

Safety and feasibility of day case ureteroscopy and laser lithotripsy (URSL) in patients with a solitary kidney

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Introduction The management of nephrolithiasis in patients with a solitary kidney poses a treatment challenge. The study aimed to evaluate the outcomes of ureteroscopy and laser stone fragmentation (URSL) for renal stones in these patients treated in our university teaching hospital.

Material and methods Between July 2012 and December 2014, seventeen cases of URSL for stones in a solitary kidney were reviewed. Patient demographics, stone dimensions, perioperative and post-operative outcomes were recorded in a prospectively maintained database. Serum creatinine levels pre-procedure and at follow-up were also compared.

Results Seventeen cases of URSL were conducted with a mean age of 52.9 ± 19.9 years. 8 of the 17 (47%) patients had stones in multiple locations and 13 (76%) were in the lower pole. The mean \pm SD stone size and BMI were 13.0 ± 8.9 mm and 31.6 ± 5.8 kg/m², respectively. The stone free rate (SFR) was 82.5%. Fourteen (82.5%) patients were discharged the same day and 16 cases (94%) were discharged within 24 hours. For patients with deranged pre-operative serum creatinine, the mean serum creatinine level improved from 131.2 ± 68.3 µmol/L pre-URSL to 106.5 ± 36.7 µmol/L at follow-up. There was one Clavien grade II complication with a patient requiring additional antibiotics for post-operative urinary tract infection. There were no other major or minor complications.

Conclusions Day case ureteroscopy for stone disease in a solitary kidney is safe and feasible with a low complication rate and an overall improvement in renal function.

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INTRODUCTION

In patients with a solitary kidney minimally invasive treatments preserving their renal function with a low risk of procedure-related complications are of paramount importance [1]. In the absence of a contralateral functioning kidney, such outcomes are pivotal to avoid organ loss and subsequent risk of haemodialysis and transplantation. Percutaneous nephrolithotomy (PCNL), extracorporeal shock wave lithotripsy (ESWL) and ureteroscopy and laser stone fragmentation (URSL) are now the standard treatment modalities for the majority of upper tract stone diseases [2]. None, however, are without their complications making the management of nephroli-

hiasis in this cohort of patients particularly challenging. PCNL, while demonstrating excellent stone-free rates (SFR), is associated with a high risk of bleeding, a complication which is of particular concern for patients with a solitary kidney as the risk of haemorrhage is greater due to compensatory hypertrophy of the renal parenchyma [3, 4]. SWL, while non-invasive, has been associated with the development of Steinstrasse, impaired renal function and a high risk of stone recurrence [5, 6].

URSL has shown to be an effective alternative to PCNL and SWL in the treatment of urinary tract stones with low complication rates and high stone-free rates in patients with bilateral kidneys [7]. However, only a few studies have reported outcomes

of URSL treatment in cases of a solitary kidney, thus we present our series of patients who underwent URSL for renal stones in a solitary kidney.

MATERIAL AND METHODS

We retrospectively analysed the outcomes of all URSL for renal/ureteric calculi in patients with a solitary kidney between July 2012 and December 2014 from our prospective database. Anatomical or functional cases of solitary kidney were established based on either a history of contralateral nephrectomy or by confirmation of poor function with dimercaptosuccinic acid (DMSA) scan or mercapto-acetyltriglycine (MAG-3) renogram. Patients who, during the study period, underwent multiple URSL for renal calculi were counted as separate cases provided that they had established stone-free status prior to the repeated URSL.

All patients underwent preoperative evaluation with history, physical examination, serum biochemistry, haematocrit level, urinalysis and imaging studies – a non-contrast abdominal computed tomography (CT) scan with additional ultrasonography (USG) or abdominal X-ray kidney-ureter-bladder (KUB). The demographic details of the patient population, stone characteristics including location and size, perioperative and postoperative outcomes were collected in a prospectively maintained database. Determination of stone size has been previously described [8] – this was calculated by measuring the maximum stone diameter on a CT scan or, in the case of multiple stones, the sum of the maximal dimensions of each stone.

Serum creatinine levels pre- and post-procedure were available from the electronic records and were also compared. Post-serum creatinine levels were defined as the serum creatinine at the time of follow-up up to 3 months post-URSL. SFR was defined as complete disappearance of stones or clinically insignificant residual fragments of 2 mm or less (2X, stone free level 2) [9]. At 6–12 weeks follow-up all patients underwent a plain radiograph of the kidneys, ureters and bladder to establish whether the patient had reached stone-free status. There was one case of a patient with a history of radiolucent stones thus this patient underwent USG to establish stone-free status.

Surgical technique

Informed consent was obtained from all patients. Under a general anaesthetic, patients had an initial cystoscopy and placement of a safety wire. A rigid ureteroscope was then used to visualise the ureter

and advance the second guidewire into the kidney. In cases of large or multiple renal stones a ureteral access sheath was introduced over a second guidewire. Flexible ureteroscopy and laser fragmentation was subsequently performed with all accessible stones fragmented to 1 or 2 mm or dust and larger fragments actively retrieved with a Cook Ngage stone extractor and sent for biochemical analysis. A 6F ureteral stent was placed after URSL, which was subsequently removed within 2 weeks.

