ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

Multistaged retrograde intrarenal surgery for large renal stones – our institutional experience

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Submission: 09-01-2023 Revision: 04-06-2023 Publication: 01-07-2023

ABSTRACT

Background: Recent advances such as retrograde intrarenal surgery (RIRS) have become an acceptable and widespread technique for upper urinary tract stone management. However, the outcome and complication of staged RIRS for large stone burden (>2.0) still needs to be reported. A total of 150 cases of renal calculi were treated by RIRS in a single center. Among these, 30 had renal stone size larger than 2.0 cm. **Aims and Objectives:** This study was conducted to present our views, experience, and outcomes of Retrograde Intra Renal Surgery for the Management of Large Renal Stones in Staged Manner using Flexible Ureteroscope with Holmium Laser as energy Source. **Materials and Methods:** Between March 2020 and January 2022, we admitted 150 patients with upper urinary tract stones who underwent RIRS using 30 Watt Holmium laser lithotripsy in our institute. Post-surgery, all the cases are evaluated in terms of stone free rates (SFR) complications and effectiveness of RIRS. **Results:** A total of 150 patients having upper urinary tract stones were included in this study (84 male and 66 female patients). All patients underwent RIRS using 30 watt holmium laser lithotripter. The overall SFR was 90.6%. The average stone size was 1.1 cm with average operation time of 100.6 min. Average hospital stay was 2.2 days. The average pain score was 2.1/10 by the Numerical Rating Scale. No major complications (Clavien Dindo III- V) were noted in the study groups. **Conclusion:** Through our study, we concluded that RIRS for large renal stone management is an effective and safe treatment modality currently.

Key words: Extracorporeal shock wave lithotripsy; Percutaneous nephrolithotrisy; Stone free rates; Upper urinary tract stones

Access this article online

Website: http://nepjol.info/index.php/AJMS

DOI: 10.3126/ajms.v14i7.51282

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

Basic treatment options for upper urinary tract stones are extra corporeal shock wave lithotripsy (ESWL), ureteroscopic (semirigid) lithotripsy and percutaneous nephrolithotripsy (PCNL); however, application of these methods has some limitations in pregnant women and in patients with anatomic malformations or large stone burdens.[1] Retrograde intrarenal surgery (RIRS) in recent years has allowed endourologists to treat complicated upper urinary tract stones successfully. The available literature pertaining to the present study also reports that RIRS for stone treatment is not inferior to ESWL or PCNL in both safety and efficacy.[1] The aim of the study is to collect, and report all the available details based on review by medical records concerning outcomes, efficacy, and also complications including mortality after RIRS.

Aims and objectives

This study was conducted to present our views, experience, and outcomes of Retrograde Intra Renal Surgery for the Management of Large Renal Stones in Staged Manner using Flexible Ureteroscope with Holmium Laser as energy Source.

MATERIALS AND METHODS

A total of 150 patients diagnosed with upper ureteral or renal calculi were treated by RIRS with 30 watt holmium laser lithotripsy (SPHYNX 30 WATT HOLMIUM LITHOTRIPTER) between March 2020 and January 2022 by a single surgeon in Govt Mohan Kumaramangalam Medical College and super speciality Hospital, Salem. Patients are admitted and subjected to investigations and

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planned for RIRS. Staghorn calculi of stone size >4.0 cm and cases with complex anatomy, multiple calculi >3 no's and RIRS combined with other procedures are excluded from the study. Primary stone-free rate (SFR) was defined as the absence of significant residual stone burden over 4 mm by endoscopic inspection with ureteroscopy and postoperative ultrasound Kidney urinary badder (KUB) or non-contrast computed tomography during the 4-week follow-up after RIRS. The complication rate and severity were defined according to the Clavien Dindo classification.

Surgical techniques

RIRS procedure was done in lithotomy position under general anesthesia with epidural Analgesia. Cefotaxim 1mg was given intravenously 30 min before the start of procedure as a prophylactic antibiotic. RIRS was started after a semirigid ureteroscope-assisted insertion of a hydrophilic safety guide wire, confirming its position with Fluoroscopy and passing an Ureteric sheath of size 10.0–14.0 Fr (depending on the caliber of the ureter) over the guide wire. After confirming the position of ureteric sheath and stone site with fluoroscopy, flexible ureteroscope is introduced and RIRS was performed. Stones are fragmented using Holmium Laser Lithotripsy. 5 Fr Double J ureteric stent was placed after completion of the whole procedure for 10 days for ureteral protection and further ureteral stricture prevention in all patients.

