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MEDICAL STATISTICAL ASSESSMENT AND PROGNOSTIC FACTORS IN THE DEVELOPMENT OF UROLITHIASIS

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Abstract
A review of published data on the epidemiology of urolithiasis demonstrates considerable regional variability in prevalence, driven by climatic, environmental, socioeconomic, and ethnodemographic factors. A higher proportion of male patients has been identified, which is associated with lifestyle characteristics and metabolic features. The disease most frequently affects individuals of working age, peaking between 30 and 55 years, thereby imposing a significant medical and economic burden. The high recurrence rate, reaching 15–50 percent within the first five years, remains one of the key therapeutic challenges. The obtained data highlight the necessity to improve preventive strategies and to individualize patient management approaches.

Keywords: Urolithiasis, epidemiology, prevalence, risk factors, recurrence, prevention.

Introduction

According to international epidemiological studies, the prevalence of urolithiasis in the general population ranges from 5% to 15%. A number of authors [1, 2, 4, 6, 8] have reported a significant increase in morbidity in recent decades, which has made urolithiasis one of the major medical and social challenges facing modern healthcare systems.

The disease is most widespread in industrially developed countries, which is associated with several factors including unbalanced diets, excessive consumption of fast food and animal proteins, low fluid intake, physical inactivity, chronic stress, and changes in climatic conditions [11, 14, 15].

The high frequency of occurrence and the risk of severe and potentially life-threatening complications determine the significant social burden of this pathology. According to the literature, up to 11% of patients become disabled due to inadequate treatment methods and are left with a single functioning kidney, 22% to 28% develop complications associated with surgical interventions, and mortality after open operations reaches 3% [1, 5, 8, 11, 13, 14].

The medical and economic relevance of urolithiasis is determined by prolonged rehabilitation periods and loss of working capacity among a considerable proportion of patients [9, 14, 15].

The search for new approaches to medical care for patients with urolithiasis is driven by the high prevalence of the disease, its predominance among individuals of working age, the ongoing upward trend in morbidity, the high recurrence rate, the probability of adverse outcomes and complications, and the complexity of selecting individualized treatment strategies among numerous therapeutic options. Moreover, determining the specific mechanisms of stone formation in individual patients remains challenging, which reduces the effectiveness of metaphylactic measures.

The aim of this study was to conduct a medical-statistical analysis of prognostic factors in the development of urolithiasis based on published data.

Results of the study

A review of published epidemiological data reveals substantial regional variability in the occurrence of urolithiasis. These disparities arise due to a complex combination of environmental and sociodemographic determinants, such as climatic conditions, ecological situation, economic status, and ethnic composition of the population [8, 9]. Furthermore, differences in epidemiological methodology, including variation in diagnostic approaches, limitations in medical reporting systems, and the lack of organized screening programs, contribute to incomplete case identification.

According to international statistics, the prevalence of urinary stone disease ranges from approximately 5% to 9% across European countries, remains lower in most Asian regions at 1% to 5%, increases to nearly 13% in North America, and can reach or exceed 20% in the Middle East, particularly in Saudi Arabia [11, 12, 14]. Studies from Central Asia similarly demonstrate a progressive growth in incidence and disease burden over recent decades [5, 6, 7].

Certain territories are recognized as endemic for urolithiasis. These include regions with persistently high temperatures and arid climate, zones with pronounced continental weather patterns, as well as areas exposed to severe cold. The most affected geographic locations comprise northern Australia, southern regions of North America, both coasts of South America, countries of Asia Minor, parts of Northeast Africa, and the southern and eastern areas of Asia [11, 12, 14].

Numerous publications have confirmed a higher proportion of male patients compared to females [6, 11, 14, 16]. This trend is hypothetically associated with specific lifestyle and metabolic factors, including increased uric acid production,

insufficient hydration, excessive animal-protein consumption, and occupational hazards more typical among men (diagramma 1).

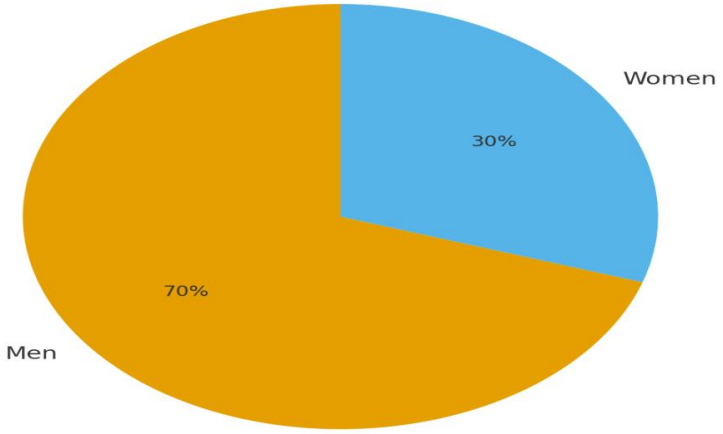

Diagramma 2. Sex distribution of urolithiasis based on retrospective literature analysis.

