

DOI: <https://doi.org/10.34921/amj.2025.2.030>**SİDİK DAŞLARININ TƏRKİBİNİN XÜSUSİYYƏTLƏRİ****S.M.Kolupayev¹, V.N.Lesovoy¹, O.P.Medvedeva², M.A.Lesovaya³, V.V.Qarqin⁴**¹A.Q.Podrez ad. Xarkov Milli Tibb Universiteti Urologiya, nefrologiya və andrologiya kafedrası,²Xarkov Fiziki-Texniki institutunun Milli elmi mərkəzi,³Xarkov Beynəlxalq Tibb Universiteti Peşəyönlü fənlər kafedrası,⁴Xarkov Milli Tibb Universiteti Patoloji anatomiya kafedrası, Xarkov ş., Ukrayna

Məqalədə 124 xəstənin sidik yollarından təbii yolla xaric olmuş və ya azinvaziv üsullarla xaric edilmiş sidik daşlarının tərkibinin infraqırmızı spektroskopiyaya vasitəsilə tədqiqinin nəticələri şərh edilmişdir.

Tədqiq edilən sidik daşı nümunələrinin əksəriyyətinin (106 nümunə – 74,2%) tərkibinin iki və ya daha artıq mineraldan ibarət olduğu müşahidə edilmişdir. Sidik daşlarının tərkibində hansı mineralın 50%-dən çox olmasından asılı olaraq 3 tipi ayırd edilmişdir: 1-ci tip – oksalat-kalsium daşları: bunların tərkibində kalsium-oksalatın monohidratları (vevelit) və dihidratları olan (vedelit) növləri vardır; 2-ci tip – fosfor-kalsium daşları: bunların ümumi kütləsinin 50%-dən artığı apatit, hidroksiapatit və flüorapatitdən ibarətdir; 3-cü tip – tərkibində sidik turşusu və onun dihidratı daha çox olan daşlardır.

1-ci tip sidik daşları digər daşlara nisbətən daha çox və xüsusilə kişilərdə müşahidə edilmişdir.

2-ci və 3-cü tip daşların rastgəlmə tezliyi isə pasiyentlərin cinsiyyətindən asılı olmamışdır. 1-ci tip sidik daşlarına bütün yaş qruplarında rast gəlinərsə də, onların 30-39 yaşlı şəxslərdə daha çox (41,38) olduğu müşahidə edilmişdir. 2-ci tip sidik daşları isə 40-49 yaşlı pasiyentlər qrupunda digər yaşlara nisbətən artıq (33,3%) olmuş, böyük yaş qruplarında get-gedə azalmışdır. 3-cü tip daşların ən az rast gəlinədiyi yaş qrupu isə 30-39 yaşlar idi. Sidik daşlarının bu tipinə 50-59 yaşlı pasiyentlər qrupunda daha çox – 52,94% təsadüf edilmişdir.

Açar sözlər: sidikdaşı xəstəliyi, sidik daşlarının mineral tərkibi, cinsiyyət, yaş

Ключевые слова: мочекаменная болезнь, морфология, минеральный состав мочевых камней, пол, возраст

Key words: urolithiasis, mineral composition of urinary stones, gender, age

CHARACTERISTICS OF URINARY STONE COMPOSITION**S.M.Kolupayev¹, V.M.Lisovyi¹, O.P.Medvedeva², M.A.Lisova³, V.V.Gargin^{3,4}**

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The article discusses the results of the study of the mineral composition of urinary stones obtained as a result of self-expulsion, as well as the use of minimally invasive surgical techniques in 124 patients with urolithiasis.

There was a mixed composition of the stone in most patients – 106 (74.2%), consisting of two or more mineral components. Depending on the predominant component, the volume fraction of which was more than 50% of the sample, urinary stones were classified into 3 mineral types: type 1 – oxalate-calcium concrements, the dominant component of which is calcium oxalate in the form of monohydrate (vevelite) or dihydrate (vedelite); type 2 – phosphate-calcium, in which more than 50% of the volume is represented by apatite, hydroxylapatite or fluorapatite; type 3 – stones, the dominant substance of which is uric acid or uric acid dihydrate. Most urinary stone samples were represented by concrements of type 1, which was significantly more common in male patients. No gender dependence in the prevalence of stones of types 2 and 3 was found. Type 1 urinary stones were observed in all age categories, with a predominance in patients

aged 30-39 years (41.38%).

