ORIGINAL PAPER

UROLITHIASIS

Management of lower ureteric stones: a prospective study

Mohamed Etafy[2], Gamal A.M. Morsi[1], Mansour S.M. Beshir[1], Sheri S. Soliman[1], Hussein A. Galal[1], Cervando Ortiz–Vanderdys[3]

[1]*Faculty of Medicine, Urology Department, Al–Azhar University, Assiut, Egypt*
[2]*Jackson Health System, Miami, FL, USA*
[3]*Universidad Central de Venezuela, Escuela de Medicina Luis Carreño, Caracas, Venezuela*

Article history
Submitted: Jan. 14, 2013
Accepted: Aug. 22, 2013

Correspondence
Mohamed Etafy
15959 SW 95 AVE #3A
33157 Miami,
United States
phone: +1 78 65 479 596
mhamdan102@gmail.com

Objective. To discuss the current concepts in lower ureteric stone management.
Material and methods. Between October 2008 and November 2010, 190 patients of both sexes and of different age groups with lower ureteric stones, underwent in situ extracorporeal shock wave lithotripsy (ESWL) (48 cases), ureterorenoscopy (URS) (120 cases) and open stone surgery (OSS) (22 cases).
The patients' clinical and radiological findings, as well as stone characteristics, were reviewed and correlated with the stone–free status.
Results. In the ESWL group, the operative time was 43.13 +22.5 min; the average number of sessions/patients was 1.5 sessions; the average number of SW/patients was 4500 SW/patients; the average energy was 16.5 kV; the average stone burden was 7.8/mm; the overall stone–free rate was 75% (36/48); and the average radiation exposure time was 3.5 min.
In the URS group, the operative time was 49.21 +16.09 min; the average stone burden was 10.81mm; the overall stone–free rate was 97.5% (117/120); the average hospital stay was 3.99 days; and the average radiation exposure time was 0.75 min.
In the OSS group, the operative time was 112.38 +37.1 min; the overall stone–free rate was 100% (22/22); and the average hospital stay was 9.74 days.
Conclusion. In the management of patients with lower ureteral stones, URS, SWL and OSS were considered acceptable treatment options.
This recommendation was based on the stone–free results, morbidity and retreatment rates for each therapy.

Key Words: management ‹› stones ‹› SWL ‹› URS ‹› OSS ‹› ureter

INTRODUCTION

Distal ureteral stones may be treated with medical options including Extracorporeal Shock Wave Lithotripsy (ESWL) with or without a stent; ureteroscopy (URS) with extraction or intracorporeal lithotripsy; and, rarely, open (OSS) and laparoscopic stone surgery. Owing to their equivalent efficacies, ESWL and URS were both considered acceptable treatment options [1]. Although URS is an invasive procedure, in the hands of an experienced urologist it proves to be a highly effective procedure, with success rates of nearly 100% in the distal ureter and negligible retreatment rates, low cost, and widespread availability [2]. Increased experience with the use of ESWL showed that ureteral calculi didn't fragment as reliably as kidney stones. Several experimental and clinical studies showed that lack of an expansion chamber and stone fluid interfaces were responsible for this phenomenon [3].
Our aim was to refine guidelines regarding the optimal selection of treatment modality for our patients with lower ureteral stones.

PATIENTS AND METHODS

This prospective non–randomized study includes one hundred and ninety patients of both sexes and of dif-

10.5173/ceju.2013.04.art19

ferent age groups, with lower ureteric stones. The patients underwent *in situ* ESWL (48 cases), URS (120 cases) and open stone surgery (OSS) (22 cases) in over 2 years between October 2008 to November 2010.
Inclusion criteria:
- Patients with lower ureteric stones (below the sacroiliac joint) being unilateral or bilateral, primary or recurrent (after ESWL, URS or OSS).
- Stones less or more than 20 mm in size (the stone burden will be measured in a plain X–ray).
- Patients with radio–opaque lower ureteric stones (for ESWL).
- Large stone particles in the lower third ureter after ESWL for ipsilateral renal stones.
- Steinstrasse in the lower third ureter after ESWL for ipsilateral renal stones.

