Emergency Ureteroscopic Management of Ureteral Stones: Why Not?

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OBJECTIVES To describe a single-center experience in the emergency ureteroscopic management of ureteral stones.

METHODS We retrospectively considered the data from 144 patients (mean age 49.6 years, range 23 to 82) who had had obstructive ureteral stones and had undergone emergency ureteroscopy with stone retrieval. Intracorporeal pneumatic lithotripsy was performed when necessary. At the end of the procedure, a ureteral catheter was systematically left in place in 100 patients (69.4%) and removed within 24 hours. In the remaining 44 patients, a double-J stent was preferred and was removed within 30 days, depending on the clinical course. Stone-free status was defined as the complete absence of fragments at 1 month of follow-up.

RESULTS The calculi were more frequently localized in the distal ureter than in the proximal one (90.3% versus 9.7%, respectively). The overall mean stone diameter was 9.1 mm (range 5 to 20). The overall stone-free rate was 92.4%. A greater stone-free rate was obtained in those with stones less than 10 mm (95.8%) than in those with stones larger than 10 mm (89%, $P = 0.002$). Similarly, a significantly better outcome occurred for those with stones located in the distal ureter (94.6%) than for those with stones in the proximal one (71.4%, $P = 0.004$). The overall complication rate was 4.2%. The mean hospital stay was 2.5 days (range 1 to 7).

CONCLUSIONS In our experience, emergency ureteroscopy in cases of obstructive ureteral stones proved to be safe and effective. It has the main advantage of offering both immediate relief from pain and stone fragmentation. Additional extensive studies are warranted to corroborate these findings. UROLOGY 69: 27–33, 2007. © 2007 Elsevier Inc.

Renal colic is often caused by ureteral stones, with most of them located in the distal ureter.[1] When conservative drug therapy does not resolve the symptoms, the placement of a ureteral catheter or nephrostomy tube represents the classic procedure performed for renal colic due to acute ureteral obstruction. These maneuvers can offer a prompt relief from pain for the patient, and they are usually followed by ureteroscopy (URS) or extracorporeal shockwave lithotripsy (ESWL), which currently represents the mainstay of treatment for ureteral stones.[2] Although URS is a more invasive treatment option than ESWL, the success rate of the latter is probably lower, especially for mid and distal ureteral stones.[3,4]

To date, ESWL, as a first-line therapeutic option, applied rapidly after the onset of renal colic, has been given very limited attention. Only two randomized trials have been reported, both with encouraging results, even if most cases were of proximal ureteral stones.[5,6] Emergency ESWL is an attractive proposition, because it can result in both stone disintegration and relief from acute obstruction.

Recently, the miniaturization of ureteroscopes, together with the introduction of the holmium laser, has improved stone-free rates and decreased the complication rates, widening the indications for URS.[7] Similar to ESWL, emergency URS can result in both stone disintegration and relief from colic pain. However, significant data on the ureteroscopic management of ureteral stones in an emergency setting are completely lacking.

We describe our experience in the emergency ureteroscopic management of ureteral stones. The outcome, complications, and supposed advantages of this approach were critically analyzed and compared with other treatment options.

MATERIAL AND METHODS

Study Population

We considered 144 patients (55 men and 89 women, mean age 49.6 years, range 23 to 82) in this retrospective analysis. All had

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Table 1. Operative and perioperative results obtained with emergency ureteroscopy

