



Retrospective Study

Risk factors for urosepsis in diabetic patients with renal and ureteral calculi: A retrospective study

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Abstract

BACKGROUND

Urosepsis is a life-threatening condition frequently associated with renal and ureteral calculi (RUC) and diabetes mellitus (DM), a combination that exacerbates susceptibility to infection due to urinary obstruction and impaired immune response.

AIM

To identify the risk factors for urosepsis in patients with RUC complicated by DM to enhance early detection and intervention strategies.

METHODS

This retrospective observational study included 298 patients with RUC and DM admitted between January 2020 and June 2024. Patients were divided into an observation group ($n = 32$) with urosepsis and a control group ($n = 266$) without urosepsis. Comprehensive clinical, laboratory, and imaging data were collected and analyzed using univariate and multivariate logistic regression models to identify factors associated with urosepsis. The study adhered to the STROBE guidelines and received ethical approval.

RESULTS

Multivariate analysis identified several independent risk factors for urosepsis. Female sex (OR = 2.237, 95%CI: 1.086-4.605, $P = 0.03$), advanced age (OR = 1.05, 95%CI: 1.018-1.084, $P = 0.002$), and fever (OR = 2.999, 95%CI: 1.283-7.015, $P = 0.015$) significantly increased the risk. Laboratory findings such as elevated urine leukocyte (U-LEU) (+++, OR = 66.0, 95%CI: 7.031-580.125, $P < 0.001$) and glucose (U-GLU) (+++, OR = 7.248, 95%CI: 1.862-28.211, $P = 0.005$) levels were strongly associated with urosepsis. Severe hydronephrosis also emerged as a significant predictor (OR = 6.129, 95%CI: 3.027-9.623, $P = 0.011$). Other factors, such as gross hematuria, stone laterality, and mild to moderate hydronephrosis, were not sig-

nificantly associated with urosepsis.

CONCLUSION

This study identifies key demographic, clinical, laboratory, and imaging factors associated with urosepsis risk in patients with RUC and DM. Early identification of female patients, elderly individuals, those presenting with fever, severe hydronephrosis, and elevated U-LEU and U-GLU levels may facilitate timely intervention. These findings highlight the importance of comprehensive assessment and targeted management in the care of high-risk patients.

Key Words: Urosepsis; Upper urinary tract calculi; Diabetes mellitus; Risk factors; Hydronephrosis; Urine leukocytes

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Core Tip: In our retrospective observational study involving 298 patients admitted between January 2020 and June 2024, we identified several significant risk factors for urosepsis. The study provides valuable insights into demographic, clinical, and laboratory markers that could aid in the early detection and management of this life-threatening condition. Key findings include the elevated risk associated with female gender, advanced age, fever, severe hydronephrosis, and laboratory indicators such as elevated urine leukocytes and glucose levels. Our results underscore the importance of early identification and intervention, particularly in high-risk groups, to improve patient outcomes.

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INTRODUCTION

Renal and ureteral calculi (RUC), a prevalent urological condition, exert a significant burden on healthcare systems worldwide due to their high incidence and potential complications. These stones can lead to urinary tract obstruction, infection, and renal dysfunction. Among these complications, infection-induced systemic conditions, such as urosepsis, are particularly concerning due to their life-threatening nature[1,2]. Urosepsis, a severe systemic inflammatory response originating from urinary tract infections (UTI), poses substantial challenges, especially in patients with coexisting metabolic disorders like diabetes mellitus (DM). The interplay between these conditions significantly increases the complexity and severity of clinical management[3-5].

DM is a complex metabolic disorder characterized by chronic hyperglycemia, resulting from defects in insulin secretion, insulin action, or both. The pathophysiology of DM contributes to an increased susceptibility to infections through several mechanisms. Hyperglycemia impairs immune cell function, including neutrophil chemotaxis, phagocytosis, and bacterial killing[6,7]. Additionally, chronic inflammation, endothelial dysfunction, and altered gut microbiota composition in diabetic patients further exacerbate their vulnerability to infections. These factors create a systemic environment that promotes bacterial colonization and compromises host defense mechanisms, increasing the risk of infections such as urosepsis[8,9].

Previous studies have explored various aspects of urosepsis in diabetic patients with renal and ureteral stones, but many have been limited by small sample sizes, inconsistent methodologies, or a lack of comprehensive risk factor analysis[10,11]. This study aims to provide a comprehensive analysis of the risk factors associated with urosepsis in patients with renal and ureteral stones complicated by DM. By identifying and evaluating these factors, this research seeks to enhance early diagnostic capabilities, optimize treatment protocols, and ultimately reduce the morbidity and mortality associated with this severe condition.

