Original Article

Evaluation of Safety and Efficacy of Ureteroscopic Lithotripsy in Managing Ureteral Calculi

*IkramUllah**
*Bakhtawar Gul Wazir***
*Khursheed Alam**
*Muhammad Islam**
*Faridullah Shah**
*Sadaqat Ali Khan**

**FCPS Trainee*
***Assistant Professor*
Institute of Kidney Diseases, Hayatabad Medical Complex (HMC), Peshawar

Objective: To evaluate the safety and effectiveness of Ureteroscopic Lithotripsy for the treatment of ureteral calculi by using Swiss Lithoclast.

Study Design: Descriptive Case series study.

Place and Duration: This study was carried out at the Institute of Kidney Diseases, Hayatabad Peshawar from July 2009 to February 2011.

Subjects and Methods: The study included patients of either gender over 14 years of age who had ureteric stones and were managed with ureteroscopic lithotripsy using Swiss Lithoclast at our institute. Consecutive sampling technique was employed. Patients who had already received treatment at some other health care facility, those <14 years of age, or those having radiolucent stones, stones over > 2cm, failure to apply Swiss Lithoclast were excluded from the study.

Results : Out of a total of 82 patients, 70.73%(n= 58) were males and 29.26% (n=24) were females. The age ranged from 17-97 years, with the mean age of 43.31 years. The success rate of stone removal in the upper, middle and lower ureter was 72.72%%, 87.5% and 95.23% respectively. The overall success rate was 85.15%.The overall complication rate was 17.04 % and the main complications included ureteral perforation (n=2), ureteral avulsion (n=1), urosepsis (n=2) and stone migration (n=10).

Conclusion: Ureteroscopic lithotripsy using Swiss Lithoclast is a safe and effective method of managing ureteric stones measuring less than 2 cm.

Key Words: Ureteral calculi. Ureteroscopic Lithotripsy. Swiss Lithoclast

Address for Correspondence
Dr. IkramUllah,
Trainee Registrar,
Institute of Kidney Diseases,
Hayatabad Medical Complex (HMC),
Peshawar
E-mail: petarian88106@yahoo.com

Introduction

Endourological treatment of urinary calculi has rapidly evolved over the last two decades. Ureteroscopic lithotripsy, Shock wave lithotripsy (SWL), Laparoscopic lithotomy, and percutaneous nephrolithotomy have emerged as new modalities. In recent years, the advent of small caliber ureteroscopes and advances in intraureteral lithotripsy has allowed high rates of successful and safe endoscopic treatment of ureteral calculi. [1,2]

Ureteroscopy (URS) has gained widespread use for the diagnosis and treatment of supra vesical urinary tract diseases. URS is the most advocated treatment for patients with ureteral calculi with stone free rate greater than 90% after a single treatment. Open ureterolithotomy is no longer considered as a valid option in a well equipped endourological center. With the introduction of insitu extracorporeal shock wave lithotripsy and different intracorporeal techniques in to urologic practice, up to 95% ureteral stones can be successfully treated by minimally invasive method.[3-8] However, due to the 18-25% failure rates of primary ESWL, ureteroscopy and intracorporeal lithotripsy have become an alternative treatment modality for ureteral stones. [9, 10] There are currently several devices for intra-corporeal lithotripsy. With the help of electro hydraulic, ultrasonic, pneumatic, or laser lithotriptors, treatment of ureteral stones has been achieved with very high success rates. [7, 11, 12] The pneumatic contact lithotripters combines high efficacy with minimal tissue trauma, and was first introduced in the early 1900s. [13, 14] Tunc L et al[15] noted that URS using pneumatic lithotripsy should be used as the first-line treatment rather than SWL for stones larger than 10 mm.

The present study was undertaken to determine the safety and effectiveness of URS with pneumatic Lithotripsy in our patients managed for ureteric calculi measuring < 2cm.

Materials and Methods

This descriptive case series study was carried out at Institute of Kidney Diseases Hayatabad Peshawar from July 2009 to February 2011. Informed consent was taken from all the patients. Permission was sought from the hospital ethics committee for conducting the study. All patients of either gender over 14 years of age who had ureteric stones and were managed with ureteroscopic lithotripsy using Swiss Lithoclast at our institute were included in the study. Consecutive sampling technique was employed. Patients who had already received treatment at some other health care facility, those <14 years of age, or those having radiolucent stones, stones over > 2cm, failure to apply Swiss Lithoclast were excluded from the study.

