

COMPARISON OF MEAN OPERATIVE TIME IN PERCUTANEOUS NEPHROLITHOTOMY AND RETROGRADE INTRARENAL SURGERY FOR RENAL STONES >2 CM: A SINGLE-CENTER EXPERIENCE

Husnain Hamza Tariq^{*1}, Durre Shahab², Adnan Khan³, Danish Gul⁴, Faizan Ali⁵, Saeed Akhter⁶

^{*1,4,5}MBBS, PG-Urology, Department of Renal Transplant and Urology, PAF Hospital, Islamabad

²MBBS/FCPS/FRCS, Consultant Urology, Department of Renal Transplant and Urology, PAF Hospital, Islamabad

³MBBS/FCPS-Gen Surg, PG-Urology, Department of Renal Transplant and Urology, PAF Hospital, Islamabad

⁶MBBS, MD, American Diplomat, Professor and HOD of Department of Renal Transplant and Urology, PAF Hospital, Islamabad

^{*1}husnainhamza771@gmail.com

DOI: <https://doi.org/10.5281/zenodo.17129484>

Keywords

Article History

Received: 20 May 2025

Accepted: 21 June 2025

Published: 07 July 2025

Copyright @Author

Corresponding Author: *
Husnain Hamza Tariq

Abstract

Background: Urolithiasis is a common condition with high prevalence in Pakistan, which lies in the Stone Belt. For renal stones larger than 2 cm, percutaneous nephrolithotomy (PCNL) has been the standard treatment, though retrograde intrarenal surgery (RIRS) has recently emerged as a minimally invasive alternative with advances in endourology.

Objectives: To compare operative time, stone clearance, hospital stay, transfusion requirements, and need for additional procedures between PCNL and RIRS in patients with renal stones >2 cm.

Study design: Cross-sectional study.

Settings & Study duration: Urology Department, PAF Hospital Islamabad from 18th February 2025 to 18th May 2025.

Methods: A total of 139 patients with renal stones >2 cm were included after informed consent and preoperative evaluation. Patients opted for either PCNL (Group 1) or RIRS (Group 2). Demographics, stone characteristics, operative time, hospital stay, hemoglobin drop, blood transfusion, stone clearance, ICU stay, and need for additional procedures were recorded on a structured proforma. Statistical analysis was performed using SPSS v23, with $p \leq 0.05$ considered significant.

Results: Of 139 patients, 62 underwent PCNL and 77 underwent RIRS. Mean operative time was significantly lower in RIRS compared to PCNL (152.51 ± 36.46 vs 179.89 ± 45.56 min, $p=0.0001$). Hospital stay was also shorter in the RIRS group (2.30 ± 1.08 vs 2.69 ± 1.02 days, $p=0.027$). Stone clearance, need for additional procedures, and blood transfusion rates showed no statistically significant difference between groups.

Conclusion: RIRS offers significantly shorter operative time and hospital stay compared to PCNL for renal stones >2 cm, with comparable outcomes in terms of stone clearance and complication rates. It may be considered a minimally invasive alternative in selected patients.

Keywords: Urolithiasis, Percutaneous nephrolithotomy, Retrograde

intrarenal surgery, Renal stones, Operative time

INTRODUCTION

Urolithiasis is an existing illness affecting all age groups across global population¹. Due to location of Pakistan in the Stone Belt, kidney stone disease is highly prevalent with average prevalence of 2.8%. This high prevalence and lifetime risk of recurrence of renal stones (10-75%), this condition imposes a significant burden on healthcare infrastructure². Modern innovative industry, endoscopic instruments advancements and miniaturization has simplified the interventional planning for carrying out these procedures for renal stones¹. Since its introduction, percutaneous nephrolithotomy has almost completely replaced open surgery for kidney stones management³. In today's era, it has become the procedure of choice for large (>2cm) stones³.

