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ORIGINAL PAPER

Semirigid ureteroscopy: the effect of previous ipsilateral intraureteral manipulations on stone clearance

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Abstract We investigated whether previous intraureteral manipulations had an effect on the stone-free rates (SFR) after semi-rigid ureteroscopy (URS) with pneumatic lithotripsy. A retrospective review of all patients who were treated for ureteral stones at two different institutions from June 2003 through January 2010 was performed. Data of 161 URS procedures were analyzed. Stone size, location (distal, mid and proximal) and number (single and multiple), patient demographics and previous intraureteral manipulations were recorded. Patients were grouped as having undergone a previous ipsilateral intraureteral manipulation (Group 1) or not (Group 2). Stone location and number, stone clearance and ancillary procedures were compared. There were no significant differences between Group 1 versus Group 2 for age ($p > 0.05$), gender ($p > 0.05$), stone site ($p > 0.05$) and stone size ($p > 0.05$). Stones with multiple locations were more frequent in Group 1 (18.5%); however, the difference did not reach statistical significance between the two groups. Similarly, the frequency of multiple stones was also higher in Group 1 (29.6%). Stone site, diameter and gender were comparable in both groups. Stone-free rate of all patients was 84.6% after the first intervention. This rate increased to 98.1% after secondary procedures. Univariate analysis revealed that SFR after URS were low in patients who underwent previous intraureteral manipulations (Group 1:55.6% vs. Group 2:89.1%). SFR after the first intervention were related with stone size, location and number. Additionally, multiple logistic regression analysis indicated a relationship between previous intraureteral manipulations and initial stone clearance rates. Spontaneous passage of stone fragments after URS was associated with stone burden, location, number and previous intraureteral manipulations. Further multiple logistic regression analysis showed that only previous intraureteral manipulations were associated with the expulsion of the stones left for passage.

Keywords Ureterorenoscopy · Previous manipulations · Stone free · Stone passage

Introduction

Urolithiasis is a disease with the risk of recurrence even after a long period of time following the first successful treatment. A remarkable number of patients may undergo more than one intervention for treatment during their lifetime. Ureter is a frequent location where stones may be found and the management differs according to the size, location and number of stones. A treatment option for this group of patients is ureteroscopy (URS). A considerable number of studies have been carried out to outline the factors associated with the outcomes of URS. However, the impact of previous intraureteral manipulations on the outcomes of URS remains unclear. We investigated whether previous intraureteral manipulations had an effect on the

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stone-free rates (SFR) after semi-rigid URS with pneumatic lithotripter assisted stone disintegration.

Patients and methods

A retrospective review of all patients who were treated for ureteral stones at two different institutions from June 2003 through January 2010 was performed. A total of 228 patients (233 renal units) underwent URS. All stones were documented with either non-contrast computerised tomography (CT) or intravenous urography (IVU). Patients with accompanying renal calculi ($n = 7$), URS treatment following unsuccessful shock wave lithotripsy ($n = 24$) and previous history of open ureteral surgical procedures ($n = 1$) were excluded from the study.

Thirty-three patients were lost at follow-up and seven patients had missing data. The remaining 161 URS procedures data were used for the analysis.

Stone size, location (distal, mid and proximal) and number (single and multiple), patient demographics and previous intraureteral manipulations were recorded. Secondary or post-stent ureteroscopy has the advantage of working through a dilated ureter. We do not prefer preoperative stenting for URS so we had no patients preoperatively stented. Any intraureteral manipulations including URS for various indications, retrograde catheter placement, especially, as part of percutaneous nephrolithotripsy (PCNL) and ureteral stent placement for any reason [e.g. before shock wave lithotripsy (SWL) therapy to decrease the risk of "steinstrasse" especially in patients with large stone burden or solitary kidneys] were the previous intraureteral manipulations in our patient groups. In addition to the mentioned factors, impacted stones and ureteral strictures defined intra-operatively were also recorded. The demographic data of patients included in the study are shown in Table 1.

