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OPTIMAL MINIMALLY INVASIVE TREATMENT OF URETEROLITHIASIS

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ABSTRACT

Objective: To determine the relative safety and efficacy of lithotripsy (intra-and extra-corporeal) in the management of ureterolithiasis at various anatomical subdivisions by auditing our experience between 1996 - 1998.

Material and Methods: Medical records and radiographic studies of patient with primary ureteric calculi treated at this hospital between January 1996 and December 1998 were reviewed for demographic data, site and size of calculi, treatment sessions, complications and treatment outcome. Patients were divided into extra-corporeal lithotripsy (ESWL) group and were treated on Dornier MPL 9000™ echo-guided lithotriptor and intra-corporeal lithotripsy (ISWL) group treated with Swiss lithoclast™ (EMS, Switzerland).

Results: During this period 364 patients with primary ureteric calculi were treated, of these 150 patients had ESWL and 214 patients were treated by ISWL. Proximal abdominal ureteric calculi were successfully treated in 92% by ESWL compared to 75% with ISWL. Iliac stone were only treated by ISWL with a stone free (SF) rate of 97%. For pelvic calculi SF was 95% for both groups.

Conclusions: In-situ ESWL is an ideal treatment for ureteric calculi. URS + ISWL is an equally effective and safe modality. ESWL is ideally suited for upper abdominal ureteric calculi. URS + ISWL has a high SF for iliac ureterolithiasis. For pelvic ureteric calculi results of the two treatment modalities are comparable with relatively better safety profile for ESWL.

Key words: ureter; ureteral calculi; lithotripsy; ureteroscopy
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INTRODUCTION

Although present day urologist's armamentarium, is so replete with tools to treat ureterolithiasis, management options are by no means less controversial today to what it was nearly a decade back (1). Each individual stone, presents the physician and the patient with a dilemma, in the era in which myriad of management options are available.

Evolution of technology in the last two decades has revolutionized the treatment of ureteric calculi. At one time, open ureterolithotomy and stone basket manipulation were the mainstay of treatment. But with the advent of lithotripsy, management of urolithiasis has taken a quantum leap. Now with high safety and comparable efficacy profile lithotripsy has superseded (2) all other treatment modalities for ureteric calculi.

Presently the two most frequently used options for ureteric calculi that require intervention, are ESWL and ISWL or contact lithotripsy applied by attaining endoscopic access to the calculi. In the present study we are presenting data from our institution on the usefulness of these two modalities in the last three years in over 350 consecutive patients with primary ureterolithiasis. Efficiency quotient (E.Q.) (3) is used to determine the efficacy, whereas the safety profile is determined by reviewing perioperative morbidity. The relative efficacy of either forms of lithotripsy in various anatomical subdivi-

sions of ureter is also determined to establish indications at different locations.

MATERIAL AND METHODS

We retrospectively reviewed medical records and radiographic studies of consecutive patients treated for primary ureteric calculi by either ESWL or URS + ISWL between January 1996 and December 1998. Patients with multiple calculi, or secondary ureteric calculi were excluded. Charts reviewed for demographic data, site and size of calculus and complications during and after treatment were noted and statistically analyzed. Size of the calculus is measured in two dimensions on a plain x-ray (perpendicular and parallel to the long axis of ureter). For the ease of description, the ureter is divided into three parts. Abdominal ureter from ureteropelvic junction to upper border of sacro-iliac (SI) joint; Iliac ureter lying parallel to SI joint and pelvic ureter from lower border of SI joint to uretero-vesical junction.

Pre-procedural intravenous urogram was done in all patients, unless contraindicated. A post treatment plain x-ray and/or ultrasound confirmed complete stone clearance. Additional information for patients who underwent ESWL included number of shock waves and average energy setting. All patients in the ESWL group were treated on Dornier MPL 9000™ echo-guided lithotriptor. In the URS + ISWL group, rigid ureteroscope with a straight channel to accommodate the lithoclast probe was used. Stone fragments were retrieved either with forceps or stone basket.

Ureteroscopy was performed with a rigid tapered (7 - 8.5 and 8 - 9.8F) scope after initial dilatation of ureteric orifice and intra- mural ureter with either a tapered metal dilator or balloon. Stone fragmentation performed by using pneumatic lithotripsy with the Swiss lithoclast™ (EMS, Switzerland). Post treatment JJ stents (multi-length 4.7 and 6.0F) was left in place, whenever, the surgeon felt that stone burden was large or ureteroscopy was prolonged or traumatic. In all other patients a 5F open-ended ureteric catheter was placed, attached externally to a 16F Foley's catheter (4). The attending physician responsible in the consulting clinics did post procedure evaluation. Treatment outcome was defined as radiographic evidence of fragmentation and stone clearance. Efficacy was subjectively assessed by efficiency quotient (EQ) (3). EQ was determined by using the following formula:

$$\frac{\text{Stone free \} \times 100}{100 + (\text{Re-treatment rate \} + \text{Ancillary procedure \})}$$

All patients with abdominal (except for stones in the proximal 1-2 cm), iliac and proximal pelvic ureteric calculi were offered URS + ISWL as a primary therapeutic option. Patients with calculus in distal pelvic ureter were given an option to choose between the two options once they were explained the pros and cons of both modalities. Stones in the proximal 1 - 2 cm of abdominal ureter were primarily treated by ESWL unless there is difficulty in localization. Pushed back calculi were not considered in this study.

