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Evaluation of Pre-Ureteroscopic Dilatation of Ureteric Orifice for Ureteric Stones Extraction

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ABSTRACT

Objective: To evaluate pre-ureteroscopic dilatation of ureteric orifice as a step of ureteroscopy for extraction of ureteric stones. Patients and Methods: Our study included 120 patients with ureteral stones treated by ureteroscopy from February 2024 to March 2025. All patients had ureteral stones up to 15 mm in size, and did not respond to conservative management, or had hydronephrosis secondary to symptomatic ureteral stones and failed ESWL. All underwent semi-rigid ureteroscopic (7.5-9.5 Fr) manipulation. The stone was disintegrated and removed by pneumatic lithotripter and Dormia basket or forceps. Group II also had endoscopic dilatation. Group I had no dilatation. Results: The stones were removed completely in 70 cases (58.3%), 28 cases in-group I and 42 cases in-group II and incompletely (in situ fragmentation) in 20 cases (16.6%) 12 of them in-group I and other 8 in-group II. In these 20 cases, no sizable fragments were seen endoscopically or fluoroscopically. Stone removal failed in 30 cases, 20 from group I, and 10 from group II. Overall stone clearance rate after ureteroscopy was 46.7% in-group I and 70% in-group II (p =0.18). Regarding complications, ureteral mucosal abrasions occurred in 68 cases, 40 of them were in-group I, and 28 cases in-group II. Fifty-six of these cases were managed conservatively with JJ ureteral stents and the remaining 12 cases were managed with ureteric catheters. Ureteral avulsion occurred in two cases from group I during Dormia basket manipulation. Repeat ureteroscopy was needed in 6 cases (2 from group II and 4 from group I) to obtain a stone free status. Fever occurred in 28 cases (12 (20%) from group I and 16 (26%) from group II) after ureteroscopy, 2 had hydronephrosis and were managed conservatively. Conclusions: Pre-ureteroscopic dilatation of the ureteric orifice can be limited to cases with stenotic ureteral orifices, or impacted stones.

Keywords: *Ureteroscopy, Stone, Balloon, Dilatation.*

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1. INTRODUCTION

Urinary stones are problems in the field of urology. Ureteral stones cause pain that travels from the lower back to the groin. Most ureteral stones pass on their own. Do not need treatment. Most patients with stones that are 10 mm or larger need surgical treatment because these stones usually do not clear with medical expulsive therapy. The chance that a stone will pass by itself depends on the size, shape, position of the stone and the swelling of the ureter, which probably relates to how the stone has been stuck. Ureteral stones that measure 4–5 mm have a 40–50 % chance of passing on their own. Stones that are larger than 6 mm have a chance of passage that is below 5 %. This does not mean that a 1 cm stone cannot pass or that a 1–2 mm stone will always pass without trouble. Most stones that are expelled happen within six weeks after symptoms start. Ureteral stones that are found in the part of the ureter when a patient first comes in have a 50 % chance of passing naturally compared with 25 % and 10 % chances in the middle and upper parts of the ureter [1]. Surgical treatments for ureteral stones include ESWL, ureteroscopy, PNL, laparoscopic surgery and rarely open surgery [2]. Extracorporeal lithotripsy is the method for treating most upper urinary stones because it has low risk and is easy to use. Ureteral stones that are larger than 1 cm are less responsive to ESWL, which is explained by the expansion-space theory [3]. Park and colleagues [4] studied the results of ESWL. Ureteroscopy for ureteral stones both in the upper and lower parts and showed that while the success rate of ESWL fell sharply for stones larger than 1 cm (83.6 % compared with 42.1 %) the stone-free rate with ureteroscopy stayed the same regardless of stone size (88.9 %, versus 86.6 %).

