Original Article

Outcomes of flexible uretrorenoscopy for solitary renal stones up to 15 mm, hits and misses: A single-surgeon experience

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Abstract

Abstract: Introduction: In this study, we retrospectively evaluated the outcomes of flexible uretrorenoscopy (fURS) for removal of solitary renal stones sized up to 15 mm.

Material and Methods: We evaluated the data of 115 patients who underwent fURS at our unit between Jan 2018 and Dec 2019. All fURS were performed by a single surgeon using Flex-2 flexiscope. Ureteral Access sheath (UAS) of size 9/11 fr was used in all patients. Stones were fragmented using 20 watts laser. Few fragments were retrieved using Nitinol zero tip basket for assessment of the passability of remaining dust and sent for stone analysis. Data pertaining to demographic characteristics, stone size, stone site, operative time, intra and post operative complications were retrieved from the records.

Results: Of the 115 patients who underwent fURS, 71 (61.7%) were male and 44 (38.2%) were female. Average age of patients was 32.9±8.9 years; the average body mass index was 22.9±3.9 kg/m2. Average size of the stone was 11.0±1.5 × 10.2±1.3 mm. The stone free rates at the end of 3 weeks and 3 months were 97% and 99%, respectively.

Conclusion: fURS is an effective minimally-invasive procedure for removal of single stones up to 15 mm in size. We observed minimal morbidity rates and acceptable stone free rates in our series.

Keywords: Flexible uretrorenoscopy, laser, renal stones

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INTRODUCTION

The last decade has witnessed considerable advances in the surgical management of renal stones, especially those up to 2 cm in size. The clearance rates achieved with extracorporeal shock wave lithotripsy (SWL) are quite variable and depend on the stone location, renal anatomy, stone density, and even the type of equipment used. The reported success rates range between 22% and 74%, depending on the above-mentioned factors.[1-3] Percutaneous nephrolithotomy (PCNL) is associated with high stone-free rates (up to 98% success rate), especially for lower pole calculi with similar size. However, flexible uretrorenoscopy (fURS) is currently the preferred modality for the removal of solitary renal stones. Owing to its minimally invasive nature, fURS is associated with lesser

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postoperative morbidity compared to the more invasive procedures.[4,5]

Since the first reported fURS by Demetrius and Bagley in 1987, the technique has considerably evolved and has been used for managing renal stones up to 20 mm.[6] The initially developed fiberoptic flexible scopes have been upgraded to digital scopes and offer better maneuverability and visual access.[7] In addition, the recent introduction of disposable scopes, new lasers, and accessory equipment has helped improve the stone-free rates with minimal morbidity.[8-10] In this study, we retrospectively analyzed the outcomes of fURS for stones sized up to 15 mm using fiberoptic flexible ureteroscope Flex-2 (Karl Storz, Tuttlingen, Germany) and 20 watt Ho: Yag laser (Karl Storz, Tuttlingen, Germany). We also discuss the difficulties encountered and the complications.

MATERIALS AND METHODS

We retrospectively analyzed data pertaining to 115 patients who underwent fURS between January 2018 and December 2019. We primarily use fURS for patients with single stone. All patients were evaluated for general/regional anesthesia. Preoperative stone evaluation included ultrasound (USG) kidney, ureter, and bladder (KUB) region, intravenous urography, and urine culture. Patients with positive urine culture were administered culture-sensitive antibiotics, and negative culture was documented before the definitive procedure.