The patients were initially assessed by adequate history, thorough examination and investigations (biochemical analysis, blood count, urinalysis and culture of urine). Intravenous pyelogram was taken to confirm the diagnosis and determine the location and size of stones. Prophylactic antibiotics were employed in all patients. The procedure was performed with the patient under general anesthesia. The access to the calculi was retrograde in all patients. A 9.5f rigid ureteroscope (Karl Storz Germany) was used transurethrally and safety guide wire was inserted into the ureter as a cystoscopic procedure. The ureteroscope was introduced via ureteral orifice without ureteral dilation. Flow of irrigation was controlled by a valve attached to the ureteroscope and accelerated with squeezing pump as needed during operation. Lithoclast probe was passed through the working channel, placed in contact with the calculi, and stones were fragmented down to pieces smaller than 2 mm in diameter under video monitoring and foot control switch. Fragmented stones were removed out of the ureter as much as possible using basket or forceps. A JJ stent (6fr) was placed whenever decided necessary in cases of ureteral edema secondary to an impacted calculus, ureteral injury, and upward migration of stone fragments, marked bleeding, residual stones, and the surgeon's preference. A plain radiography of the kidney, ureters and bladder (KUB) was performed 3 weeks after surgery to assess residual stone fragments. Success was defined as symptoms free and no evidence of residual stones larger than 2 mm in diameter. Intravenous pyelogram was performed in all patients after 2 months to verify ureteral patency.

Complications arising during the course of management were managed according to standard protocols. A search was made for any ureteral perforations visually at the time of surgery. All ureteral perforations were managed with double JJ insertion after stopping the procedure as soon as possible. For any ureteric avulsion, identified intra-operatively, re-implantation into the bladder was done in the same setting. Urosepsis was diagnosed with clinical findings, fever > 38.5° C and positive urine culture. Patients with stone migration were managed with double-J insertion and further ESWL. All patients who suffered from ureteral perforation underwent intravenous pyelography 2 weeks after removal of ureteral stent in order to rule out any ureteral stricture or extravasation of contrast material.

The data were analyzed through SPSS version 10 and various descriptive statistics were used to calculate frequencies, percentages, means and standard deviation.

Results

Out of a total of 82 patients, 70.73 %(n= 58) were males and 29.26% (n=24) were females. The age ranged from 17-97 years, with the mean age of 43.31 years.

58.53% (n=48) patients had calculi in the left ureter, 34.14% (n=28) in the right and 7.31% (n=6) patients had bilateral Ureteric calculi which were treated simultaneously. 88 ureteral calculi were treated in 82 patients. Amongst 88 stones, 22 (25%) stones were in the upper ureter, 24(27.27%) in the middle ureter and 42 (47.72%) stones were in lower ureter.

Satisfactory fragmentation was achieved in 85.15 % patients. 6 (27.27%) calculi in upper ureter were pushed up in the kidney during the procedure which was later treated with ESWL. JJ stent (6fr) was left in 66 (80%) patients. Ureteral stent was left in place for 2 to 8 weeks according to postoperative condition of the ureter. Ureteral perforations were treated with stent indwelling for 4 to 8 weeks without open surgery.

Overall success rate was 85.15%. The success rate in the upper, middle and lower ureter was 72.72%, 87.5% and 95.23% respectively (**Table I**)

Table I: Ureter Stones and Success Rate. (n =88)

Site of stone	No. of Stones	Success Rate	Percentage
Upper ureter	22	16	72.72%
Middle Ureter	24	21	87.5%
Lower Ureter	42	40	95.23%
Total	88	77	85.15%

The overall complication rate was 17.04 % and the main complications included ureteral perforation (n=2), ureteral avulsion (n=1), urosepsis (n=2) and stone migration (n=10).

In all uncomplicated cases (n=77), patients spent one night in the hospital and were discharged the day following intervention. The hospital stay was longer for patients with ureteral perforation (n=2), ureteral avulsion (n=1), urosepsis (n=2) and stone migration (n=10). The mean stay for these later patients was 6 days. There was no in-hospital mortality.

Discussion

At our institute we are increasingly employing newer modalities for managing ureteric calculi. The management of ureteric stones has seen a change from open to conservative surgery, and then minimal invasive surgery, laparoscopic surgery Extra-corporeal Shock wave lithotripsy, and endoscopic removal. Intracorporeal lithotripsy devices and ureteroscopic invention has made treatment of ureteric stones much convenient. The treatment alternatives for ureteral stones are SWL, several intra corporeal lithotripsy techniques and finally open ureterolithotomy in selected cases. Although stones less than 4-5 mm in diameter can pass spontaneously without causing significant problems, [16] larger stones need treatment and can be managed by minimally invasive methods. On the other hand, larger stones are a subgroup that is difficult to decide on treatment options, because theses stones are more likely to have obstruction, infection, or impaction. [17] Also, the higher risk of renal damage associated with obstruction requires these patients to be treated immediately. Size, number, localization and composition of the stones, the degree of hydronephrosis, patient's characteristics, and available technology are the other factors affecting the choice of treatment method.