2. PATIENTS AND METHODS

Our study included 120 patients with ureteral stones treated by ureteroscopy February 2024 to March 2025 at the Urology department of Burjeel Royal hospital. All patients were subjected to the following: Clinical evaluation (full history taking and complete clinical examination), laboratory investigations (urine analysis, urine culture and sensitivity when indicated, complete blood picture, fasting blood sugar, blood urea, serum creatinine and liver function tests) and imaging study (kidney, ureter and bladder film (KUB), abdomino-pelvic ultrasound (US), intravenous urography (IVU), multi-slice computed tomography (MSCT) in some cases and magnetic resonance urography (MRU) in some cases. The patients included in the study had ureteral stones up to 15 mm in size, which did not respond to conservative management, or had hydronephrosis secondary to the symptomatic ureteral stones and had failed ESWL. There were no skeletal abnormalities in any of the patients, as documented by the preoperative KUB, IVU, and MSCT. The age's in-group I ranged from 16 to 67 years with a mean age of 39.49 years while in-group II the ages ranged from 25 to 68 years with a mean age of 41.47 years. The male to female ratio was 3.3:1 in-group I and 1:1 in-group II. All patients were randomized into two groups, each comprised of 60 cases. The first group (group I) underwent semi rigid ureteroscopic manipulation without endoscopic dilatation. The second group (group II) was subjected to semi rigid ureteroscopic manipulation with endoscopic dilatation. Informed consent was signed by all enrolled patients.

3. RESULTS

Retrograde semi-rigid ureteroscopies were performed on 120 patients split into two groups to remove 120 ureteral stones (38 located in the proximal ureter, 4 in the mid-ureter, and 78 in the distal region). Every group included 60 cases. In the first group (group I), ureteroscopic stone manipulation was carried out without endoscopic dilation of the ureteral orifice prior to the introduction of the ureteroscope, while patients in the second group (group II) underwent ureteroscopic stone manipulation following endoscopic dilation using balloon or Teflon dilators. Table 1 shows that there was no significant difference in baseline renal function between the two groups.Concerning stone locations in our patients, group I had 20 individuals with upper third ureteric stones, while group II consisted of 18 patients (Table 2). Four patients with stones in the middle third of the ureter were in the group. Group I consisted of thirty-six patients with stones in the lower third of the ureter, while group II included forty-two patients (Table 2). No statistically significant variations were found in the patient characteristics related to stone locations between the two groups. The stone was entirely removed following fragmentation using a pneumatic lithotripter in 70 instances (58.3%), with 28 cases in-group I and 42 cases (41.7%) in-group II. The stone was partially removed (i.e. in situ fragmentation) in 20 instances (12 from group I and 8 from group II (Table 3). In these 20 instances, no significant pieces were observed to be retrieved with the Dormia basket both endoscopically and fluoroscopically. No statistically significant differences were found in the choice of stone extraction methods between the two groups. The average working time for patients' in-group I (without dilation) was 40 minutes, while in-group II (with dilation) it was 45 minutes. The operative time difference between the two groups was not statistically significant, yielding a p-value of 0.285 (Table 4). The duration of hospital stay after surgery varied from 1 to 4 days for patients in-group I, averaging 2.5 days, while for group II, it ranged from 2 to 4 days, with an average of 3 days (Table 5). The disparity was statistically significant, showing a p-value of 0.010. The true clinical significance is

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challenging to assess because the computed difference of 0.7 days varies from 0 to 1.4 when considering the 95% confidence intervals. In this study, the stone clearance rate post-ureteroscopy was 28 (46.7%) for group I and 42 (70%) for group II. In 20 instances, stones fragmented on-site: 12 (20%) in-group I and 8 (13.3%) in-group II. Consequently, the total success rate stood at 58%. Stone removal was unsuccessful in 30 instances, with 20 from group I and 10 from group II. (Table 6). The primary notable difference in results between the two groups was related to stone-free status following the intervention, with a p-value of 0.016. The distinction was also clinically important, showing a stone-free rate of 70% with dilation compared to 46.7% without. Concerning complications, ureteral mucosal abrasions were observed in 68 instances, with 40 belonging to group I and 28 to group II. Fifty-six of these cases were treated conservatively with the use of JJ ureteral stents, while the other 12 cases were treated with the insertion of ureteric catheters (Table 7). The JJ stents remained in position for two to four weeks in patients with ureteral wall perforation and in the patient examined for impacted stone. Ureteral avulsion happened in two instances of group I during the manipulation of stone with a Dormia basket, followed by exploration. A second ureteroscopy was required in 6 instances to remove large stone fragments to achieve stone-free status. Two were from group II and four were from group I. Fever developed in 28 cases following ureteroscopy; 2 of these had hydronephrosis and were treated conservatively with intravenous antibiotics, antipyretics, and IV fluids. Group I consisted of 12 patients (20%), while group II had 16 patients (26%). Urine culture was conducted, and antibiotics were administered appropriately, resulting in fever resolution within 3 days. Haematuria occurred in 24 patients (39%) and persisted for under 48 hours, being managed conservatively. Complications from the Dormia basket happened in 10 instances: two ureter avulsions, all within group I; six retained Dormia baskets, four from group I and two from group II. There were instances of broken baskets in two cases of group II (Table 8). The only statistically significant difference in complications between the two groups was the occurrence of false passage and mucosal abrasion, with a p-value of 0.043. It was also clinically important, showing a 46% occurrence with pre-treatment dilatation compared to 66% without it.

