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ORIGINAL ARTICLE

Management of Calculus Anuria Using Ureteroscopic Lithotripsy as a First Line Treatment: Its Efficacy and Safety

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ABSTRACT

Purpose: To present our experience with emergency ureteroscopic lithotripsy (URSL) on ureteral stones related with acute kidney injury (AKI).

Place and Duration: In the Department of Urology for three years duration from January 2019 to January 2020.

Material and methods: We retrospectively analysed 27 patients consisting of 54 ureteral units (UU) undergoing URSL. There were 9 females and 18 males with M: F of 2:1 The anuria cause was bilateral obstruction with calculi in 21 cases, and unilateral obstruction with calculi in 33 cases with contralateral nephrectomy. In the same session, bilateral ureteroscopy was performed for bilateral synchronous ureteral stones. The anuria duration ranged from 12hours to 3-days. After the procedure, all patients ureteral stent were systematically removed. The operation was accomplished 6-12 hours afterward hospitalization. After surgery; all individuals were followed for minimum one-month.

Results: A total of 27 urgent URSL were performed in 9 (33.3%) females and 18 (66.7%) males with an average age of 51 (range 32 to 73). Percutaneous nephrostomy was performed in 2 (7.4%) patients and in 2 (9.5%) patients with bilateral stones, the ureteral units (UU), severely wedged distal hard stones. These patients were candidates for open surgery, ureterolithotomy, 6 to 8 weeks afterward the initial intervention (PCN+ URSL). The improvements in renal function as demonstrated by post-obstruction diuresis and serum creatinine were compared in the two groups of patients using the Fisher's exact test. In 20 (71.1%) patients, URSL proved to be an effective therapeutic approach for obstruction removal and stone removal. Repeat surgery was required in 3 (11.1%). In 3 (11.1%) patients, URSL caused significant damage to the mucosa with a guide wire in the area of the damaged ureteral calculus. Ureteral stenting was sufficient to treat this complication. Stone or fragment migration was observed in 5 (18.5%) patients, all of which were in the upper stone position, and this procedure was the main reason of failure. In the first 24 hours, mild macroscopic haematuria was detected which did not require treatment. Postoperatively, 6 (22.2%) patients had high fever. Body temperature reversed back to usual within four days after getting the high dose and intravenous injection of a third-generation cephalosporin antibiotic (ureteral stent culture for Escherichia coli and positive urine culture).

Conclusion: Calculus anuria is a therapeutic emergency that necessitates timely analysis and decompression management. URSL is the appropriate technique for designated patients and can be accomplished securely and has a high achievement rate with insignificant incidence of morbidity.

Key words: Ureteral stones, ureteroscopy; surgery; kidneys, anuria, abnormalities; outcome and treatment.

INTRODUCTION

Renal colic is one of the most common urological emergencies and requires appropriate examination and careful personalized management depending on the patient's condition[1-2]. About 95% is caused by the migration of stones. It poses a serious health problem, according to an estimated risk of recurrence in approximately 50% of patients 5 years after the first attack[3]. In general, the main goal of treating renal colic is to minimize the patient's symptoms with appropriate drug therapy and to facilitate stone passage where possible when there is no indication for surgical intervention. Taking into account the drainage of the kidneys depending on the patient's condition, the most common endourological method is the insertion of a ureteral catheter or nephrostomy tube[4]. After the patient has fully recovered, stone removal is performed. One of the most difficult urological emergencies requiring urgent surgical treatment is acute renal failure due to obstruction of stones. Acute kidney failure is a condition in which the glomerular filtration rate changes rapidly, which is related with increased levels of urea nitrogen and creatinine in the blood[5-6]. In this situation, a very fragile segment of the population consists of patients with a single surgical or functional kidney who require urgent hospitalization. Overall, most surgeons prefer minimally invasive therapy to drain the kidneys, such as minimal percutaneous nephrostomy or ureteral stenting, but advanced technology opens up new possibilities for the ultimate treatment of ureteral stones at first presentation[7-8]. The lack of a septic condition of the patient, assessed by whole blood tests and imaging tests, makes it possible to attempt ureteroscopy and remove stones from the very first application. Ureteroscopic lithotripsy is the most commonly used procedure for ureteral stones and is appreciated by most surgeons as safe and effective[9-10]. Advanced techniques have made it possible to use advanced endoscopic

