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Complementary Ureterorenoscopy after extracorporeal Shock Wave Lithotripsy in proximal ureteral stones: success and complications

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SUMMARY

OBJECTIVE: The aim of this study was to demonstrate the effect of extracorporeal shock wave lithotripsy application on the success and complications of ureteroscopic lithotripsy in proximal ureter stones.

METHODS: The data of 87 patients who did not respond to shock wave lithotripsy and underwent ureteroscopic lithotripsy were retrospectively analyzed and classified as group I, and 99 patients who received ureteroscopic lithotripsy as primary treatment were classified as group II. Demographic features, response to treatment, and preoperative and postoperative complications were compared between the two groups.

RESULTS: There was no difference between the two groups in terms of gender, operation times, stone sizes, and ureteroscope diameters. (p>0.05). Infective complications such as postoperative fever, pyelonephritis, and urosepsis were similar in both groups (p=0.142, p=0.291, and p=0.948). Stone migration was observed in 10 (11.5%) and 6 (6.1%) patients in groups I and II, respectively (p=0.291). Impacted stone was seen in 47 (54%) patients in group I and in 15 (15.2%) patients in group II (p<0.0001). Mucosal laceration occurred in 11 (12.6%) and 3 (3%) patients in groups I and II, respectively (p=0.028). Ureteral perforation was detected in 3 (3.4%) patients in group I and 1 (1%) patient in group II, whereas ureteral avulsion was not observed in either group (p=0.524).

CONCLUSIONS: It was concluded that the application of shock wave lithotripsy before ureteroscopic lithotripsy in proximal ureter stones did not affect the success. Although the results are similar in terms of postoperative infection, shock wave lithotripsy application has been found to increase the risk of stone impaction into the mucosa and ureteral laceration.

KEYWORDS: Ureteral calculi. Extracorporeal shockwave lithotripsy. Ureteroscopy. Mucosal laceration.

INTRODUCTION

Ureteroscopic lithotripsy (URS) and extracorporeal shock wave lithotripsy (SWL) are the most common treatment modalities in the treatment of proximal ureteral stones[1]. According to the European Urology Association (EAU) guideline, the first-line treatment for proximal ureteral stones larger than 10 mm is URS, while SWL and ureteroscopy are recommended as the appropriate primary treatment options for proximal ureter stones smaller than 10 mm[2]. SWL is applied as an additional treatment in patients where URS fails; while URS is used as an additional treatment in patients where SWL fails[3]. The URS procedure performed after SWL is called "Salvage," "Secondary," or "Complementary" URS[4,5].

There are a number of studies in the literature comparing these two methods that are commonly used in the treatment of ureteral stones[3,6-8]. However, studies regarding the efficacy and complications of complementary URS in ureteral stones in patients unresponsive to SWL are scarce[4,5]. In this study, we aimed to investigate the effects of SWL treatment on the success and complications of URS in proximal ureteral stones.

METHODS

In the study, the medical files of patients who underwent URS for proximal ureteral stones between January 2017 and October 2019 in our clinic were retrospectively reviewed. The proximal ureter was defined as part of the ureter between the ureteropelvic junction and the upper border of the sacroiliac joint. In total, 186 patients whose data were completely recorded and who underwent SWL and URS were included in the study. The SWL failure was considered to be the absence of stone fracture after three sessions of SWL. The URS procedure that was performed after the failure of SWL was named as complementary URS as in the literature[5]. Regarding classification, 87 patients who underwent complementary URS were named as group I and 99 patients who underwent URS as primary treatment were named as group II.

The criteria for exclusion from the study included the patients who underwent previous URS, Percutaneous nephrolithotomy, open or laparoscopic ureterolithotomy, percutaneous nephrostomy or double-J stent placement before the

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procedure, patients who had any congenital kidney anomaly (urethrovesical junction stenosis, etc.) and underwent operation due to this anomaly, patients who did not want to continue SWL treatment, and those with pain and worsening hydronephrosis (Figure 1).

