

## PERCUTANEOUS NEPHROLITHOTOMY AND RETROGRADE INTRARENAL SURGERY FOR TREATMENT OF RENAL STONE SIZE BETWEEN 1.0 CM AND 2.5 CM: A COMPARATIVE STUDY

VISHWAS BAHETI<sup>1\*</sup>, PANKAJ TRIVEDI<sup>1</sup>, UDAY DOBARIA<sup>2</sup>, FATEH SINGH MEHTA<sup>3</sup>

<sup>1</sup>Department of Urology, Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India. <sup>2</sup>Department of Surgery, HCG Hospital, Ahmedabad, Gujarat, India. <sup>3</sup>Department of Surgery, Geetanjali University, Udaipur, Rajasthan, India. Email: vishwas.baheti@gmail.com

Received: 12 July 2022, Revised and Accepted: 31 August 2022

### ABSTRACT

**Objectives:** The objectives of this study were to evaluate the efficacy and safety of retrograde intrarenal surgery (RIRS) and percutaneous nephrolithotomy (PCNL) in treatment of renal stone size between 1 cm and 2.5 cm.

**Methods:** This comparative prospective study was conducted in the Department of Urology of a tertiary care teaching hospital of Rajasthan from January 2019 to June 2020. Patients were fully informed about the study protocol and a written informed consent has obtained from patients with renal stone disease without any comorbid conditions, posted for RIRS, and PCNL. Stone free rate, post-operative complications, hospital stay, operation time, and cost between RIRS and PCNL for treatment of renal stone size between 1 and 2.5 cm were compared.

**Results:** Out of total 313 patients, 212 patients underwent PCNL and 101 patients RIRS. The stone clearance rate was significantly better in PCNL (92.45%) than RIRS (85.15%). The hospital stay was significantly less in RIRS (2.02±1.36 days) when compared to PCNL (3.89±2.18 days). Mean operative time for PCNL was significantly less, that is, 71.81±12.89 min as compared to 85.79±13.94 min in RIRS. Post-operative complications were more in PCNL group than RIRS.

**Conclusions:** This study concluded that PCNL when compared to RIRS both have advantages and disadvantages according to size and location of stone, post-operative complications, stone free rate, and operation cost. Judicious use of PCNL and RIRS should be done according to above-mentioned parameters.

**Keywords:** Retrograde intrarenal surgery, Percutaneous nephrolithotomy, Shock wave lithotripsy, Renal stone.

© 2022 The Authors. Published by Innovare Academic Sciences Pvt Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>) DOI: <http://dx.doi.org/10.22159/ajpcr.2022v15i12.45813>. Journal homepage: <https://innovareacademics.in/journals/index.php/ajpcr>

### INTRODUCTION

Kidney stones are hard deposits of minerals and salts that form inside kidneys. Calcium, struvite, uric acid, and cystine stones are different types of renal stone found in kidneys. Shock wave lithotripsy (SWL), retrograde intrarenal surgery (RIRS), percutaneous nephrolithotomy (PCNL), mini perc, and ultra-tiny PCNL are some of the therapeutic techniques used for renal stones [1,2].

RIRS is a reliable and efficient treatment for patients with obesity, musculoskeletal deformities, renoureteral malformations, infundibular stenosis, bleeding disorders, in whom other treatment options are insufficient [1]. RIRS has become a viable alternative therapy for the treatment of renal calculi in recent years. Now that, ureteroscopy technology has advanced, calculi at almost all urinary tract locations can be accessed without restriction [3]. There are known indications for ureteroscopy, including unsuccessful SWL and incapacity to undergo SWL due to pregnancy, coagulopathy, or morbid obesity [4]. The stone clearance rate for renal stones <2 cm for RIRS is better than that for SWL as a primary procedure, and a good clearance rate is also achieved following the failure of SWL.

PCNL which is based on the creation of a suitable percutaneous renal access, dilation of this tract, and fragmentation and elimination of the stone fragments using the nephroscope through an access sheath, is a good technique for the treatment of stone in all age groups. PCNL has become the preferred treatment, especially in cases of complex, large staghorn calculi, since the first successful stone removal was performed by a nephrostomy in 1976 [5]. Nowadays, except for the situations including contraindications for general anesthesia, anticoagulant therapy, untreated urinary tract infection, atypical bowel interposition, potential malignant kidney tumor, and pregnancy, PCNL has become a

standard modality in the treatment of kidney stones that are larger than 2 cm in diameter and that do not respond to extracorporeal SWL [6].

