



## EFFECTIVENESS OF ESWL IN UPPER URINARY TRACT CALCULI

### Üst üriner sistem taşlarında ESWL'nin etkinliği

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**J Surg Arts (Cer San D), 2014;7(2):69-74. <http://dx.doi.org/10.14717/jsurgarts.2014.148>**

#### ABSTRACT

Urolithiasis is a worldwide common medical problem. Its treatment has dramatically changed in the last decades. The best method of stone treatment is still debatable.

To evaluate the effectiveness of Extracorporeal Shockwave Lithotripsy (ESWL) in treatment of upper urinary tract stones (single or multiple).

A cohort study was conducted in Omdurman military hospital, Khartoum, Sudan. It included all patients with upper urinary tract stone that managed by ESWL after acceptance of the informed consent (January 2011 to April 2013). The results were evaluated after 3 months follow up. The stone-free rate was correlated with stone number, site and patient characteristics using the Student's t test.

There were 149 patients (98 males, 51 females). Their mean age was  $37.9 \pm 17.9$  years (range 2-76 years). The locations of stone were in the kidney and ureter in 72.5% and 27.5% respectively. Response was variable in different sessions. Overall stone-free rate was 96.6%. Failure to clear the fragmented stones was in 3.4%. Rate of complete resolution is not affected by the site of stone impaction and number of stones ( $p=0.8$  and  $0.9$  respectively).

ESWL is effective method in the treatment of upper urinary tract stones.

**Keywords:** Urolithiasis, extracorporeal shockwave lithotripsy (ESWL), upper urinary tract, success rate.

#### ÖZET

Böbrek taşları dünya çapında bir problemdir. Tedavisi son on yılda dramatik bir şekilde değişmiştir. Ancak en iyi yöntem hala tartışmalıdır.

ESWL'nin üst üriner sistem taşlarının tedavisindeki etkinliğinin saptanması amaçlanmıştır. Bu kohort çalışma Hartum (Sudan)'da bulunan Omdurman hastanesinde tasarlanmıştır. Ocak 2011-Nisan 2013 arasında hastaneye gelen hastalar çalışmaya alındı. Hastalar işlem sonrasında 3 ay süreyle takip edildiler. Taşsız dönem yüzdesi taş sayısı, yeri ve hastanın özelliklerine göre ilişkisi Student t testi ile araştırıldı.

Çalışmaya 98'i erkek, 51'i bayan 149 hasta katıldı. Yaş ortalaması  $37.9 \pm 17.9$  yıldır (2-76). Taşların %72.5'i böbrekte, %27.5'i ise üreterde yerleşmişti. Tedaviye cevabın çeşitli faktörlere bağlı olarak değişkenlik gösterdiği saptandı. Hastaların %96.6'sında taşsız bir dönem sağlandı. Vakaların %3.4'ünde taşlar temizlenemedi. Taşların yerleşim yeri ve sayısı tam cevapta etkili olmadığı saptandı (Sırasıyla  $p=0.8$  ve  $0.9$ ).

Sonuç olarak, ESWL'nin üst üriner sistem taşlarının tedavisinde etkili olduğu saptanmıştır.

**Anahtar kelimeler:** Üriner sistem taşı, ESWL, üst üriner sistem, başarı oranı.

## INTRODUCTION

Urinary lithiasis represents important clinical and economic issues to the healthcare system throughout the world (1). It is a common medical problem with worldwide prevalence of approximately 2% to 3% in the general population (2). Urolithiasis is a problem that has confronted clinicians since the time of Hippocrates, and many physicians have extensive experience in its clinical management. In recent years, technological advancements have greatly facilitated the diagnosis of stone disease. The management is also becoming increasingly well defined (3). The best method of treatment for stones treatment is still debatable (4,5). Choice of treatment relies on patient's condition, surgeon's experience, patient's preference and available technology (6).

The surgical management of urinary calculus disease has changed dramatically in the past decades. Minimally invasive options have made open stone surgery nearly obsolete. The development of shock wave lithotripsy, percutaneous nephrostolithotomy techniques and intracorporeal lithotripsy devices has conferred unprecedented management tools for upper tract stones. Moreover, transfusion rates, hospital costs, and convalescence periods have been markedly reduced when compared to open surgery (7).

