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ORIGINAL PAPER

Ureteroscopic retrograde intrarenal surgery after previous open renal stone surgery: initial experience

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Abstract The management of renal calculi following previous open surgery represents a challenge for urologists. The aim of this study is to evaluate the outcomes and safety of ureteroscopic laser retrograde intrarenal surgery (RIRS) for renal calculi following prior open renal surgery. The charts of 53 patients who underwent RIRS for renal calculi following prior open surgery for urolithiasis were reviewed. Both flexible and semi-rigid ureteroscopes were utilized together with holmium: YAG laser for stone disintegration. Intravenous urography, computed tomography (CT) and ultrasound were used to evaluate the patient, perioperatively. Stone size ranged from 5 to 32 mm (mean 14.3 mm). The mean operative time was 86 min (20–130). The overall stone-free rate was 92.4%. The overall stone-free rates after one and two-procedures were 79.2% (42 cases) and 92.4% (49 cases), respectively. Four patients (7.5%) had larger residual fragments, 2 (3.8%) of them underwent SWL, and 2 (3.8%) cases were followed up conservatively. Major complications were reported in two patients (3.8%). Stone analysis revealed calcium oxalate in 39 patients, uric acid in 5, calcium phosphate in 4, struvite in 3, and cystine in 2 cases. Ureteroscopic retrograde intrarenal surgery for renal calculi following prior open renal surgery was a minimally invasive, safe procedure with a high success rate. It is a viable alternative for PNL in managing recurrent renal calculi efficiently.

Keywords Flexible ureterorenoscopy · Holmium Laser lithotripsy · Percutaneous nephrostolithotomy · Urolithiasis

Abbreviations

CT	Computed tomography
Holmium:YAG	Holmium:yttrium aluminium garnet
IVU	Intravenous urography
PNL	Percutaneous nephrostolithotomy
RIRS	Retrograde intrarenal surgery
SWL	Extracorporeal shock wave lithotripsy

Introduction

The surgical management of urolithiasis has undergone dramatic changes and witnessed technological innovations in the field of urologic surgery over the past 20 years [1].

Although shock wave lithotripsy (SWL) is recommended as the first-line therapy for the treatment of intrarenal calculi <20 mm [2, 3], the success rate decreases when treating multiple calculi, lower-pole stones, and hard stones like calcium oxalate monohydrate [4]. PNL (percutaneous nephrostolithotomy) is considered the standard of care for complex renal stones >20 mm, multiple renal stones, and lower-pole stones because of its high stone-free rates. Yet, PNL also carries greater morbidity than SWL and ureteroscopy (URS) [5, 6].

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The indications for open surgery have been narrowed significantly in the era of PNL, SWL and ureterorenoscopy. However, open surgery for nephrolithiasis still has role in selective cases [7, 8].

The management of recurrent renal calculi after previous open surgery represents challenge for urologists. It is not known whether endoscopic management of recurrent stones is technically more challenging following previous open renal surgery as a result of anatomical distortion.

Although PNL is an alternative option for primary and recurrent renal calculi, yet associated fibrosis with previous open renal surgery makes renal puncture and tract dilation difficult [10].

Recent studies have confirmed the efficacy and safety of RIRS using both semi-rigid and flexible endoscopes to treat intrarenal calculi and SWL resistant calculi [9, 11, 12, 17, 19].

The aim of our study is to evaluate the outcomes and safety of retrograde ureterorenoscopy and holmium laser lithotripsy to treat intrarenal calculi after previous open renal surgery for urolithiasis.

Materials and methods

Between April 2006 and April 2010, 645 patients underwent ureteroscopy for upper tract calculi in our department at Assiut University Hospital. The notes of all 645 patients were reviewed and all patients who had previously had open surgery for renal stones were selected ($n = 53$). A detailed retrospective chart review was on this cohort (37 males, 16 females). All the patients had calculi after prior renal surgery for stones at least 6 months after last surgical intervention. Patients with renal calculi without previous renal surgery or those with prior renal surgery but undergone PNL or SWL were excluded from the study.

Regarding the comorbidities, 22 patients had hypertension, 13 had diabetes mellitus, and 9 cases were on aspirin which was stopped one week before ureteroscopy. All patients were offered SWL and PNL as alternative treatment options. Informed consent was obtained and included specific information of the possible need for multiple ureteroscopic procedures and stent placement. All patients evaluated by intravenous urography and/or spiral CT scan preoperatively to define the calyceal system anatomy together with the location and total stone burden (measured by the cumulative diameter of the intrarenal stones).

