

EXPERIENCE OF EXTRACORPOREAL SHOCKWAVE LITHOTRIPSY FOR KIDNEY AND UPPER URETERIC STONES BY ELECTROMAGNETIC LITHOTRIPTOR

Bakhtawar Gul Wazir, Mian Iftikhar ul Haq, Faheem ul Haq, Akhtar Nawaz, Ahmed Nawaz, Ikramullah, Mohammad Jamil*

Institute of Kidney Disease, Hayatabad, Peshawar, *Department of Anaesthesia, Ayub Medical College, Abbottabad, Pakistan

Background: Extracorporeal Shock Wave Lithotripsy (ESWL) is a non-invasive treatment of urinary stones which breaks them, by using externally applied, focused, high intensity acoustic pulse, into smaller pieces so that they can pass easily through ureter. Shock wave generation, focusing, coupling and stone localisation by fluoroscope or ultrasound are the basic components of ESWL. ESWL has some complications and is contraindicated in certain situations. The aim of this study was to evaluate the effectiveness and safety of ESWL in kidney and upper ureteric stones by Electromagnetic Lithotripter. **Methods:** All adult patients with renal and upper ureteric stones having a diameter of up to 1 Cm were included in the study. Basic evaluation such as history, examination, ultrasound and excretory urography were performed. Electromagnetic lithotripsy was done and data were collected on a printed proforma from 1st January 2008 to 30th March 2009 in Institute of Kidney Diseases, Peshawar. **Results:** Out of a total of 625 patients 463 were male and 162 were female; 67.36% of patients were having renal stones, 23.84% upper ureteric and 8.8% both renal and ureteric stones. Complications noted were renal colic in 9.76%, haematuria in 3.2%, steinstrasse in 2.72%, and fever in 1.12% of patients. The stone free rate was 89% and 7% of patients were having stone fragments <4 mm. ESWL failed in 4% of patients. **Conclusion:** ESWL is a safe and effective way of treating kidney and upper ureteric stones.

Keywords: Extracorporeal shock wave lithotripsy (ESWL), kidney and upper ureteric stones

INTRODUCTION

Extracorporeal shock wave lithotripsy (ESWL) is the non-invasive treatment of urinary and biliary stones.^{1,2} It was developed in the early 1980s in Germany by Dornier Medizintechnik GmbH and, within a few years; ESWL became a standard treatment of calculosis.³ It is estimated that more than one million patients are treated annually with ESWL in the USA alone.^{4,5}

The lithotripter attempts to break up the stone with minimal collateral damage by using externally applied, focused, high intensity acoustic pulse.^{4,6} The patient lies down in the apparatus bed, with the back supported by a water filled coupling device placed at the level of kidneys. A fluoroscopic X-ray imaging system or an ultrasound imaging system is used to locate the stone, and the focal point of shock wave is focused on the stone. The treatment usually starts at the machine's lowest level, with a long gap between pulses, in order to accustom the patient to the sensation. The frequency of pulses and the power level are then gradually increased, so as to break up the stone more effectively. The successive shock wave pressure pulses result in direct shearing forces, as well as cavitation bubbles surrounding the stone, which fragment the stone into smaller pieces, so that they can easily pass through the ureter.⁷⁻⁹ The process takes about an hour.^{6,8,10}

The ESWL works best with stones between 4 mm–2 cm in diameter, that are still located in the kidney and up to 1cm stone in the upper ureter.^{5,6,8} The complications of ESWL are renal colic, bleeding, steinstrasse, gastro intestinal tract side effects, hypertension, and mortality.^{8,10,11} The ESWL is contraindicated in pregnancy, uncontrolled coagulopathy, uncontrolled hypertension, urinary tract obstruction distal to the stone, and urinary tract infection with fever.^{7,8,11}

The aim of this study was to evaluate the effectiveness and safety of ESWL in kidney and upper ureteric stones by electromagnetic lithotripter.

MATERIAL AND METHODS

This was a descriptive study of 625 patients, which was conducted in Institute of Kidney Diseases Peshawar, Pakistan, from 1st January 2008 to 30th March 2009. All patients having kidney stones up to 2 Cm and upper ureteric stones up to 1cm, having age of 20 years or more and having normal renal function tests were included in this study. Patients having pregnancy, uncontrolled coagulopathy, uncontrolled HTN and urinary tract infection with fever were excluded from this study. An informed consent was taken and then pre-treatment history, clinical examination, routine blood tests, urine analysis, urine culture, intravenous urography and Ultrasound were done.

The ESWL, through an electromagnetic lithotripter was done in patients who fulfilled the inclusion and exclusion criteria. One to three sessions of ESWL were done until a stone free-state or stone fragments <4 mm were achieved. After ESWL treatment routine follow up included ultrasonography, blood pressure control, laboratory tests and plain X-ray KUB.

Post-ESWL complications were noted. All the above information were collected and entered into a semi structured proforma.

