Ureteroscopy in proximal ureteral stones after shock wave lithotripsy failure: Is it safe and efficient or dangerous?

Muhammet Fatih Kilinc, MD;[*] Omer Gokhan Doluoglu, MD;[*] Tolga Karakan, MD;[*] Ayhan Dalkilic, MD;[¥] Nurettin Cem Sonmez, MD;[¥] Yasin Aydogmus, MD;[§] Berkan Resorlu, MD[+]

[*]Department of Urology, Ankara Training and Research Hospital, Ankara, Turkey; [¥]Department of Urology, Sisli Hamidiye Etfal Training and Research Hospital, Istanbul, Turkey; [§]Department of Urology, Etimesgut Military Hospital, Ankara, Turkey; [+]Department of Urology, 18 Mart University, Canakkale, Turkey

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Abstract

Introduction: We assessed the effectiveness of ureteroscopy (URS) in proximal ureteral stones performed after shock wave lithotripsy (SWL) failure, and determined outcomes in terms of success rate, complications, and operation time.
Methods: We analyzed data of patients with previous unsuccessful SWL (Group I) and the ones that did not have SWL or URS before (Group II) for proximal ureteral stones between December 2007 and August 2014. Group I included 346 patients who underwent complementary URS and Group II 209 patients who underwent primary URS. Success rates, operation time and complications were compared between groups.
Results: Success rates of complementary and primary URS were 78.9% and 80.9%, respectively. The difference in success rates was not statistically significant between groups ($p = 0.57$). The complication rates of complementary URS was 12.1%, and 9.5% in primary URS ($p = 0.49$). No statistically significant differences were noted in terms of gender, age, stone size and side, or lithotripter type between groups. The mean operation time and need for balloon dilatation were higher in complementary URS group compared to the primary URS group, and the difference was statistically significant ($p < 0.05$).
Conclusions: Complementary URS may be used safely after SWL failure in proximal ureteral stones. Its success rate and morbidities are similar to primary URS, except for longer operation time and an increased need for balloon dilatation.

Introduction

Shock wave lithotripsy (SWL) and ureteroscopy (URS) are two common modalities in the management of proximal ureteral stones.[1] European Association of Urology (EAU) and American Urological Association (AUA) guidelines have recommended URS or SWL as first-line treatment options.[2] SWL is an effective and non-invasive treatment method in urolithiasis, particularly in stones located in the upper third of the ureters.[3,4] However, URS is a more invasive technique when compared to SWL. URS became the most efficient treatment method in proximal ureteral stones after the development of small-calibre, semi-rigid and flexible endoscopes and the holmium:YAG laser. Today, the greatest dilemma faced by urologists is to choose between SWL and URS.

A number of factors influence the final results of SWL,[3-5] and if no fragmentation occurs after several unsuccessful sessions, the stone is considered SWL-resistant; the case is deemed a SWL-failure and the patient therefore undergoes URS. URS has been described as "salvage" or "second" URS in cases of SWL-resistant stones.[6] We have used the term "complementary URS" in our study instead of those terms. Only a few studies have investigated the effect of previous SWL and outcomes of complementary URS.

In this study, we investigated outcomes of URS as a primary treatment, and after failure of SWL in the treatment of proximal ureteral stones.

Methods

Study population

After obtaining approval of the Institutional Review Board, we reviewed data of consecutive patients treated at our Urology Department for a single, radiopaque proximal upper ureteral stone between December 2007 and August 2014. Proximal ureter was defined as the part of ureter between the ureteropelvic junction and the upper border of the sacroiliac joint. The treatment decision was taken according to stone size (first choice of proximal ureteral stones <1 cm was SWL), existence of anatomical and congenital abnormalities, comorbidities, high body mass index, bleeding disorders, untreated urinary tract infections, personal preference, or available equipment. The patients who were treated with URS for proximal ureter stones either after failure of SWL (n = 346) (Group I) or primarily (n = 209) (Group II) were included in the study. Patients with previous URS, percutaneous antegrade URS, laparoscopy, or open surgical ureterolithotomy were excluded. All patients had kidney function tests, urinalysis, kidney-ureter-bladder (KUB) radiography, computerized tomography (CT) or intravenous urography (IVU), and ultrasonography before surgery.