However, with the recent technological developments in endourology, retrograde intrarenal surgery (RIRS) has also emerged as a very proficient method for treatment of nephrolithiasis⁴. Likewise, since the dawn of new laser systems and advanced flexible ureteroscopy with small-sized ureteroscopes, RIRS has expanded its limit to the treatment of kidney stones larger than 2 cm.⁵ Both procedures are extensively compared for different aspects like stone clearance, invasiveness, Safety, hospital stay, operative time with most of the results showing PCNL has a better stone free rates than RIRS but longer hospital stay, and a higher hemoglobin drop that does not translate into higher transfusion rates. Complications are comparable⁴.

Also there are wide variations in reported operative time for both groups. Iqbal et al reported a mean operative time of 151.26±105 minutes during PCNL for stone size more than 2 cm¹ while wishahi et al reported operative time of 72.1 ± 14.9⁶ for PCNL. Youldas et al reported mean operative of 57.65 ± 11.56 min⁷ whereas et al reported operative time to be 124.8±24.17 min in patients undergoing RIRS⁸.

We have compared the two modalities for operative time, stone clearance, ICU and hospital

stay, number of blood transfusion, drop in hemoglobin and need for additional procedure.

PATIENTS AND METHODS

The study was conducted after the approval of ethical committee at Urology Department, PAF Hospital Islamabad from 18th February 2025 to 18th May 2025. All the patients presenting to urology clinic with renal stones > 2cm undergoing PCNL or RIRS were included in the study after detailed history and clinical examination. Urine analysis and culture, renal function tests, CT scan of kidney and bladder without contrast, complete blood count, and coagulation profile pre-anesthesia workup were done in all patients. Patients were counseled in detail regarding the pros and cons of PCNL as well as retrograde intrarenal surgery and were given options to opt for either procedure. All patients were divided in two groups by based on patient's choice. Group 1 included patients undergoing PCNL and group 2 included patients undergoing RIRS. All procedures (PCNL/RIRS) were done by consultant urologists at PAF Hospital Islamabad under general anesthesia in prone/lithotomy position.

Operative time was recorded from the start of cystoscopy to the end of the double-J stent. Stone clearance was defined as no residual fragment requiring additional procedure confirmed on CT-scan, X-ray KUB or ultrasound at three weeks time, hospital stay was defined as Total number days starting from to the day of surgery to the day of discharge. Number of blood transfusion and need for additional procedure were also recorded. Information about patients' age, sex, stone size, stone location, co morbidities, stone hardness,, hospital stay, operative time ,ICU stay , Number of blood transfusion and need for additional procedure were recorded on specifically designed proforma All procedures were followed by principle investigator.

The SPSS version 23 was used for statistical analysis and descriptive statistics was calculated for both qualitative and quantitative variables.

Frequency percentage was calculated for qualitative variables like gender, side, location, need for additional procedure and stone clearance in each group. Mean $\pm$ SD was calculated for quantitative variables like age, stone size, operative time, hospital and ICU stay, number of blood transfusion and need for additional procedure. Effect modifiers like age, gender, size, location were controlled by stratification. P-value $\leq$ 0.05 will be considered significant.

RESULTS:

A total of 139 patients with mean age of 43.71 ± 14.04 Years including 89 males and 50 females were included in study. Mean stone size was 3.22 ± 1.04 cm while renal pelvis was the most common stone location (table-1) Seventy seven of 139 patients under went RIRS with

mean age of 43.52 ± 14.05 Yr and mean stone size of 2.64 ± 0.48 cm while 62 patients underwent PCNL with mean age of 43.9 ± 14.5 Years and mean stone size of 3.05 ± 1.81 cm (table-1).Renal pelvis was most common location in both groups while staghorn stones were mostly seen in PCNL group.