Table 1: Comparison between the two studied groups according to renal function.

	Without dilatation (n = 60)	**With dilatation (n = 60)**	**p-value**
Urea			
Range	19.0 - 73.0	16.0 - 68.0	
Mean ± SD	33.87 ± 13.33	34.53 ± 14.86	0.798
Mean ± CI95	33.87 ± 3.44	34.53 ± 3.84	
Creatinine			
Range	0.50 - 2.2	0.60 - 3	
Mean ± SD	1.06 ± 0.44	1.95 ± 4.96	0.169
Mean ± CI 95	1.06 ± 0.11	1.95 ± 1.28	
P-value: calculated with two-sample t-test.			
CI95: 95% confidence interval.			

Table 2: Comparison between the two studied groups according to stone site.

Stone Location in Ureter	**Without dilatation (n = 60)**	**With dilatation (n = 60)**	**p-value**
Upper third	20 (33.3%)	18 (30.0%)	0.844*
Middle third	4 (6.6%)	0 (0.0%)	0.119**
Lower third	36 (60.0%)	42 (70.0%)	0.339*
* Chi square test p-value for comparing the two study groups.			
** Fisher exact test p-value for comparing the two study groups.			

Table 3: Comparison between the two studied groups according to technique of stone extraction.

Technique of stone extraction	**Without dilatation (n = 60)**	**With dilatation (n = 60)**	**X^2 p-value ***
Dormia basket	56 (93.3%)	58 (96.7%)	0.675
Forceps	4 (6.7%)	2 (3.3%)	
* Chi square test p-value for comparing the two study groups.			

Table 4: Comparison between the two studied groups according to the operative time.

Time (min.)	**Group I (Without dilatation) (n = 60)**	**Group II (With dilatation) (n = 60)**	**p-value**
Range	20.0 - 145.0	25.0 - 115.0	
Mean ± SD	40.0 ± 28.54	45.0 ± 21.98	0.285
Mean ± CI95	40.0 ± 7.37	45.0 ± 5.68	

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P-value: calculated with two-sample t-test.
CI95: 95% confidence interval.

Table 5: Comparison between the two studied groups according to hospital stay.

Hospital stay (day)	Group I Without dilatation (n = 60)	Group II With dilatation (n = 60)	p-value
Range	1-4	2-4	
Mean ± SD	2.3 ± 1.6	3 ± 1.3	0.010*
Mean ± CI95	2.3 ± 0.4	3 ± 0.3	
P-value: calculated with two-sample t-test.			
CI95: 95% confidence interval. * Significant difference.			

Table 6: Comparison between the two studied groups according to the outcome.

	Without dilatation (n = 60)	With dilatation (n = 60)	X^2 p-value *
Stone free	28 (46.7%)	42 (70.0%)	0.016
Fragmented in situ	12 (20.0%)	8 (13.3%)	0.462
Failed	20 (33.3%)	10 (16.7%)	0.058
* Chi square test p-value for comparing the two study groups.			

Table 7: Comparison between complications occurred in both groups.

	Without dilatation (Group I)	With dilatation (Group II)	X^2 p-value *
Pain	12 (20%)	14 (23%)	0.825
Fever	12 (20%)	16 (26%)	0.517
Haematuria	10 (16%)	14 (23%)	0.494
False passage and mucosal abrasion	40 (66%)	28 (46%)	0.043
* Chi square test p-value for comparing the two study groups.			

Table 8: Complication of Dormia basket.

	Without dilatation	With dilatation	Fisher p-value*
Broken Basket	-	2 (3.3%)	0.496
Retained Basket	4 (6.6%)	2 (3.3%)	0.679
Avulsion of Ureter	2 (3.3%)	-	0.496
* Fisher exact test p-value for comparing the two study groups.			