SWL technique

SWL was performed as an outpatient procedure using the Multimed Classic (Elmed, Ankara, Turkey). A tablet of diclofenac sodium (50 mg for body weight <70 kg, 100 mg for >70 kg) was given orally minutes before the procedure. The shock wave was delivered at a rate of 80 impulses per minute. The maximum number of shock waves per session was 2000. During each session, the patient was observed for 1 to 2 hours. KUB radiography and ultrasound were performed to evaluate stone-free status and hydronephrosis after each session at 1 week. SWL failure was considered if the stone persisted after 3 sessions of SWL or increasing degree of hydronephrosis was detected. All procedures were performed by experienced urologists.

Ureteroscopy technique

URS procedure was performed in all patients in the lithotomy position, under general anesthesia, using a 6/7.5F semirigid ureteroscope (Richard Wolf, Knittlingen, Germany) with a holmium laser or pneumatic lithotripter. The safety guidewire (0.035 inch) was placed into the ureteral orifice through the ureteroscope, and under the guidance of the catheter, the ureteroscope was introduced directly up to the stone. The ureteral orifice or ureteral stricture was dilated with balloon dilators, and auxiliary equipments were used as needed to prevent upward migration of the stone into the renal pelvis. Large fragments were removed using a stone retrieval device. The entire ureter was examined by endoscope to determine presence of any residual stones and/or mucosal injuries following complete removal of the stone. In addition, fluoroscopy was used to search for residual stone fragments. A double J stent was placed in all patients. Intraoperative and postoperative complications were graded according to modified Satava[7] and Clavien[8] systems, respectively. The stent was removed 2 to 4 weeks after surgery. All operations were performed by surgeons with at least 3 years of experience.

KUB radiography was performed on postoperative day 1 to exclude residual stones. Stone-free status was examined at postoperative week 4 by KUB or CT, if needed, and defined as radiologic absence of stone or asymptomatic in patients with stone fragments <4 mm in size, also called "insignificant residual calculi."

Statistical analysis

Data analysis was performed with PASW 18 (SPSS/IBM, Chicago, IL) software. Kolmogorov-Smirnov and Probability-Plot tests were used to verify the normality of the distribution of continuous variables. Descriptive statistics were shown as mean ± standard deviation, and the number of cases and percentage for variables with a normal distribution and categorical variables, respectively. Student-t test was used for intergroup analyses of continuous variables. Categorical variables were analyzed with Chi square test. Statistical significance was set at $p < 0.05$.

Results

The patients were divided into 2 groups according to previous SWL failure or primary treatment with URS. There were 346 were patients in Group I, and 209 patients in Group II. Group 1 and Group 2 success rates of proximal ureteral stones were >1 cm (77.4% and 79.8%) and <1 cm (80.1% and 83%), respectively, yet these are not statistically significant ($p = 0.35$ and $p = 0.61$). The mean operation time and need for balloon dilatation were higher in Group I and the differences between groups were statistically significant ($p < 0.05$). There were no significant differences between groups for gender, age, stone size, stone side, intra- and postoperative complication rates, or lithotripter type (Table 1).

Intraoperative complications were graded according to modified Satava classification system, and peroperative

