Audit of Extracorporeal Shockwave Lithotripsy in 210 Sudanese Patients at Gezera Hospital for Renal Diseases & Surgery (GHRD&S) Sudan

Mohamed El Imam[1], Omran O[1], Osman Taha[2], Faisal Nogud [3] Abdelmahmod A[4], Walaa I[5], Elsamani Widaa[4], Nsrdeen Yosif[6], Elhadi Miskeen [7]

ABSTRACT

Background: Extracorporeal Shock Wave Lithotripsy (ESWL) was the breakthrough in urolithiasis management in the 20th century.

Objectives: to audit the outcome of ESWL and evaluate its cost effectiveness on the treatment of stone disease in Gezira Hospital for Renal Disease and Surgery (GHRD&S), Sudan

Methods: This is a prospective study of 210 patients. ESWL was performed with SLX MX STORZ machine. The number of shocks administered, and the degree of energy were supervised with maximum allowance of 2500-3000 shocks and 5-7 energy in kidney and/or 3000-3500 shock 7-8 energy level for ureteral stone with modification when it was indicated

Results: Out of 210 patients; 28, 12, 28 and 2 patients had upper, mid, lower ureteric and vesical stones respectively. Where as 140 patients had renal stones. The success rate of fragmentation of the stones with ESWL was 97.1% for the renal, 92 % for the upper and lower ureter and 83.3% for mid ureteric stones. Vesical stones were not amenable for fragmentation in this study. The overall success rate was 95%. The complications were haematuria in one patient, pain and steinstrasse in two patients. There were no cases of post ESWL renal failure, hypertension and/or residual calculi.

Conclusion: This modality of treatment was found to be less costly, acceptable with short hospital stay and short work absence.

Keywords: Gezera, extracorporeal shockwave lithotripsy

The introduction of extracorporeal shockwave lithotripsy (ESWL) by Chaussy in 1980[1] had revolutionized the management of urinary calculi[2]. Hundreds of underwater shockwaves were generated outside the patient's body and focused on the stone. Stone fracture mainly is due to spalling, cavitations and layer separation.

Cavitations' bubbles are produced in the vicinity of the stone at the tensile phase of each shockwave. Bubbles expand, stabilize and finally collapse violently, creating stone-damaging secondary shock waves and micro jets[3].

1-Urologist, 2- Professor of pediatric surgery, 3- Associated professor of pediatric surgery 6- Assistant Professor of Medicine Residence, 7- Teaching assistant , department of Obs&Gyn , University of Gezira, Sudan, 4- Resident, 5- Registrar of surgery , Gezira Hospital for Renal Disease &Surgery , Sudan.

Correspondence: Mohamed El Imam, Associated professor ,University of Gezira, Wad Medani, Sudan PO BOX 20, Telfax; +249511846203 , E-mail mohammedimam@hotmail.com

Shockwave lithotripsy is noninvasive and requires the least anaesthesia in comparison with other treatment modalities for renal calculi and there lies its popularity[4]. However, in the last decades, there have been changes in thinking regarding methods of patients' selection, changes in the technique and technologies designed to increase the efficacy of shockwaves. With appropriate patients selections significant improvements in stone-free rates were achieved[4]. Currently, the contraindications to ESWL treatment are restricted to pregnancy, severe skeletal malformations, severe obesity, aortic and/or renal artery aneurysms[5-6]. Moreover, ESWL should not be carried out in patients with bleeding diathesis or urinary tract infection. However, pacemaker is not an absolute contraindication for the procedure[7]. Despite the effectiveness and successful results of shock wave application, the effect of some varying parameters, namely number of shockwaves, electrical discharge volume, projection of shockwave and electrode age are

still to be evaluated. There is no significant relationship between the electrical discharge volume and the stone disintegration[8]. A part from urology, shockwaves have been used in orthopaedics and traumatology to treat various insertional tendinopathies and delayed or malunion of fractures[9].