RESULTS

There were a total of seventeen cases of URSL in a solitary kidney between July 2012 and December 2014, comprising of 11 males and 6 females with a mean age of 52.9 ± 19.9 years (range, 18 to 80) and a mean BMI of 31.6 ± 5.8 kg/m². Patient demographics and stone characteristics are shown in Table 1 and Table 2, respectively. There were 8 (47%) cases of multiple renal stones. The most common site for stone location was the lower pole of the kidney (76%). The large majority of stones were of mixed composition and there were no cases of struvite stones on biochemical analysis.

The intraoperative and postoperative outcomes are shown in Table 3. The mean operative time was 62.4 ± 23.1 minutes (range, 25 to 129 minutes) and 7 out of 17 (41.2%) procedures were performed without an access sheath. Fourteen cases (82.4%) achieved stone free status after the initial procedure. The remaining three were in a difficult lower pole calyx and could not be cleared completely ureteroscopically. These patients were asymptomatic and were discussed in our multi-disciplinary team meeting for a period of observation first.

We did not routinely check the post-operative creatinine immediately after the procedure with 14 patients getting discharged the same day. For patients with borderline or abnormal renal function this was measured and the mean serum creatinine levels pre-

Table 1. Patient demographics ($n = 17$)

	Patient demographics, n (%)
Gender	
Male	11 (64.7)
Female	6 (35.3)
Age (year), mean \pm SD	52.9 ± 19.9
BMI (kg/m ²), mean \pm SD	31.6 ± 5.8
Solitary kidney, n (%)	
Contralateral non-functioning kidney	9
Previous nephrectomy	8

BMI – body mass index; SD – standard deviation

Table 2. Stone characteristics ($n = 17$)

Stone size (mm), mean \pm SD	13.0 \pm 8.9
Cumulative stone location, n (%)	
VUJ	1 (2.9)
Distal ureter	3 (8.8)
Mid ureter	3 (8.8)
Upper ureter	0 (0)
PUJ	5 (14.7)
Renal pelvis	1 (2.9)
Upper renal pole	3 (8.8)
Mid renal pole	5 (14.7)
Lower renal pole	13 (38.2)
Stone composition, n (%)	
Calcium oxalate	1
Uric acid	1
Cystine	3
Mixed	10
Unavailable	2

Table 3. Intraoperative and postoperative outcomes ($n = 17$)

Operative time (min), mean \pm SD	62.4 \pm 23.1
Use of access sheath, n (%)	10 (58.8)
Initial stone free rate, n (%)	14 (82.4)
Preoperative serum creatinine ($\mu\text{mol/L}$), mean \pm SD	125.6 \pm 73.9*
Postoperative serum creatinine ($\mu\text{mol/L}$), mean \pm SD	102.1 \pm 33.8**
Complication rate, n (%)	1 (5.9)
Time to discharge, n (%)	
Same day	14 (82.4)
<24 hours	2 (11.8)
>24 hours	1 (5.9)

*all patients, ** based on 14 patients for whom both pre- and post-serum creatinine levels were available

and post-procedures was $125.6 \pm 73.9 \mu\text{mol/L}$ and $102.1 \pm 33.8 \mu\text{mol/L}$, respectively (percentage decrease of 18.7%).

Complications were classified according to the Clavien grade. Of all 17 patients, there was only 1 complication noted, which necessitated treatment with antibiotics and was classified as Clavien grade II. Of significance, however, is that the patient was re-admitted 3 days post-ureteroscopy with sepsis although a cause for this was not clearly identified with negative urine and blood cultures. The patient had a background of multiple admissions with presumed lower respiratory and urinary tract infections, thus it is debatable whether this was a true complication of ureteroscopy or simply an exacerbation of her lower respiratory infection.

The vast majority of cases were discharged the same day of the procedure (82.4%). It is noteworthy that of the remaining cases, one was a social admission and 2 patients were hospitalized overnight for observation as they underwent their respective procedures later during the day of the procedure. Thus, only

one case in our study required procedure-associated hospitalisation for more than 24 hours. However, by contrast to the other 16 cases, this patient had undergone emergency URSL secondary to urosepsis and had already been hospitalised for 6 days prior to undergoing ureterscopy.