Exclusion criteria:
- Patient's refusal.
- Severe orthopedic deformities (that interfere with coupling mechanism, lithotomy position or supine position).
- Bleeding diathesis.
- Pregnancy (for ESWL).
- Morbid obesity (for ESWL).
- Female patient in the child bearing period (for ESWL).
- Patients with ipsilateral distal ureteral stricture (for ESWL).

The treatment modality chosen for an individual is primarily based on patient choice after explanation of the available treatment options and the drawbacks, complications and advantages associated with each one. A written consent for acceptance of the procedures and possible complications is obtained. According to the stone size, number and location, the eligible patients with distal ureteral calculi (below the sacroiliac joint) are classified into three groups:
1. ESWL group: 48 patients.
2. URS group: 120 patients.
3. OSS group: 22 patients.

A meticulous history was taken for every patient as well as a clinical examination and investigation in the form of urine analysis, kidney, ureter, bladder X–ray (KUB), abd–pelvic US, intravenous urogram (IVU), non–contrast spiral abd–pelvic CT scan, ECG for patients >40 years and laboratory investigation.

The SWL group

This group included 48 patients. They were treated by ESWL using Siemens Lithostar, which was provided anesthesia–free as using the sedative–analgesia pethidine together with one of the non–steroidal anti–inflammatory drugs (NSAIDs) was enough to achieve a successful session.

Operative technique
1. Patient bowel preparation: a mild laxative and carbon tablets were taken the night before the procedure.
2. Patient positioning on the lithotripter: the patients were treated in the oblique prone position with rotation to the stone–bearing side at about 30 degrees. The patient's head can be placed at either end of the table, according to the side of the stone.
3. Stone localization: the standard localization system used for lower ureteric stones is the X–ray localization system where the stones were localized in two different planes in 0 and 30 degree views.

Shock wave administration: in the cases treated by 4. Siemens Lithostar, we began with 0.1 energy, then after 100 shocks the energy was increased in a stepwise manner and could be increased up to 6 in every session. Energy of the Siemens Lithostar is scaled from 0.1 to 8, which equals focal pressure of 300 to 650 bar.

Patient follow–up
Early postoperative follow–up
On the second day post–ESWL treatment, urine analysis of the available patients was performed and repeated the third day post–ESWL for the indicated and available patients. If there were no complications, a plain KUB film was done 15 days after the last session to infer about the stone and its clearance. We cannot proceed to subsequent interventions before a minimum of two weeks have passed after the last session.
Long term follow–up occurred for all patients after one month, three months and six months postoperatively. The follow–up tools include:
1. Clinical assessment: both subjective and objective (patients were asked whether they had any flank pain, colic, hematuria, stone clearance or other urinary tract symptoms).
2. Urine analysis and urine culture and sensitivity (When indicated).
3. KUB film.
4. Abdominal ultrasonography.

The ureteroscopic group

This group included 120 patients. The treatment of the lower ureteric stones in this group was done using semirigid Storz ureteroscope 7.5–9 Fr. along with pneumatic or electrohydraulic lithotripsy. The procedure was done with patient under spinal or general anesthesia and in the lithotomy position.
Operative technique
- Adult patients underwent urethrocystoscopy with a standard 21 Fr. cystoscope sheath. A 0.038/150

