EFFECTIVENESS OF FLEXIBLE URETEROSCOPY AND LASER LITHOTRIPSY IN THE MANAGEMENT OF URINARY CALCULI IN PATIENTS WITH CONGENITAL ABNORMALITIES OF THE KIDNEY AND URETER

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ABSTRACT

Introduction: We present our experience with retrograde intrarenal surgery (RIRS) in patients with calculi in congenital anomalies of the upper urinary tract.
Methods: A total of 29 patients with urinary stones and congenital anomalies of the kidney and ureter, including duplicated collecting system, horseshoe kidney (HSK), malrotated kidney, ureteropelvic junction stenosis (UPJ-S), and ectopic pelvic kidney (EPK), were treated with RIRS between January 2008 and December 2014. Success was defined as the absence of stone fragments or the presence of only asymptomatic insignificant residual fragments <3 mm.
Results: A total of 35 procedures were performed. There was UPJ-S in two of the six patients with HSK and they were both treated with endopyelotomy. There were bilateral stones in two patients with HSK and one of these was treated in two separate sessions. In the UPJ-S group, endopyelotomy and lithotripsy were simultaneously performed in all but three patients who were treated in separate sessions. There was UPJ-S in one patient with an EPK, and endopyelotomy and laser lithotripsy were performed in separated sessions. Significant residual stones were detected in four patients. No major intraoperative or postoperative complications were seen.
Conclusion: RIRS is an effective and well-tolerated treatment option in the management of urinary calculi patients with anomalous upper urinary tracts.

Keywords: Anomalous kidney, anomalous ureter, flexible ureteroscopy, urolithiasis.

INTRODUCTION

Congenital abnormalities of the urinary tract occur in approximately 3.3-11.1% of the population and account for 50% of all congenital abnormalities.[1] Commonly encountered congenital abnormalities of the upper urinary tract (kidney and ureter) include: duplicated collecting system (DCS, incidence: 1/125 live births), horseshoe kidney (HSK, 1/400 live births), malrotated kidney (MRK, 1/939 live births), ureteropelvic junction stenosis (UPJ-S, 1/800-1,000 live births), and ectopic pelvic kidney (EPK, 1/2,000-3,000 live births).[1-5] It is thought that individuals with these abnormalities have a higher susceptibility to hydronephrosis, urinary tract infection (UTI), and stone disease than individuals with normal urinary tracts.[5] For example, the incidence of urolithiasis in patients with HSK is 21-60%.[3]

The treatment options for stone disease in patients with congenital abnormalities of the upper urinary tract can be challenging. Although extracorporeal shock wave lithotripsy (ESWL) and percutaneous

nephrolithotomy (PCNL) are the most frequently used methods for managing patients with urinary stones in anomalous kidneys, these treatment modalities may be complicated in several circumstances.[6] Moreover, minimally invasive surgery, including ESWL, PCNL, and laparoscopy, may not be suitable or be contraindicated in these patients.[6]

Recent developments in flexible ureteroscopic devices, such as small-caliber actively deflectable flexible ureteroscopes, nitinol baskets, graspers, access sheaths, and holmium lasers, have promoted retrograde intrarenal surgery (RIRS), a more efficient and less morbid modality, as a reliable alternative to other treatment options in the management of patients with anomalous-system stones. There have been some studies regarding the management of patients with anomalous-system stones,[5-7] most of which have been limited to HSK and EPK. In this study we present our experience with flexible ureteroscopy and laser lithotripsy of urinary calculi in patients with congenital anomalies of the upper urinary tract.

METHODS

A total of 29 patients with upper urinary system stones and congenital abnormalities of the kidney and ureter, including DCS, HSK, MRK, UPJ-S, and EPK, were treated with flexible ureteroscopy and holmium laser lithotripsy between January 2008 and December 2014. Symptoms presented included chronic back and abdominal pain, acute renal colic, haematuria, and UTIs. A computed tomography (CT) scan was performed in all cases to determine both the type of the congenital defect and stone characteristics, including size, number, and localisation.

