

ORIGINAL ARTICLE

Associated factors of early infectious complications after ureterorenoscopy for stone disease: a prospective study

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ABSTRACT

Background: Infectious complications constitute a significant postoperative concern following ureterorenoscopy (URS) for urinary stone disease. Therefore, identification of associated clinical and procedural factors may improve perioperative risk stratification. This study aims to determine the frequency and associated factors of early infectious complications within 30 days following URS for stone disease at a tertiary care hospital in Karachi, Pakistan.

Methods: A prospective longitudinal study was conducted at Liaquat National Hospital, Karachi from March- July, 2026. A total of 164 patients aged 18–80 years who underwent semi-rigid or flexible URS for stone disease were enrolled through non-probability consecutive sampling. Baseline demographic, clinical, stone-related, and perioperative data were recorded. Early infectious complications were assessed within 30-day follow-up visits. Bivariate analysis and multivariable logistic regression identified independent predictors of infection.

Results: The median age of patients was 39 years and 70.1% of participants were male. The early infectious complication rate was 11.0% after 30 days of follow-up. UTI was the most common complication (66.7%), followed by urosepsis (16.7%). On multivariable logistic regression, stone size was the only significant independent predictor of early postoperative infectious complications (aOR = 1.26; 95% CI: 1.01–1.56; $p = 0.039$), with each additional millimeter increasing infection odds by 26%. Upper ureter stone location showed a clinically meaningful trend ($p = 0.064$).

Conclusion: Early infectious complications occurred in 11.0% of patients within 30 days of URS, with greater stone size independently associated with infection. This highlights the need for enhanced perioperative assessment and postoperative surveillance in patients with larger stones.

Keywords: Ureterorenoscopy, Urinary Tract Infection, Urosepsis, Urinary Calculi, Urolithiasis

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Introduction

Urolithiasis is a major global health concern, with rising incidence and recurrence rates that impose significant clinical and economic costs worldwide and considerably impair patients' quality of life. (1) Worldwide, the prevalence of

urinary stones ranges from 5% to 15%. (2) The condition is becoming increasingly common, especially among people of working age.

Recent Global Burden of Disease data reported that the burden was continuously high in males across all age groups, with a 48% increase in prevalent cases and a 47% increase in new cases of urolithiasis among individuals aged 20–54 between 1990 and 2021, with the

highest incidence rates observed in those aged 50–54. (3)

Although extracorporeal shock wave lithotripsy (ESWL) and laparoscopic ureterolithotomy remain important treatment options for ureteric calculi, the choice of intervention depends on factors such as stone size, location, degree of obstruction, patient characteristics, and available expertise. A systematic review and meta-analysis showed that URS offers superior overall stone-free rates compared to ESWL, but the perforation rate is higher for Ureteroscopic Lithotripsy (URSL). (4)

Recent evidence from a systematic review of over 939,000 patients shows that the occurrence of infection-related complications ranges from 0.8% to 18.2%. (5) A study by Devos et al. reported a 7.3% incidence of early infectious complications after URS, with urosepsis occurring in 1.5% of cases, and identified older age as a significant predictor on multivariate analysis. (6) A febrile UTI occurred in 13% of patients within the first month postoperatively, a higher rate than reported in other studies. (7) A systematic review and meta-analysis of 13 studies comprising 5,597 patients reported a pooled postoperative urosepsis rate of 5.0% after URS, with preoperative stent placement, positive preoperative urine culture, older age, diabetes mellitus, ischemic heart disease, and longer procedure time as significant risk factors. (8) Sohn et al. identified preoperative bacteriuria, hydronephrosis, and placement of urethral catheters, ureteral stents, or percutaneous nephrostomy tubes as important risk factors for infectious complications after ureteroscopic procedures. (9)

For the treatment of ureteral and renal calculi, URS has become a commonly adopted treatment option. (5) Still, early postoperative infectious episodes such as UTI and urosepsis remain a major issue, as evident in the

international data. (8) However, data obtained from Pakistan and other similar resource-limited settings remain limited. (11) Stone disease is highly common in Pakistan (10, 12), corresponding to a high demand for patient care by tertiary care facilities located in Karachi. The predictive value of preoperative urine culture results, stone burden, diabetic status, and antibiotic prophylaxis adequacy for early infectious complications remains unexplored, thereby obstructing the development of targeted preventive strategies. Therefore, this study aims to determine the frequency and associated factors of early infectious complications within 30 days following URS for stone disease. The findings will address the current knowledge gap by determining the frequency and associated risk factors of early infections following URS, thereby informing risk stratification and targeted preventive strategies.