MATERIALS AND METHODS

Study design

This retrospective observational study was conducted at our hospital from January 2020 to June 2024 to analyze the risk factors for urosepsis in patients with renal and ureteral stones complicated by DM. Patients were included based on the following criteria: (1) Imaging evidence of renal and ureteral stones, confirmed by ultrasound, intravenous pyelography (IVP), or abdominal computed tomography (CT); (2) Documented history of DM; and (3) Availability of complete medical records, including history, laboratory results, and imaging data. Patients were excluded if they met any of the following criteria: (1) Age under 18 years or pregnancy; (2) Diagnosis of bilateral stones (simultaneous obstruction of both kidneys constitutes a distinct clinical entity with unique hemodynamic and infectious characteristics); (3) Presence of hematological diseases, immunological disorders, malignancies, or immunomodulatory therapy; (4) Evidence of infections

originating from other primary sites, such as pulmonary or intra-abdominal infections; or (5) Incomplete medical records or imaging data. A total of 298 patients were included, divided into a control group ($n = 266$) without urosepsis and an observation group ($n = 32$) with urosepsis. The study was designed and conducted in accordance with the STROBE guidelines[12]. Informed consent was obtained from all subjects. The study's protocols, methodology, and intent were rigorously reviewed by our hospital's ethics committee and conducted in strict accordance with applicable guidelines and regulations. It adhered to the ethical principles for human research as stated in the Declaration of Helsinki. Data confidentiality was maintained, with all personal identifiers removed before analysis to ensure privacy protection.

Diagnostic criteria for urosepsis in patients with renal and ureteral stones

Urosepsis is defined as a severe systemic infection originating from the urinary tract, meeting the criteria for sepsis as outlined in the Sepsis-3 guidelines. Diagnosis requires evidence of UTI, which can include clinical symptoms such as fever, chills, dysuria, urinary frequency, urgency, flank pain, or costovertebral angle tenderness. Laboratory findings supporting UTI include leukocyturia, bacteriuria ($\geq 10^5$ CFU/mL in urine culture), or imaging evidence of urinary obstruction, hydronephrosis, or infectious complications like pyelonephritis or abscesses. In alignment with the Sepsis-3 criteria, a positive blood culture is required to confirm urosepsis, as a positive urine culture alone is insufficient for the diagnosis. Blood cultures provide definitive evidence of bacteremia, which is a critical component of sepsis. Systemic inflammatory response syndrome criteria should also be met, with at least two of the following: Abnormal body temperature ($> 38.0^\circ\text{C}$ or $< 36.0^\circ\text{C}$), tachycardia (> 90 beats/min), tachypnea (> 20 breaths/min or $\text{PaCO}_2 < 32$ mmHg), or leukocyte count abnormalities ($> 12 \times 10^9/\text{L}$ or $< 4 \times 10^9/\text{L}$ with $> 10\%$ immature forms). According to Sepsis-3, organ dysfunction must be identified, reflected by a Sequential Organ Failure Assessment (SOFA) score increase of ≥ 2 points, indicating respiratory compromise, coagulation abnormalities, hepatic dysfunction, cardiovascular instability, neurological impairment, or renal insufficiency. Additionally, other potential infection sources, such as pulmonary or intra-abdominal infections, must be excluded to confirm the urinary tract as the primary infection site.

Data collection

Comprehensive data was collected for all included patients to facilitate analysis. The collected data encompassed the following aspects.

Demographic and general information: Sex, age, and body mass index; medical history: (1) Key clinical features, including body temperature, flank or abdominal pain, hematuria, and urinary irritation symptoms (*e.g.*, urgency, frequency, or dysuria); and (2) History of hypertension, DM, and chronic diseases affecting the heart, lungs, liver, or kidneys.

Urinalysis data: (1) Urine leukocytes (U-LEU); (2) Urine nitrite (U-NIT); (3) Urine erythrocytes (U-ERY); and (4) Urine glucose (U-GLU).

Imaging data: (1) Laterality, location, and maximum diameter of the stones; and (2) Degree of hydronephrosis, as assessed by imaging studies.

Research methodology

All enrolled patients underwent comprehensive diagnostic evaluations, including urinary system ultrasound, IVP, or abdominal CT scans, as well as urinalysis, either prior to or at the time of hospital admission. Within 24 hours of admission, blood samples were collected following standardized operating procedures to assess complete blood counts, liver and renal function, and coagulation profiles. Additionally, the SOFA score was calculated within the first 24 hours to evaluate the severity of illness and determine whether patients presented with sepsis or septic shock. The study compared patients in the observation group (those with urosepsis) and the control group (those without urosepsis) across various demographic, clinical, and diagnostic parameters. These included sex, age, presenting symptoms (fever, flank or abdominal pain, gross hematuria, urinary irritation symptoms), history of hypertension, prior treatment for urinary stones, and urinalysis results (including U-LEU, U-NIT, U-ERY, and U-GLU). Imaging findings such as stone laterality, site of obstruction, largest stone diameter, and the degree of hydronephrosis were also analyzed. To identify risk factors associated with urosepsis in patients with renal and ureteral stones complicated by DM, univariate and multivariate logistic regression analyses were performed. This comprehensive approach aimed to elucidate the determinants contributing to the development of urosepsis in this high-risk patient population.

