

Influence of Prognostic Factors on the Outcome of Extracorporeal Shock Wave Lithotripsy in Upper Urinary Tract Stone Disease

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Abstract

Background and Aims: Urolithiasis has an overall prevalence of 2-3% worldwide. Extracorporeal shock wave lithotripsy (ESWL) is one of the noninvasive procedures used for the management of the same. The outcome after ESWL depends on various factors which include position, size, number and composition of stones, double-J (DJ) stenting, presence of hydronephrosis etc. The present study is aimed to assess the effect of stone related factors such as size, number, location; renal factors such as hydronephrosis and patient factors such as obesity, habitus, on the outcome of ESWL in urolithiasis.

Methods: A set of 280 patients with calculi in the kidney and ureter were subjected to ESWL during the period from April 2005 to September 2008, with pre and post-ESWL serial studies of the calculi, including x-ray and ultrasonography (USG). The results were subsequently assessed for the influence of prognostic factors on the outcome, using the Chi-Square test.

Results: Overall stone free rate was 63%. Upper pole renal stones had a significant clearance over the lower pole stones ($p=0.01$). Clearance of ureteric stones of $<1\text{cm}$ in size, was significantly greater than that of those $>1\text{cm}$ ($p=0.03$). Patients with hydronephrosis showed a statistically significant clearance over patients without hydronephrosis ($p=0.034$). Clearance of single stone was also significantly better than that of multiple stones ($p=0.001$). Sixteen patients underwent DJ stenting pre-ESWL, of which 8 were cleared of the stone, without significant difference.

Conclusions: The size, position, and number of calculi had a significant impact on the outcome after ESWL. Calculi with hydronephrosis obtained better clearance.

Keywords: Extracorporeal Shock Wave Lithotripsy; Urinary tract, Stones

Introduction

Extracorporeal shock wave lithotripsy (ESWL) is one of the non invasive procedures available for the treatment of urinary tract calculi. It was first used for medical purposes in 1980, since then numerous modifications have been done to improve its efficacy in the management of urolithiasis. Externally generated fixed number of shock waves are focused towards the desired site of the stone and augmented to a particular level. Procedure is repeated thrice and the patient is examined radiologically for the clearance of the stone. Post ESWL, ultrasound and X-ray KUB are used to re-assess the stone. The outcome

is influenced by various factors with reference to the characteristics of the stone, renal anatomy, patient habitus, etc (1, 2).

The present study is aimed to assess the effect of the stone related factors: size, number, location of the stone and, renal factors: presence or absence of hydronephrosis on the outcome of ESWL in the

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treatment of urinary tract stone disease.

Materials and Methods

Total of 280 patients with calculi sized 5mm to 2cm in the kidney, upper and mid ureter, admitted in MGM Medical College & MY Hospital, Indore, India, from April 2005 to September 2008, were included in the study. Patients were evaluated by urine routine and microscopy, urine culture, renal function tests, ultrasonography (USG), X-ray kidney ureter and urinary bladder (KUB), intravenous urography (IVU) and CT scan, and the findings were recorded. Size, number, location of calculi, and presence of obstruction and hydronephrosis were noted. Bleeding profile was evaluated using platelet count, bleeding time, clotting time and prothrombin time. Body mass index (BMI) was also recorded for each patient.

All were subjected to ESWL using a 3rd generation electro hydraulic Dornier lithotripter. Maximum of three sittings of ESWL were given, each of 3000 shocks @ 60-70 shocks per minute, at an interval of 3 days to 2 weeks. Written and informed consent was taken from all patients before each sitting ESWL. Bowel was prepared with laxatives and enemas and the patient kept nil by mouth for 4 hrs prior to each sitting of ESWL. The procedure was performed without any type of anaesthesia or sedation. Each sitting provided 3000 shocks to patient initially at 10kv which was gradually increased to 24kv within 500 initial shocks. Regular monitoring of F2 (target point) was done with fluoroscopy, during the procedure. Patients with severe acute urinary

tract infection (UTI) were treated with antibiotics initially; ESWL was done after the control of infection. On completion of the procedure, every patient was given a course of antibiotics.