Extracorporeal shock wave lithotripsy (ESWL) has been introduced in the early 1980's as an alternative approach and disintegrates stones in the kidney and upper urinary tract through the use of shock waves (2,8,9). ESWL is being non-invasive, having a low rate of complications, and no need for anaesthesia (2). Efficacy of ESWL is best measured by the stone-free rate, typically within 3 months of ESWL therapy to allow time for passage of stone fragments (10).

Currently, the contraindications for ESWL treatment are restricted to pregnancy (2,3), severe skeletal malformations, severe obesity, urinary tract obstruction distal to the stone and aortic and/or renal artery aneurysms (2). Despite its noninvasive nature, ESWL is not complication free<sup>11</sup>. Broadly speaking the complications of ESWL are steins trasse (obstruction due to fragments becoming lodged in the ureter), haematoma, infection, and sepsis (2).

This study was carried out to evaluate the effectiveness of ESWL in treatment of upper urinary tract calculi.

## PATIENTS AND METHODS

Total coverage hospital based Cohort study was carried out in Omdurman Military Hospital. It included all patients from both genders with upper urinary tract stone less than 2 cm in diameter that

treated by ESWL during the period from January 2011 to April 2013. Ethical considerations were obtained from research ethical committee of Sudan Medical Specialization Board and acceptance of the pre-given informed consent by patients prior to commence into study. Exclusion criteria were the presence of ureteric strictures, coagulopathies, non-functioning kidneys, pregnancy, malignant disease, florid infection, and under anti-inflammatory or immunosuppressive treatment. All patients were treated with the same lithotripter (Siemens). Preoperatively, patients were evaluated by means of serum creatinine level, urinalysis, urinary culture, coagulation profile, plain abdominal X-ray (KUB) film, i.v. urography and renal ultrasound.

ESWL therapy is usually started at a low voltage until the patient becomes accustomed to the shocks, and the voltage is then gradually increased to a maximum of 4000 within 60 to 90 minutes. The average number of shocks per session range between 3000-4000. Preinterventional sedation with diazepam and pethidine were applied. During sessions fruseamide and intravenous fluids were used to be given routinely. In children general anesthesia was needed. All the patients were treated in the supine position. Ureteric JJ stents were placed in selected patients before ESWL. All patients were reviewed 1 week after the first ESWL session using a KUB film and renal ultrasound to assess fragmentation and the presence of renal obstruction. Repeat treatment was carried out if there was inadequate fragmentation of the stone. If there was no response after five sessions, the case was considered an ESWL failure. Follow-up using a KUB film and renal ultrasound was continued every 2 weeks until there was complete stone clearance. All follow-up data were analyzed after the 3-month visit. Treatment success was defined as complete stone clearance with no residual fragments (RFs).

Using a predesigned and tested questionnaire the data was collected and spread in master sheet. It included personal data, symptoms and signs, method of diagnosis, and the site and size of stones and number of sessions of ESWL used. The collected data was entered computer and managed statistically using SPSS computer program. Numerical data was expressed as a mean  $\pm$  SD. The stone-free rate was correlated with patient characteristics and stone size, site and numbers using the Student's t-test. The confidence level was set as 95% and p value less than 0.05 considered statistically significant.

## RESULTS

The study included 149 patients, 98 (65.8%) males and 51 (34.2%) females with male to female

ratio of 1.9:1. Their mean age  $\pm$  SD was  $37.9 \pm 17.9$  years (range 2-76 years). Renal function test was performed in all patients' pre and post intervention. Pre-interventional mean urea  $\pm$  SD was  $27.3 \pm 12.6$  mg/dl (range 7- 115 mg/dl) and mean Creatinine  $\pm$  SD was  $0.9 \pm 0.6$  mg/dl (range 0.2-6.9 mg/dl). Post-interventional mean urea  $\pm$  SD was  $27.3 \pm 8.6$  mg/dl (range 10-75 mg/dl) and mean Creatinine  $\pm$  SD was  $0.8 \pm 0.3$  mg/dl (range 0.3-1.9 mg/dl) (p values 0.6 and 0.8 respectively).

All patients were diagnosed by ultrasound scan, then after intravenous urography (IVU) was performed to confirm the diagnosis and visualize the

whole tract, whereas CTU only required in 5 (3.4%) of patients. Stones were single in 88 (59.1%) and multiple in 61 (40.9%) of candidates. Stones were in the left side of upper urinary tract in 62 (41.6%) and bilateral in 28 (18.8%) of patients. Mean stone size was 1.3 cm ( $\pm$  0.4 cm) (Range, 0.6 to 2 cm).

