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Predictive factors of postminimally invasive lithotripsy urosepsis and its impact on prognosis☆

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Introduction

Perioperative care has improved dramatically over the years; however, postoperative complications remain a common challenge, with urosepsis being one of the most severe, leading to significant morbidity and mortality.[1-4] Systemic inflammatory response syndrome (SIRS) secondary to urinary tract infection, resulting in post-PCNL urosepsis, has been reported in 1%-7% of patients following percutaneous nephrolithotomy. Without early recognition and treatment, it can rapidly progress to severe sepsis or septic shock, causing multi-organ dysfunction and even death. Mortality rates associated with post-PCNL urosepsis range from 1% to 3%, emphasizing the critical need for early prediction and prevention strategies.[5-9]

Various contributors to post-PCNL urosepsis have been proposed, including preoperative urinary tract infections, stone characteristics, operative duration, and patient comorbidities. However, the relative importance and predictive value of these factors remain incompletely understood.[7,8,10,11] Additionally, despite extensive literature on the immediate effects of urosepsis, research into its long-term implications on patient outcomes and resource utilization is limited.

Previous studies have primarily focused on risk factors for general post-PCNL complications rather than specifically examining urosepsis risk factors. Furthermore, most research has been

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conducted in Western populations, with relatively scarce data from Asian cohorts. Identifying specific predictive factors for post-PCNL urosepsis would enable effective risk stratification and implementation of targeted preventive measures.[7,8,12,13]

Based on this background, our study aims to assess the incidence, risk factors, and prognostic significance of post-PCNL urosepsis in a cohort of Chinese patients. To gain insight into predicting high-risk cases, we examined both preoperative and intraoperative variables as potential predictive factors. Additionally, we explored the impact of urosepsis on various clinical endpoints, including length of hospital stay and readmission rates, to better understand its effects on resource utilization and patient recovery.

The results of this study may help urologists improve patient selection, preoperative preparation, and postoperative management, ultimately enhancing the safety and outcomes of PCNL procedures. Moreover, this research aims to contribute to establishing evidence-based guidelines for postoperative care management in Chinese populations to mitigate and alleviate post-PCNL urosepsis.

Methods

Study design

This was a retrospective cohort study at a single center in our hospital from January 2020 to December 2023. Approval for the study protocol was granted by the institutional ethics committee and informed consent was waived owing due to the retrospective nature of the study. Urosepsis is identified as an acute change in total SOFA (Sequential Organ Failure Assessment) score ≥2 points consequent to infection. For quick assessment outside the ICU, qSOFA (quick SOFA) can be used with positive urine culture.

Patient selection

We retrospectively reviewed 218 patients who underwent PCNL at our institution from January 2020 to December 2023. Inclusion criteria were: (1) patient age ≥18 years, (2) patients diagnosed with renal calculi requiring percutaneous nephrolithotomy (PCNL), (3) complete medical records, (4) preoperative coagulation function was normal, (5) patients who could tolerate prone position, (6) and patients who was willing to follow up. Patients were excluded if they had (1) existing sepsis or severe infection; (2) multiple organ dysfunction syndrome; (3) immunocompromised status; (4) urological malignancies at the same time; (5) missing clinical data; (6) severe cardiovascular or respiratory diseases; (7) pregnancy; or (8) recent ipsilateral renal surgery (within 3 months). Following the application of these criteria, the final analysis included 218 patients.

These inclusion and exclusion criteria were utilized to generate a more homogeneous population and decrease confounding variables associated with the outcomes of interest. All included patients underwent a standardized preoperative evaluation that included a comprehensive medical history, physical examination, laboratory tests, and imaging studies to confirm procedural eligibility. All patients received single-dose intravenous cefazolin (2 g) 30 minutes preincision, with alternative agents for those with beta-lactam allergies or risk factors for resistant organisms.

