toxin with the protein of the renal glomeruli (with the basement membrane) leads to the formation of an autoantigen, in response to which autoantibodies to renal autoantigens are formed. The damaging factors are the complex of autoantigen and autoantibodies, its decomposition products, and biologically active substances (gm stamin, bradykinins, acetylcholine, and serotonin). In glomerulonephritis, the primary lesion is always the glomerular lesion. Damage to the tubules in all forms of glomerulonephritis is secondary.An early sign of glomerulonephritis in children is increased urinary excretion of acidic mucopolysaccharides, a consequence of impaired metabolism. In healthy children, the daily urinary excretion of acidic mucopolysaccharides depends on age and gender. At the age of 1 to 3 years, the lowest excretion of them is noted, in older children (from 12 to 15 years) the excretion of acidic mucopolysaccharides is maximal. Metabolic disorders of acidic mucopolysaccharides occur very early and have a differential diagnostic value.Previously, it was believed that degenerative lesions of the tubules are an independent kidney disease (nephrosis). Lipoid nephrosis is now allowed to exist as an independent disease only in children under 3 years of age. In other cases, they talk about nephrotic syndrome, which accompanies various kidney diseases. The addition of nephrotic syndrome to diffuse glomerulonephritis worsens the disease, reducing the overall protective reactions. According to Victor (1968), the increase of fatty substances in the blood in lipid nephrosis (nephrotic syndrome) plays a role in maintaining colloidal osmotic blood pressure with a lack of protein. However, this point of view is not generally accepted and further research is required.Pyelonephritis is a very common disease in children. A. Y Pytel and N. A. Lopatkin (1970), R. F. Yezersky (1971) believes that pyelonephritis ranks second in frequency after respiratory tract infections.In pyelonephritis, a nonspecific inflammatory process affects the renal pelvis, calyx, and parenchyma of the kidney (mainly its intervertebral tissue).

Girls are more likely to develop pyelonephritis, which is due to the anatomical features of their genitourinary system.[28] Pyelonephritis is most often caused by E. coli, staphylococcus, enterococcus. The penetration of microorganisms into the kidney can occur ascending through the ureter, as well as hematogenous and lymphogenic pathways. In hematogenous pyelonephritis, the primary focus of infection is more often located in the urinary or genital tract, but other localization is also possible.The condition of the child is essential for the occurrence of pyelonephritis. Eating disorders, hypovitaminosis. cooling, fatigue, reducing the body's resistance, make it susceptible even to low-virulent microorganisms. Pyelonephritis often develops due to congenital abnormalities of the urinary tract. In about 1/z of cases, chronic bilateral pyelonephritis leads to renal failure.

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