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Original Article

Efficacy of semirigid ureterorenoscopy with the use of ureteral acsess sheath in the treatment of impacted ureteral stones: A prospective randomized study

Ercument Keskin[1], Abdullah Erdogan[1], Ibrahim Karabulut[2]

[1]Department of Urology, Faculty of Medicine, Erzincan Binali Yildirim University, Erzincan, Turkey
[2]Department of Urology, University of Health Sciences, Erzurum Training and Research Hospital, Erzurum, Turkey

Abstract

Aim: To investigate the advantages of using Ureteral Access Sheat (UAS) with semirigid ureterorenoscopy in patients with impacted ureteral stones.

Materials and Methods: One hundred and 22 adult patients that presented to our clinic with the complaint of impacted stones in the middle and upper parts of the ureter and were scheduled for surgical treatment. The procedure was performed without UAS in control group and using UAS in study group.

Results: No significant difference was found between the two groups in terms of age, gender, stone disease history, presentation complaint, stone side, size, density and localization, degree of renal hydronephrosis, complications and length of hospital stay. Stone migration, operation time, duration of fluoroscopy, and postoperative additional surgical intervention rates were significantly lower in the UAS group [26.2% (n = 16) vs 11.5% (n = 7), p = 0.037; 35.46 ± 5.3 min vs 25.56 ± 4.2 min, p < 0.001, 5.50 ± 0.86 sec vs 3.24 ± 0.69 sec, p < 0.001; and 19.7% (n = 12) vs 6.6% (n = 4), p = 0.032, respectively]. The operation was successful in 48 (78.7%) patients in the control group and 57 (93.4%) in the UAS group, with a statistically significant difference (p = 0.019).

Conclusion: The use of UAS in the treatment of middle-upper impacted ureteral stones presents as an advantageous method due to the shorter operation time and lower rates of intraoperative stone migration and high success rates of the operation.

Keywords: Impacted ureteral stones; semirigid ureterorenoscopy; ureteral acsess sheath

INTRODUCTION

Ureteral stone disease is common in the global community. These stones are often less than 5 mm, and the probability of spontaneous passage is between 71 and 98% (1). Impacted ureteral stones are those that remain in the same position for more than two months and do not allow the contrast agent to pass distally to the stone in contrast-enhanced images or the guide to pass through the edges of the wire, and their treatment process is difficult (2,3). Although extra corporeal shock wave lithotripsy (ESWL) with ureteroscopy (URS) is the first choice in the treatment of proximal ureteral stones less than 10 mm, intra corporeal lithotripsy with URS is preferred in stones over 10 mm and impacted stones (4). However, even after a successful intervention, fragmented stones may remain in the ureter, and even those smaller than 4 mm can cause urinary tract infection and pathologies.

Ureteral access sheath (UAS) is currently used in the treatment of urolithiasis with flexible ureterorenoscopy (FURS). One of the important advantages of UAS is that it allows better visualization and reduces intrarenal pressure (5,6).We investigated the advantages and disadvantages of UAS in combination with semirigid ureterorenoscopy in patients that underwent URS in our clinic for the last two years. To the best of our knowledge, there are no studies on this subject in the literature.

MATERIALS and METHODS

After obtaining approval from the Ethics Committee of Health Sciences University Erzurum Training and Research Hospital (approval number: 37732058-53), 122 adult patients that presented to our center with impacted upper and mid-ureteral stones between August 3, 2016 and August 3, 2018 and planned to be treated with URS were included in the study. The patients provided written informed consent. Patients with renal failure, coagulation disorder, history of ureteral reimplantation or urethral reimplantation surgery, postural anomalies, history of solitary kidney, and dilatation due to ureteral stenosis

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Corresponding Author: Ercument Keskin, Department of Urology, Faculty of Medicine, Erzincan Binali Yildirim University, Erzincan, Turkey **E-mail:** keskinerc@hotmail.com

were not included in the study. Before the study, a preoperative evaluation was performed including medical history, physical examination, routine hematological and biochemical tests, complete urine analysis, kidney ureter bladder radiography (KUB), renal ultrasonography (US), and intravenous pyelography (IVP) and/or non-contrast-enhanced computed tomography. Renal scintigraphy was also used when required. The stone size was calculated according to the formula provided by the European Urological Association guidelines (4).