RESULTS

Overall 364 patients of primary ureteric calculi were treated in the 3-year period. They are divided into ESWL and ISWL groups.

In the ESWL group, there were a total of 150 patients treated during the period. There was a clear male preponderance with a male to female ratio of 2.5: 1 (108 males and 42 females). Age ranged from 11 to 75 years (± 19.2) with a mean of 38 years. ESWL patients are further considered in three groups; based upon the number of treatment required to attain stone free status.

The ESWL patients who achieved complete stone clearance in a single sitting included a total of 134 (89%) patients with a male to female distribution of 2.9: 1 (100 males and 34 females). There were 76 left sided and 58 right-sided calculi. Stone size determined in two dimensions varied from 4 - 24 mm (7.2 mm) and 2 – 12 mm (10.2 mm) respectively. Majority (77%) had stones in the proximal and distal ends of the ureter. Sixty-nine (51%) patients had stones in abdominal ureter, 12 (9%) in proximal pelvic ureter, and 53 (40%) in distal pelvic ureter. Average shock waves used were 1995.7. Energy setting was between 14 - 20 with a mean of 18.8 kV.

***Table 1** - Comparative analysis between ESWL and ISWL for calculi at different anatomical sub-divisions of the ureter (abdominal, iliac and pelvic).*

	ESWL			URS + ISWL		
	No.	Mean size (mm)	SF %*	No.	Mean size (mm)	SF %*
Abdominal	80	7 and 11	92	53	12 and 14	75
Iliac	-		-	57	9 and 10	97
Pelvic	70	7 and 11	95	104	8 and 12	95

** stone free rate*

Thirteen (8.7%) patients in ESWL group required two sittings for stone clearance. Size of the stone varied from 7 - 18 mm (mean 10.8) and 5 - 13 mm (mean 6.3). Average number of shock waves was 3735 at an energy setting of 18.2 kV. There were 9 calculi in abdominal ureter and 4 in the pelvic.

Three patients required three sittings of ESWL for complete stone clearance. Mean stone size was 12 and 22 mm. Two patients had calculi in proximal abdominal and one in proximal pelvic ureter. They received a mean of 5553.3 shock waves at an average energy setting of 18 kV.

Complications, requiring active intervention or extra hospital stay were noted in 19 patients (13%). This included pain requiring in-patient stay with injectable analgesics in 8 patients (4.2%), and sepsis requiring injectable antibiotics in 8 (4.2%). Eight patients developed stein-strasse; of these five had spontaneous passage; 1 patient, however, required ESWL to the leading fragment and 2 had to have endoscopic procedure to clear the obstruction. These two patients had residual fragments at a site not amenable to ESWL thereby requiring ureteroscopy.

Of the 10 patients who failed to achieve stone clearance with ESWL alone, 5 had primary treatment failure while 5 others had fragmentation without complete clearance. Of these 4 were later treated endoscopically, using ISWL. One patient, however, required open ureterolithotomy from impacted stone.

In the URS + ISWL group during the same period, there were 214 patients. This comprises of 176 males and 38 females. Age ranged from 18 - 70 (±17.2) years with a mean of 32 years. Mean stone size was 11 and 08 mm. Fifty-three stones were in abdominal ureter, 57 in iliac and 104 in pelvic. Eighty-seven (41%) patients had double J stent placed following ureteroscopy when URS is prolonged, there are residual calculi, or there is mucosal edema or injury. Overall success rate was 90% with URS + ISWL, whereas, 21 (10%) had some ancillary procedure performed to attain stone free status. Differential success rate at various sections of the ureter is detailed in (Table-1). High failure rate for upper ureteric calculi was due to inadvertent push back into the lower pole calyx or proximal sinuous ureter (in both conditions beyond the reach of semi-rigid ureteroscopes), ureteric injury and mucosal edema rendering further treatment difficult.

Of the 21 failed cases 16 had ESWL with or without push back, whereas 5 patients had open surgery. Analysis of the failed cases showed that there was technical difficulty in 6, inadvertent pushback in 5 and large impacted calculi in the other ten warranting an added procedure.

