International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Researcher Article *DOI: 10.61336/im/26-4-114*

A Prospective Study to assess the predictive value of Renal Stone Culture for Urosepsis following Renal Surgery in Tertiary Care Center.

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Received: 28-03-2026
Revised: 02-04-2026
Accepted: 18-04-2026
Published: 25-04-2026

Abstract

Background & Methods: The aim of the study is to Prospective Study to assess the predictive value of Renal Stone Culture for Urosepsis Renal Surgery. This is a Prospective Cohort Study Design. Study conducted on patients admitted in the Department of General surgery, M.Y. Hospital Indore Duration of study for 01 year. ***Results:*** Stone culture was highly useful as a "rule-out" test and moderately useful as a "rule-in" test. Ruling out urosepsis (NPV = 97.4%): A negative stone culture strongly predicts absence of urosepsis. Clinical impact: If stone culture is negative, urosepsis is very unlikely. This can prevent unnecessary antibiotics or invasive monitoring. A positive stone culture raises suspicion but does not guarantee urosepsis (less than 1 in 2 such patients develop it). Clinical impact: Positive result should trigger closer monitoring and early intervention, but not automatic diagnosis of urosepsis. Sensitivity (85.7%) and specificity (88.4%) are both high, meaning the test is reliable in most cases. Statistical confirmation: Chi-square = 19.26, $p < 0.001$, highly significant association. ***Conclusion:*** After renal surgery, renal stone culture is a useful predictor of infectious complications, such as SIRS & urosepsis. Patients who have positive stone cultures are significantly more likely to have a systemic infection. Every patient receiving renal stone surgery should be evaluated for routine stone culture analysis. This can help reduce morbidity related to urosepsis & guide focused antibiotic therapy. In a tertiary care context, early detection & treatment of high-risk patients can greatly enhance patient outcomes.

Keywords: predictive, Renal, Stone, Culture, Urosepsis & Surgery.

INTRODUCTION

Urosepsis, a severe systemic infection arising from a urological source, remains a significant risk following renal surgery, especially in the context of renal stone disease[1]. The condition not only poses a critical threat to patient health but also contributes to increased healthcare costs and extended hospital stays.

Early identification and management of risk factors for postoperative infections are paramount in improving patient outcomes. Among these, the microbial colonization of renal stones has been suggested as a potential harbinger for postoperative infectious complications, including urosepsis[2].

Renal stone disease is a prevalent condition worldwide, with a considerable proportion of patients requiring surgical intervention for stone removal. Despite advancements in surgical techniques and perioperative care, the risk of postoperative infection, including urosepsis, remains a concern[3].

The hypothesis that bacteria harbored within renal stones could contribute to postoperative infections has led to increased interest in the utility of renal stone cultures[4].

However, because to advancements in PCNL technology, limits of shockwave lithotripsy, & a rise in kidney stone occurrence, PCNL has become more useful in recent years. PCNL provides higher efficacy, a reduced rate of injuries, less discomfort, & a quicker recovery. However, during the post-PCNL phase, problems such as hemorrhage, urosepsis, systemic inflammatory response syndrome (SIRS), damage to the renal collecting system, & renal failure may occur. Sepsis is the most frequent cause of death after PCNL, despite the fact that death is uncommon. The frequency of infectious complications following PCNL may be influenced by a number of factors[5]. Risk factors for infectious complications following PCNL include female sex, diabetes, preoperative stenting, elevated blood leukocyte, elevated neutrophil-to-

lymphocyte ratio, hydronephrosis, multiple puncture access, positive preoperative urine culture, pyuria, stone infection, stone size, intraoperative lavage rate, positive renal pelvis urine culture (RPUC), positive stone culture (SC), infectious stones, longer operating time, postoperative residual stone, & perioperative blood transfusion[6-7].

MATERIALS AND METHODS

Patients will be recruited after a detailed history & clinical examination according to inclusion criteria. It will be followed by informed consent after a complete description of the study & handover of the patient information document.

