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Patients' life quality during ureterorenoscopy, ureterorenoscopy plus JJ insertion and shock wave lithotripsy in the management of distal ureteral stone: a prospective clinical study

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Abstract

Background: To clarify the effects of ureterorenoscopy (URS) and shock wave lithotripsy (SWL) on patients' life quality in the management of distal ureteral stone (DUS) with using Short Form 36 (SF 36).

Methods: The present study was conducted in a prospective manner between July 2018 and July 2021. Patients who had DUS stone smaller than 1.5 cm were accepted as candidates for the study. Preoperative patient characteristics and treatment outcomes were recorded. Also, the SF-36 form was completed one day before the procedure and one month after the procedure. Patients were divided into three groups according to treatment modality as SWL, only URS, and URS including JJ stent insertion.

Results: Totally, 44 patients were treated with SWL, 27 patients were treated with URS, and 31 patients were treated with URS including JJ insertion. Hospitalisation period was significantly shorter in the SWL group ($p=0.001$). Additionally, patients treated with SWL had a significantly lower analgesia requirement rate (31.8% in SWL group, 77.8% in URS group and 64.5% in URS + JJ stent group, $p=0.001$). Stone-free status and complications did not significantly differ between groups ($p=0.846$ and $p=0.096$). Physical functioning score and role physical domains were significantly increased in patients treated with SWL ($p=0.005$ and $p=0.031$). Similarly, highest improvement for the body pain domain was achieved in the SWL group ($p=0.006$).

Conclusion: The present study showed that URS, URS with JJ insertion and SWL are safe and reliable procedures for the management of DUS. However, hospitalisation time was significantly shorter and analgesia requirements were significantly lower in favour of SWL. Additionally, SWL was related with better SF-36 domains including physical functioning, role physical and body pain.

Keywords: Distal ureteral stone, SF-36, SWL, URS

1 Background

Distal ureteral stone (DUS) is detected in approximately 7% of women and 12% of men during their lifespan, and previous studies showed that untreated DUS is associated with deterioration of patients' quality of life, increasing pain reliever use, number of hospital admissions, hydronephrosis, and loss of kidney function [1].

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With advancing technology, open surgery techniques for DUS have been almost abandoned, and minimal invasive treatment modalities including ureteroscopy (URS) with holmium laser and shock wave lithotripsy (SWL) are chosen more commonly for the management of DUS [2]. According to the European Association of Urology (EAU) guideline, URS and SWL are equally recommended for the treatment of distal ureteral stones [3].

Previous reports investigated the outcomes of URS and SWL for the treatment of DUS and found controversial results. Verze and colleagues compared URS and SWL in the management of DUS with 0.5–1.5 cm size, and the authors stated that both techniques had satisfactory results [4]. However, in another study, Zeng et al. achieved 93.3% success rate with URS and 78.1% success rate with SWL and stated stone clearance rate was significantly higher in favour of URS [5]. Moreover, the impact of both techniques on patients' daily activities was ignored by many urologists.

Although, previous reports evaluated the success and complications of URS and SWL for the management of DUS, only a few studies focused on the impact of URS and SWL on patients' life quality. The present study aimed to clarify the effects of URS and SWL on patients' life quality with using Short Form 36 (SF 36).

2 Methods

The present study was conducted in a prospective manner according to the Helsinki Declaration between July 2018 and July2021. The study period was planned as three years. Patients who had DUS stone smaller than 1.5 cm were accepted as candidates for the study. The diagnosis of ureteral stones in all patients was made by non-contrast computed tomography (CT) of the abdomen and pelvis. The longest diameter measured on CT was accepted as the stone size. All patients had not received any prior treatment for the same stone. Type of treatment modality was chosen by the joint decision of the patient and the surgeon. All URS operations and SWL procedures were performed by the same surgeon. Patients with concomitant kidney stone, patients who underwent URS in emergency situation, and patients with JJ stent and/or nephrostomy tube were excluded from the study. Moreover, other exclusion criteria were presence of bilateral ureteral stone, patients aged < 18 years, and inability to complete the SF-36 form.

