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PECULIARITIES OF STRUCTURE AND MORPHOGENESIS OF UREATIC STONES IN RESIDENTS OF DEVELOPED INDUSTRIAL REGION

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Introduction. Urolithiasis is rightly called the "disease of civilization." According to the World Health Organization, the incidence of the disease has increased 1.5 times over the past 12 years. One in a hundred people in the world suffers from it. Despite advances in surgical treatment of kidney stones, conservative treatment of this disease cannot be called successful today: many patients (approximately 70%) have to endure repeated renal colic due to recurrence of urolithiasis.

The effectiveness of treatment of urolithiasis is not limited to one goal - to rid the patient of urinary stones from any location and does not guarantee the absence of recurrence of stone formation. Treatment in the next period after removal includes the destruction of the stone, be sure to rehabilitate kidney function and metaphylaxis of this disease. Existing treatment regimens include mandatory individual diet therapy and antibacterial therapy for one month after stone removal (destruction). It is essential to use drugs that improve renal hemodynamics and increase ureteral contractility, non-hormonal anti-inflammatory drugs and diuretics that promote crystal disaggregation. Then, depending on the form of urolithiasis, it is recommended to take courses to prevent the formation of stones in order to correct metabolic disorders. However, urolithiasis is still a difficult problem to treat. Urinary stones are the result of complex changes in biological processes in the kidneys. It is extremely difficult to install them. A lot of effort has been spent on solving them. One of the problems is the timely determination of the final mechanism of primary stone formation in order to determine effective ways of metaphylaxis of the disease.

Minerals of biogenic origin are integral elements of the structure of many living organisms. Along with genetically physiogenic minerals, pathogenic biominerals are also common. These include, but are not limited to, urolithiasis, which is caused by urolithiasis.

The study of uroliths began with the use of an arsenal of methods of mineralogy and petrography in the early twentieth century. For the first time in 1922 G. Nakano, and in 1923 L. Kaiser, having made thin sections of urinary stones and studied their sections in polarized light by the classical method of petrographic analysis, described cystine and crystals of aqueous calcium oxalates.

Currently, the ontogeny of minerals is a developed branch of genetic mineralogy. The available information makes it possible to reconstruct the conditions of their origin and growth according to the external form and features of the internal structure of minerals and mineral aggregates. Extensive experience in the study of inorganic compounds can and should be effectively used in biology and medicine to elucidate the possible mechanisms of biomineral formation in processes of pathogenic origin based on their geological counterparts.

The aim of the work is to identify some features of the ontogenesis of uroliths from the kidneys of the inhabitants of Dnipropetrovsk region, primarily related to the structure and morphology of these formations.

Research methods. To perform the work, a comparative analysis of the morphology of more than 246 renal uroliths of the Dnipropetrovsk region was performed and their petrographic study was performed. The morphology of uroliths was studied using a stereoscopic binocular microscope MBS-9. Microscopic examination of urolith sections is performed using an optical polarization microscope MIN-8.

Discussion of results. It is noted that the chemical composition of oxalates, phosphates, urates, carbonates and mixed stones. The stones, as a rule, had mainly a layered structure and were a mixture of minerals and organic matter. The amount of stone-forming minerals did not exceed three, other minerals were determined as impurities. Several inorganic substances were usually present in the structure of the stone, and given the predominance of one of them, one could speak of the composition of the stone. The following associations were most often found in stones: 1) rosin, vevellite and vedelite; 2) rosin and vevellite; 3) sodium urate, uric acid and vevellite; 4) sodium urate, uric acid, rosin, newberite, struvite or brushyt. The mineral composition usually indicated different conditions of their formation.

Solids differ from each other not only in mineralogical composition, but also in structure and texture. The construction of a solid body, which is a urinary stone, is characterized by structural and textural features due to its origin and subsequent transformation (genesis). Structure and texture indicate the construction of matter at different levels. The structure of rocks of chemical origin, including urinary stones, is characterized by the degree of crystallization and size (size) of grains.

According to the degree of crystallinity, the stones were: a) crystalline - with fairly well-formed crystals; b) cryptocrystalline - which consist of the smallest crystals, which are not visible even when magnified (this structure is often called pelitomorphic); c) vitreous - do not have distinct crystals (in the stage of formation), a solid vitreous mass is determined; d) porphyry - large grains interspersed with the total vitreous or crystalline mass; e) debris - stones cemented from debris (brackish).

Depending on the construction of the constituent substance, urinary stones were divided by us into 3 groups: 1) crystalline, among which there are two subgroups (monomineral and polymineral); 2) amorphous and 3) mixed - composed of salts of different acids. Depending on the location of the crystals, radial, spherulitic, globular, and chaotic structures were determined. The most common was the radial-radial structure, characterized by the orientation of the elongation of the crystals in the direction of the radii of the stone, perpendicular to its surface. The second most frequent was the spherulite structure, which was a radially located sectoral process. In addition, met and globular structure, characterized by the presence in the stones of aggregates of small balls of amorphous substance.