Table 1. Patient characteristics

	Group I	Group II	*p* value
No. patients	346	209	
Age (years)	43.2 (±15.8)	44.5 (±14.7)	0.36
Sex			
Men	225 (65%)	135 (64.6%)	0.91
Women	121 (35%)	74 (35.4%)	
Stone size (mm)	11.19 (±4.41)	11.24 (±4.48)	0.88
Stone side			
Right	156 (45.1%)	91 (43.5%)	0.16
Left	190 (54.9%)	118 (56.5%)	
Complication rate	42 (12.1%)	20 (9.5%)	0.49
Success rate			
<1 cm	80.1%	83.0%	0.35
>1 cm	77.4%	79.8%	0.61
Operation time (min)	35.99 (±12.9)	31.89 (±9.7)	0.01
Need of balloon dilatation	21 (6.1%)	5 (2.4%)	0,01
Stone migration	29 (8.3%)	20 (9.5%)	0.82
Lithotripter type			
Pneumatic	150 (43.3%)	105 (50.2%)	0.80
Holmium laser	196 (56.6%)	104 (49.8%)	

complications were graded according to modified Clavien classification system (Table 2).

The procedures were converted to open surgery in 6 (1.08%) patients in Group I, and in 2 (0.36%) patients in Group II due to the inability to reach the stone, impacted stones, severe ureteral stricture, tortuous, kinked, or angulated ureter, ureteral perforation or avulsion, or technical problems. The intraoperative stone migration rate was 8.8% ($p = 0.82$). Double J stents were inserted in all patients. The complication rate was higher in Group I than Group II (12.1% vs. 9.5%, respectively) ($p = 0.49$). Most intraoperative complications were modified Satava grades I or II. Only 2 (0.3%) patients had grade III injuries, and they were in Group I. Fever was the most frequent postoperative complication (18%), particularly in Group I ($p = 0.03$). Modified Clavien grade IV injuries were not seen in any of the groups.

Discussion

In determining the management of proximal ureteral stones, a number of factors are important, including location, impaction and size of the stone, renal colic, pain duration, presence and grade of obstruction, cost, and availability of instruments.[9] EAU 2014 guidelines recommended that proximal ureteral stones <10 mm should be removed using SWL if active stone removal is recommended, and the stones >10 mm should be removed using URS or SWL.[10] Although SWL is the first option, it is non-invasive, and can be performed as an outpatient procedure; its disadvantages include a high re-treatment rate, long treatment time, inability to dissect a large or impacted stone, anatomical and physical abnormalities of patients, experiences of surgeon or technician, and technical difficulties.[6,11,12] Therefore, SWL failure is not rare in proximal ureteral stones. Although efficiency and success rates of complementary URS are not well-established, it is a common procedure used in cases of SWL failure in proximal ureteral stones.

Table 2. Intra- and postoperative complications

	Group I	Group II	*p* value
No. complications			
Intraoperative complications			
Satava I (Observation)	20 (3.6%)	12(2.1%)	0.13
Mucosal tears	9 (1.62%)	5 (0.9%)	0.23
Mild bleeding	3 (0.54%)	2 (0.36%)	0.27
Malfunction or breakage of instruments	4 (0.72%)	1 (0.18%)	0.11
Proximal stone migration requiring observation	4 (0.72%)	4 (0.72%)	0.81
Satava II (requiring endoscopic retreatment)	16(2.8%)	6 (1.08%)	0.32
Proximal stone migration treated with endoscopic surgery in the same session	6 (1.08%)	4 (0.72%)	0.83
Mucosal injury (false route or thermal injury) requiring secondary URS	2 (0.36%)	0	0.21
Inability to reach stone requiring secondary URS	5 (0.9%)	2 (0.36%)	0.08
Ureteral perforation requiring nephrostomy insertion and secondary URS	2(0.36%)	0	0.32
Severely bleeding termination of the procedure and secondary URS	1 (0.18%)	0	0.13
Satava III (requiring open surgery)	6 (1.08%)	2 (0.36%)	0.61
Inability to access ureter or reach stone requiring conversion to open surgery	3 (0.54%)	1 (0.18%)	0.11
Ureteral perforation	1 (0.18%)	1 (0.18%)	0.54
Ureteral avulsion	2 (0.36%)	0	0.09
Perioperative complications			
Clavien I			
Fever	8 (1.4%)	2 (0.36%)	0.03
Hematuria	5 (0.9%)	3 (0.54%)	0.09
Clavien II			
UTI	7 (1.2%)	2 (0.36%)	0.03
Clavien III			
Renal colic	1 (0.1%)	0	0.43
Stone migration	15 (2.7%)	11 (1.9%)	0.82
Ureteral perforation	4 (0.72%)	2 (0.36%)	0.57
Ureteral avulsion	2 (0.36%)	0	0.07
Clavien IV			
Sepsis	0	0	
Clavien V			
Death	0	0	

URS: ureteroscopy; UTI: urinary tract infection.