Patients were evaluated before each next sitting with USG and X-ray KUB to re-assess the calculi if any, for their number, size and location. In case of multiple calculi on one side, calculi causing obstruction, hydronephrosis and large calculi were treated in that order. Absence of calculi or calculi <4mm on serial USG, X-ray KUB after the third sitting was considered as clearance.

Different groups were made according to number, size and position of the stone, and presence of hydronephrosis and analyzed.

Statistics

Statistical analysis of the data was obtained using Chi-square test.

Results

Total numbers of patients included in this study were 280, of which 176 (63%) were cleared of stones. Percentage clearance of renal calculi in the upper, middle and lower pole was 75%, 57.15 and 28.6% respectively (Table 1). Thus the clearance of calculi of any size from upper pole of kidney was significantly better than from lower pole ($p=0.001$). Furthermore, in upper pole, larger stones (>10 mm) were significantly better cleared than smaller ones ($p=0.02$). On the other hand, none of the stones of >10 mm size in lower pole got cleared (Table 1).

Table 1. Clearance of renal calculi with ESWL

Location of renal stone	Size of the stone	No. of patients	No. of patients cleared	p-value
Upper pole (64)	5-10 mm	16	8 (50%)	0.02
	10-20 mm	48	40 (83%)	
Middle pole (56)	5-10 mm	36	24 (67%)	0.03
	10-20 mm	20	8 (40%)	
Lower pole (56)	5-10 mm	40	16 (40%)	0.001
	10-20 mm	16	0 (0%)	
Total	5-20 mm	176	96 (54.5%)	

Table 2. Clearance of ureteric and pelvi-ureteric (PU) calculi

Location of the stone	Size of the stone	No. of patients	No. of patients cleared	p-value
Upper ureter and PU (56)	5-10 mm	26	20 (77%)	0.451
	10-20 mm	30	24 (80%)	
Mid ureter (48)	5-10 mm	22	16 (73%)	0.422
	10-20 mm	26	20 ((77%)	
Total	5-20 mm	104	80 (77%)	

There was no significant difference between the percentage clearance of mid ureteric calculi (75%), and pelvi-ureteric (PU) and upper ureteric calculi (78.6%). Also, the clearance of smaller (5-10 mm) and larger (10 mm) calculi, at both of these sites was not statistically different (Table 2).

Multiple calculi were present in 11 patients with average of three stones. ESWL was directed towards the stone causing obstruction, hydronephrosis, and then the large sized stone, in that sequence. Clearance was seen in none of the patients in this group.

Hydronephrosis was present in 96 patients; 65 of them had ureteric or PU calculi. Of these 96, 76 (79.2%) were cleared of their stones, compared with 100 out of 184 non-hydronephrotics ($p=0.034$). The severity of hydronephrosis was not found to be related to stone clearance. DJ stenting was done in 16 patients, which had no statistical significance over stone clearance.

None of the patients had radiologically detectable lesions in the kidney or other organs after lithotripsy, known secondarily to be caused by it. None had gross hematuria after the procedure as well. Twenty-two patients reported colicky pain after the procedure (steinstrasse). No anomalies such as diverticulae or fusion anomalies were found.

Discussion

Overall stone clearance in present study was 63%. Recently most studies have reported clearance rates ranging from 78% to 86.7% for renal, and 84.2% to 88.7% for ureteric stones (1-4).