Preoperative patient characteristics (age, sex, body mass index (BMI), comorbidities, previous stone surgery) and stone-related parameters (stone size, stone opacity and stone side) were recorded. Also, hospitalisation period, post procedural analgesia requirements, stone-free status and complications were noted. Success was defined as no stone fragment on kidney-ureter-bladder graphy and urinary ultrasonography three week after the procedure. Also, the SF-36 form was completed one day before the procedure and one month after the procedure. Patients were divided into three groups according to treatment modality as SWL, only URS and URS including JJ stent insertion. Groups were compared according to preoperative data, treatment results and SF-36 form outcomes.

2.1 URS and SWL technique

All URS procedures were performed in under general anaesthesia. First cystoscopy was performed and a safety guide wire was inserted into the ureter. Then, an 8 F ureterorenoscope (Karl- Storz, Tuttlingen, Germany) was inserted into the ureter, and stone fragmentation was done with holmium laser. Stone fragments were extracted with a nitinol basket. The JJ stent was inserted in cases with solitary kidney, patients with chronic kidney disease, distal ureteral stenosis or ureteral injury.

SWL treatment was done using the Dornier Compact Sigma (Dornier MedTech GmbH, Wessling, Germany) in supine position. Intramuscular analgesic was applied 30 min before the procedure, and SWL was performed with the following settings: 1500–3000 impulses, 100/150 pulses/min, and energy, 8–12 J per session.

2.2 SF-36 form

The SF-36 is a self-reported questionnaire to evaluate physical functioning and well-being [6]. The survey contains three domains about physical functioning, three domains about emotional functioning, one domain related to pain, and one domain associated with general health. The SF-36 form was filled one day before the procedure and one month after the procedure. Each scale is directly converted into a 0–100 scale on the supposition that each question carries equal weight. Higher scores are associated with less disability.

2.3 Statistical analysis

Statistical analysis was done with the Statistical Package for the Social Sciences version 20 (SPSS IBM Corp., Armonk, NY, USA). Normality of distribution of the variables was evaluated by the Shapiro–Wilk test and Q-Q plots. The ANOVA test was used for comparison of normally distributed parameters between three groups, and the Kruskal–Wallis test was used for non-normally distributed parameters. For post hoc analysis to compute pairwise comparisons, Tukey test and Games-Howell test were used. Categorical variables were categorized and assessed using the $\chi 2$ test or Fisher's exact test. Quantitative data are presented as mean ± standard error values. The data were evaluated at 95% confidence level

and *P* value of less than 0.05 was accepted as statistically significant.

3 Results

At the end of the study period, 44 patients were treated with SWL, 27 patients were treated with URS, and 31 patients were treated with URS including JJ insertion. Age, sex, mean BMI, the presence of hypertension and diabetes mellitus were similar between groups ($p=0.248$, $p=0.717$, $p=0.170$, $p=0.272$ and $p=0.750$, respectively). In addition, stone size and side of stone were comparable between groups ($p=0.182$ and 0.935). In contrast, non-opaque stones were significantly more common in the URS and URS + JJ groups ($p=0.004$) (Table 1).

Hospitalisation period was significantly shorter in the SWL group (6.1 h in SWL group, 21.1 h in URS group and 20.4 h in URS + JJ stent group, $p=0.001$). Additionally, patients treated with SWL had a significantly lower analgesia requirement rate (31.8% in SWL group, 77.8% in URS group and 64.5% in URS + JJ stent group, $p=0.001$). Stone-free status and complications did not significantly differ between groups ($p=0.846$ and $p=0.096$) (Table 2). Oral and intramuscular analgesia was applied to patients with renal colic and no additional treatment was needed. Hydration was sufficient for patients with haematuria. The patient who developed sepsis recovered after antibiotic therapy and supportive treatment.

Pre-procedural SF-36 domains were similar between groups (physical functioning, $p=0.101$; physical role, $p=0.364$; body pain, $p=0.366$; general health, $p=0.107$; vitality, $p=0.687$; social functioning, $p=0.220$; emotional role, $p=0.180$; and mental health, $p=0120$). Physical functioning score was significantly increased in