The age distribution of type 2 stones had similar characteristics, with the maximum number of patients with this type of stone being in the age range of 40-49 years (33.3%), with a further decrease in this indicator in older age groups. The minimum number of cases of type 3 stone formation was registered among patients aged 30-39 years (5.88%). In the following age periods, the quantitative presence of this type of stone increased with a maximum value in the age range of 50-59 years (52.94%).

Introduction. Urolithiasis is a widespread disease with a recurrent course, its prevalence according to epidemiological studies is 1-20% and is increasing annually in all countries of the world [1, 2]. This disease is polyetiological. Among the factors contributing to the development of urolithiasis are ethnic, geographic, demographic, metabolic [3, 4], connected with variable pathology of urinary system [5-7] and stone formation [8, 9]. A wide range of chemical compounds has been identified in the composition of urinary stones, which depends on the type of metabolic disorders. According to the recommendations of the European Association of Urology, stone analysis is mandatory in case of primary stone formation, early recurrence after interventional therapy, as well as late recurrence after a long period of absence of stones in the kidneys and urinary tract [10]. Infrared spectroscopy is considered the gold standard in assessing the mineral composition of stones [9, 11]. Population studies conducted in European and Asian countries have found geographical differences in the distribution of stones by mineral composition, gender, and age of patients.

There are conflicting views on the gender and age dependence of the course of urolithiasis, as well as the formation of certain inorganic compounds in the composition of stones [12]. Studying the features of the mineral composition of urinary calculi in patients of different sexes and at different ages is appropriate and will contribute to the individualization of the preventive, therapeutic and metaphylactic strategy of this disease.

Purpose of work consisted in studying the dependence of the mineral composition of urinary stones on the gender and age characteristics of patients.

Material and methods. The mineral composition of urinary stones obtained as a result of spontaneous passage, as well as as a result of the use of minimally invasive surgical methods (extracorporeal shock wave lithotripsy, percutaneous nephro-

lithotripsy, contact ureterolithotripsy) was studied in 124 patients with urolithiasis (men - 76, women - 48) aged from 20 to 74 years (average age – 49.70 ± 12.83 years). As a method of assessing the mineral composition of the stone, infrared spectroscopy (IRS) was used on an IR spectrophotometer IKS-29 (LOMO) in the spectral range of $4000-400\text{ cm}^{-1}$. Powder preparations obtained by grinding fragments of urinary stones in agate mortars to a particle size of $\sim 1-10$ microns were studied. The samples were prepared in the form of transparent compressed tablets from a mixture of potassium bromide, which served as a matrix, and the substance under study. The powder was ground and mixed in a special closed box. Pressing was carried out immediately before recording the spectra. The mineral composition of the stone was estimated based on the identification of absorption bands characteristic of certain chemical compounds in the infrared range. In samples with mixed mineral composition, the dominant component was determined, the volume fraction of which was more than 50% of the sample volume. Based on the dominant mineral, the mineral type of the stone was determined, after which, according to medical documentation, a retrospective analysis of the frequency of detection of stones of different mineral types in groups of patients with different gender and age characteristics was performed.

Statistical processing of data obtained during the study was carried out using Microsoft Excel 2016 spreadsheets and Statistica 10 (StatSoft, USA). When choosing statistical procedures, the methodological requirements of the International Congress on Harmonization of Clinical Trials ICH / GGP were taken into account. Quantitative data are presented in the form of $M \pm \delta$, where M is the sample mean, δ is the standard deviation. Comparison of qualitative data in two groups was carried out using the Pearson agreement criterion (χ^2) and Fisher's exact criterion (in the case of five or fewer observations in one of the subgroups). The critical significance level when testing hypotheses was taken equal to 0.05.

Results and their discussion. A wide range of chemical compounds was identified in the composition of stones of different structural types, in which calcium oxalate was most often

present in the form of monohydrate (wavelite), calcium phosphates in the form of hydroxylapatite, as well as uric acid. Aragonite was found in isolated samples, struvite, cystine, brushite (Table 1).