Table 1 Description of the demographic properties of patients and comparison between two groups (previous intraureteral manipulation vs. no such history)

Variables	Total	Previous manipulations (Group1)	No previous manipulations (Group 2)	*p* value
Number of patients	161	27	134	
Age (years)	46.1 ± 13.2	45.6 ± 12.7	47.8 ± 14.1	0.6
Gender				
Male	97 (60%)	18 (66.7%)	79 (59%)	0.7
Female	64 (40%)	9 (33.3%)	55 (41%)	
Stone site				
Right	80 (49.7%)	11 (40.7%)	69 (51.5%)	0.8
Left	81 (50.3%)	16 (69.3%)	65 (48.5%)	
Stone number(%)				
Single	133 (82.6%)	19 (70.4%)	114 (85.1%)	0.064
Multiple	28 (17.4%)	8 (29.6%)	20 (14.9%)	
Stone location(%)				
Distal Ureter	101 (62.7%)	14 (51.9%)	87 (64.9%)	0.059
Mid Ureter	29 (18%)	4 (14.8%)	25 (18.7%)	
Proximal Ureter	20 (12.4%)	4 (14.8%)	16 (11.9%)	
Multiple Location	11 (6.8%)	5 (18.5%)	6 (4.5%)	
Stone diameter(mm)	12.4 ± 6.4 mm	14.4 ± 8.5 mm	12.1 ± 5.9 mm	0.5 (Mann–Whitney *U* test)
Postoperative ureteral stent placement				
Yes	65 (40.4%)	17 (63%)	48 (35.8%)	0.009
No	96 (59.6%)	10 (37%)	86 (64.2%)	
Stone-free rates after first interventions	137 (85%)	15 (55.6%)	122 (91%)	0.000
Stone-free rates after secondary procedures	158 (98.1%)	25 (92.6%)	133 (99.2%)	0.02
Impacted stones	7 (4.3%)	0	7 (5.2%)	0.2
Ureteral stricture observed during URS	20 (12.4%)	2 (7.4%)	18 (13.5%)	0.1
Pneumatic lithotripter utilization	134 (83.2%)	19 (70.4%)	115 (85.8%)	0.01

URS procedure

A semirigid ureteroscope (8.5/11.5 Fr-Karl StorzTM) was used in all cases.

The procedures started by the introduction of a guidewire through the ureteral orifice. Balloon dilatation was undertaken for ureteral strictures, however, dilatation of ureteral orifice was not required in any patient (Table 1). Small stones were removed with either forceps or baskets and stones fragmented to the size of the lithotripter tip (5Fr) were left for spontaneous passage according to surgeon discretion. Decision of ureteral stent placement was made according to the stone location, size, number, operation time, presence of impacted stones and intraoperative complications.

Follow-up

Plain X-ray of the kidneys, ureters and bladder (KUB) was utilized routinely. A non-contrast CT was utilized in cases of equivocal findings. All patients were evaluated at the postoperative first and 10–12 weeks. Stones were left for spontaneous passage in 98 patients. A secondary intervention (SWL, URS, stent administration) was performed either if spontaneous passage of stone/s did not occur at the end of 12 weeks or in the presence of pain not responding to medical treatment. None of the patients received drugs to facilitate the passage of the stones. Stone-free patients were defined either immediately after surgery or during the follow-up period of patients with stones left for spontaneous passage who expelled the stones.

Statistics

Patients were grouped as either having a positive history of previous ipsilateral intraureteral manipulation (Group 1) or not (Group 2). Patient age and stone size were compared by using the independent samples *t* test. The Mann–Whitney *U* test was used for variables with skewed distribution. Stone location and number, stone clearance and ancillary procedures were compared with the Chi-square test. Multiple regression analyses were also used in the assessment of groups.

Results

A total of 161 URS procedures were included in the study. The demographic data are shown in Table 1. There were no significant differences between Group 1 versus Group 2 for age ($p > 0.05$), gender ($p > 0.05$), stone site ($p > 0.05$) and stone size ($p > 0.05$). Multiple stones were more frequent in Group 1(18.5%); however, the difference did not reach statistical significance between the two groups. Similarly, the frequency of multiple stones was also higher in Group 1(29.6%). Stone site, diameter and gender were comparable in both groups (Table 1). Subserosal perforation of the ureter was seen in 1 (3.7%) case from group 1 and no other serious complication was recorded.