The data were collected on a specially designed proforma for these patients. After labelling of data into SPSS-10, descriptive statistics like mean, median, standard deviation and percentages were calculated accordingly.

RESULTS

Total number of patients was 625, in which 463 (74.04%) were male and 162 (25.9%) were female. The mean age was 40.15 years. Out of 625 patients, 421 (67.36%) were having renal stones, 149 (23.84%) upper ureteric stones and 55 (8.8%) were having both renal and ureteric stones. Three hundred and three patients (48.48%) were having left sided stones, 290 (46.4%) were having right side stones and 32 patients (5.12%) were having stones on both sides. Age distribution of the patients is given in Table-1.

Post-ESWL complications were noted in which flank pain was most common complication as shown in Table-2. Out of 625 patients, 556 (88.96%) patients were stone free on X-ray KUB and U/S renal tract, (Table-3).

Table-1: Age Distribution

Age Ranges (Years)	Patients	Percentage
20-30	127	20.32
31-40	210	33.6
40-50	158	25.28
51-60	130	20.8

Table-2: Complications

Complication	Patients	Percentage
Flank pain	61	9.76
Haematuria	20	3.2
Steinstrasse	17	2.72
Fever	7	1.12

Table-3: Success and Failure Rates

Post-ESWL status	Patients	Percentage
Stone-free	556	88.96
<4 mm Fragment	44	7.04
ESWL Failure	25	4.00

DISCUSSION

ESWL is non invasive and widely accepted as first line treatment for majority of urinary calculi. There are different types of lithotripters available, which are usually characterised by the type of shockwave

generator like electrohydraulic, electromagnetic and piezoelectric.^{5,7,10} Stone size and composition is very important for success of ESWL. Calcium oxalate monohydrate, calcium phosphate and cystine stones are difficult to fragment.^{8,9}

In our study the mean age was 40.15 years. In a study from Quetta¹², the peak incidence was in the age group of 21-40 years. Akhter MS¹³ reported mean age of 38.24 years. In another study conducted by Butt A¹⁴, the mean age was 37.7 years.

In our study the male to female ratio was 2.8:1. Arian GM¹⁶ reported male to female ratio 4:1. Rajput AP¹² and Akhter MS¹³ conducted studies in which they reported male to female ratio 3.8:1 and 2.5:1 respectively. Butt A¹⁴ reported male to female ratio 2.2:1.

In our study flank pain was the commonest complication, which was 9.76%; it was treated by prescribing NSAIDs. Tombolini P¹⁷ and Botoca MR¹⁸ conducted studies in which they reported incidence of pain to be 6.2% and 10.2% respectively. Butt A¹⁴ reported pain incidence in 5.9% patients after ESWL treatment. Pain was also a common complication after ESWL in study conducted by Mohayuddin N.¹⁹

Haematuria was the 2nd most common complication in our study, which settled within 3-4 days. In our study haematuria was noted in 3.2% cases. Botoca MR¹⁸ and Maheshwari P²⁰ reported same incidence of haematuria after ESWL treatment.

Steinstrasse is a well known complication of treatment of large renal or ureteric calculi with ESWL.^{7,9,11} In our study steinstrasse was reported in 2.72%. It was treated either by prescribing NSAIDs and alpha blockers or giving ESWL to the leading stone of steinstrasse. Tombolini P¹⁷ and Botoca MR¹⁸ noted steinstrasse in 2-3% of patients. Butt A¹⁴ reported steinstrasse in 2.9% of cases.

Fever may occur after ESWL for urolithiasis. Fever was due to urinary tract infection which was treated by prescribing specific antibiotics according to urine culture and sensitivity. In our study it was noted in 1.12% of cases. Butt A¹⁴ reported it in 1.7% of cases. Mohayuddin N¹⁹ noted it in 2.5% of patients.

Stone clearance after ESWL is influenced by a number of factors, i.e., stone, patient and machine.^{6,7,9} In our study the stone free rate was 89% and insignificant stone fragments, i.e., <4 mm size were 7%. Kamran T²¹ noted stone clearance rate of 90%. Coz F²² and Butt A¹⁴ reported stone clearance rates of 87% and 96.5% respectively. ESWL clearance rate in a study from Saudi Arabia²³ varied between 70-75%.

CONCLUSION

ESWL is the non invasive way of treating kidney and upper ureteric stones for indicated patients due to low complication and failure rate.

