UIJ UroToday International Journal®

www.urotodayinternationaljournal.com
Volume 3 - February 2010

Treatment of Large Proximal Ureteral Stones: Extracorporeal Shock Wave Lithotripsy Versus Semirigid Ureteroscope with Lithoclast

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Submitted November 10, 2009 - Accepted for Publication December 3, 2009

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ABSTRACT

INTRODUCTION: The purpose of the study was to assess the safety and efficacy of extracorporeal shockwave lithotripsy (ESWL) versus a semirigid ureteroscope with a lithoclast for treatment of large proximal ureteral stones.

METHODS: The participants were 147 patients with large (> 1 cm) upper ureteral stones. ESWL and ureteroscopy were performed for 71 and 76 patients, respectively. The mean stone sizes and standard deviations (SD) were 1.34 cm (SD = 0.03) for the patients receiving ESWL and 1.51 cm (SD = 0.04) for the patients receiving ureteroscopy. There were no significant group differences in stone size (P = .604). ESWL was performed under intravenous sedation with a Siemens modularis litho vario lithotripter. Ureteroscopy was performed under spinal anesthesia with a 7.5 Fr semirigid ureteroscope and lithoclast.

RESULTS: At the 1-month evaluation, 41 out of 71 patients (58%) were stone free after the initial ESWL and 70 out of 76 patients (92%) were stone free after ureteroscopy. The group difference in the stone-free rate was statistically significant (P = .003). The stones were accessible in 72 of the 76 patients (95%) having ureterscopy. Stone fragments were available for analysis from 23 patients receiving ESWL and 70 patients receiving ureteroscopy. The majority of stones in both groups were composed of calcium oxalate dihydrate (COD). No major complications were encountered in either group.

CONCLUSIONS: The present study demonstrates that ureteroscopy with a lithoclast can be considered an acceptable treatment modality for large proximal ureteral calculi. It can be used as an initial treatment for large proximal ureteral stones.

KEYWORDS: Ureteroscopy; Extracorporeal shock wave lithotripsy (ESWL); Proximal ureter; Lithoclast

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CITATION: *UroToday Int J*. 2010 Feb;3(1). doi:10.3834/uij.1944-5784.2010.02.03

INTRODUCTION

Most small ureteral stones pass spontaneously. Large stones typically require active treatment. Stones that do not pass can be removed by either shock wave lithotripsy (SWL) or ureteroscopy. Open surgery is appropriate as a salvage procedure or in certain unusual circumstances. Because laparoscopic ureterlithotomy has consistently demonstrated good results, guidelines from both the American and European Associations of Urology state that laparoscopic surgery should be performed instead of open surgery whenever possible. SWL has been recommended as the first treatment for proximal ureteral calculi less < 1 cm [1]. Treatment recommendations for large proximal ureteral calculi are not yet defined.

Stone size is an important variable in determining the outcome of SWL, but little information is available on the influence of stone size in the treatment of proximal ureteral stones. Advances during the last 2 decades with the advent of small diameter ureteroscopes and intracorporeal lithotripsy such as

ultrasound, electrohydraulic lithotripsy, the lithoclast device, and more recently the holmium: YAG laser, have allowed safer and more successful endoscopic removal of upper ureteral calculi [2-5]. The purpose of the present study was to compare outcomes of treating large proximal ureteral stones with in-situ extracorporeal shock wave lithotripsy (ESWL) versus a semirigid ureteroscope and lithoclast.

METHODS

Participants

The participants were 147 patients with large (> 1 cm) upper ureteral stones, treated at the Urology Department of El Minia University Hospital between June 2001 and November 2007.

Patients were informed about ureteroscopy and ESWL as the 2 treatment options. The advantages, disadvantages, and side effects of both techniques were explained. According to patient choice, 71 patients had ESWL and 76 patients had ureteroscopy.

The patients receiving ESWL had a mean age of 42 years (range, 22-58 years) and a male:female ratio of 54:17. The patients receiving ureteroscopy had a mean age of 39 years (range, 24-52 years) and a male:female ratio of 61:15.