DISCUSSION

The last 30 years has witnessed a dramatic expansion in the use of ureteroscopy primarily due to the rapidity of technological advances, namely the development of electrohydraulic and ultrasonic lithotripsy, new grasping devices, semi-rigid flexible ureteroscopes and intra-corporeal holmium laser technology. Indeed, ureteroscopy has been reported to be effectively and safely employed for stone treatment in complex patient groups such as pregnancy, obesity, bleeding diathesis and large renal stones [10–17]. Our results show that ureteroscopy for stone disease in a solitary kidney is a safe and effective procedure that does not cause deterioration in renal function, which is consistent with previous reports. There have been concerns regarding the risk of renal dysfunction secondary to high pressure irrigation during URSL [18]. Studies investigating URSL treatment in the solitary kidney to date have shown no significant alteration in mean serum creatinine levels pre and post-procedure [9, 19, 20, 21]. Indeed our study suggests that for patients with deranged renal function, this improves following URSL, which was observed for both ureteric and renal stones.

To our knowledge there have been 4 studies which have evaluated the safety and efficacy of URSL in the treatment of renal stones in the solitary kidney, all of whom have concluded good outcomes with URSL including high stone-free rates, low morbidity rate and minimal impact on renal function [9, 19, 20, 21]. The initial SFR and final SFR across these studies have ranged from 64.4% and 83.3% to 66.6% and 95.8%, respectively. In a retrospective study of 24 patients, Atis et al reported a stone-free rate of 83.3% following the first procedure, which is similar to our results in which 82.4% achieved stone free status following URSL [9]. By contrast to our study in which the 3 patients who did not achieve stone-free status did not undergo second stage URSL, Atis et al. reported an increase in stone-free status to 95.8% after second-stage URSL [9].

By comparison to URSL, outcomes of PCNL and SWL have been much more extensively studied in the solitary kidney. With regards to the latter, the use of SWL is limited by its low stone-free rates versus its comparators [22, 23]. Both Resorlu

et al. and Kruck et al. found that URSL and PCNL provide significantly higher stone-free rates and a lower re-treatment rate by contrast to SWL [22, 23]. In a recent study, Yuruk et al. reported that, though both SWL and URSL can be conducted safely for patients with a solitary kidney, 23.3% and 5.5% of patients required salvage URSL following SWL and URSL, respectively, resulting in the number of sessions required to achieve a stone-free status being significantly greater in the SWL group by comparison to URSL [19]. Furthermore, the externally applied shockwaves are associated with the potential risk of perirenal or subcapsular hematoma which although rare, are relatively severe complications for patients with a solitary kidney [24]. In the long-term, though conflicting reports exist, SWL has been associated with the development of new-onset hypertension and diabetes mellitus [25, 26]. Its effects on renal function is yet another matter of debate, with Cass et al. reporting a clinically significant long-term deterioration in renal function while other studies have contradicted these findings [27, 28].

PCNL is also associated with significant complications such as haemorrhage, as mentioned previously, as well as injury to the surrounding viscera, sepsis and loss of kidney [3, 4]. Though associated with high stone-clearance rates, the potential complications of PCNL in patients with a solitary kidney cannot therefore be ignored. The Clinical Research Office of the Endourological Society (CROES) Percutaneous Nephrolithotomy Global Study found that by comparison with bilateral kidney patients, patients with a solitary kidney had significantly higher levels of renal impairment, lower stone-free rates and significantly greater transfusion rates [29].

We report a comparatively low complication rate (5.9%) by comparison to previous studies. There were no cases of major complications, consistent with the findings of two previous studies investigating the safety of URSL in the solitary kidney. Yuruk et al. reported 5 cases of colicky pain classified as Clavien grade 3a, although details of the intervention were not specified [19]. The authors did speculate that the lower pain threshold in the patient population and

the routine placement of a ureteral stent were plausible explanations for the patients' symptoms [19]. To date there have been no cases reported in the literature of renal haematomas, ureteral wall injuries or death from URSL treatment in the solitary kidney. [9, 19–21].

The majority of stone procedures in our series were done as a true day-case procedure. With its low complication rate, several reports have shown URSL to be suitable as outpatient surgery for the treatment of urolithiasis in the normal functioning kidney [30]. Atis et al. and Giusti et al. reported mean hospitalisation times for patients who underwent URSL for the solitary kidney of 1.56 ± 0.32 days and 1.4 ± 0.6 days, respectively [9, 21]. Our results have shown that a substantially high proportion of patients were discharged on the day of procedure indicating that URSL in the case of solitary kidney is feasible in the day case setting, which is of clear benefit for the patient and in terms of cost-effectiveness and efficiency of health care services.

Our study is the first reported series from the UK on the outcomes of ureteroscopy for stone disease in a solitary kidney, which shows the safety and efficacy even as a day-case procedure. The present study has some limitations. This is an analysis of data collected in a single institution comprising of a small sample size. Furthermore, our study did not assess the long-term effects of URSL on complication rates and renal function. Future studies should report on the long-term outcomes of URSL on these patients to confirm our findings.

CONCLUSIONS

Ureteroscopy for stone disease in the solitary kidney is effective, prevents stone-related complications while showing an overall improvement in renal function for some patients. Its safety and feasibility with a low complication rate lends itself to being suitable as a day-case procedure in this cohort of patients.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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