Retrograde Intrarenal Surgery, Another Minimally Invasive Procedure for Upper Tract Urolithiasis: Our initial Experience at a Tertiary Care Hospital

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Background: As the advancement in technology and miniaturization of equipments, RIRS provides an alternative way to PCNL by minimizing the risks related to PCNL in the treatment of Urolithiasis. Objective: The aim of this study was to explore our initial experience with RIRS in terms of feasibility, the efficacy and safety for the management of Urolithiasis. Materials and Methods: This prospective study was carried out in the Department of urology Super Specialty Hospital Shereenbagh, Government Medical College Srinagar over a period of 6 months from October 2019 to April 2020. This study comprised of patients admitted with upper tract stones who opted for RIRS after being properly explained the procedure. Follow up NCCT KUB was obtained after 5 weeks of RIRS to look for the clearance of stone. Results: A total of 46 patients were enrolled. The age of the Patients ranged from 26 to 63 years with a mean age of 44.23 years. Out of total 46 patients, preoperative DJ stenting was ensured in 42 patients. In two patients RIRS was converted to PCNL. In our study stone free rate was 81.8% (36/44) after the single session of RIRS. Residual stone was higher in cases of lower calyceal stones, stones in multiple calyces and stone burden >2cm. Residual stones 3-4 mm were present in 14 patients and > 5mm in 2 pts.. Operative time ranged from 55 minutes to 195 minutes (average time 100.57 minutes). Patients were discharged after 36 hrs. There were no major complications in our study. Conclusion: RIRS has not only the advantage of being minimally invasive, but also is associated with low rate of complications, less morbidity and good stone free rate and short hospital stay. RIRS appears to be a safe and effective alternative to PCNL for upper tract stones. Keywords: RIRS, Laser, SFR, UAS, PCNL.

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efficacy of RIRS in lower pole stones have increased [13]. Under this background we conducted this study to look for the feasibility, efficacy and safety of RIRS for the management of Urolithiasis in our set-up.

METHODS

This prospective study was carried out in the Department of urology Super Specialty Hospital Shereenbugh, Government Medical College Srinagar over a period of 6 months from October 2019 to April 2020. This study comprised of patients admitted with the diagnosis of nephrolithiasis and upper ureteric stones who opted for RIRS after being properly explained the procedure.

Aim

The aim of this study was to explore our initial experience with RIRS in terms of feasibility, the efficacy and safety for the management of upper tract calculi.

Inclusion Criteria

- Patients with upper tract calculi of age >15 years and above
- Patients with renal and/or upper ureteric stones (single/multiple)
- Stone burden <1 to 3 cm
- Patients with stones in any of the calyces; >1 calyces; pelvis; and upper ureteric stones
- Previous history of URS or ESWL or Open surgery.
- Patients with comorbidities such as diabetes, hypertension, and patients on anticoagulants.
- Anatomically abnormal kidneys such as solitary kidney, horseshoe kidney, and ectopic kidney.

Exclusion Criteria

- Patient preference
- Age group <15 years
- Stone burden more than 3 cm.
- Complete staghorn calculus.

All patients were subjected to the routine preoperative workup, negative urine culture and plain CT KUB with contrast enhancement and, data was collected. A total of 46 patients were enrolled during the period of our study. Among these preoperative DJ stenting was ensured in 42 patients. This initial ureteroscopy helps to dilate the ureter, manage any stone fragment, to discover any undiagnosed pathology like malignancy and ureteral condition. UAS (ureteral access sheath) 10/12 F is placed over a 0.038 teflon guide wire under C arm. Irrigation tubing is attached to the flexible digital ureterorenoscope from Olympus to provide the clear vision using a guarded pressure pump. All calyces are being inspected. Basket is used for stones or fragments <1 cm for repositioning to appropriate location. A 230 micron laser fiber is used with the Holmium YAG laser of 35 watts of Karl Storz make (Calculase III). The Laser settings used were as follows: Fragmentation → high energy (1-2 J) with low frequency (3-5 Hz) with short pulse duration ; Dusting → Low energy (0.2-0.5 J) with high frequency (10-20 Hz) with long pulse duration and for Popcorn effect → High energy (1 J) with high frequency (10-20 Hz) with long pulse duration. A few stone fragments are removed by basket for analysis. Finally contrast study is performed for any intravasation and pelvicalyceal system is reexamined with flexible ureterorenoscope. We placed DJ stent at the end in all patients. At the end of the procedure access sheath was removed under flexible ureterorenoscope direct vision to see any ureteric injury due to insertion of ureteral access sheath. Patients are being monitored postoperatively for any complication. We usually discharged our patients after 36 hrs. Follow up NCCT KUB was obtained after 5 weeks of RIRS to look for the clearance of stone burden. Stone size≥3mm on follow up NCCT KUB was considered as residual stone, while a size of >5mm was taken as significant.

Statistical Methods

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean ±SD and categorical variables were summarized as frequencies and percentages.

