Flexible ureterorenoscopy for the patients with anatomic variations, skeletal anomalies and solitary kidney

Selçuk Sarıkaya,[1] Engin Kaya,[1] Murat Zor,[1] Çağrı Şenocak,[2] Ömer Faruk Bozkurt,[2] Selahattin Bedir[1]

(1) University of Health Sciences, Gulhane Research and Training Hospital, Urology, Ankara, Turkey

(2) Kecioren Research and Training Hospital, Urology, Ankara, Turkey

Date submitted:
Feb 11, 2018
Date accepted:
Aug 06, 2018
Online publication date:
September 15, 2018

Corresponding Author:
Selçuk Sarıkaya
Gulhane Research and Training Hospital, Urology, Ankara, Turkey
drselcuksarikaya@hotmail.com

Keywords: Urolithiasis, renal, anomaly, stone, disease.

ABSTRACT

Aims: The management of kidney stones with congenital kidney anomalies and abnormal variations continue to pose challenges to urologists. The treatment options include open surgery, extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), laparoscopy and ureterorenoscopy (rigid or flexible). **Methods:** In this study, we retrospectively reviewed health records of patients with abnormal urinary tract anatomy due to both congenital or acquired reasons who were operated between January 2009 and July 2016. **Results:** The study included a total of 66 patients with anatomical abnormalities or solitary kidney. These patients had various congenital or acquired abnormalities. Fifty-four patients were stone free after the first intervention, and the initial operations were successful. Two patients with horseshoe kidney had severe bleeding, and the operation was canceled. One of these two patients underwent PCNL surgery. **Conclusions:** In recent years, endoscopic stone surgery has gained increasing popularity due to improved techniques. The most important development in this area was in F-URS and retrograde intrarenal surgery. However, current literature is limited regarding patients with urinary tract abnormalities. Our results demonstrate that F-URS seems to be a safe and effective procedure for urinary tract anatomical variations. However, studies involving larger patient series would yield more information.

Introduction

The management of kidney stones with congenital kidney anomalies and abnormal variations continue to pose challenges to urologists. The treatment options include open surgery, extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolitotomy (PCNL), laparoscopy and ureterorenoscopy (rigit or flexible) (1).

Urinary tract abnormalities can be divided into two categories; congenital or acquired. Horseshoe kidney(HSK), duplicated ureter, bifid pelvis, polycystic kidney, pelvic ectopic kidney, and renal rotation anomalies are common congenital anatomical disorders. On the other hand, ureteroneocystostomy, ileal conduit and ileal neobladder are examples of acquired urinary tract abnormalities. Solitary kidney would be due to both congenital and acquired reasons. All of them can cause stone formation due to urinary stasis, urinary tract infection or metabolic abnormalities. These conditions also make stone interventions difficult. Both endoscopic or open surgical treatment options are more difficult for sugeons when considering success and complication rates.

With the increasing experience on endourological techniques and minimally invasive surgery, flexible ureterorenoscopy (F-URS) has become a viable surgical option for the treatment of kidney stones with congenital anomalies and abnormal anatomy. Several studies have been conducted in the literature that are reporting the success and complication rates for retrograde intrarenal surgery in different patient groups. The success and complication rates are different according to the difficulty of anatomical conditions.

In this study, we aimed to present multicentric F-URS experiences in difficult conditions with anomalous kidneys and ureters or acquired abnormal anatomy. The results of the interventions and the complications were noted.

Methods

In this study, we retrospectively reviewed 66 patients, with abnormal urinary tract anatomy due to both congenital or acquired reasons, that were operated between January 2009 and July 2016 at urology departments of Gulhane and Kecioren Research Hospitals. 17 patients had Horseshoe kidney, 11 had rotation anomalies, 17 had solitary kidney, 3 had pelvic ectopia, 1

had pelvic ectopia and scoliosis, 1 had polycystic kidney, 1 with ileal conduit, 5 with duplicated ureter, 1 had bifid pelvis, 2 had scoliosis and rotation anomalies, 2 had pitotic kidney and rotation anomalies, 1 had solitary kidney and rotation anomalies, 1 with severe scoliosis and 3 had diverticular stones.

