Ureteroscopy for nephrolithiasis in transplanted kidneys

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Introduction: *While percutaneous nephrolithotomy (PCNL) is often the procedure of choice for renal and ureteral calculi in transplant kidneys, retrograde ureteroscopy (URS) is a less frequently applied but excellent option if stone burden is small. We retrospectively examined nine surgical cases performed in seven patients in what appears to be the largest single institutional series reported to date.*
Materials and methods: *Seven patients underwent nine retrograde URS between June of 2009 and September of 2013, by two endourologists. These cases were reviewed retrospectively.*
Results: *Among the nine procedures, we were able to address the stone(s) endoscopically in seven. Among these procedures, laser lithotripsy was used in six cases, and basket stone extraction was applied in four procedures. Ureteral stents were placed following six procedures with ureteral access and treatment. Postoperative imaging revealed the patient to be stone free after five of the seven procedures with ureteral access and treatment. There were two postoperative urinary tract infections, and no major complications. Of the nine total procedures, six were outpatient, two were followed by observation stay < 24 hours, and one patient was admitted > 24 hours. Among the two failures, one underwent PCNL and the other had percutaneous nephrostomy (PNT) placed but expired from unrelated causes prior to the intended PCNL.*
Conclusions: *Retrograde URS with laser lithotripsy and/or basket extraction is a reasonable option for treating small renal transplant stones, with most patients in our series being discharged as outpatients, having complete stone clearance and avoiding PCNL.*

Key Words: transplanted kidneys, ureteroscopy, nephrolithiasis

Introduction

Renal calculi are uncommon in renal transplant patients, but when they arise they can lead to severe morbidity.[1,2] Renal transplant lithiasis occurs in 0.4%-1.0% of patients.[3] Treatment modalities are similar to those used in the general population, including shock wave lithotripsy (SWL), percutaneous nephrolithotomy (PCNL), and ureteroscopy (URS).

Data is limited about the efficacy and complications regarding use of retrograde URS in these patients, particularly with regard to use in stone disease. Del Pizzo et al describe a series of 14 patients with renal transplants who required retrograde URS, four of whom had urinary calculi.[4] Hyams presented an additional 12 patients treated with URS for stone disease, seven of which were retrograde and five were antegrade.[5] Given the small size of these data sets, we reviewed our own data to evaluate retrograde URS in the management of nephrolithiasis.

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Materials and methods

Via retrospective review of case logs, we identified a cohort of seven patients undergoing nine retrograde flexible URS procedures between June of 2009 and September of 2013, by two endourologists. We included all patients who had flexible retrograde URS performed for the intention of stone treatment in a transplanted kidney. These cases were reviewed retrospectively via electronic medical record to identify preoperative, intraoperative, and postoperative data which were recorded in standard fashion.

All patients were treated in the operating room under general anesthesia. Patients were placed into the dorsal lithotomy position. We obtained access via the patient's urethra with a cystoscope (flexible in men, rigid in women), and were able to gain access to the ureter with occasional difficulty, typically using a 6 Fr straight ureteral catheter and a stiff angled hydrophilic guidewire. When necessary owing to stone size, lithotripsy was performed with a 200 micron laser fiber delivering holmium:yttrium-aluminum-garnet (Ho:YAG) laser energy, starting at 8 Hz and 1 joule with variation of settings depending on stone behavior. Success was defined as radiographic clearance of stones documented postoperatively (with computed tomography or renal ultrasonography). See Figures 1 and 2.

Figure 1. Stone in the lower pole of a patient's transplanted kidney, shown here in the lower right quadrant of the patient's abdomen.

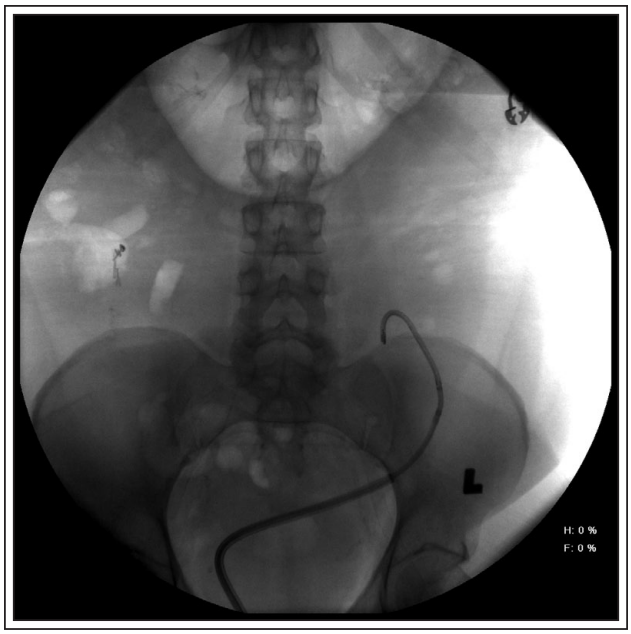

Figure 2. Ureteroscope in the same kidney after contrast has cleared, angled in multiple directions to reach stone.

