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Emergency ureteroscopic lithotripsy in acute renal colic caused by ureteral calculi: a retrospective study

Mohammed A. Al-Ghazo · Ibrahim Fathi Ghalayini · Rami S. Al-Azab · Osamah Bani Hani · Ibrahim Bani-Hani · Mohammad AbuHarfil · Yazan Haddad

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Abstract This work was conducted to evaluate the safety and efficacy of emergency ureteroscopic lithotripsy in patients with ureteral stones. From May 2003 to December 2010, 244 patients (184 men and 60 women, mean age 45.6 ± 12.7 years (range 22–73 years) were treated with emergency ureteroscopic lithotripsy for ureteral calculi. All patients were divided into three groups according to the stone location in the ureter. Intracorporeal lithotripsy when necessary was performed with the Swiss lithoclast. The overall stone-free status was defined as the complete absence of stone fragments at 4 weeks, postoperatively. A double J stent was inserted in selected patients if there was significant ureteral wall trauma, edema at the stone impaction site, suspected or proved ureteral perforation, and if the stone migrated to the kidney. The overall success rate was 90.6%. The success rates were different according to the stone site. The success rate of groups A, B and C was 69.4, 94.8 and 96.6%, respectively. The overall rate of ureteral stent insertion at the end of the procedure was 177/244 (72.5%). The rate of stent insertion was 41/49 (83.7%), 32/46 (69.6%) and 104/149 (69.8%) in groups A, B and C, respectively. The overall complication, failure, and stricture rate was 32/244 (13.1%), 23/244 (9.4%) and 0.8%, respectively. With the recent advances in ureteroscopic technology, intracorporeal probes and stone extraction devices, emergency ureteroscopy is found to be a safe and effective procedure with immediate relief from ureteral colic and ureteral stone fragmentation.

Keywords Ureteroscopy · Ureteral stones · Ureteral colic · Ureter · Emergency

M. A. Al-Ghazo (✉) · I. F. Ghalayini · R. S. Al-Azab · O. Bani Hani · I. Bani-Hani · M. AbuHarfil
Department of General Surgery and Urology, Faculty of Medicine, Jordan University of Science and Technology, PO Box 3030, Irbid 22110, Jordan
e-mail: alghazo@just.edu.jo

Y. Haddad
Faculty of Applied Medical Sciences, King Abdullah University Hospital, Jordan University of Science and Technology, Irbid, Jordan

Introduction

Over the past several decades, there has been a significant increase in the prevalence of nephrolithiasis in the general population; the lifetime risk for the disease is reported to be between 10 and 15% in the United States [1]. Acute renal colic is a common disorder observed in the emergency room. It is usually described as acute flank pain radiating to the groin and it is often caused by ureteral stones [2]. During recent years, unenhanced helical computed tomography has been introduced as a quick and contrast-free alternative to intravenous urography used in patients with acute flank pain [3]. The introduction of extracorporeal shock wave lithotripsy (ESWL) and ureteroscopic stone extraction or disintegration (URS) for stones in the ureter has made open surgery unusual and, in the majority of cases, unnecessary [4].

There are reports of stone-free rates above 90% in the treatment of ureteral stones with both modalities, ESWL and URS [5]. The first step in the treatment of acute renal colic caused by obstructing ureteral stones is medical relief from symptoms. When a drug therapy does not resolve the symptoms, the placement of a ureteral catheter or a nephrostomy tube is the next step [6]. These simple procedures can provide a prompt relief from symptoms and they are usually followed by URS or ESWL, which currently

represents the main options in the treatment of symptomatic ureteral stones [7].

There is today a general consensus on the superiority of the minimally invasive therapeutic procedures, but there is a debate on whether ESWL or URS should be the first line treatment for patients with ureteral stones. The definite preference must be based on the knowledge of advantages ad disadvantages of these procedures. ESWL is a non-invasive procedure and does not need general or regional anesthesia, it needs only analgesia or sedation, The main disadvantage of ESWL is that repeated treatment is needed frequently in many patients. However, in URS, repeated treatment is needed less frequently, general or regional anesthesia is always needed, and URS might be associated with a higher risk of complications.

The recent technical development of small caliber semirigid and flexible deflectable ureteroscopes and the development of diminutive intracorporeal lithotripsy probes have made the retrograde access to urinary calculi throughout the entire ureter a more feasible and low-risk technique [8].

Similar to ESWL, emergency URS can result in both stone disintegration and relief from colic pain [9]. However, there are few published data regarding emergency ureteroscopic management of ureteral colic due to ureteral stones.