Variable	Overall (n = 144)	Stone Location			Stone Size		
		Proximal (n = 14)	Distal (n = 130)	*P* Value	<10 mm (n = 71)	>10 mm (n = 73)	*P* Value
Operative time (min)							
Mean	45	49	42	NS	42	50	NS
Range	25–80	35–80	25–65		25–55	30–65	
Lithotripsy (n)	128 (88.8)	12 (85.7)	116 (89.2)	NS	58 (81.6)	70 (95.8)	0.03
Postoperative stent (n)	44 (30.5)	5 (35.7)	39 (30)	NS	26 (36.6)	18 (24.6)	NS
Initial stone-free rate (%)	83.3	64.3	90.7	0.002	91.5	82.1	0.02
Overall stone-free rate (%)	92.4	71.4	94.6	0.008	95.8	89	0.04
Treatment failures (n)	8 (5.5)	3 (21.4)	5 (3.8)	0.006	2 (2.8)	6 (8.2)	0.04
Complications (n)	6 (4.2)	1 (7.1)	5 (3.8)	NS	1 (1.4)	5 (6.8)	0.04

Data in parentheses are percentages.
Treatment failure defined as stone migration, failed ureteroscopic access.
Complications included urosepsis, perinephric hematoma, ureteral lesions.
$P < 0.05$ considered statistically significant.

undergone emergency (within 12 hours of admission to the emergency room) URS at the Santo Antonio General Hospital (Oporto, Portugal) from January 2002 to December 2004. All patients provided written informed consent before the procedure. The indications for active emergency treatment were as follows: acute renal colic proved to be resistant to anti-inflammatory agents, ureteral calculus of up to 20 mm, no evidence of urinary tract infection or acute renal failure, and no more than one previous admission to the emergency room for renal colic. Pregnant women were excluded. All patients underwent radiologic examination (plain x-ray and ultrasonography or unenhanced computed tomography, as necessary) to determine stone location and size. Proximal and distal ureteral stones were defined as those above and below the pelvic brim, respectively, as suggested by Hollenback *et al.*[8]

Ureteroscopic Procedure

URS was performed under general or spinal anesthesia with an 8F semirigid ureteroscope (Karl Storz Endoskope, Tuttlingen, Germany) and the aid of fluoroscopy. When necessary, pneumatic intracorporeal lithotripsy was performed with the Swiss Lithoclast (EMS Medical, Nyon, Switzerland), and attempts were made to remove stone fragments with endoscopic graspers, although small fragments (less than 3 mm) were largely left to pass spontaneously.

At the end of the procedure, a ureteral catheter was systematically left in place in 100 patients (69.4%) and removed within 24 hours. In the 44 remaining patients, a double-J stent was inserted because of significant tissue trauma and edema at the impaction site or suspected ureteral perforation, mild or severe dilation, a large fragment still in place, or the stones had been pushed back to the pyelocaliceal system. The mean treatment time was 45 minutes (range 25 to 80).

After treatment, all patients were evaluated by urinalysis, urine culture, and renal function tests. The scheduled postoperative radiologic follow-up included plain abdominal film on day 1 to assess the initial stone-free rate and, for those with a stent in place, to confirm the correct stent position. At day 15 postoperatively, another plain abdominal film was performed, before stent removal, which was scheduled about 15 to 21 days after the procedure, depending on availability. In a few selected cases, the stent was maintained in place for 1 month, at which point another plain abdominal film was obtained.

The treatment outcome was assessed by the postprocedure stone size. The production of fragments less than 3 mm was considered successful fragmentation. The overall stone-free status was defined as the complete absence of calculus at 1 month of follow-up.

Statistical Analysis

A standard statistical software program was used. The chi-square test or Fishers' exact test when appropriate, was used to determine any significant differences in the nominal data between the two groups. The two-tailed *t* test was used to access the significance regarding continuous data. A $P < 0.05$ was considered significant.

RESULTS

The calculi were more frequently localized in the distal ureter than in the proximal one (90.3% versus 9.7%, respectively). The overall mean stone diameter was 9.1 mm (range 5 to 20). No significant difference was found in size between proximal and distal stones (8.8 mm and 9.0 mm, respectively, P = NS). In 16 patients (11.1%), intracorporeal lithotripsy was not required; this was the case mostly for distal ureteral stones (Table 1).

