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Research Article

Risk Factors Analysis of Urosepsis Following Retrograde Intrarenal Surgery: A Retrospective Study

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Abstract

Background: Sepsis post retrograde renal surgery (RIRS) is a grave complication. Proper monitoring, antibiotic management, and understanding of risk factors are crucial to reduce sepsis risk and enhance patient outcomes. ***Objective***: To determine risk factors causing postoperative sepsis after RIRS for renal stones. ***Methods***: A retrospective/prospective cohort enrolled 145 patients who underwent RIRS for renal and/or ureteral stones at Ghazi AL-Hariri Hospital for Surgical Specialties. Eligible patient data were collected, including demographic (age, gender), stone parameters (site, side, size), preoperative and postoperative investigations and antibiotic regimen, operative parameters (type of ureteroscope used, prior DJ stent), and postoperative records. ***Results:*** Patients aged 19-69 years, predominantly males (60.7%), and 25.5% had diabetes. Stones were predominantly located in the upper pole (36.6%), 44.8% of stones were medium-sized (15-20 mm), and 49.7% were moderate density (800–1200 HU). Post-operatively, 17% of cases developed urosepsis. Multivariate analysis identified diabetes, longer surgery duration, elevated postoperative CRP, and uncontrolled HbA1c as independent risk factors for urosepsis. *E. coli* was the most common pathogen (44%). The average hospital stay was 2 days, with 49.7% discharged within a single day. The median duration of DJ stenting was 6 weeks. ***Conclusions***: Analysis highlights the multifactorial risk of developing urosepsis post-RIRS, including diabetes, longer procedural time, higher postoperative inflammatory markers, and complex stone characteristics. Comprehensive preoperative planning and meticulous intraoperative techniques will alleviate these risks and help urologists maximize patient outcomes and minimize urosepsis incidence.

Keywords: Infection, Preoperative preparation, Postoperative care, Retrograde intrarenal surgery, Urosepsis.

تحليل عوامل خطر تعفن الدم بعد الجراحة الكلوية الرجعية: دراسة بأثر رجعي

الخلاصة

الخلفية: الإنتان بعد جراحة الكلى الرجعية (RIRS) هي من المضاعفات الخطيرة. تعد المراقبة السليمة وإدارة المضادات الحيوية وفهم عوامل الخطر أمرا بالغ الأهمية لتقليل مخاطر الإنتان وتعزيز نتائج المرضى. **الهدف**: تحديد عوامل الخطر المسببة للتعفن بعد الجراحة بعد RIRS لحصوات الكلى. **الطرائق**: سجلت مجموعة بأثر رجعي / مستقبلية 145 مريضا خضعوا لعلاج RIRS لحصوات الكلى و / أو الحالب في مستشفى غازي الحريري للتخصصات الجراحية. تم جمع بيانات المرضى المؤهلين، بما في ذلك التركيبة السكانية (العمر والجنس) ، ومعلمات الحصوات (الموقع ، الجانب ، الحجم) ، وفحوصات ما قبل الجراحة وبعدها ونظام المضادات الحيوية، والمعلمات الجراحية (نوع منظار الحالب المستخدم، ودعامة DJ السابقة)، وسجلات ما بعد الجراحة. **النتائج**. المرضى الذين تتراوح أعمارهم بين 19 و 69 عاما، ومعظمهم من الذكور (60.7٪)، و 25.5٪ يعانون من مرض السكري. كانت الحصى في الغالب في القطب العلوي (36.6٪)، و 44.8٪ من الحصى متوسطة الحجم (15-20 مم)، و 49.7٪ متوسطة الكثافة (800-1200 HU). بعد الجراحة، أصيبت 17٪ من الحالات ب urosepsis. حدد التحليل متعدد المتغيرات مرض السكري، ومدة الجراحة الأطول، وارتفاع CRP بعد الجراحة، و HbA1c غير المنضبط كعوامل خطر مستقلة للإصابة بالتيوفر. كانت الإشريكية القولونية هي العامل الممرض الأكثر شيوعا (44٪). كان متوسط الإقامة في المستشفى يومين، مع خروج 49.7٪ منهم في غضون يوم واحد. كان متوسط مدة دعامة DJ 6 أسابيع. **الاستنتاجات**: يسلط التحليل الضوء على المخاطر متعددة العوامل للإصابة بداء القلاحية بعد RIRS، بما في ذلك مرض السكري، ووقت إجرائي أطول، وعلامات التهابية أعلى بعد الجراحة، وخصائص الحصوات المعقدة. سيؤدي التخطيط الشامل قبل الجراحة والتقنيات الدقيقة أثناء الجراحة إلى تخفيف هذه المخاطر ومساعدة أطباء المسالك البولية على تحسين نتائج المرضى إلى أقصى حد وتقليل حدوث التهاب بول.

