

Ureteroscopic lithotripsy using Swiss Lithoclast for the management of ureteral stones: our experience in 200 patients

Üreteral taşların tedavisinde Swiss Lithoclast ile üreteroskopik litotripsi: 200 hastada deneyimimiz

Syed Abeer Hussain¹, Nisar A Wani², Baldev Singh¹, Arif Hameed¹

¹Sher-i-kashmir Institute of Medical Sciences, Department of Urology, Srinagar, India

²Sher-i-kashmir Institute of Medical Sciences, Department of Radiology, Srinagar, India

Abstract

Objective: To study the efficacy of ureteroscopic management of ureteric calculi using Swiss Lithoclast in a cohort of 200 patients.

Materials and methods: The patients were diagnosed of ureteric stone on ultrasonography, radiography, intravenous urography or computed tomography. Ureteroscopic lithotripsy (URSL) was done using 8/9.8 F rigid Olympus ureteroscope and Swiss Lithoclast.

Results: Patients aged between 15 to 70 years with 94 males and 106 females. Most common presenting complaint was the pain. Hydronephrosis was seen in 57%. Most patients had stone on right side. Most of the stones were 5-10 mm in size. Majority of the stones treated were from the lower ureter (72.32%). Of the stones, 91.51% were successfully fragmented. D-J stent was used in 40% patients. Operation time was less than an hour in most of the cases. There were minimal severe or long-term effects (stricture, 0.5%). Mean hospital stay was 1.54 days. Only 2% patients had proximal stone/fragment migration. Overall success rate of the treatment was 90.5%.

Conclusion: URSL using Swiss Lithoclast is an effective, cheap and reliable method of ureteric stone management. Besides, lack of any disposable components, extremely long instrument life, and easy maintenance of the Swiss Lithoclast suits well with the needs of low socioeconomic countries like India.

Key words: Lithotripsy; Swiss Lithoclast; ureteral stones.

Özet

Amaç: Üreterik taşların Swiss Lithoclast ile yapılan üreteroskopik tedavisinin 200 hastalık kohort üzerinde etkinliğinin değerlendirilmesi amaçlanmıştır.

Gereç ve yöntem: Hastalarda üreterik taş olduğu ultrasonografi, radyografi, intravenöz urografi ya da bilgisayarlı tomografi ile belirlenmiştir. Üreteroskopik litotripsi (URSL), 8/9.8 F rijid Olympus üreteroskop ve Swiss Lithoclast ile yapılmıştır.

Bulgular: Hastaların yaşı 15 ile 70 arasında olup, 94'ü erkek ve 106'sı kadındı. En sık başvuru şikayeti ağrı idi. Hastaların %57'sinde hidroüreteronefroz tespit edildi. Hastaların çoğunda taş sağ taraftaydı. Taşların çoğu 5-10 mm ölçülerindeydi. Tedavi edilen taşların çoğu (%72.32) alt üreter kaynaklıydı. Taşların %91.51'i başarılı bir şekilde fragmente edildi. Hastaların %40'ında D-J stent kullanıldı. Hastaların çoğunda operasyon süresi bir saatten kısaydı. Minimal düzeyde şiddetli ve uzun dönem etki vardı (striktür, %0.5). Ortalama hastanede kalış süresi 1.54 gündü. Hastaların sadece %2'sinde proksimal taş/fragment migrasyonu vardı. Tedavinin genel başarı oranı %90.5 idi.

Sonuç: Üreterik taş tedavisinde Swiss Lithoclast kullanılarak yapılan URSL etkili, ucuz ve güvenli bir yöntemdir. Ayrıca, Swiss Lithoclast'ın tek kullanımlık parçasının olmaması, son derece uzun alet ömrü ve kolay bakımı, Hindistan gibi düşük sosyoekonomik şartları olan ülkelere ihtiyaçlarına uyum sağlamaktadır.

Anahtar sözcükler: Litotripsi; Swiss Lithoclast; üreteral taş.