In 108 (72.5%) stones were located in the kidneys; 55 (36.9%) were found in renal pelvis. In 41 (27.5%) stones were located in the ureters; 25 (16.8%) were found in upper ureter (table 1). In 87 (58.4%) it was accompanied by hydronephrosis with variable degrees as mild in 42 (28.2%) and severe in 7 (4.7%) of patients.

<b>Table 1: Stone location in study group (n=149)</b>			
<b>Stone location</b>		<b>Frequency</b>	<b>Percent</b>
<b>Kidney</b>	Lower pole	19	12.8
	Upper & lower poles	2	1.3
	Upper pole	14	9.4
	Middle pole	18	12.1
	Pelvis	55	36.9
	<b>Total</b>	<b>108</b>	<b>72.5</b>
<b>Ureter</b>	PUJ	4	2.7
	Upper ureter	25	16.8
	Mid ureter	6	4.0
	Lower ureter	6	4.0
	<b>Total</b>	<b>41</b>	<b>27.5</b>
<b>Total</b>		<b>149</b>	<b>100.0</b>

Pre-intervention DJ stents were placed in 113 (75.8%). All procedures were carried out without anaesthesia except in 3 children (2.01%) general anaesthesia was needed. The response to ESWL was variable in different sessions. In the 1st session of ESWL the stone was completely resolved in 46 (30.9%) and moderately changed in 66 (44.3%) of cases. In the 2nd session it was completely resolved in

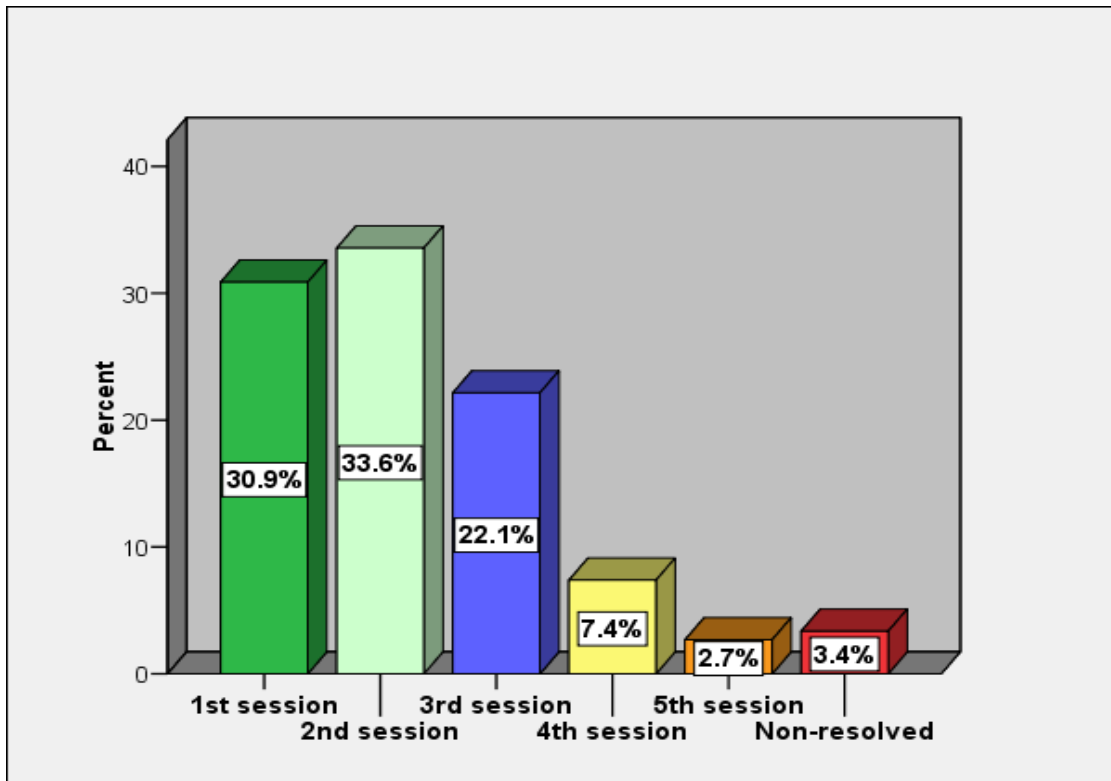
50 (33.6%) and moderately changed in 27 (18.1%) of cases. In the 3rd session it was completely resolved in 33 (22.1%) and moderately changed in 9 (6%) of cases. In the 4th session it was completely resolved in 11 (7.4%) and moderately changed in 4 (2.7%) of cases. Whereas in the 5th session it was completely resolved in 4 (2.7%) and moderately changed in 2 (1.3%) of cases (Table 2).

