

Original Article

Comparison of Stone-Free Rates after Ureteroscopic Pneumatic Lithotripsy in Impacted vs. Non-Impacted upper Ureteral Stones

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HIGHLIGHTS

- Pneumatic transurethral lithotripsy in upper ureteral impacted stones has a better success rate compare to non-impacted stones.
- Stone-impaction could prevent upper ureteral stones from migration during lithotripsy.

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ABSTRACT

Introduction

Stone impaction in ureteral is defined as an unchanged stone location for at least 2 months or an inability to pass guidewire up to the stone intraoperatively. This study aims to evaluate the effect of stone impaction on pneumatic transurethral lithotripsy in upper ureteral stones. And to assess if stone impaction could be a factor that prevents retropulsion of upper ureteral stones.

Methods

In this retrospective cohort study, patients referred with upper ureteral stone to the urology clinic of Sina hospital between May 2014 to May 2018 were evaluated. The patients were divided into two groups: those with stone impaction (Group A) and those without impaction of stone (Group B). Transurethral lithotripsy (TUL) procedure with pneumatic lithotripter was performed in all patients. The data were extracted from patients' documents and files retrospectively and analyzed. Quantitative data were shown by the number (%) and they were compared by chi-square test. The p-value < 0.05 was considered statistically significant.

Results

70 patients with upper ureteral stones were evaluated. 38 patients (54.2%) in group A and 32 (45.7%) in group B. Average stone size was 7 mm (5-12) and there wasn't a significant difference in stone burden between the two groups. Stone-free rate (SFR) was significantly less in group B. (90% in group A versus 19% in group B, p-value < 0.001). Almost 1.7% of patients experienced complications, there wasn't a significant difference between the two groups.

Conclusions

Based on the better success rate of pneumatic TUL in upper ureteral impacted stones in comparison with non-impacted stones, we could conclude that having an impacted stone could be a favorable risk factor for successful TUL. The reason could be less migration of these types of stones.

Keywords: Ureteral Calculi; Pneumatic; Lithotripsy; Impaction

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Introduction

Urinary stones are a major burden on healthcare facilities. About 88.6% of these cases are ureteral stones. The diverse range of modalities available for the management of ureteral stones is watchful waiting, transurethral lithotripsy (TUL), extracorporeal shockwave lithotripsy (ESWL), flexible ureterorenoscopy and laser lithotripsy, and open or laparoscopic ureterolithotomy. Historically, many ureteral stones treated by open ureterolithotomy, however, after introducing ESWL and rigid ureteroscopes, these methods went popular in the world. In recent years, urologists have shown an interest in laser lithotripsy by flexible ureteroscope and laparoscopic ureterolithotomy. The second one is generally used in giant ureteral stones and after failed endourological attempts. Thus, the non-medical management for ureteral stones is moving toward less invasive therapies such as TUL and ESWL. The first one provides better success rates from 76.9-100% but can also cause failures in the form of migration of stone to the pelvis, inability to reach and fragment stone, and failure to extract stone fragments. TUL has its complications, as well, such as the avulsion of the ureter (the most horrible complication), ureteral perforation, and perioperative bleeding (1-3).

Stone impaction in ureteral stones is defined as the unchanged stone location for at least 2 months (4). Some urology texts defined the inability to pass guidewire up to the stone intraoperatively, as impaction of stone. Recently, some studies tried to find predicting models to estimate stone impaction (5). The purpose of this study is to evaluate the effect of stone impaction on pneumatic transurethral lithotripsy in upper ureteral stones and to assess if stone impaction could be a factor that prevents retropulsion of upper ureteral stones.

Methods

In this retrospective cohort study, patients referred with upper ureteral stone to the urology clinic of Sina hospital between May 2014 to May 2018 were enrolled. Inclusion criteria were all upper ureteral stones that remained over 6 weeks or those larger than 6 millimeters. Our exclusion criteria were severe ureteral stricture (inability to pass ureteroscope from the ureter and reach stone), retroperitoneal fibrosis, giant (>5cm) ureteral stones, second-session lithotripsy, and missing data in files.