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INTRODUCTION

Sepsis is a major postoperative complication that may occur following various surgical interventions, including retrograde intrarenal surgery (RIRS) for kidney stones [1]. The identification of risk factors for sepsis in this scenario is important due to the rising burden of stone disease, coupled with the complexity of the management of such disease. Renal stone disease is one of the common conditions affecting millions of people worldwide, with a prevalence of approximately 10-15% in industrialized nations [2].

Over the past few decades, the management of stone disease has evolved significantly, with minimally invasive techniques such as RIRS becoming a first-line treatment option for renal stones [3]. IRS, which utilizes flexible ureteroscopy to fragment and subsequently remove stones, offers advantages such as decreased recovery times and lower complication rates than traditional open surgery [4,5]. However, like all surgical procedures, RIRS is not without risks.; some of the common complications include UTIs and even sepsis, especially in cases where patients have underlying diseases or infected stones [6]. Studies have estimated that postoperative fever occurs in approximately 4.4% of patients, with an incidence of urosepsis at around 0.7% [6,7]. The presence of infected stones significantly increases both the risks, so preoperative assessment and proper antibiotic prophylaxis are also important [8,9]. Urinary sepsis, or urosepsis, is defined as sepsis caused by an infection in the urogenital tract and is characterized by fever, chills, and an alteration in mental status that can rapidly progress to septic shock if not promptly managed [10]. The epidemiology of urinary sepsis shares a close link with stone disease; patients undergoing surgical management of kidney stones are at increased risk owing to the possible bacterial translocation from infected stones into the bloodstream [7,11]. The etiology of urinary sepsis often involves multi-drug-resistant organisms, especially in patients with prior antibiotic exposure or infected stones [12]. Diagnosis of urosepsis typically relies on urine and blood cultures, along with imaging studies to identify any obstructive uropathy or abscess formation [13]. A systematic approach to diagnosis and management is essential to prevent progression to severe sepsis or septic shock [11,13]. While previous research has emphasized the problems associated with RIRS, there is still a need to thoroughly analyze the risk variables contributing to postoperative sepsis, especially in varied patient populations. The current literature focuses mostly on specific risk variables or small cohorts, leaving gaps in our understanding of the multifactorial nature of urosepsis after RIRS. The current study seeks to identify the risk factors for postoperative sepsis following RIRS for renal stones and to suggest hospital preventive policies that could be implemented by analyzing patient demographics, stone characteristics, and intraoperative data. Understanding these factors will contribute to improved patient outcomes and inform the best practices in the management of stone disease using RIRS

METHODS

Setting and study design

A retrospective/prospective cohort study was conducted to evaluate the risk factors contributing to sepsis following retrograde intrarenal surgery (RIRS). Data was collected from 145 patients who underwent RIRS for renal and/or migrated ureteric stones at Ghazi Al-Hariri Hospital for Surgical Specialties, Baghdad, taken between May 2022 and October 2024.