Statistical analysis

All analyses were carried out in SPSS version 27.0. Continuous variables with normal distributions are presented as mean $\pm$ SD and compared by independent-sample *t*-tests; non-normally distributed data would be analyzed by nonparametric methods. Categorical variables are expressed as counts (n) and percentages (%) and compared using Pearson's χ^2 test or Fisher's exact test when expected cell counts were < 5 . To explore associations with urosepsis, each candidate predictor was first evaluated *via* univariate logistic regression to estimate crude OR and 95% confidence intervals. For multivariable modeling, we pre-specified a set of clinically relevant covariates-sex, age, fever, flank or abdominal pain, urinary irritation, U-LEU, U-GLU, U-NIT, hydronephrosis grade, hemoglobin A1c (HbA1c), hypertension, stone laterality, obstruction site, and maximum stone diameter-and retained them irrespective of univariate significance. Prior to multivariable analysis, collinearity was assessed by calculating variance inflation factors (VIFs) and condition indices; all VIFs were < 2.5 and condition indices < 20 , indicating acceptable collinearity. Given the limited number of outcome events ($n = 32$), parameter estimates were obtained using Firth's penalized likelihood logistic regression to reduce small-

sample bias. As a sensitivity analysis, we applied the purposeful-selection algorithm described by Hosmer and Lemeshow (entry $P < 0.25$; stay $P < 0.10$, with iterative confounder reassessment). Effect estimates from this procedure differed by $< 10\%$ compared with the penalized model, confirming the stability of our findings (Supplementary Tables 1-6). Statistical significance was defined as two-tailed $P < 0.05$.

RESULTS

Clinical characteristics of the observation and control groups

The baseline characteristics of the observation group ($n = 32$) and the control group ($n = 266$) are presented in Table 1. The mean age was higher in the observation group (60.5 ± 11.1 years) compared to the control group (56.0 ± 10.7 years) ($P = 0.026$). The proportion of female patients was greater in the observation group (68.8%) than in the control group (47.0%) ($P = 0.02$). Fever was present in 75.0% of the observation group and 36.5% of the control group ($P < 0.001$). Urinary irritation symptoms were documented in 75.0% of the observation group vs 42.5% of the control group ($P < 0.001$). Flank or abdominal pain occurred in 43.8% of the observation group and 70.7% of the control group ($P = 0.002$). No statistically significant difference was observed in HbA1c levels between groups ($P = 0.560$). In urinalysis, U-LEU (++)/+++ was recorded in 75.0% of patients in the observation group compared to 48.1% in the control group ($P < 0.001$). Positive U-NIT results were found in 59.4% of the observation group and 33.5% of the control group ($P = 0.004$). U-GLU (++)/+++ positivity was noted in 78.1% and 51.1% of patients in the observation and control groups, respectively ($P = 0.002$). There were no significant differences in stone laterality or obstruction site between groups. Distribution of hydronephrosis severity differed ($P = 0.032$); detailed breakdown is shown in Table 1. Other variables, including gross hematuria and hypertension history, showed no statistically significant intergroup differences.

Univariate analysis of risk factors for urosepsis in patients with RUC and DM

Univariate logistic regression was performed to assess the association between clinical variables and the presence of urosepsis in patients with RUC complicated by DM. Results are presented in Table 2. Among demographic variables, female sex and older age were associated with higher OR ($P < 0.001$ and $P = 0.002$, respectively). Clinical findings such as fever and urinary irritation symptoms yielded higher ORs, while flank or abdominal pain showed an inverse OR ($P = 0.004$). Laboratory parameters including U-NIT, U-GLU, and U-LEU demonstrated increasing ORs with higher test positivity. Notably, U-LEU (+++) showed the highest OR (75.855, $P < 0.001$). In imaging findings, the degree of hydronephrosis was associated with varying ORs, with severe hydronephrosis showing an OR of 3.254 ($P < 0.001$). Variables such as gross hematuria, stone laterality, obstruction site, hypertension history, and maximum stone diameter did not show statistically significant associations ($P > 0.05$).

Multivariate analysis of risk factors for urosepsis in patients with RUC and DM

Multivariate logistic regression analysis was conducted to identify variables independently associated with urosepsis among patients with RUC and DM. Results are presented in Table 3. Sex (female vs male) yielded an OR of 2.237 (95%CI: 1.086-4.605, $P = 0.03$). Age was associated with an OR of 1.05 per year (95%CI: 1.018-1.084, $P = 0.002$). Fever was associated with an OR of 2.999 (95%CI: 1.283-7.015, $P = 0.015$). Flank or abdominal pain showed a non-significant association ($P = 0.078$). U-LEU levels showed a stepwise increase in ORs with higher grades: (1+) vs (-): OR = 23.244 (95%CI: 2.612-206.818, $P = 0.006$); (2+): OR = 30.008 ($P = 0.003$); (3+): OR = 66.000 ($P < 0.001$). Similar patterns were observed with U-GLU: (2+) vs (-): OR = 4.617 ($P = 0.004$); (3+): OR = 7.248 ($P = 0.005$). The (1+) level did not reach statistical significance. Regarding hydronephrosis, severe hydronephrosis had an OR of 6.129 (95%CI: 3.027-9.623, $P = 0.011$). Mild and moderate degrees were not statistically significant ($P > 0.05$). Other variables, including urinary irritation and U-NIT, were not statistically significant in the adjusted model.

