Is RIRS emerging as the preferred option for the management of 2 cm-4 cm renal stones: our experience

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Introduction: *The European Association of Urology (EAU) and the American Urological Association (AUA) guidelines recommend percutaneous nephrolithotomy (PCNL) as the first-line treatment of renal stones greater than 20 mm, however multistage retrograde intrarenal stone surgery (RIRS) is reported to have high stone-free rates (SFR), fewer complications and a rapid learning curve. This study presents our experience of RIRS in the management of 2 cm-4 cm renal stones.*

Materials and methods: *A retrospective study was performed of all patients who underwent RIRS for 2 cm-4 cm renal stones over a period of 22 months. The demographics of 71 patients as well as the stone and procedural demographics were recorded. Pre and postoperative radiological assessment was performed by NCCT scanning in 83% of the patients* ***and u****reteral access sheaths were used in only 12% of the patients. The severity of surgical complications was determined according to the Clavien-Dindo system.*

Results: *RIRS was performed on 71 patients for renal stones with a mean size of 26 mm. The mean number of procedures per patient was 2.1 and the overall SFR was 81%. Few complications were encountered and only 1 patient had III-b Clavien complication.*

Conclusion: *The study further supports RIRS as a safe and efficacious treatment option for renal stones of 2 cm-4 cm in size. Although both the EAU and AUA do not currently recommend RIRS as the first-line treatment of such stones, it appears to be emerging as a commonly utilized primary modality.*

Key Words: renal stones, flexible ureteroscopy, retrograde intrarenal surgery, urinary tract calculi, holmium laser fragmentation

Introduction

Extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL) and retrograde intrarenal stone surgery (RIRS) are the treatment modalities commonly used in managing renal calculi. PCNL is currently recommended as the first-line treatment of renal calculi larger than 20 mm. Furthermore, it is stated that RIRS cannot be recommended as the first-line treatment for renal stones > 20 mm.[1] While international guidelines recommend PCNL as the treatment of choice for large renal stones, recent studies show that multistage RIRS can achieve a high rate of stone clearance with low morbidity.[2] We present a retrospective study of our experience of flexible ureteroscopy and holmium laser fragmentation performed for renal stones with sizes ranging from 20 mm-40 mm and assess the efficacy of this modality as a suitable alternative treatment for such stones.

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Materials and methods

Our approach is to offer RIRS as the preferred treatment option to patients presenting with renal stones between 20 mm and 40 mm in diameter. PCNL was discussed as a second option since it is documented to have a higher complication rate, however patients with stones larger than 40 mm were not advised RIRS. Other factors including the number and location of

TABLE 1. **Patient demographics: (71 patients)**

Sex (male : female)	42 (59%) : 29 (41%)
Mean age (years)	45 (range 16-82)
Mean (BMI)	27.6 (range 15-49)
Pre-procedural DJ stenting	9 (13%)
Initial treatment with SWL	7 (10%)
Initial treatment with PCNL	2 (3%)
Primary flexible URS	62 (87%)

BMI = body mass index; SWL = shock wave lithotripsy; PCNL = percutaneous nephrolithotomy; URS = ureteroscopy

the calculi, the anatomy and function of the kidneys, body mass index (BMI) and comorbidities were also taken into consideration.

The merits and complications of both modalities were explained including the possibility of having to repeat the ureteroscopic sessions and an informed consent was taken for all patients.

Eighty-three patients underwent RIRS between January 2013 and October 2014 of whom 12 had secondary RIRS for renal stones smaller than 20 mm due to failed ESWL. These patients were excluded leaving 71 patients in the study. Eight out of these patients had RIRS performed in both kidneys hence 79 renal units were treated. The patients' demographics, stone parameters and procedural demographics were recorded in Tables 1, 2 and 3. There were no patients with coagulopathy. The stone burden in each renal unit was measured as the sum of the longest axial diameters of all the stones and the volume of an individual stone was calculated using the equation of volume for an ellipsoid structure.[3] The total stone volume in each kidney was obtained by adding the individual stone volumes.