Inclusion and exclusion criteria

All patients of ≥18 years of age and patients without active infection prior to the procedure were included in our data collection. In contrast, patients with incomplete medical records or missing data or culture-positive urinary tract infections (UTIs) and systemic infections, patients undergoing concurrent procedures during the same surgical session, for e.g., nephrostomy or percutaneous nephrolithotomy (PNL) were excluded from our data.

Outcome measurements

The outcome measurements include reporting demographic information such as age (years), gender, and body mass index (BMI). Stone parameters include stone site, side (left/right), size (cm), and Hounsfield Unit (HU). Preoperative and postoperative investigations like body temperature, urine culture and sensitivity (C and S), complete blood count (CBC), C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), and glycated hemoglobin (HbA1c). Preoperatively, all patients received Amikacin 500 mg or Ceftazidime vial 1.0 g according to the patient's renal function status, and post-operatively, the antibiotic regimen changed according to culture and sensitivity. Operative parameters were also reported, including the type of ureteroscope used (1st use disposable, 2nd use disposable, reusable), previous DJ stent placement, duration of operation (minutes), duration of DJ stent placement (days), and total operation time (minutes). Regarding postoperative data, stone-free status (yes/no), management of residual stones by extracorporeal shock wave lithotripsy (ESWL) or RIRS, postoperative pain and irritative urinary symptoms, hospital stay (days), and duration of postoperative Double-J Stent (DJ stent) placement (days) were reported. The data were collected and analyzed to identify significant risk factors associated with postoperative sepsis after RIRS.

Definitions of study parameters

Systemic inflammatory response syndrome (SIRS): a clinical syndrome characterized by the 2001 International Sepsis Definitions Conference as extremes of body temperature, heart rate, ventilation, and immune response. SIRS can occur in response to multiple insults, including systemic infection, trauma, thermal injury, or sterile inflammation [14].
Sepsis: SIRS and infection are either documented or strongly suspected [14].
Stone-free status: Defined as the absence of residual stone fragments ≤ 4 mm as confirmed by postoperative imaging (ultrasound, CT scan) [15].

Ethical considerations

The study protocol was approved by the institutional ethics committee of the Arab Board of Health Specializations. All methods used in the study adhered

to the principles outlined in the Declaration of Helsinki, ensuring the anonymity and privacy of all participants.

Statistical analysis

The data were analyzed using SPSS version 24.0. Descriptive statistics, numbers, and percentages were employed to summarize the patient's demographics and risk factors. The chi-square test compared categorical variables. In contrast, continuous data were compared using the Mann-Whitney U test. A *p*-value < 0.05 was significant for all tests.

RESULTS

The study includes 145 cases, with an age distribution range between 19 to 69 months, with a median of 47 months of age and a standard deviation of 13.2. Most cases (40.0%) fall in the 40-59 years age group, males (60.7%) more than females. Thirty-seven cases had a history of DM; in terms of BMI, the most common category is Overweight (46.2%), followed by Normal weight (29.7%) and Obesity (23.4%). Underweight individuals are only one patient (Table 1).

Table 1: Distribution of demographic and clinical data (n=145)

Parameters	Result n(%)
Age Distribution	
Young Adults (18–39)	35(24.1)
Middle-Aged (40–59)	58(40)
Elderly (≥60)	52(35.9)
Gender Distribution	
Male	88(60.7)
Female	57(39.3)
Diabetes Prevalence	
Diabetic	37(25.5)
Non-Diabetic	108(74.5)
BMI Distribution	
Underweight (<18.5)	1(0.7)
Normal (18.5–24.9)	43(29.7)
Overweight (25–29.9)	67(46.2)
Obese (≥30)	34(23.4)