RESULTS

A total of 46 patients were enrolled during the period of our study. The age of the Patients ranged from 26 to 63 years with a mean age of 44.23 years. Out of these 27 were males and 19 were females. Twenty-eight patients had right sided procedures and 18 patients had left sided procedures. Out of total 46 patients, preoperative DJ stenting was ensured in 42 patients. Intraoperative views of RIRS are depicted in Figures 1 to 2, and stone dust passing through perurethral Foley’s catheter after RIRS is shown in Figure-3. Figure-4 shows RGP demonstrating complete duplication with infundibular stenosis and calyceal calculi and figure 5 depicted fluoroscopic view during RIRS.

In two patients RIRS was converted to PCNL. Three patients had stones with infundibular stenosis, one in upper calyx, one in lower calyx, and another had patient had complete duplication of pelvicalyceal system with stone present in the upper blind calyx of superior moiety. Patient with upper calyceal stone with infundibular stone was managed by RIRS after reestablishing the communication with help of the Laser fibre. The patient with complete duplication (Figure-4) of pelvicalyceal system having stone in the superior
moiety in upper calyx (stenosed neck) was dealt with RIRS as in the above case.

One patient of infundibular stenosis with a stone obstructing the calyceal neck in the lower pole calyx leading to cystic dilatation with stones in the cystic cavity was converted to PCNL because of technical difficulty. One more patient with lower calyceal stone was converted to PCNL because of difficult anatomy due to previous open renal stone surgery. One patient with stone in the pelvis had angiomyolipoma in the lower pole and was successfully managed with the RIRS without any complication. Stone free rate (SFR) and time taken is analysed in Table 1 to 3.

Overall average operative time = 100.57 minutes. Average operative time in the initial half of our patient cohort was 113 minutes whereas the average operative time in the latter half of our patient cohort was 88.14 minutes. Hematuria cleared up in majority of the patients within 6-8 hours of surgery and in all patients within 14 hours. Pain score on the day of surgery and the first POD was calculated using the VAS score and ranged from 2-7 with an average 3.06. Analgesic required was 2 doses of paracetamol 1g i.v on the day of surgery. Three patients complained of the pain in the flank region persistently for 3-4 days and were managed with oral analgesics. One patient developed steinstrass postoperatively after stent removal and developed fever on and off for 10 days and was managed initially with antibiotics. Steinstass did not resolve until 5 weeks postoperatively and was managed then by second setting of RIRS. Residual stones 3-4 mm were present in 14 patients and were managed by observation policy while two cases with residual stone >5mm including the patient with steinstrasse were managed by second RIRS after 5 weeks of index RIRS. We discharged 44 patients after 36 hrs. Patients were advised to resume their routine work after 4-5 days of surgery in most of the cases. Stent were removed after 2 weeks of surgery.

| Location of stones | Number of patients | No. of patients with residual stones | Stone free rate (%) |
|-------------------|-------------------|-------------------------------------|---------------------|
| Upper calyx       | 3                 | 0                                   | 100                 |
| Middle calyx      | 3                 | 0                                   | 100                 |
| Lower calyx       | 10                | 4                                   | 60                  |
| Pelvis            | 4                 | 0                                   | 100                 |
| Multiple calyces  | 15                | 4                                   | 73.33               |
| Upper ureter      | 9                 | 0                                   | 100                 |
| Total             | 44                | 8                                   | 81.8                |

| Stone Burden(cm) | Number of patients | Patients with residual stones | Stone free rate |
|------------------|--------------------|-------------------------------|-----------------|
| <1               | 8                  | 1                             | 87.5            |
| 1-2              | 29                 | 5                             | 82.7            |
| >2               | 7                  | 2                             | 71.4            |
| Total            | 44                 | 8                             | 81.8            |

| Stone Burden(cm) | Operative Time(min) | Average time(min) |
|------------------|---------------------|-------------------|
| <1               | 55-72               | 64                |
| 1-2              | 63-124              | 98                |
| >2               | 115-195             | 153               |

*operative time=Time taken by the surgeon, i.e., the time was calculated from starting the endoscopic procedure till catheterization. Anesthesia, positioning and preparation time were not included.
DISCUSSION

RIRS provides safe and effective method alternative to PCNL in the surgical management of renal or upper ureteric stones, though there remains a debate for stone clearance in case of RIRS as compared to PCNL. There seems to be lesser learning curve for RIRS as compared to the PCNL though cost is an issue in case of RIRS. RIRS is less invasive than PCNL. Grasso and associates [10] have shown the use of RIRS for large renal stones in patients who had comorbid conditions and were not fit for PCNL. Hyams et al., [14] reported using RIRS for the treatment of renal stones with diameters of 20–30mm in 120 patients. They achieved 63% SFR when a stone-free state was defined as no residual stones or only clinically insignificant stone fragments of <2mm were present. If the stone-free state was defined as no residual stone fragments of <4 mm, the SFR would increase to 83%. Prabhakar et al., [15] reported that RIRS could achieve a 100% SFR in treating renal stones with an average diameter of 25mm after a single or staged procedure. They considered complete clearance, if there were no fragments on USG screening after 3 weeks. Twenty six (86.6%) their patients out of 30 had complete clearance in the first sitting and 4 (13.3%) patients needed re-look flexible ureteroscopy. All four patients had residual fragments less that 6 mm which needed only basketing; there was no need for fragmentation.

