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Retrospective Analysis: The Effect of the Seasonal Changes on the Frequency of Urinary System Stone Operations

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Abstract

Aim: Urolithiasis is a multifactorial disease influenced by various factors, including climate and seasonal changes. While climatic effects on stone formation have been studied, seasonal variations in urinary stone surgeries remain underexplored. To investigate the seasonal variation in the frequency of urinary stone surgeries over a three-year period and assess potential seasonal influences on surgical incidence and emergency department visits.

Materials and Methods: A retrospective review of 841 urinary stone surgeries and 509 transurethral resections of the prostate (TUR-P) procedures (as controls) performed between January 2018 and December 2020 was conducted. Procedures were categorized by meteorological seasons. Statistical analysis was performed using chi-square tests to evaluate differences in seasonal distribution.

Results: Urinary stone surgeries showed a significant seasonal variation, with the highest frequency in summer (27.8%) and the lowest in spring (19.3%) ($p<0.05$). No similar seasonal trend was observed in TUR-P procedures. The majority of patients were female (66.0%) with a mean age of 49.7 years. The ureter and kidneys were the most common locations of stone formation. Most patients underwent ureterorenoscopy, and postoperative DJ stenting was frequent (79.5%). Residual stones and complications were infrequent.

Conclusion: The findings demonstrate a statistically significant increase in urinary stone surgeries during summer, suggesting seasonal influences on disease manifestation. These results highlight the importance of heightened clinical awareness and preventive measures, particularly during warmer months, to reduce the burden of urinary stone disease and emergency department visits.

Keywords: Urolithiasis, seasonal variation, urinary stone surgery, summer incidence, hydration, endourological procedures

Introduction

Urolithiasis is a multifactorial disease characterized by the formation of calculi in the kidney, ureter, bladder, or urethra. It is a common cause of emergency department visits, most frequently presenting as renal colic; an acute and severe flank pain that often radiates to the groin and may be accompanied by hematuria and dysuria. The prevalence of renal colic varies globally, ranging between 5% and 15%, depending on geographical, environmental, genetic, and lifestyle-related factors (1). Recurrence rates are as high as 50%, and the incidence is significantly higher in men (2).

Numerous factors contribute to the development of urinary stones, including race, gender, body mass index, dietary patterns, fluid intake, and climate. Certain "stone belt" regions have been identified at regional and global levels, where the incidence of urolithiasis is disproportionately high. For instance, populations in the Western Hemisphere demonstrate elevated prevalence rates (approximately 5-9% in Europe, 12% in Canada, and 13-15% in the United States, particularly in the southeastern states) compared to those in the Eastern Hemisphere, where rates are generally lower (1-5%) (3,4). A well-known high-risk region is the so-called Afro-Asian stone belt (5), which spans from Egypt, Saudi

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Arabia, Sudan and the UAE to Kuwait, Iran, Pakistan, Thailand, India and the Philippines, with prevalence figures ranging from 4% to 20% in various studies (6). Climatic and seasonal factors have gained increasing attention due to their potential impact on hydration status and metabolic processes involved in stone formation. In hot and arid environments, increased perspiration and insensible water loss lead to reduced urinary volume and increased solute concentration, which promote crystal formation. Moreover, greater exposure to sunlight stimulates vitamin D synthesis, which may result in hypercalcemia—a known risk factor for calcium-based stones. These mechanisms suggest that urinary stone incidence may vary with seasonal changes, particularly in warmer months when dehydration is more likely.

Although the relationship between climate and urolithiasis has been previously examined, few studies have focused specifically on seasonal variation in the frequency of stone-related surgical interventions. Moreover, much of the existing literature on this topic is several decades old and may not accurately reflect current population dynamics or environmental trends. The primary aim of this study is to determine whether a seasonal pattern exists in the surgical management of urolithiasis by comparing the frequency of urinary stone operations across different seasons. The findings may help inform preventive strategies, guide future etiologic research, and provide insights into potential seasonal influences on clinical practice.

