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Disorders of Calcium-Phosphorus Metabolism in Children with Chronic Pyelonephritis

Kamalova Lobar Yagmurovna
Bukhara State Medical Institute named after Abu Ali ibn Sino, Uzbekistan

Resume. The connection between the condition of the oral cavity and general somatic diseases is constantly emphasized by dentists. This arouses the constant interest of researchers to study the features of the course of dental pathology against the background of some forms of somatic diseases. In the literature, there is information about the condition of the hard tissues of the teeth, periodontal tissues and the mucous membrane of the oral cavity in children with chronic pyelonephritis. Morphological association of pathological processes in children with chronic pyelonephritis is manifested by kidney and periodontal tissues, lymphocytic infiltration, fibrosis, damage to microvascular vessels. With the development of chronic pyelonephritis, structural and functional changes in periodontal tissues become dystrophic, accompanied by vasoconstriction of microvessels and tissue sclerosis.

Keywords: Chronic pyelonephritis, oral cavity, sick children, chronic renal failure, cytological examination.

The state of the body is formed by various factors of the internal and external environment, among which the state of calcium-phosphorus exchange takes an important place (Balabolkin M.I. and others, 1996; Konoplya E.E., 2002).

Disruption of the structure and function of organs involved in the regulation of phosphorus-calcium metabolism is the cause of various diseases that develop during the child's life (Korovina N.A., Zakharova I.N., 2000; Cheburkin A.V. and others, 2005). .

Kidneys are the main organ in regulating phosphorus-calcium homeostasis in both physiological and pathological conditions (Chumakova O.V., Kartamisheva N.N., 2004).

The main physiological function of the kidneys is to maintain the homeostatic parameters of the body. When primary urine is formed in the vascular glomerulus, it includes all trace elements of blood plasma. Active reabsorption of minerals and water begins in the proximal tubules. Absorption of monovalent cations in the initial part of the tubules is an active process, and in the last part of the tubules - active and passive. Absorption of divalent cations is an active process. Anions passively follow cations. 10-20% of the filtered cations are absorbed in the distal tubules. The reabsorption process of microelements is under the control of the nervous and endocrine systems. When tubules are damaged, the active and passive reabsorption of trace elements from primary urine is disrupted, which leads to a decrease in their content in the body (Panchenko L.F., 2004). On the other hand, deformed mineral metabolism contributes to the pathogenesis of kidney diseases and creates a kind of "circle" (Kuznetsova E.G., 2007).

A number of authors have conducted studies that revealed that the composition of elements such as magnesium, zinc, copper, and iron was disturbed in the body of children with chronic pyelonephritis.

Thus, Makarov T.P. (2001) noted in their work that in children with chronic pyelonephritis, the clearance and excretion of zinc significantly increased compared to healthy children, which indicates an increase in excretory failure and a decrease in the intracellular capacity of neutrophils with the development of this pathology. cases such as the killing of microorganisms, a steady decrease in immunity were noted.

Disorders of magnesium metabolism in children with chronic pyelonephritis are characterized by a decrease in its level in hair and blood serum. One of the causes of magnesium deficiency found in children with the localization of the pathological process in the tubulointerstitial tissues of the kidneys is the increased excretion of this macroelement through the kidneys (Kuznetsova E.G., 2007).

The ability of the kidney to perform homeostatic functions determines the main role of this organ in the processes of bone resorption and bone formation, as well as in the mineralization of teeth (Vander A., 2000).

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The defeat of the tubulo-interstitial apparatus in pyelonephritis in children is accompanied by changes in the state of phosphorus-calcium metabolism. According to A.A. According to Baranova A.A. (2005), in children aged 8 months to 14 years with a diagnosis of "Chronic pyelonephritis", the concentration of calcium in blood serum is reduced in 77.78% of children with primary pyelonephritis and 78.95% of children with secondary pyelonephritis. A decrease in phosphorus levels was found in 77.78% of children with primary pyelonephritis and 31.58% of children with secondary pyelonephritis. These disorders are characterized by impaired reabsorption in children with microbial-inflammatory diseases of the kidneys.

Svintsitskaya V.I. According to (2009), densitometric (x-ray and ultrasound) studies revealed changes in bone mineral density in more than half (54.3%) of children with pyelonephritis, among which 25% of children had bone mineral density below chronological age. 29.3% constitute the risk group for the development of osteopenia.

According to the results of the bone mineral density study, 37% of children with chronic pyelonephritis had a decrease in the integral index - bone tissue strength index, while in 9% of children, the bone tissue strength index corresponds to osteoporotic changes in the bone (Kaladze N.N., Titova E.E., 2008).