REFERENCES

1. Abe T, Akakura K, Kawaguchi M, Ueda T, Lehkawa T, Ito H, *et al.* Outcomes of shockwave lithotripsy for upper urinary tract stones: a large scale study at a single institution. *J Endourol* 2005;19:768–73.
2. Chako J, Moore M, Sankey N, Chandhoke PS. Does a slower treatment rate impact the efficacy of extracorporeal shock wave lithotripsy for solitary kidney or ureteral stones? *J Urol* 2006;175:1370–3.
3. Kim FJ, Rice KR. Prediction of shockwave failure in patients with urinary tract stones. *Curr Opin Urol* 2006;16:88–92.
4. Krambeck AE, Gettman MT, Rohlinger AL, Lohse CM, Patterson DE, Segura JW. Diabetes mellitus and hypertension associated with shock wave lithotripsy of renal and proximal ureteral stones at 19 years of followup. *J Urol* 2006;175:742–7.
5. Lee C, Ugarte R, Best S, Monga M. Impact of renal function on efficacy of extracorporeal shockwave lithotripsy. *J Endourol* 2007;21:490–3.
6. Lee YH, Tsai JY, Jiaan BP, Wu T, Yu CC. Prospective randomized trial comparing shock wave lithotripsy and ureteroscopic lithotripsy for management of large upper third ureteral stones. *Urology* 2006;67:480–4.
7. Lindqvist K, Holmberg G, Pecker R, Grenabo L. Extracorporeal shock wave lithotripsy or ureteroscopy as primary treatment for ureteric stones: a retrospective study comparing two different treatment strategies. *Scand J Urol Nephrol* 2006;40:113–8.
8. Madaan S, Joyce AD. Limitations of extracorporeal shock wave lithotripsy. *Curr Opin Urol* 2007;17:109–13.
9. Micali S, Grande M, Sighinolfi MC, De Stefani S, Bianchi G. Efficacy of expulsive therapy using nifedipine or tamsulosin, both associated with ketoprofene, after shock wave lithotripsy of ureteral stones. *Urol Res* 2007;35:133–7.
10. Skolarikos A, Alivizatos G, De La Rosette J. Extracorporeal shock wave lithotripsy 25 years later: complications and their prevention. *Eur Urol* 2006;50:981–90.
11. Weiland D, Lee C, Ugarte R, Monga M. Impact of shock wave coupling on efficacy of extracorporeal shock wave lithotripsy. *J Endourol* 2007;21:137–40.
12. Rajput AP, Khan S, Khan M, Din S, Haq Nawaz. Present trend of urolithiasis in Balochistan: a single center experience. *J Coll Physicians Surg Pak* 2002;12:618–22.
13. Akhtar MS, Akhtar FK. Utility of the lithoclast in the treatment of upper, middle and lower ureteric calculi. *Surgeon* 2003; 1:144–8.
14. Butt AU, Khurram M, Ahmed A, Hasan Z, Rehman A, Farooqi MA. Extracorporeal shock wave lithotripsy. *J Coll Physicians Surg Pak* 2005;15:638–41.
15. Keely FX Jr, Moussa SA, Smith G, Trolley DA. Clearance of lower pole stones following shock wave lithotripsy: effect of infundibulopelvic angle. *Eur Urol* 1999;36:371–5.
16. Arain GM, Malik SA, urinary calculus disease: a study of 267 cases at Sir Ganga Ram Hospital Lahore over 2 years. *Biomedica* 1997;13:38–41.
17. Tombolini P, Ruppolo M, Bellorofontae C, Zaatari C, Follini M. Lithotripsy in the treatment of urinary lithiasis. *J Nephrol* 2000;13:71–82.
18. Botoca MR, Bucuras V, Minciu R, Cumpănaș A, Bioborean P, Miclea F. ESWL-first line treatment in renal stones; Timisoara Med J [serial online] 2003;53(2): available from: URL:http://www.tmj.ro/dump_articol.html?id_numar=2&id_articol=46
19. Mohayuddin N, Malik HA, Hussain M, Tipu SA, Shehzad A, Hashmi A, *et al.* The outcome of extracorporeal shock wave lithotripsy for renal pelvic stone with or without JJ stent- a comparative study. *J Pak Med Assoc* 2009; 59:143–6.
20. Maheshwari P, Andankar MG, Saple AL, Oswal AT. Extracorporeal shock wave lithotripsy: complications and their prevention. *Bombay Hosp J [serial online]* 2002;44(2):181–4. Available at: http://www.bhj.org/journal/2002_4402_apr/endo_181.htm.
21. Kamran T. Pneumatic lithotripsy for the management of ureteric calculi. *J Coll Physicians Surg Pak* 2003;13:101–3.
22. Coz F, Ozivieto M, Bustos M, Lyng R, Stein C, Hinrichs A. Extracorporeal shock wave lithotripsy of 2000 urinary calculi with modulith SL: success and failure according to size and location of stones. *J Endourol* 2000;14:239–6.
23. Ghafoor M, Halim A. Extracorporeal shock wave lithotripsy in the treatment of ureteric stones: experience from Tawam Hospital, United Arab Emirates. *Ann Saudi Med* 2002;22:18–21.

Address for Correspondence:

Dr. Bakhtawar Gul Wazir, Department of Urology and Transplant, Institute of Kidney Diseases, Hayatabad, Peshawar, Pakistan. **Cell:** +92-333-9125814

Email: dr_bgul@hotmail.com