The patients with sterile urine culture were treated with a single dose of broad-spectrum antibiotic (first-generation intravenous cephalosporin) before the procedure. Those with urine culture growth were first treated with an appropriate antibiotic regime and underwent the procedure only after their culture was confirmed to be negative. The patients were evaluated in terms of demographic characteristics, stone size, stone localization, degree of hydronephrosis, duration of operation, duration of fluoroscopy, need for additional surgery, length of hospital stay, and intraoperative and postoperative complications.

Surgical technique

First, all patients underwent underwent C-arm fluoroscopy and cystoscopic evaluation in the lithotomy position under spinal or general anesthesia. Then, a hydrophilic guide wire was advanced through the ureter. To exclude any other ureteral pathology and dilate the ureter, ureteroscopy was performed with a 4.5F Wolf® semirigid ureteroscope over the guide wire. It was confirmed by URS that the stone was impacted. The patients were randomized into the UAS and control groups using a computer program. In the control group, the ureter was accessed by URS with a guide wire to reach the stone. In the UAS group, a 9.5/11.5 Fr UAS was placed over the guide wire under fluoroscopic guidance and the ureteroscope was advanced through UAS to reach the stone. Lithotripsy was performed carefully using a Holmium: yttrium-aluminum-garnet (YAG) laser (Quanta, Italy®) to avoid mucosal damage. First, the central part of the stone was fragmented to provide fluid passage; then, through circular movements, the area between the stone and the mucosa was reached, and the stone was released. The stones were fragmented until powdered, and then a guide wire was pushed to the proximal of the stone for safety purposes. The laser was adjusted to 0.5-1.2 j energy and 8-12 Hz frequency, and fragmentation was achieved with 272 µ fibers. Fragments smaller than 3 mm were left to pass spontaneously and larger and suitable stones were removed by stone forceps. A 4.8 Fr 28 cm double-J (JJ) ureter catheter was placed in 45 patients in the control group and 51 patients in the UAS group. The JJ catheters were withdrawn under sedoanelgesia three-four weeks postoperatively. The stone-free rates of all patients were evaluated by KUB X-ray and US at one month postoperatively. For non-opaque stones, non-contrast tomography was used to evaluate the treatment success. Success was determined as a complete stone-free rate or clinically non-significant residual fragments (<3 mm).

For statistical analysis IBM SPSS Statistics Version 20 Windows package program was used. The compliance of data to normal distribution curve was evaluated by Shapiro-Wilk test. Normally distributed data were presented as mean ± standard deviation (SD). Continuous variables and categorical data were compared using Student-t test, and chi-square test. A p value <0.05 was significant.

RESULTS

A total of 122 patients who met the criteria were included in the study. There were 61 patients each in the control and UAS groups. The mean age of the patients was 43.11 ± 15.85 and 45.02 ± 15.21 years in the control and UAS groups, respectively, indicating no significant difference (p = 0.500). The male/female ratio was 41 (67.2%)/20 (32.8%) in the control group and 35 (57.4%)/26 (42.6%) in the UAS group (p = 0.262). No significant difference was found between the two groups in terms of stone disease history, presentation complaint, stone side, size, density and localization, degree of renal hydronephrosis, and preoperative urine culture positivity (Table 1).

Table 1. Comparison of the demographic data and stone characteristics of the patients

	Control group	UAS group	p
Age (years)	43.11 ± 15.85	45.02±15.21	0.500
Gender M/F n (%)	41 (67.2%) / 20 (32.8%)	35 (57.4%) / 26 (42.6%)	0.262
BMI kg/m^2	26.31 ± 4.58	26.91±4.99	0.486
Stone disease history absent/present n (%)	36 (59%) / 25 (41%)	42 (68.9%) / 19 (31.1%)	0.258
Presentation complaint n (%)			
Side pain	42 (68.9%)	48 (78.7%)	
Hematuria	17 (27.9%)	12 (19.7%)	0.450
Urinary system infection	2 (3.3%)	1 (1.6%)	
Stone side left/right n (%)	31 (50.8%) / 30 (49.2%)	40 (65.6%) / 21 (34.4%)	0.99
Stone size (mm)	9.09 ± 2.6	9.04±2.87	0.921
Hounsfield unit	706.32 ± 224	690.77±235	0.710