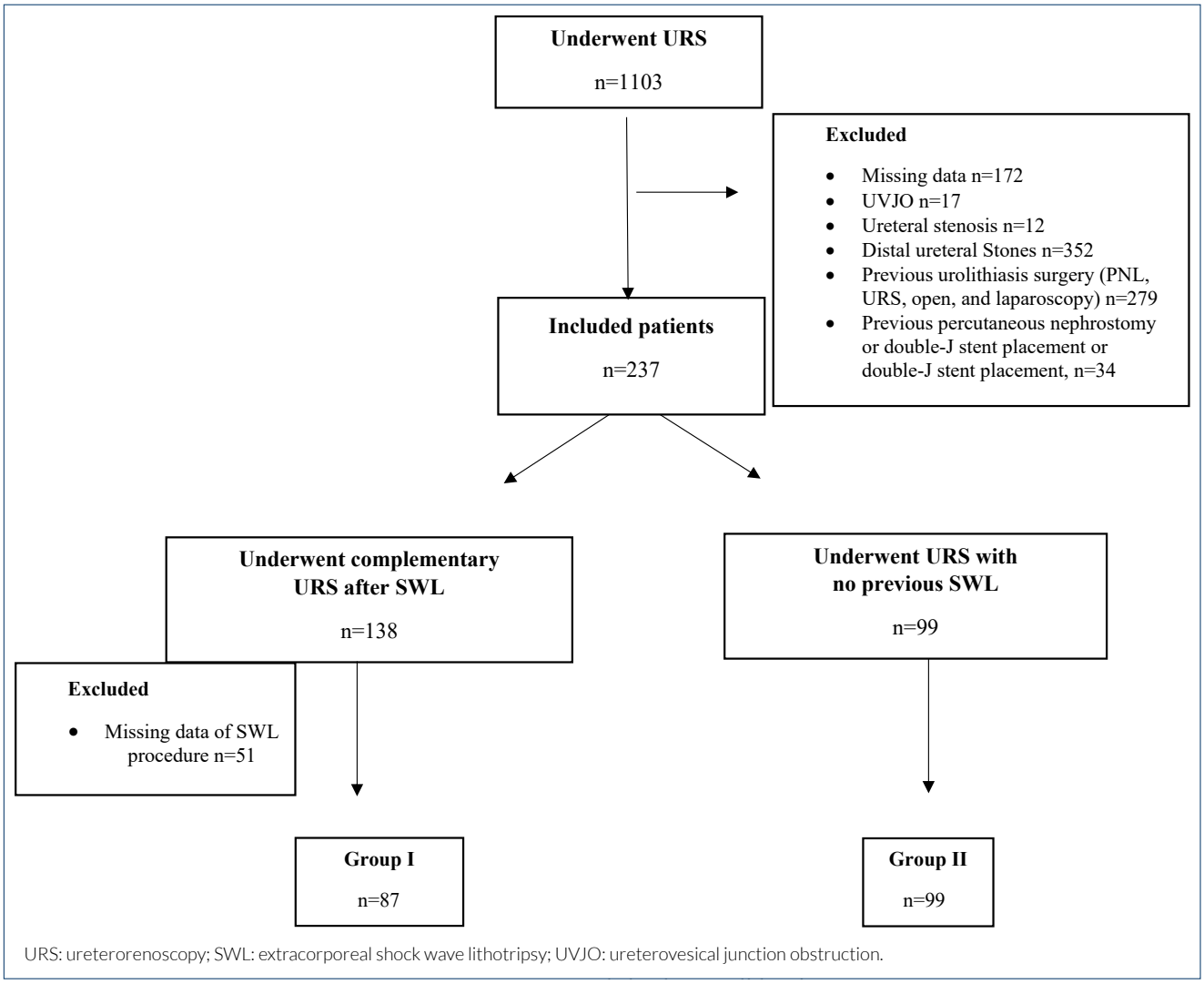
The SWL procedure was performed using electrohydraulic generators (Dornier HM-3) and at most three sessions at 1 week intervals. The shock wave per session was 80 impulses per minute and the maximum number of shock waves was 2000. The SWL failure was considered as the stone not breaking after three sessions of SWL application.

The URS procedure was performed under general and spinal anesthesia. Patients were administered 1 g of cefazolin sodium intravenously for prophylaxis. During the URS procedure, a 0.035-inch guidewire was introduced into the ureter and 7/9 Fr semirigid ureteroscopes (Karl Storz) were used. The Holmium YAG laser system was used in all patients as an energy source for stone crushing.

Intraoperative and postoperative complications were classified according to the modified Satava[9] and modified Clavien[10] systems, respectively. Body temperatures of 38°C and above were considered fever. Renal colic, which was severe enough to require analgesic use, was considered significant.

Patients with opaque stones were evaluated by plain abdominal X-ray and ultrasound (US) on the postoperative day 1 to evaluate the stone-free rates of the groups. Patients with residual stones and push back stones were evaluated by computed tomography (CT) scan in the first month and fragmented stones measuring >4 mm were considered residual.

