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RESEARCH ARTICLE
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RISK FACTORS FOR INFECTIOUS COMPLICATIONS IN PATIENTS WHO UNDERWENT RETROGRADE INTRA RENAL SURGERY (RIRS).

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ABSTRACT

Background: Retrograde intrarenal surgery (RIRS) has become an increasingly popular minimally invasive technique for the management of renal calculi. Despite its safety profile, infectious complications such as urinary tract infection (UTI), fever, and urosepsis remain clinically significant and can increase morbidity, hospital stay, and healthcare costs. Identifying risk factors associated with post-RIRS infectious complications is essential for improving patient outcomes. This study aimed to evaluate the risk factors for infectious complications in patients undergoing RIRS at a tertiary care centre in Pakistan.

Methodology: This prospective observational study was conducted at Pakistan Kidney Centre over a period of two years, including 240 patients who underwent RIRS for renal stones. Demographic data, comorbidities, preoperative urine culture, stone burden, operative time, intraoperative irrigation pressure, stent placement, and perioperative antibiotic use were recorded. Patients were monitored for postoperative infectious complications including fever, urinary tract infection, and sepsis. Statistical analysis was performed using SPSS version 25, and multivariate logistic regression was applied to identify independent risk factors. A p-value of <0.05 was considered statistically significant.

Results: Out of 240 patients, infectious complications were observed in a significant proportion of cases. The most common complication was postoperative fever, followed by urinary tract infection and urosepsis. Significant risk factors identified included positive preoperative urine culture, prolonged operative time (>60 minutes), large stone burden (>2 cm), high intrarenal pressure during irrigation, and diabetes mellitus. Patients with preoperative double J stent placement had a lower risk of infection. Multivariate analysis confirmed that positive urine culture and prolonged operative time were independent predictors of post-RIRS infectious complications ($p<0.05$).

Conclusion: Infectious complications following RIRS are influenced by multiple preoperative and intraoperative factors. Positive urine culture, prolonged operative duration, large stone burden, and diabetes mellitus significantly increase the risk of postoperative infection. Proper preoperative evaluation, sterile urine confirmation, optimized operative time, and careful patient selection can significantly reduce infectious morbidity following RIRS.

Keywords: Retrograde intrarenal surgery; RIRS; renal stones; infectious complications; urosepsis; risk factors; Pakistan Kidney Centre.

INTRODUCTION

Renal stone disease (urolithiasis) is a common urological condition with a rising global incidence, affecting both developed and developing countries.1,2 The burden of disease is particularly significant in regions with hot climates and limited access to healthcare resources, including Pakistan.3,4 Advances in endourological techniques have revolutionized the management of renal calculi, shifting from open surgery to minimally invasive procedures with improved patient outcomes and reduced morbidity.5,6

Among these techniques, retrograde intrarenal surgery (RIRS) has emerged as an effective and minimally invasive modality for the treatment of renal stones, particularly those less than 2 cm in size or in anatomically challenging locations. RIRS utilizes flexible ureteroscopes and laser lithotripsy to achieve stone fragmentation and clearance without the need for percutaneous access.7,8 The procedure is associated with shorter hospital stay, reduced postoperative pain, and quicker recovery compared to traditional approaches such as percutaneous nephrolithotomy (PCNL).9,10

Despite its favorable safety profile, RIRS is not without complications. Infectious complications, including postoperative fever, urinary tract infection (UTI), and urosepsis, remain a major concern and can lead to serious morbidity and, in severe cases, mortality. 11,12These complications are primarily attributed to increased intrarenal pressure during irrigation, bacterial colonization of stones, prolonged operative time, and pre-existing urinary tract infections. In particular, urosepsis following RIRS is a life-threatening condition that requires prompt recognition and management.

Several studies have attempted to identify risk factors associated with infectious complications following RIRS.13 Factors such as positive preoperative urine culture, diabetes mellitus, large stone burden, prolonged operative duration, and the use of high irrigation pressures have been implicated.14 Additionally, the presence of indwelling urinary devices, such as double J stents, may influence infection risk either by promoting bacterial colonization or facilitating drainage depending on the clinical context.

In developing countries like Pakistan, where patient presentation is often delayed and comorbid conditions such as diabetes are prevalent, the risk of postoperative infections may be further amplified.15 Moreover, variability in preoperative preparation, antibiotic protocols, and intraoperative techniques can influence outcomes. Therefore, identifying and understanding these risk factors in local populations is crucial for optimizing perioperative care and minimizing complications.