The initial stone-free rate was 83.3%, and the overall stone-free rate was 92.4%. A more favorable outcome was obtained for those with stones less than 10 mm than for those with stones greater than 10 mm (95.8% versus 89%, $P = 0.02$). Similarly, more favorable results were found for those with distal ureteral stones than for those with proximal ones (stone-free rate of 94.6% versus 71.4%, respectively, $P = 0.008$; Table 1).

Failure of ureteroscope insertion occurred in 2 patients, who presented with severely impacted distal stones. These were managed with a nephrostomy tube. Other treatment failures were represented by stone migrations, which occurred in 6 patients. Migrated stones were successfully treated later by ESWL. Other minor complications included urosepsis (1 patient), perinephric hematomas (1 patient), and minor ureteral perforation (4 patients). These latter cases were treated conservatively with double-J stent insertion; none required open surgery. The mean hospital stay was 2.5 days (range 1 to 7).

COMMENT

Most ureteral stones can be observed with a reasonable expectation of uneventful stone passage, and this strategy is generally less costly and less invasive than any other option, if successful.[9] Ureteral stones with a diameter less than 5 mm will pass in up to 98% of cases; however, for stones with a diameter greater than 7 mm, the overall chance of spontaneous passage is low.[2]

When active ureteral stone treatment is warranted, the best procedure to choose depends on several factors, including stone size and location, operator experience, patient preference, available equipment, and related costs.

The standard first-line approach in the management of symptomatic ureteral stones is relief of obstruction by insertion of a nephrostomy tube or double-J stent and fragmentation of the stone later by ESWL. Insertion of a nephrostomy tube under local anesthesia is relatively less invasive, and it is considered to be better if evidence of sepsis is found at presentation. Nevertheless, its potential disadvantages include leakage, dislodgement of the tube, and the need to manage the stoma.[10] Insertion of a double-J stent, apart from complications such as ureteral perforation and failure to pass the stent in some cases, may increase the risk of urosepsis. Furthermore, the presence of a stent results in a reduction of the shock wave energy reaching the stone and causes ureteral constriction and edema of the wall, both of which may reduce the chance of successful fragmentation or the passage of fragments after ESWL.[11]

URS represents a safe and minimally invasive procedure in the management of ureteral stones.[7] Advancements in technology have made it a safe and highly successful procedure, reducing its complication rates.[12] In the present series, the overall stone-free rate was 92.4% and increased to 94.6% when only distal ureteral stones were considered. The overall complications rate was 4.2%, which decreased to 1.4% when only the smaller (less than 10 mm) stones were considered. These results resemble those from current studies on electively scheduled URS, which range from 86.6% to 94.6% for all ureteral stones, increasing to 95.6% to 100% for distal ones.[13–18]

Our study has some limitations, namely its retrospective design and that no comparison with a control group was done. Still, to our knowledge, this is the first report focusing on ureteroscopic management of ureteral stones in emergency situations. "Emergency" indicates that the procedure was performed rapidly after the onset of renal colic due to the ureteral stone (within 12 hours of admission to the emergency room). Thus, a systematic pain evaluation, using a specific pain scale, was not performed at admission. None of the patients had been admitted more than one previous time to the emergency room and all had failed to receive any benefit from medical therapy.

Common expectant therapy generally combines pain relief, an antispasmodic agent, and advice regarding hydration. The published data relating this issue are sparse, and the role of medical therapy and even the ideal analgesia is still unclear. More recent works have been directed at treatment combinations to reduce edema and inhibit stone-induced ureteral spasm.[18] Our first approach in this study population was represented by medical pain relief, consisting of the administration of anti-inflammatory drugs and antibiotics. Because it is widely recognized that infection within the ureter is a possible cause of calculi retention, an antibiotic is generally used when a medical expulsive therapy for ureteral stones is provided.[19]

Only at their second admission to the emergency room did we discuss with the patients the possibility of an active treatment, URS. Because of the lack of an ESWL machine at our center during the study period, we did not take into account this other attractive option, as recently suggested by some investigators.[5,6,10,20]