In principle, stones along the whole upper urinary tract can be treated. The ideal situation is a stone in the kidney pelvis less than 2.5cm in diameter or an unimpacted stone at the upper or lower ureter. The main determinants for treatment outcome are stone burden, infection, intrarenal anatomy and fluid dynamics[10].

PATIENTS AND METHODS

This was a prospective cross-sectional study designed to evaluate the introduction of ESWL for the first time in Gezira Hospital for Renal Disease and Surgery (GHRD&S), Sudan. This hospital is auspiced by the International Society of Urology (ISU), reflecting the spectra of rejuvenation of urological services in Sudan. In the period from Aug. 2005 to Aug. 2006, 210 cases were treated according to strict criteria and guideline for ESWL. Selection was conducted either by stone and/or patient's criteria. The stone should be less than 2.5 cm. However, patients with recurrent stones -after surgery- up to 3 cm were allowed to have the procedure after the introduction of JJ stent prior to the session. Only radio-opaque stones were included because of technical difficulties in detecting radiolucent stones. The fluoroscopy machine used was SLX STORZ.

Informed consent was taken from every patient.

Patient's preparation for ESWL:

History and examination were taken from all patients. Patient on anticoagulants and NSAIDS were advised to stop taking the medicines before the procedure. Urine culture to prove eradication of urinary tract infections was performed. Blood investigations including platelets, blood urea, serum creatinine, electrolyte, prothombin time and partial thromboplastin time were done.

Stone size and evidence of urinary tract obstruction were obtained from IVU/CT and/or retrograde pyelogram. Pre ESWL urethral stent were inserted in patients with big stones and when precise visualization of stone was difficult.

Fluoroscopy was used to determine the location of the stone. The machine used was SLX MX STORZ. Plain abdominal radiography was done to confirm stone position and size. Routine intravenous antibiotics were administered. The procedures were performed under intravenous pethidine (50 mg) for adult patients and general anaesthesia for pediatric age groups.

Exclusion criteria:

Patients with morbid obesity, deformed skeleton, pregnancy were excluded as well as those who have bleeding tendency, prosthetic valves or pacemakers.

Positioning of patients, Imaging and conduction:

Patients with renal stone and upper ureteric stone lay supine position where as those with lower ureteric stone adopted prone position. Periodic imaging at intervals of 300 – 500 shocks was set.

Shockwave administration:

The number of shocks administered, and the degree of energy were supervised with maximum allowance of 2500-3000 shocks and 5-7 energy in kidney and/or 3000-3500 shock 7-8 energy level for ureteric stone with modification when it was feasible.

The stone was considered not amenable to be fragmented by SWL if three complete guided energies and advocated number of shocks were delivered without any satisfactory results.

Post-shock wave lithotripsy patient care:

All cases were treated on outpatient basis and the patients and were encouraged to stay for 4 hours in hospital following each session and to maintain adequate oral fluid intake. Oral analgesia was prescribed as needed. Temperature and vital signs were closely monitored. Haemorrhage and urinary obstruction were anticipated and ultrasonography was used to confirm the latter.

RESULTS

Two hundred and ten patients were enrolled

in this study with male to female ratio of 1.1:1 (table1) Different age groups were seen including early childhood. The youngest child was only 2 years old. Success rate was 95%

Table (1) Sex versus site of stone distribution of patients under went ESWL in Gezira Hospital for Renal Diseases and Surgery 2005

Site	Male	Female	otal
Renal	75	65	140 (66.67%)
Upper ureter	20	08	28 (13.33%)
Mid ureter	05	07	12 (%5.71)
Lower ureter	13	15	28 (13.33%)
Urinary bladder	01	01	02 (%0.95)
Total	114	96	210 (100%)
%	%54.28	%45.72	%100

All the stones encountered in our patients were radio-opaque and composed of calcium oxalate with increased preponderance of uric acid.