Results

Retrograde flexible URS for nephrolithiasis was performed nine times in seven patients (one patient underwent three procedures). A summary of the patient demographic information is contained in Table 1. The most common presenting symptom was lower abdominal pain, in six patients. Other presenting symptoms included hematuria (2), fever (2), and recurrent urinary tract infection (2) (some patients had more than one sign or symptom). The mean length of time between renal transplantation and presentation with renal stone was 7.4 years. Average age at presentation was 60 years. Information related to the renal stone disease is tabulated in Table 2. There was a previous history of stones in three patients. There was no record of stone disease in the kidney donor in any case. Stone location was renal in all patients, except one, which was in the distal ureter. There were a mean of four stones in each patient, with the largest stone being an average of 7 mm.

A summary of operative details is contained in Table 3. Mean operative time was 73 minutes (range 50-148 minutes). Following the procedure, six patients were discharged as outpatients, two stayed overnight for observation, and one stayed for 7 days (required percutaneous nephrostomy, and had unrelated respiratory issues).

TABLE 1. **Patient demographics**

Mean age (range)	60 years (40-72)
Mean BMI (range)	22 (17-29)
Gender (No.)	Female (4), Male (3)
Race (No.)	Caucasian (4), African-American (1), Asian (1), Native American (1)
Mean years since transplant (range)	7.4 (4-10)
Donor source (No.)	Living (4), Deceased (3)
Cause of end stage renal disease (No.)	Obstructive uropathy/stones (1) Type 1 Diabetes Mellitus (3) Reflux nephropathy (1) Type II Diabetes Mellitus (1) Polycystic kidney disease (1)
Comorbidities (No.)	Hypertension (6) Coronary artery disease (5) Diabetes Mellitus (6)
No. with prior shockwave lithotripsy	1
No. with prior URS with lithotripsy	1
Underlying metabolic abnormality (No.)	Short gut syndrome (1), Hyperparathyroidism (1)

BMI = body mass index; URS = ureteroscopy

TABLE 2. **Stone characteristics**

Mean No. stones (range)	4 (1-11)
No. with previous history of stones	3
Mean largest stone (range)	7 mm (3-10 mm)
Presenting symptoms	
No. with hematuria	2
No. with abdominal pain	6
No. with recurrent UTI	2
No. with fever	2

UTI = urinary tract infection

TABLE 3. **Operative details**

Mean operative time (range)	73 minutes (50-148)
Hospital length of stay	6 DC from PACU 2 overnight stay < 24 hours 1 admitted for 1 week (required PNS, respiratory issues)
Access sheath used	5 cases (of 7)
Laser lithotripsy	6 cases (of 7)
Stone basketing	4 cases (of 7)
Stent placed	6 cases (of 8)

Details of the procedures are indicated in Table 4. We were able to obtain access to the renal pelvis in eight of nine procedures, and in seven procedures we were able to access the stone(s). We used a flexible Olympus ureteroscope URF-P5 to perform all procedures. Ureteral access sheaths were used in five of eight patients in which access was obtained. A stent was left after five of the seven procedures with successful access and stone treatment. Laser lithotripsy was used in six of these seven procedures. Basketing with a nitinol tipless basket was used during four of these seven procedures, and in one instance was all that was needed to remove the stone (the one successful case without laser). Electro-hydraulic lithotripsy was also used in one case for stone clearance. This was used along with holmium laser lithotripsy in the patient who had submucosal stones that required three procedures for ultimate clearance of her stone burden.

The two failures owed to inability to obtain access to the ureter (1 case), or successful flexible ureteroscope insertion but inability to access the stone due to difficult angles (1 case). The stone locations in these two patients were in the ureter and lower pole, respectively. One of these patients underwent PCNL with successful clearance of stone. The other patient had a percutaneous nephrostomy (PNT) placed, but expired from complications related to chronic kidney disease and renal failure prior to successful treatment.

TABLE 4. **Cases and procedures**

Patient	No. of procedures	Type of procedure	Stone location	Success?
1	1	Retrograde flexible ureteroscopy	Kidney, lower pole	yes
2	1	Retrograde flexible ureteroscopy	Kidney, UPJ	yes
3	1	Retrograde flexible ureteroscopy	Kidney, lower pole	yes
4	1	Retrograde flexible ureteroscopy	Kidney, lower pole	no - difficult angle, unable to fragment stone
5	1	Retrograde flexible ureteroscopy	ureter	no - unable to obtain access
6	1	Retrograde flexible ureteroscopy	Kidney, lower pole and upper pole	yes
7	3	Retrograde flexible ureteroscopy	Kidney, all poles - submucosal	after 3rd procedure

UPJ = ureteropelvic junction

All complications in our study were Clavien I or II, and included postoperative pain and a postoperative urinary tract infection requiring antibiotics in one patient. The single death described in the study did not seem to be related to our procedure in any way. This patient died of sepsis in the setting of severe DKA and left eye proptosis with a mucor infection. It occurred approximately 1 month after attempted ureteroscopy. His case was aborted due to inability to obtain access, and does not appear to be related to his subsequent hospitalization and death.