instruments which have significantly reduced the complication rate and offer a high success rate. An increasing number of studies are evaluating, describing and discussing the use of ureteroscopy as the 1st line endourology technique for ureteral stones[11]. Patients with a solitary kidney can take advantage of today's benefits to become stone-free faster and maintain normal kidney function without losing viable nephrons. Ureteroscopy solves the symptomatic problem with pain relief, provides stone fragmentation and ensures adequate renal drainage with minimal complications, and may even be used in selected cases in patients with solitary kidney[12]. Ureteroscopic lithotripsy (URSL) is the 1st line management of ureteral stones for bilateral synchronous ureteral stones, with options being an incremental or synchronous procedure of URSL[13]. Bilateral same-session ureteroscopy (SSBU) can shorten the total time of surgery and hospital stay, avoid multiple surgeries and anesthesia, and minimize recovery time and complications, provided the surgeon has sufficient experience with endoscopic procedures[12-13]. Günlüsoy et al. testified that bilateral pneumatic lithotripsy can be securely used in one session and has augmented achievement rate with less morbidity and a short stay in hospital[14].

The aim of this study is to present our experience with emergency ureteroscopic lithotripsy (URSL) on ureteral stones related with acute kidney injury (AKI).

MATERIALS AND METHODS

This retrospective analysis was performed at the Department of Urology for three years duration from January 2019 to January 2020. 27 patients clinically presented with urolithiasis and acute anuria were urgently treated with SSBU or URSL. There were 18 males and 9 females with M: F of 2:1 The anuria cause was bilateral obstruction with calculi in 21 cases, and unilateral obstruction with calculi in 33 cases with contralateral nephrectomy. In retrospect, patients are grouped by anuria duration. Group A comprised subjects with anuria for up to 48 hours and patients in Group B with anuria for more than 48 hours. The 2 groups were related in rapports of postoperative renal function recovery on the 7th postoperative day. The renal function recovery based on the amount of serum creatinine concentration and post-obstructive diuresis. Therefore, we compared the relationship between immediate URSL and the anuria duration after successful obstruction relief and early postoperative restoration of renal function using Fisher's exact test. The URSL initially started on the side where the size of the stone was small in size. All interferences were performed under general or regional anesthesia using the single-channel semi-rigid ureteroscope (Ch).

The subjects were immediately hospitalized. On admission, a detailed history of pain, diuresis, fever, haematuria, as well as the duration and symptoms of uremia was recorded. Urine output in the range of 0-100 ml / 24 hours was considered anuria. A systemic inspection with a general physical examination and specific orientation to the genitourinary system was accomplished, and positive results were reported. The studies comprised a comprehensive haematological examination, serum creatinine, blood urea, potassium levels and serum electrolytes. In all cases, ultrasound (US) and regular abdominal radiography were performed to assess the location, number and size of stones, echogenicity, the grade of hydronephrosis (UHN), the renal cortex thickness and the presence of a single kidney. Before the procedure (45 minutes), patients were administered a single intravenous antibiotics shot (cephalosporins or fluoroquinolones), which were then sustained during hospitalization. It was possible to access the URS in all cases without the need to dilate the opening of the ureter. At the procedure completion, an endoscopic examination was performed to exclude stone residues larger than 2 mm or damage to the ureter. Surgery duration was calculated from the time the ureteroscope was introduced into the urethra until the endoscope was finally withdrawn. The distal and proximal stones in ureter were distinct as stones below and above the pelvic margin, correspondingly, as recommended by Hollenback et al. All patients will routinely receive a Pigtail 6 Fr ureteral polyurethane stent or a 6 Ch ureteral probe. Postoperative ureteral probes removed at 1-5. days (mean 2.4). The choice to replace the ureteral stent was based on intraoperative and clinical features such as the duration of anuria, stone size and number, stone density, stone-free status in the first days after surgery, mucosal edema, urine volume, and laboratory tests. After 2 to 4 weeks; removal of Double J ureteral stents (DJ) were done under local anesthesia. All patients were evaluated by assessing daily diuresis, plasma urea, serum creatinine and potassium until normal or satisfactory levels were attained after surgery. As confirmation of the AKRI, we used a serum creatinine reduction of ≥33% after the intervention. On the first postoperative day, a flat abdominal radiograph and ultrasound were performed (in order to assess the initial value of the stone and confirm the correct positioning of the stent) and at follow-up visits (after 2-4 weeks).

