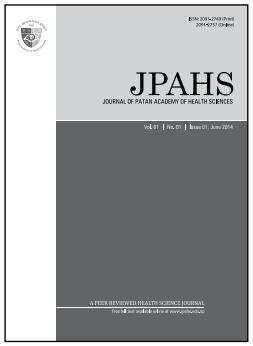

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Extracorporeal Shock Wave Lithotripsy in Management of Urolithiasis

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ABSTRACT

Introductions: Since 1980, when Chaussy in West Germany first demonstrated the efficacy of Dornier prototype lithotripsy HM1, extra corporeal shock wave lithotripsy has become a convenient, noninvasive, outpatient procedure used to fragment urinary stones. It is a standard internationally accepted first line preferred option for the management of renal stone less than 2.5 cm size.

Methods: A cross sectional study was conducted in the department of surgery of Shree Birendra Hospital on outpatient department basis during the period of March 2002 to February 2012. All consecutive patients presenting with renal and upper ureteric stones detected either on X-ray or ultrasound of the Kidney-Ureter-Bladder who were treated with extra corporeal shock wave lithotripsy. Descriptive analysis included age, sex, stone location, need of total session, use of double J stent and complications.

Results: Total 710 diagnosed cases of urolithiasis were taken for the study. The youngest age was 16 years and oldest 69 years of age. Overall stone clearance rate was 73.52%. The stone free rate for upper, middle, and lower calyx were 85.94%, 90.20% and 50.52% respectively.

Conclusions: Extracorporeal shock wave lithotripsy was successful in the management of the stones smaller than 2.5 cm in all caliceal locations and minimal morbidity.

Keywords: ESWL, steinstrasse, urolithiasis

Plain Language Summary

ESWL with new generation Lithotripter was safe and effective in adult out patients with urolithiasis less than 2.5 cm in functioning kidney without distal obstruction or urine infection. Stone clearance was 70%. DJ stenting was done in stone larger than 2 cm.

INTRODUCTIONS

Since 1980, when Chaussy in West Germany first demonstrated the efficacy of Dornier prototype lithotripsy HM1, shock wave lithotripsy (SWL) has become a convenient, noninvasive, outpatient procedure used to fragment most urinary stones.[1] It is a standard internationally accepted first line preferred option for the management of renal stone less than 2.5 cm size.[2] After the introduction of the original electro-hydraulic Dornier HM-3 and its high power delivery, lithotripters have been developed with new sources for generation of shock waves, such as electromagnetic and piezoelectric sources.[3]

Beside Extracorporel Shockwave Litotrapsy (ESWL), other minimally invasive surgical options revolutionized the treatment of urolithiasis and now open surgery is performed only in cases of contraindication or where facility is not available. Shree Birendra Hospital (SBH), Kathmandu Nepal introduced ESWL in 1987.

Various studies have been published regarding the outcome of ESWL, but there is lack of data from local institutes in Nepal where the prevalence of urolithiasis is still high.

METHODS

This was a cross sectional study conducted in the Department of Surgery of SBH, the teaching hospital of Nepalese Army Institute of Health Sciences (NAIHS), during the period of March 2002 to February 2012. All consecutive patients older than 16 years of age, presenting with renal and upper ureteric stones who underwent ESWL on outpatient department (OPD) basis were included in the study. All patients were evaluated with complete haemogram, coagulation tests, blood urea, serum creatinine, urine for routine and culture sensitivity, X-ray KUB and ultrasound abdomen - pelvis and intravenous urogram (IVU) or computerize tomography (CT) scan before subjecting them to shock wave treatment. Patient with renal an upper ureteric stones more than 5 mm and less than 2.5 cm, with normal renal function in non obstructed kidney were included in this study. The size of the stone was calculated by ultrasound and X-ray in all cases. Patient with active urinary tract infection, renal failure, uncorrected distal obstruction, gross hydronephrosis, pregnancy, abdominal and renal artery aneurysm, coagulation disorder, obesity and cardiac problem were excluded from the study. Patients who developed complication during study period or refused to complete study were also excluded from study. Data was analyzed age, sex, stone location, need of total session, use of double J stent (DJ stent) and any complication. Approval for study was taken from hospital authority.