In this study, we represent our experience in the emergency ureteroscopic management of acute renal colic caused by ureteral stones.

Patients and methods

From May 2003 to December 2010, 244 patients (184 men and 60 women; mean age 45.6 ± 12.7 years; range 22–73 years) were treated with emergency ureteroscopic lithotripsy for ureteral calculi (within 24 h of admission to the emergency room) at King Abdullah University Hospital. Medical records of these patients were available for analysis in this retrospective study. All the patients provided an informed consent before the procedure. Inclusion criteria included acute renal colic resistant to medical therapy, no evidence of urinary tract infection, no acute renal failure, patient presented to the emergency room for the first time, and stone size above 7 mm. Children, pregnant women, and patients with radiolucent stones were excluded. All patients were divided into three groups according to the stone location in the ureter; group A consisted of patients with upper ureteral stones ($n = 49$), group B consisted of patients with stones in the midureter ($n = 46$), and group C consisted of patients with lower ureteral stones ($n = 149$). All patients underwent imaging studies (plain X-ray, ultrasonography, non-enhanced computed tomography (CT scan), or intravenous urography) to evaluate the stone size and location. Proximal and distal ureteral stones were defined as those above and below the pelvic brim, as suggested by Hollenback et al. [10], while midureteral stones were located over the sacral bone. URS was performed under general or spinal anesthesia with a 7.5 Fr semirigid ureteroscope (Wolf) or 8 Fr (Karl Storz Endoskope, Tuttlingen, Germany) with the aid of fluoroscopy.

Intracorporeal lithotripsy when necessary was performed with the Swiss lithoclast (EMS Medical, Nyon, Switzerland). Stone fragments were removed with stone graspers, although small fragments (<3 mm) were left to pass spontaneously. At the end of the procedure, a ureteral catheter was inserted in 7 patients in group A, 4 patients in group B, and 12 patients in group C, with multiple small stone fragments (<3 mm) and the catheter was removed within 24 h. A double J stent was inserted if there was a significant ureteral wall trauma, edema at the stone impaction site, suspected or proved ureteral perforation, and if the stone migrated to the kidney. Before discharge, a plain X-ray was done for all patients to assess the initial stone-free status (stone fragments <3 mm were considered successful treatment) and, for those with a double J stent in place to confirm the correct stent position. The overall stone-free status was defined as the complete absence of stone fragments at 4 weeks, postoperatively.

The Chi-square test, Kruskal–Wallis and Fisher's exact test were used to compare parameters between the different groups. $P < 0.05$ was considered statistically significant. Statistical analysis was performed with computer software (Statistical Package for the Social Sciences, version 16.0).

Results

Table 1 shows that ureteral stones were more frequently localized in the distal ureter (149) than in the midureter (46) or in the proximal ureter (49). There were no significant differences regarding age and gender (P value 0.57 and 0.21, respectively) between the three groups. The overall success rate at 4 weeks postoperatively was 90.6%. The success rates were different according to the stone site. The success rate of groups A, B and C was 69.4, 94.8 and 96.6%, respectively. The success rate of group A was statistically significant and lower than that of groups B and C ($P < 0.001$). The success rate of group B was statistically insignificant when compared with that of group C. The overall stone size was 0.92 ± 0.25 mm (range 7–1.9 mm). No significant difference was found in stone size between groups A, B, and C. A statistically significant outcome was obtained for those patients with stone size 10 mm than for those with stone size >10 mm ($P < 0.001$, Fig. 1). Similarly, more favorable results were found for those with lower ureteral stones than for those with upper or

Table 1 Results and complications according to ureteral stone location

Variables	Group A	Group B	Group C	Total	*P* value
No. of cases	49	46	149	244	
Mean age (range)	44.7 ± 14.9 (25–73)	44.9 ± 13.1 (27–70)	46.1 ± 11.9 (22–73)	45.6 ± 12.7 (22–73)	0.57
Male:female ratio	30/19	41/5	113/36	184/60	0.007
Initial stone-free rate	24/49 (49.0)	37/46 (80.0%)	131/149 (87.9%)	192/244 (78.7%)	0.001
Overall stone-free rate	34/49 (69.4%)	43/46 (95.8)	144/149 (96.6%)	221/244 (90.6%)	0.001
Failure rate	8/49 (16.3%)	4/46 (8.7%)	11/149 (7.4%)	23/244 (9.4%)	0.18
Stent indwelling	41/49 (83.7%)	32/46 (69.6%)	104/149 (69.8%)	177/244 (72.5%)	0.52
Overall complication rate[a]	8/49 (16.3%)	6/46 (13.0%)	18/149 (12.1%)	32/24 4 (13.1%)	0.75
Mean hospital stay in days (range)	2.2 ± 0.9 (1–4)	1.7 ± 0.8 (1–4)	2.1 ± 1.1 (1–5)	1.9 ± 1.2	0.04