Table 1. Types of mineral compounds and their frequency of detection in urinary stones

Type of mineral	Frequency of presence in kidney stones (%), n=124
Wavellite	93 (74.2%)
Hydroxylapatite	66 (53.2%)
Uric acid	30 (24.2%)
Weddellite	22 (17.7%)
Ammonium urate	11 (8.8%)
Calcium carbonate	5 (4%)
Aragonite	3 (2.4%)
Cystine	6 (4.8%)
Struvite	2 (1.6%)
Brushit	1 (0.8%)

Monophase stones, which were composed of a single mineral, were discovered in 32 (25.8%) patients. In most patients – 106 (74.2%). The stones had a mixed mineral composition, which in the infrared spectrum was characterized by the presence of two, three, or four main phases corresponding to different mineral components.

Depending on the dominant component, the volume fraction of which is more than 50% of the sample, urinary stones were classified into 3 mineral types: type 1 – oxalate-calcium concrements, the dominant component of which is calcium oxalate in the form of monohydrate (wavelite) or dihydrate (weddelite); type 2 – phosphate-calcium, in which more than 50% of the volume is

represented by apatite, hydroxylapatite or fluorapatite; type 3 – stones, the dominant substance of which is uric acid or uric acid dihydrate. In single samples of stones of types 2 and 3, aragonite, calcium carbonate, struvite, cystine, brushite were determined.

The majority of urinary stone samples were represented by type 1 stones, which were significantly more common in male patients (Table 2).

The obtained data correlate with the results of epidemiological studies, which indicate a higher prevalence of calcium oxalate lithiasis among men [13]. There is information about a more frequent detection of phosphate-calcium stones among women, urate stones among men [14], however, in our study, no gender dependence in the prevalence of stones of types 2 and 3 was found.

Type 1 urinary stones were observed in all age categories, with a predominance in patients aged 30-39 years (41.38%). In older age groups, a decrease in the number of cases of type 1 stone formation was observed, with the minimum value of this indicator among patients aged 60-69 years (6.90%).

The age distribution of type 2 stones had similar characteristics, with the maximum number of patients with this type of stone belonging to the age range of 40-49 years (33.3%), with a further decrease in this indicator in older age groups.

The minimum number of cases of type 3 stone formation was recorded among patients aged 30-39 years (5.88%). In the following age periods, the quantitative presence of this type of stone increased with a maximum value in the age range of 50-59 years (52.94%) (Fig. 1).

Table 2. Distribution of mineral types of urinary stones depending on the gender of patients

Mineral type of urinary stone	Total number of patients, N=124	Men, N=76	Women, N=48	P-value
Type I	58 (46.8±8.8%)	42 (33.9± 8.3%)	16 (12.9±5.9%)	0.002†
Type II	35 (28.2±7.9%)	11 (8.9± 5.0%)	20 (16.1±6.5%)	>0.05‡
Type III	31 (25±7.6%)	23 (18.6±6.8%)	12 (9.7±5.2%)	>0.05‡

Notes: † - reliability of differences, according to the Pearson agreement criterion (χ^2), at the significance level $p \leq 0.05$; ‡ - reliability of differences, according to the Fisher criterion, at the significance level $p \leq 0.05$