In order to determine the success criteria (endoscopically defined intraoperative success), we determined stone-free rate (SFR) and stone diameters ≤ 2 mm. Remaining fragments smaller than 2mm not removed because they could pass through them, but the largest fragments were removed with a stone grasper or Dormia sound. Postoperative success (general condition without stones) was determined by the absence of stone fragments larger than 2 mm in diameter on the preliminary follow-up radiograph. The postoperative and intraoperative complications related to the procedure were reported and recorded according to the Clavien-Dindo classification of surgical complications. All patients gave written informed consent prior to participation, and then ureteroscopy was performed.

RESULTS

A total of 27 urgent URSL were performed in 18 (66.7%) men and 9 (33.3%) women with an average age of 51 (range 32 to 73). Percutaneous nephrostomy was performed in 2 (7.4%) patients and in 2 (9.5%) patients with bilateral stones, the ureteral units (UU), severely wedged distal hard stones. These patients were candidates for open surgery, ureterolithotomy, 6 to 8 weeks after the primary intervention (PCN+ URSL). The duration of anuria varies from 1 to 4 days. During the procedure, we did not

observe any case of pyuria. The stone burden was determined by measuring the maximum size of the stone. In the case of more than one stone, these dimensions add up. The clinical characteristics and characteristics of the stones in our study population are presented in Table 1.

The percentages without stones were classified according to the location of the stones in Table 2. The migration of the stones (push-back) to the kidney occurred in 4 UU patients, 3 UU patients with unilateral obstruction, and in 1 UU patient with bilateral obstruction, DJ stents with bilateral obstruction remained in these ureters during manipulation of upper ureter stones. Extracorporeal shock wave lithotripsy (SWL) was applied to migrating stones 6-12 days after URSL, after serum creatinine returned to normal.

In Table 4, patients are grouped by duration of anuria (up to 48 hours and over 48 hours). The improvements in renal function as demonstrated by post-obstruction diuresis and serum creatinine were compared in the two groups of patients using the Fisher's exact test.

In 20 (71.1%) patients, URSL proved to be an effective therapeutic approach for obstruction removal and stone removal. Treatment modalities related to UU are presented in Table 5.

Repeat surgery was required in 3 (11.1%). A classification (modified Clavien system) for the assessment of perioperative complications was proposed (Table 6).

In 3 (11.1%) patients, URSL caused significant damage to the mucosa with a guide wire in the area of the damaged ureteral calculus. Ureteral stenting was sufficient to treat this complication. Stone or fragment migration was observed in 5 (18.5%) patients, all of which were in the upper stone position, and this procedure was the main reason of failure. In the first 24 hours, mild macroscopic haematuria was detected which did not require treatment. Postoperatively, 6 (22.2%) patients had high fever. Body temperature reversed back to usual within four days after getting the high dose and intravenous injection of a third-generation cephalosporin antibiotic (ureteral stent culture for Escherichia coli and positive urine culture). The most common complication was post-operative "pain" (renal colic), forced rehospitalisation in 5 patients (18.5%) with solitary kidney.

