The Effectiveness of Flexible Ureterorenoscopy for Opaque and Non-opaque Renal Stones

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Purpose: To evaluate the treatment success rate of flexible ureterorenoscopy (URS) for opaque and non-opaque renal stones.

Materials and Methods: Ninety-four patients, who underwent flexible URS for renal stones between October 2012 and January 2014, were included. The patients were divided into two groups according to stone radiolucency. The patients were evaluated with preoperative and postoperative (at the weeks 4) computed tomography. Success of the treatment was defined as stone-free status and residual fragments < 4 mm.

Results: Success of the treatment was observed in 79 (84%) patients. Sex, stone size, and stone location were factors affecting treatment success. Seventy-five (79.8%) patients had opaque stones, and 19 (20.2%) had non-opaque stones. The treatment success rates for opaque and non-opaque stones were 86.6% and 73.6%, respectively (P = .167). Flexible URS was a successful modality with acceptable morbidity to treat renal stones.

Conclusion: These results show that radiolucent and opaque stones can be effectively treated by flexible URS.

Keywords: kidney calculi; therapy; lithotripsy; ureteroscopy; ureteroscopes.

INTRODUCTION

Urolithiasis is a common disease, affecting 3-5% of the population in developed countries, and its prevalence is increasing worldwide.[1,2] Management of urolithiasis includes observation, medical expulsive therapy, extracorporeal shock wave lithotripsy (SWL), and surgical modalities.[3-6] Kidney function, degree of obstruction, stone size, stone location, symptom severity, urinary tract infection status, high treatment success rate and minimal invasiveness are the most important factors influencing treatment choice in patients with urinary tract stone disease.[5,6]

Flexible ureterorenoscopy (URS) has over the last decade become an increasingly important modality to treat ureteral and kidney stones. Several reports have described the effectiveness and safety of flexible URS for treating multiple and large intra-renal stones.[7-9] This treatment is associated with low morbidity rates and successful outcomes.[10]

Fluoroscopy is commonly used during endourologic procedures such as ureteroscopy,[11] which assists the urologist during surgical intervention. Uric acid and xanthine stones are radiolucent.[12] The incidence of uric acid stones is 2.1-37.7%.[13] Diagnosing and removing radiolucent stones may be difficult using any interventional modality.

Stone-free rates determine treatment success, independently of the procedure. Recent discussions have focused on the clinical value of residual fragments after treatment. Methods of reducing the rate of residual fragments, which affects treatment success, are being investigated. We evaluated the treatment success rate of URS for opaque and non-opaque renal stones in this study.

MATERIALS AND METHODS

This study was approved by the Institutional Ethics Committee of Bozok University (2014/10-56).

Data of 108 consecutive patients who underwent retrograde intra-renal surgery for renal stones between October 2012 and January 2014 were evaluated retrospectively. Six patients had urinary tract abnormalities (4 horseshoe kidney and 2 duplex ureter), and eight were < 18 years old. These patients were excluded from the study. Case characteristics, including sex, age, history of kidney treatment (SWL, percutaneous nephrolithotripsy [PNL], flexible URS, or open surgery), and stone location, number and size were noted. Access sheath could not be placed in 15 cases in the first session. We applied double J (DJ) ureteral stent for passive dilatation and performed flexible URS 21 days later in these cases. All patients underwent preoperative low-dose non-contrast helical computed tomography (CT) and, X-ray of the kidneys, ureter and bladder (KUB). According to KUB, stones were classified as opaque and non-opaque. All patients were free of urinary tract infections preoperatively.

A DJ stent was placed if needed. DJ stents were removed at the end of 4 weeks, and all patients were evaluated for treatment success by CT and X-ray of the KUB. Success of the treatment was determined as stone-free status and

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Table 1. The preoperative data of patients.

Variables	Opaque Stone	Non-opaque Stone	Overall	*P* Value
Number of patient, (%)	75 (79.8)	19 (20.2)	94	
Age of patients, years, median (range)	44 (23-74)	43 (19-62)	43.5 (19-74)	.101
Gender of patients (female/male)	31/44	5/14	36/58	.229
Stone size (mm2), median (range)	120 (30-288)	100 (28-360)	110 (28-360)	.152
Stone location, no (%)				.290
Pelvis	42 (56)	7 (36.8)	49 (52.1)	
Lower pole	19 (25.3)	6 (31.6)	25 (26.6)	
Other locations	14 (18.7)	6 (31.6)	20 (21.3)	
Side of kidney (left/right), no	33/42	8/11	41/53	.882
Hydronephrosis, no (%)				.414
Grade 0	44 (58.7)	14 (73.7)	58 (61.7)	
Grade 1	13 (17.3)	2 (10.5)	15 (16)	
Grade 2	17 (22.7)	2 (10.5)	19 (20.2)	
Grade 3	1 (1.3)	1 (5.3)	2 (2.1)	
Previous intervention history, no (%)				.672
No	56 (82.4)	12 (17.6)	68 (100)	
SWL	16 (72.7)	6 (27.3)	22 (100)	
PNL	3 (75)	1 (25)	4 (100)	