Stones were left for spontaneous passage ($n = 98$, 61%), cleared ($n = 56$, 35%) or left for a second intervention ($n = 7$, 4%). The details for all patients are shown in Table 1. Outcome of the initial URS for group 1 and group 2 patients are shown in Fig. 1a and b. Total stone free rate was 84.6% after the first intervention. This rate increased to 98.1% after secondary procedures. The secondary procedures were URS ($n = 16$, 66%), SWL ($n = 4$, 17%), open surgery ($n = 3$, 13%) and laparoscopy ($n = 1$, 4%). Univariate analysis revealed that SFR after URS were significantly lower in Group 1 (patients who underwent previous intraureteral manipulations) when compared to Group 2 (Group 1:55.6% vs. Group 2:89.1%). SFR after the first intervention were related with stone size, location and number (Table 2). Factors found to be associated with initial stone clearance rates were further evaluated with separate and pooled multiple logistic regression analysis (Tables 3, 4). Both separate and pooled multiple logistic regression analyses revealed that previous intraureteral manipulations were related with initial stone clearance rates. Stone location was associated with stone clearance, only in pooled multiple logistic regression analysis. The remaining factors, stone size and number of stones were not found to be associated with initial stone clearance rates.

The outcome of stone fragments left for spontaneous passage has also been analysed.

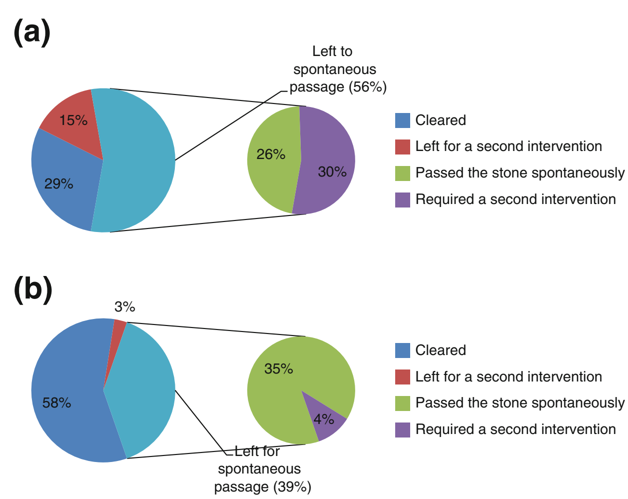

Fig. 1 **a** Outcome of the initial URS in patients who have a positive history of previous intraureteral manipulations. **b** Outcome of the initial URS in patients without a history of previous intraureteral manipulations

Table 2 Factors analyzed for the outcome of the interventions

	Results of first intervention			Results after ancillary procedure			Results of stones left to spontaneous passage		
	Stone free	Not stone free	*p* value	Stone free	Not stone free	*p* value	Stone free	Not stone free	*p* value
Total numbers									
	137 (85.1%)	24 (14.9%)	0.000	158 (98.1%)	3 (1.9%)	0.000	81 (82.7%)	17 (17.3%)	0.000
Stone diameter (mm)									
	11.7 ± 5.5	16.4 ± 9.5	0.002	12.4 ± 6.3	13.3 ± 11.9	0.5	11.9 ± 4.5	15.6 ± 8.7	0.01
Postoperative ureteral stenting									
Yes	49 (75.4%)	16 (24.6%)	0.04	63 (96.9%)	2 (3.1%)	0.7	28 (71.8%)	11 (28.2%)	0.02
No	88 (91.7%)	8 (8.3%)		95 (99%)	1 (1%)		53 (89.8%)	6 (10.2%)	
Stone Location									
Proximal	14 (70%)	6 (30%)	0.000	18 (90%)	2 (10%)	0.038	12 (70.6%)	5 (29.4%)	0.05
Mid	22 (75.9%)	7 (24.1%)		29 (100%)	0		17 (77.3%)	5 (22.7%)	
Distal	95 (94.1%)	6 (5.9%)		100 (99%)	1 (1%)		50 (90.9%)	5 (9.1%)	
More than one location	6 (54.5%)	5 (45.5%)		11 (100%)	0		2 (50%)	2 (50%)	
Stone number									
Single	119 (89.5%)	14 (10.5%)	0.001	130 (97.7%)	3 (2.3%)	0.1	70 (87.5%)	10 (12.5%)	0.008
More than one	18 (64.3%)	10 (35.7%)		28 (100%)	0		11 (61.1%)	7 (38.9%)	
Stone site									
Left	70 (86.4%)	11 (13.6%)	0.8	79 (97.5%)	2 (2.5%)	0.7	44 (88%)	6 (12%)	0.8
Right	67 (83.7%)	13 (16.3%)		79 (98.7%)	1 (1.3%)		37 (77.1%)	11 (22.9%)	
Previous ipsilateral intraureteral manipulations									
Yes (Group 1)	12 (44.4%)	15 (55.6%)	0.000	25 (92.6%)	2 (7.4%)	0.02	7 (46.7%)	8 (53.3%)	0.000
No (Group 2)	122 (91%)	12 (9%)		133 (99.3%)	1 (0.7%)		74 (89.2%)	9 (10.8%)	

