Safety and efficacy of ESWL lithotripsy as a primary modality of treatment for upper ureteric stones: A 5-year experience - single center study

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Abstract

Urinary stone disease is a major health care problem due to its high prevalence and incidence. The aim of the study is to evaluate the safety and efficacy of ESWL lithotripsy as a primary modality of treatment for upper ureteric stones. From October 2011 to October 2016, 400 patients (300 male and 100 female) with upper ureteral stones were admitted to Al-Diwaniya teaching hospital, urology unit and enrolled in this study, their age range from 18 to 65 years with a mean age of 40 ± 3 years. All patients were evaluated by history, physical examination, laboratory investigation (including urinalysis, full blood count, coagulation profile and renal function tests). The stone size, location, opacity and degree of obstruction were assessed by preoperative radiographic imaging studies, including KUB, ultrasound and computerized tomography (CT scan). The overall stone-free rate at three months was 95% (380/400). Clearance after first sitting was 70% (280/400), after second sitting was 20% (80/400) and after third sitting was 5% (20/400). Clearance of stone in patients with stone size ≤ 1 cm was 97% (388/400), and in patients with stone size > 1cm was 5% (340/400). Five per cent (20) of cases did not have successful outcome. In conclusion, the results of our study show that ESWL as a primary modality for upper ureteric stones treatment has an overall success rate of 95%. Success rate drops with increasing size of stone, duration of stone in ureter, and no anesthesia is required.

Keywords: ESWL lithotripsy; Ureteric stones; KUB

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Introduction

Urinary stone disease is a major health care problem due to its high prevalence and incidence. The disease is very common among both men and women, stones form twice as often in men as in women with estimated prevalence among the population of 2 to 3% and an estimated lifetime risk of 12% for white males and 5 6% for white females. The

life time recurrence rate is approximately 50%. The interval between recurrences is variable, with approximately 10% within one year, 35% within five years, and 50% within 10 years. The peak age in men is 30 years; women have a bimodal age distribution, with peaks at 35 and 55 years. Most of ureteral stones are renal in origin and they pass through the renal calyces to the pelvis and subsequently to the ureter. Primary stone formation in the ureter requires an already existing obstructed urinary flow. Despite an improved understanding of the mechanisms of stone formation it is obvious that ureteral stones are still a problem afflicting an increasing number of patients worldwide [1]. The Ureter is divided in to three thirds; The upper third of the ureter is usually taken to be that portion of the ureter lying above the sacro-iliac joint, the lower third of the ureter is the portion below the level at which the ureter crosses the bifurcation of the common iliac artery and the middle third is the portion between them. However, in the report from the analysis of treatment outcomes was considered on the basis of the proximal and distal ureter, the proximal ureter that was taken to include the proximal and middle thirds as described above [2]. Extracorporeal lithotripsy (ESWL) is the technique of focusing externally generated shock waves at a target (the stone). First used in humans in 1980. The first commercial lithotripter, the Dornier HM3, became available in 1983 [3]. ESWL revolutionized kidney and ureteric stone treatment [3]. The goal of the surgical treatment of patients suffering from ureteral calculi is to achieve complete stone clearance with minimal attendant morbidity. Improvements in surgical technology, such as ESWL, rigid and flexible ureteroscopes, the holmium: YAG laser, and basket devices, has greatly augmented the urologist's ability to efficiently treat such patients, regardless of the size or location of the ureteral calculus. Although the treatment options available to the urologist are greater now than they have ever been, most patients with ureteral calculi do not require intervention. Ureteral calculi 4 mm or smaller will usually pass spontaneously, although in some cases with discomfort and expense to the patient. Ureteral calculi of any size may be associated with renal obstruction, and care must be taken to prevent irreversible damage to the kidney, whether the patient selects expectant or active treatment [4]. The management of calculi in the urinary tract has been revolutionized by the introduction of extracorporeal shock wave lithotripsy (ESWL) in the early 1980s [5]. ESWL has been recommended as a first-line treatment for upper ureteric calculi in several studies with a success rate of 80-90% [6, 7]. With the advent of small-caliber and flexible ureteroscopes, the paradigm of treatment of upper ureteric stones has shifted towards ureteroscopy with success rates approaching 95% but not without its share of

complications. ESWL, on the other hand, is noninvasive and less morbid with a low complication rate. We would like to present our prospective data of treatment of upper ureteric stones with ESWL as primary modality and evaluate the factors affecting successful fragmentation and clearance [8].