floppy–tipped guide wire (with 0.038–inch diameter and 150 cm length) was usually applied through an open tip ureteral catheter.
- In cases when the introduction of the usual guide wire failed, the 0.035/150 Zebra guide wire (with 0.035–inch diameter, 150–cm length, 3 cm floppy tip and 60 cm Uroglide) was a useful alternative. The ureteroscope was used to deploy the guide wire when there was difficulty in passage of both wires through the ureteral orifice.
- A balloon dilator (acute dilatation) was used to dilate the intramural ureter before the initial introduction of the ureteroscope.
- The ureteroscope was then passed alongside the guide wire into the bladder, the ureteral orifice was carefully engaged, and the ureteroscope was again passed alongside the guide wire under both direct and fluoroscopic guidance. The ureteroscope was advanced up the ureter, and the ureteral lumen was examined up to the level of the stone.
- In the case of a large stone, a Lithoclast was used to fragment the stone, and then the fragments removed by a Dormia basket. Small stones were removed directly using a Dormia basket or grasper forceps without initial lithotripsy. A revising ureteroscopic inspection, as well as the fluoroscopic guide, was done to detect any ureteral injuries or any residual stone fragments requiring further manipulations. At the end of the maneuver, in cases of ureteral stricture or vigorous manipulation of the ureter, a stent was inserted either by ureteral catheter or JJ stent.
- The irrigation during URS was done using a distilled water bag connected to the input channel, which allowed controlled irrigation and thus helped avoid stone migration. In cases with impacted stones, we used the wash flush by applying pressure on the irrigating bag. This was to overcome the problem of difficult stone visualization in these cases.

Patient follow–up
Immediate follow–up
The vital data of the patients was evaluated and an abdominal examination was performed to detect any complications (urinoma or internal hemorrage). KUB film was done on the second day to assess stone disintegration.

Long term follow–up
All patients were followed up one week, one month, three months and six months postoperatively.

Open surgery group

This group includes 22 patients for treatment of lower ureteric stones.

Operative technique
- With the patient in the supine position a Pfannenstiel or midline suprapubic incision is used which begins as a semi lunar transverse incision 2–3 cm above the symphisis pubis.
- The anterior rectus sheath is incised horizontally curving upwards on either side to avoid the inguinal canal laterally. The edge of the rectus sheath is grasped with clamps and the rectus muscle is bluntly separated, the midline is then taken down sharply or with electrocautery. A curved clamp is used bluntly to enter the perivesical space just above the pubis. The attenuated transversalis fascia is incised in the midline, and then extra peritoneal exposure is provided.
- The ureter is then mobilized carefully, preserving its adventitia. Ureterolithotomy is done through a longitudinal incision just on the stone. The stone is then grasped out of the ureter by the stone forceps.
- Patency of the ureter is assured by placement of a ureteral stent distally.
- In cases where a ureteric stricture was present, a stent was left behind. If no stricture was found then an uretero vesical reimplantation combined with anti–reflux techniques were performed followed by the insertions of an ureteral stent.
- The wound is then closed in layers after good hemostasis and a tube drain is placed.

Patient follow–up
Immediate follow–up
The vital data of the patients was evaluated and an abdominal examination was performed to detect any complications (urinoma or internal hemorrhage). KUB film was done following the procedure to ensure a stone–free result.

Long term follow–up.
All patients were followed up one week, one month, three months and six months post operatively.

Statistical analysis

Statistics were done by computer using "Epi–Info, version 6.04", a word–processing, database and statistics program (WHO, 2001).
1. x^2 and SD (mean and standard deviation): to measure the central tendency of data and the distribution of data around the mean value.
2. Student's t test: for testing statistical significant difference between means of two samples.
3. X^2 (Chi square) test: to test statistical significant relation between different variables or grades (qualitative data), or percentage.
4. Fisher exact test: for comparing two or more independent proportions when the expected observation in any cell of the Table is below 5.

5. Analysis of variance (ANOVA) for comparison between more than 2 groups of parametric data
- Significant result is considered if P <0.05
- Highly significant result is considered if P <0.01

RESULTS

In this study we compared three treatment options in managing lower ureteral stones.
We included 190 patients in this study who harbored lower ureteric stones of variable stone character. Various adult age groups of both sexes were included in this study. Comparison of age of subjects between the three groups using a one way ANOVA test showed that there was a high significant difference between the groups (see Table 1) with the younger patients (47.5 on average) undergoing URS and the older patients (51.5 on average) undergoing OSS. There was no statistical significant difference between groups regarding gender (see Table 1).

There were high significant differences in the stone size between the three treatment groups with the smaller stones (7.8 mm on average) being treated by URS and the larger stones (29 mm on average) by OSS (see Table 2).