We had 140 (66.67%) patients with renal stone, either in upper, middle or lower calyceal system with approximately equal right and left side locations. Upper and lower ureteric stone were found each in 28(13.33%)

Table (2) Parameters of stones underwent ESWL in Gezira Hospital for Renal Diseases and Surgery

Site	Right	Left	Solitary	Multiple
Renal	75	65	130	10
upper ureter	12	16	2	00
mid ureter	07	05	12	00
lower ureter	14	14	22	06
urinary bladder	00	00	02	00

patients, where as 12(5.71%) patients had mid ureteric stone and only two patients had vesical stone. Multiple stone were of a significant number (table2).

Parameters of Applications of ESWL in our unit at Gezira Hospital for Renal Diseases and Surgery were shown in table 3.

Table (3)

Site	Mean energy	Mean of shock wave	Frequency	Mean time (min)
Kidney	5-7	2500-3000	90	35
Upper ureter	8-6	2500--3000	120	30
Mid ureter	7	3000	120	29
Lower ureter	7-9	Up3500	120	35
Urinary bladder	9	4000--3000	120	30

In 140 patients with renal stones only 4 cases failed to respond favorably. Most of the patients were stone free in the first session, not only that but also in some cases even before they completed the allocated number of shock (121 patients 86 %).

DISCUSSION

Shockwaves are specific sound waves produced by shockwave generators; the generators currently available have different physical properties and represent different technical solutions. The measurement of shockwave pressure is necessary in laboratory settings to define the physical characteristic of a given shockwave source.

Table (4) Success rate and failure per Session of ESWL in Gezira Hospital for Renal Diseases and Surgery

Site	Total	1st session	2nd session	3rd session	Failure	Total success
Renal	140	121	10	5	4	136)(%97.14
Upper ureter	28	20	4	2	2	(%92.86)026
Mid ureter	12	08	1	1	2	(%83.33)010
Lower ureter	28	15	8	3	2	(%92.86)026
Urinary bladder	02	0	0	0	2	(%00.00)000

Table (5) ESWL and open surgery parameters

parameters	**ESWL**	**Operative**
Anaesthesia	Analgesia	General anaesthesia
Mean time	25min	2hours
Hospital stay	Hours4-6	4-7days
Work absence	1-5days	21day-6month
Expected cost	100.000 SD	150.000 SD
Schedule time for all	1year	2years
Minimal personnel for application	one	5
Patient preference	preferred	Not preferred
Total successful rate	%95	%98

The stone-free rate or the percentage of complications is used to describe the efficacy and safety of lithotriptors[11]. ESWL has revolutionized the management of renal stones: the imaging capacity of 1st and 2nd generation machines limited the effective localization to the collecting system[12].

This strict criterion that we adopted was the yard stick for the high success rate of this service.

Because of the guidelines, the success rate was possible. Most of the patients were stone free in the first session (table 4). ESWL and ureteroscopy is currently the mainstay of treatment for upper ureteric stone. Unlike upper or lower ureteric stones, mid ureteric stones were not common in our series {12 cases (5.7%)} yet the rate of failure was relatively high (16.7). This might be due to interposition of transverse processes between shock waves and stones. This suggests that although ESWL has a definite role in the treatment of lower ureteric stones, it may be less successful in middle ones[13].

ESWL has proved to be the treatment of choice for renal calculi in the pediatric age group[14]. All kids treated were with renal calculi and they did respond with only one session of a max energy 5-6 levels. Fluoroscopy was used to check after 500 shocks to decrease the hazard of radiation and the procedure was to be terminated if the calculus could not be relocated.

Vesical stones were not amenable to treatment by this procedure in our series.

ESWL is unparalleled modality for treating urinary stones as regards its non-invasive nature, minimal morbidity, and decreased length of hospitalization and anaesthesia requirements (table 5). As building experience with ESWL grows people uncover an ever increasing number of complications.

