

Original Research Article

Comparative evaluation of retrograde intrarenal surgery versus percutaneous nephrolithotomy for 1-2 cm renal calculi: a retrospective comparative study

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ABSTRACT

Background: Renal calculi measuring 1-2 cm presents a therapeutic dilemma between retrograde intrarenal surgery (RIRS) and percutaneous nephrolithotomy (PCNL). The present study aimed to compare clinical outcomes, complications and stone clearance rates between these two modalities.

Methods: This retrospective comparative study was conducted in the Department of Urology and Renal Transplant, JNU Medical College, Jaipur, from January 2025 to January 2026. A total of 250 patients were included, of whom 80 underwent RIRS and 170 underwent PCNL. Demographic variables, stone characteristics, operative outcomes and postoperative complications were analysed.

Results: The stone-free rate was 95.0% in the RIRS group and 98.2% in the PCNL group. Mean operative time was 1.8 hours in the RIRS group compared to 1.3 hours in the PCNL group. Bleeding complications were more common in the PCNL group (28.8%) whereas fever and sepsis were more frequent following RIRS. Hospital stay was similar in both groups.

Conclusions: Both RIRS and PCNL are effective treatment options for intermediate-sized renal calculi. RIRS offers a minimally invasive alternative, whereas PCNL provides superior stone clearance in selected patients.

Keywords: RIRS, PCNL, Renal calculi, Stone-free rate, Urolithiasis

INTRODUCTION

Renal stone disease is a common urological condition with increasing global incidence and recurrence rates.¹ Advances in endourological techniques have significantly improved the management of renal calculi over the last decade.² For renal calculi measuring between 1 and 2 cm, both retrograde intrarenal surgery (RIRS) and percutaneous nephrolithotomy (PCNL) are widely accepted treatment modalities.³ Several studies have reported favorable outcomes with RIRS in terms of reduced postoperative pain, shorter hospital stays and faster recovery.^{4,5} However, PCNL continues to demonstrate superior stone clearance rates, particularly

for larger and anatomically complex stones.⁶ Although multiple comparative studies have been published, the optimal treatment strategy for intermediate-sized renal calculi remains controversial.⁷ Few studies from Indian tertiary care centers have compared real-world outcomes of RIRS and PCNL in this subset of patients.⁸ Therefore, this study was conducted to evaluate and compare the outcomes of RIRS and PCNL in a tertiary care teaching hospital.

METHODS

This retrospective comparative study was conducted at the Department of Urology and Renal Transplant, JNU Medical College, Jaipur, from January 2025 to January

2026. Patients aged 18-60 years with renal calculi measuring 1-2 cm who underwent either RIRS or PCNL were included. Pediatric patients, congenital renal anomalies and staghorn calculi were excluded. A total of 250 patients were included, of whom 80 underwent RIRS and 170 underwent PCNL. RIRS was performed using a flexible ureteroscope with Holmium: YAG laser employing both dusting and fragmentation techniques. DJ stenting was performed in all cases. PCNL was performed using a standard 22 Fr tract with a tubeless approach. Outcome measures included stone-free rate, operative time, hospital stay, postoperative complications and requirement of auxiliary procedures.

Statistical analysis

Continuous variables were expressed as mean values and categorical variables as frequencies and percentages. Data were analyzed using Statistical Package for Social Sciences (SPSS) version 26.0. Categorical variables were compared using Chi-square test. A p value of less than 0.05 was considered statistically significant. The study was approved by the Institutional Ethics Committee. Owing to the retrospective design, informed consent requirement was waived.

RESULTS

A total of 250 patients were included in the study, comprising 80 patients in the RIRS group and 170 patients in the PCNL group (Figure 1). Table 1 presents the demographic characteristics of the study participants. The mean age was 32 years in the RIRS group and 45 years in the PCNL group. Male patients constituted the majority in both groups (66.3% and 63.5%, respectively).

Table 1: Demographic profile of study participants.

Variables	RIRS (n=80)	PCNL (n=170)
Mean age (years)	32	45
Male	53 (66.3%)	108 (63.5%)
Female	27 (33.7%)	62 (36.5%)

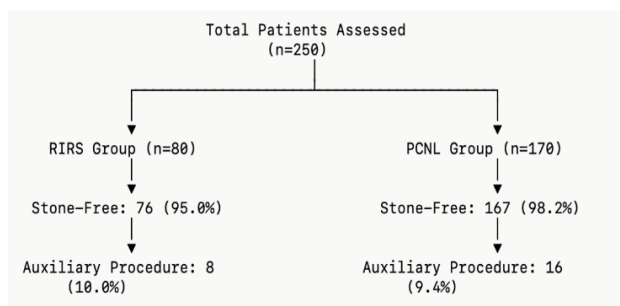


Figure 1: The flow of study participants and their allocation to the RIRS and PCNL groups.

Table 2 summarizes the clinical characteristics of renal calculi. The mean stone size was 11 mm in the RIRS

group compared with 17 mm in the PCNL group. Renal pelvic stones were the most common stone location in both groups.