RESULTS

The characteristics of all 150 patients, including 84 male (65.7%) and 66 female (34.3%) patients, who underwent RIRS are presented in Table 1. The average body mass index was 26.73 kg/m^2 (28.12 kg/m^2 in men and 25.30 kg/m^2 in women), and the pre-operative creatinine level was 1.42 mg/dL (average, 1.23 mg/dL in men and 0.99 mg/dL in women). Most patients presented with gross flank pain (108 cases, 75%) followed by pyuria (12 cases, 8%) and gross hematuria (27 cases, 18%). Most patients who had a previous history of urolithiasis underwent shock wave lithotripsy (SWL) (35 cases, 23.3%) and PNL (21 cases, 14%) before RIRS. The overall operation time is 100.6 min (including the anesthesia induction and reverse period). As much as 33 of 150 patients (22%) underwent bilateral RIRS for lithotripsy, compared with 69 right-side RIRS (46%) and 48 left-side RIRS (32%). For 15 patients (10%), the stone sizes were larger than 2.0 cm by KUB or computer tomography measurement. After the RIRS procedure, the average hospital stay and pain score were 2.31 days and 2.12, respectively, by Numerical Rating Scale after the RIRS procedure. The Double-J catheter was removed about 14 days after the RIRS, and we followed the residual stone by ultrasound KUB on the 1st week and 1st month for SFR. The overall SFR was 90.6% in the 1st-month follow-up. For patients whose stone burden was larger than 2 cm (30 cases included staged RIRS cases), the operation time and stone size versus SFR are summarized in Table 2. 30 cases underwent staged RIRS because of hardness of the stone needing increased operative time, comorbidities such as chronic obstructive pulmonary disease (COPD), cardiovascular disease, and stroke. The SFR in >2 cm group was 85% by single RIRS and up to 95% with staged RIRS. No major complications were noted by two-staged RIRS. A total of 12/150 patients experienced complications including fever within 24 h after RIRS (6 cases, 4%) flank pain (3 case, 2%), and readmission due to urosepsis (3 cases, 2%; Table 3). The overall complication rate in 30 days was 4.2%. No major complications (Clavien Dindo III-V) were noted in our study.

DISCUSSION

According to the European Association of Urology guidelines panel in 2015, cumulative stone diameter was suggested as the main parameter for treatment consideration for kidney stone treatment.[2] PCNL should be considered as the treatment of choice for stones whose size is larger than 2.0 cm.[3] At present, ESWL is considered the first-line treatment for stones <2.0 cm without unfavored risk factors. However, ESWL is limited by relatively low SFR by stone burden and location, even after multiple sessions. Recent studies have also revealed that shockwaves have the potential to induce vessel rupture and cause unstable hemodynamic condition of thekidneys.[4] Schnabel et al.,[5] reported that the incidence of post-ESWL hematoma was around 0.53% even after the need for further surgical intervention. Another study by Lee et al.,[6] noted that the incidence of subcapsular or perirenal hematoma was around 0.32%. Thus, considering the SFR and

Table 1: Characteristics of the study samples

Variables	N	%
Sex		
Male	84	56
Female	66	44
Side		
Right	69	46
Left	48	32
Bilateral	33	22
BMI (kg/m^2)		
Overall	26.73 kg/m^2	-
Male	28.12 kg/m^2	-
Female	25.30 kg/m^2	-
Clinical symptoms		
Hematuria	27	18
Pyuria	12	8
Flank pain	108	72
AKI	3	2
Previous stone treatment history		
Overall	56	37.3
ESWL	35	23.3
PCNL	21	14

BMI: Body mass index, ESWL: Extra corporeal shock wave lithotripsy, PCNL: Percutaneous nephrolithotripsy

Table 2: Stone size and operative time versus stone free rates

Stone size (cm)	n	Right	Left	Bilateral	Average operative time	Clearance rate (%)
<1.0	24	3	0	21	74.5 min	95
1.0–2.0	96	48	42	6	92.7 min	92
2.0–3.0	15	9	5	1	105.2 min	84.2
>3.0	15	8	7	0	130.0 min	80.5
Overall SFR	-	-	-	-		87.9

SFR: Stone free rates

Table 3: Compications after retrograde intra renal surgery

Symptoms	n (%)
Fever	6 cases (4)
Flank pain	3 cases (2)
UTI	3 case (2)
Hospital stay	2.3 days