Initially, cystoscopy was performed for both bladder examination and detection of the anatomical locations of ureteral orifices, especially in cases with a DCS. In this study, a rigid ureteroscope was used prior to flexible ureteroscopy for two reasons: 1. to treat lower or middle ureteral stones, and 2. to reveal congenital ureteral anomalies. Having completed the cystoscopy or rigid ureteroscopy, an access sheath (Flexor ureteral access sheath 11/13 F 35 cm; Cook Medical, Bloomington, Indiana, USA) was introduced over a 0.038-inch hydrophilic guidewire. A URF-P5 flexible ureteroscope (Olympus, Tokyo, Japan) was then introduced. A holmium YAG laser (Sphinx®, Lisa Laser, 30 watts, Katlenburg-Lindau, Germany) in combination with 200 µm or 272 µm laser fibres (Lithofib® and Flexifib®, Lisa Laser, Katlenburg-Lindau, Germany) were used accordingly. After stone fragmentation, a nitinol basket (Ngage® nitinol stone extractor 2.2 Fr 115 cm basket; Cook Medical, Bloomington, Indiana, USA) was used for the removal of small stone fragments. Prior to the lithotripsy, endopyelotomy was performed in patients with UPJ-S. Endoscopically, intra-operative success was defined as extraction of all stone fragments or laser lithotripsy of all stones to fragments <3 mm. After fragmentation and removal of stones, a double-J stent (DJS) was left in place in all cases according to the type of the ureteral and renal pathology. In cases where the ureteral access sheath or flexible ureteroscope could not be advanced up to the proximal ureter due to ureteral and renal pathologies, a DJS was inserted into the ureter and the intervention was delayed for approximately 1 month. Stone clearance was assessed intraoperatively and checked postoperatively using a CT scan at 3 months. Success was defined as the absence of stone fragments or presence of asymptomatic insignificant residual fragments <3 mm. For this descriptive study, data were presented as mean ± standard deviation or as ratios.

RESULTS

A total of 35 procedures in 29 patients were included in this study (Table 1). There was UPJ-S in two of the six patients with HSK, who were both treated with endopyelotomy. While this procedure was performed together with laser lithotripsy in one session for one patient, endopyelotomy and laser lithotripsy were performed separately for the other patient. There were bilateral stones in two patients with HSK and one of these was treated in two separate sessions. In the UPJ-S group, while endopyelotomy and lithotripsy were simultaneously performed in six patients, the remaining three patients were treated in two separate sessions. There was UPJ-S in one patient in the EPK group, and endopyelotomy and laser lithotripsy were performed in separate sessions.

Operative and postoperative results are shown in Table 2. Placement of a DJS was performed in all patients except in four uneventful procedures. A ureteral access sheath was placed in 29 out of 35 procedures. The operations were completed without an access sheath in one HSK, three DCS,

and two EPK patients. No major intraoperative or postoperative complications were seen. One minor intraoperative complication (minor ureteral trauma), for which the procedure was not discontinued, was seen in a patient with EPK. Postoperative complications were detected in three patients: renal colic (in DCS), persistent haematuria (in UPJ-S), and acute pyelonephritis (in HSK); these three patients were treated conservatively. Significant residual stones were detected in four patients, all with UPJ-S. In the UPJ-S group, stenosis recurred in two of nine patients at postoperative Month 6 and this was treated with open surgery.

DISCUSSION

Duplicated Collecting System

Identification of the ureteral orifice may be difficult in a DCS, especially in complete duplication. Therefore, rigid ureteroscopy should be performed before flexible ureteroscopy. In a study of four patients with stones in a DCS and treated with RIRS, while two patients were completely stone-free for the first-session of RIRS, two patients required ancillary therapy (one as second-session RIRS and the other was referred for ESWL for residual stones).[7] The success rate in our study was 75%. Our series is the largest series containing patients with renal stones in a DCS and treated with flexible ureteroscopy.

Table 1: Patient and stone characteristics.