Study Design: Prospective study.

Inclusion criteria:-

1. Adults aged 18 years or older of either gender.
2. Patients scheduled for surgical intervention (e.g., percutaneous nephrolithotomy, ureteroscopy, or other relevant procedures) for renal stones.
3. Patient who has given consent.

Exclusion criteria:-

1. Active Urinary Tract Infections (UTI):
2. Immunocompromised Status:
3. Inability to follow up.
4. Patient who has not given consent.

Statistical Analysis Plan Sample size:-

Data will be entered into a Microsoft Excel sheet & analyzed using SPSS SOFTWARE 25.0 (TRIAL VERSION). Continuous data will be expressed in terms of mean & SD or Median .Categorical data will be expressed in the form of proportions & percentages. Appropriate statistical tests like the Fisher's exact test or Chi-square goodness-of-fit test will be done, & a p-value <0.05 will be considered statistically significant.

RESULTS

Table 01: Age Distribution

S. No.	Age Group	No.	Percentage	P Value
1	18-30	05	10	$\chi^2 = 16.40$
2	31-40	14	28	p = 0.00256
3	41-50	16	32	Significant (p < 0.05)
4	51-60	13	26	
5	More than 60	02	04	

The majority of patients were in the 41–50 years (32%) & 31–40 years (28%) age groups, indicating that renal stone disease requiring surgical intervention is most common in middle-aged individuals. Only a small proportion (4%) were above 60 years. The distribution shows a statistically significant variation, suggesting age-related clustering. This may reflect higher metabolic activity & lifestyle factors in this age group.

Table 02: STONE SIZE

S. No.	STONE SIZE	No.	Percentage	P Value
1	05-15	12	24	$\chi^2 = 6.52$
2	16-25	25	50	p = 0.0384
3	26-35	13	26	Significant

Half of the patients (50%) had stone sizes between 16–25 mm, followed by 26% in the 26–35 mm group. Smaller stones (5–15 mm) accounted for 24%. The distribution was statistically significant. This suggests that most patients presented along moderately sized stones requiring intervention.

Table 03: ORGANISM

S. No.	ORGANISM	No.	Percentage	P Value
1	ENTEROCOCCUS SP.	02	04	$\chi^2 \approx 65.1$
2	ESCHERICHIA COLI	04	08	p < 0.00001
3	KLEBSIELLA PNEUMONIAE	03	06	Highly significant
4	N/A	39		
5	PROTEUS MIRABILIS	02	04	

Among positive cultures, the most common organism was Escherichia coli (8%), followed by Klebsiella pneumoniae (6%), Enterococcus species (4%), & Proteus mirabilis (4%). A large proportion (N/A) reflects culture-negative cases. The distribution was highly significant. Gram-negative organisms predominated, consistent along urinary tract infections.

Table 4: POST-OP COMPLICATION

S. No.	POST-OP COMPLICATION	No.	Percentage	P Value
1	URINARY LEAKAGE	02	04	$\chi^2 \approx 13.8$
2	FEVER	07	14	$p \approx 0.008$
3	THORACIC COMPLICATIONS	02	04	Significant
4	BLEEDING	01	02	
5	FEVER along BLEEDING	05	10	

Fever (14%) & fever along bleeding (10%) were the most common complications. Other complications included urinary leakage (4%), thoracic complications (4%), & bleeding (2%). The variation was statistically significant. Infectious complications appear to be the most frequent.

Table 5: READMISSION IN 30 DAYS

S. No.	READMISSION IN 30 DAYS	No.	Percentage	P Value
1	NO	43	86	$\chi^2 \approx 25.9$
2	YES	07	14	$p < 0.00001$
				Highly significant

Readmission within 30 days occurred in 14% of patients, while 86% did not require readmission. The difference was highly significant. This indicates generally good postoperative outcomes. Readmissions may be related to complications such as infection or residual stones.