The age of our patients ranged from 26 to 63 years with a mean age of 44.23 years. In our study stone free rate was 81.8% (36/44) after the single session of RIRS. Rate of residual stone was higher in cases of lower calyceal stones, stones in multiple calyces and stone burden >2cm. Residual stones 3-4 mm were present in 14 patients and were managed by observation policy. The two patients with significant residual stone size (>5mm) were subjected to second stage of RIRS after 5 weeks of index RIRS with complete clearance. Anatomical factors that affect the failure to access lower pole in fURS were evaluated [16]. Although acute IPA <30° and length of infundibulum >3 cm were found to be associated with lower SFRs, while width of infundibulum had no effect. Increase in deflection with
technological developments and improvements in surgical technique have led flexible ureteroscopes to reach lower pole more easily. Repositioning lower pole stones with tipless nitinol baskets to other calyces that are accessed easily has increased the treatment success of fURS in the management of lower pole stones [17].

In the study by Prabhakar et al., [15], operating time was 45 minutes to 190 minutes (average time 92 minutes) the time was calculated from starting the endoscopic procedure till catheterization. In our study operative time ranged from 55 minutes to 195 minutes (average time 100.57 minutes). Average operative time in initial half of our patient cohort was 113 minutes whereas the average operative time in the latter half of our patient cohort was 88.14 minutes. This is in consistence with short learning curve of RIRS.

Endoscopic stone treatment is more difficult in patients with a history of open surgery due to intra renal anatomic distortion. Osman et al., [18] reported SFRs of 79.2% and 92.4% after first and second procedures in 53 patients with an average stone diameter of 14.3 mm. They noted 2 (3.7%) intraoperative complications, including a ureteral perforation and extravasation, and a hemorrhage not requiring blood transfusion; while 9 postoperative complications (18%) were noted. In our study, one patient with lower calyceal stone was converted to PCNL because of difficult anatomy due to previous open renal stone surgery causing closure of infundibulum.

With regard to RIRS in infundibular stenosis and stones in calyx diverticulum, Koopman et al., [19] dilated the calyx neck with either balloon dilatator or laser incision, and succeeded to reach the stone in calyx diverticulum in 94% of 108 patients. General SFR was 90%, while they reported a SFR of 75% for 2-3 cm stones with addition of SWL. Chen et al., [20] opened the calyx neck with only laser incision in 43 patients, and had success in 35 patients (81.4%) after the first session. Five of the remaining 8 patients were stone-free after the second session, and they reported an overall SFR of 93% without any major complication. In our study, three patients had stones with infundibular stenosis, one in upper calyx, one in lower calyx, and another had patient had complete duplication of pelvicalyceal system with stone present in the upper blind calyx of superior moiety. Patient with upper calyceal stone with infundibular stone was managed by RIRS after reestablishing the communication with help of the Laser fibre incision. The patient with complete duplication of pelvicalyceal system having stone in the superior moiety in upper calyx (blind) was dealt with RIRS as in the above case. One patient of infundibular stenosis with a stone obstructing the calyceal neck in the lower pole calyx leading to cystic dilatation with stones in the cystic cavity was converted to PCNL because of technical difficulty.

In the study by Prabhakar et al., [15], no major complications were reported. All the patients were discharged in 24 hrs. 96.6% (29/30) of patients resumed normal duties on the third postoperative day. In our study, all patients were discharged after 36 hours of the surgery. Patients were advised to resume their routine work after 4-5 days of surgery in most of the cases. There were no major complications in our study except one patient developed steinstrasse after DJ Stent removal who was managed successfully initially with antibiotics and latter on with ReRIRS. Hematuria cleared up in majority of the patients within 6-8 hours of surgery and in all patients within 14 hours. Pain score on the day of surgery and the first POD was calculated using the VAS score and ranged from 2-7 with an average 3.06. One patient in our study with stone in the renal pelvis had angiomyolipoma in the lower pole and was successfully managed with the RIRS without any complication which was unfit for PCNL.

**CONCLUSION**

RIRS has not only the advantage of being minimally invasive, but also is associated with low rate of complications, less morbidity and good stone free rate and short hospital stay. Large stone burden and lower calyceal stone location are the important factors deciding low SFR in RIRS. There is minimal requirement of postoperative analgesics. RIRS is better modality than PCNL were angioembolization facilities are not available and also in patients with bleeding diathesis and obesity. Hence, RIRS appears to be a safe and effective alternative to PCNL for upper tract stones up to a stone burden of 3cms, and seems to be potentially safer in certain situations including bleeding diathesis.

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