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Original Article

Previous shock-wave lithotripsy treatment does not impact the outcomes of flexible ureterorenoscopy

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ABSTRACT

Objective: Shock-wave lithotripsy (SWL) is the first-line treatment for the active removal of small and medium-sized kidney stones. Flexible ureterorenoscopy (fURS) is recommended after failed SWL treatment. The aim of this retrospective analysis is to evaluate whether prior unsuccessful SWL treatments affect the outcomes of fURS.

Material and methods: Data from 206 patients who underwent fURS for the treatment of renal stones between September 2009 and January 2011 were collected, and the patients were divided into two groups according to their previous SWL treatment. The patient demographics, stone characteristics, operation and fluoroscopy times, stone-free rates and complications were compared.

Results: Of the patients, 114 (55.3%) did not undergo SWL prior to fURS (Group 1), whereas 92 (44.6%) completed a minimum of 3 sessions of SWL and waited at least 2 weeks before the fURS operation (Group 2). Although the mean stone number was higher in Group 2, this difference was not significant (p=0.06). The mean operation (p=0.12) and fluoroscopy times (p=0.69) were similar between the groups. The mean operation time per mm^2 stone and fluoroscopy time per mm2 stone were not significantly different (p=0.64 and p=0.76, respectively). The length of the hospitalization and the overall complication rates were similar. After the third postoperative month, the stone-free rates were not different between the groups (82.5% and 86.9%, respectively, p=0.38).

Conclusion: The stone-free and complication rates of fURS were not affected by previous SWL therapy.

Key words: Flexible ureterorenoscopy; kidney stone; shock wave lithotripsy.

Introduction

Shock wave lithotripsy (SWL), percutaneous nephrolithotomy (PNL) and flexible ureterorenoscopy (fURS) are the currently available minimally invasive treatment modalities for the active removal of kidney stones. The collecting system anatomy and stone location together with stone size are the most important parameters in choosing the most appropriate treatment option.[1-3] Although PNL has high stone-free rates regardless of stone size, the procedure is relatively invasive and is associated with numerous complications.[4] However, SWL seems to be affected by stone location, with documented stone free rates of 82.8%, 83.4% and 67.5% for upper, middle and lower calices, respectively.[5]

Improvements in endoscope design, optical quality and laser devices have made fURS an effective option for the treatment of kidney stones. The high stone-free rates combined with low rate of complications have resulted in the widespread usage of fURS.[6,7] However, recent guidelines recommend fURS as a salvage therapy after SWL failure unless the stone is localized in the lower pole.[8] To our knowledge, there is limited information regarding the success rates of fURS performed after failed SWL treatment.[9] We herein report our data to demonstrate whether failed SWL has an impact on the outcome of fURS treatment.

Material and methods

Study design

In our tertiary referral center, 206 patients were treated with fURS between September 2009 and January 2011 for their kidney stones. The data regarding the demographic and stone characteristics of these patients were analyzed retrospectively. To demonstrate the effects of previous SWL treatment on the outcomes of fURS therapy, the patients were divided into two groups according to their previous history

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of SWL treatment (to the same kidney, for the same stone). Group 1 was composed of patients without a history of SWL (114 patients), and Group 2 was composed of patients with a history of SWL (92 patients). Stone-related and operative parameters, including complications and stone-free rates, were compared.

The patients' demographic parameters, including age, sex, and BMI, and the size, number and location of the stones were recorded. The preoperative laboratory tests included serum creatinine and hemoglobin measurements, platelet counts, coagulation screen tests and urine cultures. All of the patients had sterile urine culture before the surgery. The stone size was assessed as the surface area calculated according to the European Association of Urology guidelines.[8] Considering the possible difference between the stone size in the patients with and without previous SWL treatment, we also calculated the operation time and fluoroscopy time necessary for 1 mm^2 of stone burden.

SWL treatment

After obtaining an informed consent for the SWL treatment, the patients in Group 2 were treated at our institution using the Dornier Compact Sigma (Dornier MedTech GmbH, Wessling, Germany) by a single senior urologist. SWL was performed under ultrasonography guidance in all possible cases with an interval of 10 days between sessions. Patients were considered SWL-resistant if the stone was either not fragmented or was still too large for spontaneous passage at the end of the second week after third session.

