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Original Research Article

EFFICACY AND SAFETY OF SEMI-RIGID URETEROSCOPY, FLEXIBLE URETEROSCOPY, AND SHOCK WAVE LITHOTRIPSY FOR INITIAL TREATMENT OF PROXIMAL URETERAL STONES- A COMPARATIVE STUDY

ADNAN M[1], AHMAD I[2], KHAN MAH[3*], SAIFULLAH[1], HUSSAIN M[5], JAVED N[5]

[1]*Department of Urology, Bakhtawar Amin Medical & Dental College Multan, Pakistan*
[2]*Department of Pediatric Urology, Bakhtawar Amin Medical & Dental College Multan, Pakistan*
[3]*Department of Urology, Bakhtawar Amin Trust Hospital Multan, Pakistan*
[4]*Department of Urology, Sharif Medical & Dental College Lahore, Pakistan*
[5]*Department of Urology Pediatric Urology, The Children Hospital & The University of Child Health Sciences Lahore, Pakistan*
**Correspondence author email address:* dr.mr.abrarahmad@gmail.com

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Abstract: *This study was designed to compare the efficacy and safety of semi-rigid ureteroscopy, shock wave lithotripsy and flexible ureteroscopy for treating proximal ureteral stones. A retrospective study was conducted in the Urology Department of Bakhtawar Amin Trust Hospital, Mukhtar A. Sheikh Hospital Multan & Lahore from 06th Sep 2021 to 06th Sep 2022. A total of 100 patients with 11-20mm proximal ureteral stones were included in the study. The patients underwent one of the three procedures; semi-rigid ureteroscopy (23 patients), shock wave lithotripsy (35 patients) and flexible ureteroscopy (42 patients) and their results were compared. The study was conducted on a total of 100 patients. The hospital stays and operation time duration in the SWL group was shorter than in the URS groups ($p < 0.001$). F-URS had a higher success rate than SWL or SR-URS ($p < .001$), and that of SR-URS was higher as compared to SWL ($p<.001$). The furs group had the highest efficiency quotient. Complication grading based on the modified Clavien classification system does not show significant differences. f- URS had a lesser need for the auxiliary procedure, shorter hospital stays, and longer operation duration than SR-URS. F-URS is an effective lithotripsy procedure in treating 11-20mm proximal ureteral stones with fewer complications and retreatment requirements than SWL and SR-URS.*

Keywords: Ureteral stones, lithotripsy, ureteroscopy

Introduction

Urinary tract stones are a common occurrence. Available treatment modalities are open surgery, laparoscopy, percutaneous nephrolithotomy, ureteroscopy (URS) and Shock wave lithotripsy (SWL) (Lai et al., 2020; Rukin et al., 2017). According to the American Urological Association guidelines, SWL and URS are recommended for stone sizes 1.1 to 2 cm. According to these guidelines, URS is an optimal option, but increased morbidity and complications must be considered compared to the other methods (Assimos et al., 2016; Türk et al., 2016). Recent studies have compared the safety and effectiveness of available treatment modalities for large proximal ureteral stones(Deng et al., 2019; Kozyrakis et al., 2019; Lai et al., 2020). Technology advancement has led to the increased use of flexible ureteroscopy (f-URS). Semi-rigid ureterorenoscopy (sr-URS) has been compared with f-URS, and SWL has been compared with SR-URS(Abdeldayem et al.; Çitamak et al., 2018). However, studies comparing all three treatment modalities for proximal ureteral stones are unavailable. This study compares the efficacy and safety of semi-rigid ureteroscopy, shock wave lithotripsy and flexible ureteroscopy for treating proximal ureteral stones.

Methodology

A retrospective study was conducted in the Urology Department of Bakhtawar Amin Trust Hospital, Mukhtar A. Sheikh Hospital Multan & Lahore from 06th Sep 2021 to 06th Sep 2022. The study included patients who had 11-20 mm proximal ureteral stones. Those under 18 who had previous surgery on the same side, multiple stones, concomitant intra-renal

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stones, concurrent pregnancy and solitary kidney were excluded. Computed tomography, ultrasound and X-ray were done for stone detection. Patients were told about treatment options, associated risks, and complications before selecting the procedure. Informed consent was taken from the hospital.