Methods

This prospective longitudinal study was conducted at Liaquat National Hospital, Karachi, Pakistan, from 21 March, 2026 to 21 July, 2026 after ethical approval (ERC No.3268-2025-LNH-ERC) dated 23 sep 2025. Written informed consent was obtained from all eligible patients undergoing URS, and confidentiality of participant information was maintained throughout the study.

Sample size was calculated using the OpenEpi online calculator (Version 3.0, SSPropor module). Anticipated frequency of 7.3% for infectious complications following URS as reported by Devos et al (6) was considered with a 95% confidence level and a 4% margin of error, the required sample size was 163 patients.

Patients aged 18–80 of either gender scheduled for retrograde semi-rigid or flexible URS for stone removal were included using non-probability consecutive sampling. Patients

undergoing URS for other reasons, with unsuccessful ureteral access attributable to anatomical abnormalities, neurogenic bladder, concomitant ureteric stones, coagulation disorders, immunosuppression, or active urinary tract infection (UTI) were excluded from the study. A preoperative temperature of $\geq 38^{\circ}\text{C}$ was considered indicative of fever.

Demographic and clinical data were recorded one day before surgery. Stone size was operationally defined as the maximum diameter of the largest ureteral or renal calculus identified on CT KUB, measured in millimeters (mm). All procedures were performed as inpatient ureteroscopy (URS) under general anaesthesia by a consultant urologist with at least 5 years of relevant experience in endourological procedures. A semi-rigid ureteroscope was used for ureteral access and direct visualization of the stone. Stone fragmentation was performed with flexible ureteroscope the resulting fragments were retrieved as appropriate. Operative details, including operative time, the amount of irrigation fluid used, and selective placement of a ureteral stent, were recorded. Following completion of the procedure, patients were monitored postoperatively and either observed overnight or discharged when clinically stable according to the treating team's routine postoperative practice. Patients discharged after the procedure were prescribed a 5-day course of prophylactic antibiotics.

Patients were followed prospectively for 30 days after surgery, with scheduled assessments at 2 weeks and 30 days postoperatively. At each follow-up assessment, patients were evaluated for symptoms and clinical features suggestive of infection, and information regarding any unscheduled hospital or emergency department visits, readmissions, or treatment received for

suspected infection was documented where applicable. Early postoperative infectious complications were defined and recorded as UTI, pyuria, pyelonephritis, or urosepsis. Relevant clinical findings, investigations, and treatment provided during the follow-up period were documented on the structured proforma. Patients who did not attend the scheduled follow-up were contacted, where feasible, to determine whether any postoperative infectious complication or emergency healthcare visit had occurred during the 30-day follow-up period.

The analysis was performed using R software. Data distribution was assessed using the Shapiro–Wilk test. Variables demonstrating an approximately normal distribution were expressed as mean $\pm$ standard deviation, whereas non-normally distributed variables were summarized as median with interquartile range. Analysis was adjusted for age, gender, stone size and stone location as potential cofactors. Continuous variables were compared using independent t test or Mann–Whitney U test, while categorical variables were analyzed using Chi-square test or Fisher's exact test. Univariable logistic regression was carried out to estimate crude odds ratios and those with a p value < 0.20 were included in a multivariable logistic regression model to derive adjusted odds ratios for independent predictors of early infectious complications. The variables demonstrating complete or quasi complete separation were excluded from the regression analysis and reported descriptively. A p-value of < 0.05 was considered statistically significant.

Results

The median (IQR) age of study cohort was 39.0 (29.0–50.0) and 70.1% of participants were male. Nearly 83% had no co-morbidity. Early infectious complications within 30 days following URS occurred in 18 of 164 (11.0%)

patients. Of these, 9 cases (50.0%) were identified at the 2-week follow-up and 9 cases (50.0%) at the 30-day follow-up. UTI was the most frequent complication, occurring in 12 patients (7.3%), followed by urosepsis in 3 patients (1.8%) and other infectious complications in 3 patients (1.8%). Median stone size was 7.0 (6.0–10.0) mm with mid ureter stones being most predominant.