Procedure details

Patients were placed in the lithotomy position after induction of anesthesia. The preferred choice of anesthesia was general anesthesia; however, patients who were not fit or who refused general anesthesia were subjected to regional anesthesia. All procedures were performed by a single surgeon. All fURS were performed using the access sheath (UAS, Cook Medical Inc., USA). Cystoscopically, a 0.035-inch straight tip Terumo wire was placed under fluoro guidance followed by initial ureteroscopy using semi-rigid ureteroscope of 7/8.5 (Karl Storz, Tuttlingen, Germany). The objective was to assess the pliability of the ureter. Subsequently, an access sheath 9/11 (CookCook Medical Inc., USA) was placed under fluoro guidance and once in position, the fURS was performed. No safety wire was used by us. In case of any difficulty in performing semi-rigid ureteroscopy or placing the access sheath, the procedure was abandoned and a 6 Fr. Double–J (DJ) stent placed. The patient was then called after 2 weeks for the definitive procedure. Before the surgery, a negative urine culture was documented. All procedures were performed by the same surgeon using single Flex X-2 scope (Karl Storz, Tuttlingen, Germany). Stone was disintegrated using 20 watts Ho:yag laser (Karl Storz, Tuttlingen, Germany). A 365 μ flat tip fiber was used in a majority of our patients; however, in those lower calyces where the deflection was hampered with 365 μ flat tip fiber (acute infundibulo pelvic angle), A 230 μ fiber was used to pulverize the stone. If it was feasible to reposition the stone from a difficult calyx to a favorable calyx, it was done forthwith using zero tip nitinol 2.2 Fr basket (Cook Medical Inc., USA). A favorable calyx is the one in which the stone can be easily seen and fragmented with minimal deflection of the scope. The stones were fragmented till they were no longer visible on fluoroscopy. Few fragments were retrieved using basket (Cook Medical Inc., USA, nitinol 2.2 fr.) to assess the feasibility of spontaneous passage of the remaining fragments; if there was any difficulty in retrieval, the stone was further pulverized so as to attain the passable size. The stone fragments were sent for stone analysis (Fourier Infrared spectroscopy). A DJ stent was placed in all patients at the end of the procedure. The operative time (in minutes) was noted from the initiation of placement of the access sheath till the placement of the DJ stent. Fluoro time (in seconds) was noted for all patients. Any untoward intraoperative event was recorded. All patients were administered injection furosemide (1 mg/kg body weight) at the end of the procedure. Patients were started on orals once they recovered from anesthesia and were discharged after 1 day of observation. Patients were advised to report immediately in case of fever or severe flank pain. Postoperative clearance was documented by X-ray and USG of the KUB region before the stent removal.

Any procedural difficulties (including the need to reposition), intraoperative or postoperative complications, and stone-free rates were noted. Complications were stratified as per the Clavien–Dindo classification. Patients were followed up for 3 months from the date of the procedure.

RESULTS

During the study period, a total of 115 patients underwent fURS for stones sized up to 15 mm. Of these, 99 procedures were performed under general anesthesia, whereas 16 were performed under regional anesthesia. The demographic, clinical, and stone characteristics are summarized in Table 1. The intraoperative parameters are summarized in Table 2. Out of 115 patients, 83 (72.3%) required preoperative stenting for the definitive procedure. In 32 patients (27.8%), the access sheath (9/11 Cook Cook Medical Inc., USA) could be placed primarily. Of these 32 patients, 20 were female and 12 were male. Therefore, the access sheath could be placed in the first attempt in 45.4% of female patients and only in 16.9% of male patients. The surgical parameters are summarized in Table 2.

Thirty-five out of 115 patients (30.4%) required stone repositioning. Of these, 9 had pelvic stones, whereas 26 had lower calyceal stones. The calyx of choice for repositioning was decided intraoperatively based on the convenience of the operating surgeon; it was the middle calyx for 17 stones and the upper calyx for 18 stones. After the stones were adequately pulverized using flat tip laser, a few fragments were basketed out to assess the feasibility of the passage of the remaining fragments and to perform stone analysis. Data pertaining to stone composition are presented in Figure 1. Postoperative X-ray and USG KUB showed complete clearance in 112/115 patients (98%). Three patients had residual fragments (4 mm in two patients and 5 mm in one patient). These three patients were followed up monthly for 3 months with USG; one of the two patients with 4 mm residual stone passed the stones spontaneously, while one patient who had a residual calculus of 5 mm did not pass the stone up to 3 months and was subsequently lost to follow-up. Therefore, the clearance rate at 3 months for stones up to 15 mm was 99%. On subgroup analysis disaggregated by stone size (<10 mm, 10–12 mm, and 13–15 mm), the clearance rates for calculi sized up to 12 mm was 100%, irrespective of the site and composition of the stone. The residual stone rate for stones >13 mm at 3 months was 1%.