Table 1. *Demographics of patients in the different groups*

	ESWL	URS	OSS
Age Range	20–69	13–67	28–76
Mean age ±SD	47.46 ±12.4	44.38 ±10.73	51.52 ±12.18
No. patients	48	120	22
p–value		F = 4.21, p = 0.01	
Male	43 (89.8%)	107 (89.2%)	22 (100%)
Female	5 (10.2%)	13 (10.8%)	0 (0%)
p–value		X^2 = 2.60, p = 0.2721	

Table 2. *Characteristics of the stones in the different groups*

	ESWL	URS	OSS
Stone size (mm)			
Range	4–20	4–40	5–40
Mean ±SD	7.81 ±3.42	10.81 ±4.7	28.79 ±8.27
p–value		F = 124.6, p = 0.0000	
Stones <10 mm	36 (75.7%)	38 (31.7%)	1(5.3%)
Stones >10mm	12 (24.3%)	82 (68.3%)	21 (94.7%)
p–value		X^2 = 30.33 , p = 0.0000	
Stone impaction	4 (8.1%)	96 (80%)	21 (94.7%)
p–value		X^2 = 70.15 p = 0.0000	
Radio–opacity	48 (100%)	106 (88.3%)	21 (94.7%)
p–value		X^2 = 6.8, p = 0.033	

There was a high significant difference between groups in stone impaction (see Table 2).
In our ESWL group, 4 patients (8.1%) had impacted stones of which 2 (50%) became stone–free. Of the patients with non–impacted stones, 34 of the patients (76%) became stone–free.
There was a significant difference in radio–opacity between groups (see Table 2).
There was a high significant difference between groups when comparing percentage of success (see Table 3) with only a 75% success with ESWL and a considerably better 97.5% or more success rate for the more invasive modalities (URS 97.5% and OSS 100%).

Effect of stone criteria on the outcome
Effect of stone burden

Table 3. *Overall success of intervention*

	ESWL	URS	OSS
Success	36 (75%)	117 (97.5%)	22 (100%)
Failure	12 (25%)	3 (2.5%)	0
p–value		X^2 = 26.1, p = 0.0000	

Table 4. *Table (ESWL): Effect of stone burden on ESWL therapy*

	Stone size		
	<10 mm	≥10 mm	p–value
No. of cases	28	20	
Average operative time (min)	48.93 ±15.5	65.75 ±20.3	t = 3.33, p = 0.0016
Stone–free rate	26/28 (92.9%)	6/9 (66.7%)	X2 = 3.89, p = 0.0485
Sessions /patient			
1	19 (82.6%)	4 (17.4%)	
2	7 (31.8%)	15 (68.2%)	X2 = 12.03, p = 0.0024
3	2 (66.7%)	1 (33.3%)	
SW/patient			
3000	3 (60%)	2 (40%)	
4000	7 (43.7%)	9 (56.3%)	X2 = 6.02, p = 0.0012
5000	7 (63.7%)	4 (36.3%)	
6000	11 (68.8%)	5 (31.2%)	
No. of kV			
15	9 (64.3%)	5 (35.7%)	
16	6 (42.9%)	8 (57.1%)	
17	9 (60%)	6 (40%)	X2 = 1.89, p = 0.7562
18	4 (80%)	1 (20%)	
19	1 (50%)	1 (50%)	

1. In the ESWL group (see Table 4):
There was a high significant relation between size of stone, number of sessions and clearance. No significant relation between size of stone and number of kV.
2. In the URS group (see Table 5):
There was a high significant relation between stone size, operative time, method used and complications rate.
3. In the OSS group (see Table 6):
There was no significant relation between stone size, operative time, methods used and complication rate.