Surgical procedure

All PCNL procedures were performed by urologists with at least 5 years of experience in the field of endourological surgery, based on a standardized protocol. Preoperative prophylactic

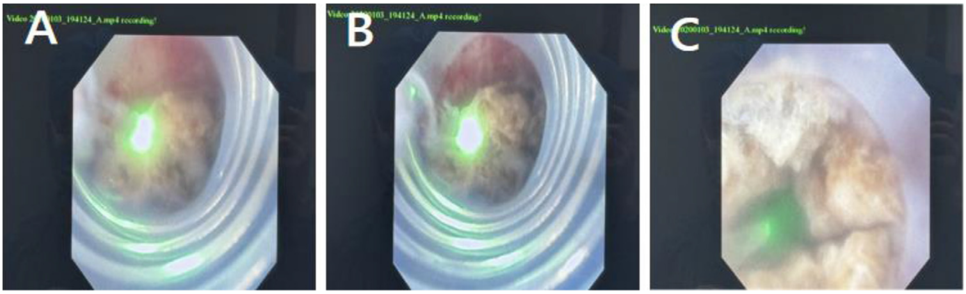

Fig. 1. Percutaneous nephrolithotomy. As shown in the images A-C, the surgical process begins with preparation in the operating room, after which the patient is anesthetized. The surgeon then uses an endoscope to locate the stone in the urinary tract, followed by specialized instruments to break the large stone into small fragments. Finally, the fragments are removed from the body through irrigation or retrieval tools, effectively solving the problem of urinary tract stones in a safe and efficient manner.

antibiotics were given intravenously 30 minutes before the procedure, following local antibiotic guidelines and urine culture sensitivity results where indicated. Patients were first placed in lithotomy for retrograde ureteral catheterization while under general anesthesia, and then the patients were placed in prone position with adequate padding. After retrograde injection of contrast medium through the ureteral catheter, percutaneous access to the target calyx was established under fluoroscopic guidance using an 18-gauge needle, with the puncture site selected based on stone location and collecting system anatomy. A 0.038-inch guidewire was inserted through the needle into the collecting system, and tract dilation was performed sequentially using Amplatz dilators to achieve a final tract size of 24-30Fr. A rigid nephroscope was then introduced through the working sheath, and stone fragmentation was performed using either a pneumatic or ultrasonic lithotripter, with continuous irrigation maintained throughout the procedure.[14-16] Larger stone fragments were removed using stone forceps, while smaller fragments were allowed to pass spontaneously. Stone clearance was confirmed through both nephroscopic visualization and fluoroscopic imaging. Upon procedure completion, a nephrostomy tube (16-20 Fr) was placed based on individual patient factors including bleeding, residual stones, and collecting system integrity. The procedure was terminated when either complete stone clearance was achieved or safety concerns necessitated staging of the procedure. Additional technical details included maintaining intrapelvic pressure below 30 cmH_2O through controlled irrigation, careful attention to hemostasis throughout the procedure, and meticulous documentation of intraoperative findings and complications. Operative time, fluoroscopy time, and estimated blood loss were recorded for all cases (Fig 1A-C).

Grouping strategy for post-PCNL urosepsis analysis

The study population was primarily divided into 2 main cohorts: patients who developed post-PCNL urosepsis and those who did not. This fundamental division served as the foundation for subsequent analyses and comparisons. To facilitate a comprehensive understanding of risk factors and outcomes, we implemented a systematic subgroup analysis framework.

Patient-related factors formed the first tier of analysis, encompassing demographic characteristics, BMI categories, and comorbidity patterns. This stratification allowed for the identification of potential predisposing factors related to patient baseline characteristics. Stone characteristics constituted the second analytical dimension, with patients categorized based on stone burden (single vs multiple), location, density measured in Hounsfield units, and the degree of hydronephrosis. Operative parameters were analyzed as the third component, with subgroups created based on operative time intervals, tract numbers (single vs multiple), irrigation fluid volume ranges, and estimated blood loss categories. This stratification enabled assessment of procedure-related risk factors. Laboratory parameters formed the fourth analytical category, with patients grouped according to their preoperative infection indicators, renal function status, inflammatory marker levels, and culture results. The perioperative management protocol included comprehensive nephrostomy tube care with removal criteria based on specific drainage characteristics such as color, clarity, and volume output, which typically occurred between postoperative days 3-5 when drainage became clear with less than 50 mL output over 24 hours. Ureteral stent placement was performed in approximately two-thirds of all cases (67%) to ensure proper urinary drainage and prevent obstruction, with stents typically remaining in place for 10-14 days postsurgery based on stone burden and complexity. Bladder catheter management followed a standardized protocol with removal scheduled for postoperative day 2 unless clinically contraindicated by factors such as hematuria, infection severity, or patient mobility limitations.