This study was conducted to evaluate the risk factors associated with infectious complications in patients undergoing RIRS at a tertiary care center in Pakistan. By analyzing both preoperative and intraoperative variables, the study aims to provide evidence-based insights that can help clinicians implement preventive strategies, improve surgical outcomes, and reduce the burden of infection-related morbidity following RIRS.

METHODOLOGY

This prospective observational study was conducted at the Pakistan Kidney Centre over a period of two years. A total of 240 patients who underwent retrograde intrarenal surgery (RIRS) for renal calculi were included in the study using a consecutive sampling technique.

Inclusion and Exclusion Criteria

Patients aged ≥18 years diagnosed with renal stones and scheduled for RIRS were included. Patients with active untreated urinary tract infection, immunocompromised status, congenital renal anomalies, or incomplete clinical data were excluded from the study.

Data Collection

Detailed demographic and clinical data were collected for all patients, including age, gender, body mass index (BMI), and comorbidities such as diabetes mellitus and hypertension. Preoperative

evaluation included urine routine examination and urine culture sensitivity. Only patients with sterile urine or adequately treated infections prior to surgery were taken for the procedure.
Stone-related factors such as size (stone burden), location, and number of stones were recorded using radiological imaging (ultrasound and/or CT scan). Operative variables including duration of surgery, use of ureteral access sheath, intraoperative irrigation pressure, and placement of double J (DJ) stent were documented. Details regarding perioperative antibiotic prophylaxis were also noted.

Surgical Procedure
All procedures were performed under general or spinal anesthesia using standard flexible ureteroscopy and laser lithotripsy techniques. Irrigation was maintained using normal saline, and care was taken to minimize intrarenal pressure. At the end of the procedure, decision for DJ stent placement was made based on intraoperative findings and surgeon preference.

Outcome Measures
Patients were monitored postoperatively for infectious complications, including:
- Fever (body temperature ≥38°C)
- Urinary tract infection (confirmed by urine analysis and culture)
- Urosepsis (defined according to clinical criteria including systemic inflammatory response and positive cultures)

Patients were followed during hospital stay and, where applicable, in early postoperative follow-up.

Statistical Analysis
All data were entered and analyzed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The association between risk factors and infectious complications was assessed using chi-square test and independent t-test where appropriate.
Multivariate logistic regression analysis was performed to identify independent predictors of postoperative infectious complications. A p-value of <0.05 was considered statistically significant.

RESULTS
A total of 240 patients undergoing RIRS were analyzed. Infectious complications (fever, UTI, urosepsis) were observed in a subset of patients. The results are presented below.

Table 1: Baseline Demographic and Clinical Characteristics (n = 240)

Variable	Value
Mean age (years)	45.6 ± 12.4
Male gender	148 (61.7%)
Female gender	92 (38.3%)
Diabetes mellitus	68 (28.3%)
Hypertension	74 (30.8%)
Mean BMI (kg/m²)	27.2 ± 4.1
Positive preoperative urine culture	52 (21.7%)
Sterile urine culture	188 (78.3%)

Table 2: Stone and Operative Characteristics

Variable	Value
Mean stone size	1.8 ± 0.6 cm
Stone burden >2 cm	86 (35.8%)
Stone burden ≤2 cm	154 (64.2%)
Mean operative time	58.4 ± 18.7 min

Variable	Value
Operative time >60 min	102 (42.5%)
Operative time ≤60 min	138 (57.5%)
High intrarenal irrigation pressure	74 (30.8%)
DJ stent placed	160 (66.7%)

Table 3: Postoperative Infectious Complications

Complication	Number (%)
Fever	38 (15.8%)
Urinary tract infection (UTI)	26 (10.8%)
Urosepsis	12 (5.0%)
Any infectious complication	56 (23.3%)
No complication	184 (76.7%)

Table 4: Association of Risk Factors with Infectious Complications

Risk Factor	Infection Present (n=56)	No Infection (n=184)	p-value
Positive urine culture	24 (42.8%)	28 (15.2%)	**<0.001**
Diabetes mellitus	22 (39.3%)	46 (25.0%)	**0.03**
Stone burden >2 cm	30 (53.6%)	56 (30.4%)	**0.002**
Operative time >60 min	34 (60.7%)	68 (37.0%)	**0.001**
High irrigation pressure	26 (46.4%)	48 (26.1%)	**0.004**
DJ stent placed	30 (53.6%)	130 (70.6%)	**0.02** (protective)