Regarding stone sites, the upper pole is the most common site for stone formation, accounting for 33.1%. This indicates a significant prevalence of stones located in the upper pole of the kidney. In contrast, 26.2% of stones in the renal pelvis were detected in the mid and lower pole. Most stones (44.8%) are between 15 and 20 mm, 37.2% of stones are < 15 mm, and only 17.9% are > 20 mm. Regarding stone density distribution, 49.7% fall into the moderate density (800–1200 HU) group, 31.7% have high-density, and only 18.6% have low-density. For side distribution, 54.5% was distributed on the right sides (Table 2). Regarding preoperative versus postoperative status analysis, most patients (44.1%) experienced no significant changes in body temperature post-operatively, (39.3%) reported an increase, while 16.6% had a decrease. Most patients (44.8%) had no white blood cell count (WBC) changes post-operatively. Around 40.7% had a decreased WBC count. Preoperatively, 37.9% had elevated renal function test (RFT). Post-operatively, the percentage of patients with an elevated RFT decreased to 26.2. All patients had negative CRP status preoperatively; post-operatively, 57.9% remained negative, and 42.1% turned positive. There is a statistically significant difference in changes between preoperative and postoperative data (Table 3).

Table 2: Stone parameters (n=145)

Parameters	Result n(%)
Stone Site Distribution	
Upper Pole	48(33.1)
Pelvis	38(26.2)
Lower Pole	33(22.85)
Mid Pole	26(17.9)
Stone Size Distribution	
Small (<15 mm)	54(37.2)
Medium (15–20 mm)	65(44.8)
Large (>20 mm)	26(17.9)
Stone Density Distribution	
Low density (<800 HU)	27(18.6)
Moderate Density (800–1200 HU)	72(49.7)
High density (>1200 HU)	46(31.7)
Stone Side Distribution	
Right	79(54.5)
Left	66(45.5)

Table 3: Descriptive statistics of preoperative and postoperative parameters (n=145)

Parameters	Result n(%)	*p*-value (Chi-square)
Temperature Change		
Increased	57(39.3)	0.0015
Decreased	24(16.6)	
No Change	64(44.1)	
WBC Change		
Increased	59(40.7)	0.0021
Decreased	21(14.5)	
No Change	65(44.8)	
RFT Status		
Preoperative		
- Elevated	55(37.9)	0.0013
- Normal	90(62.1)	
Postoperative		
- Elevated	38(26.2)	
- Normal	107(73.8)	
CRP Status		
Preoperative		
Negative	145(100)	
Positive	0(0)	
Postoperative		
Positive	38(26.2)	0.0018
Negative	107(73.8)	

Out of the 145 patients, 25 developed urosepsis. This accounts for 17% of the total patient population (Figure 1).

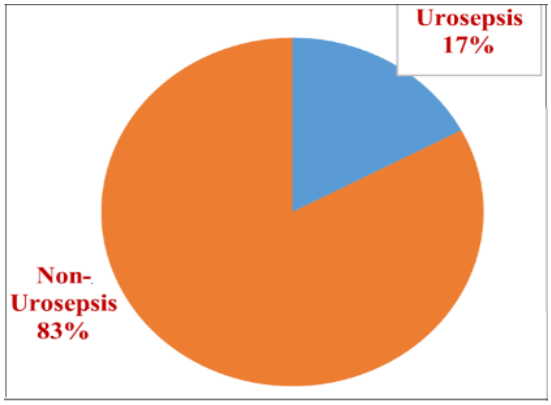

Figure 1: Distribution of urosepsis vs non-urosepsis.

For all urosepsis patients, urine C&S was done, and most cases were associated with *E. coli* (44%), making it the most significant pathogen to monitor and manage. Other notable pathogens include *Klebsiella* (24%), *Proteus* (16%), and *Staph. aureus* (12%), and Pseudomonas was the least common but still present in 4% of cases (Figure 2).