Technique

Second generation cephalosporin antibiotic was given on induction. Under general anesthesia, the patient was placed in the dorsal lithotomy position. Using 22 Fr cystoscope, a 0.035-mm flexible guide wire (Roadrunner, Cook Medical) passed to the ureter. A second 0.038-mm safety guide wire was placed under fluoroscopic guidance using a dual lumen Ureteral Access Catheter. This was quite sufficient to access the ureter with ureteroscopy without need for balloon dilation. Ureteral access sheath (12/16FForté, Applied Medical, CA, USA) was placed in 41(77%) patients to allow optimal visualization, maintain low intrarenal pressure, and facilitate extraction of stone fragments. The use of an access sheath was indicated in large stones or multiple stones where multiple passages through the ureter were required. No difficulty was encountered during insertion of the access sheath. Both semi-rigid (6.5 F, Richard-Wolf, Tuttlingen, Germany) and flexible (7.2 F, FLEX-X, STORZ, Tuttlingen, Germany) ureterorenoscopes were used for treatment together with Holmium: YAG Laser lithotripsy with 200 and 365 micron fibers. For lower-pole stones, they were displaced to the renal pelvis or the upper calyx to facilitate the laser disintegration, decrease scope fatigue, and avoid loss of deflection.

The laser energy setting varied depending on stone composition (mean 1.0 J) at a frequency of 5 ± 15 Hz. All stones were fragmented into small fragments that could be retrieved with small caliber nitinol baskets or forceps and sent for analysis.

At the end of the procedure, a double-J stent was placed. The patients were discharged 1–2 days following surgery on antibiotic for 5–7 days, analgesic, and Detrusitol to minimize irritative symptoms secondary to stent placement.

Follow-up was done by ultrasound and Plain X-ray film 1–2 weeks after the primary procedure. Stone-free status was defined by the absence of stones in the kidney or residual fragments $\leq$3 mm that could pass spontaneously. The second or third procedure was done 10–15 days after the last ureteroscopic intervention. KUB or spiral CT and ultrasound 6–8 weeks after the last procedure to assess stone clearance and detect late complications especially stricture formation (Figs. 1, 2).

Results

Fifty-three patients (37 males, 16 females) who underwent retrograde ureteroscopy and Holmium laser lithotripsy for recurrent renal stones were identified. The mean patient age was 51 years (range 18–65). All the patients had recurrent renal calculi after prior renal surgery for stones. Table 1 shows patients' characteristics. Stone characteristics are included in Table 2.

The total number of intrarenal calculi was 162. The mean stone size was 14.3 mm (5–32) and mean number of stones per patient was 3.05 [2–8]. Preoperative DJ stent placement was reported in 18 (34%) cases for indications

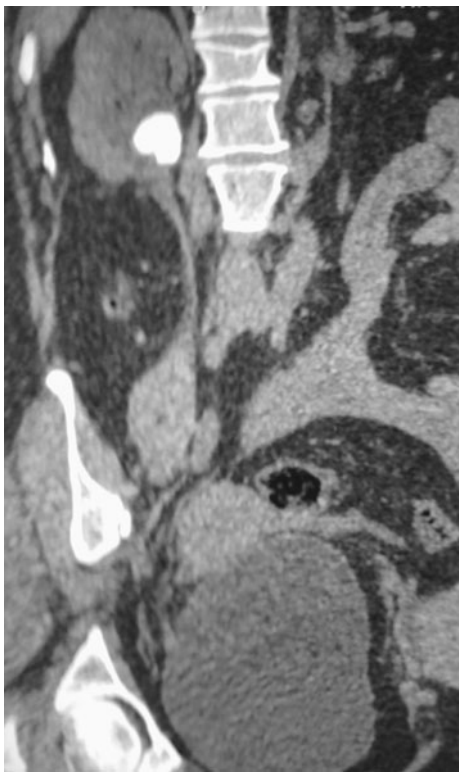

Fig. 1 Preoperative CT image of stone pelvis RT kidney

Fig. 2 Postoperative CT image of same patient with complete clearance of stone

Table 1 Patients characteristics ($n = 53$ patients)