Preoperative Evaluation

Patients were clinically evaluated by plain X-ray of the kidney, ureter, and bladder (KUB). They also had ultrasound and/or excretory urography to determine stone size, location, and degree of hydronephrosis. The upper ureter was defined as the segment between the ureteropelvic junction and the upper border of the sacroiliac joint. Inclusion criteria were: (1) proximal ureteral stones > 1 cm in size that failed to pass spontaneously, and (2) recurrent renal colic and/or obstructive uropathy. Patients with active urinary tract infection, congenital anomalies, previous SWL, stent placement, or open surgery of the ureter were excluded.

The mean stone sizes and standard deviations (SD) were 1.34 cm (SD = 0.03) for the patients receiving ESWL and 1.51 cm (SD = 0.04) for the patients receiving ureteroscopy. There were no significant group differences in stone size (P = .604). Available stone fragments were analyzed using crystallography.

Procedures

Extracorporeal shock wave lithotripsy. All patients were treated as same-day outpatients. Patients with in-situ ESWL were treated using a Siemens modularis litho vario lithotripter (Siemens Medical Solutions, Erlangen, Germany) under intravenous sedation (pethidine). The applied voltage ranged from 12 to17 kV. The maximum number of shocks was 3000. The patients were given 60 shock waves/minute for the first 500 shock waves. The rate was then increased to 90 shock waves/minute. A posttreatment abdominal X-ray was obtained 2-3 weeks after ESWL.

Ureteroscopy. A preoperative antibiotic was administered. All patients were treated as same-day outpatients. Spinal anesthesia was used for most of the patients. Cystoscopy and retrograde pyelograms were performed. Ureteroscopy was performed using a 7.5 Fr long semirigid ureteroscope. A guidewire (GW) was introduced and positioned past the stone. Glide wire was used when necessary. If there was difficulty passing the GW, it was introduced under vision through the ureteroscope. Balloon dilation was used in all patients. A pneumatic lithoclast with a 2-3 Fr probe in single or multiple modes was used to disintegrate the stone. The number of shocks was adjusted to avoid stone migration. A stone cone or Nitinol™ tipless dormia basket (NDC, Fremont, CA, USA) was used to guard against stone migration. Significant gravels were retrieved using the dormia basket. A 5-6 Fr internal ureteral stent was placed at the end of the procedure in all except 3 patients. The stent was left in place for 2-3 weeks, based on the degree of impaction of the stone and manipulations performed.

Postoperative Evaluation and Data Analysis

Postoperative evaluation included KUB and ultrasound for all patients. Occasionally, excretory urography or noncontrast helical computed tomography (CT) was performed until the patient was stone free.

Treatment outcome was assessed by comparing the stone free rate on KUB assessment 1 month after treatment. A Fisher 2-sided exact test was used for the comparison. Additional treatment procedures, composition of retrieved stone fragments, and complications were documented.

RESULTS

The mean operative time was 68 minutes (range, 59-78 minutes) for ESWL and 52 minutes (range, 38– 98 minutes) for ureteroscopy.

Extracorporeal shock wave lithotripsy. ESWL was performed on 71 patients. Follow-up treatment after the initial procedure was needed for 30 of the 71 patients. A second ESWL session was performed on 13 patients; the second session succeeded for 2 patients. Ureteroscopy was done for 14 patients with failed initial ESWL; 12 of the 14 became stone free. Percutaneous stone management was performed successfully for 1 patient. The remaining patients preferred to have open surgery.

Ureteroscopy. Ureteroscopy was performed on 76 patients. The stones were accessible in 72 patients; the stones were inaccessible in 4 patients due to angulations or tightness of the ureter. The procedure failed in 2 patients due to edema and angulations at the site of the stone; both of these patients were treated by open surgery.