Table 5: Multivariate Logistic Regression Analysis (Independent Predictors)

Variable	Odds Ratio (OR)	95% CI	p-value
Positive urine culture	3.12	1.65–5.89	**<0.001**
Operative time >60 min	2.48	1.32–4.67	**0.004**
Stone burden >2 cm	1.92	1.05–3.51	**0.03**
Diabetes mellitus	1.74	1.01–3.01	**0.04**
High irrigation pressure	2.11	1.18–3.78	**0.01**
DJ stent placement	0.58	0.34–0.92	**0.02** (protective)

DISCUSSION

Retrograde intrarenal surgery (RIRS) has become an established minimally invasive modality for the management of renal calculi, offering high stone-free rates with reduced morbidity compared to traditional surgical approaches. However, despite its favorable safety profile, infectious complications such as fever, urinary tract infection (UTI), and urosepsis remain clinically important adverse events that can significantly impact postoperative recovery, prolong hospital stay, and increase healthcare costs. In the present study, we evaluated the risk factors associated with infectious complications following RIRS in a cohort of 240 patients at a tertiary care center in Pakistan.

The overall incidence of infectious complications in our study was 23.3%, with postoperative fever being the most frequent event, followed by UTI and urosepsis. This incidence is comparable to previously reported literature, where infectious complication rates after RIRS range between 10% and 25%, depending on patient selection, preoperative infection status, and perioperative protocols. The relatively higher end of this range in our study may reflect delayed presentation of patients, higher stone burden, and a significant proportion of comorbid conditions such as diabetes mellitus, which are common in our population.

One of the most significant findings in our study was that positive preoperative urine culture was the strongest independent predictor of postoperative infectious complications (OR 3.12, p<0.001). This finding is consistent with multiple studies demonstrating that bacteriuria, even when treated preoperatively, is associated with an increased risk of postoperative sepsis due to bacterial colonization within stones and renal collecting systems. This emphasizes the importance of strict preoperative urine sterilization and appropriate culture-directed antibiotic therapy before proceeding with RIRS.

Another important independent risk factor identified was prolonged operative time (>60 minutes) (p=0.004). Longer operative duration is often associated with increased intrarenal pressure, prolonged irrigation, and greater manipulation of infected or colonized stones, all of which can facilitate bacterial translocation into the bloodstream. Similar findings have been reported in previous studies, where operative time has been consistently linked with higher postoperative infectious morbidity.

Large stone burden (>2 cm) was also significantly associated with infectious complications (p=0.03). Larger stones are more likely to harbor bacteria within their matrix and often require longer fragmentation time, increasing both operative duration and intrarenal pressure. This reinforces the need for careful patient selection and consideration of staged procedures in cases of large or complex renal stones.

In our study, diabetes mellitus was identified as a significant risk factor (p=0.04). Diabetic patients are known to have impaired immune responses, higher susceptibility to infections, and poorer glycemic control during surgical stress, all of which contribute to increased postoperative infectious risk. This finding aligns with existing literature highlighting diabetes as an important comorbidity influencing outcomes in endourological procedures.

We also observed that high intrarenal irrigation pressure was significantly associated with infectious complications (p=0.01). Elevated pressure can facilitate pyelovenous and pyelolymphatic backflow, allowing bacteria and endotoxins to enter systemic circulation, thereby increasing the risk of sepsis. This highlights the importance of maintaining low-pressure irrigation systems during RIRS to minimize infectious risk.

Interestingly, double J (DJ) stent placement appeared to be a protective factor (OR 0.58, p=0.02). Stenting may facilitate adequate urinary drainage, reduce intrarenal pressure, and prevent obstruction-related bacterial proliferation. However, it is important to note that indwelling stents can also serve as a nidus for infection if left for prolonged periods; therefore, timing of removal remains crucial.

Multivariate analysis confirmed that positive urine culture and prolonged operative time were the strongest independent predictors of infectious complications, suggesting that both preoperative infection control and intraoperative efficiency play a central role in preventing postoperative morbidity.

The findings of this study have important clinical implications, particularly in resource-limited settings such as Pakistan, where patients often present late with large stone burden and pre-existing infections. Strict adherence to preoperative urine sterilization protocols, optimization of glycemic control in diabetic patients, reduction of operative time, and maintenance of low intrarenal pressure should be prioritized to reduce infectious complications following RIRS.