Table 1 Comparison of demographic data between groups

	SWL ($n=44$)	URS ($n=27$)	URS + JJ ($n=31$)	*P* value
Age (years)	41.2 ± 11.9	41.7 ± 15.5	46.4 ± 15.8	0.248
Sex				0.717
Male	31 (70.4%)	18 (66.7%)	19 (61.3%)	
Female	13 (29.6%)	9 (33.3%)	12 (38.7%)	
BMI (kg/m^2)	26.8 ± 3.1	25.4 ± 3.7	25.5 ± 3.8	0.170
Presence of DM	5 (11.3%)	2 (7.4%)	2 (6.4%)	0.750
Presence of HT	6 (13.6%)	5 (18.5%)	9 (29.0%)	0.272
Previous stone surgery	9 (20.4%)	8 (29.6%)	9 (29.0%)	0.573
Stone size (mm)	8.5 ± 1.4	8.2 ± 2.1	8.9 ± 2.0	0.182
Stone opacity	44 (100%) [a]	25 (92.6%) [b]	25 (80.6%) [b]	***0.004***
Side				0.935
Right	26 (59.1%)	15 (55.6%)	19 (61.3%)	
Left	18 (40.9%)	12 (44.4%)	12 (38.7%)	

SWL—Shock Wave Lithotripsy, *URS*—Ureteroscopy, *BMI*—Body Mass Index, *ASA*—American Society of Anaesthesiologists, *DM*—Diabetes Mellitus, *HT*—Hypertension. The same letters (such as a-a) define that there is no difference, different letters (such as a-b) define that there is a difference

Table 2 Comparison of post-procedure data between groups

	SWL ($n=44$)	URS ($n=27$)	URS + JJ ($n=31$)	*P* value
Hospitalization (hours)	6.1 ± 1.9[a]	21.1 ± 17.8[b]	20.4 ± 16.7[b]	**0.001**
Analgesia requirements	14 (31.8%)[a]	21 (77.8%)[b]	20 (64.5%)[b]	**0.001**
Stone free status	35 (79.5%)	23 (85.2%)	26 (83.9%)	0.846
Complications				0.096
Renal colic	2 (4.5%)	3 (11.1%)	3 (9.7%)	
Fever	–	1 (3.7%)	1 (3.2%)	
Macroscopic hematuria	1 (2.3%)	1 (3.7%)	–	
Sepsis	–	1 (3.7%)	–	

SWL—Shock Wave Lithotripsy, *URS*—Ureteroscopy

Lower-case letters are used to define the group that makes the difference. The same letters (such as a-a) define that there is no difference, different letters (such as a-b) define that there is a difference

patients treated with SWL ($p=0.005$). In addition, the physical role domain was increased in all groups, but the increment was significantly higher in the SWL group ($p=0.031$). Similarly, highest improvement for the body pain domain was achieved in the SWL group ($p=0.006$). In contrast post-procedural SF-36 domains including general health, vitality, social functioning, emotional role and mental health did not have significant differences ($p=0.103$, $p=0.518$, $p=0.835$, $p=0.340$ and $p=0.612$, respectively). Pre- procedural and post procedural SF-36 scores are summarized in Table 3.

4 Discussion

Management of DUS is the one of the hottest topics in urology, and controversy continues as to what is the best treatment. Many studies which analysed the outcomes of URS and SWL in the management of DUS, focused on only stone-free rates and complications, but not patients' general health [2, 3, 5]. In the present study, we obtained similar results with regards to URS and SWL, but hospitalisation time was significantly shorter and analgesia requirements were significantly lesser in favour of SWL. Also, SWL achieved significantly better results in SF-36 subdomains including physical functioning, role physical and body pain.

Table 3 Comparison of pre-procedure and post-procedure SF-36 parameters between groups

	SWL ($n=44$)	URS ($n=27$)	URS + JJ ($n=31$)	*P* value
Physical functioning (PF)				
Before	52.0 ± 4.3	51.3 ± 6.5	49.5 ± 5.5	0.101
After	55.2 ± 6.9[a]	49.6 ± 5.7[b]	50.6 ± 5.2[b]	***0.005***
Role physical (RP)				
Before	45.8 ± 6.6	44.7 ± 11.1	43.7 ± 4.0	0.364
After	51.6 ± 8.0 [a]	46.7 ± 7.5 [b]	47.2 ± 4.8 [b]	***0.031***
Bodily pain (BP)				
Before	41.2 ± 8.1	41.2 ± 6.5	39.3 ± 5.9	0.366
After	52.8 ± 9.5 [a]	47.5 ± 8.5 [b]	46.5 ± 7.6 [b]	***0.006***
General health (GH)				
Before	54.5 ± 3.9	55.3 ± 6.5	52.1 ± 6.8	0.107
After	55.1 ± 5.0	53.9 ± 7.1	51.9 ± 6.8	0.103
Vitality (VT)				
Before	60.7 ± 3.7	61.0 ± 5.3	59.8 ± 5.1	0.687
After	55.4 ± 5.7	55.5 ± 5.9	54.3 ± 5.5	0.518
Social functioning (SF)				
Before	41.1 ± 6.4	44.3 ± 7.1	41.7 ± 4.9	0.220
After	45.6 ± 6.9	46.3 ± 8.1	45.4 ± 6.3	0.835
Role emotional (RE)				
Before	49.2 ± 6.5	50.6 ± 7.9	46.6 ± 10.2	0.180
After	49.9 ± 5.7	49.5 ± 6.1	47.2 ± 8.0	0.340
Mental health (MH)				
Before	48.1 ± 8.1	44.5 ± 8.7	46.6 ± 5.8	0.120
After	49.8 ± 5.7	47.8 ± 7.8	48.6 ± 5.5	0.612