Gender distribution, operation time, stone size, ureteroscope diameter, development of mucosal laceration, ureteral perforation, avulsion, postoperative fever, death due to pyelonephritis



URS: ureterorenoscopy; SWL: extracorporeal shock wave lithotripsy; UVJO: ureterovesical junction obstruction.

Figure 1. The flow chart.

and urosepsis, presence of impacted stone, stone migration, and stone-free rates were compared between the two groups.

All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Statistical analysis

The consistency of continuous variables to normal distribution was investigated with the Kolmogorov-Smirnov test. Variables with Gaussian distribution were presented as mean±SD, and variables with non-Gaussian distribution were shown as median (25–75th percentile). Student's t-test was used for comparison of variables with normal distribution, and the Mann-Whitney U test was used for comparison of variables with normal distribution. Pearson's χ^2 test or Yates' χ^2 test was used to compare group rates.

RESULTS

The mean age of the patients was 56.9±17.3 years in group I and 51.2±15.9 years in group II (p=0.021). There was no difference between the groups in terms of gender distribution, operation time, stone size, and ureteroscope diameter, but the frequency of the stone location on the right side was significantly higher in group II (p>0.05 and p=0.017) (Table 1).

The stone-free rates were 67.8 and 64.6% on the first postoperative day, and 85.1% and 78.8% in the first postoperative month in groups I and II, respectively. There was no statistically significant difference between the two groups in terms of stone-free rates both on the first postoperative day and in the first postoperative month (p=0.649 and p=0.270).

Infective complications such as postoperative fever, pyelonephritis, and urosepsis were similar in both groups (p=0.142, p=0.291, and p=0.948).

Stone migration was observed in 10 (11.5%) and 6 (6.1%) patients in groups I and II, respectively (p=0.291). Impacted stone was seen in 47 (54%) patients in group I and in 15 (15.2%) patients in group II (p<0.0001). Mucosal laceration occurred in 11 (12.6%) and 3 (3%) patients in groups I and II, respectively, and this difference was statistically significant (p=0.028). Ureteral perforation was detected in 3 (3.4%) patients in group I and 1 (1%) patient in group II, whereas ureteral avulsion was not observed in either group (p=0.524) (Table 2).

DISCUSSION

According to the EAU guidelines, the first-line treatment for proximal ureteral stones is URS or SWL[2]. The choice of ureteral treatment method depends on the localization of the stone, its size, presence and duration of renal colic, presence of dilation, patient selection, and available equipment[3,11,12]. Although SWL success rates for proximal ureteral stones vary between 40% and 82%, the URS success rate is higher than SWL[13-15]. According to our data, in patients with proximal ureter stones, the failure rate in primary cases was calculated as 21.2% and as 14.9% in secondary cases. In the literature, the URS failure rate for all stone localizations is 6.1–7.7% in primary cases and 3.5% in those who underwent complementary URS. The

Table 1. Demographic data, stone characteristics, ureteroscope diameters, and operation times in groups I and II.

	Group I (n=87)	Group II (n=99)	p-value
Age, year	56.9±17.3	51.2±15.9	**0.021**
Gender, M/F	55/32	67/32	0.523
Stone size, mm	11.1±3.8	11.9±4.7	0.210
Side			
Right (n)	40	63	**0.017**
Left (n)	44	36	
Bilateral (n)	3	0	
Diameter of ureteroscope			
7Fr (n)	63	62	0.156
9Fr (n)	24	37	
Operation time, min	33.3±18.2	34.3±12.6	0.681

M/F: Male/Female. Bold values indicate statistical significance at the p<0.05 level.

Table 2. The complications in groups I and II.

	Group I (n=87)	Group II (n=99)	p-value
Hydronephrosis (n)	73	71	**0.047**
Impacted stone (n)	47	15	**<0.0001**
Fever (n)	8	3	0.142
Pyelonephritis (n)	4	1	0.291
Stone migration (n)	10	6	0.291
Renal colic (n)	4	1	0.291
Mucosal laceration (n)	11	3	**0.028**
Ureteral perforation (n)	3	1	0.524
Avulsion (n)	0	0	–
Macroscopic hematuria (n)	5	2	0.344
Urinary tract infection (n)	6	2	0.203

Bold values indicate statistical significance at the p<0.05 level.

URS success rate is lower in proximal ureter stones compared with distal ureter stones. The failure rate of the primary URS in distal ureteral stones is 3.3%, while it is 4.4% in the complementary URS, and there is no statistically significant difference between the primary and complementary URS success rates (p>0.2)[3,4,16]. In our study, all patients had proximal ureter stones, and the failure rate was 21.2% in primary cases and 14.9% in secondary cases.