LIMITATIONS

This study has certain limitations. Being a single-center observational study, results may not be generalizable to all populations. Additionally, variability in surgical technique and operator experience may have influenced outcomes. A multicenter randomized study would provide stronger evidence.

CONCLUSION

Infectious complications following RIRS are multifactorial in origin. Positive preoperative urine culture, prolonged operative time, large stone burden, diabetes mellitus, and high intrarenal pressure significantly increase the risk of postoperative infection. Implementation of strict preoperative

evaluation, optimized surgical technique, and careful perioperative management can substantially reduce infectious morbidity and improve patient outcomes.]

REFERENCES

1. Lang J, Narendrula A, El-Zawahry A, Sindhwani P, Ekwenna O. Global trends in incidence and burden of urolithiasis from 1990 to 2019: an analysis of global burden of disease study data. European urology open science. 2022 Jan 1;35:37-46.
2. Sorokin I, Mamoulakis C, Miyazawa K, Rodgers A, Talati J, Lotan Y. Epidemiology of stone disease across the world. World journal of urology. 2017 Sep;35(9):1301-20.
3. Hafeez A, Dangel WJ, Ostroff SM, Kiani AG, Glenn SD, Abbas J, Afzal MS, Afzal S, Ahmad S, Ahmed A, Ahmed H. The state of health in Pakistan and its provinces and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet Global Health. 2023 Feb 1;11(2):e229-43.
4. Khan SU, Sheikh MR, Dimen L, Batool H, Abbas A, Nuta AC. Nexus between health poverty and climatic variability in Pakistan: a geospatial analysis. Frontiers in Environmental Science. 2023 May 19;11:1180556.
5. Indurani MS, Rubi P, Shukla AK, AWASTHI A. Modern Urological Approaches to Renal Stone Disease: Diagnostic Advances and Therapeutic Innovations. KIDNEYS. 2026 Jan 26;15(1):155-66.
6. Khaled Alsmadi J. A Study of Minimally-invasive Renal Stone Removal vs. Traditional Techniques in Urology. EUROPEAN UROLOGY. 2024 Sep 8;85:608-15.
7. Inoue T, Okada S, Hamamoto S, Fujisawa M. Retrograde intrarenal surgery: Past, present, and future. Investigative and clinical urology. 2021 Feb 22;62(2):121.
8. Wang J, Wang Y, Yin J, Xia L. Efficacy of flexible ureteroscopy lithotripsy and percutaneous nephrolithotomy in the treatment of patients with kidney stones and their impact on inflammatory response and renal function. Annali Italiani di Chirurgia. 2024 Apr 20;95(2):220-6.
9. Alazaby H, Khalil M, Omar R, Mohey A, Gharib T, Abo-Taleb A, El-Barky E. Outcome of retrograde flexible ureterorenoscopy and laser lithotripsy for treatment of multiple renal stones. African Journal of Urology. 2018 Jun 1;24(2):146-51.
10. Li Q, Wan L, Liu S, Li M, Chen L, Hou Z, Zhang W. Clinical efficacy of enhanced recovery after surgery in percutaneous nephrolithotripsy: a randomized controlled trial. BMC urology. 2020 Oct 20;20(1):162.
11. Liu L, Xiao Y, Yue X, Wang Q. Safety and efficacy of enhanced recovery after surgery among patients undergoing percutaneous nephrolithotomy: a systematic review and meta-analysis. International Journal of Surgery. 2024 Jun 1;110(6):3768-77.
12. Petrosillo N, Granata G, Boyle B, Doyle MM, Pinchera B, Taglietti F. Preventing sepsis development in complicated urinary tract infections. Expert Review of Anti-infective Therapy. 2020 Jan 2;18(1):47-61.
13. Dybowski B, Bres-Niewada E, Rzeszutko M, Tkaczyk A, Woźniak B, Wójcik M, Znajdek Z. Risk factors for infectious complications after retrograde intrarenal surgery–a systematic review and narrative synthesis. Central European journal of urology. 2021 Sep 9;74(3):437.
14. Khusid JA, Hordines JC, Sadiq AS, Atallah WM, Gupta M. Prevention and management of infectious complications of retrograde intrarenal surgery. Frontiers in Surgery. 2021 Aug 9;8:718583.
15. Khan FU, Fang Y, Khan Z, Khan FU, Malik ZI, Ahmed N, Khan AH, Rehman AU. Occurrence, associated risk factors, and treatment of surgical site infections in Pakistan. European Journal of Inflammation. 2020 Oct;18:2058739220960547.