Table 3 Separate multiple logistic regression analysis

	Initial stone clearance		Initial stone clearance of stones left to spontaneous passage	
	OR (95% CI)	*p* value	OR (95% CI)	*p* value
Number of stones	2.5 (0.6–10.1)	>0.05	3.0 (0.6–13.8)	>0.05
Stone location				
Proximal	0.3 (0.04–2.9)	>0.05	0.4 (0.02–6.6)	>0.05
Mid	0.5 (0.06–3.8)	>0.05	0.7 (0.05–11.2)	>0.05
Distal	2.9 (0.4–20.6)	>0.05	1.8 (0.1–26.7)	>0.05
Multiple	Intercept		Intercept	
Stone size (1 cm)	2.9 (0.9–8.8)	>0.05	2.7 (0.7–10.7)	>0.05
Previous intraureteral manipulations	8.9 (2.8–27.8)	0.000	9.1 (2.3–35.8)	0.002

Table 4 Pooled multiple logistic regression analysis

	Initial stone clearance		Initial stone clearance of stones left to spontaneous passage	
	OR (95% CI)	*p* value	OR (95% CI)	*p* value
Number of stones	1.9 (1.1–3.2)	>0.05	2.2 (0.5–9.5)	>0.05
Stone location	1.9 (1.1–3.2)	0.01	1.6 (0.8–3.1)	>0.05
Stone size (1 cm)	2.8 (0.9–8.7)	>0.05	2.8 (0.7–10.9)	>0.05
Previous intraureteral manipulations	7.0 (2.4–20.3)	0.000	8.1 (2.1–30.9)	0.002

Results of this subset of patients ($n = 98$) showed similarities in all patients.

82.7% ($n = 81$) of patients passed their stones and required no further procedure following ureteroscopic intervention. Stone burden, location and number and previous intraureteral manipulations were related with passage of the stone fragments left after URS (Table 2). Both separate (OR 9.1, CI 2.3–35.8, $p = 0.002$) and pooled (OR 8.1, CI 2.1–20.9, $p = 0.002$) multiple logistic regression analysis indicated that only previous intraureteral manipulations had an effect on the rate of passage of stones (Tables 3, 4).

Discussion

URS is the preferred approach for the surgical treatment of ureteral stones [1] with low complication and high success rates [2, 3]. The reported overall stone-free rate of semirigid URS for ureteral stones is remarkably high at 85–100% depending on stone location [2, 4, 5]. The initial stone free rate independent of location was 85% in our patients; this rate increased to 98% after ancillary procedures. SFR were related with the stone location, stone size, previous ipsilateral intraureteral manipulations and stone location. Although SFR are inferior to URS, SWL is another safe and effective treatment option for the treatment of ureteral stones [6].