Urinary stones were characterized by a mixed composition. They are formed with the participation of amorphous minerals with impurities of salts of different composition. Comparing the size and alternation of crystals in stone with data on physicochemical properties of urine, the severity of the inflammatory process, we can determine the conditions Depending on the placement of crystals in the stones, radial-radial, spherulite, globular, and random structures are distinguished.

The next textural feature of urinary stones is hollowness. Pores are identified in most stones (92.7%). Usually the void is a few percent of the mass of the stone and is formed due to the presence of a series of cavities in the stone. This cavity occurs in crystalline stones due to recrystallization processes, and in amorphous stones - due to dehydration. In cases where the cavity is up to 50% or more, the cavities were located mainly in the central part of the stone and arise due to dissolution processes.

The recognized classification of the mineral composition of uroliths is their distribution by the anionic radical of the corresponding acids. Usually urinary stones are referred to a certain type of the predominant mineral component (compound), the amount of which exceeds 50%. Monomineral in urology are stones, in which one of the crystalline phases is more than 95%. The vast majority of uroliths studied by the authors of the Dnipropetrovsk region have a mixed mineral composition. Currently, 29 crystalline phases have been identified in the composition of kidney stones in the world, most of which are calcium compounds. Some of them occur in geological objects, others are a specific product of human life.

A petrographic study showed that in most cases the urinary calculus is a cryptocrystalline aggregate, which consists mainly of individual cryptocrystalline grains of oxalates: veddyllite and vewellite with a slight admixture of phosphate in the form of amorphous apatite (colophane), (predominantly enriches the central, "nuclear" part of the sample), uric acid dihydrate (in the form of single grains found in the peripheral part of the sample). Organic matter is distributed extremely unevenly. Its main part is concentrated in the form of highly dispersed inclusions between individual microblocks of mineral grains and apophyses of the “organic core”, at the same time, a slightly inferior amount of organic matter is localized in cracks and micropores, which are often interconnected and form a “necklace” structure.

Organic matter was mainly represented by thin films along the surfaces of individual oxalate grains (“organic jacket”) and lumpy accumulations in the pore space between individual mineral grains; much less often, organic matter forms ribbon and vein accumulations separating polychronous generations of aggregates of the mineral component. Separate rare crystals of uric acid dihydrate are observed on the outer border of the calculus.

Most of the studied samples showed that the calculi are not an absolutely monolithic substance, but have cracks filled with organic matter. In this case, cracks propagate both concentrically and radially from the central core to the periphery. The number of cracks, their direction and the number of organic inclusions can determine the strength characteristics of the calculus.

The structural features of the central part of a number of urinary stones noted that the mineral substance was represented by oxalates: predominantly vevellite and, in a very small amount, very rare, tiny grains of weddellite. Organic matter mainly filled exogenous cracks.

At the same time, a feature of the structure of the peripheral part was noted that the microlayer structure and crack systems were filled with organic matter. In some areas, we observed the "mobilization" of organic matter from microinclusions and thin films separating individual blocks of crystals into microcracks forming a "ripple" subparallel to the directive directions of cracks of higher orders. In the total volume of mineral matter of oxalate composition, wevellite predominated with a sharply subordinate amount of weddellite.

Conclusions. Thus, urinary stones have a different composition and, depending on the species, mainly consist of calcium oxalate, less belongs to the crystals of uric acid, sodium uric acid or ammonium. All stones consist of organic and mineral matter. Many of them are mixed in composition. The mineral composition includes from 6 to 17 or more trace elements such as copper, magnesium, zinc, iron and the like. The common minerals are identical and do not depend on the place of residence of patients. The only difference is in their percentage.

The central part of the uroliths is usually represented by accumulations of organic matter containing a fine mineral component. A characteristic feature of all mineral individuals without exception is their large-scale microblocking and the presence of inclusions of organic matter. Characteristics such as color, size, shape and nature of the surface of uroliths of the inhabitants of Dnipropetrovsk region are not very informative to establish their mineral composition. Thus, the current practice of determining the composition of uroliths by their external signs, which is used by practical urologists, on the basis of which the appointment of medical and dietary recommendations is formed, is not scientifically sound and practically unacceptable. Most likely, this approach leads to a large number of recurrences of urolithiasis. Only a set of large-scale studies, combining morphological analysis of the sample and its petrographic study aimed at identifying structural features and mineral composition of urolith, can confidently establish the basic laws of its ontogenesis and determine adequate and unambiguous decision in choosing methods and methods of disease prevention. The accumulation of analytical material on the ontogenesis of uroliths and its generalization, taking into account local conditions and the state of the environment, helps to solve an important social task - to prevent the spread and ensure effective treatment of urolithiasis.

The variety of structure and texture of urinary stones characterizes them mainly as layered-hollow formations, which allows the use of destructive technologies against them. However, for greater efficiency of lithotripsy it is necessary to study the physical and technical characteristics of stones, to determine the features of stone destruction, taking into account the volume and location of the stone in the kidney cavity. The development of ways to weaken the strength characteristics of stones due to the combined use of litholytic, surfactants with different methods of lithotripsy can increase efficiency.

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