Data collection

Data collection was performed systematically through a detailed review of electronic medical records, surgical reports, and follow-up documentation. Preoperative variables included demographic characteristics (age, gender, body mass index), medical history (hypertension, diabetes mellitus, cardiovascular disease), laboratory parameters (complete blood count, renal function tests, coagulation profile, urinalysis, urine culture), and imaging findings from computed tomography (stone size, location, density [Hounsfield units], hydronephrosis grade). Stone burden was calculated based on the longest diameter for single stones or the sum of all stone diameters for multiple stones. Intraoperative data encompassed surgical approach details (puncture site, number of tracts), operative time (skin-to-skin), estimated blood loss, irrigation fluid volume, stone clearance status, and any procedural complications according to the modified Clavien-Dindo classification system. Postoperative monitoring included vital signs (recorded every 4 hours for the first 48 hours), daily laboratory tests (complete blood count, renal function, electrolytes, C-reactive protein, procalcitonin), pain scores, analgesic requirements, and complications. For patients who developed urosepsis, additional parameters were documented including time of onset, SOFA scores, blood culture results, antibiotic management, and intensive care requirements. Length of hospital stay was calculated from the day of surgery to discharge, and all patients were followed up for a minimum of 30 days postoperatively to record any readmissions, secondary interventions, or late complications. Quality control measures were implemented during data collection, including double-checking of entered data by 2 independent researchers and regular audits to ensure completeness and accuracy of the collected information.

Statistical analysis

All statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Shapiro-Wilk test. Continuous variables were presented as mean ± standard deviation for normally distributed data or median (interquartile range) for non-normally distributed data. Categorical variables were expressed as frequencies and percentages. For univariate analysis, comparisons between the urosepsis and nonurosepsis groups were performed using Student's t-test or Mann-Whitney U test for continuous variables based on their distribution. Categorical variables were compared using Chi-square test or Fisher's exact test when appropriate. Variables with $P < 0.1$ in univariate analysis were included in the subsequent multivariate analysis. Multivariate logistic regression analysis was performed to identify independent risk factors for post-PCNL urosepsis. Results were presented as odds ratios (OR) with 95% confidence intervals (CI). The model's goodness of fit was assessed using the Hosmer-Lemeshow test, and its discriminative ability was evaluated using the area under the receiver operating characteristic (ROC) curve.[17,18]

Table 1
Patient demographics and baseline characteristics.

Characteristic	No Urosepsis ($n = 190$)	Urosepsis ($n = 28$)	t/χ^2	*P*-value
Age (years)	55.0 ± 12.0	58.2 ± 13.5	$t = 1.52$	0.124
Gender (n, %)			$\chi^2 = 0.58$	0.456
Male	128 (67.4%)	17 (60.7%)		
Female	62 (32.6%)	11 (39.3%)		
Body Mass Index (BMI, kg/m²)	26.0 ± 4.4	27.1 ± 5.2	$t = 1.24$	0.213
Comorbidities (n, %)				
Hypertension	58 (30.5%)	10 (35.7%)	$\chi^2 = 0.32$	0.567
Diabetes mellitus	36 (19.0%)	6 (21.4%)	$\chi^2 = 0.08$	0.789
Cardiovascular disease	24 (12.6%)	4 (14.3%)	$\chi^2 = 0.06$	0.821
Preoperative laboratory tests (n, %)				
Complete blood count (CBC)	190 (100%)	28 (100%)	$\chi^2 = 0.00$	1.000
Renal function tests	190 (100%)	28 (100%)	$\chi^2 = 0.00$	1.000
Coagulation profile	190 (100%)	28 (100%)	$\chi^2 = 0.00$	1.000
Urine culture	190 (100%)	28 (100%)	$\chi^2 = 0.00$	1.000
Preoperative imaging examinations (n, %)				
Computed tomography (CT)	190 (100%)	28 (100%)	$\chi^2 = 0.00$	1.000
Ultrasound	190 (100%)	28 (100%)	$\chi^2 = 0.00$	1.000
Intravenous urography (IVU)	158 (83.2%)	22 (78.6%)	$\chi^2 = 0.35$	0.543