Table 1: Demographic, clinical, and stone characteristics in the study population

Parameter	*n*=115
Age (years)	32.9±8.9
Sex (male:female)	71:44
Body mass index (kg/m^2)	22.9±3.9
ASA Grade	
I	94
II	20
III	1
Comorbidity	
Hypertension	18
Diabetes	3
Chronic kidney disease	2
Hypothyroid	1
Side (right:left)	70:45
Size (mm)	11.0±1.5 × 10.2±1.3
Number according to stone size (mm)	
<10	5
10-12	84
13-15	26
Number of stones	
Solitary	113
Multiple	2

ASA: American Society of Anesthesiologists

Table 2: Operative parameters

Parameters	*n*=115
Site of the calculus	
Upper calyx	13
Middle calyx	11
Lower calyx	61
Pelvis	28
Upper calyx and lower calyx	1
Pelvis and lower calyx	1
Preoperative hemoglobin (g/dL)	10.9±0.9
Postoperative hemoglobin (g/dL)	10.7±0.88
Operative time (min)	44.67±6.6
Fluoro time (s)	22.3±4.6
Laser fiber used (μ)	
365	103
230	12

The postoperative complications, according to the Clavien–Dindo classification are summarized in Table 3. Grade 1 complications were noted in 12/115 patients (10.4%). These included low-grade fever, which responded to parenteral antibiotics. Two patients developed Grade IV complications, i.e., urosepsis as defined by the American College of Chest Physicians and the Society of Critical Care Medicine (2001). These patients required intensive care unit (ICU) admission. All patients who developed postoperative fever were subjected to postoperative urine culture; of these, *Escherichia coli* was cultured in seven patients, *Klebsiella pneumoniae* in three patients, and *Staphalococcus aureus* in two patients. The two patients who were admitted to ICU had positive urine and blood culture for *Pseudomonas aeruginosa*. They were treated aggressively by the intensivist and recovered well. DJ stent removal in these 14 patients was done as soon as they became afebrile.

One patient developed partial avulsion of the pelvic ureteric junction during basket retrieval of the stone. In this patient, the stone was disengaged and then fragmented *in situ* and a DJ stent was placed. He remained stable in the postoperative period; intravenous urography done at 3 months revealed normal kidney with no residual obstruction.

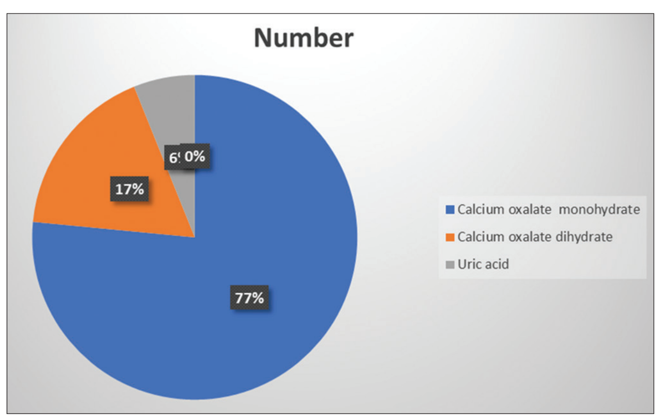

Figure 1: Pie chart showing the stone composition in our cohort

Table 3: Postoperative complications as per the Clavien-Dindo classification

Grade	Complications	*n* (%)
I	Fever	12 (10.4)
II	nil	nil
IIIB	Perforation/partial avulsion of pelviureteral junction	1 (0.86)
IVb	Urosepsis requiring ICU admission	2 (1.7)

ICU: Intensive care unit

DISCUSSION

The etiopathogenesis of genitourinary stone disease is multifactorial. Lifestyle, environmental factors, socioeconomic conditions, and associated metabolic syndromes have all been implicated in its causation. With the changing trends, the lifetime probability of developing stones is approximately 14%.[11-13]

The EUA and AUA guidelines strongly recommend SWL as the treatment of choice for stones sized up to 20 mm; however, we did not have the option of SWL owing to the lack of equipment in our setting. Therefore, PCNL or fURS were the only available options for us. PCNL is a good option for calculi sized up to 15 mm; however, fURS is our preferred modality for the treatment of solitary stones sized <15 mm owing to its minimally invasive nature. We have adopted a cut-off size of 15 mm for fURS because the larger the stone size, the greater is the probability of stone dust. This increases the need for retreatment and auxiliary procedures, especially for lower pole stones up to 20 mm.[14] This is reflected in the results of our study, wherein the best stone-free rates were observed for stones sized <12 mm (nearly 100%). In addition, the overall success rate was 99%, irrespective of the stone location.

In the era of SWL, the lower pole anatomy is given due importance to predict the stone clearance rates.[1,3] However, with the fURS, it is feasible to enter the lower calyces and fragment the stones. Relocation of the lower pole stones to a more favorable calyx, where they can be adequately dusted, is one of the factors that help improve the results. This relocation to improve the success of clearance was reported by Schuster *et al*. in their study, relocation of stones from the lower pole increased the clearance rates to approximately 100%.[15] A second factor that helps improve the success rate is fragment removal with basket; this provides an insight to the operating surgeon whether the remaining fragments are small enough to pass naturally or not.