The above mentioned studies have declared that

the most important factor in predicting the outcome of ESWL in urinary calculi was the stone size and found that the smaller (<8-10mm) renal and ureteric stones are significantly better cleared than larger ones. We noted that in the lower pole smaller stones had much better clearance than lower pole larger stones ($p=0.001$), finding similar to that reported by previous observers. However, among the upper pole stones, larger stones were better cleared than smaller ones ($p=0.02$). We also found that size of the calculus did not affect the clearance of ureteric and PU stones as the clearance rate of smaller and larger stones was not significantly different (Table 2). This is another contradictory finding to those reported recently by Lam et al (5) who achieved stone clearance rates of 74% and 43% for stones <10mm and >10mm respectively.

In our series, none of the patients with multiple stones got rid of their stones. In addition, all patients with single stone of >1cm and who got cleared, necessarily required three sittings, whereas majority of those <1cm single stone obtained clearance in two sittings. These finding are also supported by the studies of Logarakis et al (6), 2000, El-Damanhoury et al (7), 1991, and Mobley et al (8), 1993 who showed that increase in stone burden either by an increase in the stone size or number (i.e. multiple stones), leads to decreased effectiveness of ESWL and increased necessity of ancillary procedures.

Location of stone is also very important point to consider while treating a patient with urinary stone disease. ESWL was found to be significantly more effective ($p=0.0001$), in clearing upper pole stones (75%) than those situated at the lower pole (28.6%).

Similarly, the clearance of upper pole calculi when compared to the combined group of mid pole and lower pole kidney calculi was also statistically better ($p=0.03$). Although, a very important factor for stone clearance is its disintegration, and the disintegration rate of lower caliceal stones treated by ESWL does not differ much than that of stones in other localizations within the kidney. However, the clearance of the fragments is not as similar, due to the unfavourable spatial anatomy of the lower pole collecting system (9). Various long-term studies by different authors have reported a stone free rate of 41-73% for lower pole stones (9). Literature also supports our findings except for an unusual finding of better clearance of larger upper pole calculi than smaller ones. Even for lower calyx calculi, we consider ESWL as first choice for smaller stones (<10mm) because of its noninvasiveness, less significant complications, faster convalescence and greater patient acceptance, along with no significant difference in stone-free rate when compared to retrograde intrarenal surgery (9).

Recently in an excellent article clearance rates for stone located at upper, mid and distal ureter were 82%, 73% and 74% respectively (10). Delakas et al (11) declared distal ureteric stones and stones >10mm to be the strongest independent predictors of failure of ESWL in ureteric stones. Yet we did not find any significant difference between clearance of mid ureteric calculi (75%), and pelvi-ureteric (PU) and upper ureteric calculi (78.6%). However, majority of upper ureteric and PU junction calculi were cleared in two sittings, in comparison to mid ureteric calculi, majority of which took three sittings (Table 3).

Stone clearance from hydronephrotic systems was found to be significantly better than non-hydronephrotic ones ($p=0.034$). Kageyama and associates evaluated middle and lower ureteral calculi with moderate or severe hydronephrosis and reported poorer outcome in the hydronephrotic systems (12). Kumar and co-workers showed that

in a hydronephrotic system fragments are more likely to be retained as residual calculi (13). On the other hand Demirbas and colleagues (14) in patients with solitary lower ureteric calculus, and, Seitz and co-workers (15) in patients with solitary upper ureteric calculus found that the degree of urinary obstruction caused by the calculus did not affect the success of calculus clearance with ESWL. Wadhwa et al (16) found that the clearance time of upper ureteric stones increases with increase in severity of hydronephrosis. However, in present study, the degree of hydronephrosis did not seem to affect the clearance.

It was noted that DJ stenting had no statistical significance over stone clearance. A recent randomized study also reported that the routine use of internal stents before ESWL does not improve outcome in terms of stone-free rate (17).

Conclusions

Extra corporeal shock wave lithotripsy remains 'sine qua non' in the armamentarium of the urologist in the treatment of urinary tract stone disease. We recommend that criteria for proper patient selection should always include the size, number and location of the stone, and presence or absence of hydronephrosis. In our experience, presence of hydronephrosis is a better prognostic factor for ESWL related clearance of stones.

Conflict of Interest

None declared.

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