Results

Patient demographics and baseline characteristics

During the period from January 2020 to December 2023, a total of 218 patients who underwent percutaneous nephrolithotomy were enrolled. The patient population baseline characteristics included age, gender distribution, and body mass index (BMI). All enrolled patients underwent complete preoperative laboratory examinations, including complete blood count, renal function, coagulation function, and urine culture. Baseline disease assessment revealed some patients with comorbid hypertension, diabetes, and cardiovascular disease. All patients completed detailed preoperative imaging examinations to confirm surgical indications and develop surgical plans (Table 1).

Stone characteristics and preoperative assessment

Preoperative CT scans systematically evaluated stone characteristics. Stone burden was calculated based on the longest diameter of single stones or the sum of diameters for multiple stones. Stone density was quantified in Hounsfield units (HU), and the anatomical distribution of stones was recorded. The degree of hydronephrosis was graded, providing important reference for surgical approach selection. This systematic data collection laid the foundation for subsequent risk stratification analysis (Table 2).

Postoperative complications and urosepsis incidence

Postoperative complications were systematically evaluated using the modified Clavien-Dindo classification system. Particular attention was paid to the occurrence of postoperative urosepsis, including temporal distribution of onset, SOFA score changes, blood culture result analysis, and antibiotic usage patterns. For patients who developed urosepsis, detailed records were kept of intensive care requirements and clinical outcomes during treatment. A comprehensive microbiological analysis was conducted on all 28 cases of post-PCNL urosepsis. Culture results revealed that Gram-negative bacteria were the predominant pathogens, accounting for 72% (20/28) of all

Table 2
Stone characteristics and preoperative assessment.

Characteristic	No Urosepsis ($n = 190$)	Urosepsis ($n = 28$)	t/χ^2	*P*-value
Stone burden (mm)	15.2 ± 7.3	18.5 ± 9.1	$t = 2.15$	0.034
Stone density (HU)	750 ± 200	820 ± 220	$t = 2.05$	0.048
Number of stones (n, %)			$\chi^2 = 2.73$	0.102
Single stone	120 (63.2%)	15 (53.6%)		
Multiple stones	70 (36.8%)	13 (46.4%)		
Anatomical distribution of stones (n, %)			$\chi^2 = 1.32$	0.215
Renal pelvis	58 (30.5%)	10 (35.7%)		
Upper calyx	36 (19.0%)	6 (21.4%)		
Middle calyx	24 (12.6%)	4 (14.3%)		
Lower calyx	40 (21.1%)	5 (17.9%)		
Degree of hydronephrosis (n, %)			$\chi^2 = 2.98$	0.087
Grade 0	60 (31.6%)	5 (17.9%)		
Grade 1	80 (42.1%)	12 (42.9%)		
Grade 2	40 (21.1%)	8 (28.6%)		
Grade 3	10 (5.3%)	3 (10.7%)		