The main reason for URS failure involves the problems in accessing it. In cases where successful access is achieved, URS failure is usually associated with stone size, localization, and the presence of hydronephrosis. The migration of the stone to the kidney, especially in the presence of hydronephrosis, is considered an important cause of URS failure in proximally located stones. Along with the fluid flow used during the URS procedure, the type of lithotriptor used to break the stone is also important in the migration of the stone. Stone migration is more common with pneumatic lithotriptors compared with laser lithotriptors. The migration of the stone to the kidney is seen in 6.7% of URS procedures[15]. In our study, the Holmium YAG laser was used in all patients. Although the stone retropulsion rate was higher in the complementary URS group (6.1 vs. 11.5%), it was not statistically significant (p=0.291).

Another cause of URS failure is impacted stones. Approximately, 4% of ureteral stones are impacted[17]. Prolonged stay of a ureteral stone in the same localization and/or SWL application facilitates the impaction of the stone by causing inflammation, edema, and hypertrophy in the ureteral wall[3,17]. Furthermore, patient age and stone size tend to be higher in impacted stones[18]. The incidence of impacted stone is higher in patients who undergo primary URS compared with complementary URS. In a study conducted by Tuğcu et al.[4], the rate of impacted stone was 35.1% in the complementary URS group and 9.85% in the primary URS group, whereas these rates were 38.4 and 17.4% in a study by Irer et al.[19]. In our study, the rate of impacted stone was significantly higher in the complementary URS group compared to the primary URS group (54 vs. 15.2%) (p<0.0001). In our study, we assume that the higher rate of impacted stone, especially in the complementary URS group, can be attributed to the fact that mean stone volume and average patient age were higher than in the literature. In addition, three sessions of SWL application may also play a role in higher impacted stone rate.

In a study comparing primary and complementary URS procedures, the success of URS in both primary and complementary URS groups was found to be 82.6%[19]. In another study conducted by Klinc et al.[5], success rates were 83 and 80.1% for stones smaller than 1 cm and 79.8 and 77.4% for stones larger than 1 cm in primary and complementary URS applications, respectively. There was no statistical difference between groups with regard to success rates in both stone sizes (p=0.35 and p=0.61). In these two studies, proximal ureteral stones were investigated. In our study, there was no statistically significant difference in terms of URS success rate between patients who underwent primary and complementary URS, and success rates were 78.8 and 85.1%, respectively (p=0.27).

Shock waves of SWL increase the edema and inflammation in urothelial mucosa and enhance the fragility of mucosal small vessels[20,21]. Theoretically, complications are expected to be high in interventions performed after SWL. However, in many studies, no significant difference was found between the complementary and primary URS in terms of total complication rates[4,5,22]. Yet, when complications are classified, it has been reported that Clavien grade I complications such as minimal mucosal laceration, mild bleeding, fever, and renal colic are seen more frequently in ureteral interventions after SWL[19,23,24]. Clavien grade I complication rate was 9.3% in the complementary URS group and 4.3% in the primary URS group, and the difference was statistically significant (p<0.001)[19]. Also, in this study, the ureteral perforation rate was 0.6% in the primary URS group and 1.2% in the complementary URS group (p<0.001). In our study, mucosal laceration rates were 3 and 12.6% for the primary and complementary URS, respectively. For the mucosal laceration, this difference was statistically significant (p=0.028), and there was no significant difference between fever, renal colic, ureter perforation, and urinary infection rates (p=0.142, p=0.291, p=0.524, and p=0.203).

CONCLUSIONS

It has been shown that SWL applied before the URS procedure does not affect URS success and has very low major complication rates similar to those in the primary URS. In light of this, it can be concluded that SWL increases the risk of the impacted stone in the ureter and elevates the risk of mucosal laceration during URS; however, it can also be said that the complementary URS procedure after SWL is as successful and safe as the primary URS procedure. The limitation of this study is that control of any residual stone was performed with a plain abdominal X-ray and US on postop day 1 only, and a CT scan was not carried out for all patients.

AUTHORS' CONTRIBUTIONS

ED: Conceptualization, Data curation, Formal Analysis, Project administration, Supervision, Writing – original

draft, Writing – review & editing. **EÖ:** Conceptualization, Project administration, Writing – original draft. **DST:** Conceptualization, Project administration, Supervision. **ÖD:** Data curation, Formal Analysis, Project administration, Writing – original draft. **MK:** Data curation, Formal Analysis, Project administration, Writing – original draft. **UO:** Conceptualization, Data curation, Formal Analysis, Project administration, Supervision, Writing – review & editing.

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