Abbreviations: SWL, extracorporeal shockwave lithotripsy; PNL, percutaneous nephrolithotomy.

residual fragments < 4 mm, and failure was determined as the presence of residual fragments ≥ 4 mm.[14] Stone size was evaluated as the surface area, which was calculated according to the European Association of Urology guidelines.[15] Complications of the study were classified according to the modified Clavien-Dindo classification.[16]

Technique

The operation was performed under general anesthesia in the lithotomy position. Fluoroscopic guidance was used when needed. After cystoscopy, the hydrophilic guidewire was inserted into the ureter. Semi-rigid ureteroscopy was performed to visualize the ureter and facilitate placement. A ureteral access sheath (12/14 French [F]) was placed in all cases. A flexible ureterorenoscope (Flex X2™, Storz, Tuttlingen, Germany) with a 272-µm laser fiber were used during the procedure. Lithotripsy was performed with a laser lithotripter (Quanta System™, Varese, Italy). A nitinol basket catheter (1.5 F, 120 cm, Plastimed, Ankara, Turkey) was used at the end of the lithotripsy procedure to remove fragments from the collecting system. Fluoroscopy was performed at the end of the procedure to evaluate stone clearance. Three methods were used to fragment stones:[17]
1. Drilling method: Multiple drill holes were made in the stone.
2. Painting method: The fiber was moved over the stone, similar to painting.
3. Popcorn method: The stone was disintegrated with a laser fiber. This caused the fragments to fly, like popcorn.

Statistical Analysis

were performed using the Statistical Package for the Social Science (SPSS Inc, Chicago, Illinois, USA) version 15.0. A sample size calculation was performed to analyze the correlation between the variable opaque, non-opaque and fluoroscopy time, using the G-Power Program, commonly used in medical research. Power of the performed test was 100% for alpha value of 5% for the comparison of fluoroscopy time variable between opaque, non-opaque group. Quantitative variables

Table 2. Peri- and post-operative data of patients.

Variables	Opaque Stone	Non-opaque Stone	Overall	*P* Value
Treatment success rate, no (%)	65/75 (86.7)	14/19 (73.7)	79/94 (84)	.167
Operation time, min, median (range)	50 (30-105)	55 (35-75)	51 (30-105)	.193
Fluoroscopy time, min, median (range)	12 (5-23)	6 (3-12)	11 (3-23)	< .001
Complications, no (%)	16 (21.3)	4 (21.1)	20 (21.3)	.979
Access sheath, no (%)	69 (92)	17 (89.5)	86 (91.5)	.724
Hospital stay, day median (range)	1 (1-2)	1 (1-2)	1 (1-2)	.572
Double J stent placement, no (%)	68 (91)	15 (79)	83 (88)	.156

Table 3. Logistic regression analysis results according to treatment success rate.

Variables	Multivariate Analysis		
	Odds Ratio	**95% CI**	***P* Value**
Age	0.993	(0.909-1.084)	.870
Gender	0.267	(0.033-2.164)	.216
Stone size	3.009	(1.372-6.597)	.006
Operation time	0.996	(0.927-1.070)	.909
Fluoroscopy time	1.283	(0.902-1.825)	.166
Opaque or non-opaque	4.732	(0.119-187.696)	.408
Left or right kidney	0.667	(0.095-4.695)	.684

Abbreviation: CI, confidence interval.

were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), and were analyzed by Student's *t*-tests, one way ANOVA, Mann-Whitney *U* tests or Kruskal-Wallis tests as appropriate. Qualitative variables were expressed as numbers and percentages, and were assessed by chi-squared tests. Proportions of categorical variables were analyzed using Pearson's chi squared test or Fisher's exact test; if the minimum expended count was < 5, the comparisons of the categorical variables rate were performed using Fisher's exact test. Multivariate logistic regression analyses were performed to determine the association of treatment of success and affecting factors with the. A *P* value < .05 was considered to indicate significance.

RESULTS

Ninety-four patients (43.5 range, 19-74 years; 58 males and 36 females) with upper urinary tract stones were treated. Median stone size was 110 mm^2 (range, 28-360 mm^2). Forty-nine stone were located in the pelvis, 25 were in the lower pole, and 20 were in other calyceal systems. Fifty-three stones were in the right kidney and 41 were in the left kidney. Seventy-five stones were opaque, and 19 were non-opaque or semi-opaque. Detailed preoperative data are given in **Table 1**.