Coming to the comparison , the RIRS group has statistically significant lesser operative time compared to PCNL group (152.51 ± 36.46 mins vs 179.89 ± 45.56 mins, p-value 0.0001).Also the hospital stay was much lesser in RIRS group compared to PCNL group (2.69 ± 1.02 vs 2.298 ± 1.08 days , p-value 0.02). There was no statistically significant difference with respect to Stone clearance, need for additional procedures in either group (table-2).

Table 1: Baseline Characteristics of Study Population (n = 139)

Variable	Total (n=139)	PCNL (n=62)	RIRS (n=77)
Gender			
Male	89 (64.0%)	42 (67.7%)	47 (61.0%)
Female	50 (36.0%)	20 (32.3%)	30 (39.0%)
Mean Age (years)	43.71 ± 14.04	43.9 ± 14.5	43.52 ± 14.05
Mean Stone Size (cm)	3.22 ± 1.04	3.05 ± 1.81	2.64 ± 0.48
Stone Location			
Upper pole	3 (2.2%)	0 (0%)	3 (3.9%)
Pelvic	51 (36.7%)	21 (33.9%)	30 (39.0%)
Mid pole	2 (1.4%)	0 (0%)	2 (2.6%)
Lower pole	22 (15.8%)	10 (16.1%)	12 (15.6%)
Multiple stones	34 (24.5%)	8 (12.9%)	26 (33.8%)
Staghorn stones	27 (19.4%)	23 (37.1%)	4 (5.2%)

Table 2: Comparison of Surgical Outcomes Between PCNL and RIRS

Outcome Variable	PCNL (n=62)	RIRS (n=77)	p-value
Mean Operative Time (min)	179.89 ± 45.56	152.51 ± 36.46	0.0001
Mean Hospital Stay (days)	2.69 ± 1.02	2.30 ± 1.08	0.0277
Stone Clearance	44 (71.0%)	47 (61.0%)	0.221
Blood Transfusions Required	9 (14.5%)	10 (13.0%)	0.794
Additional Procedures Needed	17 (27.4%)	27 (35.1%)	0.335

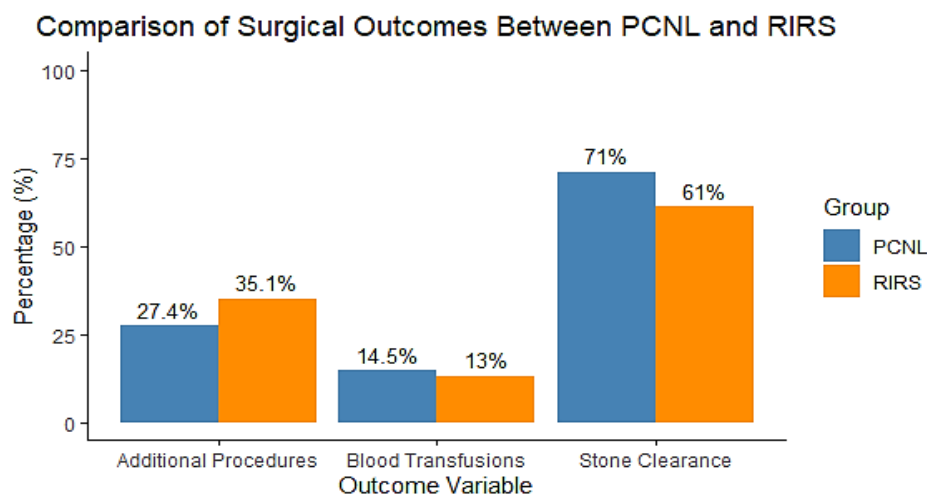


Figure 1: Comparison of Surgical Outcomes Between PCNL and RIRS

DISCUSSION

Both PCNL and RIRS are commonly used modalities for treatment of renal stones, RIRS being the newer modality and being less invasive is getting more and more popular. Palermo Marti JL et al reported similar success rate to in stones >2cm with lower low complication rate, faster recovery and shorter hospital stay making RIRS as alternative PCNL in majority of cases ⁹.