	DCS	HSK	MRK	UPJ-S	EPK	Overall
Patients, n	8	6	3	9	3	29
Procedures, n	8	8	3	12	4	35
Renal units, n	9	8	3	12	4	36
Sex (M/F)	4/4	5/1	1/2	7/2	0/3	17/12
Mean age, years (range)	37±8 (27-51)	36±7 (30-48)	30±3 (27-33)	34±9 (21-48)	32±10 (24-43)	34±8 (21-51)
Mean BMI, kg/m^2 (range)	26±4 (21-32)	24±3 (21-28)	20±4 (18-24)	27±3 (24-31)	26±4 (24-31)	26±4 (18-32)
Laterality, n						
Right	3	-	1	4	1	9
Left	4	4	2	5	2	17
Bilateral	1	2	-	-	-	3
Localisation, n						
Upper calyx	2	1	-	-	-	3
Middle calyx	4	2	-	-	-	6
Lower calyx	4	6	-	4	3	17
Renal pelvis	4	12	3	9	3	31
Upper ureter	2	-	-	-	-	2
Number of stones	16	21	3	13	6	59
Mean stone number, n (range)	2.2±1.3 (1-4)	2.6±1.4 (1-5)	1.3±0.6 (1-2)	1.4±0.5 (1-2)	2.0±1.7 (1-4)	2.2±1.8 (1-5)
Mean stone size, mm (range)	7.2±3.7 (3-16)	7.8±4.3 (2-16)	10.0±4.1 (4-13)	11.5±4.3 (8-22)	7.2±4.7 (2-13)	8.5±4.4 (2-22)
Mean stone burden (mm) (range)	15.6±4.8 (10-23)	20.4±8.3 (11-31)	13.3±3.2 (11-17)	16.5±5.4 (!1-27)	14.3±6.7 (10-22)	17.2±6.6 (10-31)

DCS: duplicated collecting system; HSK: horseshoe kidney; MRK: malrotated kidney; UPJ-S: ureteropelvic junction stenosis; EPK: ectopic pelvic kidney; BMI: body mass index.

Table 2: Operative and postoperative results.

	DCS	HSK	MRK	UPJ-S	EPK	Overall
Mean operation time, mins (range)	57±13 (45-70)	84±34 (30-130)	50±9 (45-60)	80±42 (35-130)	57±13 (45-70)	72±33 (30-130)
Mean hospital stay, hours (range)	26±4 (24-36)	27±10 (18-28)	22±3 (18-24)	29±11 (24-48)	20±7 (12-24)	26±8 (12-48)
Placement of internal stent	5/8	6/6	3/3	9/9	2/3	25/29
Internal stenting time (days) (range)	23±7 (15-30)	22±7 (15-30)	27±6 (20-30)	28±5 (15-30)	28±4 (25-30)	25±6 (15-30)
Stone-free rates, n						
No residual fragments	5	3	-	4	3	15 (52%)
<3 mm	3	2	3	2	-	10 (34%)
≥3 mm	-	1	-	3	-	4 (14%)
Overall	8	5	3	6	3	25 (86%)

DCS: duplicated collecting system; HSK: horseshoe kidney; MRK: malrotated kidney; UPJ-S: ureteropelvic junction stenosis; EPK: ectopic pelvic kidney.

While unilateral RIRS was performed in seven patients, bilateral RIRS was performed in one patient. The overall stone-free rate (SFR) in our series was 100%. We think that access sheath placement is the most important stage in RIRS in patients with a DCS. Since the access sheath could be advanced up to the kidney, RIRS was performed without the access sheath in 3 patients (37.5%).

