



Outcome of Retrograde Intrarenal Surgery and Percutaneous Nephrolithotomy in the Treatment of Upper Calyceal Stone of ≤ 2 cm in Diameter

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Received: 21 - 09 - 2021
Accepted: 09 - 12 - 2021
Conflicts of interest: None

Abstract

Back ground: The incidence of renal calculi is rising and more patients are presenting with small renal calculi. The treatment options for renal calculi ($d < 2$ cm) are ESWL, percutaneous nephrolithotomy (PCNL) and retrograde intrarenal surgery (RIRS). The development of minimal invasive surgery for the treatment of renal calculus has led to an increase in success rates and, at the same time, has decreased the morbidity associated with these treatments.

Objective: The study aimed to evaluate outcome of retrograde intrarenal surgery (RIRS) and percutaneous nephrolithotomy in the treatment of upper calyceal stone of $d < 2$ cm in diameter.

Methods: 60 Patients with radiopaque upper calyceal stone ($d < 2$ cm) were admitted and underwent RIRS (Group A) & PCNL (Group B) in Urology department as per inclusion and exclusion criteria by purposive sampling (30 patients in each group). Complete clinical evaluation including history, physical examination, relevant examinations & laboratory investigations were performed.

Result: Mean age was 37.23 ± 11.59 years (range 18-62 years) in group A and 40.10 ± 11.49 (range 18-65 years) in group B. Mean operative time was significantly lower in group A (90.13 ± 18.79 min) than group B (107.36 ± 16.4 min) ($p < 0.05$). Mean volume of irrigation fluid used during surgery, mean drop in the postoperative hemoglobin concentration, hospital stay, mean VAS score at 8 hours & 24 hours after operation were significantly lower in RIRS group than PCNL group ($p < 0.05$). We achieved a stone clearance of 90.00% in the RIRS group and 96.67% in the PCNL group. The difference in stone clearance in two groups was not statistically significant ($p = 0.30$).

Conclusion: The study concluded Retrograde intrarenal surgery (RIRS) in the treatment of upper calyceal stone of $d < 2$ cm in diameter is a feasible, effective and safe treatment option. Given the added morbidity in PCNL, RIRS should be considered standard therapy in these patients.

Keywords: RIRS, PCNL, upper calyceal stone

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Introduction:

Urolithiasis is a common disease with globally increasing incidence and significant socio-economic implications.¹ Urinary stone disease is nearly doubled in last 15 years from 6.3% in 1988-1994 to 16.6% in 2007-2013.² During acute episode of urinary stone disease spontaneous passage occur in about 68% of stone smaller than 5mm & 47% between 5-10mm. Thus larger as well as smaller stone may need some form of intervention.³ Treatment of urinary stone disease has advanced over last 30 years. Minimal invasive procedure has almost completely replaced open surgery in patient with kidney stone over the past 2 decade (AUA Ureteral Calculi Guideline). Percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS) and shockwave lithotripsy (SWL) are the current management options for small renal calculi.⁴

Percutaneous nephrolithotomy which was first described in 1976 (Fernstrom & Johansson 1976) has become the procedure of choice for large burden renal calculi and a management option for small renal calculi,⁵ Currently guideline on urolithiasis recommends PCNL as first line treatment of kidney stone >20 mm in diameter.⁶ Although high success rate exceeding 95% have been reported with PCNL there are still significant complications including-urinary extravasation (7.2%), bleeding necessitating transfusion (11.2-17.5%), postoperative fever ((21-32.1%), septicemia (0.3-4.7%), colonic injury (0.2-0.8%) or pleural injury(0.0-3.1%) associated with this procedure.⁷