[a] Complications included urosepsis, ureteral perforation, ureteral avulsion, gross haematuria lasting >72 h, and false passages

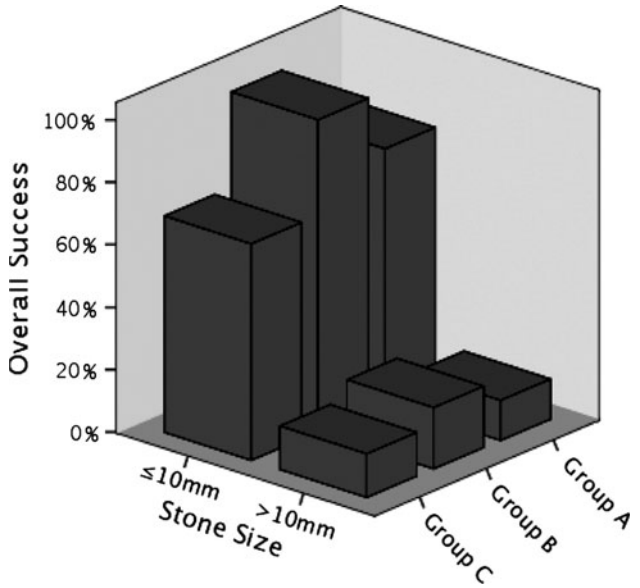

Fig. 1 Success according to stone size and stone location in the ureter. $P < 0.001$

midureteral stones ($P < 0.005$). The success rate in men was lower than in women (88.3 vs. 92.4%), but the difference was statistically insignificant ($P = 0.33$). Residual stones larger than 3 mm were observed in 23 patients at 4 weeks of follow-up; there was failure in 14 cases owing to the stone being pushed back into the kidney, in 7 cases owing to ureteral perforation, and in 2 cases owing to incomplete fragmentation and bleeding in the ureter that impaired vision.

The overall rate of ureteral catheter and double J stent insertion at the end of the procedure was 177 (72.5%). The rate of stent insertion was 41/49 (83.7%), 32/46 (69.6%) and 104/149 (69.8%) in groups A, B and C, respectively (Table 1). The overall failure rate was 23/244 (9.4%). One patient who failed URS lithotripsy was lost to follow-up; 4 patients were stone-free after 3 weeks of medical expulsive therapy; 7 patients needed a second URS for stone removal; the remaining 11 failed patients reached a stone-free status with ESWL (8 patients) and flexible URS with holmium laser (3 patients). The most common complications of emergency URS were ureteral pain requiring analgesics and gross haematuria lasting above 72 h, urosepsis/fever, ureteral perforation, ureteral avulsion, and false passages. Minor perforation was noticed in seven patients, three perforations in group A, two in group B, and two in group C. These perforations were treated by double J stent insertion (4 stent indwelling retrogradely, 2 antegradely percutaneous and 1 stent inserted by combined technique (upper ureteral perforation). We used a combined technique because we were unable to insert the guide wire retrogradely in a female patient, and then we tried percutaneously to insert it antegradely but the guide wire all the time went out through the perforation. We left the wire going through the perforation percutaneously and then we performed ureteroscopy from down until we reached the perforation site, the guide wire was seen going retroperitoneally through the perforation site. It was pulled down by grasping forceps until its end reached the external meatus of the urethra and a double J stent was successfully inserted over the guide wire. In one case, the lower ureter was avulsed by dormia basket and it was treated by reimplantation using psoas hitch technique. Intravenous urography (IVU) was done for these patients 2 weeks after the stent removal (the stent was removed after 4 weeks). There was ureteral stricture in one patient from group B and in one patient from group C. The overall stricture rate was 0.8%. The overall complication rate was 32/244 (13.1%). There was no significant difference in the postoperative complications between the three groups ($P = 0.75$).