Flexible ureterorenoscopy technique

Written informed consent was obtained from all patients prior to the operation. A safety guide wire was placed into the renal pelvis in the lithotomy position after the induction of general anesthesia. The ureter and ureteropelvic junction were visualized using a 9.5 F semi-rigid ureteroscope. Ureteral balloon dilatation was performed as needed, and an access sheath was placed, particularly in patients who had stones larger than 2 cm. Accessible calices were determined under fluoroscopic guidance. A 7.5 F fiberoptic (Storz FLEX-X^2, Tuttlingen, Germany) or 8.7 F digital flexible ureteroscope (DUR-D Gyrus ACMI, Southborough, MA, USA) and a 200 or 273 μm laser fiber were used. We used a holmium laser machine set at 1.0-1.5 J and 8-10 Hz. At the end of laser lithotripsy, the stone fragments smaller than 2 mm were left for spontaneous passage, whereas larger fragments were removed with basket catheters. A 4.8 F double J stent was routinely placed in each patient and was removed 2 weeks after the procedure. The operative time was defined as the time passed from insertion of the cystoscope to the completion of the stent placement.

The initial postoperative stone free rates were determined at the time of hospital discharge with a kidney-ureter-bladder radiogram (KUB). Follow-up stone-free rates were determined in an outpatient clinic setting at third postoperative month via low dose computerized tomography (CT). The procedure was considered successful if the patient was stone free. Perioperative and postoperative complications were also noted.

Statistical analysis

Continuous variables were compared using Student's t and Mann-Whitney U tests, and proportions of categorical variables were analyzed using the chi-square or Fisher›s exact test. The statistical significance was set at $p<0.05$, and all of the reported p values were two-sided. The data analysis was performed using Statistical Package for the Social Sciences 16.0 (SPSS In., Chicago, IL, USA).

Results

The demographics of the patients in Groups 1 and 2 are presented in Table 1. There was no significant difference between the groups in terms of gender and BMI, though the patients in Group 1 were older (p=0.02).

The localization and number of stones were similar (Table 2). The proportion of patients with lower pole stones was high in both groups (52.5% and 45.9% for Groups 1 and 2, respectively). Presumably, the stone size was significantly smaller in Group 2 due to previous SWL treatment (155.6±103.3 mm^2 vs. 177.2±105.2 mm^2, respectively; p=0.03). However, the operation time per mm^2 stone (21.8±12.7 vs. 21.5±15.8 min/mm^2, p=0.64) and fluoroscopy time per mm^2 stone (0.54±0.21 vs. 0.57±0.32 min/mm^2, p=0.76) were similar between the groups.

The duration of hospitalization for both groups was not different (Table 2). No severe complications, such as ureteral avulsion, severe sepsis or ureteral stricture, were noted in either of the groups. Fever was the most common complication. Steinstrasse, urosepsis and transient increases in the serum creatinine levels were other complications (Table 2). Overall, the complication rates were comparable in the groups (6.1% and 2.1% in Groups 1 and 2, respectively; p=0.3).

At the discharge from the hospital, the stone-free rates were 85% in Group 1 and 85.8% in Group 2, as verified by first postoperative day KUB. All of the patients were available for a third postoperative month CT scan, which revealed that the stone-free rates were similar in both groups (82.5% and 86.9%, respectively; p=0.38).

Discussion

The development of flexible ureteroscopes with better vision and improved flexibility has allowed endourologists to access

Table 1. Patient demographics

Parameters	Group 1 (114 patients, 55.3%)	Group 2 (92 patients, 44.6%)	p value
Gender (F/M, number)	54/60	44/48	0.94
Mean age (years)	45.4±15.9 (14-80)	40.4±14.5 (11-80)	0.02
Mean BMI (kg/m^2)	26.3±4.7 (17.7-55.1)	24.8±3.8 (19-41)	0.7