ESWL was performed in all patients with the Edap Technomed Sonolith Parktis Version lithotripter. Stones were localized using fluoroscope and ultrasonography. All patients were treated in supine position. The stones treated were predominantly radio opaque. Patients did not undergo any special bowel preparation prior to the procedure except for overnight fast. A double J stent was placed in patients with stone size greater than 2 cm before subjecting to ESWL. Treatment was initiated with 14 kV and adjusted from 11 to 22 kV depending on the tolerance of the patient, location of the stone and the nature of the stone. Maximum of 3000 shocks were delivered in one.

All patients received Ciprofloxacin 500 mg twice a day and Diclofenac 50 mg thrice a day following the procedure for a period of 5 days. Patients were followed every month for a period of three months to make a final evaluation. Successful results were defined as complete stone clearance by ultrasound or KUB X-ray at three months.

RESULTS

Total 710 diagnosed cases of urolithiasis (renal and upper ureteric stone) were included in the study. The youngest was 16 years and oldest 69 years of age. The size of stone ranged from 5.6 mm to 23 mm. Overall stone clearance rate was 73.52% (522 out of 710).

Table 1. Characteristic of stones in 710 (M: 380, F: 330) urolithiasis patients who underwent ESWL

1	Mean age of the patients	41.5 years
2	No. of Male patients	380 (53.52%)
3	No. of Female patients	330 (46.47%)
4	Maximum no. of stones size (10-15mm size)	411 (57.88%)
5	No. of cases with single stone	467 (65.77%)
6	No. of cases with multiple stones	243 (34.22%)
7	Patient with right side stone	364 (51.26%)
8	Patient with left side stone	346 (48.73%)

Regarding the location of the stone and stone free rate for upper, middle and lower calyxes were 85.94%, 90.20% and 50.52% respectively. The stone free rate for the bilateral kidney, PUJ stone and upper ureter was 68.42%, 61.29% and 53.85% respectively. Stone free rate in a single session was 75.67%, 71.13% and 30.2% of patients in the upper, middle and lower caliceal system respectively.

Table 2. Location of stone and stone clearance rate

S.N.	Location of the stone	Total no of cases (n=710)	Total stone clearance no (n=522)
1	Upper calyx	185 (26%)	159 (85.94%)
2	Middle calyx	194 (27.32%)	175 (90.20%)
3	Lower calyx	192 (27.04%)	97 (50.52%)
4	PUJ	31 (4.3%)	19 (61.29%)
5	Upper ureter	13 (1.83%)	7 (53.84%)
6	Bilateral	95 (13.38%)	65 (68.42%)
	Total	710	522 (73.52%)

Out of 710 only 37 (5.21%) patients with stones size more than 2 cm had DJ stent before ESWL.

Table 3. Outcome of the study

1	Mean no. of shock wave and energy	2345 and 16.3kV
2	Total no of stone clearance in 1st session	403 (56.76%)
3	Spontaneously stone passage noted within 24 hours	431 (60.70%)
4	Mean duration of procedure	43.5 minutes
5	Total no. of patient with major complication (Steinstrasse)	51 (7.1%)
6	No. of cases needed DJ stent before procedure	37 (5.21%)

Skin bruise, nausea, minor pain and early haematuria were noted in most of the cases. Steinstrasse with colicky developed in 51 (7.1%) patients, of which 31 needed DJ stent and ureterescopic intervention. The surgical treatment after failure included pyelolithotomy and ureteroscopy with intracorporeal lithotripsy.

DISCUSSIONS

The management of urinary stone disease has changed with the advances in technology. Until the introduction of minimally invasive treatments, the majority of the urinary stones with no spontaneous passage were usually managed by open surgery. Nowadays the rate of open surgical procedures for the urinary stone disease is below 5%. Modern therapies such as ESWL, Ureteroscopy, Percutaneous Nephrolithotomy (PCNL) and Retrograde Intra Renal Surgery (RIRS) have replaced open procedures and open surgery is performed only in cases of failure and contraindication for minimal invasive methods.[4]

ESWL treatment for urolithiasis started on February 7, 1980 in Munich using a Dornier HM-1 lithotripter (the device was designed by the aero-spatial company Dornier and was initially intended for testing supersonic planes components). Stone localization can be done by ultrasound and X-ray fluoroscopy.[5] Newer lithotripters have a double guiding system (ultrasound and X-ray).[6] Extracorporeal shock wave lithotripsy has gradually become the first line of treatment for upper urinary tract stones diseases worldwide. It is the least invasive procedure compared to other methods and has achieved 70-90% success rate.[7] European treatment guidelines recommends ESWL treatment for all stones larger than 5 mm.[8]

Our lithotripsy, Sonolith Practice of Edap Technomed features an electro hydraulic generator, which incorporates a conductive medium in which sparks are created. The electrode itself is located within the ellipsoidal reflector, which has been designed to reduce pain without compromising efficacy. Voltage may be continuously set from 10 to 22 KV. Coupling between patient and water is assured by a membrane covered with ultrasound conductive gel. The lithotripsy has a double localization system. The major advantage of second generation lithotripter is anaesthesia free shock wave lithotripsy treatment.