Materials and Methods

Between 1 January 2018 and 31 December 2020, a total of 841 urinary stone surgeries and 509 transurethral resections of the prostate (TUR-P) procedures—selected as the control group—were retrospectively reviewed and classified according to the four meteorological seasons: spring (March–May), summer (June–August), autumn (September–November), and winter (December–February). TUR-P cases were chosen as the control group based on the assumption that, unlike urinary stone disease, benign prostatic hyperplasia and its surgical treatment are not influenced by environmental or seasonal factors. This comparison aimed to determine whether the incidence of urinary stone surgeries demonstrated a seasonal trend beyond general surgical activity. This study was reviewed and approved by the Ethics Committee of Bezmialem University for the application titled "Retrospective Analysis: The Effect of Seasonal Changes on the Frequency of Urinary System Stone Surgeries" during the 11th Interventional Research Committee meeting, with unanimous approval (decision number: E-54022451-050.05.04-19936, date: 25.05.2021). All procedures were conducted in accordance with the principles of the Declaration of Helsinki.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics, version 22.0, a widely used software package in biomedical research. The primary statistical method for categorical variables was the chi-square test, used to assess associations between groups and determine whether observed differences were statistically significant. A p value of <0.05 was considered indicative of statistical significance.

Results

A total of 841 urinary stone operations performed between January 1, 2018, and December 31, 2020, were evaluated. The seasonal distribution of these procedures was as follows: 19.3% (n=162) in spring, 27.8% (n=234) in summer, 26.3% (n=221) in autumn, and 26.6% (n=224) in winter. In the control group, consisting of 509 patients who underwent TUR-P during the same period, the seasonal distribution was 15.9% (n=81) in spring, 22.2% (n=113) in summer, 29.7% (n=151) in autumn, and 32.2% (n=164) in winter. According to the comparative analysis, the rate of urinary stone operations was significantly higher in summer than in spring (27.8% vs. 19.3%, $p<0.05$). Additionally, the rate of urinary stone operations in summer was significantly higher than the rate of TUR-P operations in the same season (27.8% vs. 22.2%, $p<0.05$). The association between surgical procedure type and seasonal distribution was analyzed using the Pearson chi-square test, indicating a statistically significant difference in seasonal distributions between the two groups ($\chi^2=10.640$, $p=0.014$).

The mean age of the study population was 49.7±15.8 years, with a predominance of female patients (66.0%). The most common stone locations were the ureter (45.9%) and the kidney (44.1%). The majority of patients underwent Type 3 surgery (83.8%), followed by Type 4 (8.7%). Left-sided stones (54.0%) were slightly more frequent than right-sided stones (46.0%) among patients with laterality data (n=767). Hydronephrosis was present in 54.8% of the patients at diagnosis. Flank pain (75.1%) was the most common presenting symptom, followed by nausea/vomiting (5.5%) and urinary retention (5.5%). More than half of the patients (58.1%) had a history of previous stone disease, and 27.5% had undergone prior stone surgery. Preoperative extracorporeal shock wave lithotripsy (ESWL) was reported in 7.6%, while only 0.4% required postoperative ESWL. Residual stones were observed in 8.3% of the cases. A preoperative DJ stent was placed in 12.6% of patients, whereas postoperative DJ stents were used in 79.5%. Comorbidities were present in 34.6% of patients. Postoperative complications (fever, bleeding, infection, organ injury) were rare, occurring in only 1.1% of the patients. The mean stone size was

212.5±257.8 mm², and the mean creatinine level was 1.12±0.81 mg/dL. The mean symptom duration prior to presentation was 16.4±12.9 days, and the mean hospital stay was 2.05±2.54 days (Table 1).

Discussion

In this study, patients who underwent surgery for urinary system stones in our clinic over approximately three years, were retrospectively analysed to investigate whether seasonal temperature variations influence the frequency of urinary stone surgeries. Our results demonstrated a statistically significant increase in urinary stone surgeries during the summer months, with a corresponding decline in spring. In contrast, the seasonal distribution of TUR-P procedures, selected as a control group, remained relatively stable and was not significantly elevated in summer. These findings suggest a potential association between seasonality and the incidence of symptomatic or obstructive urinary stone disease requiring surgical intervention.

The observed summer peak in stone surgeries is consistent with existing evidence indicating that warm weather and dehydration may play a crucial role in stone formation and symptomatic presentation (7). Several pathophysiological mechanisms may explain this relationship. High ambient temperatures during summer months increase insensible water loss through perspiration, leading to reduced urine output and increased urinary solute concentration—key factors in promoting crystallization and stone formation. Additionally, enhanced sunlight exposure may lead to increased vitamin D synthesis and calcium absorption, potentially raising urinary calcium levels and promoting calcium-based stones (8,9). Geographical studies have similarly identified higher stone disease prevalence in hot, arid regions, often referred to as “stone belts”. Our findings support this climate-stone link and extend it to surgical outcomes, emphasizing that environmental factors may not only influence stone formation but also the clinical burden on healthcare systems during warmer months. It is noteworthy that despite global warming and climate shifts, seasonal patterns in stone-related hospital visits and procedures remain evident, reinforcing the relevance of weather-related risk factors.