The location of stones was detected using intravenous urography (IVU) or computed tomography (CT). All procedures were performed at lithotomy position under general anesthesia except one patient who had ileal conduit and underwent at supine position.

We used the same technique for F-URS which was previously described in several studies except one patient who had ileal conduit (1-3).

Operation technique

Flexible ureterorenoscopy operations were performed under general anesthesia. The patients were given dorsal lithotomy position and 10% povidon iodine was used for genital region sterilization. Rigid ureterorenoscope (6.4Fr-8.4Fr single-channel ureteroscope, Olympus Winter & Ibe Gmbh Hamburg, Germany) was used for cystoscopy and ureteroscopy. Hydrophilic guide wire(Cook guidewire, 0.038 inch, Cook Medical Bloomington, IN) was inserted into the ureter and renal collecting system via rigid ureterorenoscope. After leaving the guide wire in the ureter, the ureteroscope was taken out. Ureteral access sheath(9.5-11.5Fr or 12-14Fr and 35cm or 45cm hydrophilik coated ureteral access sheath, Cook Medical Bloomington,IN) was inserted into the ureter using C-arm fluoroscopy unit(Ziehm 8000, Ziehm İmaging GmbH. Nuremberg Germany) or without fluoroscopy. Access sheath sizes were recorded. A 7.5 F fiberoptic (Storz FLEX-X 2, Tuttlingen, Germany) or 8.4 F fiberoptic Olympus were used. A 273µm or 365µm laser probe (Sureflex lithotripsy fiber, AMS, Minnesota USA) were inserted through the working channel when the tip of the flexible ureterorenoscope was in vertical position and the stones were fragmented with a holmium-aluminum-garnet (Ho:YAG) laser(Stonelight, AMS, Minnesota USA). The staining and popcorn methods were used. The fragmented stones were as small as possible and some of these stones were collected at the end of the operations. Nithinol baskets(1.5F N-Gage Cook Medical Bloomington, IN) were used for collecting these stones that were fragmented into small sizes and stone fragments were sent for analysis. Double J catheters were inserted with using rigid ureteroscope(6.4Fr-8.4Fr Single Channel Ureteroscope, Olympus Winter&Ibe Gmbh Hamburg Germany) or rigid cystoscope(-21Fr Single Channel Rigid Cystoscope, Olympus Winter&Ibe Gmbh Hamburg Germany) for the patients that had ureteral stricture and the patients that access sheath would not be able to inserted. With this method, passive dilatation for the ureters were gained and the second stage operations were formed in a safe way. Double J(DJ) stents were 6Fr width, 24cm, 26 cm or 28cm length(Double J stent set, Geotek Medical, Ankara, Turkey).

Results

66 patients with anatomical abnormalities or solitary kidney were included in the study. These patients had various congenital or acquired abnormalities (Table 1). The mean age was 40.04 years (range 23-66 years). 42 patients (63.6%) were male and 24 (36.4%) were female. Stone size range was between 5 to 26mm. Stones were mostly located in renal pelvis (Table 1). 29 patients (43.9%) had Extracorporeal shock wave lithotripsy (ESWL) prior to operation. 7 patients (10.6%) had nonopaque stones, 3 (4.5%) had semiopaque stones and 56 (84.9%) had opaque stones. Access sheath was not inserted for 7 patients (10.6%) due to ureteral strictures. 54 patients were stone free after the first intervention and initial operations were successful. 2 patients with horseshoe kidney had severe bleeding and the operation was cancelled. 1 of these 2 patients was undergone PCNL surgery. Transitional cell carcinoma of upper urinary tract was detected during the surgery and it was endoscopically treated. Access was not achieved for 5 patients and 2 of these patients had rotation anomalies, 1 had scoliosis and rotation anomalies, 1 had solitary kidney and 1 had pelvic ectopia. For 1 patient that had solitary kidney, there was pushback for stone and additional intervention was necessary (Table 2).