Table 1. Clinical and stone characteristics of study population.	
Variables	
Anuria < 100 mL/24-hour, no. (%) 4 (14.8) Duration, no. (%)	
48-hour	18 (66.7)
72-hour	5 (18.5)
Hydronephrosis, no. (%) Grade-I	8 (29.7)
Grade-II	13 (48.1)
Grade-III	6 (22.2)
Level of serum creatinine (µmol/L)	488 (range, 190-750)
Level of blood urea (mmol/L)	26 (range,12-40)
Plasma potassium level (mmol/L)	5.8 (range 5.1- 6.2)
Stone size (mm) Overall	8 (4-14)
< 10 mm	38 (70.4%)
>10 mm	16 (29.6%)
Stone number, no. (%) Solitary	40 (74.1)
Multiple	14 (25.9)
Stone opacity (%) Radiolucent	9
Radiopaque	45
Localization, no. (%) Distal ureter	44 (81.5)
Proximal ureter	10 (18.5)
Surgery time (hour)	6-12
Mean time of surgery(min)	33 (range, 20-60)
Mean stay in hospital (day)	5.2 (3-13)
Grasper/ Basket / forceps use (per ureteral unit)	34 (62.9%)

Table 2. Stone-free rates as function of stone location.				
Stone Free Rate Ureteral Units	Stone Localization			Stone Size
----- -----	Proximal n = 10	Distal n = 44	< 10 mm n = 38	> 10 mm n = 16
Postoperatively 37 (68.5)	6 (60)	33 (75)	30 (78.9)	6 (37.5)
Overall, 30 days after operation 44 (81.4)	4 (40)	11 (25)	7 (18.4)	9 (62.5)

Postoperative observations of patients are presented in Table 3.

Table 3. Postoperative monitoring of study population.				
Monitoring	POD 1	POD 3	POD 7	POD 10
Ultrasonography	+	+	Distal n = 44	< 10 mm n = 38
Plain abdominal film	+		38 (86.3)	34 (89.5)
Post obstructive diuresis Range, 2400-8300 mL/24-hour	+	-----	40 (90.9)	36 (94.7)
Laboratory analysis				
Mean complete blood count	+	+	+	-----
Serum creatinine	+	+	+	+
Blood urea	+	-----	+	+
Plasma potassium	+		+	+
Urine from ureteral stent for UC	+		-----	-----

Table 4. Indicators of renal function recovery on the 7th post-operative day in relative to time of anuria preceding to admission.

Variables	Group A	Group B	*P*
Diuresis < 2500 mL/24-hour	14	2	.0008
≥ 2500 mL/24-hour	6	5	
Serum creatinine (μmol/L) 50-110	11	3	.0001
≥110	9	4	

Table 5. Treatment type in relative to ureteral units.

Treatment Type	Ureteral Units, no. (%)
Ureteral stent + URSL	42 (77.8)
DJ stent + URSL + SWL	11 (20.3)
URSL + OP+ PCN	1 (1.9)

Table 6. Complications classified conferring to the modified Clavien system.

CCS Grade	Patients-Ureteral Units no. (%)	
	Grade 1	
Stone/fragment migration		5 (18.5)-6 (22.2)
Mucosal laceration		3 (11.11)-5 (5.6)
Fever		6 (22.2)
Hematuria		4 (14.8)
Renal colic		5 (18.5)
	Grade 2	
Pyelonephritis		1 (3.7)
Urinary tract infection		2 (7.1)
	Grade 3	
Stent migration		1 (3.7)