Age	Mean 51 years (18–65)
Gender	
Male	37 (69.8%)
Female	16 (30.2%)
Previous open renal surgery	53 (100%)
Preoperative DJ stent	18 (38%)
Anatomic abnormality	6 (11.3%)
Duplex kidney	3 (5.6%)
Horseshoe kidney	2 (3.7%)
Ectopic pelvic kidney	1 (1.8%)
Site localization	
Right	28 (52.8%)
Left	18 (33.9%)
Both sides	7 (13.3%)

Table 2 Stone characteristics

Total stone number	162 (100%)
Stone location	
Upper calyx	35
Middle calyx	41
Renal pelvis	38
Lower calyx	48
Stone size (mm)	5–32 (mean 114.3 mm)
Number of stones per patient	2–8 (mean 3.05)

that included pre-ESWL stenting in 7 (13.2%) cases, post renal surgery in 6 (11.3%) cases, presence of a solitary kidney in 1 (1.9%) case, and referred from outside hospital in 4 (7.5%) cases. The perioperative results are summarized in Table 3.

The mean operative time was 86 min (20–130). The operative time was measured from the time of cystoscopy to the end of stent placement. The procedure that lasted 20 min was aborted because of the bleeding, which occurred and resulted in poor vision. A double-J ureteral stent was placed at the end of each therapeutic procedure and was removed 7–10 days after the final procedure. Stone-free rates after the procedures are included in Table 4.

The stone-free rate after the single procedure was 79.2%. The overall stone-free rate after the second procedure was 92.45% during follow-up. Four patients (7.5%) had larger residual fragments that ranged 5–12 mm after the second procedure. Two (3.7%) of them underwent SWL and the other two (3.7%) cases were followed up conservatively.

Table 3 Perioperative results

Operative time (min)	82 (20–130) min
Use of access sheath	41 (77%) patients
Postoperative ureteral DJ stent	53 (100%) Patients
Intra-operative complications	2/53 (3.7%) patients
Ureteral perforation + extravasation	1 (1.8%)
Bleeding and abortion of procedure	1 (1.8%)
Postoperative complications	9/53 (17%) patients
Febrile UTI	4
Hematuria	1
Acute urine retention	1
Steinstrasse	2
Obstructive anuria	1

As regards stone localization, 9/9 patients (100%) with upper-pole calculi, 9/10 (90%) with middle-calyx calculi, 19/22 (86.4%) with lower-pole calculi, and 12/12 (100%) with pelvic calculi achieved stone-free status after a second procedure.

There were two (3.7%) intra-operative complications (Table 3). One patient had significant bleeding that resulted in poor visibility, which led to the procedure being immediately terminated. However, no blood transfusion was necessary. This patient underwent an uncomplicated second procedure 2 weeks later. The other patient had a ureteral perforation that was managed conservatively with a ureteral stent. A follow-up IVP 6 weeks after stent removal documented resolution of the perforation without stricture formation.

Postoperative complications were reported in 9 (17%) cases as noted in Table 3.

Four cases of low-grade fever and febrile UTI were managed conservatively with antibiotics in the outpatient clinic. Two cases had steinstrasse after the last procedure; one of them required ureteroscopy and laser lithotripsy, and the other patient was managed conservatively with stent placement for 2 weeks. One patient with a single kidney developed obstructive anuria 1 month after the last procedure due to earlier disintegrated fragments and was managed successfully with ureteroscopy and DJ stent.

Stone analysis revealed calcium oxalate in 39 (73.6%) patients, uric acid in 5 (9.4%) patients, calcium phosphate in 4 (7.5%) patients, struvite in 3 (5.6%) patients, and cystine in 2 (3.7%) patients.

Discussion

Both SWL and PNL are treatment options for renal stones (stone size <20 mm and 20 mm or more, respectively) in both the European Association of Urology (EAU) and American Urological Association (AUA) guidelines [2, 3].

Recent guidelines have recommended flexible ureteroscopy, a procedure that has a far superior success rate to that of SWL, for patients with lower-pole stones [3]. Flexible ureteroscopy is recognized as an effective treatment for SWL-refractory stones, and it is considered as the first-line treatment, especially for hard stones [3].

While PNL has an excellent success rate in treating a large renal stone burden, it is more invasive, with a significant rate of major complications [13–16].

