BIOCHEMICAL MARKERS OF UROLITHIASIS

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.https://doi.org/10.5281/zenodo.18830087

ARTICLE INFO

Received: 26th February2026
Accepted: 27th February 2026
Online: 28th February 2026

KEYWORDS

urolithiasis, relapse, metabolic factors, biochemical parameters, prevention.

ABSTRACT

Biochemical markers of urolithiasis (urolithiasis) include 24-hour urine and blood analysis to identify the risk of stone formation and assess kidney function. Biochemical analysis of 24-hour urine for metabolic disorders. This crucial test provides information on the chemical composition of urine. This information is absolutely essential for selecting effective specific prevention for recurrent urolithiasis. The test also helps identify patients at high risk of future stone formation. A biochemical analysis of 24-hour urine (collected over 24 hours) is performed to determine pH (acidity), calcium, oxalates, uric acid salts, sodium, phosphates, citrates, magnesium, creatinine, and total urine volume. A test of calcium, oxalates, and urate (uric acid salts) in urine: An increased level of one of the three components (calcium, oxalate salts, uric acid) in 24-hour urine indicates a predisposition to stone formation in the genitourinary system..

Introduction. Recurrent urolithiasis (URS) occurs in 30–50% of patients within 5–10 years of the initial episode. Adverse consequences include chronic pain, urinary tract infections, renal dysfunction, and a significant reduction in quality of life.

According to regional studies, the prevalence of URS in different regions of Uzbekistan varies from 1.0% to 8.5%, with an average national prevalence of approximately 4.5% of the population. Urolithiasis is the second most common urological disease after urinary tract infections. These data demonstrate that URS is a significant public health problem in Uzbekistan, with variable prevalence across regions.

Various European countries have demonstrated prevalence rates ranging from 1% to over 10%, but overall, the average European figure is in the range of 5–9% of the population.

Insufficient knowledge of metabolic factors and the lack of standardized meta-prevention algorithms necessitate research aimed at a detailed study of biochemical markers and the development of appropriate strategies for preventing recurrent stone formation.

Purpose of the study. To evaluate biochemical markers of ICD and develop a practical algorithm for meta-prophylaxis.

Material and research methods. A prospective cohort study was conducted. The study population was divided into two groups: the main group - 312 patients with recurrent

urolithiasis (two or more clinically confirmed episodes in the past 3 years); the control group - 200 patients with newly diagnosed stones.

Blood and urine parameters included: calcium metabolism: total and ionized calcium, parathyroid hormone, vitamin D; phosphorus metabolism; uric acid levels; urine oxalates and citrates (24-hour collection); urine pH and specific gravity assessment; complete blood count and biochemistry (creatinine, urea, electrolytes). The following methods were used: standard laboratory analyzers; 24-hour urine collection according to clinical guidelines; statistical processing (t-test, logistic regression, ROC analysis).

Results and discussion. In the study group, a significant increase in the mean values of biochemical parameters was observed: serum calcium ($p < 0.01$), uric acid ($p < 0.01$), urinary oxalates ($p < 0.001$), and a decrease in citrate levels ($p < 0.001$) compared to the control group.

Statistical analysis revealed that elevated urinary oxalates increased the risk of recurrence by 2.4 times (OR = 2.4; CI 1.6–3.5); hypocitraturia was a significant independent factor (OR = 1.8; CI 1.3–2.7); low urine pH (<5.8) was associated with an increased risk of urate stones ($p < 0.05$). Recurrences were observed more frequently in patients with hypercalcemia—41.7% versus 27.5% in the control group. High uric acid levels were detected in 53.8% of the study group and 35% of the control group. The proposed meta-prevention algorithm can reduce the frequency of recurrent episodes and improve patients' quality of life.

The findings confirm that metabolic disturbances play a key role in the recurrence of urolithiasis. Patients with recurrent episodes were more likely to have abnormalities in calcium, oxalate, and uric acid metabolism, as well as low levels of citrate, a natural inhibitor of crystallization. These markers are considered prognostic risk factors for recurrent stone formation and should be included in routine screening of patients with urolithiasis. The influence of diet and lifestyle is also important: increased protein and salt intake increases the risk of recurrence, while adequate fluid intake and citrate-containing foods have a preventive effect.

Conclusions. Metabolic disturbances, including hypercalcemia, hypocitraturia, and elevated oxalate levels, are closely associated with recurrent urolithiasis. Comprehensive metabolic testing should become standard in the management of patients with urolithiasis. The proposed meta-prevention algorithm may reduce the incidence of recurrent episodes and improve patients' quality of life. Future research should evaluate the effectiveness of the proposed algorithm in multicenter trials.

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