These complications could be early or late e.g. if ESWL is administered during

infection there can be serious spread of infection, septicaemia and pyelonephritis. The incidence of pain, fever and haematuria will also be higher[15]. Pain during ESWL depends on the type of energy source and amount of energy used. We found that there was increased need for analgesia in women, younger patients or patients where higher voltage was applied. Severe haematuria should raise a suspicion of coagulopathy or uncontrolled infection. Out of 150 (71%) patients presented with haematuria, only 2(1%) cases had severe bleeding that necessitated transfusion. One of these two had impaired renal function and undetected bleeding tendency. Injury to surrounding organ is very rare. There are reports of the injury to the lung and liver,[16] in contrast we didn't encounter any of these. Steinstrasse or street of stones is an unusual complication of ESWL where several fragments are linked up in the ureter to cause obstruction. The patient may be asymptomatic or may present with colic. This could be prevented by JJ stent[17]. Though open surgery has a very tangible role in the whole third world, where there are no facilities of minimal invasive procedures, is time saving, cost effective and with less imposition on patients.

CONCLUSIONS

The success rate of ESWL was found to be 97.1% for the renal, 92% for the upper and lower ureter and 83.3%for mid ureteric stones. Vesical stones were not amenable for fragmentation in this study and the overall success rate was 95%. The complications encountered during this procedure were comparable to the literature. This modality of treatment was found to be less costly, acceptable with short hospital stay, short work absence and requires just analgesia in comparison to the conventional open surgery.

REFERENCES

1- Chaussy C, Brendal W. Schmiedt E. Extracoropereally induced destruction of kidney stones by Shockwaves. Lancet 1980; 2:12 65-8.

2- Fang Y.K, Ho Sh, Peh OH etal. ESWL and intracorporeal lithotripsy for proximal ureteric calculi. Ann Acad Med Singapore 2003; 32: 80-3.

3- Loske AM, Prieto FE, Ternandez F Van Lauwelaert J. Tandem shock wave cavitation enhancement for extracorporeal lithotripsy. Phys Med Biol 2002; 47(22): 3945-57.

4- Putman SS, Hamilton BD, Johnson DB. The Use of shockwave lithotripsy for renal calculi. Curr Opin Urol 2004; 14(2): 117-21.

5- Loughlin KR. Management of urologic problem during pregnancy. Urology 1994; 44: 159-169.

6- Ignatoff JM Nelson JB. Use of ESWL in a solitary kidney with renal artery aneurysm. J Urol 1993; 149; 359-360.

7- Tiselius H, Ackermann D, Alken P. Guidelines on urolithiasis. Europeans Urology EAU updates. 2005; 23-25.

8- Sarica K. Isikay L, Kilic S et al. Stone disintegration effect of shockwave projection and electrode age on this parameter in standard stone model. Int. Urol. Nephrol 1997; 29(3): 281-6.

9- Thiel M. Application of shockwaves in medicine Clin orthop Relat Res 2001 (387): 18-21.

10- Karlsen SJ. ESWL in urolithiasis an update Tidsskr Nor Laegeforen 1996; 116(24): 2889-92.

11- WilbertDM. A comparative review of extracorporeal shockwave generation. BJU International 2002; 90: 507-511.

12- OLSBURGH J., Ramsay J. Lithotripsy for ureteric stones. Throw away the ureteroscope. BJU International 2003;91(9): 771-772.

13- Joshi HB, Obadey OO and Rao PN. A comparative analysis of nephrostomy. JJ stent and Urgent in situ ESWL for obstructing ureteric stones. BJU International 1999; 84: 264-269.

14-Busaidy SS Prem AR, Medhata M et al. Paediatric ureteric calculi: efficacy of primary in situ ESWL. BJU1998; 82: 90-96.

15- Fujita K. Mizuno T, Ushiyama T et al. Complicating risk factors for pyelonephritis after ESWL. Int. J. Urol 2000; 7 (6): 224-30.

16- Abe H, Nisimura T, Osawa S et al. Acute pancreatitis caused by ESWL for bilateral renal pelvis calculi. Int J Urol 2000; 2: 65-8.

17- Awadi KA. Abdul Halim H. Kehinde EO et al. A comparison of incidence with and without JJ Stenting. BJU Int 1999; 84 (6): 618-21.