Original Article

Comparative Study between Slow Shock Wave Lithotripsy and Fast Shock Wave Lithotripsy in the Management of Renal Stone

Deb Prosad Paul[1], Debashish Das[2], A S M Zahidur Rahman[3], A K M Zamanul Islam Bhuiyan[4]

Abstract

Background: *Renal calculi are frequent causes of ureteric colic. Extracorporeal shock wave lithotripsy is the most common treatment of these stones. It uses focused sound waves to break up stones externally.* **Objective**: *To compare the efficiency of slow and fast delivery rate of shock waves on stone fragmentation and treatment outcome in patients with renal calculi.* **Materials and Methods:** *This prospective study was done in the department of Urology, National Institute of Kidney diseases and Urology, Sher-e-Bangla Nagar, Dhaka from July 2006 to June 2007. Total 90 patients were treated using the Storz Medical Modulith ® SLX lithotripter. Patients were divided into Group A, Group B and Group C – each group having 30 subjects. Group A was selected for extracorporeal shockwave lithotripsy (ESWL) by 60 shock waves per minute, Group B by 90 shock waves per minute and Group C by 120 shock waves per minute.* **Results:** *Complete clearance of stone was observed in 24 patients in Group A and 13 patients in both Group B and Group C in first session. In Group A only 3 patients needed second session but in Group B and Group C, 12 and 8 patients needed second session. In Group A only one patient needed third session but third session was required for 3 patients in Group B and 5 patients in Group C for complete clearance of stone. In Group A, subsequent sessions were performed under spinal anesthesia and in Group B under sedation and analgesia (p>0.001). Mean number of sessions for full clearance of stones in group A was 1.37 ± 0.85, in Group B was 1.8 ± 0.887 and in Group C was 2.0 ± 1.083. Significant difference was observed in term of sessions among groups (p>0.05). In first follow-up, complete clearance of stones was seen in 24 patients in Group A and 13 in both Group B and Group C. In second follow-up, 3 patients in Group A, 12 in Group B and 8 in Group C showed complete clearance of stones. It was observed that rate of stone clearance was higher in Group A than in Group B and Group C. Multiple logistic regression analyses revealed that slow delivery rate (60 SW/min) as well as age (younger), symptom (painful) at onset, stone location (upper and middle calyx) and size (small) were independent prognostic factors determining stone clearance after ESWL of renal stone.* **Conclusion:** *Slow rate shock wave delivery improves efficacy of ESWL treatments of renal stone and decreased number of sessions, shock waves and treatment time.*

Key words: *ESWL, Renal stone, Slow wave*

J Enam Med Col 2013; 3(1): 24-28

Introduction

Stone formation in the kidney is one of the oldest and widespread disease known to human being.[1] Calculi have been found in the renal pelvis, presumably in the urinary bladder, of an Egyptian

1. *Associate professor, Department of Surgery, Enam Medical College & Hospital, Savar, Dhaka*
2. *Assistant Professor, Department of Surgery, Enam Medical College & Hospital, Savar, Dhaka*
3. *Professor, Department of Surgery, International Medical College, Tongi, Gazipur*
4. *Professor, Department of Urology, National Institute of Kidney Diseases and Urology, Dhaka*

Correspondence *Deb Prosad Paul, Email: drdebpaul@yahoo.com*

mummy estimated to be in 4800 BC.[2] Reference to stone formation was made in early Sanskrit written in India in 6th century BC.[1] The prevalence of the urinary stone disease is estimated 2-3%.[2] Male to female ratio is 3:1.[1]

In the management of this problem, past 20 years had witnessed revolutionary changes in this field. Treatment of stone disease moved dramatically from an open operative procedure to endoscopic, minimally invasive methods and non-invasive methods.[5] Among these, noninvasive procedure is the most popular. Treatment of renal stone depends on stone size, shape, composition, position and degree of obstruction, presence of infection, single kidney and abnormal anatomy and functional status of the kidneys.

Over the last two decades the management of urinary stone diseases has radically changed.[4] Open surgery has been almost completely replaced by minimally and noninvasive procedure, mainly extracorporeal shockwave lithotripsy and ureteroscopy.[5] Introduction of extracorporeal shockwave lithotripsy (ESWL) in 1980 has dramatically changed the management of renal and ureteral calculous disease.[6] It has been the preferred method of treatment of renal and ureteral stones for the last 25 years.[3] With ESWL, renal and ureteral calculi are broken into smaller fragments by shockwaves and can then pass spontaneously with urine as small fragments. ESWL is noninvasive, requires less anesthesia than other forms of treatments for renal stones, and may render patients stone-free without surgical intervention or endoscopic procedures.