DISCUSSION

The overall stone–free rate in patients treated by ESWL in our study was 75% as 36 out of 48 patients are stone–free. Our rate falls within the distal ureteral stone–free rate according to literature, which ranges from 53% to 96% [4, 7, 8]. Abdelghany et al. 2011 [5] and Fayed et al., 2007 [6] reported a stone clearance of 84% and 88% respectively, of ESWL for lower ureteric calculi.
In addition to this value in treatment of distal ureteral stones, ESWL has a number of advantages over ureteroscopy, namely: shorter operative time, fewer complications, and faster convalescence. In the 12 cases (25%) with negative results, the stone failed to disintegrate even after the third session. However, the stone clearance failed due to the stone being too hard and the development of severe persistent colicky pain with progression to upper urinary tract obstruction. Therefore, these failed cases were shifted to other methods of treatment such as URS.
The overall stone–free rate in the URS group in our study was 97.5%. Zeng et al., 2003 [9] found that on day 7 after treatment, stone clearance was noted in 88.3% of cases in the URS group and on day 28, stone clearance was noted in 93.3% of cases. Sowter and Tolley, 2006 [10], reported that the overall stone–free rate was 92.4% and increased to 94.6% when only distal ureteral stones were considered. Eden and Associates, 2003 [11] estimated that the ESWL and ureteroscopy have 50% and 89% success rates respectively, in the treatment of multiple distal ureteral stones.
In recent years, the advent of small caliber ureteroscopes and advances in intracorporeal lithotripsy, such as ultrasound, pneumatic, electro–hydraulic, Neodymium: YAG laser, Pulsed Dye laser and most recently the Holmium: YAG laser, have allowed more successful and safer endoscopic removal of ureteral calculi [14].
In our study, the size of the stone was an important factor in determining the response to ESWL. With increased size, the number of sessions, shocks and also the rate of voltage were increased while the post procedure stone–free rate decreased. Other authors report similar findings such as Seitz et al., 2008 [15]. Abdelghany et al., 2011 [5] reported a significantly higher stone–free rate when stone size was <8 mm. Bierkens et al., 1998 [16] stated that the smaller the stone, the greater the likelihood of success with ESWL and the best results were achieved for stones <1 mm. Abdel–Khaleke et al., 2003 [17] stated that stones with a transverse diameter of <10 mm were associated with stone–free rate 89.7% compared to 83% for those with a transverse diameter of >10 mm. However, Seitz et al., 2008 [15] reported that only the maximum diameter of the stone affected the ESWL success. The authors of this study emphasized that these findings are in accordance with the AUA recommendations that ESWL can be used for the management of distal ureteric stones of 11 to 20 mm.
Disintegration failure in those patients and the need for more shock waves may be explained by hampered targeting of the stone and dampened shock waves because of excess of fat [18].

Table 5. *Table (URS): Effect of stone burden on URS therapy*

	Stone size		
	<10 mm	≥10 mm	p–value
No. of cases	38	82	
Average operative time (min)	42.5 ±15.79	52.16 ±14.7	t = 3.2, p = 0.0002
Lithotripsy	2 (22.2%)	7 (77.8%)	
Lithotripsy & Grasper forceps	12 (19%)	51 (81%)	
Lithotripsy & Dormia basket	2 (28.6%)	5 (71.4%)	X^2 = 17.37, p = 0.0016
Grasper forceps	17 (63%)	10 (37%)	
Dormia basket	5 (35.7%)	9 (64.3%)	
Complication rate	3 (13.6%)	19 (86.4%)	X^2 = 4.05, p = 0.0442

Table 6. *Table (OSS): Effect of stone burden on OSS therapy*

	Stone size		
	<10 mm	≥10 mm	p–value
No. of cases	4	18	
Average operative time (min)	90 ±0	113.9 ±30.4	
Method of stone treatment			
Open ureterolithotomy	4 (100%)	12 (66.7%)	X^2 = 0.49, p = 0.4851
Open ureterolithotomy with reimplantation	0	6 (33.3%)	
Complication rate	4 (100%)	10 (55.6%)	X^2 = 0.77, p = 0.3809

In our study, the URS treated patients with a stone size of <10 mm had a stone–free rate of 92.8%, while for patient with stones ≥10 mm the stone–free rate was 89.5%. Therefore, stone size does not affect the result of URS in the treatment of the lower ureteric stones. URS was also more efficacious than ESWL for treatment of stones >10 mm in size. Bierkens et al. 1998 [16], had similar results and concluded that ESWL provides a safe option for the management of lower ureteric calculi, provided that the stones are <10 mm as larger stones are best treated by URS. Ojas et al., 2003 [19] reported that retrospective and prospective studies have demonstrated that patients with stones greater than 8 mm or multiple ureteral stones have better stone–free outcomes with URS.