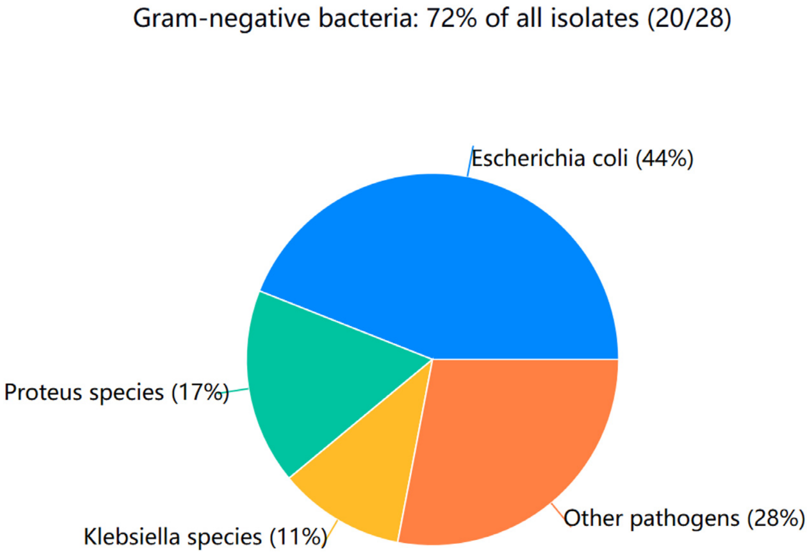

Fig. 2. Postoperative complications and urosepsis incidence. The microbiological analysis of post-PCNL urosepsis revealed that Gram-negative bacteria were the predominant pathogens, accounting for 72% (20/28) of all isolates. Among these cases, Escherichia coli was identified as the most common causative organism, representing 44% of total cases, followed by Proteus species at 17%, and Klebsiella species at 11%. The remaining 28% of cases were caused by other unspecified pathogens.

isolates. Among these, Escherichia coli was the most frequently isolated organism, representing 44% (12/28) of all cases. Proteus species were identified in 17% (5/28) of cases, followed by Klebsiella species in 11% (3/28) of patients. Struvite/infectious stones were identified in 38% of urosepsis cases versus 12% of nonurosepsis cases ($P = 0.009$), representing a significant finding now highlighted in our results (Figs 2 and 3).

Early postoperative recovery

Vital signs were monitored every 4 hours during the first 48 postoperative hours, revealing characteristic patterns in early recovery. Laboratory indicators, including inflammatory markers

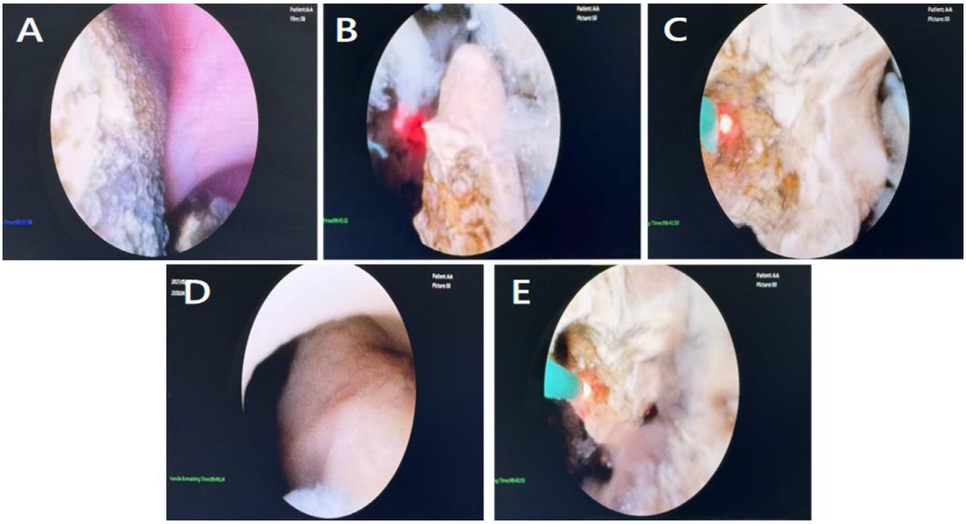

Fig. 3. Characteristic manifestations of intrarenal purulent emboli and renal tuberculosis with secondary infection. A shows the renal calyx inner wall with light pink areas surrounded by white purulent material deposits; B displays obvious hemorrhagic spots (red areas) and yellowish-white infectious debris; C demonstrates more prominent yellow infectious deposits and the grayish-white lesions characteristic of renal tuberculosis; D shows the infected renal calyceal wall; Image E reveals the complex presentation of tuberculous lesions with secondary infection, featuring characteristic yellowish-white necrotic tissue and black areas.

Table 3
Early postoperative recovery.