F: female; M: male; BMI: body mass index

Table 2. Stone parameters and operative findings

	Group 1 (n=114, 55.3%)	Group 2 (n=92, 44.6%)	p value
Mean stone size (mm^2)	177.2±105.2 (60-581)	155.6±103.3 (60-580)	0.03
Stone number (n)			
Single	81 (71%)	59 (64.1%)	0.06
2	27 (23.7%)	21 (22.8%)	
≥3	6 (5.3%)	12 (13.1%)	
Stone localization			
Upper Calyx	9 (8.9%)	11 (8.1%)	0.22
Middle Calyx	3 (3%)	13 (9.6%)	
Lower Calyx	53 (52.5%)	62 (45.9%)	
Pelvic	13 (12.9%)	24 (17.8%)	
Multiple	23 (22.8%)	25 (18.5%)	
Mean fluoroscopy time (min)	1.6±0.9 (range:0.3-4.0)	1.5±0.8 (range:0.3-4.0)	0.69
Mean operative time (min)	60.9 23.7 (range:20-145)	54.4±16.4 (range:20-145)	0.12
Length of hospitalization (hours)	31.1±39.2 (range:16-192)	29.9±37.4 (range:17-120)	0.71
Success			
Stone free	94 (82.5%)	80 (86.9%)	0.38
Residual stone	20 (17.5%)	12 (13.1%)	
Complication			
Overall	7	2	0.3
Fever	3	0	
Steinstrasse	2	1	
Transient increase in creatinine levels	0	1	
Urosepsis	2	0	

the entire collecting system. Together with recently developed accessories such as laser fibers and basket catheters, it is now possible to fragment and clear stone fragments in almost every location. As a result, fURS has gained popularity over the last decade in the treatment of kidney stones. However, recent guidelines do not recommend fURS as the first-line treatment due to the higher success rates of PNL for larger stones and the less invasive nature of SWL for smaller stones. [8,10]

The success of SWL may be diminished by stone-related parameters such as stone type, stone size and stone location, and by patient-related parameters such as obesity. For stones that are 1 cm or less in diameter, the reported stone-free rates after SWL range from 63% to 76%.[11] The success rates decrease to 43% for stones 11 to 15 mm in diameter and 30% for 16 to 20 mm in diameter.[12] The reported stone-free rate of SWL for lower pole calculi is 25-85%.[12] The stone type, steep infundibulum-pelvic angle, long calyceal neck and narrow infundibulum impair the treatment outcome of SWL.[8] Stone hardness is another problem with SWL. Stones composed of brushite, calcium oxalate monohydrate, or cystine are particularly hard and are usually resistant to SWL.[13] Therefore, fURS is generally recommended for small and medium-sized kidney stones when SWL treatment fails.[8] However, contemporary studies report that fURS is not affected by the stone's location or hardness.[14,15] It is also suitable for obese patients.[16] As a result, fURS is often used as a salvage modality following SWL. Although factors affecting the success of fURS have been defined in the literature, limited data exist on whether a previous SWL failure predicts the outcome of fURS.[9]

The spatial anatomy of the lower renal pole plays a significant role in the stone-free rate after both SWL and fURS treatments.[17,18] Grasso and Ficazzola[18] evaluated 90 stone burdens that were located in lower pole and treated with fURS and showed that success rates decrease significantly when the stone size exceeds 20 mm. Of the 19 failures, 8 were secondary to the inability to access the lower pole.[18] In another study, El-Nahas et al.[19] compared fURS with SWL for the treatment of lower pole stones and showed that fURS had significantly higher success rates but no increase in the complication rates. In our study, the majority of the stones were located in the lower pole in both groups (52.5% vs. 49.5%). Although we did not calculate the stone-free rates for the different stone localization, the overall success rates were not affected and were similar to those of published series.[7]

The operation time is a good predictor of the surgical experience and the complexity of the case and is significantly affected by the stone size, location, multiplicity, calyceal anatomy and presence of hydronephrosis.[20] In this study, the impact of surgical experience can be ignored because all of the procedures were performed by a single experienced endourologist. It is also possible to ignore the stone location and multiplicity because these parameters were similar in both groups. To exclude the effect

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of stone size, we calculated the operation time for 1 mm^2 of the stone to be removed, but the final analysis showed no difference between the groups.