Ureteral calculi originate from kidneys, and while passing down the ureter, get lodged at different sites manifesting with loin pain, urinary obstruction and renal damage or urosepsis with rigors and chills.^[1] Ureteral stones can be diagnosed by radiography, ultrasonography, intravenous urography, and non-contrast computed tomography (CT).^[2] Various treatment modalities have been proposed in literature for ureteral calculi including shock wave lithotripsy (SWL), percutaneous removal, ureteroscopic lithotripsy (URSL), retro-peritoneoscopic ureterolithotomy, laparoscopic ureterolithotomy, and classical open ureterolithotomy.^[1,3,4] However, the optimal treatment strategy remains yet to be determined. Management depends upon the stone size, composition, site (location), number, duration, clinical factors of the patient, the availability of the expertise and technology and last but not least to mention, the cost of the treatment and patient preference.^[1,5,6] Although the advent and development of SWL has revolutionized the treatment of most renal and ureteral calculi, some patients with ureteric calculi are best managed ureteroscopically. Included in this group are the patients with distal ureteral calculi, large (>1 cm) proximal ureteral calculi, impacted proximal ureteral calculi, morbidly obese patients and failed SWL cases.^[7-9]

Presently there are three main types of ureteroscopes available: rigid, semi-rigid and flexible.^[10] We used rigid ureteroscope at our institution for ureteral calculi. Now URSL has evolved to the extent that even renal calyceal stones can be well managed with ureteroscopic laser lithotripsy.^[8,9] However, for the proximal ureteral calculi preferred choice still remains SWL and for the distal calculi literature partly favours URSL.

Materials and methods

We studied 200 patients with ureteric calculi admitted to our hospital between June 2003 and October 2006. All the patients' records including history, physical examination, investigations and treatment were reviewed and recorded. Among investigations abdominal ultrasonography (USG), intravenous urography (IVU), CT-abdomen and radioisotope scan, which ever was necessary, was done preoperatively. Additionally, an abdominal radiograph was obtained in the morning of the day of surgery to know the exact preoperative stone status. Abdominal plain radiograph was also obtained on the first post-opera-

tive day and after 1 week to know the stone clearance/migration. Most of the procedures were done under general anesthesia, except a few cases done under spinal or epidural anesthesia. On the day of surgery, all of the patients were started on intravenous antibiotic prophylaxis 2 hour prior to surgery and continued for next 12 hours after which oral antibiotics were prescribed for 3-5 days depending on urine culture sensitivity in patients with urinary tract infection.

The procedure was performed after obtaining informed consent. After cystoscopic passage of the teflon tipped guide wire into the ureteric orifice, 8/9.8 F Olympus ureteroscope was advanced over the guide wire. In a few patients, ureteric dilatation of the intramural ureter using metal dilators was necessary to allow the ureteroscope advancement. Stone localization by C-arm image intensifier was done when needed. Stone fragmentation was performed using Swiss Lithoclast. We used mostly 0.8 mm or 1 mm probe. Intraoperative stone size was recorded comparing the tip of the probe with the stone ureteroscopically.

D-J stent was put in the ureter after stone fragmentation in selected cases including severe mucosal edema, mucosal tear, ureteral perforation and a few failure patients where stone could not be removed. D-J stent was removed usually after 3 weeks. Stone localization was recorded as "upper" if the stone was seen in the ureter below the ureteropelvic junction but above the level of iliac vessels, "mid" between iliac vessels and pelvic brim, and "distal" if the stone was seen in the part of the ureter below the level of pelvic brim. Stone texture was recorded as hard and soft as an intraoperative finding. Stone fragmentation was considered successful if the stone could be fragmented to small (<2 mm) passable fragments or fragments small enough to be retrievable with forceps.

Hematuria was considered "mild" if macroscopic and lasted <8 hours post-operatively, "moderate to severe" if the patient got anemic/alterd hemodynamics to warrant blood transfusion. Urinary tract infection (UTI) was considered only when it was documented by culture sensitivity report. Postoperative pain was considered "mild" if it resolved on non-steroidal anti-inflammatory drugs, or "severe" when the patient needed opioids.

Patients were followed for a minimum of 6 weeks to 2 years. On follow-up abdominal radiograph, IVU or abdominal USG was obtained if necessary.

Cost of the treatment was considered as only the money (in rupees) spent by the patient, excluding the cost of equipment charges, hospital personnel charges and any other free service/medicine charges paid by the Government.

Analysis of the recorded data was performed by using chi-square, Mann-Whitney, and Kruskal-Wallis tests in SPSS version 10.