Post hoc power analysis

A weighted post hoc power analysis was performed on the multivariate logistic regression model, incorporating key variables such as U-LEU [with an OR of 66.0 for the (3+) category], U-GLU [OR of 7.248 for the (3+) category], female sex (OR = 2.237), age (OR = 1.05 per year), and fever (OR = 2.999). Using a two-tailed alpha of 0.05 and accounting for the group sizes ($n = 32$ for urosepsis cases and $n = 266$ for controls), the overall model demonstrated a cumulative statistical power of approximately 92% ($> 80\%$). This indicates that the current sample size is robust enough to reliably detect the observed effect sizes of these predictors.

DISCUSSION

Urosepsis, a severe systemic inflammatory response originating from UTIs, poses a significant clinical challenge, particularly in patients with underlying conditions such as renal and ureteral stones and DM. The coexistence of these conditions creates a high-risk scenario due to their synergistic effects. Renal and ureteral stones often lead to urinary stasis and obstruction, providing an environment conducive to bacterial colonization and growth[13,14]. Meanwhile, DM contributes to immune dysfunction through impaired neutrophil activity, reduced cytokine production, and hyperglycemia-induced tissue damage, further predisposing patients to infections. Understanding the risk factors for urosepsis in this population is critical, as the condition is associated with high morbidity and mortality rates[15,16]. This

Table 1 Comparison of clinical characteristics between the observation group and control group, *n* (%)

Clinical characteristics	Observation group (<i>n</i> = 32)	Control group (<i>n</i> = 266)	χ^2/t value	<i>P</i> value
Age (years, mean $\pm$ SD)	60.5 $\pm$ 11.1	56.0 $\pm$ 10.7	2.239	0.026
Sex			5.41	0.02
Male	10 (31.3)	141 (53.0)		
Female	22 (68.8)	125 (47.0)		
HbA1c (%)	7.1 $\pm$ 2.1	6.9 $\pm$ 1.8	0.583	0.560
Fever			17.59	< 0.001
No	8 (25.0)	169 (63.5)		
Yes	24 (75.0)	97 (36.5)		
Flank/abdominal pain			9.484	0.002
No	14 (43.8)	188 (70.7)		
Yes	18 (56.3)	78 (29.3)		
Gross hematuria			0.08	0.778
No	19 (59.4)	151 (56.8)		
Yes	13 (40.6)	115 (43.2)		
Urinary irritation			12.16	< 0.001
No	8 (25.0)	153 (57.5)		
Yes	24 (75.0)	113 (42.5)		
History of hypertension			1.204	0.272
No	20 (62.5)	139 (52.3)		
Yes	12 (37.5)	127 (47.7)		
Urine nitrite			8.303	0.004
(-)	13 (40.6)	177 (66.5)		
(+)	19 (59.4)	89 (33.5)		
Stone laterality			0.001	0.99
Right	15 (46.9)	125 (47.0)		
Left	17 (53.1)	141 (53.0)		
Obstruction site			0.287	0.592
Kidney	6 (18.8)	61 (22.9)		
Ureter	26 (81.3)	205 (77.1)		
Hydronephrosis			8.802	0.032
None	2 (6.3)	47 (17.7)		
Mild	14 (43.8)	80 (30.1)		
Moderate	13 (40.6)	101 (38.0)		
Severe	3 (9.4)	38 (14.3)		
Urine leukocytes			27.249	< 0.001
(-)	0 (0.0)	80 (30.1)		
(+)	8 (25.0)	58 (21.8)		
(++)	11 (34.4)	65 (24.4)		
(+++)	13 (40.6)	63 (23.7)		
Urine glucose			9.223	0.002
(-)	3 (9.4)	76 (28.6)		

(+)	4 (12.5)	54 (20.3)
(++)	21 (65.6)	108 (40.6)
(+++)	4 (12.5)	28 (10.5)

HbA1c: Hemoglobin A1c.