Although the factors affecting fluoroscopic screening time during PNL are well documented, there are no published data on fURS.[21] The stone size is significantly related to the fluoroscopy time during PNL and seems to be increased in difficult cases, particularly in cases that require multiple accesses. Similar to the operation time, we calculated the time necessary for removing a 1 mm^2 stone and could not demonstrate a statistically significant difference.

It has been shown that SWL causes some degree of renal injury.[9] Although advances in shock wave technology have led to the production of systems with lower complication rates, the debate continues on the short- and long-term complications of SWL treatment.[9] Holland et al.[22] explained their decreased success rates of salvage fURS with partially embedded fragmented stones into the mucosa. Conversely, Pillippou et al.[9] could not detect a statistically significant difference in the stone clearance rates after fURS in patients with or without previous SWL treatment. They also demonstrated that complications, procedure duration and length of hospitalization were similar between the groups. However, the laser energy used for the stone fragmentation was higher in patients without prior SWL, whereas the rate of ureteric stenting at the end of the procedure was higher for the patients in the salvage group. Similarly, we did not detect any difference in the operation time, hospitalization length, postoperative complications and success rates of fURS in patients with or without prior SWL treatment. Unfortunately, we could not compare the laser energy used between the groups because we did not record these data.

The overall complication rate of ureterorenoscopy has ranged from 6% to 23% in various studies.[23] In our study, the overall complication rate was 6.1% and 2.2% for Group 1 and Group 2, respectively (p=0.3). The urosepsis observed in 2 patients in Group 2 was managed with parenteral antibiotics and supportive measures. No major complication was observed, and none of the patients had a secondary intervention for complications. The lower complication rate observed in our series may be attributed to a high volume of stone cases in our clinic.

Incomplete fragmentation and residual stone fragments are among the problems that urologists confront when SWL fails.[24] In this study, the patients in Group 2 also had stone fragments scattered through the collecting system as a result of incomplete stone clearance. However, although the stone number in Group 2 was higher, this difference was not significant (p=0.06).

The retrospective and non-randomized fashion is the most important limitation of our study. Therefore, prospective and randomized studies are necessary to confirm that prior SWL does not have a negative impact on the outcomes of fURS.

In conclusion, our results demonstrate that fURS has similar success and complication rates in patients with and without prior SWL treatment. Further studies are necessary to confirm our findings.

Ethics Committee Approval: Because of the retrospective design of the study, ethical committee approval was not obtained.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

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References

1. Danuser H, Muller R, Descoeudres B, Dobry E, Studer UE. Extracorporeal shock wave lithotripsy of lower calyx calculi: how much is treatment outcome influenced by the anatomy of the collecting system? Eur Urol 2007;52:539-46.
2. Srisubat A, Potisat S, Lojanapiwat B, Setthawong V, Laopaiboon M. Extracorporeal shock wave lithotripsy (ESWL) versus percutaneous nephrolithotomy (PCNL) or retrograde intrarenal surgery (RIRS) for kidney stones. Cochrane Database Syst Rev 2009:CD007044.
3. Argyropoulos AN, Tolley DA. Evaluation of outcome following lithotripsy. Curr Opin Urol 2010;20:154-8.
4. de la Rosette J, Assimos D, Desai M, Gutierrez J, Lingeman J, Scarpa R, et al. The Clinical Research Office of the Endourological Society Percutaneous Nephrolithotomy Global Study: indications, complications, and outcomes in 5803 patients. J Endourol 2011;25:11-7.
5. Turna B, Ekren F, Nazli O, Akbay K, Altay B, Ozyurt C, et al. Comparative results of shockwave lithotripsy for renal calculi in upper, middle, and lower calices. J Endourol 2007;21:951-6.
6. Breda A, Ogunyemi O, Leppert JT, Schulam PG. Fexible ureteroscopy and laser lithotripsy for multiple unilateral intrarenal stones. Eur Urol 2009;55:1190-7.
7. Breda A, Ogunyemi O, Leppert JT, Lam JS, Schulam PG. Flexible ureteroscopy and laser lithotripsy for single intrarenal stones 2 cm or greater - is it the new frontier? J Urol 2008;179:981-4.