We used UAS (9/11 frCook Medical Inc., USA) in all our fURS procedures. We believe that it facilitates repeated unhindered passage to the upper tract, provides better visual access and reduces intrarenal pressure by providing effective outflow of the irrigating fluid. Similar observations have been made in published literature.[16,17] Before the placement of the access sheath, diagnostic ureteroscopy was performed using 7/8.5 ureteroscope. A similar protocol was proposed by Rodríguez-Monsalve Herrero *et al*.[5,10] Difference is that they recommended it in case of difficulty in passing the UAS, while we have used it up front with the aim to avoid opening of the new UAS in case the ureteroscope does not easily enter the ureter. Thus, to minimize the cost, in these cases, we placed a DJ stent and the patients were called after 2 weeks for the definitive procedure. In previous studies, severe ureteral injuries were reported more frequently in male patients as compared to females; in addition, the incidence of severe ureteral injury was seven-fold higher in nonstented patients as compared to stented patients.[18] Moreover, for patients with difficult UAS placement, some surgeons resort to active dilation of the ureter before UAS placement.[19] We have adopted a different approach. In our series, we routinely performed initial ureteroscopy to assess the compliance of the ureter. Subsequently, UAS placement was attempted only in patients with compliant ureters. Patients with noncompliant ureters were stented, and the definitive procedure was performed after 2 weeks. This was done to avoid inadvertent ureteral injury. In our cohort, difficult UAS placement was observed more frequently in male patients as compared to female patients. However, this difference was likely related to individual factors rather than on sex.

We did not use any safety guidewire as we placed our initial guidewire under fluoro guidance and the access sheath was also placed under fluoro guidance. Moreover, we utilized fluoroscopy to confirm the position of our flexiscope once inside the renal pelvicalyceal system (PCS). This has also been mentioned in the literature. However, for a beginner or trainee, we would recommend to have safety wire in place.[20]

As basketing is associated with injury and also more intrarenal time (thus increasing the risk of sepsis), we curtailed the use of basket to relocate the stone, extract a few fragments so as to obtain the specimen for stone analysis and also to judge the passability of the remaining fragments.

The most common complication of fURS in our hands was postoperative fever (10.4%); all patients responded to parenteral antibiotics and early removal of DJ stent. Two patients (1.7%) developed severe sepsis requiring ICU admission. The stone size in these two patients was 14 × 10 and 15 mm × 11 mm, respectively, and the average operative time was 60 min. One calculus was in the upper calyx while the other was in the lower calyx. This is in accordance with the reported rate of 1.7%–18.8% in the literature. In a series reported by Fan *et al*., larger stone burden and longer operative time was a risk factor for sepsis (size of 2.06 ± 0.43 cm vs. 1.66 ± 0.52 cm and operative time of 99.42 ± 19.08 vs. 73.37 ± 19.37 min). They further observed that 15.5% of patients with stone size of >2 cm had infectious complications visa vis 4.64% for stones size <2 cm. The overall operative time in our cohort was 44.67 ± 6.6 min, while the average stone size was $11.05 \pm 1.5 \times 10.2$ mm $\pm$ 1.3 mm.[21] The cut off size of 15 mm for fURS in our study was also to avoid urosepsis.

Some limitations of our study should be considered while interpreting the results. We did not use noncontrast computed tomography (CT), which is the gold standard for preoperative evaluation of stone burden. However, in our setting, the cost of CT is a major barrier that prevents its routine use for the evaluation of stone burden. Moreover, the associated radiation hazard is another drawback of CT. Previous studies have demonstrated the efficacy of US as the first-line imaging modality for nephrolithiasis.[22] Second, the duration of follow-up was relatively short (3 months). In our setting, patients do not turn up for follow-up once they are stone free. Finally, only 2 out of 115 patients in this study had multiple stones. Therefore, our results are not applicable to patients with multiple stones.