Many studies have compared PCNL and RIRS with respect to operative time hospital stay, stone clearance and complications. Akman T et al reported compared patients with renal stone in size of 2-4 cm and found better stone free rates in PCNL group after one session (73.5% and 91.2% for RIRS and PCNL respectively, $P=0.05$), shorter operation time in PCNL group (58.2 ($\pm$) 13.4 min vs 38.7 ($\pm$) 11.6 min for RIRS and PCNL respectively, $P < 0.0001$), more Blood transfusions and higher Overall complication rates in the PCNL group, but the differences were not statistically significant. Hospital stay was significantly shorter in the RIRS group (30.0 + 37.4 vs 61.4 + 34.0 h, respectively; $P < 0.001$) ¹⁰.

Jiang K et al in there meta-analysis reviewed PCNL versus RIRS in patient with solitary kidney for stone size > 2cm and found better stone free rates in PCNL group, more steinstrasse but lesser blood loss in RIRS group, while operative time and complication were similar in both groups ¹¹. Shi X et al compared the evaluate the clinical

efficacy and safety of retrograde RIRS and PCNL in stones greater than 2 cm and found better stone clearance (74.42% vs 34.88%, $p < 0.001$) and lower need for additional procedure (16.28% vs 63.79%, $p < 0.001$) in PCNL versus RIRS group ¹².

Palermo JL et al in there comparison of PCNL versus RIRS reported better stone free rates (80.6% vs. 73.6%) in PCNL group however results were not statistically significant along with shorter operative time (85 vs 112 minutes). RIRS has significantly shorter hospital stay (16 h vs. 98 h) and lower complication rate (19.4% vs. 6.6%, $p=0.001$) ¹³. Bozkurt OF et al in their study in patients with stone size from 15-20 mm RIRS and PCNL were comparable with respect to stone free rates, need for additional procedure while patients undergoing PCNL need more blood transfusions ¹⁴. Zhang Y et found similar results as already documented in for-mentioned literature with PCNL achieving higher higher 1-session stone-free rate while RIRS has lesser bleeding and shorter postoperative hospital stay ¹⁵.

Our results are very much similar with a few differences with published literature. Our operative time was much lesser in RIRS group (152.51 $\pm$ 36.46 mins vs 179.89 $\pm$ 45.56 mins, p -value 0.0001) contrary above mentioned studies. Betterment in instruments and techniques could possibly be one cause while

presence of more staghorn stones in PCNL group can be another reason for this finding. Hospital stay was much lesser in RIRS group compared to PCNL group (2.69 ± 1.02 vs 2.298 ± 1.08 days, p-value 0.02) which is consistent with already published literature. While most of the published literature cited better stone clearance and lesser need for additional procedure in PCNL, our study demonstrate slightly better but no statistically significant difference in two groups. Again slightly bigger stone size and more staghorn stones in PCNL group can be possible reason.

We recommend new and better designed studies as technique and equipment of RIRS has undergone many refinements like continuous aspiration access sheaths, better scopes and laser systems. RIRS could be a better substitute for PCNL in selected patients. PCNL will still be the procedure of choice for stagehorn and complex renal stones.

Conclusion

There is statistically significant difference in PCNL and RIRS with respect to stone clearance, blood transfusion and need for additional procedures. RIRS has shorter hospital stay and operative time