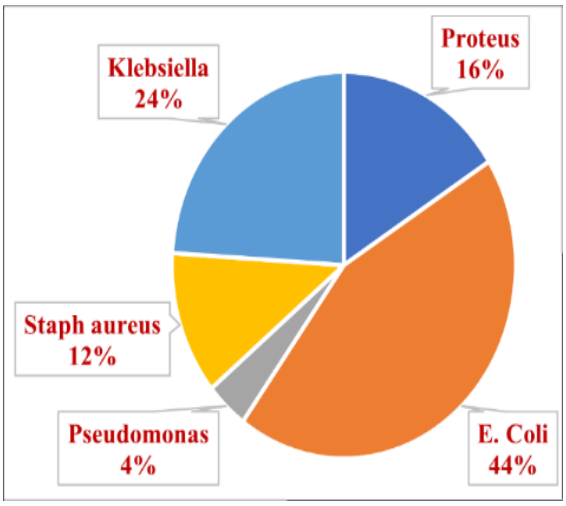

Figure 2: Distribution of urine culture post operatively

The use of ureteroscopes was distributed among first-use disposable, second-use disposable, and reusable types, with the second-use disposable flexible ureteroscope being the most common (42.8%). More than half (56.6%) of the patients had a prior DJ stent, which is mostly for more complex cases requiring pre-stenting. Most patients (52.5%) had a DJ stent duration of less than six weeks. The mean duration of the operation was 63.8 minutes, with a median duration of 63.0 minutes and a standard deviation of 20.2 minutes, indicating some variability in the operation times (Table 4).

Table 4: Distribution of operation parameters (n=145)

Parameters	Result n(%)
Type of Ureteroscope	
1st use	36(24.8)
Disposable Flexible	62(42.8)
Reusable Flexible	47(32.4)
Previous DJ Stent	
Yes	82(56.6)
No	63(43.4)
Duration of DJ Stent (week)	
< 6 weeks	43(52.5)
≥ 6 weeks	39(47.5)
Duration of Operation (min)	
Mean Duration	63.8
Median	63.0
Standard	20.2
Shortest	32
Longest	98

In the postoperative period, most patients (64.1%) were stone-free after the RIRS procedure, with a majority (73.1%) managed by ESWL and a smaller group (26.9%) managed by a second session RIRS. For irritative voiding symptoms, the majority (73.8%) experienced irritative symptoms, while 26.2% did. The typical hospital stays range from 1 to 4 days, with an average of around 2 days, with 49.7% remaining just one day in the hospital. DJ stent time range of 4 to 8 weeks, with the median stent duration of 6 weeks (Table 5). Regarding the interpretation comparison between urosepsis and non-urosepsis (Table 6). Regarding BMI, the majority of both urosepsis and non-urosepsis patients fall into the overweight category (52.0% and 53.3%, respectively). In urosepsis cases compared to non-urosepsis cases, the normal BMI category is slightly fewer cases. A significantly higher proportion of urosepsis patients (72%) were diabetic cases compared to non-urosepsis patients (32.5%).

Table 5: Postoperative status (n=145)

Parameters	Result n(%)
Stone-free postoperative	
Yes	93(64.1)
No	52(35.9)
Management of residual ***stone***	
ESWL	38(73.1)
RIRS	14(26.9)
Irritative symptoms postoperative	
No	38(26.2)
Yes	107(73.8)
Hospital stay duration	
1 day	72(49.7)
2 days	36(24.8)
≥ 3 days	37(25.5)
DJ Stent time duration	
4 weeks	79(54.5)
5 weeks	22(15.2)
6 weeks	39(26.9)
8 weeks	5(3.4)