Discussion

Currently, there seems to be a shift away from non-invasive ESWL in favor of more invasive ureteroscopic options. The

reasons for this shift are the recent advances in ureteroscopic technology, intracorporeal probes, and extraction devices [11, 12]. The most important advance in endoscopy is miniaturization of the ureteroscope itself. As recently as a decade ago, the diameter of a standard ureteroscope was 11 Fr. The dramatically reduced diameters of modern ureteroscopes have made standard ureteroscopes of 6–8 Fr available.

Consequently, ureteral dilatation is rarely needed when using modern ureteroscopes and reaching the upper ureter or renal pelvis is now a more straightforward, safe procedure than it was with the earlier generation of ureteroscopes. Similarly, stone graspers and other instruments to manipulate the stone are reduced in size. The target of conservative management is to relieve symptoms like colic and pain, and especially, in the case of small stones, to await spontaneous passage.

It is well known that 80% of small ureteral stones (<4 mm) pass spontaneously. To relieve the symptoms (colic and pain, vomiting, a.o.), we use conservative treatment. We use Diclofenac sodium or Tramal as strong analgesics and we use alpha-blockers (Tamsulosin). In this manner, we give the patient the chance of a spontaneous passage of the stone. We usually do not use DJ catheters or nephrostomy in small stones (<4 mm). However, for stones with a diameter >7 mm, the overall chance of spontaneous passage is low [13]. Therefore, in this study, we treat patients only with stones (>7 mm) by URS.

When active treatment of ureteral stones is arranged for, the procedure to choose depends on several factors, including stone size and location, available equipments, patient preference, surgeon experience, and the cost of the procedure.

URS is considered a safe and minimally invasive procedure in the treatment of ureteral stones [11]. The recent advances in ureteroscopic technology, intracorporeal probes, and stone extraction devices have made URS a safe and highly successful procedure, reducing its complication rates [14].

In this series, the overall stone-free rate was 90.6% and increased to 96.6% when only stones in the distal ureter were considered. The overall complication rate was 13.1%, which decreased to 2.5% when only stones $\leq$10 mm in size were considered. These results are consistent with the results in many published series [9, 15–17].

Ureteral stricture was observed as a late complication of URS in two patients (0.8%, one patient in group A and one patient in group B), a rate which is consistent with data in literature [18].

Retrograde stone migration during URS remains a significant problem. Clinical studies published in the 1990s have reported an incidence of 40–50% for ureteral stone migration from the proximal ureter and 5–10% for migration from the distal ureter [19, 20]. According to the recent advances in ureteroscopic technology, intracorporeal probes, and the use of stone cone, the incidence of this problem has decreased.

In the present series, the overall rate of stone migration was 6.3 and 15.8% for upper ureteral stones. Our results are comparable with those results in recently published series [21]. According to the development of flexible URS and Holmium laser for stone disintegration, stone migrating upward could be treated by flexible URS, but unfortunately, flexible URS was available in hospital only 1 year ago. The reported rate of ureteral perforation and avulsion during URS is 0–4% [22]; the rate of ureteral perforation (2.8%) in this study is similar to these values.

The overall failure rate in this series was 9.4%, increasing to 16.3% in the proximal ureteral stones, which are consistent with the reported results [21].

Ureteral stenting after ureteroscopic lithotripsy is a common practice to prevent postoperative complications such as ureteral obstruction. It was reported that uncomplicated URS can be performed without routine stenting with minimal patient discomfort and a low incidence of postoperative complications [23, 24]. It was also reported that patients, in whom a stent was not inserted, were not at increased risk for complications and postoperative symptoms including flank pain after URS compared with those with a stent, and ureteral stenting after uncomplicated URS stone fragmentation was no longer absolutely necessary in all cases [25]. In the present study, ureteral stenting was used in selected cases (72.5%). There was no difference in the incidence of sepsis, ureteral stricture or flank pain between the two groups with and without stents.

As it is clear from the discussion above, the outcome results in our series which are related to emergency URS are comparable with the outcome results from many published series dealing with elective URS or emergency URS stone treatment.

This study has some drawbacks since it is a retrospective one and the number of patients is relatively small. It is noteworthy that a study comparing emergency URS with elective one outcome has never, to the best of our knowledge, been previously published, so in the next study we will address this issue.

Conclusion

With the recent advances in ureteroscopic technology, intracorporeal probes, and stone extraction devices, emergency URS is found to be a safe and effective procedure with immediate relief from acute flank pain and ureteral stone fragmentation. The cost of this procedure should be less than other treatment modalities. This is because of the

low retreatment rate and no necessity for auxiliary procedures before treatment.

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