In our study, 4 patients (8.1%) in the ESWL group had their stones impacted.

Some believe that pre–ESWL impacted ureteral stone manipulation or stent placement is required to achieve disimpaction and improve the ESWL outcome. We treated all our patients *in situ* without any attempts to manipulate the stone or implement a ureteral stent. This contributed in decreasing the percentage of morbidity with ESWL and minimized the operative time as well as the cost of this procedure in our study. Others report similar findings [7, 8].

In our ESWL group, 4 patients (8.1%) had impacted stones of which 2 (50%) became stone–free. Of the patients with non–impacted stones, 34 of the patients (76%) became stone–free. Therefore, stone–free rate in ESWL treatment of lower ureteric stones was affected by stone impaction. This has also been reported by Sayed, 1995 [20] who stated that the lack of expansion chamber and edema of ureteral wall makes treatment of impacted stones more difficult, thus needing more number of sessions, shocks and higher voltage rate for success. They also reported that the pre–ESWL auxiliary measures were higher for impacted stones (64%) and the stone–free rate for impacted stones was less than that of non–impacted stones. Kirkali et al. 1993 [21] treated patients of impacted stones with up to 34.500 shocks to obtain good fragmentation. They concluded that ESWL could succeed in treating impacted stones with URS or OSS being good alternatives.

In our URS group, 96 patients (80%) had impacted stones and of those, 77 (90%) became stone–free. For patients with non–impacted stones, 23 (96%) were rendered stone–free, thus, stone–free rate in URS for lower ureteric stones is not affected by stone impaction the way it is in ESWL. Chang et al. 2001 [22] had similar findings and concluded that URS was the best choice in selected patients who had stones >10 mm in size with evidence of impaction and severe colicky pain.

In our OSS group, 21 patients (94.7%) had impacted stones and the resultant stone–free rate was 100%. For patients with non–impacted stones, stone–free rate was also 100%. Anagnostoa and Tolley, 2004 [23] reported that open ureterolithotomy is rarely indicated; current indications include situations involving anatomical ureteral abnormalities, large impacted stones, and failure of minimally invasive methods.

CONCLUSIONS

URS is more effective than ESWL for the treatment of distal ureteral calculi.

In selected patients who had stones >10 mm in size with evidence of impaction and severe colicky pain, we strongly consider URS as the best treatment option. Open ureterolithotomy is rarely indicated; current indications include cases involving anatomical ureteral abnormalities, large impacted stones, and failure of minimally invasive methods.