Regarding temperature change preoperatively and post-operatively in urosepsis cases, 72% of patients experienced an increase in temperature compared to 32.5% of non-urosepsis patients. For WBC change, 60% of urosepsis patients had increased WBC counts compared to 36.7% of non-urosepsis patients. Regarding CRP status, 100% of patients with both urosepsis and non-urosepsis had negative CRP, while post-operatively, 72% of urosepsis patients had positive CRP compared to 16.7% of non-urosepsis patients. Preoperative HbA1c was done for diabetic cases; 77.8% of diabetic urosepsis patients had uncontrolled HbA1c compared to 63.2% of non-urosepsis diabetic patients. Regarding the previous DJ stent (prior to RIRS), in urosepsis patients (48%) had a previous DJ stent, and for the duration of the DJ stent in these urosepsis patients, it was distributed between (50%) < 6 weeks and (50%) ≥ 6 weeks. Based on this analysis, neither the presence of a preexisting DJ stent, in terms of its existence, nor even the duration for which a DJ stent was present, does not relate significantly to the development of urosepsis. Lastly, regarding the duration of the procedure, urosepsis patients had a mean duration of 70.0 minutes, compared to 62.8 minutes for non-urosepsis patients, and a median time of 76.0 minutes for urosepsis patients and 61.5 minutes for non-urosepsis patients with a standard deviation of 19.4 minutes for urosepsis patients and 18.5 minutes for non-urosepsis patients. Diabetic patients, increased temperature, elevated WBC, postoperative positive CRP, uncontrolled HbA1c, and longer procedure durations are statistically significant *p*-values that indicate

increased risk associated with urosepsis. In contrast, BMI, previous DJ stent placement, duration of the previous DJ stent, and the types of flexible scopes used show no significant association with urosepsis status in our data.

Table 6: Comparison (Urosepsis *vs*. non-Urosepsis)

Parameter	Urosepsis (n=25) n(%)	Non-Urosepsis (n=120) n(%)	*p*-value
BMI Categories			
Underweight (<18.5)	0(0.0)	1(0.8)	
Normal (18.5-24.9)	6(24)	31(25.8)	0.646
Overweight (25-29.9)	13(52)	64(53.3)	
Obesity (≥30)	6(24)	24(20)	
Diabetic Status			
- Diabetic	18(72)	19(15.83)	0.0001
- Non-Diabetic	7(28)	101(84.17)	
Temperature Change			
- Increased	18(72)	39(32.5)	0.0021
- Decreased	2(8)	22(18.3)	
- No Change	5(20)	59(49.2)	
WBC Change			
- Increased	15(60)	44(36.7)	
- Decreased	3(12)	18(15)	0.0034
- No Change	7(28)	58(48.3)	
CRP Status			
Preoperative			
- Negative	25(100)	120(100)	0.0001
- Positive	0(0.0)	0(0.0)	
Postoperative			
- Negative	7(28)	100(83.3)	0.0003
- Positive	18(72)	20(16.7)	
HbA1c (for Diabetic cases)			
- Controlled (≤ 7.0%)	4(22.2)	7(36.8)	0.0015
- Uncontrolled (> 7.0%)	14(77.8)	12(63.2)	
Previous DJ Stent			
Yes	12(48)	70(58.3)	0.36
No	13(52)	50(41.7)	
Duration of DJ Stent (weeks)			
< 6 weeks	6(50)	37(52.9)	0.84
≥ 6 weeks	6(50)	33(47.1)	
Duration of procedure (min)			
- Mean Duration	70	62.8	
- Median Duration	76	61.5	
- Standard Deviation	19.4	18.5	0.0032
- Shortest Duration	35	32	
- Longest Duration	95	98	
Types of Flexible			
1st use disposable	6(24)	29(24.2)	
2nd use disposable	13(52)	49(40.8)	0.507
Reusable Flexible	6(24)	42(35)	

*Chi-square test used for all parameters, except t-test used for duration of procedure