CONCLUSION

fURS is an effective minimally invasive procedure for the removal of solitary stones up to 15 mm in size. We observed minimal morbidity rates and acceptable stone-free rates in our cohort.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Lingeman JE, Siegel YI, Steele B, Nyhuis AW, Woods JR. Management of lower pole nephrolithiasis: A critical analysis. J Urol 1994;151:663-7.
2. Albala DM, Assimos DG, Clayman RV, Densted JD, Grasso M, Gutierrez-Aceves J, *et al*. Lower pole I: A prospective randomized trial of extracorporeal shock wave lithotripsy and percutaneousnephrostolithotomy for lower pole nephrolithiasis – Initial results. J Urol 2001;166:2072-80.
3. Tuckey J, Devasia A, Murthy L, Ramsden P, Thomas D. Is there a simpler method for predicting lower pole stone clearance after shockwave lithotripsy than measuring infundibulopelvic angle? J Endourol 2000;14:475-8.
4. Prezioso D, Di Martino M, Galasso R, Iapicca G. Laboratory assessment. Urol Int 2007;79:20-5.
5. Giusti G, Proietti S, Villa L, Cloutier J, Rosso M, Gadda GM, *et al*. Current standard technique for modern flexible ureteroscopy: Tips and tricks. Eur Urol 2016;70:188-94.
6. Johnston WK 3rd, Low RK, Das S. The evolution and progress of ureteroscopy. Urol Clin North Am 2004;31:5-13.
7. Proietti S, Dragos L, Molina W, Doizi S, Giusti G, Traxer O. Comparison of new single-use digital flexible ureteroscope versus nondisposable fiber optic and digital ureteroscope in a cadaveric model. J Endourol 2016;30:655-9.
8. Doizi S, Kamphuis G, Giusti G, Andreassen KH, Knoll T, Osther PJ, *et al*. First clinical evaluation of a new single-use flexible ureteroscope (LithoVue™): A European prospective multicentric feasibility study. World J Urol 2017;35:809-18.
9. Secker A, Rassweiler J, Neisius A. Future perspectives of flexible ureteroscopy. Curr Opin Urol 2019;29:113-7.
10. Rodríguez-Monsalve Herrero M, Doizi S, Keller EX, De Coninck V, Traxer O. Retrograde intrarenal surgery: An expanding role in treatment of urolithiasis. Asian J Urol 2018;5:264-73.
11. Rukin NJ, Siddiqui ZA, Chedgy EC, Somani BK. Trends in upper tract stone disease in England: Evidence from the Hospital episodes statistics database. Urol Int 2017;98:391-6.
12. Geraghty RM, Jones P, Somani BK. Worldwide trends of urinary stone disease treatment over the last two decades: A systematic review. J Endourol 2017;31:547-56.
13. Romero V, Akpinar H, Assimos DG. Kidney stones: A global picture of prevalence, incidence, and associated risk factors. Rev Urol 2010;12:e86-96.
14. Bozzini G, Verze P, Arcaniolo D, Dal Piaz O, Buffi NM, Guazzoni G, *et al*. A prospective randomized comparison among SWL, PCNL and RIRS for lower calyceal stones less than 2 cm: A multicenter experience: A better understanding on the treatment options for lower pole stones. World J Urol 2017;35:1967-75.
15. Schuster TG, Hollenbeck BK, Faerber GJ, Wolf JS Jr. Ureteroscopic treatment of lower pole calculi: Comparison of lithotripsy in situ and after displacement. J Urol 2002;168:43-5.
16. Auge BK, Pietrow PK, Lallas CD, Raj GV, Santa-Cruz RW, Preminger GM. Ureteral access sheath provides protection against elevated renal pressures during routine flexible ureteroscopic stone manipulation. J Endourol 2004;18:33-6.
17. Kaplan AG, Lipkin ME, Scales CD Jr, Preminger GM. Use of ureteral access sheaths in ureteroscopy. Nat Rev Urol 2016;13:135-40.
18. Traxer O, Thomas A. Prospective evaluation and classification of ureteral wall injuries resulting from insertion of a ureteral access sheath during retrograde intrarenal surgery. J Urol 2013;189:580-4.
19. Shvero A, Herzberg H, Zilberman D, Mor Y, Winkler H, Kleinmann N. Is it safe to use a ureteral access sheath in an unstented ureter? BMC Urol 2019;19:80.
20. Dickstein RJ, Kreshover JE, Babayan RK, Wang DS. Is a safety wire necessary during routine flexible ureteroscopy? J Endourol 2010;24:1589-92.
21. Fan S, Gong B, Hao Z, Zhang L, Zhou J, Zhang Y, *et al*. Risk factors of infectious complications following flexible ureteroscope with a holmium laser: A retrospective study. Int J Clin Exp Med 2015;8:11252-9.
22. Vijayakumar M, Ganpule A, Singh A, Sabnis R, Desai M. Review of techniques for ultrasonic determination of kidney stone size. Res Rep Urol 2018;10:57-61.