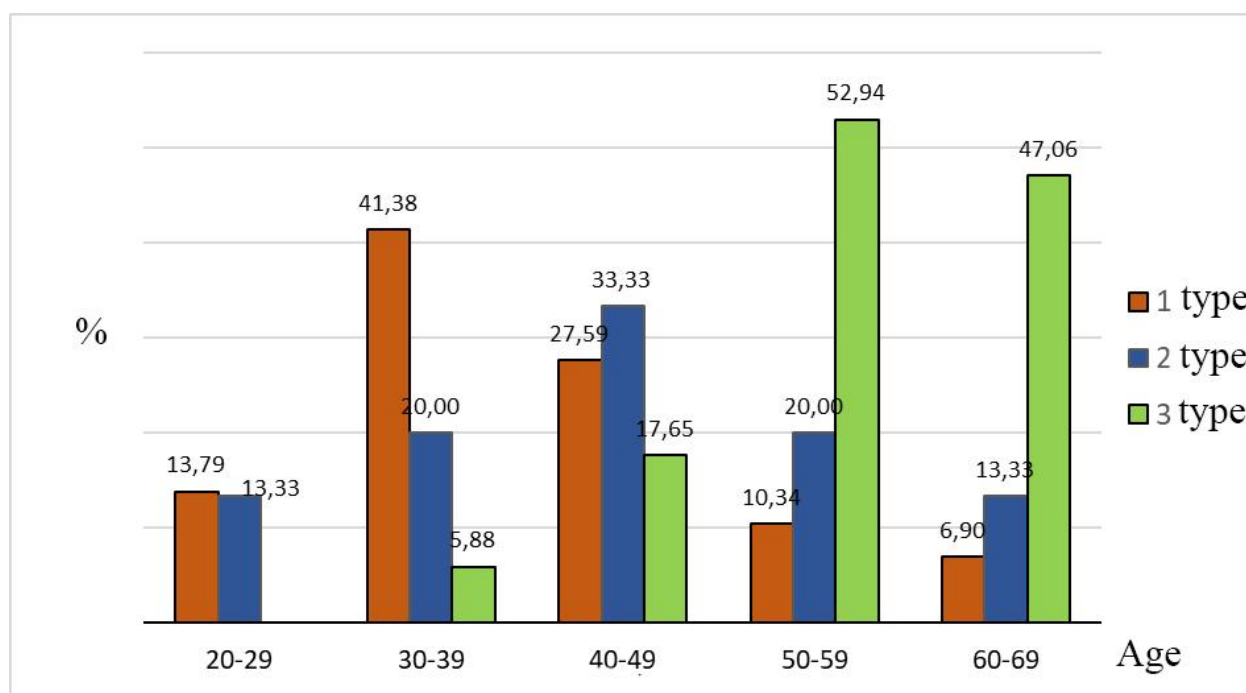


Fig. Distribution of mineral types of urinary stones depending on the age of patients

When conducting infrared spectroscopy, a wide range of chemical compounds was identified in the composition of urinary stones, in which calcium oxalate in the form of monohydrate, calcium phosphate in the form of hydroxylapatite and uric acid were most often identified. In single samples, calcium carbonate, aragonite, struvite, brushite, cystine were found. The data obtained are consistent with previously conducted studies, according to which the main components of kidney stones are oxalate-calcium and phosphate-calcium compounds [15].

We should estimate that current work performs one more accent on necessity to involve different specialist for estimation of pathogenesis even widespread diseases [16, 17]

especially with digital medicine and artificial intelligence development [18, 19] and non-invasive method of investigation [20-22].

Conclusions. The mineral composition of urinary stones has its own characteristics, depending on the gender and age of the patients. The formation of oxalate-calcium urinary stones is most characteristic of men, the peak incidence falls on the age of 40-49 years. Gender characteristics of the distribution of stones, the dominant components of which are calcium phosphate and uric acid were not detected. The frequency of detection of uric acid stones increases with age, the inverse relationship is characteristic of the age distribution of phosphate-calcium concrements.

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ОСОБЕННОСТИ СОСТАВА МОЧЕВЫХ КАМНЕЙ

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Резюме. В работе представлены результаты изучения инфракрасной спектроскопией особенностей минерального состава мочевых камней, полученных в результате самостоятельного отхождения, а также применения малоинвазивных хирургических методик у 124 больных мочекаменной болезнью в зависимости от пола и возраста обследуемых.

У большинства пациентов – 106 (74,2%) – наблюдался смешанный состав камня, состоящий из двух и более минеральных компонентов. В зависимости от преобладающего компонента, объемная доля которого составляла более 50% образца, мочевые камни были классифицированы на 3 минеральных типа: тип 1 – оксалатно-кальциевые конкременты, доминирующим компонентом которых является оксалат кальция в виде моногидрата (вевелита) или дигидрата (веделита); тип 2 – фосфатно-кальциевые, в которых более 50% объема представлено апатитом, гидроксилapatитом или фторапа-

титом; тип 3 – камни, доминирующим веществом которых является мочева́я кислота́ или дигидрат мочево́й кислоты. Большинство образцов мочевых камней были представлены конкрементами типа 1, что достоверно чаще встречалось у пациентов мужского пола. Гендерной зависимости в распространенности камней типов 2 и 3 не обнаружено. Мочевые камни типа 1 наблюдались во всех возрастных категориях, с преобладанием у пациентов в возрасте 30-39 лет (41,38%). Возрастное распределение камней типа 2 имело схожие характеристики, при этом максимальное количество пациентов с данным типом камней приходилось на возрастной диапазон 40-49 лет (33,3%), с дальнейшим снижением этого показателя в старших возрастных группах. Минимальное количество случаев образования камней типа 3 зарегистрировано среди пациентов в возрасте 30-39 лет (5,88%). В последующие возрастные периоды количественное наличие этого вида камней увеличивалось с максимальным значением в возрастном диапазоне 50-59 лет (52,94%).

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