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Outcomes of Extra Corporeal Shock Wave Lithotripsy in Renal and Ureteral Calculi

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ABSTRACT

Background

Since the introduction in early 1980s, Extracorporeal Shockwave Lithotripsy (ESWL) became the accepted first line treatment modality for renal and upper ureteric stones. It is simple, safe and effective noninvasive procedure which can be performed without anaesthesia in outpatient basis. The objective of this study was to determine the efficacy of ESWL to achieve complete stone clearance in the patients with different sizes of renal and upper ureteric stones.

Objective

The aim of this study was to assess the outcome, efficacy and complications of ESWL in the treatment for renal and ureteric stones in terms of the site and the size of the stone in the patients presented at Dhulikhel Hospital Kathmandu University Hospital.

Method

In this prospective study a total of 430 (214 renal and 216 ureteric) cases of urinary stone disease in 257 male and 173 female patients treated by ESWL at Dhulikhel Hospital, Kathmandu University Teaching Hospital during time period of May 2010 to June 2012 were included. Data of patients with renal and ureteric stones were evaluated for stone site, size, and number of sessions. Data were analyzed using spss 13.0.

Result

Out of 430 cases, the overall stone free rate in after 1st session was 341 (79.3%) at one month and in three months follow up (3 sessions) it was increased up to 414 (96.3%). In 16 (3.7%) patients treatment was failed. Average size of the stone was 12.24 (SD± 3.65) mm.

Stone free rate was 154 (72%) in the case of renal and 187 (86.6%) in the case of ureteric stones in first session. In three months follow up (three sessions) it was 204 (95.4%) and 210 (97.2%) respectively for renal and ureteric stones. In relation to size the stone free rate in <10mm, 10-15mm and > 15mm was 97%, 97% and 90%.

Conclusion

ESWL is the first line preferred choice for renal and upper ureteric stones which provides the maximum stone free rate in the case of stone size smaller than 1.5cm.

KEY WORDS

ESWL, outcome, renal stones, ureteric stones, urinary stone disease, urolithiasis

INTRODUCTION

The concept of fragmentation of stones by using shock waves was first noted in Russia in 1950s.[1] However the first clinical application of Extracorporeal Shock Wave Lithotripsy (ESWL) was done in 1980 with successful fragmentation of renal stone.[1,2] After modification of the Dornier-®HM-1 (Human model-1) lithotriptor to HM-2 in 1982 and HM-3 in 1983, ESWL has been widely used in clinical practice as first-line treatment modality for the majority of urinary stones throughout the world.1,2 United States Food and Drug Administration (US FDA) approved ESWL in 1984.[2-4]

ESWL is a simple, safe and noninvasive procedure for treatment of urinary stones which usually does not require general anaesthesia. A urinary stone is a crystalline structure. If it is bombarded with shock waves with sufficient energy it will be disintegrated into fragments.[5] In ESWL, shock waves are generated by a source external to the patient's body and are transmitted through the body and focused on a renal or ureteric stone. The uniqueness of this modality is the initial generation and propagation of shock waves through the body are weak and only they become sufficient strong when reach at the focused target, where they generate enough force to fragment a stone or disintegrate it completely. The fragmented stones tend to pass spontaneously along with urine. Based on shock wave generator, there are three primary types of lithotripters: electrohydraulic (spark gap), electromagnetic, and piezoelectric.[6,7] According to recommendation of American Urological Association Stone Guidelines Panel in 1997, ESWL is still the first line method of treatment for ureteral and renal stones smaller than 2cm size.[8,9]

METHOD

This is a prospective observational study performed in Dhulikhel Hospital from May 2010 to June 2012. The diagnostic workup included plain X-ray Kidney, Ureter and Bladder (KUB) and ultrasonography of abdomen. Patients who gave informed consent and with a single radio dense stone in kidney, proximal and mid ureter were included for ESWL in the present study. Exclusion criteria were patients for whom ESWL is contraindicated because of pregnancy or a coagulation disorder. Further, patients with multiple stones and/or stone in the distal ureter were also excluded from the study. Patients with urinary tract infection were treated prior to ESWL with a course of antibiotic on the basis of urine culture and sensitivity report before procedure. A double – J stent was inserted prior to ESWL in the patients having stone size more than 20mm. Before starting ESWL treatment informed consent was taken from all patients.