the potential risk of bleeding, SWL may not be the first choice for patients who suffer from larger (>2.0 cm) or complicated upper ureteral calculi, especially for those with solitary kidney or coagulopathy. By contrast, PCNL is another surgical treatment for upper urinary tract calculi. This procedure allows for rapid removal of multiple stones and is associated with high SFR. However, it can also lead to some significant complications such as severe bleeding (11.2–17.5%), urinary tract extravasations (7.2%), colonic iatrogenic injury (0.8%), and even pleural injury (3.1%).[7] Ahmed et al., reported that pre-operative urine culture positivity and secondary calyceal stones can increase PCNL complication rates and SFR. In a global study on 1448 cases by Wei et al., the calyceal site was associated with decreased fitness for PCNL surgery and an increased risk of post-operative complication compared with renal site. Although recent studies have suggested that ultramini PCNL (UMP) can reduce the incidence of complications and that its SFR is not inferior in comparison with RIRS,[8-10] Schoenthaler et al.,[11] noted that the complication rates in UMP and RIRS are comparable with current series and earlier studies, but the prone position of UMP still results in cardiovascular insult in some patients who have an underlying disease such as obesity, COPD, congested heart failure, or cardiovascular accident. RIRS has progressed rapidly since the 1990s, when the holmium: Yttrium aluminum garnet laser system was introduced. RIRS become popular with the development of the more durable models such as Flex-X from Karl Storz Endoskope, Tuttlingen, Germany and URF-P from Olympus, Tokyo, Japan. Furthermore, the recently introduced compact aperture digital video scope and disposable video scope contributed to becoming more popular of RIRS RIRS is constantly evolving and has also recently been used to treat renal sinus cysts besides stones. Because of its minimal invasive nature and high SFR, RIRS is being widely used to treat patients with large renal stones over the past few years.[12-14] Hyams et al.,[15] indicated post-RIRS stone-street rate incidence rate of 1.7% among patients whose stone sizes are around 2.0 cm to 3.0 cm. Mariani[16] also reported a stone-street incidence rate of 18.7% in cases where renal stones are larger than 4.0 cm. In this study, 10 patients had upper urinary tract calculi size more than 2.0 cm, and 4 of these 10 patients (45.5%) underwent staged RIRS due to the large stones size (range, 2.0–4.3 cm; average stone size, 2.6 cm) with comorbidities of COPD, congested heart failure, and cardiovascular accident. Two patients had steinstrasse with hydronephrosis after the removal of double-J stent, but the stones passage in the 1st-month follow-up under conservative oral hydration treatment. In our study, the overall SFR in the study group was 87.9% without major complication in patients whose stone burden was over 2.0 cm (2.0–3.0: 84.2%; >3.0 cm: 80.5%). According to our study group, RIRS has the advantages of being minimally invasive with good SFR, renal function preservation, short hospital stay, and low complication rate not inferior to PCNL/UMP. In some selected patients with comorbidities or psychogenic fear of invasive procedure concerns, staged RIRS for upper urinary tract calculi treatment may be the primary choice. However, it is not with dis advantages, the operative times are high compared with standard PCNL or UMP. But still due to its high SFR we think RIRS could be the optimal choice for stones >2 cm.

To the best of our knowledge, RIRS for large renal stone manipulation is an effective and safe treatment modality at present. Single RIRS SFR is not inferior to rate PNL even when the stone burden is between 2.0 cm and 3.0 cm. For patients whose stone burden is over 2.0 cm, staged RIRS can also provide acceptable SFR and a lower complication and overall SFR compared with PNL/UMP[7] We believe that with the advancement of RIRS equipment such as laser fiber and electronic devices, RIRS may became more efficient for large renal stone manipulation. Furthermore, the RIRS may become the treatment of choice for large renal stones.

Limitations of the study

This study still has some limitations. First, our study included only a low number of participants. Second, the follow-up duration was short, which made it difficult to evaluate the long-term effects and complications of RIRS. Third, this is not a comparative study To overcome these limitations, prospective studies with more longitudinal designs and a larger sample size, which will enable assessing the long-term outcome of

RIRS, are necessary. In addition, long-term follow-up studies are necessary to evaluate the late postoperative complications, such as ureteral stenosis and renal function impaction.

CONCLUSION

Through our study, we concluded that RIRS for large renal stone management is an effective and safe treatment modality currently. In our study, the single RIRS stone free rate was better even when the stone size is between 2.0 cm and 3.0 cm (85%). For those patients whose stone burden was over 3.0 cm or for those with comorbidities, staged RIRS resulted in a lower complication rate, reduced hospital stay, and better SFR (80.5%).

ACKNOWLEDGMENT

We Acknowledge the tremendous help provided by Our Assistant Professors Dr. P. Senthil Kumar, Dr. N. Jayaprakash, Dr. M. Rajasekar, Dr. P. Pugazhenthi, Dr. G. Mahendran, Dr. Saravanan in admitting and following up all the Cases.

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Authors Contribution:
PP- Definition of intellectual content, Literature survey, Prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation; **RS-** Concept, design, clinical protocol, manuscript preparation; **RR-** Design of study, statistical Analysis and Interpretation and submission of Article; **SG-** Statistical Analysis and Interpretation, editing, and manuscript revision; **SS-** Coordination and Manuscript Revision.

Work attributed to:
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Source of Support: Nil, **Conflicts of Interest:** None declared.