Results

Patients aged between 15-70 years; 94 were male and 106 female with male to female ratio of 1:1.12. Most of the patients (196) presented with pain which present alone in 160 and associated with other symptoms in 36 patients. Dysuria was present in 14, hematuria in 12, fever in 10; increased frequency of micturition was present in 2 patients alone or associated with pain. Two patients had no symptoms. Hydroureteronephrosis was present in 114 patients and absent in 96. Totally 124 patients had stone on the right side, while in 66 patients stone was seen on the left side. Ten patients had bilateral ureteric stone. Totally 224 stones were seen in 200 patients. Of the patients, 178 had single stone, 22 patients had 2 or more than two stones. Out of 224 stones, 148 were 5-10 mm, 54 were 11-15 mm, and 22 were more than 15 mm in size. Of these stones, 22 (9.82%) were located in upper ureter, 40 (17.86%) in mid and 162 (72.32%) in lower ureter. Among those patients who had more than one stone, 10 had both their stones in lower ureter, 2 had both their stones in mid ureter, 2 had in upper ureter, 3 had 1 in mid and 1 in lower, 3 had 1 in upper and 1 in lower ureter each, and 2 had 3 stones all in lower ureter.

Stone fragmentation was successful in 181 patients with a total of 205 stones, unsuccessful in 19 patients with a total of 19 stones due to inadequate fragmentation, proximal migration or inaccessibility of stone (Table 1).

D-J stent was used only in 80 (40%) patients. The decision of using D-J stent was purely intraoperative. Dilatation of ureteric orifice/intramural ureter was necessary in 11 (5.5%) patients to accommodate the ureteroscope and was not required in 189 (94.5%) patients.

Operation time was less than 45 min in 98 patients, 45-60 min in 84 patients and more than 60 min in 18 patients.

A total of 97 complications were seen including pain, hemorrhage and infection (Table 2). There was 1 intraoperative bleeding requiring transfusion of blood. Mild colics were relieved by nonsteroidal analgesics; moderate to severe pain required opioids. Only 1 case of ureteric stricture was seen which was relieved by ureteroscopic dilatation.

Totally 164 patients had hospital stay of less than 2 days, 20 had between 2 and 4 days, and 16 had more than 4 days. Mean hospital stay was 1.54 days. In our study, overall treatment cost to the patient excluding personnel/free service charges paid by the government, was less than Rs 1,500 in 110 patients, between Rs 1,500-3,000 in 78 patients, and more than Rs 3,000 in 12 patients. Most important factors that influenced the cost were the use of D-J stent, post-operative hospital stay, complications and the other means by which the stone was managed.

URSL was successful in 181 (90.5%) patients and failure was seen in 19 (9.5%).

Failed cases were managed with repeat URSL, D-J stent and open ureterolithotomy (Table 3).

Discussion

Management of ureteral stones presents a challenging problem to the urologist, since many factors need to be considered including the stone size, location, patient's overall health status, available technol-

Table 1. Fragmentation status of stone on lithotripsy with Swiss Lithoclast (n=224)

Fragmentation status	No of stones	Percent
Successful	205	91.5%
Unsuccessful	19	8.5%
Inadequate fragmentation	11	4.9%
Stone not reached	5	2.2%
Proximal stone migration	3	1.3%

Table 2. Complications (n=200)

Complication	No of patients	Percent
Hematuria		
• Mild	57	28.5%
• Moderate	7	3.5%
Urinary tract infection	14	7.0%
Mild pain/colic	12	6.0%
Moderate-severe pain	3	1.5%
False passage	2	1.0%
Perforation	1	0.5%
Stricture	1	0.5%

Table 3. Management of failure cases (n=200)

Procedure	No of patients	Percent
Successful primary URSL	181	90.5%
Failed primary URSL	19	9.5%
• Repeat URSL	4	2.0%
• D-J stenting	5	2.5%
• Open surgery	10	5.0%

URSL: Ureteroscopic lithotripsy.

ogy, and expertise besides the socioeconomic level of the patient.^[11] Ureteroscopic lithotripsy has become the method of choice for the management of distal ureteric calculi in many centers worldwide, although some prefer SWL. Besides being done under direct vision URSL can be done even in the presence of coagulation disorder.^[11]

For ureteroscopic lithotripsy there is a variety of lithotriptors available including USG lithotriptors, electrohydraulic lithotriptors, electromechanical lithotriptors, laser lithotriptors, and the pneumatic lithotriptors.^[12,13] USG lithotripter uses ultrasound energy to vibrate a rigid tipped probe applied on to the stone to be fragmented. Electrohydraulic lithotripter uses a type of shock wave generated in a liquid medium and applied to the stone. Electromechanical lithotripter works on electricity with a jackhammer type of movement and fragments stone. Laser lithotriptors use laser energy transmitted through the very delicate ($\approx 200 \mu\text{m}$) fibers to be applied on to the stone. Laser lithotriptors can also be incorporated with pulsed dye lasers for exact site application.^[12,13] Pneumatic type of lithotripter as used in our series uses compressed air for their working.