RIRS and PCNL are two popular and commonly used alternative techniques for the treatment of renal stones. Over the past 20 years, flexible ureteroscopy by RIRS has been a preferred method for the treatment of renal stones [7]. Due to its high stone-free rates, PCNL is recommended as the preferable treatment for renal stones larger than 2 cm in diameter in the 2014 Urolithiasis Guideline of the European Association of Urology [8]. This study was planned to evaluate and compare the efficacy and safety of RIRS and PCNL in treatment of renal stone size between 1 cm and 2.5 cm.

### METHODS

This comparative prospective study was conducted in the Department of Urology of a tertiary care teaching hospital of Rajasthan Udaipur from January 2019 to December 2020. All patients who were admitted in urosurgical wards and diagnosed as renal stone disease were taken in this study. Ethical approval was obtained from the Institutional Ethics Committee before commencement of the study. Patients were informed about the study protocol and informed consent was taken from all the patients with renal stone disease without any comorbid conditions, posted for RIRS, and PCNL. Patients with complete investigations X-ray KUB, USG KUB, and IVP/CECT-KUB with CT urography reports were included in the study. All patients of age <10 years and with bilateral renal stones and stone size >2.5 cm RIRS and stone size <1.0 cm PCNL were exclude out.

### RIRS

Painting and draping was done in lithotomy position. 17.5 F cystoscopy sheath and 30° telescope were used for cystourethroscopy. Meatus,

urethra, prostatic urethra, bladder neck, bladder, and bilateral ureteric orifice were checked. Right/left ureteric orifice was cannulized and guide wire was placed up to pelvicalyceal system (PCS). Semirigid ureteroscopy was advanced up to PCS. Ureteral access sheath was introduced over guide wire under fluoroscopy just below the pelviuretric junction. Stylet was removed. STORZ FLEX X2 flexible ureteroscopy was loaded over guide wire and advanced up to PCS. Guide wire was removed. Calyceal system was inspected. Stone was located and dusting done using 200-micron fiber with Holmium laser 20 watt on dusting mode. All calyceal system inspected and fluoroscopically seen for residual stone. Ureteroscopy removed. Access sheath removed. Foley's catheter was kept.

#### PCNL

Painting and draping were done in lithotomy position. 17.5 F cystoscopy sheath and 30-degree telescope were used for cystourethroscopy. Meatus, urethra, prostatic urethra, bladder neck, bladder, and bilateral ureteric orifice were checked. Right/left ureteric orifice was cannulized and guide wire was placed up to PCS. Ureteric catheter advanced up to PCS. Guide wire was removed. Foley's catheter kept into bladder and ureteric catheter tide to it. The patient was asked to turn prone with all precautions. Bolsters placed, one under lower chest, and one under pelvis. Hands and legs padded and well supported. PCNL drape was applied over desired area. Air/contrast was pushed gently from ureteric catheter. PCS delineated and posterior/superior/middle/inferior calyx puncture was done under fluoroscopy guidance. Over guide wire telescopic metallic dilator used to dilate tract up to 18F. 18F Amplatz sheath placed into PCS. Nephroscope was used. Stone fragmented using laser lithotripter. All stone fragments were removed. Complete clearance assured nephroscopically and fluoroscopically. Nephrostomy was placed and Amplatz was removed.

#### Sample size

Sample size of 50 or more patients in each group was sufficient as per formula  $(n = \frac{Z^2 \alpha/2 + Z\beta)^2 p(1-p)}{E^2}$ , where confidence level of 95% and power of study 80% was considered. Proportion of no biases considered that in 50% with allowable error of 20%, but all patients during the study period were included in the study, which accounted to total 313 patients.

Stone free rate, post-operative complications, hospital stay, operation time, and cost between RIRS and PCNL for treatment of renal stone size between 1 cm and 2.5 cm were compared.

#### Statistical analysis

The data were recorded in Microsoft Office Excel 2010. The data were compiled and statistically analyzed. Analysis of data was done on the basis of inferential statistics and descriptive statistics whatever was required to fulfill the objective. Categorical variables were summarized as frequency and percentage and were analyzed using the Chi-square test. Continuous variables were summarized as mean and standard deviation and were analyzed using the t-test.  $p < 0.05$  was taken as statistically significant.