Table 1. Abnormalities and stone locations

Renal Abnormality	Stone Location						
	Pelvis	Lower pole	Middle pole	Upper pole	Ureter	Multilocalization	Total
Horseshoe Kidney	7	4	1	4		1	17
Rotation anomaly	6	3		2			11
Scoliosis	1						1
Rotation+Scoliosis		1	1				2
Pitosis+Rotation	1	1					2
Solitary kidney	6	1	2	6	1	2	18
Solitary+rotation		1	1				2
Duplicated ureter	1	1	1	1			4
Policystic kidney		1					1
Pelvic kidney		2				1	3
Pelvic kidney+scoliosis		1					1
Diverticular stone		1	1			1	3
Bifid pelvis	1						1
Total	23	17	7	13	1	5	66

Table 2. Operation results and complications

Renal Abnormality	Operation outcomes	Complications
Horseshoe Kidney	1 had upper urinary tract TCC and endoscopically treated	1 bleeding
		1 bleeding+underwent PCNL
Rotation	2-reoperation due to failed access	
Scoliosis+Rotation	1-reoperation due to failed access	
Solitary	1-reoperation due to failed access	1-stone pushback

The patient with ileal conduit was presented with severe right flank pain, fever and grade 3 hydronephrosis. Firstly, antegrade percutaneous nephrostomy tube was placed into the right kidney. F-URS was performed after the treatment of urinary tract infection. The indigo carmine solution was given via nephrostomy catheter intraoperatively to easily visualize the right ureteral orifice. Efflux from the right ureter was observed and hydrophilic guidewire was inserted to the right ureter. F-URS was placed via guidewire without ureteral access sheet. Following the successful procedure, D-J ureteral catheter was inserted and its distal tip was detached from ileal conduit. The catheter was removed on the postoperative 20th day.

Urethral catheters were removed on postoperative 1 day and mean hospitalization time was 1.4 days (1-3 days). Visual analog scale (VAS) scores were gained from 47 patients and the mean VAS score was 5,1.

Discussion

Stone disease is a common health problem for all age groups and for both genders. Flexible ureterorenoscopy is one of the most frequent endoscopic surgical techniques for stone disease treatment. Abnormal anatomic conditions, skeletal anomalies and solitary kidney cause additional risks for endoscopic surgical techniques. HSK is the most common renal fusion anomaly and its incidence is 1/400 (0.25%) (4). Stone formation rate is 20% for the patients with HSK (5,6). Regarding the anatomical abnormalities, the success rate of ESWL is lower than normal kidneys (7). Although PNL procedure has high success rate for HSK stones (93.2%), unfortunately it has increased complication rates (8). Sepsis, myocardial infarction, colonic injury, bleeding risks are higher than normal kidney stones (8,9). The laparoscopic approach can be performed at selected patients such as renal pelvis located solitary stones and larger than 2 cm stones with UPJ obstruction (10).

Molimard et al. reported that the success rate of F-URS was 88.2% with 16 mm average stone burden including 17 patients (11). In another study, 20 patients with HSK were treated with FURS. The success rate was %70 in first procedure and ESWL was performed to 6 patients as second procedure; two of them were stone free after ESWL. There was no major complication and the minor complication rate was 25% (1). In the study conducted by Ugurlu et. al, 3 of 25 patients with HSK were treated with FURS. Average stone size was 253 ± 103.69 mm2. Their success rate was 66.6%. The patients with lower calyx stones could not be treated due to high ureteral insertion (12). Several studies were determined 75%-88% SFR with adjuvant procedures (11,13). In a comparison of RIRS and ESWL, success rates were 47,7% and 79,9%, respectively (14). In the present study, the initial SFR of F-URS in horseshoe kidney was 75% and with adjuvant procedure, SFR was 100%. There was no major complication. One patient had hemorrhage in distal ureter, which was treated conservatively. With low complication rate and high stone-free rate, F-URS procedure has become an appropriate treatment option for horseshoe kidney.