Horseshoe Kidney

Management of stone disease in patients with HSK poses a clinical challenge because of the abnormal anatomy. Due to the unusual course of the upper ureter, impaired renal pelvic drainage, ureteropelvic junction obstruction, and hydronephrosis are commonly detected in these patients.[8] ESWL, PCNL, laparoscopy, and RIRS have been employed for treating patients with renal stones in HSK. Although renal stones in patients with HSK can be broken by ESWL, spontaneous passage of the fragmented stone pieces may be extremely difficult. In a study of 18 patients with stones in HSK and treated with ESWL, Kirkali et al.[9] reported that stone fragmentation to <4 mm was achieved in 78% of patients, although the SFR was only 28%. Overall, the SFR of patients with renal stones in HSK and treated with ESWL ranges from 33-78%.[9-11] Nevertheless, the retreatment rate of ESWL is up to 22.5% and the possibility of auxillary procedures is about 14.7%.[12] PCNL and laparoscopy have been successfully performed, with minor technical modifications, in the treatment of larger HSK stones.[11,12]

Since 2005, RIRS has been successfully performed in the treatment of patients with renal stones in a HSK.[6,7,11] In a study by Molimard et al.,[11] RIRS was performed without serious complications in 17 patients with HSK stones, with a mean stone burden of 16 mm and a reported SFR of 88.2%. In our study, RIRS was performed in eight renal units. Mean stone burden and overall SFR were 20.4±8.3 mm and 87.5%, respectively, which is similar to the current literature. We consider flexible ureteroscopy and laser lithotripsy as an effective treatment option in patients with HSK stones, but fragmented stone pieces should be removed, especially when dealing with lower caliceal stones.

MALROTATED KIDNEY

Although PCNL is the most effective procedure in patients with stone disease in MRK, ESWL is not as effective as the other treatment modalities due to the difficulty of spontaneous passage.[7,13] In a study enrolling 120 patients with MRK stones, ESWL conferred SFRs of 80% and 37% for stones ≤15 mm and >15 mm, respectively.[14] In contrast, success rates up to 100% were reported in patients with stone disease treated with PCNL.[13] In another small series reported by Ugurlu et al.,[7] RIRS was performed in four patients with MRK stones and

stone clearance was achieved in all patients. In the present study, RIRS was performed in three patients with MRK stones and all patients were rendered stone-free. We consider that RIRS is as effective in patients with MRK as in patients with normal kidneys.

Ureteropelvic Junction Stenosis

Although open, dismembered pyeloplasty is considered the 'gold standard' for the treatment of UPJ-S, while endopyelotomy (antegrade nephroscopic or retrograde ureteroscopic), accusize balloon, laparoscopic pyeloplasty, and robotic pyeloplasty are the other treatment options.[15] Minimal invasiveness, faster recovery, shorter hospitalisation, and direct visual control of incision are some of the advantages of retrograde ureteroscopic endopyelotomy.[15,16] Ureteroscopic endopyelotomy should be chosen in the management of patients with UPJ-S and small renal stones.[15] Therapeutic failure of retrograde pyelotomy is due to the existence of certain conditions, such as the presence of polar vessels, the length of the stenosis being >2 cm, large associated renal stone, renal function <25%, and severe hydronephrosis.[17] In the present study, while retrograde endopyelotomy and RIRS were simultaneously performed in six patients, endopyelotomy and RIRS were performed in the remaining three patients in two separate sessions. Mean stone size and mean stone burden were 11.5±4.3 mm and 16.5±5.4 mm, respectively. Although endopyelotomy was intraoperatively satisfactory, spontaneous passage was poor. Significant residual fragments remained in three patients (33.3%). The success rate of endopyelotomy was 77.7%, which was similar to that reported in the current literature.[15] We recommend that, as in HSK patients, fragmented stone pieces should be removed in patients undergoing endopyelotomy and RIRS.

Ectopic Pelvic Kidney

Ectopic position of the kidney usually presents a significant challenge to the urologist when managing patients with renal stones. ESWL is the least effective treatment option used in the management of patients with EPK stones.[7] PCNL, either alone or with laparoscopic assistance, is the most commonly performed technique for the treatment of patients with renal stones in EPK.[18] Although the SFR is acceptable after PCNL, the technique is not easy and complication rates are higher than those with normal kidneys.[18] RIRS is another option, but is associated with more technical difficulties due to ureteral kink.[5,6] There are few studies regarding RIRS in patients with renal stones in EPK.[6,7] In a study of four patients with renal stones in EPK and treated by RIRS, Weizer et al.[6] reported that the clinical success rate was 75% after only a single session. In another study by Ugurlu et al.,[7] six patients with EPK stones were treated by RIRS, the success rate of which was 66.6%. These authors also describe the difficulties of access sheath placement in these patients.[7] In our series, RIRS was performed in three patients with EPK stones. Due to the failure of access sheath placement in two of the three patients with EPK, RIRS was completed without an access sheath in two patients. Therefore, we recommend using a high-quality ureteral access sheath in the treatment of patients with EPK stones.