In children with chronic kidney disease, secondary hyperparathyroidism develops in almost all cases (Slatopolsky E, 2000; Indridason OS, 2000;).

A patient with chronic kidney disease causes secondary hyperparathyroidism, which is one of the most frequent and severe complications, along with a violation of the synthesis of hormonally active vitamin D, long-term hypercalcemia and high phosphate levels in children (Dusso A.S., Thadhani R., Slatopolsky E., 2004).). This condition, characterized by compensatory hypersecretion of parathyroid hormone, leads to morphological changes in the thyroid gland, as well as the development of fibrous osteitis, bone loss and concomitant cardiovascular diseases (Martin K. J., Gonzalez E. A., 2004). As a rule, when the level of glomerular filtration falls below 60 ml / min / 1.73 m2, the level of parathyroid hormone in the blood begins to rise (Khoroshilov S.E., Nikitin A.V., Ochechenko T.Yu., 2010;).

The parathyroid hormone produced by the parathyroid glands is directly involved in the maintenance of normal mineral metabolism and affects the growth and development of teeth, their physiological state is assessed (Volodatsky M.P. et al., 1993; Moskvina T.S. et al., 1993; Paggi A. et al. 1997; Pain MX. et al., 2000). This hormone coordinates the processes of calcification and decalcification of bone and dental tissues (Van der Sluis JM, 2000., Van Dyck M, 2001). Many authors state that the parathyroid glands are an intrasecretory organ that regulates calcium and phosphorus metabolism (Mkrtumyan A.M., 2001; ReiszL.G., 1999).

With the presence of parathyroid hormone, a constant amount of calcium (2.2 - 2.5 mmol / l) is maintained in the blood serum, which ensures a normal ratio between bone formation processes. When parathyroid hormone is overproduced, as a result of demineralization of bones and teeth, the amount of calcium in the blood increases and its excretion in urine increases (Rosen N. et al., 1993; Paggi A, Trimarchi SR. et al., 1997; Coco M, 2000).

Currently, the influence of parathyroid hormone, including on dental tissues, prevails in three directions (Bezrukova I.V., 2000; Dedov I.I. et al., 2000; Reisz L.G., 1999):

• Enzymatic destruction of the bone matrix (increasing its activity), which is carried out by affecting collagen and bone collagenase.

• Effects on enzymatic systems involved in carbohydrate metabolism and formation of organic acids (citric, etc.).

• Activation of the calcium and phosphorus ion transport system (ion pump) from the bone tissue to the extracellular fluid.

However, all these events do not occur separately in the body: the function of the parathyroid glands is affected by various hormonal regulators, especially growth hormone, which is changed by the main biochemical factor - the level of calcium (Volkov M.M., 2009., Kovesdy SR., 2008). In addition, other hormones and mediators are involved in the regulation of calcium-phosphorus exchange: thyroid hormones, thyrocalcitonin, glucocorticoids, estrogens, growth hormone and anabolic steroids are among them (Konoplya E.E., 2002., Smirnov A.V., L .V., 200.0., L.V., 200.0.).

It is known that calcium is of great physiological importance for the body. It plays a leading role in the formation of ossification and tissue structures (Salusky IB, 2001). It participates in the transmission of

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electrical impulses, reduces the permeability of cell membranes, and as a result is a leading link in the electrogenesis of nerve, muscle and gland tissue, synaptic processes, the molecular mechanism of muscle contraction, secretory and endocrine. processes of the digestive tract and the activity of the endocrine glands (Dawson-Hughes V., 1999). The presence of calcium is necessary for normal blood clotting, as it participates in the synthesis of thrombin and affects the vascular component of coagulation; synthesis of aldosterone is impossible without calcium (Dedov I.I. et al., 2000; Smirnov A.V., 2009;). With an increase in calcium concentration, the effect of antidiuretic hormone on renal tubules decreases, as a result, water loss increases (Rojinskaya L.Ya., 1998; Clase SM, 2000). Abnormal levels of calcium in blood and tissues lead to the development of not only functional, but also morphological changes in the activity of many organs and systems of the body, including the development of mineralized tissue pathology (Svintsitskaya V.I., 2009).