Lower-case letters are used to define the group that makes the difference. The same letters (such as a-a) define that there is no difference, different letters (such as a-b) define that there is a difference

Obtaining stone-free status with acceptable complication rates is the main goal of all urinary stone treatments. Pardalidis and colleagues compared URS and SWL for the management of DUS, and achieved 99% success rate with SWL and 92% success rate with URS. However, Pardalidis et al. stated that the effectiveness of SWL decreased in DUS larger than 10 mm [7]. In contrast, Honeck et al. obtained 98% success with URS and 84% success with SWL for the management of DUS, and the difference was statistically significant in favour of URS [8]. In the present study, we had comparable outcomes in regards to success and complications following URS and SWL for the treatment of DUS.

Post-procedural pain is associated with prolonged recovery time, prolonged return to normal life, and increased use of painkillers. Honeck et al. found recovery time for URS was four days and recovery time for SWL was three days, but difference was not significantly different between groups [8]. In contrast, Drake and colleagues performed meta-analysis about pros and cons of URS and SWL for DUS, and the authors concluded that URS was associated with longer hospitalisation time [9]. In the present study, we encountered significantly shorter hospitalisation time and significantly lower post-operative analgesia requirements in patients with SWL. In addition, we found that insertion of JJ stent did not significantly affect URS outcomes with regard to hospitalisation time and analgesia requirements.

Previous reports demonstrated the importance of stone treatment for patients' general health beyond stone-free status and complications. However, studies which investigated the effect of URS and SWL on patients' quality of life had controversial results. Sarıca and colleagues claimed that URS had lower impact on patients' quality of life, but did not discuss the role of JJ stent on patients' quality of life [10]. In contrast, Hamamoto et al. achieved better patient quality of life with SWL compared to URS for the management of DUS [11]. In another study, Nestler et al. showed that JJ stent after URS was associated with significantly higher discomfort [12]. In the present study, we found that SWL was associated with significantly better results in SF-36 subdomains including physical functioning, physical role and body pain in comparison with URS and URS plus JJ insertion.

The present study has some limitations. First of all, the low number in the study population could be accepted as a limitation. Secondly, the present study included data from a single hospital. However, this situation prevents possible effects of surgeon experience and skill on

results. Thirdly, the present study only focused on short-term results of URS and SWL for the management of DUS, long-term outcomes of these treatment options for distal ureteral stone could be the subject of another study. Lastly, we did not compare the cost of procedures, which may be clarified in further prospective randomized studies.

5 Conclusions

The present study showed that both URS and SWL are safe and reliable procedures for the management of DUS. However, hospitalisation time was significantly shorter and analgesia requirements were significantly lower in favour of SWL. Additionally, SWL was related with better physical functioning, physical role and body pain. The present study findings should be supported by further randomized studies with prospective manner.

Abbreviations

DUS: Distal ureteral stone; URS: Ureteroscopy; SWL: Shock wave lithotripsy; SF-36: Short Form 36; BMI: Body mass index.

Authors' contributions

CK: research design, data collection and management, manuscript writing. All authors read and approved the final manuscript.

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Availability of data and materials

All articles used in the current review available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by local Ethical Board (Meeting Decision No: 2017/154). Informed consent was obtained from all patients and the study was done in accordance with the Helsinki Declaration.

Competing interests

The authors declare that they have no competing interests.

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