Because of technological improvement in the design on modern flexible ureteroscope such as incorporation of a working channel, decrease the diameter of the scope, greater resolution obtained, improved light diffusion and extended field of vision, retrograde intrarenal surgery(RIRS) has been frequently consideration in the management of renal stone as an alternative to PCNL.⁸ The 2013 European Association of Urology(EUA) guideline recommended PCNL & RIRS as first line treatment for kidney stone >1 cm when anatomic factors make ESWL unfavorable like pregnancy, severe skeletal malformation, obesity, uncorrectable bleeding diathesis and urinary tract obstruction distal to the stone. Retrograde intrarenal surgery is an efficient and reliable treatment method for patients with obesity, musculoskeletal deformities, renoureteral malformations, infundibular stenosis, bleeding disorders in whom other treatment options are risky or insufficient.⁹ The main drawback of retrograde access

include cost, the requirement of flexible ureterorenoscopes, limited visualization, reduced size of fragment removal, and the need for flexible lithotrites and basket.¹⁰

The aim of the study is to perform a comparison of outcome between RIRS and PCNL in the management of kidney stone d"2 cm in diameter.

Materials & methods:

This hospital based prospective observational study was conducted in department of Urology, NIKDU from January 2018 to December 2018. Patient with upper caliceal renal stone ≤ 2 cm in size meeting inclusion and exclusion criteria admitted & underwent either PCNL & RIRS in Urology department of NIKDU was included in the study. Inclusion criteria were upper calyceal radio opaque stone size ≤ 2 cm, Exclusion criteria were previous surgical treatment including ESWL, congenital abnormalities, bleeding disorder, single kidney, radiolucent stone, calyceal stenosis. Purposive sampling technique was applied to collect the sample for this study. After written informed consent, a total 60 patients were selected and divided into two groups by non-randomization, Group-A for RIRS and group-B for Standard PCNL.

Independent variables were age, sex & dependent variables were duration of operation, volume of irrigation fluid required, Hemoglobin drop, pain, hospital stay, stone free rate.

A detail history and clinical examination of the patients were done. The calculus burden, anatomy of the renal collecting system and the degree of obstruction were evaluated using plain radiograph, ultrasonography of KUB, Serum creatinine and non-contrast spiral computed tomography. All preoperative routine investigations were done including coagulation profile. Preoperative management included culture specific antibiotic treatment of those with urinary tract infection, blood transfusion of those with anemia & optimization of blood sugar where appropriate. Case selected for RIRS underwent a preprocedure D/J stenting two weeks before definite surgery on ipsilateral side under SAB for passive dilatation of the ureter which ease the introduction of the access sheath during RIRS.

PCNL was done under C-arm fluoroscopic guidance by retrograde percutaneous upper calyceal access. After lithotomy position, a 6 F ureteric catheter placed transurethrally. Percutaneous access was created using an 18 G access needle into the selected calyx under

fluoroscopic guidance keeping the patient in prone position. A straight-tipped hydrophilic guidewire was placed into the collecting system. The nephrostomy tract was dilated by serial dilatation technique with metallic dilators. In Standard PCNL a 26 Fr amplatz sheath positioned into the renal collecting system. The stone was disintegrated using pneumatic lithotripsy. Nephroscopy with forceps was used to retrieve stones from calyx. Once complete clearance was confirmed fluoroscopically and endoscopically, a 6 F JJ stent was placed antegradely. Then amplatz sheath is removed after keeping a nephrostomy tube in situ.

RIRS was performed under general anesthesia with the patient in dorsal lithotomy position. The urinary bladder was entered with cystoscope. Previously placed JJ stent was removed & a guide wire (Zebra™, 0.035 in x 150 cm) sent to the ureter under C-arm guidance. A second guide wire was also passed via cystoscope which was later act as safety guidewire. 10 Fr feeding tube was placed in the bladder for the drainage of bladder during operation. A ureteral access sheath (Rocamed 10/12 Fr) was inserted under fluoroscopy to keep the tip of ureteral access sheath just below pelvi-ureteric junction. Accessible calyx was determined under fluoroscopic guidance. A 8.4 Fr digital flexible ureteroscope (Flex - XC) and 272 micrometer Laser fiber were used for treatment. We used Holmium Laser machine set of energy 1.0-1.5 J and rate of 8-10 Hz. At the end of Laser lithotripsy stone fragment smaller than 2 mm were left for spontaneous passage and basket retrieval was performed for fragment larger than 2 mm. A systemic inspection of the collecting system was performed with the help of fluoroscope to confirm the achievement of adequate fragmentation and stone clearance. A 6 f JJ stent was routinely placed in each patient and was removed 4 weeks after the procedure.