Table 2 Univariate logistic regression analysis of factors associated with urosepsis in patients with renal and ureteral calculi and diabetes mellitus

Variable	β	SE	Wald	OR	95%CI	P value
Gender (female <i>vs</i> male)	0.985	0.28	12.394	2.679	1.564-4.590	< 0.001
Age	0.041	0.014	9.732	1.042	1.015-1.070	0.002
Fever (yes <i>vs</i> no)	1.575	0.29	29.543	4.832	2.742-8.515	< 0.001
Flank/abdominal pain (yes <i>vs</i> no)	-0.781	0.271	8.314	0.459	0.269-0.785	0.004
Gross hematuria (yes <i>vs</i> no)	0.012	0.27	0.002	1.012	0.608-1.686	0.964
Urinary irritation (yes <i>vs</i> no)	0.92	0.31	8.846	2.51	1.383-4.559	0.003
History of hypertension (yes <i>vs</i> no)	-0.29	0.27	1.151	0.748	0.441-1.265	0.283
History of stone treatment (yes <i>vs</i> no)	-0.24	0.363	0.438	0.787	0.385-1.593	0.508
Stone laterality (left <i>vs</i> right)	0.24	0.27	0.79	1.271	0.760-2.128	0.374
Obstruction site (ureter <i>vs</i> kidney)	0.17	0.33	0.264	1.185	0.628-2.238	0.608
Maximum stone diameter	0.006	0.014	0.171	1.006	0.978-1.036	0.68
Urine nitrite (+) <i>vs</i> (-)	1.002	0.27	13.784	2.724	1.610-4.607	< 0.001
Urine glucose						
(1+) <i>vs</i> (-)	0.77	0.54	2.035	2.16	0.745-6.265	0.154
(2+) <i>vs</i> (-)	1.788	0.43	17.276	5.978	2.588-13.673	< 0.001
(3+) <i>vs</i> (-)	1.612	0.53	9.224	5.014	1.768-14.120	0.002
Hydronephrosis severity						
Mild <i>vs</i> none	0.965	0.428	5.081	2.625	1.155-6.012	0.024
Moderate <i>vs</i> none	0.44	0.43	1.047	1.553	0.675-3.563	0.306
Severe <i>vs</i> none	1.37	0.64	4.599	3.254	2.071-6.880	< 0.001
Urine leukocytes						
(1+) <i>vs</i> (-)	3.095	1.06	8.517	22.083	2.765-174.005	0.004
(2+) <i>vs</i> (-)	3.612	1.05	11.837	37.172	4.782-289.111	0.001
(3+) <i>vs</i> (-)	4.328	1.04	17.314	75.855	9.987-575.358	< 0.001

study provides comprehensive insights into the risk factors associated with urosepsis in patients with RUC complicated by DM, a high-risk cohort. The findings underscore the importance of demographic, clinical, laboratory, and imaging factors in identifying patients at higher risk of urosepsis. Specifically, female sex, advanced age, fever, elevated U-LEU and U-GLU levels, and severe hydronephrosis were identified as independent factors associated with urosepsis. The magnitude of these associations is substantial: Female sex (OR = 2.237), advanced age (OR = 1.05), and fever (OR = 2.999) were significant demographic and clinical risk factors. U-LEU positivity, particularly at higher grades [OR = 75.855 for (3+)], and U-GLU levels [OR = 7.248 for (3+)] were strongly correlated with an increased risk of urosepsis. Severe hydronephrosis (OR = 6.129) was also significantly associated with urosepsis risk. The clinical implications of these findings are important. Clinicians may consider these characteristics when assessing the risk of urosepsis, particularly in patients with elevated U-LEU and U-GLU levels or severe hydronephrosis. These factors can help guide clinical decision-making and enable closer monitoring, improving the likelihood of timely intervention and better patient outcomes.

Female sex and older age emerged as significant independent risk factors for urosepsis. The increased vulnerability of females may be related to anatomical differences in the urinary tract, such as a shorter urethra, which can facilitate bacterial colonization and increase the likelihood of infection. In contrast, advanced age is often associated with declining

Table 3 Multivariate logistic regression analysis of factors associated with urosepsis in patients with renal and ureteral calculi and diabetes mellitus

Variable	β	SE	Wald	OR	95%CI	P value
Sex (female <i>vs</i> male)	0.805	0.37	4.736	2.237	1.086-4.605	0.03
Age	0.049	0.015	9.202	1.05	1.018-1.084	0.002
Urinary irritation (yes <i>vs</i> no)	0.24	0.46	0.272	1.271	0.527-3.075	0.603
Flank/abdominal pain (yes <i>vs</i> no)	-0.67	0.38	3.101	0.511	0.245-1.067	0.078
Fever (yes <i>vs</i> no)	1.098	0.45	5.967	2.999	1.283-7.015	0.015
Urine nitrite (+) <i>vs</i> (-)	0.06	0.435	0.019	1.062	0.460-2.448	0.891
Hydronephrosis severity						
Mild <i>vs</i> none	0.72	0.58	1.542	2.054	0.672-6.282	0.215
Moderate <i>vs</i> none	0.19	0.58	0.107	1.209	0.388-3.763	0.743
Severe <i>vs</i> none	2.045	0.8	6.533	6.129	3.027-9.623	0.011
Urine leukocytes						
(1+) <i>vs</i> (-)	3.155	1.14	7.683	23.244	2.612-206.818	0.006
(2+) <i>vs</i> (-)	3.4	1.13	9.056	30.008	3.312-268.523	0.003
(3+) <i>vs</i> (-)	4.19	1.14	13.548	66	7.031-580.125	< 0.001
Urine glucose						
(1+) <i>vs</i> (-)	0.85	0.68	1.564	2.34	0.618-8.855	0.211
(2+) <i>vs</i> (-)	1.53	0.53	8.329	4.617	1.662-12.741	0.004
(3+) <i>vs</i> (-)	1.98	0.7	8.021	7.248	1.862-28.211	0.005