Preoperative laboratory investigations included full blood count, serum creatinine, calcium and uric acid, coagulation screening, urinalysis and culture. Pre and postoperative radiological stone assessment was performed by using abdominal NCCT scanning in 83% of the cases or a combination of plain abdominal X-rays and KUB ultrasonography in the remainder. IVU was performed prior to surgery in all patients when not contraindicated. All procedures were performed with GA under the supervision of one consultant urologist. A flexi-tip dual lumen ureteral access catheter (10 Fr, Cook) or rigid ureteroscope (Karl Storz 9.5 Fr) were initially passed followed by the flexible ureteroscope (Olympus URF-V). This was passed over a nitinol hydrophilic guidewire under fluoroscopic control. Ureteral access

TABLE 2. **Stone demographics**

No. of patients	71
No. of renal units	79
Mean stone burden (diameter) per renal unit	26.3 mm (range: 20 mm-42 mm)
Mean stone volume per renal unit	3543 mm^3 (range: 1144 mm^3-9172 mm^3)
No. of renal units with single stone	49
No. of renal units with multiple stones	30
No. of patients with stones in renal pelvis	66/71 (93%)
No. of patients with stones in upper calyx	5/71 (7%)
No. of patients with stones in middle calyx	14/71 (20%)
No. of patients with stones in lower calyx	31/71 (44%)
Mean diameter of stones in pelvis	22.4 mm (range: 20 mm-42 mm)
Mean volume of stones in the pelvis	3517 mm^3 (range: 1747 mm^3-9172 mm^3)
Mean diameter of stones in upper calyx	10.2 mm (range: 7 mm-22 mm)
Mean volume of stones in upper calyx	398 mm^3 (range: 152 mm^3-1384 mm^3)
Mean diameter of stones in middle calyx	9.4 mm (range: 6 mm-20 mm)
Mean volume of stones in middle calyx	364 mm^3 (93 mm^3-1147 mm^3)
Mean diameter of stones in lower calyx	10.7 mm (range: 6 mm-22 mm)
Mean volume of stones in lower calyx	487 mm^3 (range: 49 mm^3-2082 mm^3)

TABLE 3. **Procedure demographics**

Total no. of procedures	148
No. of renal units with one session	32 (40.5%)
Two sessions	27 (34%)
Three sessions	18 (22.8%)
Four sessions	2 (2.5%)
Mean no. of procedures per patient	2.1
Operating time	Mean 112 minutes (range 65-225)
Post procedural DJ stent	58 (82%)
Hospital stay	Mean 2.8 days (range 2-9)
Stone-free rate	81%
Complication rate (Clavien-Dindo grading)[4]	Grade II (fever) 6 (8.5%) Grade III-a, (extravasation-PCD) 1 (1.4%) Grade III-b, (Steinstrasse-URS) 1 (1.4%) Overall 8 (11.2%)
Auxiliary procedures	1 (rigid URS for Steinstrasse)

URS = ureteroscopy

sheaths (12/14 Fr, Cook) were used in only 12% of the procedures when further ureteric dilatation was necessary for passage of the flexible ureteroscope. The energy and frequency settings for the Holmium YAG laser (Odyssey, Cook) were 0.6 to 1.0 J and 7 to 12 Hz (4.2 to 12 W) using a 273 µ laser fiber. The power was increased gradually when needed to achieve stone fragmentation. Nitinol stone baskets (2.2 Fr or 1.7 Fr Cook) were used to reposition lower calyceal calculi located in sites difficult to access before laser fragmentation, however they were rarely used to retrieve stone fragments because of thorough stone disintegration.

DJ stents were inserted postoperatively in 82% of the patients whenever significant residual stones remained or ureteric trauma was suspected. The stone-free rate (SFR) was defined as residual stones of 4 mm or less seen on the NCCT scan or U/S KUB performed 3 months after the final procedure.

Results

Of the 79 kidneys treated 49 had a single stone and 30 had multiple stones with a mean stone burden and volume of 26.3 mm and 3543 mm^3 respectively. The mean operating time was 112 minutes and the number of procedures 2.1 per patient. Ureteral access sheaths were only used in 12% of the patients and 82% of the patients had post procedural DJ stenting which included all the patients in whom ureteral access sheaths were utilized. A SFR of 81% was achieved with complications in 8 patients, 6 with Clavien Grade II and 2 patients with Grade III complications.