Hydronephrosis was observed in 94.5%. Infected patients had larger stones (median 9.5 vs. 7.0 mm, $p=0.001$), with a higher proportion of stones >10 mm (27.8% vs. 11.6%), upper ureteric location (33.3% vs. 9.6%), and higher serum creatinine (1.6 vs. 1.3 mg/dL, $p=0.007$). Positive urine culture was observed in 27.8% of infected patients compared with 11.0% of non-infected patients as presented in Table I.

Table-1: Baseline demographic, clinical, and stone-related characteristics of infected and non-infected patients

	Overall (N=164)	Infected (n=18)	Not Infected (n=146)	p-value
Age, years - Median (IQR)				
Median (IQR)	39.0 (29.0–50.0)	41.0 (30.0–49.8)	39.0 (27.2–50.0)	0.406
Sex, n (%)				
Male	115 (70.1%)	15 (83.3%)	100 (68.5%)	0.305
Female	49 (29.9%)	3 (16.7%)	46 (31.5%)	
BMI (kg/m²) - Median (IQR)				
Median (IQR)	27.0 (24.5–29.4)	27.3 (25.7–29.4)	26.9 (24.5–29.4)	0.421
Comorbidity, n (%)				
None	136 (82.9%)	13 (72.2%)	123 (84.2%)	0.030
Hypertension	7 (4.3%)	3 (16.7%)	4 (2.7%)	
Diabetes Mellitus	9 (5.5%)	0 (0.0%)	9 (6.2%)	
Any comorbidity	28	5 (27.8%)	23 (15.8%)	
Presenting Symptoms n (%)				
Flank Pain	145 (88.4%)	16 (88.9%)	129 (88.4%)	1.000
Hematuria	98 (59.8%)	11 (61.1%)	87 (59.6%)	0.899
Fever	35 (%21.3)	5 (27.8%)	30 (20.5%)	0.527
Dysuria	52 (31.7%)	6 (33.3%)	46 (31.5%)	0.876
Stone Size (mm) - Median (IQR)				
Median (IQR)	7.0 (6.0–10.0)	9.5 (9.0–10.8)	7.0 (6.0–9.0)	0.001
≤10 mm	142 (86.6%)	13 (72.2%)	129 (88.4%)	0.071
>10 mm	22 (13.4%)	5 (27.8%)	17 (11.6%)	
Stone Location, n (%)				
Mid Ureter	96 (58.5%)	7 (38.9%)	89 (61.0%)	0.011*
Lower Ureter	26 (15.9%)	3 (16.7%)	23 (15.8%)	
Upper Ureter	20 (12.2%)	6 (33.3%)	14 (9.6%)	
Renal	22 (13.4%)	2 (11.1%)	20 (13.7%)	
Pre-operative Factors, n (%)				
Hydronephrosis	155 (94.5%)	18 (100.0%) **	137 (93.8%)	0.599
Positive urine culture	21 (12.8%)	5 (27.8%)	16 (11.0%)	0.059
Preop antibiotics given	140 (85.4%)	16 (88.9%)	124 (84.9%)	<0.05
No preop antibiotics		2 (11.1%)	22 (15.1%)	1.000
Previous stone episode	55 (33.5%)	9 (50.0%)	46 (31.5%)	0.192
Serum Creatinine (mg/dL) -Median (IQR)	1.3 (1.1–1.6)	1.6 (1.3–1.8)	1.3 (1.0–1.6)	0.007

*Stone location (overall) ** $p \leq 0.05$. NS = Not Significant. † Hydronephrosis present in 100% of infected cases (quasi-complete separation, Fisher p not interpretable in standard terms).

The observed infection rate was 11.0% (18/164). Complications were equally distributed across the two follow-up time

points. 9 cases (50%) detected at the 2-week visit and 9 cases (50%) identified at the 30-day visit as given in table 2.