The demographic and clinical characteristics of our study population provide additional context for the observed seasonal variation. The majority of the patients were female, with a mean age of approximately 50 years. While stone disease has traditionally been more common in men, our data showed a higher proportion of female patients. This finding may reflect changing dietary and lifestyle patterns, as recent studies suggest a narrowing of the historical sex disparity in stone disease prevalence (10). Flank pain was the most frequently reported

Table 1. Demographic and clinical characteristics of patients undergoing urinary stone surgery

Variable	Value
Age (years), mean ± SD	49.7±15.8
Sex, n (%)	
Male	286 (34.0%)
Female	555 (66.0%)
Stone location, n (%)	
Renal	371 (44.1%)
Ureteral	386 (45.9%)
Bladder	73 (8.7%)
Urethral	11 (1.3%)
Type of operation, n (%)	
Percutaneous nephrolithotomy	59 (7.0%)
Open nephrolithotomy	4 (0.5%)
Ureterorenoscopy	705 (83.8%)
Cystolithotripsy	73 (8.7%)
Laterality (n=767), n (%)	
Right	353 (46.0%)
Left	414 (54.0%)
Hydronephrosis, n (%)	
Present	461 (54.8%)
Absent	380 (45.2%)
Presenting symptom, n (%)	
Flank pain	632 (75.1%)
Hematuria	40 (4.8%)
Nausea/vomiting	46 (5.5%)
Dysuria	36 (4.3%)
Urinary retention	46 (5.5%)
Others	41 (4.8%)
Previous stone history, n (%)	
Yes	489 (58.1%)
No	352 (41.9%)
Previous stone surgery, n (%)	
Yes	231 (27.5%)
No	610 (72.5%)
Residual stone, n (%)	
Yes	70 (8.3%)
No	771 (91.7%)
Preoperative DJ stent, n (%)	
Yes	106 (12.6%)
No	735 (87.4%)
Postoperative DJ stent, n (%)	
Yes	669 (79.5%)
No	172 (20.5%)
Comorbidities, n (%)	
None	550 (65.4%)
≥1 comorbidity	291 (34.6%)
Postoperative complication, n (%)	
Yes	9 (1.1%)
No	832 (98.9%)
Stone size (mm²), mean ± SD	212.5±257.8
Symptom duration (days), mean ± SD	16.4±12.9
Hospital stay (days), mean ± SD	2.05±2.54

SD: Standard deviation

presenting symptom, and the most common stone locations were the ureter and kidney. More than half of the patients (58.1%) had a history of previous stone disease, consistent with the high recurrence rates reported in the literature. Therefore, it is recommended that individuals with urinary stone disease undergo regular follow-up visits in the urology outpatient clinic at specified intervals. Most patients underwent ureterorenoscopy, and over 79% received a postoperative DJ stent, reflecting a preference for endourological management strategies in current clinical practice. Residual stones and postoperative complications were infrequent, suggesting effective perioperative planning and surgical proficiency (11).

Study Limitations

Despite the robustness of the dataset, this study has several limitations. First, its retrospective design precludes establishing causality. Second, meteorological variables such as temperature, humidity, and sunlight exposure were not included in the analysis, which could have provided more detailed insights into seasonal effects. Additionally, the study was conducted at a single institution, potentially limiting the generalizability of the findings to regions with different climates, healthcare systems, or patient demographics. Future research incorporating environmental data, multi-center collaboration, and prospective designs may yield a more comprehensive understanding of the seasonal dynamics of urinary stone disease. Moreover, preventive strategies—such as hydration education during high-risk seasons—should be evaluated for their potential to reduce symptomatic presentations and surgical burden.

Conclusion

In conclusion, our study found a statistically significant increase in urinary stone surgeries during summer months, suggesting a seasonal influence on disease manifestation. These findings underscore the need for heightened clinical awareness and preventive strategies during warmer seasons to reduce the morbidity and healthcare resource utilization associated with urinary stone disease.

Ethics

Ethics Committee Approval: The study was approved by the Ethics Committee of Bezmialem University (decision number: E-54022451-050.05.04-19936, date: 25.05.2021). All procedures were conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent: This is a retrospective study.

Footnotes

Author Contributions

Surgical and Medical Practices: B.D., A.İ., F.G., S.A., Y.Ö.İ., Concept: B.D., Design: B.D., A.İ., F.G., Data Collection or Processing: M.E.D., Analysis or Interpretation: M.E.D., Literature Search: S.A.A., F.G., S.A., Writing: B.D., S.A.A.

Conflict of Interest: No conflict of interest was declared by the authors.

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