#### RESULTS

Maximum cases were male in both the groups, that is, 65.09% and 63.37%, respectively, in PCNL and RIRS group. Maximum number of cases belonged to the 30–49 years of age group. Maximum number of stone size of 1.5–1.9 cm was found radiologically USG in both the groups (Table 1).

The residual stones were found in 7.55% patients in PCNL group and 14.85% in RIRS group on follow-up x-ray (KUB) and USG (KUB). Hence, stone clearance rate in PCNL group was significantly higher, that is, 92.45% as compared to RIRS group, in which it was 85.15% ( $p = 0.043$ ).

Mean operative time for PCNL was  $71.81 \pm 12.89$  min as compared to  $85.79 \pm 13.94$  min in RIRS. This difference was statistically significant ( $p < 0.001$ ). Mean hospital stay was seen less in RIRS procedure

**Table 1: Comparison of baseline data of patients and stone characteristics in both the groups**

Parameters	PCNL (n=212) (%)	RIRS (n=101) (%)	p-value
Sex			
Male	138 (65.09)	64 (63.37)	>0.05
Female	74 (34.91)	37 (36.63)	
Age group (years)			
<10	7 (3.30)	0	>0.05
10–29	47 (22.17)	25 (24.75)	
30–49	86 (40.57)	39 (38.61)	
50–69	63 (29.72)	33 (32.67)	
70–90	9 (4.25)	4 (3.96)	
Side involved			
Left side	94 (44.34)	49 (48.51)	0.48
Right side	118 (55.66)	52 (51.49)	
Stone size (cm)			
1–1.4	43 (20.28)	29 (28.71)	0.25
1.5–1.9	159 (75.00)	68 (67.33)	
2–2.5	10 (4.72)	4 (3.96)	

PCNL: Percutaneous nephrolithotomy, RIRS: Retrograde intrarenal surgery

( $2.02 \pm 1.36$  days) as compared to PCNL ( $3.89 \pm 2.18$  days). This difference was also statistically significant ( $p < 0.001$ ). Mean operative cost for PCNL group was around Rs. 35786.50±4796.89 and Rs. 75645.00±5142.62 for RIRS group. This difference was also statistically significant ( $p < 0.001$ ) (Table 2).

Pain was seen in 12.74%, fever in 4.25% and bleeding in 7.55% cases of PCNL group and in RIRS group pain was in 2.97%, fever in 9.90%, and bleeding in 0.99% cases. p value was significant for pain and bleeding. Blood transfusion was done in 3.77% patients in PCNL group and none in RIRS group, which was statistically significant. Infection and sepsis were seen in 1.89% cases of PCNL group and in 4.95% patient of RIRS group (Table 3).

#### DISCUSSION

For medium-sized stones with good stone-free rates, RIRS can be a useful solution. According to some research, RIRS is an effective treatment for larger-sized stones [1]. Many studies have concluded that multisession RIRS can produce satisfactory results with little morbidity when compared to PCNL for 2–4 cm kidney stones [9], and as a result, RIRS may be utilized as a substitute for PCNL. This study was done to evaluate and compare RIRS and PCNL for renal stones size 1.0 cm–2.5 cm.

Both the groups were demographically similar and there was no significant difference for stone size and side of involvement. In the present study, stone clearance rate in PCNL group (92.45%) was significantly more than RIRS group (85.14%). Various other studies have also reported similar results such as Koyuncu *et al.* (96.1% and 90.6%), Akman *et al.* (91.2% and 73.5%), Karakoc *et al.* (91.8% and 66.6%), Zengin *et al.* (95.5% and 80.6%), and Srivastava and Chipde (92.8% and 89.2%), respectively, in PCNL and RIRS groups [4,10-13]. It is clearly evident that stone clearance rates of PCNL are better than RIRS procedure. The stone clearance rate of RIRS group when compared to other studies was also found better in the present study due to routine use of DJ stent in present study.

In the present study, the mean operative time in PCNL group was significantly less, that is,  $71.81 \pm 12.89$  min as compared to RIRS group, in which it was  $85.79 \pm 13.94$  min. Karakoc *et al.* reported that the duration of surgery was  $75.55 \pm 21.5$  min for PCNL and  $100.26 \pm 33.26$  min for RIRS [12]. The mean operative times for the RIRS and PCNL groups were  $58.2 \pm 13.4$  min and  $38.7 \pm 11.6$  min, respectively, in Akman *et al.* [11] Koyuncu *et al.*, in their study, showed that operative time in PCNL group was  $62.5 \pm 20.67$  min, and in RIRS group, it was  $67.5 \pm 22.34$  min [10]. On the other hand, the operative time of both surgeries (PCNL and RIRS) in the present study was parallel with those documented in other research done by many authors.