The nephrostomy tube was removed within 24 hours after the operation in PCNL group and wound dressing was done. Per urethral catheter was removed after 48 hours of operation in both groups if there was no complication. The JJ stent was removed after 4 weeks. Hb% was measured in 1st postoperative day to see any drop in Hb% concentration. Plain X-ray KUB region was performed in all patients prior to discharge from hospital to exclude any significant residual stone & to council the patients for D-J stent removal. Urine R/M/E & C/S, serum creatinine, plain X-ray KUB and USG of KUB were done at 1 month after the operation.

After compilation, the data was presented in the form of tables, figures and graphs, as necessary. Statistical analysis of the results was done by using computer based statistical software, Excel free software, supplied by NIKDU. Results were analyzed by Chi-square test (X^2) and Student's t-test. A 'p' value of < 0.05 was considered statistically significant.

Results

Majority of the renal stones were found in the age range 44-66 years. The mean age of Group-A and Group -B were 37.23±11.59 and 40.10±11.49 years respectively. Majority of the subjects in both the groups (63.33%, 19 in Group -A and 70.00%, 21 in Group -B) were male.

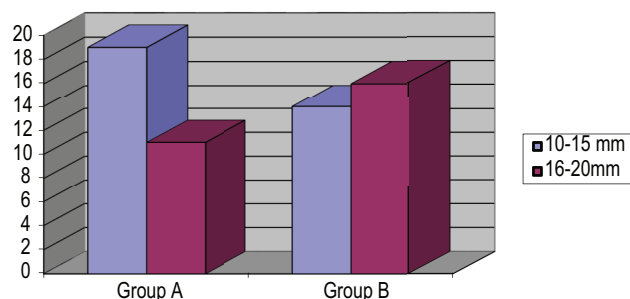


Fig-1: Comparison of stone size between groups

Table I: Comparison of age incidence of renal stone between groups

Age in years	Group A (n=30)		Group B (n=30)		P value
	No	%	No	%	
18-30 y	8	26.67	7	23.33	0.48
31-43 y	10	33.33	12	40	
44-66 y	12	40	11	36.67	
Mean± SD	37.23±11.59		40.10±11.49		
Range	18-62 years		18-65 years		

Table II: Comparison of duration of operation between groups

Duration of operation (min)	Group A (RIRS)	Group B (PCNL)	P value
50-80	11	2	0.0003
81-110	16	13	
111-140	3	15	
Mean duration of operation	7.25±1.4	9.28±2.25	

Table III: Comparison of volume of irrigation fluid required between groups

Volume (Liters)	Group A (RIRS)	Group B (PCNL)	P value
0-5 L	4	0	0.0001
6-10 L	26	21	
11-15 L	0	9	
Mean volume	7.25±1.4	9.28±2.25	

Table IV: Comparison of postoperative complications between groups

	Group A (RIRS)	Group B (PCNL)	P value
Pelvicalyceal tear	0	0	
Fever	5	3	0.447
Sepsis	1	0	0.313 ^{NS}
Blood transfusion	0	1	0.313 ^{NS}

NS: not significant

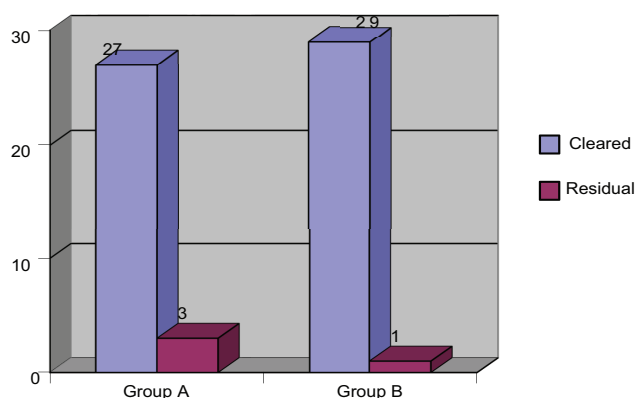


Fig. -2: Comparison of stone clearance between groups

Table V: Comparison of postoperative hemoglobin drop between groups

	Preoperative Hb (g/dL)	Postoperative Hb (g/dL)	Mean drop in Hb level	P value
Group A(RIRS)	13.04± 1.39	12.4 ± 1.25	0.62±0.5	0.073352 ^{NS}
Group B(PCNL)	13.39 ± 1.18	12.39 ± 0.94	1.00±0.79	0.00064 ^S