4. DISCUSSION

In our research, the stone was broken into pieces. Removed using a pneumatic lithotripter along with a Dormia basket or forceps. In 70 cases, which made up 58.3% of the total the stones were completely removed after being fragmented with a lithotripter. This included 28 cases in-group I and 42 cases in-group II. In 20 cases, which was 16.6% of the total the stones were only partially removed, meaning the fragmentation stayed in place. Of these 20 instances, 12 were in-group I and 8 were in-group II. In these cases, no major fragments were retrieved using the Dormia basket after using both endoscopic and fluoroscopic methods. In 30 cases, the stone removal failed completely. This included 20 cases in-group I and 10 in-group II. Dormia baskets were used in 114 cases with 56 in-group I and 58 in-group II. Ureteric forceps were used in 6 cases with 4 in-group I and 2 in-group II. As a result, the overall stone clearance rate after ureteroscopy in this study was 46.7% for group I and 70% for group II. The difference was statistically significant with a p-value of 0.016. In a 2004 study by Cecchetti et al. [5] 309 Patients underwent ureterolithotripsy without dilating the ureteral orifice or the intramural ureter. Among these 262 cases or 84.8% had stone removal. There were 16 cases or 5.2%, where the removal was incomplete. In 31 cases or 10%, the procedure was unsuccessful. The study concluded that using balloon dilation on the orifice and the intramural ureter, before placing a rigid ureteroscope helped reduce late complications linked to transurethral ureterolithotripsy. Today various intracorporeal lithotripters are available. No single device works perfectly in every situation. The method of treatment and the choice of technique depend on what equipment is available the financial resources and the experience level of the surgeon. The Swiss lithoclast, created in Lausanne, Switzerland, shatters the stones through oscillatory movements of a metal probe similar to a jackhammer (Cecchetti et al. [5]). Two primary issues