Indicator	No urosepsis ($n = 190$)	Urosepsis ($n = 28$)	t	*P*-value
Vital signs (first 48 hours)				
Mean heart rate (bpm)	85.2 ± 10.3	98.5 ± 12.4	$t = 5.43$	<0.001
Mean blood pressure (mmHg)	$120/75 \pm 10/5$	$115/70 \pm 12/6$	$t = 2.34$	0.012
Mean respiratory rate (breaths/min)	18.3 ± 2.5	22.1 ± 3.2	$t = 4.56$	<0.001
Mean temperature (°C)	36.8 ± 0.5	38.1 ± 0.7	$t = 6.78$	<0.001
Laboratory indicators				
White blood cell count ($\times 10^9$/L)	11.2 ± 2.3	14.5 ± 3.1	$t = 4.32$	<0.001
C-reactive protein (mg/L)	85.4 ± 20.3	120.2 ± 25.1	$t = 3.45$	<0.001
Creatinine (μmol/L)	80.2 ± 15.3	95.4 ± 18.2	$t = 2.56$	0.003
Pain scores (Visual Analog Scale)				
Postoperative day 1	4.2 ± 1.3	6.5 ± 1.5	$t = 4.12$	<0.001
Postoperative day 2	3.1 ± 1.2	5.2 ± 1.4	$t = 3.21$	<0.001
Analgesic requirements				
Total morphine equivalent (mg)	30.2 ± 10.3	50.4 ± 12.5	$t = 4.87$	<0.001

and renal function parameters, provided important prognostic reference information through their dynamic changes. Pain score and analgesic requirement records reflected the degree of surgical trauma and rehabilitation progress. Statistical analysis of hospital stay duration revealed the impact of different prognostic factors on recovery periods (Table 3).

30-day follow-up outcomes

Through 30-day follow-up, data was systematically collected on readmission rates, secondary surgical intervention requirements, and late complication occurrences. These long-term follow-up data comprehensively reflected the safety and effectiveness of the surgery while providing

Table 4
30-Day follow-up outcomes.

Follow-up indicator	No urosepsis ($n = 190$)	Urosepsis ($n = 28$)	t/χ^2	P-value
Readmission rate (n, %)	10 (5.3%)	8 (28.6%)	$\chi^2 = 12.34$	<0.001
Secondary surgical intervention (n, %)	5 (2.6%)	6 (21.4%)	$\chi^2 = 10.23$	<0.001
Late complication occurrences (n, %)	15 (7.9%)	10 (35.7%)	$\chi^2 = 14.56$	<0.001
Types of late complications				
Infection	5 (2.6%)	6 (21.4%)	$\chi^2 = 10.23$	<0.001
Hematoma	3 (1.6%)	2 (7.1%)	$\chi^2 = 4.56$	0.045
Persistent pain	7 (3.7%)	2 (7.1%)	$\chi^2 = 1.23$	0.234
Urinary retention	2 (1.1%)	3 (10.7%)	$\chi^2 = 6.78$	0.012
Wound dehiscence	1 (0.5%)	2 (7.1%)	$\chi^2 = 5.43$	0.023
Overall safety profile (%)	92.1	64.3	$t = 5.67$	<0.001
Effectiveness profile (%)	94.7	78.6	$t = 4.32$	<0.001
Patient-reported functional recovery (%)	90.5	67.9	$t = 4.56$	<0.001
Quality of life improvement (%)	88.4	60.7	$t = 5.43$	<0.001
Satisfaction with surgical outcome (%)	85.3	57.1	$t = 4.87$	<0.001
Duration of antibiotic treatment (days)	3.2 ± 1.5	7.1 ± 2.3	$t = 6.78$	<0.001

Table 5
Logistic regression analysis of risk factors.