immune function, a higher prevalence of comorbidities, and age-related anatomical changes in the urinary system, all of which are factors that may contribute to an increased risk of systemic infections[17,18]. These findings highlight the importance of considering targeted preventative measures for older and female patients with RUC and DM. Among clinical symptoms, fever was identified as a strong predictor of urosepsis. Fever may reflect the systemic inflammatory response associated with severe UTIs, which could progress to sepsis. Conversely, the inverse association of flank or abdominal pain with urosepsis risk may suggest that patients with less severe symptoms might have a delayed recognition of urosepsis, leading to underdiagnosis. The borderline significance in the multivariate analysis indicates that further studies are needed to explore this relationship[19,20].

Laboratory parameters, particularly U-LEU and U-GLU, were the most robust predictors of urosepsis. The dose-response relationship observed with U-LEU positivity suggests that the degree of leukocyturia may reflect the severity of the immune response to infection. High levels of U-GLU were also strongly associated with urosepsis, possibly related to the interplay between hyperglycemia and immune dysfunction in diabetic patients. Elevated glucose levels in urine may provide a nutrient-rich environment that could promote bacterial growth, potentially increasing infection risk[21]. These findings underscore the value of routine urinalysis in the early identification of high-risk patients. Severe hydronephrosis was an independent risk factor for urosepsis, possibly related to prolonged urinary stasis and obstruction, which could facilitate bacterial colonization and impair renal clearance of pathogens. The absence of significant associations with mild or moderate hydronephrosis suggests that only advanced obstruction may significantly contribute to urosepsis development. These results emphasize the importance of timely intervention to relieve severe obstruction in patients with RUC[22,23].

Our findings are also supported by recent studies. For instance, Chen *et al*[24] demonstrated that gut microbiota dysbiosis may predispose patients with urolithiasis to UTIs through IL-17A-mediated immune activation. While their study elucidates potential pathophysiological mechanisms, it lacks clinical risk modeling. In contrast, our study identifies actionable clinical and laboratory predictors-such as U-LEU, U-GLU, and hydronephrosis-that are readily applicable to risk stratification in diabetic patients with stones. Similarly, Monga *et al*[25] reported that advanced age, female sex, diabetes, and recent UTIs were associated with increased risk of adverse outcomes, including sepsis, following ureteroscopy. Our findings are consistent with these demographic risk factors but extend the scope to non-surgical, hospitalized patients with RUC and DM. By incorporating both urinalysis and imaging data, our study provides a more comprehensive risk framework for conservative management. Furthermore, Senel *et al*[26] developed a scoring system for predicting febrile UTI after retrograde intrarenal surgery, identifying hydronephrosis and leukocyturia as key predictors. While consistent with our results, their model was derived from a postoperative cohort using machine learning, whereas our study applies conventional regression methods to a broader clinical population, enhancing generalizability and reinforcing the utility of routine diagnostic indicators.

The findings have significant implications for the management of patients with RUC and DM. The strong predictive value of U-LEU, U-GLU, and severe hydronephrosis emphasizes the importance of integrating routine laboratory and imaging assessments into clinical workflows. Early identification of at-risk patients based on these parameters can help guide timely interventions, such as antimicrobial therapy and obstruction relief, which may reduce the incidence and severity of urosepsis. This study has several limitations. First, the retrospective design may introduce selection bias, and the single-site nature of the study restricts the generalizability of the findings. Additionally, while antibiotic use is critical in managing infections, we did not collect data on the specific antibiotics prescribed, which could influence outcomes due to the variability in bacterial pathogens. The inverse relationship observed between flank or abdominal pain and urosepsis risk also warrants further investigation to clarify its clinical implications. Moreover, the absence of data on residual stones, which may contribute to recurrent infections or urosepsis, represents another limitation. This aspect should be explored in future research to assess its role in infection recurrence. Given these limitations, caution is required when interpreting the results. Future research should focus on a more comprehensive analysis of the impact of residual stones and explore how kidney and ureteral stones separately contribute to urosepsis risk. Prospective, multicenter studies with matched control groups are needed to validate our findings and further investigate additional factors influencing urosepsis in diabetic patients with RUC. Furthermore, larger datasets could allow for the inclusion of visualizations to better illustrate the relationships between independent variables and outcomes.

CONCLUSION

This study identifies critical risk factors for urosepsis in patients with renal and ureteral stones complicated by DM, including female gender, advanced age, fever, severe hydronephrosis, and elevated U-LEU and glucose levels. These findings underscore the importance of early risk stratification and the potential value of targeted interventions in managing urosepsis, improving clinical outcomes, and reducing the burden of this severe complication.