Discussion

Both the European Association of Urology (EAU) and the American Urological Association (AUA) guidelines do not currently recommend RIRS as a first-line treatment for renal stones.[5] PCNL is recommended as the first-line treatment option for larger renal stones, however major complications have been reported which include hemorrhage, septicemia, extravasation, colonic and pleural injuries.[6] The overall complication rate has been reported in up to 50% of cases with major complication rates reaching 20%.[7] However more recent series have reported fewer complications.[8] There is nonetheless a lack of standardization in the reporting of the severity of complications since validated grading methods such as the Clavien-Dindo system are often not utilized[7] and furthermore a recent study giving an overview of PCNL outcomes in England reports lower bleeding, UTI and sepsis rates which the authors admit could represent an under-reporting phenomenon.[9] Also there are data that indicates functional parenchymal loss occurs after PCNL[7] which adds weight to its more invasive nature rendering it a less attractive option. Bearing in mind the established higher complication rates of PCNL, definitive data on how many procedures need to be

performed to gain and maintain surgical competence for this procedure is currently lacking.[10] Training in PCNL has a steep learning curve.[10] This is in contrast to the rapid learning curve described for flexible ureteroscopy.[11] Technological improvements in modern flexible ureteroscopes have led to the development of thinner and more durable instruments with larger working channels. Increasingly studies have shown that RIRS can be successfully applied to stones larger than 20 mm with a considerable decrease in the complication rates making this option more attractive especially for the elderly age group.[6] Furthermore safe and effective removal of multiple, large and complex intrarenal stones by RIRS, including lower pole calculi have been documented suggesting RIRS is effective for treatment of such stones.[5] This includes patients with coagulopathy who are at a greater risk of hemorrhagic and thromboembolic complications when undergoing PCNL.[12]

The use of ureteral access sheath (UAS) remains debatable. Despite the reported benefits of using UAS which are said to facilitate the repeated passage of ureteroscopes for retrieval of stone fragments, as well as maintain low intrarenal irrigating pressures thereby reducing pyelovenous backflow and the risk of sepsis,[8,13] there is however uncertainty in advising the routine use of these sheaths. Approximately 50% of patients are reported to have some degree of ureteric wall injury after their use,[14] furthermore 30% of the attempts at passing UAS are unsuccessful.[15] Some authors have suggested their utilization is at the discretion of the surgeon whereas others have stated that the routine use of UAS may not be ideal.[14] In our study UAS was used in only 12% of the patients with comparable outcomes in terms of SFRs, the number of ureteroscopic sessions per patient and complications. In a survey conducted by the EAU on the practice patterns of flexible ureteroscopy, routine use of UAS was preferred by 71% of urologists and 50% reported retrieval of larger fragments using this approach. The survey also found senior urologists were less likely to perform stone retrieval than younger urologists.[2]

In a recent review of 10 studies in which RIRS was performed on 561 patients with large stones (mean size 2.8 cm), the overall SFR was 86.3%, ranging from 47%-97%, after a mean of 1.6 procedures (range from 1.1 to 2.3).[2] In our study, the overall SFR of 81% for stones with a mean size of 26 mm compares favorably. Evidence suggests that the use of CT for assessment of residual fragments results in lower SFRs[2] and this may have had a further impact on the results of this study in which 83% of the patients had CT scanning for pre and postoperative radiological stone assessment.

Conclusion

This study further supports RIRS as a safe and efficacious treatment option for large renal stones 2 cm-4 cm in size. RIRS is documented to have a rapid learning curve and fewer complications than PCNL and although both the EAU and the AUA guidelines do not currently recommend RIRS as a first-line treatment of large renal stones, it is emerging as a commonly utilized primary modality. In this study UAS was used infrequently and pulverization of stones was preferred to retrieval by basketing, however this technique does not appear to have negatively affected the surgical outcome. □

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