8. Türk C, Knoll T, Petrik A, Sarica K, Straub M, Seitz C. Members of the European Association of Urology (EAU) Guidelines Office. Guidelines on Urolithiasis. In: EAU Guidelines, edition presented at the 25th EAU Annual Congress, Barcelona 2010. ISBN 978-90-79754-70-0.
9. Phillippou P, Payne D, Davenport K, Timoney AG, Keeley FX. Does previous failed ESWL have a negative impact of on the outcome of ureterorenoscopy? A matched pair analysis. Urolithiasis 2013;41:531-8.
10. Preminger GM, Assimos DG, Lingeman JE, Nakada SY, Pearle MS, Wolf JS Jr (AUA Nephrolithiasis Guideline Panel). Chapter 1: AUA guideline on management of staghorn calculi: diagnosis and treatment recommendations. J Urol 2005;173:1991-2000.
11. Pearle MS, Lingeman JE, Leveillee R, Kuo R, Preminger GM, Nadler RB, et al. Prospective, randomized trial comparing shock wave lithotripsy and ureteroscopy for lower pole caliceal calculi 1 cm or less. J Urol 2005;173:2005-9.
12. Sorensen CM, Chandhoke PS. Is lower pole caliceal anatomy predictive of extracorporeal shock wave lithotripsy success for primary lower pole kidney stones? J Urol 2002;168:2377-82.
13. E-Nahas AR, El-Assmy AM, Mansour O, Sheir KZ. A prospective multivariate analysis of factors predicting stone disintegration by SWL: the value of high-resolution noncontrast computed tomography. Eur Urol 2007;51:1688-93.
14. Wiener SV, Deters LA, Pais VM Jr. Effect of stone composition on operative time during ureteroscopic holmium:yttrium-aluminum-garnet laser lithotripsy with active fragment retrieval. Urology 2012;80:790-4.
15. Caskurlu T, Atis G, Arikan O, Pelit ES, Kilic M, Gurbuz C. The impact of body mass index on the outcomes of retrograde intrarenal stone surgery. Urology 2013;81:517-21.
16. Perlmutter AE, Talug C, Tarry WF, Zaslau S, Mohseni H, Kandzari SJ. Impact of stone location on success rates of endoscopic lithotripsy for nephrolithiasis. Urology 2008;71:214-7.
17. Elbahnasy AM, Shalhav AL, Hoenig DM, Elashry OM, Smith DS, McDougall EM, et al. Lower caliceal stone clearance after shock wave lithotripsy or ureteroscopy: the impact of lower pole radiographic anatomy. J Urol 1998;159:676-82.
18. Grasso M, Ficazzola M. Retrograde ureterospyeloscopy for lower pole caliceal calculi. J Urol 1999;162:1904-8.
19. El-Nahas AR, Ibrahim HM, Youssef RF, Sheir KZ. Flexible uerterorenoscopy versus extracorporeal shock wave lithotripsy for treatment of lower pole stones of 10-20mm. BJU Int 2012;110:898-902.
20. Akman T, Binbay M, Akcay M, Tekinarslan E, Kezer C, Ozgor F, et al. Variables that influence operative time during percutaneous nephrolithotomy: an analysis of 1897 cases. J Endourol 2011;25:1269-73.
21. Tepeler A, Binbay M, Yuruk E, Sari E, Kaba M, Muslumanoglu AY, et al. Factors affecting fluoroscopic screening time during percutaneous nephrolithotomy. J Endourol 2009;23:1825-9.
22. Holland R, Margel D, Livne PM, Lask DM, Lifshitz DA. Retrograde intrarenal surgery as second-line therapy yields a lower success rate. J Endourol 2006;20:556-9.
23. Geavlete P, Georgescu D, Nita G, Mirciulescu V, Cauni V. Complications of 2735 retrograde semi-rigid ureteroscopy procedures: a single-center experience. J Endourol 2006;20:179-85.
24. Skolarikos A, Alivizatos G, de la Rosette J. Extracorporeal shock wave lithotripsy 25 years later: complications and their prevention. Eur Urol 2006;50:981-90.