associated with pneumatic lithotripsy include retrograde movement of the stone or its fragments [6] and diminished lithotripsy effectiveness with considerable deflection of the probe [7]. Nevertheless, there are no thermal or cavitation effects on the tissue, and brief energy bursts lead only to superficial erosion or edema, thereby minimizing the risk of tissue damage. Extended firing directly on the mucosa may lead to ureteral perforation. The lithotripter efficiently breaks down every kind of stone, and there are also smaller, more adaptable probes accessible. No indications of long-lasting complications, fibrosis, or stricture associated with its use have been discovered [8]. The pneumatic lithotripter is cost-effective and has a short learning curve. In this study, a 7 Fr balloon dilator (Bard Co. USA) featuring a 10 cm balloon length was cystoscopically inserted into the ureter via the guide wire. The balloon was then inflated to 15F size with saline using a 10ml disposable syringe. In this research, we utilized a 9.5 rigid ureteroscope, which is narrower than the 11.5 Fr ureteroscope used by Katoh et al. [9] In a separate investigation conducted by Ziaee and colleagues [11], the stone-free (SF) rates for stones measuring 10-15 mm in the ESWL and ureteroscopy categories were discovered to be 72.5% and 78.6%, respectively. In a study involving 500 patients conducted by Sozen and colleagues [12], the stone-free rates after ureteroscopy using pneumatic lithotripsy were reported to be 90.9% for stones measuring 1 cm and 71.4% for stones smaller than 1 cm. In our research, ureteral mucosal abrasions happened in 34 instances, with 20 occurring in-group I and 14 instances in-group II. Twenty-eight of them were treated conservatively using JJ stents, while the remaining six cases were handled with ureteric catheter insertion. In one instance within group I, ureteral avulsion happened while stones were being manipulated with a Dormia basket. This case was succeeded by investigation and subsequently nephrectomy. A second ureteroscopy was required in 6 instances to remove large stone fragments and achieve stone-free status. Two belonged to group II and four were from group I. One was from group II and two from group I. Fever developed in 14 cases following ureteroscopy; one of these had hydronephrosis and was treated conservatively with intravenous antibiotics, antipyretics, and IV fluids. Group I had six patients (20%), while group II consisted of eight patients (26%). Urine culture was performed, and antibiotic therapy was administered accordingly; the fever decreased within 3 days. Haematuria occurred in 12 patients (39%), persisted for less than 48 hours, and was managed conservatively. To prevent these intraoperative complications, it is essential that pressure is never exerted against any resistance; the ureteral lumen must be visible when advancing the ureteroscope, and guide-wires should be utilized for safely navigating curves, vessels, and kinks. In the research conducted by Razaghi and colleagues [13], upward migration was observed in 14.3% (8/56) of the lithoclast cohort, whereas it was absent in the holmium: YAG cohort. They examined 112 patients with ureteral stones larger than 1 cm, randomly assigning them to undergo pneumatic or holmium: YAG laser transurethral ureterolithotripsy, with 56 patients in each group. The pneumatic group had a success rate of 85.7%, while the holmium: YAG laser group achieved a 100% success rate ($p = 0.003$). In our study, we utilized a 1-mm pneumatic lithoclast probe that matched the size of the ureteroscope (Swiss lithoclast), employing ballistic energy at a frequency of 12 Hz. Through direct contact of the probe with the calculus, the stone was shattered using a single- or multiple-shot mode until it was broken down into smaller pieces that could be expelled naturally or removed visually with a Dormia basket. Fluoroscopic guidance was utilized throughout the entire procedure. In a recent investigation, Dongol et al. [14] managed 110 patients with ureteral stones utilizing pneumatic lithotripsy along with an 8/9.8 Fr semi-rigid ureteroscope. Stones were broken into 2-3mm fragments and discarded. The total stone-free (SF) rate after 3 months of follow-up was 69.33%. In total, the rate of minor complications was 5.45%, which included five cases of minor ureteral perforations and one case of urinoma formation. The average operation duration was 50± 12.7 minutes (ranging from 13 to 105 minutes). Intramural dilation was performed on 15 patients using sequential ureteral dilators because of narrow vesicoureteral junctions. Proximal movement of stones toward the kidney was observed in 8 patients who underwent JJ stenting and were treated with ESWL.The re-treatment rate following ureteroscopic stone procedures varied between 2 and 4.5% across various studies [15,16]. Re-treatment enhances the overall success rate. In our research, a repeat ureteroscopy was required in six instances (5%) to remove large stone fragments and achieve a stone-free condition. Four of these belonged to group II, while two were in-group I. The main motivation for routinely placing a stent after ureteroscopy, to prevent ureteral obstruction caused by ureteral edema and stone fragments, has typically been seen as the standard of care. Technological improvements such as the miniaturization of ureteroscopes and the development of softer stone baskets have made ureteroscopy less traumatic, with most complications following the procedure stemming from ureteral stent placement. In addition, stents increase patient care expenses and necessitate another cystoscopy for removal unless a pull string is utilized. Minimizing stent use after ureteroscopy is expected to enhance patient care and satisfaction. The time taken for the procedure with ureteroscopy and intracorporeal lithotripsy noted by Rasool and associates [1] ranged from 25 minutes to 95 minutes. Additional research has indicated procedural durations ranging from 10 minutes to 180 minutes for the same procedure, influenced by the size of the stone and its location. In this research, the average duration of work was 40 minutes (from 20 to 145 minutes) for group I, and 45 minutes (from 25 to 115 minutes) for group II. There was no statistically significant difference in mean working time between the two groups (40 min. for group I compared to 45 min. for group II) ($p=0.285$), suggesting that balloon ureteral dilation did not significantly extend the working time. Patients undergoing ureteroscopic lithotripsy for ureteral stones experience reduced hospital stays. In our research, patients were released between one to four days post-procedure, with a mean of 2.3 days for group I and a mean of 3 days for group II. In contrast, the hospital duration in other studies was 2.4 days according to Ullah et al. [15], 24 to 72 hours as reported by Sharma et al. [17], and 4-7 days in Slivinski's et al. [18]. Ureteroscopic lithotripsy is a safe, straightforward, and effective method for treating ureteral stones. However, complications of the procedure may prolong the usual 48 hours hospital stay seen in uncomplicated cases [19].

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5. CONCLUSION

Pre-ureteroscopic dilatation of ureteric orifice is not routinely necessary for ureteroscopic stone extraction, and can be limited only for cases with stenotic ureteral orifice, or impacted stone.

Declarations

Institutional Review Board Statement:

The study was conducted in accordance with the Declaration of Helsinki and applicable institutional and regulatory requirements. The study protocol was reviewed and approved by the Institutional Review Board of Burjeel Hospitals, UAE (approval no. BURJ/RERC/2024/67).

Conflict of Interest Statement:

The authors have no conflicts of interest to declare.

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Author Contributions:

KK, MA, TA: manuscript preparation, protocol, data collection and management, manuscript editing. OM, AI, MM: Data acquisition, data analysis and management, manuscript editing. YM, MH, OI, MA: Manuscript editing, project development, data analysis, and project development. All the authors have read and approved the manuscript.

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