All patients underwent preoperative computed tomographic scan, and routine laboratory tests. They were admitted to the hospital 24 hours before the operation. On the operation day, plain abdominal radiography was done. The procedure was performed under spinal anesthesia. Ureteroscopy evaluation after inserting a guidewire was done with a semi-rigid 9.6-F Storz ureteroscope (Storz, Germany), using Pneumatic Swiss Lithoclast (Electro Medical Systems, Le Sentie, Switzerland). To prevent

stone migration, low-pressure fluid stream (ultraviolet ray sterilized tape water), and if necessary, 4-F stone baskets were used. Stone impaction in ureteric stone is defined as remaining unchanged in the same location for at least 2 months or the inability to pass guidewire up to the stone intraoperatively. A ureteral stent was inserted for 24-48 hours depending on the procedure, and if indicated, a double-J stent for 4 weeks was inserted. All of the patients were followed by a computed tomography scan or ultrasonography, three months postoperatively. The patients were divided into two groups: those with stone impaction (Group A) and those without impaction of stone (Group B).

All ethical criteria were considered such as explaining to patients about the procedure and its complications and written consent obtained from all patients. The study was under the Tehran University of Medical Sciences Ethical Committee (IR.TUMS.MEDICINE.REC.1399.298).

Data were extracted from patients' documents and files retrospectively and analyzed using SPSS version 18. Quantitative data were shown by the number (%) and they were compared by chi-square test. The p-value <0.05 was considered statistically significant.

Results

In this study, 70 patients with upper ureteral stones were evaluated. 38 patients (54.2%) had stone impaction (Group A) and 33 (45.7%) were without impaction of stone (Group B). The average age of patients was 42.13 years. 48 (68.5%) patients were male and 23 (31.4%) were female. There were no statistically significant differences between the two groups in age and gender (p-value>0.05). The average stone size was 7 mm (5-12) and there wasn't a significant difference in the stone burden between the two groups (p-value<0.001). After the extraction of data from documents, there was some missing data, which could interfere with our analysis, so 18 patients were excluded from our study and 51 patients were eligible in our final analysis. To assess operation outcomes, complete removal, residue<4mm, residue>4 mm, and stone migration were considered, of which 25, 6, 0, and 20 patients were classified in these groups, respectively. There was a significant difference in the two groups in such outcomes. Overall stone-free rate (SFR) was 60.7%, which was significantly lower in group B. (90% in group A versus 19% in group B, p-value<0.001). Table 1 shows these comparisons between the two groups. Almost 33.2 percent of patients experienced mild hematuria, which this percentage was 31.7 in group A and 34.5 in group B (p-value<0.05). There wasn't any case of severe or sustained hematuria. 1.7 % of patients experienced complications, there wasn't a significant difference between the two groups. These adverse events included: false passage (0.5%), perforation (which

Table 1. Comparison of age, gender, outcome, and success rate between group A and B

Variables		Group A Number(%)	Group B Number(%)	Total Number(%)	p-value
Age (years)(mean ±SD)		42.2±2.2	42.11±2.1	42.13±2.3	>0.05
Gender	male	25 (65.7)	23 (71.8)	48 (68.5)	>0.05
	female	13 (39.4)	10 (28.2)	23 (31.4)	
Outcomes	Complete removal	21	4	25	<0.001
	Residue < 4 mm	6	0	6	
	Residue>4mm	0	0	0	
	migration	3	17	20	
Stone-free rate		90%	19%	60.7%	<0.001

Group A: stone impaction; group B: without stone impaction

managed by double j stent) (0.3%) and urinary tract infection (1%) (Table 2).

Discussion

The management of impacted ureteral stones is a challenging entity in urology. There are several treatment options such as ESWL, TUL, and laparoscopic ureterolithotomy. Our study showed that, in upper ureteral stones, when there is stone impaction, TUL is more successful than non-impacted ones. it is probably due to stone migration in non-impacted stones which are more than others.