DISCUSSION

Acute renal failure is one of the most important emergencies that require prompt diagnosis to determine the cause and appropriate treatment by healthcare providers[11-12]. Among the human organs, the ability of the kidneys to heal almost completely is remarkable. Urologists often face non-renal causes of acute renal failure[13]. Treatment of migratory ureteral stones is very difficult as recovery of renal function depends on the duration of the obstruction. Some early studies have shown that the human kidney is able to restore its function after more than 69 days of congestion. Currently, advanced technologies make it possible to quickly intervene in the event of clogged kidneys and quickly restore normal functioning[14]. A common approach is percutaneous nephrostomy or placement of a ureteral stent to drain the kidneys. Improvements in the design of ureteroscopes, lithotripter and stone removal devices increased the success rate of the stone-free condition and reduced the number of associated complications[15]. In most patients, renal colic is first treated in a conservatory with adequate medications and hydration until the stone is removed. In complicated renal colic accompanied by fever or diagnosed oliguria, surgical treatment with a minimally invasive approach should be considered as soon as possible. The American and European Urological Societies state in their guidelines 97% of patients without stones after ureteroscopy. By comparison, the success rate in this retrospective study was 97.67%, which represents a high percentage of complete removal with no serious complications. It can be concluded that ureteroscopy as a first-line therapy, even in patients with a single kidney, may be a viable alternative to the placement of a double J stent or nephrostomy tube in selected cases[16-17]. In a similar study, Isen K and Utku V reported their results in 21 patients with stone length less than 10 mm and a stone-free percentage of 95.4%[18-19]. They used only pneumatic lithotripter for distal ureteral stones. There may be an advantage in lower costs associated with good results. The fabrication of larger parts and retropulsion's can be significant disadvantages of using only compressed air lithotripter. In this study, ultrasonic sonotrodes were preferred for proximal ureteral stones[20-21]. Nevertheless, serum pressure determined migration in one case of binding stones. In this case, the JJ stent was placed and combined with extracorporeal shockwave lithotripsy. Forceps and baskets may be used to remove the lithotripsy fragment, as some other authors have suggested in their work. The use of stone forceps may damage the mucosa. There was no significant difference with the descaling tool used in this study. Some authors suggest that YAG laser lithotripsy can be successfully used with a high success rate in proximal and distal buried stones. Fragmentation laser ureteroscopy does not appear to impact emergency efficacy[22]. However, the cost containment makes this procedure difficult to use on a daily basis.

For safety reasons, all patients in this study received a ureteral stent for 3 weeks pending re-evaluation. Serum creatinine, blood urea nitrogen, and CT KUB plain were done in the evaluation program whenever possible. After kidney function had been restored to normal, the stents were removed under cystoscopy. Mild complications related to the Double J stent have been reported, including lower urinary tract symptoms, bleeding and pain in the flank region[23].

Associated symptoms were reduced by normal hydration and training of patients to avoid full bladder filling. Some studies indicate that routine stent placement can be avoided in uncomplicated ureteroscopy with ureteral stones. One of the most dangerous conditions in the development of acute renal failure is hyperkalemia. The presence of severe hyperkalaemia may be an indication for hemodialysis. Indications for urgent preoperative dialysis include volume overload, pericarditis, metabolic acidosis, severe hyperkalemia, and uremic symptoms. Advances in technology and surgical skills have greatly reduced complications after ureteroscopy in recent years, and more and more studies are offering ureteroscopy as the first-line treatment for ureteral stones[24]. Recent studies have estimated the risk of ureteral perforation in patients with both kidneys to be 0-4%. Ureteroscopy of ureteral stones seems to be an important alternative with minimal incidence and good results in selected cases. The position of the stone may affect the results of the operation. Better outcomes and fewer postoperative complications were observed in the percentage of people without stones for stones in the pelvic position. Our analysis shows that the success of the procedure also depends on the experience of the surgeon and it is recommended to be performed in centers with extensive experience. For safety reasons, the need for a double J stent, hospital stay, and stent removal in patients with solitary kidney and acute renal failure may differ from the same procedure performed in healthy people[25]. The ultrasonic sonotrode and pneumatic lithotrites have shown good results in combination with the use of ureteral forceps for larger components. The holm

laser may be more effective, but its cost does not suggest that it is a standard everyday use technique.

CONCLUSION

The presented results indicate that emergency ureteroscopic lithotripsy is the method of choice in patients with nephrolithiasis and anuria. The reason for this conclusion is that the method preserves renal function obtained by controlled obstruction relief with rapid diuresis, provides a high percentage of stone-free patients with distal stone location, and is low in number. relatively mild cases. postoperative complications. The question is whether routine stenting is indicated after surgery.

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