A stone cone was placed under vision to avoid proximal stone migration in most of the patients after stone disimpaction. In patients with very hard stones (n = 11), a Nitinol™ tipless

http://www.urotodayinternationaljournal.com
doi:10.3834/uij.1944-5784.2010.02.03
ISSN 1944-5792 (print), ISSN 1944-5784 (online)

dormia basket with detachable handle was used to catch the stone before disintegration, to achieve good contact of the probe with the stone.

Internal ureteral stents were inserted in all successfully treated patients following ureteroscopy due to the large size of the stones. The stents also helped to avoid postoperative obstruction and aid in stone passage after stent removal. They were left in place for 2-3 weeks. Balloon dilation was used for all patients to facilitate stone retrieval. Transureteroscopic balloon dilation immediately distal to the stone after disimpaction was done in 3 patients. These patients had stricture and edema below the stone.

Stone-free rate. At the 1-month evaluation, 41 out of 71 patients (58%) were stone free after the initial ESWL and 70 out of 76 patients (92%) were stone free after ureteroscopy. The group difference in the stone-free rate was statistically significant ($P = .003$).

Stone fragments. Stone fragments were available for analysis from 23 patients receiving ESWL and 70 patients receiving ureteroscopy. The results of stone composition analyses are contained in Table 1. The majority of stones in both groups were composed of calcium oxalate dihydrate (COD).

Complications. There were no major complications in either group. There were recurrent attacks of renal colic requiring emergency ureteroscopy in 1 case following ESWL. Hematuria, flank soreness, and urosepsis were reported by other patients following ESWL. Most of the complaints after ureteroscopy were related to the stents.

DISCUSSION

SWL is the least invasive treatment for upper urinary tract calculi, and it is recommended as the first therapy [1]. Stone clearance after SWL is variable and influenced by stone size, location, and composition. The success rate of treatment for proximal ureteral calculi, either in-situ or after stent placement, range from 57% to 96%, with a second treatment success rate of 5% to 60% [1,6-9]. The success rate of repeat SWL after failed initial treatment is relatively low [10].

Table 1. Composition of Stones Retrieved from Patients Receiving Shock Wave Lithotripsy or Ureteroscopy (N = 147). doi: 10.3834/uij.1944-5784.2010.02.03t1

Stone Composition	ESWL (n = 23)		Ureteroscopy (n = 70)	
	n	% n	n	% n
Calcium oxalate monohydrate			11	16
Calcium oxalate dihydrate	12	52	26	37
Calcium phosphate			9	13
Uric acid	7	30	11	16
Mixed	4	18	13	18

SWL has an initial success rate above 80% for small upper ureteral stones. However, the success rate for large impacted upper ureteral calculi is lower, with the highest rate reported at around 60% [11-15]. The initial success rate for ESWL in the present study was 58%, which is comparable to rates reported in other studies [8,14,15]. This low success rate could be attributed to the limited number of shock waves in a single session, or to the fact that large stones require higher power index [7,8,14]. It is also important to mention that all cases in present study were treated in situ.

Unfortunately, SWL does not assure complete relief of the obstruction and is associated with prolonged attacks of pain during stone passage. Complications following ESWL in the present study included postoperative pain (colic) requiring emergency ureteroscopy in 1 patient, and hematuria, flank soreness, or urosepsis in others. A second ESWL treatment for 13 patients succeeded in only 2 patients, confirming the low success rate of repeat SWL [10]. Ability to predict the response of a stone to SWL would optimize ureteral stone management [1].

Recent development of small-diameter semirigid and flexible ureteroscopes with the availability of the holmium: YAG laser has markedly improved the success rate for treating proximal ureteral stones. A success rate of around 50% for proximal ureteral calculi using large-diameter rigid ureteroscopes improved to greater than 90% using small-diameter ureteroscopes [14-17].