Table 2: Distribution of early infectious complications within 30 Days Post-URS

Complication Type	N	% of Total	% of Infected
No complication	146	89.0%	-
Urinary Tract Infection (UTI)	12	7.3%	66.7%
Urosepsis	3	1.8%	16.7%
Other infectious complication (pyuria, pyelonephritis, urosepsis)	3	1.8%	16.7%
Total infected	18	11.0%	100%

Table 3 presents the intraoperative and postoperative parameters of the study population. Fluid usage was significantly higher in the infected group (6.0 [IQR: 4.2–7.0] L vs. 5.0 [IQR: 4.0–5.0] L). DJ stent insertion was performed in 94.4% of infected and 89.7% of non-infected patients.

Complete stone clearance was achieved in 88.9% of infected patients compared with 97.9% of non-infected patients. The median hospital stay was longer among infected patients (2.0 [IQR: 1.0–2.0] days vs. 1.0 [IQR: 1.0–1.0] day, $p < 0.001$).

Table 3: Intraoperative details and postoperative course

Variable	Overall (N=164)	Infected (n=18)	Not Infected (n=146)	p-value
Scope Type, n (%)				
Rigid	142 (86.6%)	14 (77.8%)	128 (87.7%)	0.269
Flexible	22 (13.4%)	4 (22.2%)	18 (12.3%)	
Intraoperative Parameters				
Procedure Duration (min)-Median (IQR)	20.0 (15.0–20.0)	20.0 (15.0–25.0)	20.0 (15.0–20.0)	0.135
Fluid Used (liters) - Median (IQR)	5.0 (4.0–5.0)	6.0 (4.2–7.0)	5.0 (4.0–5.0)	0.009
DJ Stent Inserted, n (%)	148 (90.2%)	17 (94.4%)	131 (89.7%)	1.000
Complete Stone Clearance, n (%)	159 (97.0%)	16 (88.9%)	143 (97.9%)	0.093
Partial stone clearance		2 (11.1%)	3 (2.1%)	0.093
Ureteral Injury, n (%)	10 (6.1%)	2 (11.1%)	8 (5.5%)	0.302
Post-operative Course				
Hospital Stay (days) - Median (IQR)	1.0 (1.0–1.0)	2.0 (1.0–2.0)	1.0 (1.0–1.0)	<0.001

The highest infection rates were observed in patients with >10mm (22.7%) and upper ureter stones (30.0%). Infection rates were comparable across age groups, while more frequent among males than females.

In the univariate analysis, hypertension (OR: 7.10, $p = 0.016$), larger stone size (OR: 1.29 per mm, $p = 0.003$), upper ureteric stone location (OR: 4.71, $p = 0.007$), and longer procedure duration (OR: 1.15 per minute, $p = 0.023$) were significantly associated with infection.

In the multivariable analysis, only stone size remained an independent predictor of postoperative infection (aOR: 1.26 per mm, 95% CI: 1.01–1.56, $p=0.039$), while upper ureteric stone location showed a borderline association (aOR: 3.42, $p=0.064$). These

findings should be interpreted cautiously given the small number of infection events and potential risk of model overfitting. All other variables were not significantly associated with postoperative infection after adjustment as shown in table 4.

Table 4: Logistic Regression: Predictors of early infectious complication.

Variable	OR	95% CI	p-value	aOR	95% CI	p-value
Female sex	0.43	0.12–1.58	0.205	0.79	0.18–3.49	0.759
Age (per year)	1.01	0.98–1.04	0.388	0.99	0.95–1.02	0.489
BMI (per unit)	1.06	0.91–1.22	0.459	-	-	-
Any comorbidity	2.06	0.67–6.33	0.208	2.62	0.59–11.64	0.206
Hypertension	7.10	1.45–34.77	0.016	-	-	-
Diabetes mellitus	0.00†	0.00–inf	1.000	-	-	-
Positive preop urine culture	3.12	0.98–9.92	0.053	2.15	0.56–8.28	0.264
No preop antibiotics	0.70	0.15–3.28	0.655	0.47	0.07–3.29	0.449
Stone size (per mm)	1.29	1.09–1.52	0.003	1.26	1.01–1.56	0.039
Stone size >10 mm	2.92	0.93–9.21	0.068	-	-	-
Upper ureter stone	4.71	1.53–14.51	0.007	3.42	0.93–12.57	0.064
Renal stone	2.03	0.60–6.85	0.253	-	-	-
Procedure duration (per min)	1.15	1.02–1.29	0.023	1.05	0.91–1.20	0.518
DJ stent used	1.95	0.24–15.68	0.531	1.21	0.12–12.29	0.870
Partial stone clearance	5.96	0.93–38.36	0.060	1.91	0.18–19.76	0.587
Ureteral injury	2.16	0.42–11.05	0.357	2.27	0.33–15.45	0.401
Flexible scope	2.03	0.60–6.85	0.253	-	-	-
Previous stone episode	2.17	0.81–5.84	0.123	-	-	-