Upper urinary tract duplication is the most common congenital anomaly of the urinary tract (15). Karakose et al. reported that they treated concurrently unilateral complete ureteral duplication and distal ureter stone by using F-URS (16). In another study, 4 patients with complete duplicated ureter were treated with F-URS and stone free rate was 50%. Both SWL and second F-URS procedure increased the success rate to 75%. In our study, the patient had an incomplete duplicated ureter and 20 mm and 10 mm renal pelvis stones at each ureter related renal moieties. Upper pole stone was treated successfully, but lower pole stone was required two ESWL sessions for complete stone clearance. No complication was encountered. F-URS can be applied safely in the treatment of stone in duplicated system.

Spinal deformities can decrease success rate of stone treatment due to abnormal anatomy and angle. Resorlu et al. reported 8 patients with spinal deformities including congenital scoliosis (n=6), ankylosing spondylitis (n=1), and spina bifida (n=1). Mean patient age was 32.5 years (8-51 years), and mean stone size was 15.8 mm (9-20 mm). The average operative time was 46.5 minutes (25-75 min), and postoperative hospital stay was 1.12 days (1-2 days). Six of the patients were stone free. Two of them underwent failure treatment. There was no severe complication (17). In another study, 7 patients were included. The stone free rate was 85.7% without any complication (18). In our study, the patient was stone free without any complication. It is reported that F-URS is safe and effective procedure for the patient with spinal deformities.

Ileal conduit is another challenging anatomy for retrograde intrarenal surgery. In these patients, the most challenging step is the visualisation and the catheterization of the ureteral neo-orifice. In some cases, ureteral strictures can accompany to the ureteral and renal stones. Hyams et al. reported their experiences on several urinary diversion types and various diseases. In that study, 5 of 21 renal units including renal stones were treated with flexible ureterorenoscopy. In one patient including 2 renal units stone, retrograde approaches were failed due to ureter orifice located in long, tortious ileal conduit. PCNL was successfully performed on one side and contralateral side was treated with ESWL (19). Retrograde F-URS is challenging procedure for the patient with urinary diversion. In particular, finding new ureteric orifices may not be easy (20). Delvecchio defined combine antegrade and retrograde approach to urinary diversion (21). In our study, indigo carmine was inserted via the percutaneous nephrostomy tube and ureteral orifice was easily visualized and catheterized. The patient was stone free without any complications.

Our study results are compatible with literature and explicitly demonstrated effectiveness of F-URS with a large patient group for anatomic abnormalities and solitary kidney.

Conclusion

In recent years, endoscopic stone surgery has gained increasing popularity related with new technologic improvements. The most important development in this area was in F-URS and retrograde intrarenal surgery. However, the literature is limited for patients with urinary tract abnormalities. Our results demonstrate that F-URS seems to be a safe and effective procedure for urinary tract anatomical variations. However, studies involving larger patient series would yield more information.

Acknowledgements

SS and EK: designed the research and SS: wrote the manuscript; SS, EK and MZ: data collection and statistical analysis, OFB and SB: revised the manuscript and statistical analysis; all authors read and approved the final manuscript.

Conflict of Interest

The authors declared they do not have anything to disclose regarding conflict of interest with respect to this manuscript.