REFERENCES

- Iqbal N, Iqbal S, Hasan A, Majeed M, Iqbal D, Shahzad M et al. Outcomes Of Percutaneous Nephrolithotomy In Elder Age Patients-Single Center Experience. J Ayub Med Coll Abbottabad. 2021 Apr-Jun;33(2):217-221
- Waqas M, Khan ZA, Ahmad S, Akbar S, Khalid N. Risk Factors of Kidney Stones in Khyber Pakhtunkhwa, Pakistan: A Descriptive Cross-Sectional Study. Cureus. 2024 Jun 24;16(6)
- Iqbal N, Iqbal S, Hasan A, Iqbal A, Blair KAA, Milstein DMJ, Akhter S. Outcome of tubeless percutaneous nephrolithotomy in elder patients: A single-center experience from a developing country. J Clin Transl Res. 2022;8(2):160-165.
- Dorantes-Carrillo LA, Basulto-Martínez M, Suárez-Ibarrola R, Heinze A, Proietti S, Flores-Tapia JP, Esqueda-Mendoza A, Giusti G. Retrograde Intrarenal Surgery Versus Miniaturized Percutaneous Nephrolithotomy for Kidney Stones >1cm: A Systematic Review and Meta-analysis of Randomized Trials. Eur Urol Focus. 2022 Jan;8(1):259-270
- Inoue T, Okada S, Hamamoto S, Fujisawa M. Retrograde intrarenal surgery: Past, present, and future. Invest Clin Urol. 2021;62(2):121-135.
- Wishahi M, El Feel A, Elkhoully A, Fahmy A, Roshdy M, Elbaz AG et al. Concerns about stone free rate and procedure events of percutaneous nephrolithotripsy (PCNL) for 2-4 cm kidney stones by standard-PCNL vs mini-PCNL-comparative randomised study. BMC Urol. 2023 ;23(1):96
- Yoldas M, Yoldas TK. Spinal versus general anesthesia in retrograde intrarenal surgery. Arch Ital Urol Androl. 2022;94(2):195-198.
- Joshi R. Early experience of Retrograde Intrarenal Surgery for Renal stone: A Descriptive Cross-sectional Study. J Nepal Med Assoc. 2020;58(227):465-469
- Palmero Martí JL, Ganau Ituren A, Valls González L. Resultados actuales de la CRIR y comparación con NLPC [Current results of RIRS and comparison with PCNL]. Arch Esp Urol. 2017 Jan;70(1):147-154
- Akman T, Binbay M, Ozgor F, Ugurlu M, Tekinarslan E, Kezer C, Aslan R, Muslumanoglu AY. Comparison of percutaneous nephrolithotomy and retrograde flexible nephrolithotripsy for the management of 2-4 cm stones: a matched-pair analysis. BJU Int. 2012 May;109(9):1384-9

- Jiang K, Zhang P, Xu B, Luo G, Hu J, Zhu J, Sun F. Percutaneous Nephrolithotomy vs. Retrograde Intrarenal Surgery for Renal Stones Larger than 2cm in Patients with a Solitary Kidney: A Systematic Review and a Meta-Analysis. *Urol J.* 2020 Jul 28;17(5):442-448
- Shi X, Peng Y, Li X, Wang Q, Li L, Liu M, Gao X, Sun Y. Propensity Score-Matched Analysis Comparing Retrograde Intrarenal Surgery with Percutaneous Nephrolithotomy for Large Stones in Patients with a Solitary Kidney. *J Endourol.* 2018 Mar;32(3):198-204.
- Palmero JL, Durán-Rivera AJ, Miralles J, Pastor JC, Benedicto A. Comparative study for the efficacy and safety of percutaneous nephrolithotomy (PCNL) and retrograde intrarenal surgery (RIRS) for the treatment of 2-3,5 cm kidney stones. *Arch Esp Urol.* 2016 Mar;69(2):67-72
- Bozkurt OF, Resorlu B, Yildiz Y, Can CE, Unsal A. Retrograde intrarenal surgery versus percutaneous nephrolithotomy in the management of lower-pole renal stones with a diameter of 15 to 20 mm. *J Endourol.* 2011 Jul;25(7):1131-5.
- Zhang Y, Wu Y, Li J, Zhang G. Comparison of Percutaneous Nephrolithotomy and Retrograde Intrarenal Surgery for the Treatment of Lower Calyceal Calculi of 2-3 cm in Patients With Solitary Kidney. *Urology.* 2018 May;115:65-70.