Complete postoperative radiographic clearance ("stone free") was noted in five of the seven cases with ureteral access and treatment. Postoperative imaging was with computed tomography in five cases and renal ultrasonography in two cases. There was no evidence of persistent obstructive stones in any patient where successful ureteroscopic access was achieved. Radiographic clearance was not obtained in two cases, both in the same patient, who ultimately underwent three URS with laser lithotripsy and electrohydraulic lithotripsy over a period of 4 years. The patient who had EHL performed had a small amount of bleeding after the procedure, however no other complications were noted. This patient was cleared radiographically after the third procedure. Multiple procedures were required due to the large stone burden. A large amount of the stone burden on imaging was also noted to be submucosal on the third URS, which was not considered to be residual stone burden after that procedure.

With regard to laboratory values, average nadir serum creatinine after transplant in the cohort was 0.98 mg/dL (SD 0.26). Peak serum creatinine before stone treatment was 1.79 mg/dL on average (SD 0.84), with the most recent serum creatinine prior to treatment 1.32 mg/dL on average (SD 0.72). Nadir recorded serum creatinine after treatment was 1.25 mg/dL (SD 0.73).

Postoperative complications were notable for persistent pain in two patients, as well as a urinary tract infection in two patients.

Discussion

Stones in transplant kidneys present a unique challenge, though the incidence is relatively uncommon. Abbot et al describes a hospitalized stone rate in transplant kidneys of 101/100,000 person years compared to 92/100,000 person years in non-transplanted kidneys.[6] Stones presenting in transplanted kidneys are typically of concern with relation to obstruction of the kidney. They can be difficult to diagnose, as the transplanted kidney does not have normal innervation and patients typically do not have the normal symptoms of colicky pain. Most patients in previous studies, including ours, present with urinary tract infections, abdominal pain, or otherwise undiagnosed decline in renal function.[7] While SWL or PCNL have typically been viewed as the best options depending on kidney size,[6] our data suggest that URS is a viable option for patients with stones in the transplanted kidney. The angle of the implanted ureter is often regarded as the most challenging aspect of the case. Our data indicates that while difficult, in most instances the ureter can be safely navigated and the stone adequately treated.

With regard to SWL, it is often cited as an option for non-invasive management of stones less than 1.5 cm in transplant kidneys.[8,9] Challacombe et al describes

use of SWL in 13 of 21 patients with transplant kidneys who required treatment for stones. Of these, eight required multiple treatments.[8] Steinstrasse is also a complication of SWL, which can be potentially devastating in a patient with a single functional transplant kidney.[10] While still an option, SWL may not be the ideal option in all patients even if the stone burden is small, particularly in solitary kidneys.

The complications associated with PCNL treatment, both in normal kidney and in transplanted kidneys, are not insignificant. Percutaneous access tends to be the preferred method of obtaining renal access for stones > 15 mm in allograft kidneys. Access can be easier in these patients due to proximity of the kidney to the abdominal wall. However, placement of transplanted kidneys in the abdomen and pelvis carry the additional risk of altered anatomy, which may potentially add to the risk of injury to bowel or other organs. Most urologists advocate ultrasound usage to guide percutaneous access in order to avoid bowel.[11,12] Renal allografts can have a scarred capsule surrounding them, which can be difficult to penetrate and dilate. Bleeding risk is also increased, due to platelet dysfunction related to the patient's underlying renal abnormalities, as well as the fact that access is typically obtained from an anterior as opposed to posterior approach.[12]

Our study has several limitations. We did not have a control group. None of the patients had impacted stones, and strictures at the uretero-vesical junction were not an issue in our patient population. This would have added increased difficulty in treating from a retrograde approach. Also of note is the small study size, though most other studies that have evaluated URS in transplant patients were also of small size. Finally, these procedures were performed at a single institution and were the product of two surgeons. Work of other surgeons may be variable, and dependent on comfort with URS as well as skill level. Given that the principle challenge of this procedure is obtaining access into the ureteral orifice, skill with endoscopy likely a significant factor.

Conclusion

Overall, good success was achieved with URS, which has typically been viewed as overly difficult in transplant patients. Seven of nine attempted URS procedures could be carried out with successful access to the ureter and kidney. One patient did require multiple treatments, but this patient had a large stone burden and ultimately many of the calcifications were determined to be submucosal. These patients often had multiple stones, but all individual stones were 10 mm or less. While PCNL may be the preferred method for patients with stones > 1.5 cm, URS appears to be an acceptable first option in patients with stones < 1.5 cm in transplanted kidneys. □

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