References

1. Atis G, Resorlu B, Gurbuz C, et al. Retrograde intrarenal surgery in patients with horseshoe kidneys. Urolithiasis. 2013;41(1):79-83.
2. Bozkurt OF, Tepeler A, Sninsky B, et al. Flexible ureterorenoscopy for the treatment of kidney stone within pelvic ectopic kidney. Urology. 2014;84(6):1285-1289.
3. Oğuz U, Balci M, Atis G, et al. Retrograde intrarenal surgery in patients with isolated anomaly of kidney rotation. Urolithiasis. 2014;42(2):141-147.
4. Ellen Shapiro E, Bauer SB, Chow JS. Anomalies of the upper urinary tract. In: Wein AJ (ed) Campbell's urology, 10th edn. W.B. Saunders, Philadelphia. 2012;3106–3143.
5. Gross AJ, Fisher M. Management of stones in patients with anomalously sited kidneys. Curr Opin Urol. 2006;16(2):100-105.
6. Raj GV, Auge BK, Assimos D, Preminger GM. Metabolic abnormalities associated with renal calculi in patients with horseshoe kidneys. J Endourol. 2004;18(2):157-161.
7. Ray AA, Ghiculete D, D'A Honey RJ, Pace KT. Shockwave lithotripsy in patients with horseshoe kidney: determinants of success. J Endourol. 2011;25(3):487–493.
8. Miller NL, Matlaga BR, Handa SE, Munch LC, Lingeman JE. The presence of horseshoe kidney does not affect the outcome of percutaneous nephrolithotomy. J Endourol. 2008;22(6):1219–1225.
9. Shokeir AA, El Nahas AR, Shoma AM, et al. Percutaneous nephrolithotomy in treatment of large stones within horseshoe kidneys. Urology. 2004;64(3):426–429.
10. Wang X, Li S, Liu T, Guo Y, Yang Z. Laparoscopic pyelolithotomy compared to percutaneous nephrolithotomy as surgical management for large renal pelvic calculi: A meta-analysis. J Urol. 2013;190(3):888–893.
11. Molimard B, Al-Qahtani S, Lakmichi A, et al. Flexible ureterorenoscopy with holmium laser in horseshoe kidneys. Urology. 2010; 76(6):1334–1337.
12. Ugurlu IM, Akman T, Binbay M, et al. Outcomes of retrograde flexible ureteroscopy and laser lithotripsy for stone disease in patients with anomalous kidneys. Urolithiasis. 2015;43(1):77-82.
13. Weizer AZ, Silverstein AD, Auge BK, et al. Determining the incidence of horseshoe kidney from radiographic data at a single institution. J Urol. 2003;170(5):1722-1726.
14. Gokce MI, Tokatli Z, Suer E, Hajiyev P, Akinci A, Esen B. Comparison of shock wave lithotripsy (SWL) and retrograde intrarenal surgery (RIRS) for treatment of stone disease in horseshoe kidney patients. Int Braz J Urol. 2016;42(1):96-100.
15. Smith P, Dunn M. Duplication of the upper urinary tract. Ann R Coll Surg Engl. 1979; 61(4):281-286.
16. Karakose A, Aydogdu O, Atesci YZ. Unilateral complete ureteral duplication with distal uretral stone: A rare entity. Can Urol Assoc J. 2013;7(7-8):E511-E512.
17. Resorlu B, Ozyuvali E, Oguz U, Bozkurt OF, Unsal A. Retrograde intrarenal surgery in patients with spinal deformities. J Endourol. 2012;26(9):1131-1135.
18. Polat F, Yesil S. Retrograde intrarenal surgery by flexible ureteroscope in patients with spinal deformities. J Spinal Cord Med. 2017;40(1):26-29.
19. Hyams ES, Winer AG, Shah O. Retrograde ureteral and renal access in patients with urinary diversion. Urology. 2009;74(1):47-50.
20. Zhong W, Yang B, He F, Wang L, Swami S, Zeng G. Surgical management of urolithiasis in patients after urinary diversion. PLoS One. 2014:31;9(10):e111371.
21. Delvecchio FC, Kuo RL, Iselin CE, Webster GD, Preminger GM. Combined antegrade and retrograde endoscopic approach for management of urinary diversion-associated pathology. J Endourol. 2000;14(3):251–256.