Table VI: Comparison of Hospital stays between groups

Hospital stay in days	Group A	Group B	P value
2-3	22	13	0.004 ^S
4-5	7	14	
6-7	1	3	

Table VII: Comparison of VAS score between groups

Visual analogue score at 8 hours	Group A	Group B	P value	Visual analogue score at 24 hours	Group A	Group B	P value
0	0	0		0	0	0	
1-3	8	0		1-3	14	0	
4-6	22	28	0.00014 ^S	4-6	16	28	0.00019 ^S
7-9	0	2		7-9	0	2	
10	0	0		10	0	0	
Mean score	4.53 ± 1.19	5.60 ± 0.77		Mean score	3.97 ± 1.15	5.03 ± 0.88	

Discussion

In this prospective observational study, 60 patients were enrolled and divided into two groups – group A & group B. Mean age was 37.23 ± 11.59 years (range 18-62 years) in group A and 40.10 ± 11.49 (range 18-65 years) in group B which were almost homogeneously distributed. There were total 19 male & 11 female patients in group A & 21 male & 9 female patients in group B. Male to female ratio in group A & group B was 1.7:1 & 2.3:1 respectively. Meyyappan K, et al (2018) treated 100 patients (71 males and 29 females) to compare RIRS and PCNL in Renal stone of 1-2 cm size. Their age ranged from 18-60 years with a mean age of 43.72 in PCNL group and 45.44 in RIRS group.¹¹ The 2 groups were comparable with regard to age & which was similar to recent study. Mhaske et al. (2017) in their study included 80 adult patients to compare the outcomes of miniaturized percutaneous nephrolithotomy (mini-perc) and retrograde intrarenal surgery (RIRS) in management of renal stones with a diameter <15 mm. Mean age was 40.12 and 38.20 years in mini-perc and RIRS group, respectively & Majority of the study participants were males.

In group A, majority of the patients (53.33%) had left sided renal stone disease. On the other hand in group B, majority of the patients (17, 56.67%) had right renal stone disease. The difference was not statistically significant ($p > 0.05$). Mean size of the stones were 1.48 ± 0.33 cm in group A and 1.59 ± 0.29 cm in group B. Calculated p value was 0.16 which is not significant ($p > 0.05$). Khan et al (2016) assessed the efficacy of retrograde intrarenal surgery (RIRS) in stones less than 2cm as compared to mini percutaneous nephrolithotripsy (mPCNL). In their study, mean stone size in RIRS group was 1.5 ± 0.23 cm & 1.5 ± 0.31 cm in PCNL group, which is similar to our study.

In this study, mean operative time was significantly lower in group A (and 90.13 ± 18.79 min) than group B (107.36 ± 16.4 min) which was statistically significant ($p < 0.05$). Meyyappan K, et al (2018) showed lower operative time in RIRS group (98.90 ± 17.2) than in PCNL group (125.6 ± 22.03 min), which is similar to present study. But Sabnis et al (2011) found operation duration ($P = 0.003$) was significantly lower in the miniperc group than RIRS group.

In recent study, the mean volume of irrigation fluid used during RIRS (Group A) was 7.25 ± 1.4 Litres while in PCNL (Group B) it was 9.28 ± 2.25 Litres and the difference between the two was found to be statistically

significant with p value of 0.0001. Meyyappan K, et al (2018) showed mean volume of irrigation fluid used during PCNL (9.16 ± 2.37 Litres) was significantly higher than in RIRS ($4.32 \pm 1/17$ Litres).

In our study, mean drop in the postoperative hemoglobin concentration in PCNL group (Group B) was 1.00 ± 0.79 gm/dl which is higher than Group A (0.62 ± 0.5 gm/dl), which is statistically significant ($p < 0.05$). Mhaske et al. (2017) showed average reduction in hemoglobin was significantly ($P < 0.05$) greater in mini perc (0.55%) than RIRS (0.42%), which is similar to our study.