For URS cases, f-URS was mostly performed in patients with stones closer to the ureteropelvic junction or those with grade III and IV hydroureteronephrosis. Sr-URS has mostly been performed in patients with stones away from the ureteropelvic junctions. Device selection was jointly based on surgeon preference, socioeconomic factors and stone characteristics. Patients were divided into SWL, sr-URS and f-URS groups. Patient data, including sex, age, stone size and location, BMI, operation time, stone-free rate, complication rate, need for retreatment and duration of hospital stay, were recorded. The pre and post-operative findings of the selected procedure were recorded. A total stone-free state or presence of stone fragments <3mm was considered a successful treatment outcome. 15-day and 3-month follow up (for auxiliary procedure) were done. Formula for efficiency quotient was = (stone free % × 100)/[100 + retreatment (%) + auxiliary procedures (%)].A modified Clavien classification system was used for grading perioperative complications.

SPSS 17.0 was used for data analysis. Qualitative variables were presented as mean and standard deviation. Qualitative variables were presented as percentage and frequency. Mann-Whitney U test was used for evaluating differences in quantitative variables. The chi-square test was used for evaluating categorical variables. P value < 0.05 was considered statistically significant.

Results

The study was conducted on a total of 100 patients. The patients underwent one of three procedures: semi-rigid ureteroscopy (23 patients), shock wave lithotripsy (35 patients) and flexible ureteroscopy (42 patients). There was no difference in sex, age, side, BMI, American Society of Anesthesiologists (ASA) score, stone size or presence of hydronephrosis in the three groups ($p \geq 0.05$). The hospital stay and operation time duration in the SWL group was shorter than in the URS groups ($p < 0.001$). F-URS had a higher success rate than SWL or SR-URS ($p < .001$), and that of SR-URS was higher as compared to SWL ($p<.001$). Stones were either not fragmented optimally or were pushed back. 16 out of 23 SR-URS patients achieved a stone-free state, and the rest were switched to f-URS. Of 42 f-URS patients, an access sheath was inserted before performing lithotripsy in 32 (76%) patients with initial f-URS. In 15 patients, the ureter was passively dilated by inserting a ureteral stent. These patients had treatment 2 weeks later; 10 were treated with f-URS and 5 with sr-URS. SWL had a higher retreatment rate than other groups ($p < .001$). F-URS had a lower auxiliary procedure rate as compared to SWL or sr-URS. URS had higher SFRs as compared to SWL ($p < .001$). The f-URS group had the highest efficiency quotient (Table I). Each SWL procedure was performed in a maximum of three sessions. The power and the mean number of waves decreased with each session; however, complications increased. Hydronephrosis negatively affected treatment outcomes in the SWL group. Complications rates were not significantly different in all groups when evaluated on the 15th day ($p = .066$); however, evaluation after the 3rd month showed a significant difference ($p = .022$). Complication grading based on the modified Clavien classification system does not show significant differences ($p > .05$). Though the overall complication rate was higher in SWL, there were minor complications per the modified Clavien classification system. 1 patient in each SR-URS and f URS group developed sepsis. No death was reported (Table II). Treatment outcomes of SR-URS and f-URS for impacted stones were analyzed. f-USR resulted in 81.2% SFR compared to SR-USR, which resulted in 51.3% SFR after the first session ($p \leq .001$). There was no significant difference in retreatment and complication rate, total SFR and stone size between both URS types ($p > .05$). f-URS had a lesser need for the auxiliary procedure, shorter hospital stays, and longer operation duration than SR-URS.