There are several studies analysing the factors that could be associated with stone clearance in URS [7, 8]. Most of these studies concluded that SFR are associated with stone burden and location of the stone within the ureter. However, no study has addressed the impact of previous intraureteral manipulations on stone clearance. Some studies have tried to evaluate the impact of an indwelling ureteral stent on the success of URS [9, 10] suggesting that there seems to be an increased stone clearance rate in this subset of patient. However, these studies are not comparable with ours since they indicate that the stents were already in place during the URS in these studies. We have tried to evaluate the effect of previous intraureteral manipulations and there were no patients with indwelling stents at the time of the operation.

The outcome of stone fragments left for spontaneous passage after fragmentation has been mentioned in some studies, but not analysed in depth [7]. Hong et al. mentioned that 6.5% of these patients could not pass stone fragments 2 weeks after treatment. However, they did not mention the number of patients with stone fragments that were left for spontaneous passage, so it is hard to reach a conclusion about this topic. In our study, in 61% of patients stone fragments were fragmented to the size of the tip of the pneumatic lithotripter and were left for spontaneous passage. We cleared all the heavy bulk of stones and left only fragments of defined size for spontaneous passage. Avoiding multiple manipulations within the ureter was the main reason of the approach preferred. Spontaneous passage was observed in 82% of the operations.

Our study results suggest that SFR after URS are related with stone burden, location within the ureter and number of stones. A higher stone burden, stones located more proximal within the ureter and multiple stones were associated with a poorer outcome.

These results obtained are similar to those published [1]. Additionally, a positive history of previous intraureteral manipulations was found to be negatively associated with successful stone clearance.

We defined intraureteral manipulations as URS and retrograde 8Fr catheter placement up to the proximal ureter prior to percutaneous renal surgery for retrograde opacification of the pelvicalyceal system. Patients with the history of these two manipulations have shown a less favourable outcome of stone clearance. Not only was the initial stone free rate low, the final SFR after the second interventions were also lower than patients without such a history. The association with a poor outcome has also been verified with multivariate analysis.

In the group of patients with a history of intraureteral manipulation, the proportion of multiple and proximal stones was higher than the remaining patients. This may be a confounding factor that has resulted in a poorer outcome. However, the poor outcome of these patients has been confirmed by multiple logistic regression analysis where no other factor showed any association even though they were associated in univariate analysis. In addition to this, these patients had a poorer outcome when the stones were left for spontaneous passage too (46.7 vs. 89.2%) and this finding has been confirmed by multivariate analysis. Various studies have reported that spontaneous passage of ureter stones at the initial diagnosis is related with stone location and size [11, 12]. The cutoff value with the highest success rates suggested by the ureteral calculi guidelines of the EAU and AUA was 4 mm [1]. This group of patients had an 80% spontaneous passage rate irrespective of stone location. In our study, despite the presence of stones left for spontaneous passage, the total rate of spontaneous passage was 82% for fragments <4 mm. By evaluating only this group of patients independently, we tried to eliminate the bias of differences of stone parameters of Groups 1 and 2. These results suggest that, in addition to stone parameters, a history of previous intraureteral manipulations is another parameter associated with a poorer outcome of stone clearance.

According to our study there is a possible relationship with the SFR of URS and previous intraureteral manipulations. The pathophysiology which would cause such an outcome is a matter of further research. However, we were able to speculate a possible explanation for the results obtained. According to our results visual pathologies of the ureter such as strictures that could possibly affect the outcome off the surgery were not more frequent in group 1. Furthermore, proximal stones (Group 1:14.8% vs. Group 2:11.9%) and multiple location stones (Group 1:18.5% vs. Group 2:4.5%) were slightly more frequent in group 1. When the outcome of the surgeries of both groups were also investigated the lower SFR of group 1 were mostly due to stones that were voluntarily left for spontaneous passage and were not expelled by the body (Fig. 1a, b). From these results we could hypothesize that trauma caused by previous intraureteral manipulations could possibly affect the functioning of the ureter. Unfortunately, we could not define the point in which the ureter was reached and the nature of the previous manipulations. However, such data may be helpful in further defining the differences of stone location and expulsion rate seen within the group. Proof of the hypothesis would require physiological studies of the situation.

In conclusion, our study indicates that previous ipsilateral intraureteral manipulations have a negative effect on the success of treatment of ureteral stones with semirigid URS. This new finding needs to be confirmed by further research and preferably with a larger number of patients.

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