DISCUSSION

Our study aimed to identify risk factors for urosepsis following retrograde intrarenal surgery (RIRS) in a cohort of 145 patients, of whom 25 (17%) developed urosepsis, which is overall higher than mentioned in previous studies [11], highlighting the necessity for careful patient monitoring and management strategies to mitigate this risk. Our findings highlight several significant risk factors, including diabetes, prolonged surgical duration, elevated postoperative inflammatory markers, and complex stone characteristics. These results align with and expand upon existing literature, providing valuable insights for optimizing patient care and reducing the incidence of postoperative sepsis. Regarding demographic analysis, we found that most of the patients are within the 40-60 age group. This is in tune with previous studies showing that this adult age is more prone to urolithiasis [8]. Males, to some degree, more than females. This reflects that male patients are frequently more affected by stone disease [16]. However, statistical analysis did not show any significant differences in the risk of sepsis regarding the patient's age or gender. Our finding that diabetes is a significant risk factor for urosepsis, with 72% of the patients with urosepsis being diabetic, is consistent with previous studies. For instance, Yang *et al*. (2023) reported a similar association, with diabetic patients having a 2.5-fold increased risk of urosepsis following RIRS [17]. This underscores the importance of glycemic control in diabetic patients undergoing RIRS, as uncontrolled HbA1c levels were also significantly associated with urosepsis in our study. These findings suggest that preoperative optimization of diabetes, including tighter glycemic control and multidisciplinary care involving endocrinologists, may mitigate the risk of postoperative infections. Implementing multidisciplinary approaches that include endocrinologists and urologists can enhance patient outcomes by ensuring comprehensive management of diabetes alongside surgical interventions. Body mass index also represented an important aspect, as an increased number of patients were overweight (46.2%) or obese (23.4%). Obesity has been connected to the rise in perioperative complications such as infection and therefore calls for

preoperative weight management programs as possible [18,19]. Regarding stone properties, the size distribution of stones indicated a notable prevalence of upper pole stones, accounting for 36.6% of cases, consistent with literature that highlights the anatomical predisposition of the upper pole to stone development [17]. Regarding stone characteristics, our study found that medium-sized stones (15–20 mm) and stones with moderate to high density (800–1200 HU) were more common in patients who developed urosepsis. This is consistent with Ozgor *et al*. (2019), who reported that larger and denser stones were associated with higher rates of postoperative infections, likely due to increased procedural complexity and incomplete stone clearance [20]. These findings emphasize the importance of preoperative imaging and risk stratification to identify patients who may require tailored surgical approaches or additional prophylactic measures. A large percentage of patients had a previous DJ stent, 56.6%, which is usually used for more complex cases. Most of these patients have had the DJ stent for less than six weeks, at 52.5%. Previous stenting can complicate the surgery and increase the risk of infection due to biofilm formation on the stent surface [21]. Proper management of these stents prior to surgery is crucial, as it can significantly influence surgical outcomes and minimize the potential for postoperative complications. The use of different types of ureteroscopes showed that second-use disposable flexible ureteroscopes were the most employed, corresponding to 42.8%, followed by reusable flexible ureteroscopes at 32.4% and first-use disposables at 24.8%. The kind of ureteroscope used and the frequency of its use are factors that may affect both the sterility and efficacy of the procedure and, therefore, infection rates [22]. Prolonged surgical duration (>60 minutes) was another significant risk factor in our study (p= 0.001). This aligns with findings from Günseren *et al*. (2021), who identified a cutoff of 75 minutes as a predictor of infectious complications [23]. Longer procedures may increase the risk of bacterial translocation and tissue trauma, highlighting the need for efficient surgical techniques and careful preoperative planning to minimize operative time. Elevated postoperative inflammatory markers, such as CRP and WBC counts, were also strongly associated with urosepsis in our cohort. These findings are consistent with Kazan *et al*. (2022), who reported that elevated CRP levels post-RIRS were predictive of infectious complications [24]. This suggests that close monitoring of inflammatory markers in the postoperative period may facilitate early detection and management of sepsis. In addition, a considerable proportion of patients demonstrated RFT values and positive CRP status post-operatively. These findings underline the importance of strictly monitoring these parameters for the prompt identification and management of sepsis in post-RIRS patients [16]. Regarding prior DJ stent usage and duration, our data was not significant. Other factors might play a more critical role in influencing the risk of urosepsis following RIRS. In a similar pattern, antibiotic use practices changed from the preoperative to postoperative periods. Although amikacin was used more frequently preoperatively, meropenem use increased post-operatively. The reason for the change of antibiotic regimen is the answer to the clinical need for treatment of postoperative infection [25]. The changing of antibiotics to broad-spectrum post-operatively recommended the offer of coverage against possible wider-range pathogens. The post-RIRS outcomes were mostly favorable, and most patients achieved a stone-free state without pain or mild symptoms; however, some of them needed further interventions with ESWL and a second session of RIRS. The mean duration of hospitalization time was within the accepted ranges and demonstrated good postoperative recovery [26]. The lengths of hospital stay were generally short, with 49.7% of the patients staying only one day post-operatively. DJ stent time ranged from 4 to 8 weeks with a median duration of 6 weeks to prevent ureteral stricture and ensure adequate healing [27]. Comparing urosepsis and non-urosepsis patients showed significant differences in various parameters. Diabetic patients with increased body temperature, WBC, postoperative positive CRP, uncontrolled HbA1c, and longer procedure duration all had a significantly higher risk for the development of urosepsis [28,29]. These findings show the importance of closely monitoring patients with these risk factors; early intervention could mitigate complications and improve overall outcomes in postoperative care. The findings of the study delineate the importance of preoperative identification of high-risk patients and the adoption of selectively targeted strategies for risk mitigation. Improved perioperative care with strict infection control, optimization of diabetes, and closely monitored procedural time can further reduce the incidence of urosepsis following RIRS. These strategies not only aim to enhance patient outcomes but also emphasize the necessity of a multidisciplinary approach in managing patients at risk for urosepsis. The outcome of the 25 urosepsis patients was that all were treated in our ward with proper management except one case admitted to the intensive care unit (ICU), and fortunately, the mortality was zero.