***Table 2** - Overall results comparing ESWL and ISWL.*

	ESWL	ISWL	P-value
Number	150	124	-
Mean stone size (mm)	10 x 07	11 x 09	-
Peri-procedural stents	12%	41%	0.0001
Ancillary procedures	15%	10%	0.2124
Re-treatment rate	21%	18%	0.4570
Stone free	93%	90%	0.3613
Efficiency quotient	68%	70%	0.7002
Complications	13%	10%	0.3483

Complication rate was 10%; this included prolonged pain requiring extra hospital stay for parenteral analgesics, sepsis requiring parenteral antibiotics, and damage to ureteric wall requiring placement of stent and percutaneous nephrostomy tube. Stone clearance was clearly better in pelvic and Iliac ureter (92 - 97%) than in the abdominal ureter, where it ranged from 60 - 81% (Table-2).

DISCUSSION

Technological advancements in the last decade have made access to symptomatic ureteric calculi possible from all directions. Antegrade approach for complex upper ureteral calculi (5), retrograde approach with contact lithotripsy and extracorporeal lithotripsy are all well established. A small subgroup of patients can, however, only be managed by ureterolithotomy using either conventional open approach (6) or laparoscopy (7). Though for routine ureteral calculi general consensus is to go for either ISWL or ESWL (1,8).

Introduction of ureteroscopes in late 1970's opened a rare insight into the live anatomy of ureter. Initially, however, because of the size constraint and rigidity of the instrument use of endoscopes was confined to the distal ureter. Refinement of technology in the 1990's with the use of fibreoptic instrument has totally replaced large (11 and 13F) rigid ureteroscopes with 7F semi rigid and flexible ureterorenoscopes. Simultaneously, development in the field of intra-corporeal lithotripsy modalities has made possible to use finer less traumatic instruments through the fibreoptic ureterorenoscopes. The transformation from the era of stone baskets, forceps and electro-hydraulic lithotripsy to laser and lithoclast has changed the way ureteric calculi are treated. All these have made URS + ISWL a safe and effective means of treatment, even in the age dominated by newer generation extra corporal shock wave lithotriptors.

ESWL was introduced in 1981 and rapidly transformed the management of ureteric calculi. Although it initially was only used for upper ureteral calculi, modification in the first generation lithotriptors and development of 2nd generation machines with dual localization have made possible to treat vast majority of ureteral calculi. Initially most ureteral stones treated by ESWL were stented but reports in the last five years have proved the efficacy of in situ ESWL (9). Besides the use of stents increases the cost and morbidity of the procedure as well. It is only indicated in the presence of significant obstruction (4,9).

We are reporting our early experience with ISWL, which was performed by several urologists with varying degrees of expertise. Complication rate was comparable to ESWL (13% for ESWL versus 10% for ISWL). Stone free rate for ISWL was 90%, marginally lower than ESWL (93%). Efficiency quotient for the groups was also comparable (68 and 70%) for ESWL and ISWL groups respectively. Since only Ureteroscopy was used for iliac ureterolithiasis, due to echo-guided nature of the lithotripsy devise, it is obviously not possible to make comparison between the two modalities for this anatomical site.

For abdominal ureteral calculi controversy exists concerning in situ treatment and ESWL following push back. We had comparable SF rate in the various sections of the ureter (92 - 95%) with ESWL (Table-1). In this particular study we have not looked into the results of calculi that were pushed back and as such our results may be biased. Still the facts remain that stone that were subjected to in situ ESWL had 92% success rate. Mueller et al. (10) reported a significant difference in success rate (62 - 97%) between in situ treated upper ureteral calculi and those that were pushed back. Graff et al. (11) concluded that obstructing proximal ureteral calculi have poorer clearance (70%) compared to in situ treated non obstructing (83%) and displaced calculi (95%). Liong et al. (12), however, felt that results of by passed calculi are better than pushed back (87% versus 81%). However, consensus, in the contemporary urological literature (1) is that stone manipulation for second-generation lithotriptors is not required. In our series for SF rate for abdominal ureterolithiasis is 75% with URS + ISWL. This was in comparison to 95% with ESWL. In our opinion, ESWL should be considered as a first option, whenever the stone could be adequately focused.

Mid-ureteral stones (in section 4) are not generally considered ideal for ESWL (13). We did

not treat any iliac ureteral calculi as our lithotriptor only has ultrasound localization. Although both anterior and posterior approaches have been employed to treat section 4 calculi. Either approach is marred by significantly high re-treatment rate (13) as shock waves are absorbed by bowel gas in the former and by the dense pelvic bone in the later. In our study with URS + ISWL SF rate is 97%.

Success of ESWL for pelvic ureterolithiasis is dependent only upon adequate localization. Many investigators have shown that in situ treatment is an ideal option for this location. All of our patients were treated with in situ ESWL in pelvic ureter with SF rate of 95%. With URS + ISWL similarly the clearance was in the range of 95%. Although ISWL and ESWL have comparable stone clearance but safety profile of ESWL is better and it should offered as a primary option.

Ideal treatment for ureterolithiasis would render the patient stone free without anesthesia, has low morbidity and cost. Such a modality is not currently available, however, significant advances in the management of symptomatic ureterolithiasis have been made recently most noticeable the in situ ESWL.

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