Discussion

The early infection rate observed in this study (11%) falls within the internationally reported range (0.8%–18.2%) (5) but is higher than the 7.3% reported by Devos et al. (2024). (13). The higher infection rate in this study may be attributable to differences in patient and stone characteristics, including stone burden and location, as well as variations in perioperative antibiotic practices and the criteria used to define and ascertain postoperative infectious complications. The differences in study populations and clinical management protocols across settings may also contribute to the observed variation in infection rates. (8, 14)

The most common infectious complications were UTI (66.7% of infected patients) followed by urosepsis (16.7%), consistent with previous literature. (6,15) Complications occurred within 30 days (100%), highlighting the importance of follow-up beyond the early postoperative period, in line with prospective studies, using 30 days' surveillance. (6, 16)

Our key finding showed that stone size was the only independent predictor of early infectious complications; with each millimeter increasing infection odds by 26%. This finding is consistent with previous studies identifying larger stone size as an independent risk factor for postoperative

infection following ureteroscopy (15, 17, 18). This may be attributable to the increased procedural manipulation and longer operative exposure associated with larger stones, which may promote bacterial dissemination. Although Sun et al. (2020) found no significant association. (19) The significance of stone size as continuous, but not categorical variable suggesting that infection risk increases progressively with stone size rather than above fixed threshold. However, these findings do not establish a definitive threshold or progressive dose-response relationship between stone size and postoperative infection.

Although upper ureter stone location was not an independent predictor after adjustment, it showed a clinically relevant association with highest infection rate among all stone locations. Previous studies reported that URS generates elevated intrarenal pressures, promoting pyelovenous and pyelolymphatic reflux, potentially increasing septic complications. (20,21,22) The lack of statistical significance may reflect the small number of patients with upper ureter stones.

Procedure duration was significant in univariable analysis but not after adjustment, suggesting its effect was largely influenced by stone characteristics. Similar findings were reported in previous studies, where longer operative time reflected greater procedural complexity rather than an independent predictor of infection. (8, 18, 23, 24)

Several variables previously reported as risk factors were not significant in our study. Sun et al. reported that female sex, diabetes, and preoperative stenting were not independently associated with infection, although previous studies identified positive preoperative urine culture as a

significant predictor (8, 25,26,27,28). Female sex was not significant, possibly due to the small number of females and infection contrasts with some studies that have reported higher infection rates in women. (29) Positive preoperative urine culture showed a borderline association, consistent with Bhojani et al. (30) but did not showed statistical significance due to small number positive cultures and infected cases.

Preoperative hydronephrosis was present in 100% of infected patients and 93.8% of non-infected patients, resulting in quasi-complete separation and exclusion from the multivariable model. The high prevalence in both groups suggests hydronephrosis may be necessary but not sufficient for infection. This finding is consistent with Sohn et al. identifying hydronephrosis as a significant risk factor for infectious complications after ureteroscopic procedures.(9)

The prospective design, complete follow-up and multivariable adjustment strengthen the study. However, small number of events, single centre design, lack of ASA grading and exclusion of hydronephrosis from multivariable model limit the findings. These findings may inform future research regarding perioperative infection prevention and may help guide the design of larger multicentre studies.

Conclusion

Stone size independently predicted an increased likelihood of postoperative infection. Early infectious complications occurred in 11.0% of patients within 30 days following ureterorenoscopy for stone disease. These findings highlight the burden of early infectious complications following ureterorenoscopy and emphasize the significance of comprehensive perioperative assessment and postoperative surveillance,

particularly in patients with a greater stone burden.

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