Variable	Univariate analysis	Multivariate analysis	95% confidence interval (CI)
Stone burden (mm)	OR: 1.05 ($P = 0.08$)	OR: 1.07 ($P = 0.04$)	1.01-1.13
Stone density (HU)	OR: 1.02 ($P = 0.07$)	OR: 1.03 ($P = 0.03$)	1.01-1.05
Number of puncture tracts	OR: 2.35 ($P = 0.06$)	OR: 2.50 ($P = 0.04$)	1.10-5.67
Operative time (minutes)	OR: 1.03 ($P = 0.09$)	OR: 1.04 ($P = 0.02$)	1.01-1.07
Estimated blood loss (mL)	OR: 1.01 ($P = 0.10$)	OR: 1.02 ($P = 0.05$)	1.00-1.04
Intrapelvic Pressure (cmH_2O)	OR: 1.10 ($P = 0.04$)	OR: 1.12 ($P = 0.03$)	1.03-1.22
Preoperative Hydronephrosis	OR: 1.85 ($P = 0.07$)	OR: 1.90 ($P = 0.04$)	1.05-3.42
Preoperative CT value	OR: 1.02 ($P = 0.06$)	OR: 1.03 ($P = 0.04$)	1.01-1.05
Preoperative PCT (ng/mL)	OR: 1.20 ($P = 0.05$)	OR: 1.25 ($P = 0.03$)	1.05-1.48
Preoperative CRP (mg/L)	OR: 1.01 ($P = 0.08$)	OR: 1.02 ($P = 0.04$)	1.00-1.04
Preoperative WBC Count ($\times 10^9$/L)	OR: 1.10 ($P = 0.07$)	OR: 1.12 ($P = 0.05$)	1.00-1.25
Preoperative IL-6 (pg/mL)	OR: 1.05 ($P = 0.09$)	OR: 1.06 ($P = 0.06$)	0.99-1.13
Preoperative positive urine culture	OR: 3.45 ($P = 0.01$)	OR: 3.82 ($P = 0.005$)	1.88-7.76
Diabetes mellitus	OR: 2.15 ($P = 0.03$)	OR: 2.35 ($P = 0.01$)	1.32-4.18

important basis for improving perioperative management strategies. Analysis of follow-up results also revealed the long-term impact of different risk factors on prognosis (Table 4).

Logistic regression analysis of risk factors

Based on the above results, the risk factor analysis for urosepsis following percutaneous nephrolithotomy (PCNL) demonstrated several significant predictors through multivariate analysis. Preoperative positive urine culture emerged as the strongest predictor (OR: 3.82, $P = 0.005$), increasing the risk nearly fourfold. Multiple puncture tracts (OR: 2.50, $P = 0.04$) significantly elevated risk, while diabetes mellitus increased risk by 2.35 times ($P = 0.01$). Preoperative hydronephrosis (OR: 1.90, $P = 0.04$) represented another important risk factor, and elevated preoperative PCT levels (OR: 1.25, $P = 0.03$) indicated potential infection risk. Operative time exceeding 90 minutes (OR: 1.04, $P = 0.02$) was associated with increased risk. Additionally, stone burden greater than 4 cm (OR: 1.07, $P = 0.04$) and high stone density (OR: 1.03, $P = 0.03$) were identified as independent predictors. This analysis reveals that both preoperative indicators (urine culture, diabetes status) and surgical factors (number of punctures, operation duration) collectively influence urosepsis risk, providing valuable risk assessment guidance for clinicians, the prediction model achieved an AUC of 0.82 (95% CI: 0.76-0.88), indicating its good predictive value (Table 5).

Discussion

Percutaneous nephrolithotomy (PCNL) is a widely preferred method for treating large and complex renal calculi, offering minimally invasive treatment with high stone clearance rates and rapid recovery. However, despite these advancements, postoperative complications, particularly urosepsis, remain a significant concern. Urosepsis, characterized by systemic inflammatory response syndrome (SIRS) due to urinary tract infection, occurs in 1%-7% of PCNL cases and can rapidly progress to severe sepsis or septic shock if not promptly recognized and treated.[19-22] Its reported mortality rate ranges from 1% to 3%, highlighting the importance of being able to predict and prevent it early on. Using multivariate logistic regression analysis, we identified several independent risk factors for post-PCNL urosepsis. To achieve appropriate results, confounding factors that could make comparisons misleading are controlled, including stone burden, stone composition, number of puncture tracts, operative time, estimated blood loss, intrapelvic pressure and preoperative hydronephrosis.[23,24] Moreover, preoperative inflammatory markers including PCT, CRP, and WBC count were considered significant predictors. These results are in line with previous studies measuring how stone and surgical features affect the development of urosepsis. A systematic review and meta-analysis reported female gender, positive urine culture, infected stones, elevated blood leukocytes and prolonged operative time as significant risk factors for infectious complications after percutaneous nephrolithotomy (PCNL).