Table I Patient characteristics and the outcome of the treatment on the 15th follow-up day

Variables	sr-URS n=23	f-URS n=42	SWL n=35	P value
Age	44.1 ± 12.1	43.6 ± 12.1	42.4 ± 13.6	0.774
Sex (male/female)	19/4	35/7	30/5	0.586
Side(right/left)	11/12	17/25	16/19	0.950
ASA score	1.64 ± 0.63	1.74 ± 0.69	1.72 ± 0.71	0.415
BMI	25.3 ± 2.6	25.4 ± 2.8	24.9 ± 2.2	0.186
Presence of hydronephrosis, n(%)	20 (86.9%)	36 (85.7%)	28 (35%)	0.059
Stone size	13.8 ±	13.7 ±	3.5±	0.06

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(mm)	2.5	2.5	2.7	2
Operation duration (min)	41.5 ± 13.8	50.3 ± 10.8	30.8 ± 3.8	< .001
Complications, n (%)	4(17.3 %)	5 (12%)	3 (8.5%)	0.06 6
Duration of hospital stay	1.4 ± 1.5	1.2 ± 1.2	0.4 ± 1.2	< .001
Efficiency quotient	0.52	0.88	0.23	

Table II Complication grading based on the modified Clavien classification system

	sr-URS n=23	f-URS n=42	SWL n=35	P value
I	4 (17.3%)	6 (14.2%)	4 (11.4%)	0.220
II	2 (8.6%)	4 (9.5%)	2 (5.7%)	0.517
III	1 (4.3%)	2 (4.7%)	1 (2.8%)	0.716
IV	1 (4.3%)	1 (2.3%)	0 (0%)	0.411

Discussion

Upper ureteral stones are usually treated through surgical intervention. Medical expulsion therapy is ineffective for stones sized 11 to 20 mm; thus, surgery is required(Yallappa et al., 2018). Selection of the treatment method is based on different factors, including pain, stone size, cost, quality of life, presence of obstruction and surgeon experience(Ahmad et al., 2021).URS and SWL are common treatment modalities; these have both advantages and disadvantages. Previously SWL was preferred for stones bigger than 10mm; recently, URS and SWL have been compared, and both are recommended for primary treatment (Drake et al., 2017). Higher SFR is achieved through URS, but it has a higher complication rate than SWL. The current study found that f-URS have lower complications and higher success rates than SWL and SR–URS. A recent study has found that due to improved technology, the complication rate of URS is decreasing with simultaneous improvement in SFR(Lai et al., 2020). Another study reported that flexible devices for removing proximal ureteral stones result in reduced complications and a higher success rate (Bhanot et al., 2021). If stones are located close to the ureteropelvic junction, there is an increased risk of them being pushed into the kidney; it was reported in 21% of cases of SR-URS in this study. Switching to f-URS is costly and time-consuming; it is further complicated by obstructed vision and hemorrhage, so the next session is required for the procedure (Esposito et al., 2019). Using f-URS, if stones are pushed back, these are accessible without additional intervention. F-URS is also better for treating concomitant renal and upper ureteral stones(Manikandan et al., 2016). In this study, many cases were intraoperatively converted to f-URS, which explains the higher rate of auxiliary procedures required after SR-URS. In this study, 16 of 23 SR-URS patients achieved a stone-free state; the rest were switched to f-URS. This shows that even if the SR-URS is the initial procedure, f-URS should be readily available to prevent the need for an additional session. Despite being less invasive, SWL cannot be used during pregnancy, morbid obesity and bleeding diathesis(Li et al., 2018). A single session of SWL has a low success rate, but repeated sessions result in SFRs comparable to URS. In the current study, SWL had a higher complication rate compared to URS due to incidence of renal colic in patients undergoing SWL. This was in line with findings of the previous studies which reported SWL associated complications (Bangash et al., 2021; Kartal et al., 2020). URS had lower complication rate due to use of flexible devices and surgeon's experience. f-URS is cost effective due to lower recovery time and complication rate and higher success rate. This study has some limitations like not considering stone composition, need for analgesia and lower urinary tract symptoms.

Conclusion

F-URS is an effective lithotripsy procedure in treating 11-20mm proximal ureteral stones with fewer complications and retreatment requirements than SWL and sr-URS.

Conflict of interest

The authors declared no conflict of interest.

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