Study limitations

Despite its contributions, this study has several limitations. Its retrospective design may introduce selection bias and limit the ability to establish causal relationships. The relatively small sample size (n = 145) may affect the generalizability of the findings, particularly in regions with different patient demographics or surgical practices. The single-center nature of the study may not fully capture variations in clinical protocols or antibiotic regimens.

Study strength

To the best of our knowledge, this is the first study to comprehensively evaluate risk factors for urosepsis following RIRS in an Iraqi population. Our study provides a multifaceted analysis of demographic,

clinical, and operative variables, offering valuable insights for urologists in similar settings. The inclusion of both preoperative and postoperative laboratory parameters, such as CRP and WBC count, further strengthens the clinical relevance of our findings.

Clinical implications

Our findings have several important clinical implications: 1) It highlights the need for comprehensive preoperative optimization, particularly in diabetic patients, to reduce the risk of urosepsis; 2) it underscores the importance of efficient surgical techniques to minimize operative time and tissue trauma; 3) it suggests that close postoperative monitoring of inflammatory markers, such as CRP and WBC counts, may facilitate early detection and management of sepsis; and 4) it emphasizes the value of preoperative imaging and risk stratification to identify patients at higher risk of infectious complications.

Area for future research

Future research should focus on innovative strategies to reduce the identified risk factors for urosepsis following RIRS. For example, studies exploring the role of urinary bacteria in postoperative infections could provide new insights into preventive and therapeutic approaches [30,31]. Additionally, advancements in imaging techniques, such as contrast-enhanced ultrasound, may improve preoperative risk stratification and surgical planning [32]. The integration of artificial intelligence (AI) into clinical practice could also enhance risk prediction and patient outcomes by analyzing large datasets to identify novel risk factors [33].

Conclusions

This study highlights the multifactorial risk origin of developing urosepsis post-RIRS. The critical risk factors are diabetes, longer procedural time, higher postoperative inflammatory markers, and complexities in stone characteristics. Amelioration of these risk factors through comprehensive preoperative planning and meticulous intraoperative techniques will thus help healthcare providers maximize patient outcomes and minimize the incidence of urosepsis. Moreover, new avenues in the prevention of infection and improvement in the outcomes of stone removal procedures might arise with the advancement of technology in ureteroscopy equipment and techniques.

Conflict of interests

No conflict of interest was declared by the authors.

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Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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