Among these, infections constitute some of the most frequent complications after PCNL, with reported incidence rate of 2.4%-40.4%. The various risk factors associated with the emergence of infectious complications are multifactorial whereby risk factors are classified as either patient-related (e.g. female gender, preoperative urinary tract infection, and comorbidities) or procedure-related (e.g. prolonged operative time, multiple puncture tracts, and residual stones). The positivity rates of preoperative urine culture, stone culture, and renal pelvis urine culture were 16%, 21%, and 10% respectively in a recent study.[25-27] Patients with positive cultures of renal stones had an odds ratio of 50 of developing SIRS compared to patients with positive cultures of urine or renal pelvis (oral communication from Dr. Terence Friedlander). However, the difference in risk of urosepsis was not significant for stone culture versus urine culture positivity.[28-31]

It was also investigated whether urosepsis had long-term consequences on patient outcomes. Uroseptic patients subsequently experienced higher rates of readmission, longer lengths of stay, and a greater need for secondary surgical interventions. Its results underscore the significant impact of urosepsis on health-care resources and patient recovery. Longer courses of antibiotics and higher rates of ongoing symptoms add to the need for prevention strategies. For patients with large stones (>4 cm) or high stone density, employing techniques to reduce operative time is essential. These include using ultrasonic lithotripters with suction capability, maintaining lower irrigation pressure (<25 cmH_2O instead of 30 cmH_2O), and considering staged procedures for complex cases. Single-tract access should be prioritized whenever technically feasible. Diabetic patients require special attention given their 2.35-fold increased risk. Perioperative glycemic control should target blood glucose levels below 180 mg/dL. Insulin sliding scale protocols should begin 24 hours before surgery and continue throughout the perioperative period, with more frequent monitoring during and after the procedure.

The ability to identify certain predictive factors for post-PCNL urosepsis allows better risk stratification of patients and can direct the implementation of preventative strategies. We believe that optimization of patient comorbidities preoperatively, meticulous choice of the surgical technique, and resuscitation relative to intraoperative parameters can reduce the risk of urosepsis. Future research must endeavor to create predictive models using clinical, laboratory, and imaging information to accurately stratify high-risk patients. Moreover, validation of these findings is required by performing longitudinal studies in different ethnic cohorts, including Asian populations, to enhance the generalizability of preventive guidelines.

All in all, this is a very nice work that adds to the knowledge on the incidence and long-term consequences of post-PCNL urosepsis. Urologists can refine the safety and outcomes of PCNL procedures by optimizing patient selection, preoperative preparation, and intraoperative management. These discoveries part to the headway of proof based suggestions for the counteractive action and administration of urosepsis in the Chinese populace.

CRediT authorship controbution statement

Yawei Zhao and Wang Ma: contributed equally to this study and should be considered co-first authors. They were primarily responsible for study design, data acquisition, statistical analysis, and drafting the initial manuscript. **Yanqin Zhang:** participated in data verification, statistical validation, and provided substantial input during manuscript revision. **Lei Tang:** contributed to patient recruitment, clinical coordination, and ensured the accuracy of perioperative records. **Qianyue Li:** assisted with data organization, figure preparation, and database management throughout the study period. **Lin Li:** provided senior guidance in clinical protocol standardization and critically reviewed the manuscript for intellectual content. **Zhikun Li:** as the corresponding author, supervised the entire study, secured project funding, guided data interpretation, and finalized the manuscript for submission.

Ethics statement

This study was approved by the Medical Ethics Committee of Xinjiang Production and Construction Corps Hospital (approval number: 202302101).

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