Stone localization n (%)			
Mid-ureter	24 (39.3%)	33 (54.1%)	
Upper ureter	30 (49.2%)	23 (37.7%)	0.262
Multiple	7 (11.5%)	5 (8.2%)	
Degree of hydronephrosis n (%)			
1	22 (36.1%)	20 (32.8%)	
2	30 (49.2%)	27 (44.3%)	0.512
3	9 (14.8%)	14 (23%)	
Preoperative urinary culture positivity n (%)	7 (11.25%)	4 (6.6%)	0.343
History of stone disease treatment failure n (%)			
None	51 (83.6%)	49 (80.3%)	
ESWL	8 (13.1%)	9 (14.8%)	0.861
URS	2 (3.3%)	3 (4.9%)	

UAS: Ureteral Access Sheath, BMI: Body Mass Index, ESWL: Extracorporeal Shock Wave Lithotripsy, URS: Ureterorenoscopy

There were no major intraoperative and postoperative complications in ether group. In the control group, bleeding was detected in eight patients (13.1%) and mild mucosal laceration in 13 (21.3%) while the UAS group contained two cases (3.3%) that developed bleeding and 10 that had mucosal laceration (15.6%). The difference was not significant (p = 0.113). There was no significant difference between the two groups in terms of postoperative complications. The length of hospital stay was 2.66 ± 1.47 days and 2.54 ± 1.54 days in the control and UAS groups, respectively, but the difference was not significant (p = 0.675). Stone migration, operation time, duration of fluoroscopy, and postoperative additional surgical intervention rates were significantly lower in the UAS group [26.2% (n = 16) vs 11.5% (n = 7), p = 0.037; 35.46 ± 5.3 min vs 25.56 ± 4.2 min, p < 0.001, 5.50 ± 0.86 sec vs 3.24 ± 0.69 sec, p < 0.001; and 19.7% (n = 12) vs 6.6% (n = 4), p = 0.032, respectively]. The operation was successful in 48 (78.7%) patients in the control group and 57 (93.4%) in the UAS group, with a statistically significant difference (p = 0.019) (Table 2).

Table 2. Comparison of the operative data of the patients

	Control group	UAS group	p
Peroperative complications n (%)			
None	40 (65.6%)	49 (80.3%)	0.113
Bleeding	8 (13.1%)	2 (3.3%)	
Mucosal laceration	13 (21.3%)	10 (15.6%)	
Stone migration n (%)	16 (26.2%)	7 (11.5%)	0.037
Postoperative complications n (%)			
None	51 (83.6%)	53 (86.9%)	
Bleeding	4 (6.6%)	4 (6.6%)	0.646
Fever	1 (1.6%)	2 (3.3%)	
Urinary system infection	5 (8.2%)	2 (3.3%)	
Duration of operation (min)	35.46 ± 5.3	25.56 ± 4.2	<0.001
Duration of fluoroscopy (sec)	3.24 ± 0.69	5.50 ± 0.86	<0.001
Operation success n (%)	48 (78.7%)	57 (93.4%)	0.019
Length of hospital stay (days)	2.66 ± 1.47	2.54 ± 1.54	0.675
Postoperative ureteral stent n (%)	45 (73.8%)	51 (83.6%)	0.185
Additional surgical interventions n(%)	12 (19.7%)	4 (6.6%)	0.032

UAS: ureteral access sheath

DISCUSSION

The treatment of ureteral stones has changed greatly with the development in technology and endourological devices and techniques (7). Although ureteral stones are known to be more resistant to ESWL than renal stones, this is still a preferred treatment method due to its minimally invasive nature (8). Surgical treatment is required in case of ESWL failure. The aim of surgical treatment of ureteral stones is to completely remove the stones with minimal morbidity. While rigid and FURS are sufficient in most cases, open surgery, laparoscopic ureterolithotomy, and antegrade percutaneous methods may be necessary for large and impacted ureteral stones depending on the localization of the stone (9).