In our study, we present our results of pneumatic lithotripsy performed in patients with ureteral stones. Means of ureteroscopic Lithotripsy are electro hydraulic, pneumatic and laser. These instruments are passed through the working channel of the ureteroscope to fragment stones in to extractable pieces. In choosing a specific lithotripter operator one should take into account not only the characteristics of the stone but also the potential adverse events of the specific lithotripsy technique. [18] Every device has its advantages end limitations. The Swiss Lithoclast (a pneumatic lithotripter), originally developed at the University Teaching Hospital in Lausanne, Switzerland, is based on a jackhammer principle.[14] A projectile in the hand piece is propelled by compressed air through the probe. The compressed air originates from a small generator that is connected to a dry, clean air supply. The ballistic energy produced is conveyed to the probe base at a rate of 12Hz.[19] Continued impaction of the probe tip against the stone results in stone breakage once the tensile forces of the calculus are overcome. The metallic rods are available in five diameters: 0.8 mm, 1.0 mm, 1.6 mm, 2.0 mm, and 3.5mm. Pneumatic lithotripsy has the benefit of better stone targeting and visualization than is possible with the laser. Rapid flashes of light emanating from laser and visually obscuring protective eyewear may interfere with targeting. Nevertheless, according to recent studies comparing holmium: YAG laser with Swiss Lithoclast, holmium: YAG laser has higher stone-free rate or fragmentation rate and fewer complications.[19,20] Stone free rate holmium: YAG laser ranged from 92% to 97% and complication rate was as low as below 4%. On the other hand, stone free rate of pneumatic lithotripsy ranged from 82% to 86% and complication rate was 8% to 14% in these studies. Swiss Lithoclast had been the only available tool of ureteroscopic lithotripsy in our hospital for 2 years, so we did not have chance to compare it with other modalities including holmium: YAG laser. It is well established that pneumatic lithotripter has merits of safety and cost-effectiveness. Pneumatic lithotripter is very effective on every stone composition including calcium oxalate monohydrate and cystine stones,[19] and it is rarely traumatic to tissue and has a low complication rate. [19-21]

The rate of successful fragmentation of ureteral calculi has wide spectrum from 70.7% to 96.8%, showing a trend of higher success rate as the number of patients increases in each study and as the follow up time increases from the day of operation. [21, 22] Our results are comparable with those of other studies about pneumatic lithotripsy. The only appreciable disadvantages of pneumatic lithotripsy are the limitation of probe rigidity and the potential for proximal stone migration during treatment.

The overall rate of stone migration in this study was 11.36 and 27.27% of upper ureter stone was failed due to upward migration. The use of suction device (Lithovac) in conjunction with the lithoclast or occlusion or occlusion devices (basket, occlusion balloon catheter, stone cone) or occlusion material (lidocaine jelly) decreases the migration rate. [22] We did not use any occlusion devices to prevent upper migration. We did not have a flexible ureteroscope, so we used SWL for migrated stones left in renal collecting system.

We routinely used ureteric stents post lithotripsy. Ureteral stenting after ureteroscopic lithotripsy is a common practice to prevent postoperative complications such as ureteral obstruction. Some investigator noted that uncomplicated ureteroscopy can be performed without routine stenting with minimal patient discomfort and a low incidence of postoperative complications. [23] Densted et al. [24] reported that patients, in whom a stent was not inserted, were not at increased risk for complications and postoperative symptoms including flank pain after ureteroscopy compared with those with a stent, and ureteral stenting after

uncomplicated ureteroscopic stone fragmentation was no longer absolutely necessary in all cases.

Conclusion

Ureteroscopic lithotripsy using Swiss Lithoclast is a safe and effective method of managing ureteric stones measuring less than 2 cm.