Patients with complete obstructive ureteral stones, including a subgroup of 46 patients with proximal ureteral stones, were retrospectively divided into three groups by Joshi *et al.*[10] A nephrostomy tube or double-J stent was placed to relieve obstruction with subsequent ESWL treatment. The remaining patients underwent urgent ESWL within 1 to 14 days without previous obstruction. Success after ESWL was significantly greater only compared with the percutaneous nephrostomy group, and no significant advantage was found when comparing stent positioning and subsequent ESWL.[10] The rationale for the use of rapid ESWL after a renal colic episode is to attain the maximal stone clearance in the shortest possible time. Doublet *et al.*[20] found that immediate ESWL for obstructing ureteral stones is an effective treatment, giving results comparable to those of asymptomatic patients, with a 1-month stone-free rate of 94%. Recently, Tombal *et al.*[5] assessed the efficacy of emergency ESWL on the short-term outcome of symptomatic proximal ureteral stones and demonstrated improved elimination. Similarly, a prospective randomized trial was reported by Kravchick *et al.*[6] comparing the outcome of emergency (within 72 hours) versus scheduled (within 34 days) ESWL. They concluded that emergency ESWL is a safe and effective treatment option for those with proximal ureteral stones.

As with ESWL, URS can relieve obstruction and simultaneously help extract or fragment the obstructive stone. ESWL tends to remain the first-line option because of the lower morbidity, its less-invasive nature, and the reduced postoperative analgesia requirement.[2] The position of the stone requires consideration: ESWL gives its best results for stones in the proximal ureter, but is less successful for distal stones, also in the emergency setting.[6] In these cases, URS could play a major role.

When assessing the efficacy of a treatment, an important consideration is the time it takes to achieve stone-free status. In this respect, Peschel *et al.*[21] concluded that considerable differences between ESWL and URS can be

Table 2. Emergency ureteroscopy: comparison with emergency extracorporeal shock wave lithotripsy series (with second and third-generation lithotripters)

Investigator	Patients (n)	Proximal/Distal (n)	Mean Stone Size (mm)	SFR (%)	Failure Rate* (%)
Tombal *et al.*[3]	50	29/21	6.38 (2–10)	74	22.0
Kravchick *et al.*[6]	100	100/0	7.4 (5–12)	72	28.0
Joshi *et al.*[10]	16	9/7	8.2 (6.5–10.2)	81	18.7
Tligui *et al.*[22]	200	98/102	7 (3–20)	82	18
Present series	144	14/130	9.1 (5–20)	92.4	5.5

SFR = stone-free rate.
Data in parentheses are ranges.
* Failure indicated by need for additional procedures.

recognized and that from the patient viewpoint achieving a stone-free state as soon as possible is the ultimate goal. Therefore, most patients in their study were satisfied with URS but would not have been satisfied with ESWL, mainly because of the longer time to obtain stone-free status with the latter.[21] In our experience, we obtained a reasonable initial stone-free rate and an encouraging stone-free rate at 1 month. Thus, our patients had their problem solved in a relatively short period and with no need of additional bothersome auxiliary procedures, such as has been reported from other series in those undergoing emergency ESWL[5,6,10,22] (Table 2).

Of 11 ESWL series published between 1998 and 2003 using second and third-generation lithotripters for upper ureteral calculi, the overall stone-free rate was 75%, with a retreatment rate of 30%. This compares with 21 URS series published between 1995 and 2003, with a stone-free rate of 82% and a second procedure rate of only 10%.[23] The results for ESWL have been much better when considering reports on the HM3 Lithotriptor.[24] However, ESWL is one of the examples that got worse with time, improving patients' treatment comfort but with much worse disintegration results.

Harmon *et al.*[12] observed a decrease in the overall complication rate from 20% to 12% during a 10-year period. The decrease was attributed to the use of smaller ureteroscopes and increased surgeon experience.[12] In our experience, the two major complications were minor ureteral perforation and stone migration. The former were all treated conservatively with double-J ureteral stenting; the latter were considered to have treatment failure because they required auxiliary procedures.