At the same time, another element is phosphorus, the most important plastic component of bone and other tissue structures (Tenenhouse HS, Murer N, 2003; Mahdavi N, 2003). An adult has about 1120 grams of calcium in his body, 95-99% of which is in bone tissue, which is mainly present together with phosphorus. The total concentration of calcium in blood in the body is 2.5 mmol/l, of which 0.82 mmol/l is combined with proteins and 1.53 mmol/l is diffused calcium. The composition of the latter includes 1.33 mmol/l of biologically active ionized calcium and 0.30 mmol/l of bicarbonate, phosphate and citrate compounds (Enders DB, Rude RK, 2001). Distribution of inorganic phosphate in blood serum is not very complicated. An insignificant amount of phosphorus is bound to proteins, and basically all inorganic phosphates are ionized. Bone tissue and other mineralized tissues represent a potential storehouse of calcium. Absorption of both elements occurs in the upper intestines in a slightly acidic environment in a ratio of 1.2:1, and excretion is carried out by the kidneys and colon. As mentioned above, the intensity of these processes is regulated by the physiological system, where the parathyroid hormone plays a leading role among a number of hormones and physicochemical factors. The subtle mechanism of the regulatory and controlling effect of hormones is manifested mainly through enzyme systems, as a result of which the concentration of calcium ions is reliably maintained at a constant level (Khayutina T.L. et al., 1997; Shirokova I.V., 1999; Atsumi K, 1999). It has been shown that parathyroid hormone destroys the chromoform group of the reduced triphosphopyridine nucleotide, as a result of which the reaction in the Krebs cycle is possible only up to the stage of formation with the predominance of isocitrate and glycolysis processes, and pyruvate, lactate, citrate are formed, which leads to acidosis (Domrongkitchaiporn S, 2001). Lowering the pH of the environment increases the solubility of hydroxyapatite. The formed Ca and P ions enter the extracellular fluid blood, and if the first one accumulates in the serum due to its limitation by the kidneys, the second one increases.

The effect of parathyroid hormone on phosphorus appears quickly (after 15 minutes) and quickly decreases (Dedov I.I. et al., 2000; Borovsky E.V., 2001; Dawson-Hughes V., 1998; Olaizola L, 2000).

Regulation of calcium metabolism at the cellular level is primarily carried out by the action of parathyroid hormone on mitochondria (Waller S, 2003). It enhances the processes of tissue respiration and oxidation of pyridine nucleotides in mitochondria, and also increases the absorption of sodium, magnesium, phosphates by these structures. However, the regulation of the concentration of Ca ions in the fluid by the parathyroid glands also occurs with the help of another hormone, calcitonin, which has the opposite effect (Frazao JM, 2000; Maung NM, 2001; Giarmini S, 2001).

The release of Ca and P in mitochondria occurs with the participation of vitamin D. The latter affects the absorption of calcium from the intestine, stimulates its deposition in bone tissue, that is, its action is aimed at increasing the absorption of calcium and retention of phosphorus (Institute of Medicine, 2000; World Health Organization, 2004; Salusky IB, 2005).

In the literature, parathormone helps the absorption of Ca and P in the intestine, stimulates the formation of osteoclasts and the destruction of osteoblasts in bone tissue, increases its resorption and inhibits bone synthesis, increases phosphaturia, that is, all these processes. Those directly related to the activity of the dental system (Leontev V.K., 1994., Dawson-HughesB., 1998;).

In fact, the described symptoms accompany the biochemical and morphological features of chronic pyelonephritis and the associated hyperparathyroidism, which, in turn, affects the severity of dental pathology due to the violation of mineral metabolism. It is known that the occurrence of the carious process depends primarily on the structural characteristics of the tooth (Linnet V., Seow W.K., 2001; Moalic E., 2001). The high sensitivity of teeth to caries is usually due to the low level of enamel and dentin related to the structure

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(Borovsky E.V., 2001; Pain M.L., 2000; Robinson S, Brookes I., 2001). This deficiency largely depends on mineral metabolism, primarily Ca and P levels. On the other hand, the existing relationship between their content in oral fluid and caries may indicate that its mineral content is also one of the factors that cause caries. . This is evidenced by the well-known fact that the lack of Ca and P in water and food is important for the development of caries (Alhashimi N., 2001; Hanning M., 2001; Linnet V., 2001; Moalic E., 2001).

Despite a number of publications devoted to the study of the state of calcium-phosphorus exchange in the pathology of the oral cavity (Gorbatova L. N. s soavt., 2009., About I. et al., Holtgrave E. A. et al., 2001; Slayton R. L., 2001; Tapias M. A., 2001;), the study of the dental condition of children and adolescents with chronic pyelonephritis, as well as the main characteristics of saliva, such as buffer capacity and acid-base balance, are not covered in the scientific literature.

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