The ESWL was performed using a Lithostar® with an electromagnetic shockwave source with fully integrated fluoroscopic guidance (Siemens AG, Erlangen Germany). The maximum number of the shocks given in one session was 5000 and the maximum intensity was 6 for renal and 9 for ureteric stones.

The ESWL treatments were carried out using intramuscular injection of 50 mg Pethidine and 25 mg Promethazine prior to procedure. A seven days course of oral antibiotic (Ciprofloxacin 500 mg twice daily) was given after treatment to each patient. All patients were treated on an outpatient basis.

Follow up was done after two weeks with X-ray KUB to evaluate clearance of stone. In case of no clearance the X-ray KUB was repeated after one week. Failure of treatment was defined as either no fragmentation or post ESWL fragments greater than 6mm. Repeated ESWL sessions were performed with an interval of 3 to 4 weeks in case of initial failure with maximum of 3sessions.

Data were analyzed by spss 13.0 and expressed as mean ± SD and range. The qualitative data were compared using Chi Square test with level of significance as $P<0.05$.

RESULT

A total of 430 patients were included in this study and treated with ESWL. Of the 430 patients 257 (59.8%) were Male and 173 (40.2%) were Female with M: F ratio of 1.48:1.

The mean age of patients was 36, years with range from 14 to 85 years. The mean age of patients with renal stones was 37.2 years and the mean age of patients with ureteric stone was 34.6 years.

Regarding the site of stone, 214 (49.2%) were renal (male/female: 118/96) and 216(50.8%) were ureteric (male/female: 139/77) stones. The mean size of the renal stone was 12.97mm ± 4.13 (Range = 5.9-28mm) while the mean size for the ureteric stone was 11.61mm ± 3.05 (Range = 7-24 mm).

The overall stone free rate in after the first session was 79.3% at one-month follow up. However, the success rate of ESWL after 3 sessions was increased up to 96.3% (Table 1). Regarding the site of the stone, the first session treatment was successful in 72% of renal and 86.6% of ureteric stones ($P<0.01$). On 3 month follow up, maximum of 3 sessions treatment was found to be successful in 95.4% of renal and 97.2% of ureteric stone. Nevertheless, the treatment failure after 3 sessions was seen in 4.6% patients with renal and in 6 (2.8%) patients with ureteric stone diseases (Table 1). In addition, 4 cases developed complications with stone impaction (stainstrasse) and minimal haematuria. No other major complications were observed. None of the patients required any surgical interventions and/or hospital admission after ESWL.

While comparing the size of stone with the successful rate of ESWL, the success rate was found to be high in the stone size less than 10 mm. However, in those cases where stone size exceeds 10 mm, even 3 sessions was not enough to fragment those stones (Table 2). The stone free rate in

Table 1. Number of fragmented, partially fragmented and not fragmented cases (success rate) in renal and ureteric stone.

Stone localization	Fragmented in 1st session	Fragmented in 2nd/3rd session	Not fragmented after 3rd session	Total
Kidney	154*	50	10	214
Ureter	187*	23	6	216
Total	341	73	16	430

p=0.01

Table 2. Table showing number of fragmented, partially fragmented and not fragmented cases in different size groups of stones.

Stone Size	Fragmented in 1st session	Fragmented in 2nd/3rd session	Not fragmented after 3rd session	Total
<10mm	133	18	4	155
10-15mm	165	29	5	199
>15mm	43	26	7	76
Total	341	73	16	430

p=0.01

those cases where size of stone <10 mm, 10-15 mm and > 15 mm after first session was found to be about 86%, 83% and 56% respectively whereas, the success rate has increased to more than 90% after second session in all those cases including stone size greater than 15 mm (Table 2).