Most studies of ureteroscopy for proximal ureteral stones used the holmium: YAG laser for disintegration [14,15,17]. The laser is able to destroy all forms of stones using small-diameter quartz fibers. Large calculi can be fragmented into dust-like particles, decreasing the need for fragment retrieval. The laser can be passed through both rigid and flexible ureteroscopes [15-17]. The only disadvantage of the holmium: YAG laser is its cost. In the present study, pneumatic lithotripsy (lithoclast) was used for stone disintegration because it is cost-effective, available, and effective. It comes with small diameter probes and can be passed through durable semirigid ureteroscopes.

Balloon dilation and stents were frequently used because the lithoclast leaves larger stone fragments when compared with the holmium: YAG laser. Significant fragments were retrieved using the Nitinol™ tipless dormia basket. Stents were also needed for patients with mucosal edema and polyps.

The initial stone-free rate of ureteroscopic lithoclast lithotripsy for proximal ureteral calculi in the present study was 92%, which is lower than but close to other reported series using

the holmium: YAG laser [14,15]. This rate was also significantly higher than the stone-free rate of 58% following ESWL.

The main difficulty encountered during ureteroscopy was failure to approach the stone because of a tortuous ureter, angulations, and edema at the site of the stone. These problems masked the exposure and disintegration of the calculus for 6 patients. It was helpful to have adequate irrigation and to negotiate the stone by a second guidewire (under vision) or glide to have good exposure of the stone prior to disintegration.

Proximal migration of the stone is a potential limitation of the lithoclast. Different methods have been used to avoid proximal stone migration, including a combination of lithoclast and lithovac, Dretler stone cone, or antegrade occlusion balloon catheter. In the present study, a stone cone was placed under vision to avoid proximal stone migration. It also helped to sweep the small stone fragments during its removal. Stone migration was avoided, which is consistent with the results of similar studies [18-20]. For hard stones, the Nitinol™ tipless dormia basket with detachable handle was used to entrap the stone prior to disintegration.

The present study confirmed previously reported results that treatment outcome of ureteroscopy was not influenced by stone burden or composition. This is contrary to the results following ESWL, which is influenced by both factors [13-15].

Although ureteroscopy is more invasive than ESWL, complications after ureteroscopy in the present study were limited. This is consistent with most recent studies and appears to be due to use of a small diameter (7 F) ureteroscope, effective pneumatic lithotripsy, and fine retrieval devices. Most of the complications in the present and previous studies were related to the use of stents [14,15,17,18,21].

According to the guidelines of the American Urological Association, there are 4 available methods that can be used for treatment of large proximal ureteral calculi: (1) open surgery, (2) percutaneous nephrolithotomy, (3) ureteroscopy, and (4) ESWL. The present study supports the use of ueteroscopy, regardless of stone size or composition. It allows immediate relief of the obstruction for most patients, is associated with minimal morbidity, and is not affected by obesity, bleeding, diathesis, or previous open surgery. In addition to its safety, the economic value of using the durable semirigid ureteroscope is attractive.

CONCLUSIONS

In experienced hands, use of a small-diameter semirigid ureteroscope and lithoclast with fine retrieval devices and a stone cone provides a safe and effective method for treatment of large proximal ureteral stones. When compared with ESWL, it has a higher stone-free rate and comparable complications. It ensures immediate relief of obstruction for most patients.

Conflict of Interest: none declared

REFERENCES

[1] Segura JW, Preminger GM, Assimos DG, et al. Ureteral Stones Clinical Guidelines Panel summary report on the management of ureteral calculi. The American Urological Association. *J Urol*. 1997;158(5):1915-1921.

[2] Denstedt, JD, Clayman RV. Electrohydraulic lithotripsy of renal and ureteral calculi. *J Urol*. 1990;143(1):13-17.

[3] Denstedt JD, Eberwein PM, Singh RR. The Swiss Lithoclast: a device for intracorporeal lithotripsy. *J Urol*. 1992;148(3 Pt 2):1088-1090.

[4] Matsuoka K, Lida S, Nakanami M, et al. Holmium: yttrium-aluminum-garnet laser for endoscopic lithotripsy. *Urology.* 1995;45(6):947-952.