Table 1. Clavien classification of complications

Clavien classification	GroupA Number(%)	GroupB Number(%)	Total Number(%)
I	0	0	0
II	1.2	1.1	1
IIIa	0	0	0
IIIb	0.5	1	1.5
IV-V	0	0	0
total	1.7	2.1	1.7

Group A: stone impaction; Group B: without stone impaction

In contrast, some studies report stone impaction as a negative factor for the TUL success rate. Zheng et al., performed holmium laser ureterolithotripsy (HLU) in 338 patients. In multivariate logistic regression stone location (odds ratio = 2.11) , and stone impaction (odds ratio= 2.66) were significantly associated with failure of surgery (6). These results were in contrast to our study. It would be due to the holmium laser, but we used pneumatic lithotripsy. On the other hand, all upper, lower, and middle ureteral stones are considered in their study, however, there are only upper ureteral stones in our study. Moreover, Christian Seitz et al., assessed 543 patients with proximal or distal ureteral stones who underwent semi-rigid Ho: YAG ureterolithotripsy. SFRs for non-impacted and impacted proximal stones were 85.8% and 67.2%, respectively (p-value=0.003) (7). This

inconsistency with our results could be also due to laser use. In another large TUL series on 2,650 patients with impacted ureteral stones, SFR in upper ureteral stones was 79.3% in impacted stones, which is lower compared with 88.3% for non-impacted ones (p-value<0.001). A possible explanation for the higher SFRs could be more use of flexible ureteroscopy and laser in their cases. For example, they use laser lithotripsy in 3,447 patients. In their study, intraoperative complication rates were higher for impacted stones (7.9 versus 3.0%, p-value<0.001) (8). Although our complications were lower than this study, we didn't find a significant difference in complications between the two groups.

Recently, many authors are in favor of TUL as the first choice of ureteral stones. The last version of the European urology panel in urolithiasis strongly recommends informing patients that TUL has a better chance of achieving stone-free status with a single procedure. They also mention that that TUL has higher complication rates when compared to ESWL (9). However, they haven't considered stone impaction in guidelines, which is an important factor in the clinical decision. Binbay et al., used holmium: yttrium-aluminum-garnet (Ho: YAG) laser for lithotripsy of impacted ureteral stones and they compared it to pneumatic lithotripsy. The SFRs after a single procedure were 97.5 and 80% in the laser and pneumatic patients' groups, respectively (p-value=0.03). They concluded that laser lithotripsy management of impacted ureteric stones is eminently efficient, regardless of the stone location (10). Although considering stone impaction in this study is similar to our work, the grouping of patients is based on method, not by impaction. Besides most of their cases are distal ureteral stones. On the other hand, few studies suggest ESWL as the first-line treatment in such stones. Deliveliotis et al., suggested ESWL as the initial approach for the treatment of impacted ureteral stones and when this modality fails, alternative therapies, such as TUL, which again in conjunction with ESWL can use (4).

The main advantage of the present study is the division of patients based on stone impaction and focusing on pneumatic lithotripsy; However, it has some limitations. our sample size is smaller than we expected. There were some missing data on patients' documents which obligate us to exclude a few cases in analysis and this study was retrospective. Further randomized clinical trials are suggested by focusing on stone impaction to compare TUL with other treatment options.

Conclusions

Based on the better success rate of pneumatic TUL in upper ureteral impacted stones in comparison with non-impacted stones, we could conclude that having an impacted stone could be a favorable risk factor for successful TUL. The reason could be less migration of these types of stones.

Authors' contributions

All authors contributed equally.

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Conflict of interest

All authors declare that there is not any kind of conflict of interest.

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Ethical statement

The study was under the Tehran University of Medical Sciences Ethical Committee (IR.TUMS.MEDICINE.REC.1399.298).

Data availability

Data will be provided by the corresponding author on request.

Abbreviations

ESWL	Extracorporeal shockwave lithotripsy
HLU	Holmium laser ureterolithotripsy
SFR	Stone-free rate
TUL	Transurethral lithotripsy

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