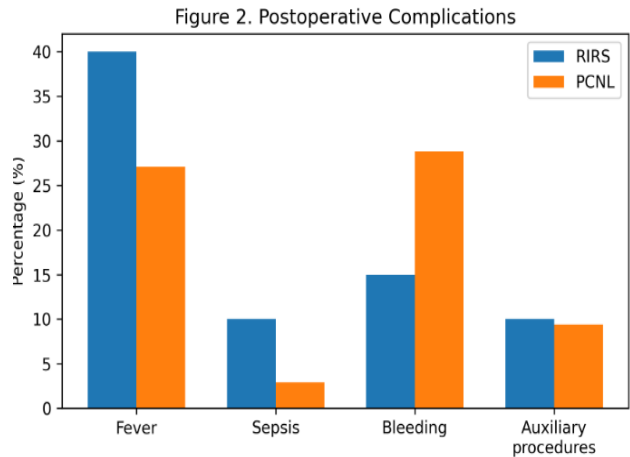


Figure 2: The distribution of postoperative complications, showing higher rates of fever and sepsis following RIRS, whereas bleeding complications were more frequent after PCNL.

Table 2: Clinical characteristics of renal calculi.

Variables	RIRS (n=80)	PCNL (n=170)
Mean stone size (mm)	11	17
Renal pelvis stones	49 (61.3%)	92 (54.1%)
Middle calyx stones	21 (26.3%)	23 (13.5%)
Lower calyx stones	12 (15.0%)	42 (24.7%)
Multiple calyceal stones	3 (3.8%)	13 (7.6%)

*Some patients had stones involving more than one calyceal location; therefore, percentages may exceed 100%.

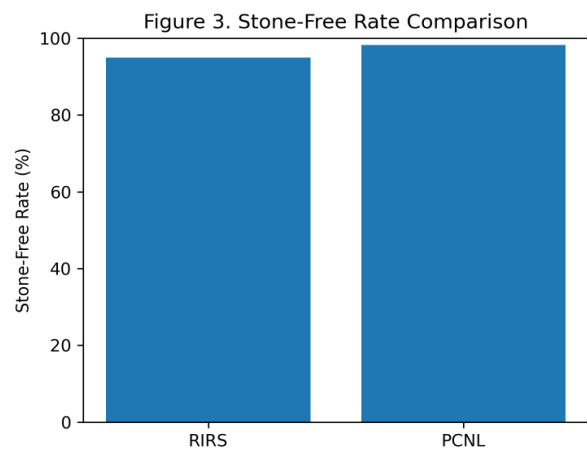


Figure 3: PCNL achieved a slightly higher stone-free rate (98.2%) than RIRS (95.0%).

Table 3: Operative outcomes and complications.

Variables	RIRS (n=80)	PCNL (n=170)
Stone-free rate	76 (95.0%)	167 (98.2%)
Operative time (hours)	1.8	1.3
Hospital stays (days)	3	3
Fever	32 (40%)	46 (27.1%)
Sepsis	8 (10%)	5 (2.9%)
Bleeding	12 (15%)	49 (28.8%)
Auxiliary procedures	8 (10%)	16 (9.4%)

Table 3 demonstrates the operative outcomes and postoperative complications. The stone-free rate was 95.0% following RIRS and 98.2% following PCNL. Operative time was longer in the RIRS group (1.8 hours) than in the PCNL group (1.3 hours), whereas the hospital stay was similar in both groups. Fever and sepsis occurred more frequently after RIRS, while bleeding complications were more common after PCNL.

DISCUSSION

The management of renal calculi measuring 1–2 cm remains a topic of considerable debate in contemporary endourology. Both RIRS and PCNL have established roles in the treatment of intermediate-sized renal stones.¹

In the present study, the stone-free rate was 95.0% in the RIRS group and 98.2% in the PCNL group. Similar findings have been reported by Akman et al and De et al who demonstrated higher stone-free rates with PCNL compared with RIRS, particularly in patients with larger stone burdens.^{9,10} The mean operative time in our study was 1.8 hours for RIRS and 1.3 hours for PCNL. Breda et al. reported longer operative duration for RIRS owing to the need for complete laser fragmentation and retrieval of stone fragments.¹¹

Hospital stay was similar in both groups. Previous studies have reported shorter hospitalization after RIRS; however, institutional discharge protocols and postoperative observation practices may influence length of stay.^{10,12}

Postoperative fever and sepsis were more common following RIRS. Elevated intrarenal pressure during flexible ureteroscopy has been implicated in infectious complications following RIRS.^{13,14}

Bleeding complications were more common following PCNL, which is consistent with previous reports describing hemorrhage as a recognized complication of renal puncture and tract dilatation.¹⁵ No patient in our study required blood transfusion.

Auxiliary procedures were required in a similar proportion of patients in both groups. These findings

support previous studies demonstrating that both modalities provide satisfactory outcomes for intermediate-sized renal calculi.

Overall, both RIRS and PCNL are effective treatment options. Treatment selection should be individualized according to stone characteristics, patient factors and surgeon expertise.

Limitations

The retrospective design may introduce selection bias. This was a single-center study, limiting generalizability. Stone-free status was assessed using X-ray KUB rather than computed tomography. Long-term recurrence data were not available.

CONCLUSION

Both RIRS and PCNL are effective treatment modalities for intermediate-sized renal calculi. RIRS offers a minimally invasive approach, whereas PCNL provides slightly higher stone-free rates. Treatment decisions should be individualized according to stone burden, anatomy and patient preference.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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