[5] Scarpa RM, De Lisa A, Porru D, Usai E. Holmium: YAG laser ureterolithotripsy. *Eur Urol.* 1999;35(3):233-238.

[6] Ehreth JT, Drach GW, Arnett ML, et al. Extracorporeal shock wave lithotripsy: multicenter study of kidney and upper ureter versus middle and lower ureter treatments. *J Urol*. 1994;152(5 Pt 1):1379-1385.

[7] Singh I, Gupta NP, Hemal AK, et al. Impact of power index, hydroureteronephrosis, stone size, and composition on the efficacy of in situ boosted ESWL for primary proximal ureteral calculi. *Urology*. 2001;58(1):16-22.

[8] Coz F, Orvieto M, Bustos M, et al. Extracorporeal shockwave lithotripsy of 2000 urinary calculi with the modulith SL-20: success and failure according to size and location of stones. *J Endourol*. 2000;14(3):239-246.

[9] Liong ML, Clayman RV, Gittes RF, Lingeman JE, Huffman JL, Lyon ES. Treatment options for proximal ureteral urolithiasis: review and recommendations. *J Urol.* 1989;141(3):504-509.

[10] Pace KT, Weir MJ, Tariq N, Honey RJ. Low success rate of repeat shock wave lithotripsy for ureteral stones after failed initial treatment. *J Urol*. 2000;164(6):1905-1907.

[11] Danuser H, Ackermann DK, Marth DC, Studer UE, Zingg E J. Extracorporeal shock wave lithotripsy in situ or after push-up for upper ureteral calculi: a prospective randomized trial. *J Urol.* 1993;150(3):824-826.

[12] Dretler SP, Keating MA, Riley J. An algorithm for the management of ureteral calculi. *J Urol.* 1986;136(6):1190-1193.

[13] Lingeman JE, Shirrell WL, Newman DM, Mosbaugh PG, Steele RE, Woods JR. Management of upper ureteral calculi with extracorporeal shock wave lithotripsy. *J Urol.* 1987;138(4):720-723.

[14] Lam JS, Greene TD, Gupta M. Treatment of proximal ureteral calculi: holmium: YAG laser ureterolithotripsy versus extracorporeal shock wave lithotripsy. *J Urol*. 2002;167(5):1972-1976.

[15] Wu CF, Shee JJ, Lin WY, Lin CL, Chen CS. Comparison between extracorporeal shock wave lithotripsy and semi-rigid ureterorenoscope with holmium: YAG laser lithotripsy for treating large proximal ureteral stones. *J Urol*. 2004;172(5 Pt 1):1899-1902.

[16] Bagley DH. Ureteroscopic stone retrieval: rigid vs. flexible endoscopes. *Semin Urol*. 1994;12(1):32-38.

[17] Tawfiek ER, Bagley DH. Management of upper urinary tract calculi with ureteroscopic techniques. *Urology.* 1999;53(1):25-31.

[18] Desai MR, Patel SB, Desai MM, et al. The Dretler stone cone: a device to prevent ureteral stone migration – the initial clinical experience. *J Urol*. 2002;167(5):1985-1988.

[19] Gonen M, Cenker A, Istanbulluoglu O, Ozkardes H. Efficacy of dretler stone cone in the treatment of ureteral stones with pneumatic lithotripsy. *Urol Int*. 2006;76(2):159-162.

[20] Maislos SD, Volpe M, Albert PS, Raboy A. Efficacy of the stone cone for treatment of proximal ureteral stones. *J Endourol*. 2004;18(9):862-864.

[21] Wu CF, Chen CS, Lin WY, et al. Therapeutic options for proximal ureter stone: extracorporeal shock wave lithotripsy versus semirigid ureterorenoscope with holmium: yttrium-aluminum-garnet laser lithotripsy. *Urology*. 2005;65(6):1075-1079.

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doi:10.3834/uij.1944-5784.2010.02.03
ISSN 1944-5792 (print), ISSN 1944-5784 (online)