Large-scale epidemiological studies conducted in the United States [12, 13, 14, 15] have shown that approximately 3.1 million working days are lost annually solely due to kidney stone disease, indicating not only a medical burden but also a significant economic impact.

Retrospective literature analysis demonstrates that the average patient age is approximately 40 years, confirming the high incidence of urolithiasis among individuals in their most productive years [1, 2, 5, 12, 14, 15]. According to several authors, this is related to heightened metabolic activity [1, 2, 3, 15].

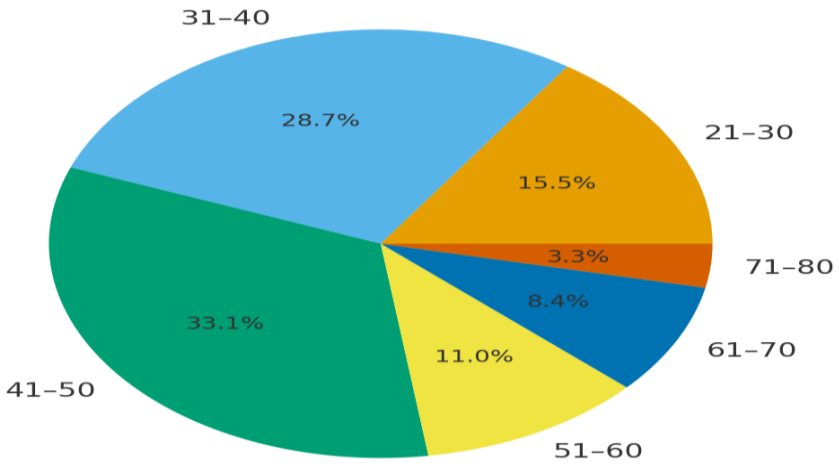

Diagramma 2. Urolithiasis epidemiology according to age based on retrospective literature analysis.

Age-related features play a significant role in predisposition to urolithiasis. The highest morbidity is observed among individuals aged 30 to 55 years due to the combined influence of metabolic activity and multiple risk factors including dietary habits, physical activity, and occupational hazards [3, 6, 10]. Among individuals over 60 years of age, the incidence of newly diagnosed urolithiasis decreases, although the likelihood of recurrent and complicated forms increases due to chronic metabolic disorders and comorbidities [4, 9, 12].

Growing focus on urolithiasis management in recent decades is associated with the adoption of modern technologies such as extracorporeal shockwave lithotripsy, nephroscopy, ureteroscopy, and laparoscopic techniques. Although the expansion of minimally invasive and instrumental interventions has increased the effectiveness of treatment, it has also forced urologists to individually select the most optimal therapeutic approach for each patient [7, 9, 10, 11, 13].

Despite considerable progress and a wide range of extracorporeal and minimally invasive endoscopic methods for stone fragmentation and removal, the incidence of urolithiasis continues to grow [1, 8, 9, 10, 14]. Globalization, technological advancements, environmental challenges, global warming [12, 14], and changes in lifestyle including disrupted circadian rhythms, unhealthy diet, sleep disturbances, sedentary behavior, and chronic stress have led to a doubling of urolithiasis cases over the past two decades in the United States, Italy, Germany, Spain, and Japan [12, 13, 14, 15].