Studies on the non-surgical treatment of ureteral stones are increasing. For this purpose, alpha 1 adrenergic receptor blockers, anti-inflammatory agents, and calcium channel blockers are the most commonly used drugs. However, these agents are recommended for non-impacted distal ureteral stones greater than 5 mm, not for the treatment of impacted stones (4).

It has been observed that the efficiency of URS increases with the development of thinner calibrated semirigid URS and FURS. Yencilek et al. (10) compared ESWL, semirigid URS, and FURS in the treatment of proximal ureteral stones, and reported the stone-free rates as 92%, 75%, and 96%, respectively. Although the stone-free rates obtained by FURS are high, this device is available only in a limited number of healthcare centers and due to the fragile nature of FURS, the treatment cost per patient increases considerably.

Gücük et al. evaluated the efficacy of antegrade percutaneous approach in impacted upper ureteral stones and found similar results to the literature in terms of the mean stone-free rate and length of hospital stay (11). However, the mean duration of operation and mean decline in hemoglobin were slightly higher than the literature. In our study, no difference was found between the complication rates, but the rate of additional surgical procedures was higher in the control group.

Pardalidis et al. used FURS with UAS in small impacted lower ureter stones and compared this procedure with the standard technique. They stated that the use of FURS with UAS was faster and more reliable and provided a stone-free rate of 95.8% (12). In our study, the stone-free rate was significantly higher in the UAS group (93.4%) compared to the control group (78.7%) ($p = 0.032$).

The use of a semirigid ureteroscope is common in the endoscopic treatment of upper and mid-ureteral stones. However, the use of semirigid URS is controversial in these stones since FURS is considered to be a better option because of its small caliber and flexibility. In some studies, it is argued that semirigid devices should be used only in the absence of flexible devices (13). The use of UAS during FURS increases the flow of fluid and improves both the quality of the image and the passage of the irrigation fluid, thus preventing the increase of intraluminal and intrarenal pressure, thereby making the procedure safer and faster (14). In cases where UAS is not used, the intrapelvic pressure may increase by 35% to 80%, which also increases the risk of perioperative infection by causing intrarenal reflux (15).

In a study by Kourambas et al., 47 patients treated for kidney stones were examined, and it was shown that the duration of procedure was 10 minutes longer and the cost of treatment was higher in patients for whom UAS was not used (16). In our study, we similarly found that in the control group, the procedure took longer and the difference was significant compared to the UAS group.

In a multicenter study by Traxer et al. (17), it was concluded that the use of UAS did not increase the risk of intraoperative ureteral damage and bleeding and even reduced the incidence of postoperative infectious complications. In another study conducted by Traxer and Thomas (18), the formation of mucosal erosion was detected in the ureter wall in half of the patients, but no smooth muscle injury occurred.

In our study, similar rates of mucosal laceration were observed in patients in the control and UAS groups [13 (21.3%) vs 10 (15.6%), $p = 0.113$], and no major complication develop in any of the patients. In the control group, stone migration to the kidney occurred in 16 patients (26.2%) and 12 cases (19.7%) required additional surgical procedures. This result is considered to be due to the higher intraureteral fluid pressure in the control group compared to the other group. In the UAS group, additional surgery was only required in for patients (6.6%); thus, the difference between the two groups was statistically significant ($p = 0.032$).

There was no significant difference between the two groups in terms of intraoperative bleeding that caused the termination of the operation. Intraoperative bleeding occurred in eight patients (13.1%) in the control group and two patients (3.3%) in the UAS group ($p = 0.113$). The duration of fluoroscopy was significantly longer in the UAS group ($p < 0.001$). However, fluoroscopy is now used even in the monitoring of residual fragments. With increasing experience, the duration of fluoroscopy during FURS decreases. This difference in the duration of fluoroscopy between the two groups in terms of radiation safety a remains open to discussion and requires further studies.

CONCLUSION

In conclusion, the use of UAS during semirigid URS in the treatment of impacted upper and mid-ureteral stones is advantageous due to the shorter duration of operation, lower rate of stone migration, and reduced requirement of additional surgery. According to the results obtained, it is expected that supporting the procedure with UAS will increase the success rates in cases where semirigid URS is first planned due to the unavailability of FURS or economic reasons.

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