Thanks to recent advances in flexible ureteroscopy and intracorporeal laser lithotripsy, current available endoscopes allow successful access to calculi throughout the intrarenal calyceal system. Recent studies have demonstrated that both semi-rigid and flexible ureterorenoscopy with holmium laser lithotripsy can be effective and safe as an alternative management option for larger and SWL-refractory intrarenal calculi [9, 11, 12, 19, 21].

Our series specifically addressed patients with recurrent stones after previous open surgery, which represents a great challenge to urologists in our locality. The access to the upper urinary tract by ureteroscopy after previous open renal surgery had many challenges. First, the associated fibrosis and distortion of the pelvic calyceal system, especially after repeated open renal procedures, which is a common finding in our locality. Secondly, bilharziasis is endemic in our region, causing inflammatory distortion of the bladder and ureters making access to the renal pelvis technically challenging.

Table 4 Stone-free success rate related to procedures and stone location

Stone localization	Patient's no.	Stone-free rate after one procedure (no stones or fragments ≤3 mm); *n* (%)	Number of patients undergoing a second procedure	Stone-free rate after second procedure (no stones or fragments ≤3 mm)); *n* (%)
Upper calyx	9	6	3	9
Middle calyx	10	8	1	9
Lower calyx	22	18	1	19
Renal pelvis	12	10	2	12
Total patient number	53 (100%)	42 (79.2%)	7 (23.7%)	49 (92.4%)

Our study shows that retrograde ureterorenoscopy/holmium laser lithotripsy is safe and efficient for management of recurrent intrarenal calculi after previous open renal surgery. We achieved total stone-free rate of 79.2 and 92.4% after single and second stage procedures, respectively. These results are comparable to similarly previously published series for RIRS with ureterorenoscopy [9, 11, 12, 16–21].

Retrograde ureterorenoscopy and Holmium: YAG laser lithotripsy has a universally low complication rate and is typically an outpatient procedure [9, 11, 12, 20].

Holmium: YAG laser has been proved to be an efficient method for treating all urinary calculi, regardless of its composition. It is the preferred lithotripsy when using flexible ureterorenoscopy [11, 12, 23, 24]. Moreover, holmium laser and ureterorenoscopy can be done safely in patients with bleeding coagulopathy for whom stopping anticoagulants is deleterious [25].

The overall complication rate of ureteroscopy, which is reported in recent literature lies between 6 and 23% [9, 11, 12, 17–24]. In our study, the overall complication rate was 20.7%. Two (3.9%) intra-operative complications were reported: one patient had significant bleeding, which resulted in poor visibility and led to termination of the procedure, and another patient had a ureteral perforation that was managed conservatively with a ureteral stent without stricture sequels during the last follow-up.

Postoperative complications were reported in 9 (17%) cases, all except two cases were managed conservatively in the outpatient clinic. One patient developed steinstrasse and required ureteroscopy and laser lithotripsy 2 months after last procedure. The other patient with a single kidney developed obstructive anuria 1 month after the last procedure due to earlier disintegrated fragments and was managed successfully with ureteroscopy and a DJ stent. The overall complication rate (20.7%), which is reported in our study, is comparable to similar published series [11, 12, 20–23].

The main advantages of retrograde ureteroscopic management of renal calculi are the minimal patient morbidity in handling of large stone burden together with short hospitalization and rapid convalescence. In our hands, the overall stone-free rate was 92.4%.This rate is practically achieved with an acceptable number of procedures in an outpatient setting with minimal morbidity and convalescence.

Limitations of our study include its retrospective nature, non-randomization, and a relative small number of cases. However, this is our initial experience with retrograde ureterorenoscopy and holmium laser for recurrent renal calculi. Long-term prospective studies with larger patient groups are recommended to standardize the role of retrograde ureterorenoscopy in management of recurrent renal calculi especially in comparison to more invasive options like PNL.

Conclusions

Retrograde ureterorenoscopy with holmium laser lithotripsy for recurrent renal calculi is a minimally invasive, safe procedure with a high success rate and low morbidity during intermediate follow-up. Multistage procedures may improve short-term stone-free rate. The procedure is an encouraging viable option for managing recurrent renal calculi efficiently with minimal morbidity especially in comorbid patients and in those on aspirin.

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