In theory, extracorporeal lithotripsy is based on the fragmentation of urinary stones into smaller fragments (that can pass spontaneously through the ureter) by shockwaves generated outside the body and focally transmitted to the stone. Fragmentation is achieved by direct shearing force, erosion or cavitations.[9] Shockwaves pass through the tissues with virtually no loss of strength, but at the liquid-stone interface they induce a powerful energy discharge due to the high variation of density and small impact surface.

Lithotripters have four basic components: shockwave generation system, focalization system, coupling mechanism and stone localization system. The shockwaves can be generated in three different ways: electro-hydraulic, spark-gap or electromagnetic. Third generation electromagnetic lithotripters provide a wide range of improvements such as high shockwave accuracy that in turn allows the procedure to be performed with little or no analgesia as well as electromagnetic shockwave stability (due to the cylindrical source), wide wave energy range and the possibility of continuous therapy supervision and energy adjustment.[10]

Extracorporeal lithotripsy treatment outcome depends on several factors which include the type of lithotripter, stone (size, location, composition and number), the anatomy and kidney function.[11] Stones larger than 15 mm and calcium oxalate monohydrate usually require several sessions of ESWL for clearance. Uric acid, calcium oxalate dihydrate as well as struvite stones are easier disintegrate. ESWL has better result with stone in upper and middle pole of the kidney, but poor outcome for stones located in the lower pole (stone free rate is 40-70%.[8] Some of the studies have questioned the use of lithotripsy in lower pole kidney stone, but many have suggested as a primary treatment modality for the stone size less than 2 cm.[12] For the optimum treatment, a good patient assistance is required without analgesia. This is even more important

after the procedure when the patient compliance with the medical recommendations is expected (fluid intake, medication, scheduled follow-up).

The overall stone free rate in our study was 73.52% (in 522 patients). The stone free rate for upper, middle, and lower calyx was 85.94%, 90.20% and 50.52% respectively. The stone free rate for the bilateral kidney, PUJ stone and upper ureter was 68.42%, 61.29% and 53.85% respectively. This result is comparable to most of the study published in the literature.

Auxiliary procedures were used before treatment in some patients which included DJ stent placed in patient with stones size more than 2 cm. Only 37 (5.21%) patients needed DJ stent before the procedure. The stone clearance rate is 56.75% (21) in stone size more than 2 cm in this study. The maximum numbers of stone size were 10 to 15 mm (57.88%), where the stone clearance rate was 76.15%.

Our patient did not have any serious complications such as perirenal hematoma or urosepsis. Most case of Steinstrasse were treated with analgesics, antibiotics and antispasmodics and extra water consumption with favorable outcome but a few cases required ureteroscopic removal of stone (URSL) and double J stent placement. Minor post procedural complication noticed in majority of the cases was haematuria which was insignificant and rarely lasted for more than 24 hours. Other minor complications observed were skin bruise, nausea and colicky pain, very similar to other studies.

Figure 1. X-ray KUB before Lithotripsy

Figure 1. X-ray KUB after Lithotripsy

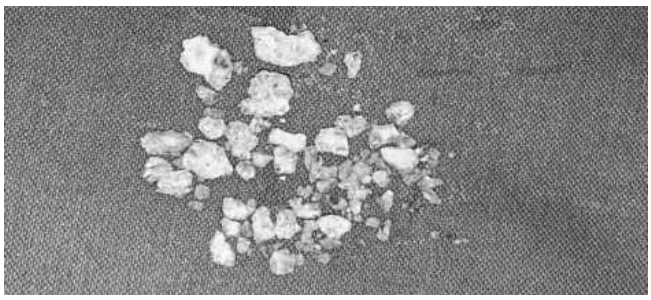

Figure 3. Stone fragments passed by patients after Lithotripsy

CONCLUSIONS

Extracorporeal shock wave lithotripsy is successful in the management of the kidney stones smaller than 2.5 cm in all caliceal locations and is safe modality with minimal morbidity with better stone clearance for upper and middle calyx.

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