Aim of the study

To evaluate the safety and efficacy of ESWL lithotripsy as a primary modality of treatment for upper ureteric stones

Patients and methods

From October 2011 to October 2016, 400 patients (300 male and 100 female) with upper ureteral stones were admitted to Al-Diwaniya teaching hospital, urology unit and enrolled in this study, their age range from 18 to 65 years with a mean age of 40 ± 3 years. All patients were evaluated by history, physical examination, laboratory investigation (including urinalysis, full blood count, coagulation profile and renal function tests). The stone size, location, opacity and degree of obstruction were assessed by preoperative radiographic imaging studies, including KUB, ultrasound and computerized tomography (CT scan).

All patients were treated with ESWL using Wolff lithotripter. Duration of symptoms was less than three weeks in 360/400 patients (90%) and more than three weeks in 40/400 (10%) patients.

All patients received a single dose of broad spectrum parenteral antibiotic at the time of procedure. Patients with small size kidney with doubtful function, abnormal coagulation profile and chronic renal failure were excluded from the study. Preoperative DJ stenting was done in 15/400 (3.75%) patients. Indications for stenting were patient with single kidney (5 patients) and severe degree of obstruction (10 patients). All of these patients were stented before undergoing ESWL. ESWL was done to those patients when serum creatinine value was return to normal level. Mean stone size was 9.2 mm (ranging from 7-16 mm). While 280 /400(70%) patients had ≤ 1 cm stones, stones more than 1 cm in size were seen in 120/400(30%) patients. All patients underwent ESWL in supine position. Analgesia in form of 50 mg of pethidine was given to all patients intramuscularly. Stone localization was done using C-arm (fluoroscopy imaging).

Mean number of shocks per stone were 3000 with mean intensity being 10 J and frequency of 1 per second. Patients were followed up with X-ray KUB at 2-weeks and if incomplete fragmentation was noticed repeat sitting of SWL was given. Patient was described as ESWL failure when incomplete or no fragmentation was found after three sittings. Criteria for clearance were symptomatic relief, absence of residual fragments on X-ray

(KUB) at three months. Parameters of patients and stone are shown in table 1.

Table 1.

Parameters of patients and stones.

Number of patients:	400
Sex	male = 300 female = 100
Age(average years)	40±3
Duration of symptoms (weeks)	<3 wks 90% >3 wks 10%
Pre-op. DJ stenting	3.75%
Stone size(mm) mean 9.2	≤1 cm 70% >1cm 30%

Results

In our study the overall stone-free rate at three months was 95% (380/400). Clearance after first sitting was 70% (280/400), after second sitting was 20% (80/400) and after third sitting was 5% (20/400). Clearance of stone in patients with stone size ≤ 1 cm was 97% (388/400), and in patients with stone size > 1cm was 5% (340/400). Five per cent (20) of cases did not have successful outcome. These cases had incomplete fragmentation and were termed as ESWL failures. They required auxiliary procedures in the form of URS and holmium YAG lithotripsy. Post-ESWL complications encountered in our patients include: Post-ESWL fever in 12(3%), septicemia in two cases (0.5%) which was treated antibiotics and stein strasse (street of stones) with colic in 6 cases(1.5%). All these patients had stones larger than 1 cm. three cases required URS and extraction of lead fragment while 9 cases passed fragments on their own. Table 2 summarizes the results.

Table 2.