In present study, we observed more complications in the PCNL group (Group B) compared to RIRS group (Group A) with one patient in the PCNL group requiring blood transfusion. 5 patients in Group A & 3 patients in Group B developed postoperative fever. One patient in RIRS developed urosepsis. All these infective complications were treated conservatively with antibiotics. But these differences were not statistically significant ($p < 0.05$). These results were comparable to that obtained by Khan et al (2016), who evaluated the efficacy of retrograde intrarenal surgery (RIRS) in stones less than 2cm as compared to mini percutaneous nephrolithotripsy (mPCNL). They observed 2 patient in RIRS group & 4 patients in mPCNL group developed postoperative fever & one patient in mPCNL group required blood transfusion.

Postoperative pain is important, and it may affect the hospital stay and comfort of the patient. In our study, mean VAS score at 8 hours & 24 hours after operation in RIRS group was 4.53 ± 1.19 & 3.97 ± 1.15 respectively. In PCNL group, mean VAS score at 8 hours & 24 hours after operation was 5.60 ± 0.77 & 5.03 ± 0.88 . The difference is significant between the RIRS and PCNL groups at P value 0.00014 & 0.00019. Meyyappan K, et al (2018) showed mean VAS score in PCNL group was 5.6 ± 1.9 and 3.76 ± 1.39 in RIRS group, which was statistically significant at P value 0.0001. This findings is similar to our study.

When compared with the RIRS group, the hospital stay was longer in the PCNL group. Mean hospital stay was 3.37 ± 1.03 days & 4.2 ± 1.12 days in group A & group B respectively. The difference was statistically significant ($p < 0.05$). The most important reasons for this were the nephrostomy catheter placed for drainage, the need for analgesia, and the need for follow-up after blood transfusion. Meyyappan K, et al (2018) showed, 36 patients who underwent RIRS got discharged in less

than 4 days whereas in PCNL group only 25 patients got discharged within 4 days which was significant at $p=0.039$. Mhaske et al. (2017) observed hospital stay was similar in both the group of patients (mini perc: 2.30 days, RIRS: 2.15 days, $P < 0.063$).

We achieved a stone clearance of 90.00% in the RIRS group and 96.67% in the PCNL group. The difference in stone clearance in two groups was not statistically significant ($p=0.30$). Our results were comparable to Khan et al (2016), they achieved a stone clearance of 95.34% in the RIRS group and 93.02% in the mPCNL group. Fayad et al (2016) found that the stone free rate was better in Group A (mini-PCNL) as compared to Group B (RIRS), at 92.72% and 84.31%, respectively; however, this also was not statistically significant

Limitations of the study

The study was conducted in a single center & performed by different surgeons. Sample size was small. & were not selected randomly. Stone composition & treatment cost was not considered in this study.

Recommendation

Large scale, multicenter study with proper randomization is needed to assess the outcome of retrograde intrarenal surgery (RIRS) and per cutaneous nephrolithotomy (PCNL) in the treatment of upper calyceal stone of $d \leq 2$ cm in diameter. Treatment cost should be considered in the study.

Authors' contribution

Conceived and designed the experiments: Mohammad Saiful Islam & Sharif Md. Shahadat Ali Khan.

Analyzed the data: Mohammad Saiful Islam & Sharif Md. Shahadat Ali Khan Contributed reagents/materials/analysis: Kazi Zikrur Razzaque, Imtiaz Enayetullah, Md. Nasiruddin and Kazi Rafiqul Abedin.

Wrote the manuscript: Mohammad Saiful Islam. All authors read and approved the final manuscript.

Conclusion

Retrograde intrarenal surgery (RIRS) in the treatment of upper calyceal stone of $d \leq 2$ cm in diameter is a feasible, effective and safe treatment option. Given the added morbidity in PCNL, RIRS should be considered standard therapy in these patients.

Acknowledgement

This study was supported & approved by the ethical review committee, National Institute of kidney diseases & Urology, Dhaka

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