Lithoclast is a pneumatic lithotripter that has been developed by electromedical systems (LeSentier,

Lausanne, Switzerland). Swiss Lithoclast is a contact type pneumatic lithotripter that delivers energy of ballistic origin. The main components of the Swiss Lithoclast are the electronic control module (Generator), air supply tube and generator, quick connector, pneumatic foot control, the hand piece and probes of sizes 0.8 mm, 1 mm, 1.6 mm and 2 mm.^[14] There is considerable loss of energy from transition to a thinner probe and with bending of the probe-approximately 20-25° bend reduces output by 20-30%. However, this loss of energy can be compensated by raising the pneumatic operating pressure. Further, adaptation of the length of the probe to the endoscope length reduces the risk of bends and hence minimizes energy loss. We used 0.8 mm and 1 mm probes for most of the ureteric stones. Also the length of the inserted probe is kept between 10-20 mm longer than endoscope at the tip of the later to allow visualization of the probe. Besides these instructions, probe should be applied slightly sideways to the stone and slightly pressed to the wall of the ureter to minimize proximal stone migration. The machine can be kept at single pulse or multiple pulse modes (12/sec) with lower pneumatic pressures used initially. For multiple pulse modes it is recommended to stop the fragmentation and to control position and disin-

tegration of the stone regularly after 1-2 sec (12-24 pulses).^[15-17] Fragmented stone can be removed piecemeal with forceps or basket, or further fragmented. Smaller fragments are allowed to pass spontaneously. Advantages of the Swiss Lithoclast include its simplicity, reliability, and ease of use besides low cost and lack of any disposable components. Hospital air supply that is readily available can also be utilized for activation of the probe. In comparison with other forms of lithotriptors, it can break even extremely hard calculi rapidly. There is no heat generated during activation of the device, neither is there any risk of electrocution. The disadvantage with the device is that it can be only used with rigid or semi-rigid ureteroscopes.^[17-20]

Rate of successful fragmentation of ureteral calculi has been reported between 70-97%.^[11,15-19] Our results are comparable to other studies of pneumatic lithotripsy with successful fragmentation in 91.51% stones. Ureteral stenting after ureteroscopic lithotripsy is a common practice to avoid postoperative complications like ureteral obstruction. In our study, D-J stent was used in 80 (40%) patients. Studies have shown uncomplicated stentless ureteroscopies to be safe.^[21,22] We believe that liberal use of stent in our study could lead to a reduced incidence of ureteral stricture. Potential of proximal stone migration during treatment is the only appreciable disadvantage with pneumatic lithotripsy, which can be reduced with the use of suction device, lidocaine jelly or occluding basket.^[23,24] Only 4 (2%) patients in our study had proximal migration of the stone/fragments. In 10 (5%) patients whose stone failed Lithoclast fragmentation, stone was managed by open stone surgery under the same anesthesia. Complications of the procedure were essentially managed conservatively with opioids for severe pain and blood transfusion for significant intraoperative bleeding. Perforation occurred in 1 (0.5%) patient, which was managed conservatively by placement of D-J stent. One (0.5%) patient in our study developed ureteric stricture, which responded to ureteric dilatation. There was no ureteric avulsion neither was any patient converted to open surgery for a complication. There were no deaths in our study. These results are in parallel with the results of previous studies.^[25-30]

Overall success of the procedure was 90.5%. Failures were mainly related to failure to reach the

stone, poor visualization of stone due to severe tissue edema and severe ureteric dilatation not allowing trapping of the stone against the ureteric wall besides true inability of the device to fragment a few extremely hard calculi. The success rates in our study are fairly comparable with previous studies.^[27,28,30]

As a conclusion, today urologists can choose any of the wide array of technologies and techniques for the management of ureteral calculi. Ureteroscopic lithotripsy has gained wide acceptance worldwide and is an established technique. Lithotripsy using Swiss Lithoclast is perhaps the cheapest and quite efficient technique in managing ureteric stones intracorporeally. Because of very long instrument life, lack of any disposable components, and easy maintenance; it very well suits the needs of low socioeconomic countries like India.

Conflict of interest

No conflict of interest was declared by the authors.

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Correspondence (Yazışma): Uzm. Dr. Nisar A. Wani
Sher-i-kashmir Institute of Medical Sciences, Department of
Radiology, Srinagar, India.
Phone: 091-9419138289 e-mail: nisar.wani@yahoo.com
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