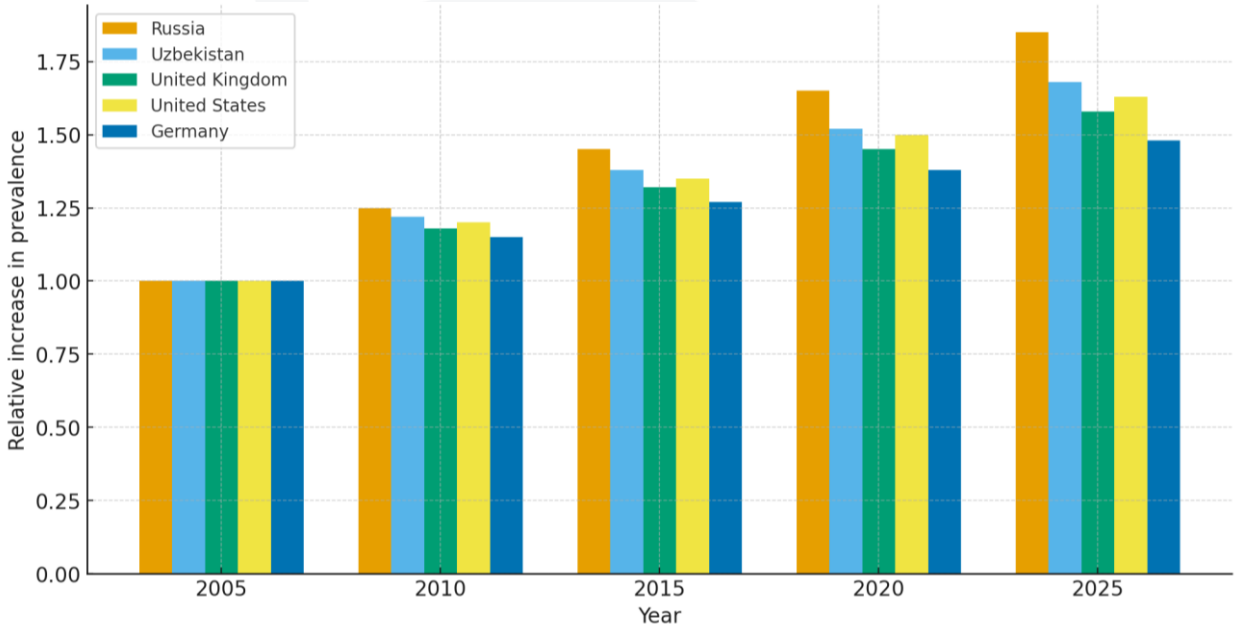

Diagramma 3. Increase in urolithiasis morbidity.

A characteristic feature and major therapeutic challenge in urolithiasis is the high recurrence rate of stone formation. Recurrence rates within five years range between 15% and 50%, depending on the disease form and treatment method, with 90% to 95% occurring during the first year after therapy [5, 14]. Long-term follow-up studies demonstrate recurrence rates up to 77% [5, 8, 11].

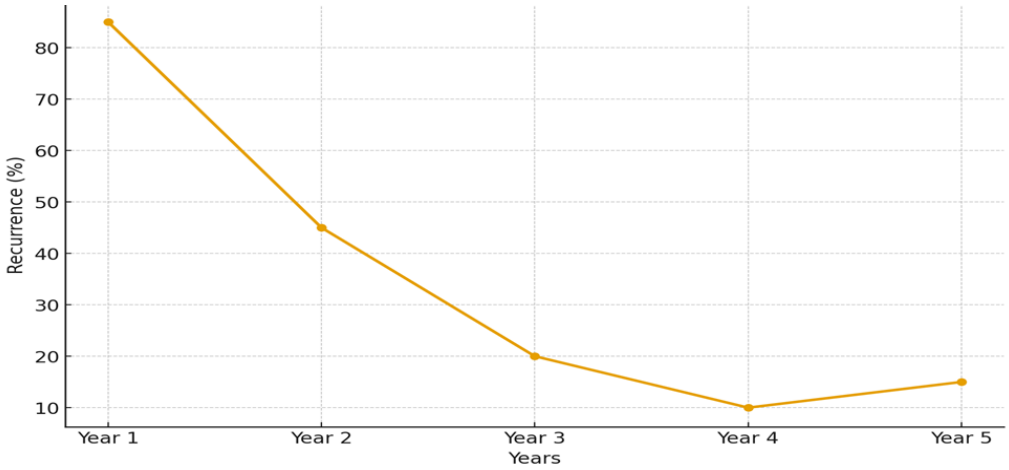

Diagramma 4. Recurrence of stone formation after treatment.

The risk of recurrence is determined by persistent or periodically arising lithogenic metabolic disorders as well as structural abnormalities in the uretero-renal system. These factors influence the chemical composition of stones and disease severity [2, 4, 10]. Treatment outcome is also critical and is influenced by the completeness of upper urinary tract clearance (presence of residual stone fragments), urinary tract dysfunction, and chronic comorbid conditions.

Conclusion

Verification of epidemiological data on urolithiasis represents a key component of modern urological and public health research. Clinical and demographic patient variability, regional differences in dietary structure, climate and environmental conditions, and inconsistency in diagnostic criteria lead to substantial disagreement in the real prevalence estimation.

Standardization of approaches to data collection and interpretation enables more accurate assessment of true morbidity, identification of trends and regional characteristics. Conducting comprehensive, standardized epidemiological studies improves the reliability of statistics, supports the creation of unified databases, and provides a basis for developing effective preventive and diagnostic-therapeutic strategies.

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