Table 6: Stone Culture vs. Urosepsis

	Urosepsis Present	Urosepsis Absent	**Total**
Stone Culture Positive	6 (TP)	5 (FP)	**11**
Stone Culture Negative	1 (FN)	38 (TN)	**39**
Total	**7**	**43**	**50**

Abbreviations:
TP = True Positive, FP = False Positive, FN = False Negative, TN = True Negative.

Table 7: Diagnostic Performance of Stone Culture for Predicting Urosepsis

Metric	Value	Interpretation
Sensitivity	85.71%	High – Detects most urosepsis cases
Specificity	88.37%	High – Correctly excludes urosepsis in most non-cases
Positive Predictive Value (PPV)	54.55%	Moderate – Positive result = higher risk, but not diagnostic
Negative Predictive Value (NPV)	97.44%	Very high – Negative result strongly rules out urosepsis
Chi-square (χ^2)	19.26	Statistically significant association
p-value	< 0.0001	Highly significant ($p < 0.001$)

The test's excellent NPV (97.4%) is its strongest clinical asset. In a population with 14% prevalence of urosepsis (7/50), a negative stone culture virtually excludes the diagnosis. The moderate PPV (54.5%) reflects that stone colonization is a risk factor but not sufficient alone to cause urosepsis – host factors, stone obstruction, and bacterial virulence also matter.

DISCUSSION

The most often performed procedure (84%) was percutaneous nephrolithotomy (PCNL), which was followed by ureteroscopy & ESWL. PCNL is regarded as the gold standard for the treatment of big & complicated renal calculi, which is reflected in contemporary clinical practice. The high percentage of PCNL cases in this study suggests that the majority of patients had stones that needed to be removed surgically[8-9].

In terms of stone size, 26% of patients had stones between 26 & 35 mm, while 50% of patients had stones between 16 & 25 mm. This implies that moderate to high stone loads were present in most cases[10]. Bigger stones are known to be linked to longer operating times, a larger chance of leftover pieces, & a higher chance of infectious complications. The risk of postoperative sepsis may be significantly increased by the presence of germs within bigger stones[11].

A subset of patients experienced postoperative complications, the most prevalent of which was fever (14%), followed by fever along bleeding (10%). Urinary leaks, pulmonary problems, & isolated bleeding were further issues[12].

Fever is frequently the first indication of an infection & may be a sign of an inflammatory reaction or underlying bacteremia. Fever & bleeding may indicate more severe surgical injuries or coagulopathy caused by infection[13]. The safety & effectiveness of contemporary surgical methods when carried out in a tertiary care setting are demonstrated by the comparatively low occurrence of serious complications[14].

16% of patients had surgical site infections (SSIs). Despite being comparatively modest, this rate is nonetheless clinically relevant. A number of variables, including as the length of the procedure, comorbidities, & the amount of bacteria in the stone, may have an impact on SSI[15].

Among 50 patients, stone culture was positive in 11 patients; of these, 6 (54.5%) developed urosepsis. Stone culture was negative in 39 patients; of these, only 1 (2.6%) developed urosepsis. The strong negative predictive value (97.4%) confirms that stone culture is most helpful in ruling out urosepsis, while a positive result indicates the need for close monitoring.

CONCLUSION

After renal surgery, renal stone culture is a useful predictor of infectious complications, such as SIRS & urosepsis. Patients who have positive stone cultures are significantly more likely to have a systemic infection. Every patient receiving renal stone surgery should be evaluated for routine stone culture analysis. This can help reduce morbidity related to urosepsis & guide focused antibiotic therapy. In a tertiary care context, early detection & treatment of high-risk patients can greatly enhance patient outcomes.

Stone culture is a valuable predictive tool, particularly for excluding urosepsis with high confidence. A negative result provides strong reassurance, while a positive result warrants vigilance but not immediate diagnosis of urosepsis. Given the statistically significant association ($p < 0.001$), stone culture should be incorporated into perioperative risk stratification for patients undergoing stone removal.

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