Several studies focused on the efficacy and safety of complementary URS in the management of ureteral stones after SWL failure.[10-15] Some of them reported the results of complementary URS in distal, middle or upper urinary tract stones. Our study has a lower success rate when compared to these studies. This may be due to including only patients with proximal ureteral stones after SWL failure into our study. However, EAU guidelines[10] have reported stone-frees rate of 81% in proximal ureteral stones larger than 1 cm after primary URS, as seen in our study. We observed that the success rate of primary URS in proximal ureteral stones larger than 1 cm was higher than that of complementary URS, although the difference was not statistically significant (77.4% vs. 79.8%) ($p = 0.61$).

Some authors explained lower success rate of procedures performed after SWL failure by intraoperative findings. Holland and colleagues[16] noted that partial stone fragmentation caused the embedding of stone fragments submucosally. Yuruk and colleagues[17] observed some non-specific and subjective intraoperative findings, such as stones covered by pseudomembranes in the urinary tract. Some others reported higher impaction rates after SWL.[13] Chaussy and colleagues[18] hypothesized that impaction of stone minimized its expansion in the mucosa, and prevented fragmentation of stones in SWL-resistant stones.

Tugcu and colleagues noted that distal, impacted stones were observed during secondary URS, and this contributed to a longer operation time.[6] We observed that operative time (35.99 vs. 31.89 min) was longer, and auxiliary equipment was needed more in Group I than in Group II ($p < 0.05$). We suppose that need for extra manipulations and use of auxiliary equipment, such as stone retrieval device, basket, and especially balloon dilatation during complementary URS, caused this difference. SWL-related mucosal edema may explain the technical difficulties and increase the need for balloon dilatation during the procedure.

Introducing miniaturized modern ureteroscopes, developing effective intracorporeal lithotripsy methods and disposable equipment, and improving the optical quality all enhances the urologist's surgical ability; therefore, problems related to stone impaction in the ureter have decreased.[19] On the other hand, the fragmenting effect of shock waves cause some changes in the ureteral mucosa, such as significant inflammatory reaction or edema; in these cases, the surgeon must overcome those problems during complementary URS.[20,21]

The intra- and postoperative complication rates were 12.1% in complementary URS, and 9.5% in primary URS ($p = 0.49$). Those rates are different from those reported in the literature (6.9% vs. 9.2 %).[13,14] The reasons for this difference may be an increased need for manipulation and auxiliary equipment, and working in a relatively weaker and narrower segment of the ureter. In addition, in recent experimental study, Shilo and colleagues[22] reported that the proximal ureter had less tensile strength, and complications tended to occur more in this part of ureter.

Our study has its limitations, including its retrospective design that could have been a source of selection bias. We did not perform stone analysis or determine its density, although they are predictor factors that affect success rate of the procedure. The other limitation is the use of two different energy sources. Collecting and recording intra- and postoperative findings and follow-up results in all cases were important for grading complications and determining the success rates in our study. However, our study is the first to investigate the outcome of complementary URS only in proximal ureter stones. The number of patients in our study groups was relatively large than in other studies.

Conclusion

Complementary URS after SWL failure in proximal ureteral stone is as safe and successful as primary URS, and they have similar morbidities, except for longer operation time and more need for balloon dilatation.

Competing interests: The authors all declare no competing financial or personal interests.

This paper has been peer-reviewed.

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Correspondence: Dr. Muhammet Fatih Kilinc, Department of Urology, Ankara Training and Research Hospital, Ankara, Turkey; mdfatihkilinc@yahoo.com