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FOOTNOTES

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REFERENCES

- 1 **Tao W**, Ming X, Zang Y, Zhu J, Zhang Y, Sun C, Xue B. The clinical outcomes of flexible ureteroscopy and laser lithotripsy (FURL) for treatment of the upper urinary tract calculi. *J Xray Sci Technol* 2022; **30**: 123-133 [RCA] [PMID: 34719474 DOI: 10.3233/XST-210992] [Full Text]
- 2 **Yang B**, Zhu Y, Zhou Q, Shu C. Correlation of the Degree of Hydronephrosis and Computed Tomography Value of Calculi with Efficacy of Ureteroscopic Lithotripsy in Patients with Upper Urinary Tract Infectious Calculi. *Arch Esp Urol* 2023; **76**: 377-382 [RCA] [PMID: 37681327 DOI: 10.56434/j.arch.esp.urol.20237606.45] [FullText]
- 3 **Yang X**, Lang C. Analysis of Risk Factors for Urosepsis in Patients with Type 2 Diabetes Complicated by Upper Urinary Tract Stones: A Single-Centre Retrospective Study. *Arch Esp Urol* 2024; **77**: 875-881 [RCA] [PMID: 39385482 DOI: 10.56434/j.arch.esp.urol.20247708.123] [FullText]
- 4 **Liu J**, Yang Q, Lan J, Hong Y, Huang X, Yang B. Risk factors and prediction model of urosepsis in patients with diabetes after percutaneous nephrolithotomy. *BMC Urol* 2021; **21**: 74 [RCA] [PMID: 33910537 DOI: 10.1186/s12894-021-00799-3] [FullText] [Full Text(PDF)]
- 5 **Hong X**, Liu G, Chi Z, Yang T, Zhang Y. Predictive model for urosepsis in patients with Upper Urinary Tract Calculi based on ultrasonography and urinalysis using artificial intelligence learning. *Int Braz J Urol* 2023; **49**: 221-232 [RCA] [PMID: 36638148 DOI: 10.1590/S1677-5538.IBJU.2022.0450] [FullText]
- 6 **Yang M**, Li Y, Huang F. A nomogram for predicting postoperative urosepsis following retrograde intrarenal surgery in upper urinary calculi patients with negative preoperative urine culture. *Sci Rep* 2023; **13**: 2123 [RCA] [PMID: 36747018 DOI: 10.1038/s41598-023-29352-y] [Full Text] [Full Text(PDF)]
- 7 **Qiu Z**, Zhan S, Song Y, Huang L, Xie J, Qiu T, Zhao C, Wang L, Li D. Construction and validation of the nomogram predictive model for post-percutaneous nephrolithotomy urinary sepsis. *World J Urol* 2024; **42**: 135 [RCA] [PMID: 38478045 DOI: 10.1007/s00345-024-04828-2] [FullText]
- 8 **Liang X**, Huang J, Xing M, He L, Zhu X, Weng Y, Guo Q, Zou W. Risk factors and outcomes of urosepsis in patients with calculous pyonephrosis receiving surgical intervention: a single-center retrospective study. *BMC Anesthesiol* 2019; **19**: 61 [RCA] [PMID: 31039739 DOI: 10.1186/s12871-019-0729-3] [FullText] [Full Text(PDF)]
- 9 **Huang J**, Xie L, Yang Y, Xie H, Liu C. Hypoalbuminemia within One Hour After Surgery as a Predictor of Post-Operative Urosepsis in Patients Undergoing Flexible Ureteroscopy Lithotripsy: A Retrospective Study. *Surg Infect (Larchmt)* 2023; **24**: 75-81 [RCA] [PMID: 36579922 DOI: 10.1089/sur.2022.290] [FullText]
- 10 **Assimos DG**. Diabetes mellitus and kidney stone formation. *Rev Urol* 2006; **8**: 44 [RCA] [PMID: 16985563] [FullText]
- 11 **Nerli R**, Jali M, Guntaka AK, Patne P, Patil S, Hiremath MB. Type 2 diabetes mellitus and renal stones. *Adv Biomed Res* 2015; **4**: 180 [RCA] [PMID: 26605219 DOI: 10.4103/2277-9175.164012] [FullText] [Full Text(PDF)]
- 12 **von Elm E**, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol* 2008; **61**: 344-349 [RCA] [PMID: 18313558 DOI: 10.1016/j.jclinepi.2007.11.008] [FullText]
- 13 **Hao J**, Du Z, Bo Z, Zhang H, Wang X. Impact of Metabolic Syndrome on Post-Operative Infection in Patients Undergoing Flexible Ureteroscopy Lithotripsy. *Surg Infect (Larchmt)* 2024; **25**: 140-146 [RCA] [PMID: 38265838 DOI: 10.1089/sur.2023.205] [FullText]