References

1. 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. J Urol. 1997; 158: 1915–1921.
2. Tugcu V, Gürbüz G, Aras B, Gurkan L, Otunctemur A, Tasci AI. Primary ureteroscopy for distal–ureteral stones compared with ureteroscopy after failed extracorporeal lithotripsy. J Endourol. 2006; 20: 1025–1029.
3. Turna B, Akbay K, Ekren F, Nazli O, Apaydin E, Semerci B, et al. Comparative study of extracorporeal shock wave lithotripsy outcomes for proximal and distal ureteric stones. Int Urol Nephrol. 2008; 40: 23–29.
4. Turk TM, Jenkins AD. A comparison of ureteroscopy to in situ extracorporeal shock wave lithotripsy for the treatment of distal ureteral calculi. J Urol. 1999; 161: 45–47.
5. Abdelghany M, Zaher T, El Halaby R, Osman T. Extracorporeal shock wave lithotripsy of lower ureteric stones: Outcome and criteria for success. Arab J Urol. 2011; 9: 35–39.
6. Fayed A, Abdelmohsen M, El Ghamrawi H. Extracorporeal shockwave lithotripsy (ESWL) in the management of lower ureteric stones EJU. 2007; 14: 94–97.
7. El-Assmy A, El-Nahas AR, Youssef RF, El-Hefnawy AS, Sheir KZ. Does degree of hydronephrosis affect success of extracorporeal shock wave lithotripsy for distal ureteral stones? Urology. 2007; 69: 431-435.
8. Köse A, Demirbas M. The modified prone position: a new approach for treating pre–vesical stones with extracorporeal shock wave lithotripsy. BJU Int. 2004; 93: 369–373.
9. Zhong W, Zeng G, Cai Y, Dai Q, Hu J, Wei H. Treatment of lower urethral calculi with extracorporeal shock–wave lithotripsy and pneumatic ureteroscopic lithotripsy: a comparison of effectiveness and complications. Chin Med J (Engl). 2003; 116: 1001–1003.

10. Sowter SJ, Tolley DA. The management of ureteric colic. Curr Opin Urol. 2006; 16: 71–76.

11. Eden C, Mark I, Gupta R, Eastman J, Shrotri N, Tiptaft R. Intracorporeal or extracorporeal lithotripsy for distal ureteral calculi? Effect of stone size and multiplicity on success rates. J Endourol. 1998; 12: 307–312.

12. Hollenbeck BK, Schuster TG, Faerber GJ, Wolf Jr JS. Safety and efficacy of same–session bilateral ureteroscopy. J Endourol. 2003; 17: 881–885.

13. Bagley DH, Kuo RL, Zeltser IS. An update on ureteroscopic instrumentation for the treatment of urolithiasis. Curr Opin Urol. 2004; 14: 99–106.

14. Scarpa RM, DeLisa A, Porru D, Usai E. Holmium: YAG laser ureterolithotripsy. Eur Urol. 1999; 35: 233–238.

15. Seitz C, Martini T, Berner L, Signorello D, Galantini A, Pycha A. Efficacy and treatment outcome of a new electromagnetic litho-tripter for upper urinary tract calculi. J Endourol. 2008; 22: 2519–2526.

16. Bierkens AF, Hendrikx AJ, De La Rosette JJ, Stultiens GN, Beerlage HP, Arends AJ, et al. Treatment of mid– and lower ureteric calculi: extracorporeal shock–wave lithotripsy vs laser ureteroscopy. A comparison of costs, morbidity and effectiveness. Br J Urol. 1998; 81: 31–35.

17. Abdel–Khalek M, Sheir KZ, Elsobky E, Showkey S, Kenawy M. Prognostic factors for extracorporeal shock–wave lithotripsy of ureteric stones A multivariate analysis study. Scand J Urol Nephrol. 2003; 37: 413–418.

18. Pareek G, Hedican SP, Lee J Fred T, Nakada SY. Shock wave lithotripsy success determined by skin–to–stone distance on computed tomography. Urology. 2005; 66: 941–944.

19. Shah OD, Matlaga BR, Assimos DG. Selecting treatment for distal ureteral calculi: shock wave lithotripsy versus ureteroscopy. Rev Urol. 2003; 5: 40–44.

20. Sayed MA. Use of ESWL in treatment of ureteral calculi. M.D. thesis. Assiut University Hospital, Assiut, Egypt. 1995, pp. 34-39.

21. Kirkali Z, Esen AA, Celebi I, Güler C. Are Obstructing Ureteral Stones More Difficult to Treat with Extracorporeal Electromagnetic Shock Wave Lithotripsy? J Endourol. 1993; 7: 277–279.

22. Chang S, Ho C, Kuo HC. Ureteroscopic treatment of lower ureteral calculi in the era of extracorporeal shock wave lithotripsy: from a developing country point of view. J Urol. 1993; 150: 1395–1398.

23. Anagnostou T, Tolley D. Management of ureteric stones. Eur Urol. 2004; 45: 714–721.