References

1. Dubosq F, Pasqui F, Girard F, Beley S, Lesaux N, Gattegno B, Thibault P, et al. Endoscopic lithotripsy and the FREDDY laser: initial experience. J Endourol 2006;20:296-9.
2. Marks AJ, Teichman JM. Lasers in clinical urology: stata of the art and new horizons. World J Urol 2007;25:227-33.
3. Yinghao S, Linhui W, Songxi Q, Guoqiang L, Chaunliang X, Xu G. Swiss lithoclast pneumatic lithotripter: report of 150 cases. J Endourol 2000; 14: 281-3.
4. Ather MH, Paryani J, Memon A, Sulaiman MN. A 10-year experience of managing ureteric calculi: Changing trends towards endourological intervention-is there a role of open surgery? BJU Int 2001;88:173-177.
5. Dirim A, Tekin MI, Aytekin C, Peskircioglu L, Boyvat F, Ozkardes H. Ureteroscopic treatment of proximal ureter stones with aid of an antegrade occlusion balloon catheter. Acta Radiol 2006; 47: 103-6.
6. Kupeli B, Biri H, Isen K, Onaran M, Alkibay T, Karaoglan U, Bozkirli. Treatment of ureteral stones: comparison of extracorporeal shock wave lithotripsy and endourologic alternatives. Eur Urol 1998; 34:474-479.
7. Naqui SA, khalogi M, Zafar MN, Rizwi SA. Treatment of uretreric stones. Comparison of laser and pneumatic lithotripsy. Br J Urol 1994; 74:694-698.
8. Maislos SD, Volpe M, Albert PS, Raboy A. Efficacy of the stone cone for treatment of proximal ureteral stones. J Endourol 2004; 18:862-4.
9. Merberger M, Hofbaur J, Tuerk C, Hobart K, Albrecth W. The management of ureteric stones. Eur Urol 1994; 25:265-268.
10. Fuchs GI, Chaussy CG, Stenal A. Current management concepts in the treatment of uretreal stones. J Endourol 1988; 2:117-120.
11. Jeon SS, Hyum JH, Lee KS. A comparison of holmium:YAG laser with Lithoclast lithotripsy in ureteral calculi fragmentation. Int J Urol 2005;12:544-7.
12. Yinghao S, Linghu W, Sangxi Q, Guogiang L, Chuanliang XU, XU G, Yongiang MA. Treatment of urinary calculi with ureteroscopy and swiss lithoclast pneumatic lithotripter: Report of 150 cases. J Endourol 2000; 14:281-283.
13. Bapat SS, Pai KV, Pumapatre SS, Yadav PB, Padye AS. Comparison of holmium laser and pneumatic lithotripsy in managing upper ureteral stones. J Endourol 2007;21:1425-7.
14. Denstedt JD, Eberwein PM, Sing RR. The Swiss Lithoclast: A new device for intracorporeal lithotripsy. J Urol 1992; 148:1088-1090.
15. Tunc L, Kupeli B, Senocak, Alkibay T, Sozen S, Karaoglan U, et al. Pneumatic lithotripsy for large ureteral stones: Is the first line treatment? Int Nephrol 2007;39:759-764.
16. Segura JW, Preminger GM, Assimos DG, Dretler SP, Kahn RI, Lingeman JE, 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.
17. Ilker NY, Alican Y, Simsek F, Turkeri LN, Akdas A. Ureteral extracorporeal shock wave lithotripsy utilizing Dornier MFL 5000. J. Endourol 1994; 8:13-14.
18. Piergiovanni M, Desgrandchamps F, Cochand-Priollet B, Janssen T, Colomer S, Teillac P, et al. Ureteral and bladder lesions after ballistic, ultrasonic, electrohydraulic, or laser lithotripsy, J Endourol 1994;8: 293-9.
19. Teh CL, Zhong P, Preminger GM. Laboratory and clinical assessment of pneumatically driven intracorporeal lithotripsy. J Endourol 1998;12:163-9.
20. Tipu SA, Malik HA, Mohhayuddin N, Sultan G, Hussain M, Hashmi A, et al. Treatment of ureteric calculi-use of Holmium:YAG laser lithotripsy versus pneumatic lithoclast. J Pak Med Assoc 2007;57:440-3.
21. Sozen S, Kupeli B, Tunc L, Senocak C, Alkibay T, Karaoglan U, et al. Management of ureteral stones with pneumatic lithotripsy: report of 500 patients. J Endourol 2003; 17: 721-4.
22. Mohseini MG, Arasteh S, Alizadeh F, Preventing retrograde stone displacement during pneumatic lithotripsy for ureteral calculi using lidocaine jelly. Urology 2006; 68: 505-7.
23. Rane A, Cahill D, Larner T, Saleemi A, Tiptaft R. To stent or not to stent? That is still the question. J Endourol 2000; 14: 479-81.
24. Denstedt JD, Wollin TA, Sofer M, Nott L, Weir M, D' A Honey RJ. Aprospective randomized controlled trial comparing non stented versus stented ureteroscopic lithotripsy. J Urol 2001; 165: 1419-22.