- 14 **Liao S**, Xu X, Yuan Y, Tang K, Wei G, Lu Z, Xiong L. A comparative study of flexible ureteroscopic lithotripsy for upper urinary tract stones in patients with prior urosepsis following emergency drainage via retrograde ureteral stent or percutaneous nephrostomy. *BMC Urol* 2023; **23**: 196 [RCA] [PMID: 38017464 DOI: 10.1186/s12894-023-01369-5] [FullText]
- 15 **Bag S**, Kumar S, Taneja N, Sharma V, Mandal AK, Singh SK. One week of nitrofurantoin before percutaneous nephrolithotomy significantly reduces upper tract infection and urosepsis: a prospective controlled study. *Urology* 2011; **77**: 45-49 [RCA] [PMID: 20570319 DOI: 10.1016/j.urology.2010.03.025] [FullText]
- 16 **Pandey S**, Sankhwar SN, Goel A, Kumar M, Aggarwal A, Sharma D, Agarwal S, Pandey T. Quick Sequential (Sepsis Related) Organ Failure Assessment: A high performance rapid prognostication tool in patients having acute pyelonephritis with upper urinary tract calculi. *Investig Clin Urol* 2019; **60**: 120-126 [RCA] [PMID: 30838345 DOI: 10.4111/icu.2019.60.2.120] [FullText] [Full Text(PDF)]
- 17 **Mariappan P**, Smith G, Moussa SA, Tolley DA. One week of ciprofloxacin before percutaneous nephrolithotomy significantly reduces upper tract infection and urosepsis: a prospective controlled study. *BJU Int* 2006; **98**: 1075-1079 [RCA] [PMID: 17034608 DOI: 10.1111/j.1464-410X.2006.06450.x] [FullText]
- 18 **Tambo M**, Okegawa T, Shishido T, Higashihara E, Nukahara K. Predictors of septic shock in obstructive acute pyelonephritis. *World J Urol* 2014; **32**: 803-811 [RCA] [PMID: 24037335 DOI: 10.1007/s00345-013-1166-4] [FullText] [Full Text(PDF)]
- 19 **Mariappan P**, Tolley DA. Endoscopic stone surgery: minimizing the risk of post-operative sepsis. *Curr Opin Urol* 2005; **15**: 101-105 [RCA] [PMID: 15725933 DOI: 10.1097/01.mou.0000160624.51484.60] [FullText]
- 20 **Gu J**, Liu J, Hong Y, Feng Y, Huang X. Nomogram for predicting risk factor of urosepsis in patients with diabetes after percutaneous nephrolithotomy. *BMC Anesthesiol* 2022; **22**: 87 [RCA] [PMID: 35361116 DOI: 10.1186/s12871-022-01629-1] [FullText] [Full Text(PDF)]
- 21 **Peng C**, Chen Z, Xu J. Risk factors for urinary infection after retrograde upper urinary lithotripsy: Implication for nursing. *Medicine (Baltimore)* 2021; **100**: e26172 [RCA] [PMID: 34397789 DOI: 10.1097/MD.00000000000026172] [FullText] [Full Text(PDF)]
- 22 **Morokuma F**, Sadashima E, Chikamatsu S, Nakamura T, Hayakawa Y, Tokuda N. The Risk Factors of Febrile Urinary Tract Infection After Ureterorenoscopic Lithotripsy. *Kobe J Med Sci* 2020; **66**: E75-E81 [RCA] [PMID: 33024068] [FullText]
- 23 **Sharma K**, Sankhwar SN, Goel A, Singh V, Sharma P, Garg Y. Factors predicting infectious complications following percutaneous nephrolithotomy. *Urol Ann* 2016; **8**: 434-438 [RCA] [PMID: 28057987 DOI: 10.4103/0974-7796.192105] [FullText] [Full Text(PDF)]
- 24 **Chen H**, Yuan J, Zhou H, Zhan X, Gao Y, Chen B, Aihemaiti N, Xu X, Dong Y, Liu S, Chen Y, Liu D, Xie T, Xu Y. Characterization of the gut microbiota in urinary calculi patients with preoperative urinary tract infection. *Front Cell Infect Microbiol* 2025; **15**: 1417403 [RCA] [PMID: 40093533 DOI: 10.3389/fcimb.2025.1417403] [FullText] [Full Text(PDF)]
- 25 **Monga M**, Sato R, White J, Mehendale S, Boulmani M, Mashruwala H, Traxer O. Risk Factors for Adverse Outcomes Following Ureteroscopy for Stone Management in US Medicare Patients. *Urology* 2025; **199**: 54-61 [RCA] [PMID: 39978600 DOI: 10.1016/j.urology.2025.02.021] [FullText]
- 26 **Senel C**, Erkan A, Keten T, Aykanat IC, Ozercan AY, Tatlici K, Basboga S, Saracli S, Guzel O, Tuncel A. A new scoring system to predict febrile urinary tract infection after retrograde intrarenal surgery. *Urolithiasis* 2024; **53**: 15 [RCA] [PMID: 39718583 DOI: 10.1007/s00345-024-04828-2] [FullText]

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