DISCUSSION

Urolithiasis is the third most common disease of the urinary tract which is surpassed only by urinary tract infections and pathologic conditions of prostate.[1] Next to ESWL, there are many other modalities for treatment of urinary stones including percutaneous nephrolithotomy (PCNL), Uretero renoscopisc lithotripsy with LASER or pneumatic force, and open surgical procedures. But ESWL has revolutionized in treatment of renal and ureteric stones after its advent in clinical application since 1982. Now it has become the standard non invasive outpatient procedure widely accepted as first line treatment for the majority of urinary stones.[1,2,6,8] It has been found that fifty percent of the patients with renal stones present between the ages of 30-50 years and the male: female ratio is 4:3.[5]

In our study Male: Female ratio was 1.5: 1. This is consistent with some literatures.[3,5] However, this ratio is varies from study to study. Ghayalini et al. showed a ratio of 1: 0.3 whereas, a ratio of 12.3 was shown by Salman et al.[10,11] showing different proportion in male to female ratio in different areas. This disparity could be due to the nature of patients included in this study as the present study has included only those patients who visited surgery OPD and indicated specifically for ESWL.

In the present study the mean age of patient was 35.99 ± 13.19 years. This is similar to other studies. In the study carried out in Western region of Nepal and Oman, the mean age of patients with urinary stone disease was 36.09 (range 16-89) and 39.9 ± 12.8 (range 19-80) years respectively.[3,12] Similar study was done in Jordan where the maximum number of patients was between 35-45 years with mean age of 42.3 ± 12 years old which is similar to our result.[13]

It has been shown that the renal stone accounted for 85 % and ureteric stone for 15 % similarly, in other study it was 41% renal, 18.8% PUJ, 37.6% ureteric and 2.7% vesico-ureteric junction (VUJ) stones.[3,12] In the present study 49.2% were found to be renal stone while 50.8% were ureteric (including both mid and upper ureteric) stones. The mean stone size in our study was found to be 12.97mm for renal stone and 11.61 mm for ureteric stone. This finding is similar to the study by Al-Marhoon et. al.[12]

The size and site of stone location had a significant role in outcome of treatment. In our study, stones located in ureter had better success rate than those located in kidney. This may be because in ureteric stone more energy can be applied in comparison to that of renal stones, for fragmentation. In studies it has been found that kidney stones require more numbers of sessions with less energy compared to ureteric stones.[13,14]

The major determinant for the outcome of ESWL is stone fragmentation and clearance rate. The success of the treatment is depended upon strength of machine, location, size, site and fragility characteristics of stone. Hard stones with less powerful machine may need several sessions to clear the stones.[5,8,15,16] Efficacy is less on hard (cystine and calcium oxalate monohydrate) stones.[8,9] When the number of shockwaves and applied a high energy after more or two sessions of ESWL the chance of complication is higher.[17]

In the study by Nomikoser al., the stone free rate for stones less than 10 mm was 77% while that decreases sharply to 50% in >20%.[15] This trend is also reflected in our study where the stone free rate in <10 mm was 97% and that in >15mm was 90%. According to site, the stone free rate in kidney and ureteric stones in 95.2% and 97.4% respectively. According to the study by Al-Marhoon et. al, the success rate in kidney and ureteric stones is 74% and 88% respectively.[12] In a study by Kijvikaiet al. the success rate has been found as high as 96% for ureteral stone less than 10mm, very similar to our study.[18]

CONCLUSION

ESWL is a very effective modality for treatment of urinary stones which can be performed in outpatient basis. The success rate depends upon size and site of stone. As stone size increases, the success rate decreases. Also the success rate is better in ureteric stone compared to renal stone. However, increasing the number of sessions of ESWL may also pose chances of more complication, thus demanding other modalities of treatment in such cases.

CONTRIBUTION

HNJ has conceptualized and designed this study whereas, BS have contributed in assisting HNJ during the study period. RMK has helped in statistical analysis. Similarly, RS has contributed in data interpretation as well as in discussion writing including editing the manuscript. IJdJ and RKM guided throughout the study period and helped in reviewing the manuscript.

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