Success of ESWL depends on stone size, composition, location, excretory function of the kidney, position of the patient, shock wave lithotripsy rate and energy level.[2]

Fragmentation of a stone occurs when the force of shockwaves overcomes the tensile strength of the stone. Fragmentation may be produced by direct force, erosion, or cavitations. The rate of shock wave administration is a very important factor for stone fragmentation. Faster rates may not be more effective because of internally canceling echoes and decreased cavitations. Slower rates are more effective and just lengthen the operative time. Although the optimal rate of treatment depends on the machine and the type of generator but it is recommended that slow shock wave lithotripsy rate is better for fragmentation of stone than fast shock wave lithotripsy rate. It is demonstrated that ESWL is most effective when waves are delivered at 60 shocks per minute.

Materials and Methods

This prospective comparative study was carried out in the department of Urology, National Institute of Kidney Diseases & Urology, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period July 2006 to June 2007. Patients presenting with loin pain with or without hematuria due to renal stone attending the Urology outpatient department of National Institute of Kidney Diseases & Urology and fulfilling patient's selection criteria mentioned below were included in the study.

Then they were numbered chronologically and divided into three groups according to time of arrival in the hospital. They were selected for 60, 90, and 120 shocks per minute respectively.

Patients having stone size <2 cm, well excreting kidney without any congenital anomalies of the genitourinary tract and inferior calyceal stone with wide infundibulopelvic angle ($>45^0$) were included in the study.

Patients with acute urinary tract infection, uncorrected bleeding disorders, uncorrected obstruction distal to the stone, pregnancy, orthopedic or spinal deformities, renal ectopy, or renal malformations (including horseshoe and pelvic kidneys) and body weight greater than 300 lb were excluded.

Results

Total 90 patients were selected for this study. Patients were divided into 3 groups – Group A, Group B and Group C. Each group had 30 patients. Table I shows distribution of patients according to age.

Table I: Distribution of patients according to age

Groups	Age range (yrs)	Mean age (±SD)	P value
A	20-80	41.00 ± 15.69	P=0.522
B	20-70	41.00 ± 11.88	
C	24-70	40.00 ± 12.24	

73.3% patients of Group A, 53.3% of Group B and 66.7% of Group C were male. 26.7% of Group A, 46.7% patients of Group B and 33.3% of Group C were female. Male to female ratio of total study population was 1.81:1 (29:16). No significant difference was observed between groups with respect to sex (p >0.05) (Table II).

Table II: Distribution of patients according to sex

Groups	Male	Female	P value
A	73.3	26.7	P >0.05
B	53.3	46.7	
C	66.7	33.3	

Figures are in percentage

Maximum patients of Group A were farmers (7), followed by service holders (6), housewives (6), businessmen (5), retired personnel (4) and others (2). Maximum patients of Group B were housewives (12), followed by businessmen (8), farmers (5), service holders (4) and others (1). Maximum patients of Group C were farmers (7), followed by service holders (6), housewives (6), businessmen (5), retired personnel (4) and others (2). Difference was observed statistically in term of occupations of both groups (p<0.05).

Table III shows mean size of the stones observed in IVU. Mean stone size of the present study population was 18.30 (±5.74) mm. No statistical significant difference was observed (p>0.05).

Table III: Mean size of the stones observed in IVU

Groups	Mean size (mm)	P value
A	17.47 ± 5.96	P>0.05
B	18.60 ± 6.22	
C	18.83 ± 5.09	

Most of the stones were within 20–24 mm in Group A (33.3%), followed by 10-14 mm (30%), 15-19 mm (23.3%) and 25-30 mm (13.3%); in Group B, 20-24 mm (36.7%), followed by 10-14 mm (23.3%) and in Group C 20-24 mm (43.3%), followed by 15-19 mm (23.3%).

Table IV shows sites of stones seen in IVU. No statistical significant difference was observed in term of position of stone (p>0.05).

Table IV: Site of stones observed in IVU

Site of stones	Group A	Group B	Group C	P value
Renal pelvis	16.7	23.3	16.7	> 0.0
Upper calyx	16.7	20.0	16.7	
Middle calyx	33.3	43.3	40.0	
Lower calyx	33.3	13.3	26.7	

Figures are in percentage

Different numbers of shock waves were given for stone pulverization as consistency of the stones was different. Some stones were soft and some were hard and very hard. Eleven (36.7%) patients in Group A received highest number of shock waves (500–1500). Highest number of shock waves (300–3500) were given in 10 (33%) patients in Group B and 10 (33.3%) patients in Group C. Highly significant difference was observed in term of given shock wave (p<0.001).

Most of the stones were pulverized at energy level 7 in Group A and 6 in both Group B and Group C. No statistical significant difference was observed in terms of energy level among groups (p>0.05).

There was complete clearance of stones in 24 patients in Group A and 13 in both Group B and Group C in first session. In Group A only 3 patients needed second session but in Group B and Group C 12 and 8 patients needed second session respectively. In Group A only one patient needed third session but 3 patients in Group B and 5 patients in Group C needed third session for complete clearance of stones. Mean number of sessions for full clearance of stones of Group A was 1.37 ± 0.85, Group B was 1.8 ± 0.887 and Group C was 2.0 ± 1.083. Significant difference was observed in term of number of sessions among groups (p>0.05).