Fluoroscopy duration was significantly shorter for non-opaque stones than that for opaque stones ($P < .001$). Operation time and hospital stay were similar in both groups ($P = .193$, $P = .572$). Detailed operative data are summarized in **Table 2**. The postoperative radiological studies at the end of week 4 revealed that 79 (84%) patients were stone free. Sixty-five (86.7%) of 75 opaque stones were cleared completely, and 14 (73.7%) of 19 radiolucent stones were cleared completely. Although no significant difference in stone-free rate was observed between the groups, the treatment success rate for opaque stones was better than that for non-opaque stones ($P = .167$). Grade 1 (fever, renal colic), grade 2 (hematuria, infection) and grade 3 complications (urinoma, steinstrasse) were defined according to modified Clavien-Dindo classification. There were 20 patients (9 renal colic, 5 fever, 4 hematuria, 2 infection) with grade 1 and 2 complications. There was not any patient with grade 3 complications. All these complications could be successfully managed with analgesics, antibiotics and hydration. The overall complication rate was 21%. In this study, according to the stone localization, stone-free rates were 64% in the lower pole; 95.9% in renal pelvis and 80% in other locations. Localization affected the treatment success of flexible URS ($P = .002$).

The multivariate logistic regression analysis was performed to evaluate the variables which affect the success. The stone size was found as the only factor that affects the success of the treatment (Odds ratio = 3.009; 95% confidence interval: 1.372-6.597) (**Table 3**). Sex, stone size, stone location, operation time, fluoroscopy duration and complication rate were significantly different between the groups after subgrouping the patients according to stone-free status. Details of the factors affecting success of the treatment are shown in **Table 2**.

DISCUSSION

Flexible URS has become an increasingly popular treatment modality for ureteral and kidney stones over the last decade.[7] Previous studies have shown that this treatment is associated with less morbidity and successful outcomes. The stone-free rate for flexible URS is 85.1-93.3%. However, those studies reported average reoperation rates of 1.3 and 2.3 for each patient.[7,8,10,18] In our study, the treatment success rate was 84% in a single operation.

Although the treatment success rate tended to be lower in the non-opaque stone group, the difference was not significant. The lower success rate in the non-opaque group could be due to the absence of the benefit afforded by fluoroscopic guidance.

Flexible URS has been reported to have a 9-25% complication rate.[19] We observed only first- and second-degree complications according to the modified Clavien-Dindo classification, and the overall complication rate was 21%. The complications were not serious, and no surgical interventions were needed.

The treatment success rates for pelvic, lower pole calyceal, and stones located in other than these anatomical positions were 95.9% (47/49), 64% (16/25) and 80% (16/20), respectively. Localization affected the treatment success of flexible URS ($P = .002$). Various studies have reported treatment success rates of 50-78%.[20-22] Treatment of lower calyceal stones > 15 mm had a lower treatment success rate by SWL compared to flexible URS and PNL. Various factors predict unfavorable results of SWL for lower calyceal stones. The European Association of

Urology (EAU) guidelines recommend flexible URS or PNL for lower calyceal stones > 15 mm.[19]

In our study, the treatment success rate was affected by stone size (multivariate logistic regression analysis), as has been reported previously.[20,23,24] As stone burden increased, the stone-free rate by flexible URS decreased. Sener and colleagues reported a 100% stone-free rate for upper urinary tract stones < 1 cm.[25] Flexible URS treatment for stones > 2 cm has high treatment success rates with acceptable complication rates.[26] We treated stones < 2 cm in our study. The improvement of flexible URS and developments in intracorporeal lithotripsy techniques, has allowed effective and safe operations. As mentioned in the 2012 guidelines of the EAU, URS is a good option for small-to-moderate sized kidney stones[15] Access sheath placement was preferred whenever possible in this study. Access sheath placement reduces intra-pelvic pressure, the need for fluoroscopy, residual stone rate and operation time.[12,27] We placed access sheaths in 86 (91.5%) patients. Flexible URS was also performed in patients in whom a ureteral access sheath could not be inserted. As the number of patients in whom a ureteral access sheath was not inserted was insufficient, no statistical comparison was performed. Fluoroscopy time was shorter in patients in the non-opaque stone group compared to the opaque stone group ($P < .001$). Stone location was determined by direct vision because the stones were radiolucent.

CONCLUSION

Our results demonstrate that flexible URS was successful for treatment of non-opaque and opaque renal stones. Furthermore, radiolucency did not affect the operative measures. However, these preliminary results should be confirmed by high-volume, randomized, prospective studies.

CONFLICT OF INTEREST

None declared.

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