Table 2: Comparison of stone clearance and other characteristics in both the groups

Operative characteristics	PCNL (n=212)	RIRS (n=101)	p-value
Stone after surgery			
Present	16 (7.55%)	15 (14.85%)	0.043*
Absent	196 (92.45%)	86 (85.15%)	
Operative time (minutes)	71.81±12.89	85.79±13.94	<0.001*
Double "J" stenting	140 (66.04%)	97 (96.04%)	<0.001*
Hospital stay (days)	3.89±2.18	2.02±1.36	<0.001*
Cost of operations (Rupees)	35786.50±4796.89	75645.00±5142.62	<0.001*

\*significant, PCNL: Percutaneous nephrolithotomy, RIRS: Retrograde intrarenal surgery

Table 3: Comparison of post-operative parameters in both the groups

Post-operative parameters	PCNL (n=212) (%)	RIRS (n=101) (%)	p-value
X-ray findings			
Present	20 (9.43)	19 (18.81)	0.01*
Absent	192 (90.57)	82 (81.19)	
Pain at discharge			
Present	27 (12.74)	3 (2.97)	0.006*
Absent	185 (87.26)	98 (97.03)	
Fever			
Present	9 (4.25)	10 (9.90)	0.07
Absent	203 (95.75)	91 (90.10)	
Bleeding			
Present	16 (7.55)	1 (0.99)	0.01*
Absent	196 (92.45)	100 (99.01)	
Blood transfusion			
Present	8 (3.775)	0	0.04*
Absent	204 (96.235)	101 (100)	
Infection and sepsis			
Present	4 (1.89)	5 (4.95)	0.13
Absent	208 (98.11)	96 (95.05)	

\*significant, PCNL: Percutaneous nephrolithotomy, RIRS: Retrograde intrarenal surgery

In the present study, mean hospital stay was seen significantly less in RIRS procedure, 2 days as compared to PCNL, 4 days. In a study by Karakoc *et al.*, mean hospital stay in PCNL group was 4.57±2.1 days, and in RIRS group, it was 1.56±0.8 days [12]. Akman *et al.* showed that mean stay was 61.4±34.0 h in PCNL group, and in RIRS group, it was 30.0±37.4 h [11] and Koyuncu *et al.* showed in PCNL 2.4±0.49 days, and in RIRS group, it was 1.09±0.29 days [10]. Most of the studies have reported significantly longer hospital stay in PCNL group compared to RIRS group. The placement of a nephrostomy for drainage, the need for analgesia, and the increased need for blood transfusions in the PCNL group may be the main causes of this.

In the present study, blood transfusion was given in 3.77% patients in PCNL group and none to RIRS group. Similar results of blood transfusion given in PCNL group only as compared to RIRS group were reported by Koyuncu *et al.*, Akman *et al.*, and Karakoc *et al.* [10-12]. This shows that there is more bleeding and more fall in mean Hb in PCNL compared to RIRS.

In the present study, fever was present in 4.25% patients of PCNL compared to 9.90% in RIRS group. Almost similar incidences of fever were reported by other studies too [10-12]. Gill *et al.* study reported very high post-operative fever rates PCNL group, particularly for female patients and patients younger than 45 years [14].

In the present study, post-operative pain was seen significantly more in PCNL (12.74%) patients compared to 2.97% patients in RIRS group. It could be more due to nephrostomy tube placed percutaneously in PCNL group compared to minimally invasive procedure of RIRS. Other literatures have not mentioned about post-operative pain in their studies.

In the present study, infection and sepsis were seen in 1.89% patients of PCNL group and in 4.95% patients of RIRS group. Similar results were also reported by other studies [10-12]. It shows that proper aseptic precautions taken during surgery can lead to decreased incidence of infection and sepsis and fever.

The present study found PCNL as cost-effective procedure as compared to RIRS. RIRS is almost double the cost of PCNL. Other studies have also shown the same results.