In the operation table, 13 patients of Group A had complaints of pain whereas 12 patients of Group B and 14 patients of Group C had complaints of pain. No statistically significant difference was observed in terms of pain among groups ($p>0.05$). No significant difference was observed in term of nausea, vomiting, steinstrasse, hematuria and infection among groups.

In first follow-up, complete clearance of stones were seen in 24 patients in Group A and 13 patients both in Group B and Group C. In second follow-up, 3 patients in Group A, 12 in Group B and 8 in Group C showed complete clearance. In third follow-up, 1 patient in Group A, 3 in Group B and 5 in Group C were declared stone-cleared. It was observed that rate of stone clearance was higher in Group A than in Group B and Group C.

Discussion

Mean age of the total population of present study was 41.07 ± 13.33 years, median age was 40 years. All patients of the present study were within 20-80 years of age. These findings correlate well with the findings of Das et al.[7] Mean age of their study population was 46.3 years (range 6–88 years).

Mean age of the present study population differs widely from that of Shenkman et al.[8] They found mean age of their respondents were 66.2 ± 9.9 SD years. These findings also differ from Ather MH et al.[9] They studied on 100 patients whose age range was 15–69 years and median age 35.5 years.

Among the sociodemographic characteristics included in the present study, age and sex are almost identical with some other studies. Similar sex distribution was also found in a study conducted by Das et al.[7] They studied on 1000 patients. Among them 71.9% were male and 28.1% were female. Ather et al also had the similar ratio.[9]

Mean stone size of the present study population was 18.30 ± 5.74 mm. Mean stone size found by Ather et al[9] was 9 ± 4 mm and Das et al[7] was 1.07 cm, which do not correlate with this study.

Mean shock wave was applied for Group A was 1808.33 ± 744.76, Group B was 2450 ± 766.77 and Group C was 2391.67 ± 767.56. Post Hoc analysis revealed that group A was statistically more significant than other two groups in terms of given lower shock wave. For complete clearance of stones Pace delivered a mean of 1200 shocks (range 100-4000) in each procedure.[6]

Ather et al [9] used ESWL for the stone clearance in the lower pole nephrolithiasis. The mean number of sessions per patient was 1.85 ± 0.88. 78% required 1-2 sessions and only 5% needed 4 sessions. Their overall stone clearance rate was 90%. These findings are similar with the present study.

From some other studies, it is also found that steinstrasse, obstruction, loin pain, hemorrhage, cardiac arrhythmias and appreciable cutaneous bruising at entry and exit sites of shock waves are side effects of ESWL.[10]

All these studies are consistent with present study in case of outcome in form of stone pulverization and clearance. Both study groups experienced a favorable outcome. However, the outcome of Group A was better than that of Group B and Group C. However, the findings in this study require validation by other studies like this one. The present study is by far the first study conducted in Bangladesh. We recommend that these types of studies should be carried out in other tertiary hospitals.

References

1. Menon M, Resnick ML. Urinary lithiasis: etiology, diagnosis and medical management. In: Walsh PC, Retik AB, Vaughan ED (Jr.), Wein AJ (eds). Campbell's urology. 8th edn. Philadelphia: Saunders, 2002: 3227-3436.
2. Stoller ML. Urinary Stone Disease. In: Tanagho EM, McAninch JW (eds). Smith's general urology. 16th edn. New York: Lange Medical Books/McGraw-Hill, 2004: 256-286.
3. Salam MA. Principles & practice of urology: a comprehensive text. Dhaka: MAS Publication; 2002 .
4. Bregg K, Riehle RA. Morbidity associated with indwelling internal ureteral stents after shock wave lithotripsy. J Uro 1989; 141: 510-512.
5. Jenkins AD. Extracorporeal shock wave lithotripsy. In: Marshall FF, Kavoussi LR (eds). Marshall textbook of operative urology. Philadelphia: WB. Saunders Company, 1996: 91-98.

6. Pace KT, Ghiculete D, Harju M, Honey RJ. Shock wave lithotripsy at 60 or 120 shock per minute; a randomized, double-blind trial. J Urol 2005; 174(2): 595-599.

7. Das G, Dick J, Bailey MJ, Fletcher MS, Webb DR, Kellett MJ et al. Extracorporeal shock wave lithotripsy: first 1000 cases at the London stone clinic. Br Med J 1987: 891-893.

8. Shenkman Z, Eidelman LA, Cortev S. Continuous spinal anesthesia using a standard epidural set for extracorporeal shock wave lithotripsy. Can J Anaesth.1997; 44(10): 1042-1046.

9. Ather MH, Abid F, Akhtar S, Khawaja K. Stone clearance in lower pole nephrolithiasis after shock wave lithotripsy – the controversy continues. BMC Urology 2003; 3: 601-604.

10. Grassow M, Spaliviero M. Extracorporeal shock wave lithotripsy. Available at: http://www.e Medicine.com/.