Results

overall stone free rate	95%
Sitting no. (%)	70% for 1st sitting 20%for 2nd sitting 5% for 3rd sitting
Clearance (%)	≤1 cm =97% >1cm =85%
Failure (%)	5%
Complications (%)	Fever =3% septicemia =0.5% colic= 1.5%

Discussion

The management of ureteral calculi represents one of the complex problems in urological practice. In planning to treat ureteral calculi, several factors are to be considered simultaneously, including stone size, chemical composition, location of the stone, anatomy of the urinary tract and the impact on the renal function, which are all depend on the availability of modern efficient radiological investigation. On the other hand available treatment modalities should also considered and need to be evaluated for their efficacy, cost and morbidity. All these considerations make the management of ureteral calculi uniquely challenging [9]. Multiple treatment modalities are available for upper ureteric stones such as: URS, PCNL, ESWL, open surgery and laparoscopic surgery. Amongst these ESWL has very good success rates and high degree of patient satisfaction. The overall stone-free rate in our study was 95% which was compares favorably with other published study for stone-free rates that can be achieved without the use of ureteroscopy. Previous studies with different lithotripters reported success rates between 80-90% [10]. In Gnanapragasam *et al* [11], stone-free rates for upper ureteric stones were 90%. Failure of ESWL was seen in patients with stone size >1.3 cm. Similarly, Mogensen and Anderson [7], reviewed outcomes of 199 patients with ureteric stones treated with ESWL. Stone-free

rates at three and six months after ESWL for upper ureteric stones were 86% and 91% respectively. Hofbauer *et al*, [12] evaluated the outcome of 1259 ureteric stones with success rate of upper ureteric stones being 98%. In our study the retreatment rate was 29% and auxiliary procedures were required in 5% cases. The American Ureteral Stones Clinical Guidelines Panel [13] reported that, for proximal ureteric stones, the success rate of ESWL was 97% for <1 cm stone and 85% for >1 cm stone. In our study 95% success was seen in cases with ≤1 cm stone while 85% success was seen in >1 cm stone. This success rate may be due to better stone localization techniques and use of standard lithotripter (Wolff lithotripter). Duration of symptoms also affects the outcome of treatment. Longstanding stones had more retreatment and failure rates. These impacted stones have a lot of surrounding mucosal edema and hence these stones have incomplete clearance. This was confirmed during URS procedures where it was found that the stone was completely fragmented with ESWL but the fragments were not cleared due to edema of surrounding mucosa. Of 40 cases with duration of symptoms of > three weeks, 20 (5%) cases required auxiliary procedures. Pushback technique was not used in any of our patients. All stones were treated without manipulating the position of the stone. In our study we also observed that the presence of DJ stents significantly reduces the success rates. DJ stents were inserted in 15 cases preoperatively of which 12(3%) patients required auxiliary procedure in the form of ureteroscopy. Ryan *et al* [14] showed that in situ ureteric stents impair ureteric peristalsis and trap large fragments thus delaying stone clearance. In 1997 the AUA published its recommendations that for stones greater than 1 cm in the proximal ureter ESWL, PCNL and ureteroscopy were all acceptable approaches [15]. Currently there seems to be a shift away from noninvasive ESWL in favor of more invasive ureteroscopy options [16]. This is because of significant advances made in ureteroscopic technology, with development of smaller caliber and flexible scopes. Also available are better stone-breaking systems (laser, efficient lithotripsy probes). Thus the success rates of ureteroscopy for upper ureteric stones approach 90–95%. But ureteroscopy is a more morbid procedure with increased hospitalization and higher complication rate. Even with small-caliber scopes ureteric perforation rates are 0-5% and stricture rates 1-4% [17, 18]. Conversely, ESWL has almost similar success rates of 95% in our study with low complication rate and failure rate with far better patient acceptance.

Conclusion

The results of our study show that ESWL as a primary modality for upper ureteric stones

treatment has an overall success rate of 95%. Success rate drops with increasing size of stone, duration of stone in ureter, and no anesthesia is required.

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