### CONCLUSIONS

This study concluded PCNL shown significantly higher stone free rate and less operative time along with cost-effective procedure as compared to RIRS; however, this procedure has significant more post-operative complications and hospital stay. For renal stone size 1–2 cm, RIRS is considered as preferred technique and for renal stone size >2 cm, PCNL is considered as gold standard as RIRS becomes a multistage procedure. Hence, judicious use of PCNL and RIRS should be done according to location and size of renal stone and anatomy of kidney.

### AUTHORS' CONTRIBUTIONS

All the authors contributed to the preparation of the final manuscript.

### CONFLICTS OF INTEREST

None.

### FINANCIAL SUPPORT

Nil.

### REFERENCES

- 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;25:1131-5. doi: 10.1089/end.2010.0737, PMID 21657824
- Ghani KR, Wolf JS Jr. What is the stone-free rate following flexible ureteroscopy for kidney stones? *Nat Rev Urol* 2015;12:281-8. doi: 10.1038/nrurol.2015.74, PMID 25868563
- Wright AE, Rukin NJ, Somani BK. Ureterscopy and stones: Current status and future expectations. *World J Nephrol* 2014;3:243-8. doi: 10.5527/wjn.v3.i4.243, PMID 25374818
- Srivastava A, Chipde SS. Management of 1-2 cm renal stones. *Indian J Urol* 2013;29:195-9. doi: 10.4103/0970-1591.117280, PMID 24082440
- Kim BS. Recent advancement or less invasive treatment of percutaneous nephrolithotomy. *Korean J Urol* 2015;56:614-23. doi: 10.4111/kju.2015.56.9.614, PMID 26366273
- Tonolini M, Villa F, Ippolito S, Pagani A, Bianco R. Cross-sectional imaging of iatrogenic complications after extracorporeal and endourological treatment of urolithiasis. *Insights Imaging* 2014;5:677-89. doi: 10.1007/s13244-014-0355-z, PMID 25256564
- Van Cleynenbreugel B, Kılıç Ö, Akand M. Retrograde intrarenal surgery for renal stones-Part I. *Turk J Urol* 2017;43:112-21. doi: 10.5152/tud.2017.03708, PMID 28717532
- Turk C, Knoll T, Petrik A, Sarica K, Straub M, Seitz C. Guidelines on Urolithiasis. Arnhem, The Netherlands: European Association of Urology; 2011.

9. Grasso M, Loisodes P, Beaghler M, Bagley D. The case for primary endoscopic management of upper urinary tract calculi: I. A critical review of 121 extracorporeal shock-wave lithotripsy failures. *Urology* 1995;45:363-71. doi: 10.1016/S0090-4295(99)80002-8, PMID 7879329
10. Koyuncu H, Yencilek F, Kalkan M, Bastug Y, Yencilek E, Ozdemir AT. Intrarenal surgery vs percutaneous nephrolithotomy in the management of lower pole stones greater than 2 cm. *Int Braz J Urol* 2015;41:245-51. doi: 10.1590/S1677-5538.IBJU.2015.02.09, PMID 26005965
11. Akman T, Binbay M, Ozgor F, Ugurlu M, Tekinarslan E, Kezer C, et al. Comparison of percutaneous nephrolithotomy and retrograde flexible nephrolithotripsy for the management of 2-4 cm stones: A matched-pair analysis. *BJU Int* 2012;109:1384-9. doi: 10.1111/j.1464-410X.2011.10691.x, PMID 22093679
12. Karakoç O, Karakeçi A, Ozan T, Fırdolas F, Tektaş C, Özkarataş ŞE, et al. Comparison of retrograde intrarenal surgery and percutaneous nephrolithotomy for the treatment of renal stones greater than 2 cm. *Turk J Urol* 2015;41:73-7. doi: 10.5152/tud.2015.97957, PMID 26328205
13. Zengin K, Tanik S, Sener NC, Albayrak S, Ekici M, Bozkurt IH, et al. Incidence of renal carcinoma in non-functioning kidney due to renal pelvic stone disease. *Mol Clin Oncol* 2015;3:941-3. doi: 10.3892/mco.2015.550, PMID 26171211
14. Gill NP, D'Arrigo L, Wit EC. Comparison of postoperative fever and effectiveness of percutaneous nephrolithotomy (PCNL) versus retrograde intrarenal surgery (RIRS) for the treatment of renal stones. *SN Compr Clin Med* 2019;1:154-9. doi: 10.1007/s42399-018-0023-6