CONCLUSION

The combination of flexible ureteroscopy and holmium laser lithotripsy is an effective and safe treatment option in the management of urinary calculi in patients with anomalous upper urinary tracts.

REFERENCES

1. Barakat AJ, Drougas JG. Occurrence of congenital abnormalities of kidney and urinary tract in 13,775 autopsies. Urology. 1991;38(4):347-50.

2. Peters AC et al., "Ectopic Ureter, Ureterocele, and Ureteral Anomalies," Wein AJ et al. (eds.), Campbell-Walsh Urology (2012) 10th edition, Philadelphia: Saunders Elsevier, pp. 3236-66.

3. Shapiro E et al., "Anomalies of the Upper Urinary Tract," Wein AJ et al. (eds.), Campbell-Walsh Urology (2012) 10th edition, Philadelphia: Saunders Elsevier, pp. 3123-60.

4. Mure PY, Mouriquand P. Upper urinary tract dilatation: prenatal diagnosis, management and outcome. Semin Fetal Neonatal Med. 2008;13(3):152-63.

5. Cinman NM et al. Pelvic kidney: associated diseases and treatment. J Endourol. 2007;21(8):836-42.

6. Weizer AZ et al. Ureteroscopic management of renal calculi in anomalous kidneys. Urology. 2005;65(2):265-9.

7. Ugurlu IM et al. Outcomes of retrograde flexible ureteroscopy and laser lithotripsy for stone disease in patients with anomalous kidneys. Urolithiasis. 2015;43(1):77-82.

8. Yohannes P, Smith AD. The endourological management of complications associated with horseshoe

kidney. J Urol. 2002;168:5-8.

9. Kirkali Z et al. Effectiveness of extracorporeal shockwave lithotripsy in the management of stone-bearing horseshoe kidneys. J Endourol. 1996;10: 13-5.

10. Locke DR et al. Extracorporeal shock-wave lithotripsy in horseshoe kidneys. Urology. 1990;35:407-11.

11. Molimard B et al. Flexible ureterorenoscopy with holmium laser in horseshoe kidneys. Urology. 2010;76(6): 1334-7.

12. Osther PJ et al. Percutaneous nephrolithotomy among patients with renal anomalies: patient characteristics and outcomes; a subgroup analysis of the clinical research office of the endourological society global percutaneous nephrolithotomy study. J Endourol. 2011;25(10):1627-32.

13. Mosavi-Bahar SH et al. Percutaneous nephrolithotomy in patients with kidney malformations. J Endourol. 2007;21(5):520-4.

14. Sheir KZ et al. Extracorporeal shock wave lithotripsy in anomalous kidneys: 11-year experience with two second-generation lithotripters. Urology. 2003;62:10-5; discussion 15-6.

15. Geavlete P et al. Ureteroscopic laser approach in recurrent ureteropelvic junction stenosis. Eur Urol. 2007;51(6):1542-8.

16. Giddens JL, Grasso M. Retrograde ureteroscopic endopyelotomy using the holmium:YAG laser. J Urol. 2000;164: 1509-12.

17. Gupta M et al. Open surgical exploration after failed endopyelotomy: a 12-year perspective. J Urol. 1997;157(5):1613-8; discussion 1618-9.

18. Elbahnasy AM et al. Laparoscopic pyelolithotomy in selected patients with ectopic pelvic kidney: a feasible minimally invasive treatment option. J Endourol. 2011;25(6):985-9.