Failed ureteroscope insertion occurred in 2 cases, and these were also considered treatment failures. Generally, we prefer not to dilate the ureter. In the case of need, we use a balloon. This happened in selected cases (overall, in 6.9% of the study population). In the 2 cases in which the insertion of ureteroscope failed, severe edema was present in the intramural part of the ureter, probably resulting from an intense inflammatory reaction from the impacted stones. In this situation, we were unable to pass a guidewire in retrograde fashion and preferred the insertion of a nephrostomy tube.

In determining the best treatment modality, cost is another important consideration. Lotan *et al.*[9] found URS to be more cost effective than ESWL for ureteral stones at all sites, with the cost difference most pronounced for stones in the distal ureter.

The routine placement of a ureteral stent after ureteroscopic stone removal has been widely recommended,[17] the rationale being a reduction of postoperative pain and ureteral obstruction at the stone impaction site and possibly facilitating the passage of small stone fragments. With the recent development of small-caliber ureteroscopes and more effective intracorporeal lithotripsy devices, it is now possible to perform URS in most patients without dilation.[25] As a result, ureteroscopic stone fragmentation has become a relatively atraumatic procedure. During the latter half of the 1990s, some investigators started to question the need for routine stenting after URS and to adopt a policy of selective ureteral stenting.[26,27] However, most urologists still use stenting as a routine practice in the common belief that problems are encountered much more frequently than reported.

We agree with Damiano *et al.*[28] that in the technique of URS, accomplishing stone fragmentation with the ballistic lithotriptor produces larger fragments that may potentially cause more problems in terms of spontaneous passage. The holmium laser creates smaller stone fragments, allowing more successful and safer endoscopic removal of ureteral calculi.[29] If available, it is believed to improve the results of URS in the emergency setting as well.

We have routinely placed a temporary (24 hours) ureteral catheter in most (69.4%) of our patients. We believe this option to be cost-effective, because we left in place the same ureteral catheter already used during URS. Most importantly, our aim was to maintain a short hospitalization time by minimizing any risk of immediate postoperative complications.

In a Phase II clinical trial, Lingeman *et al.*[30] used a temporary drainage stent in patients treated with uncomplicated URS. This new device was effective in providing temporary drainage of the ureter for 48 hours, at which time any residual ureteral edema from URS would likely have resolved. This experience indirectly confirms that temporary ureteral catheterization is not about to disappear from urologic practice. In the near future, the question will probably be answered with the aid of new technologic solutions.

We reserved double-J stent placement in selected cases, when any factors predictive for complications were recognized. We usually removed the stent after 15 to 21 days, leaving the stent in place in few cases. This was necessary when large fragments were still in place or the stones had been pushed back. These situation were considered as treatment failures, because additional stone manipulation was required.

CONCLUSIONS

Emergency URS appears to be an attractive treatment modality for obstructive ureteral stones, especially distal ones. It is safe and effective, with the main advantages of immediate relief from pain and stone fragmentation. However, this procedure requires specific technical expertise and dedicated facilities. In this setting, more extensive studies are warranted to corroborate our findings.

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EDITORIAL COMMENT

The authors present excellent results of emergency URS to remove distal or proximal ureteral stones. Emergency URS? Why not? The patient is very quickly relieved of colic pain and at the same time of the stone. The patient is back to work fast, and, therefore, the procedure might also be very cost effective. All these advantages might overcome the disadvantage of choosing a more invasive procedure compared with ESWL or conservative treatment, with the latter only an alternative in small ureteral stones 4 mm or less.

However, these results might also be possible with ESWL, provided we compare using the best lithotriptor we have, the Dornier HM3, and this is true for proximal and distal ureteral stones.[1,2] However, subsequent generations of lithotriptors have never reached the effectiveness of the HM3. Today, we compare the results of an optimal endoscopic procedure with sub-