<b>Table 2: The effect of ESWL in different sessions in study group (n=149).</b>												
<b>Effect of ESWL</b>	<b>Session</b>										<b>Total</b>	
	<b>1<sup>st</sup></b>		<b>2<sup>nd</sup></b>		<b>3<sup>rd</sup></b>		<b>4<sup>th</sup></b>		<b>5<sup>th</sup></b>		<b>No</b>	<b>%</b>
	<b>No</b>	<b>%</b>	<b>No</b>	<b>%</b>	<b>No</b>	<b>%</b>	<b>No</b>	<b>%</b>	<b>No</b>	<b>%</b>		
<b>No changes</b>	1	0.65	---	---	1	0.65	---	---	---	---	<b>2</b>	<b>1.3</b>
<b>Mild change</b>	36	24.2	26	17.4	10	6.7	5	3.4	3	2	<b>80</b>	<b>53.7</b>
<b>Moderate change</b>	66	44.3	27	18.1	9	6	4	2.7	2	1.3	<b>108</b>	<b>72.5</b>
<b>Resolved</b>	46	30.9	50	33.6	33	22.2	11	7.4	4	2.7	<b>144</b>	<b>96.6</b>
<b>Total</b>	<b>149</b>	<b>100</b>	<b>103</b>	<b>69.1</b>	<b>53</b>	<b>35.6</b>	<b>20</b>	<b>13.5</b>	<b>9</b>	<b>6</b>	<b>---</b>	<b>---</b>

Success rate was 96.6% (144/149 patients) as the stones were completely resolved by ESWL in 1st, 2nd, 3rd, 4th and 5th sessions as in 46 (30.9%), 50 (33.6%), 33 (22.1%), 11 (7.4%) and 4 (2.7%) respectively, and in only 5 (3.4%) it did not resolved completely (Figure 1).

The rate of complete resolution is affected by stone size as there was statistical significant

difference in the rate of clearance and the stone size ( $p=0.03$ ). But it is not affected by the site of stone impaction as there was no statistical significant difference in the rate of clearance and the site of impaction ( $p=0.8$ ). Similarly it is not affected by the number of stone impacted  $p=0.9$  (Table 3).



**Figure 1:** Complete resolution of stones in variable sessions in study group (n=149).

Stone number	Complete resolution of stones / session						Total
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	Non-resolved	
Multiple	17	22	14	4	2	2	<b>61</b>
Single	29	28	19	7	2	3	<b>88</b>
<b>Total</b>	<b>46</b>	<b>50</b>	<b>33</b>	<b>11</b>	<b>4</b>	<b>5</b>	<b>149</b>
<b>P=0.9</b>							

**DISCUSSION**

Kidney stones are a common and potentially preventable cause of morbidity in the general population (12). The formation of urinary tract stones was commoner in male patients, this result is in agreement with that reported by others (3,13). It is commoner in middle age groups similar results were also obtained by Alemu MH and Jan H et al.in their separate studies (13,14).

The creatinine blood test is used along with a blood urea test to assess kidney function. Both are frequently ordered as part of a basic or comprehensive metabolic panel (BMP or CMP), groups of tests that are performed to evaluate the function of the body’s major organs. In most instances, renal functional integrity is preserved after stone removal, and when renal dysfunction does occur, it is typically clinically insignificant (15). In

the current study there was no statistically significant difference in pre and post interventional renal function.

Success rate of stone fragmentation and clearance was 96.6%. In other studies the rate was lower ranging from 73.6% to 90% (15-17).

It has been generally accepted that the stone size affects the clinical outcome of ESWL treatment. Stone size has been reported as a significant predictor of ESWL success for upper urinary tract stones (9,15,19).

Stone clearance and fragmentation was affected by stone size. Interestingly, stone site and numbers were not a significant factor of the success for stone fragmentation and clearance. Similarly in study by Takahara K et al. the success rate was affected by size, but not by location and presence of hydronephrosis (15). Other authors found that success for stone fragmentation and clearance is affected by stone size, site, numbers and composition (9,18-21). Abdel-Khalek M et al. reported that the stone-free status was 1.9 times greater for patients with single compared to multiple stones (19).

In this study the success rate was found to increase with the frequencies of ESWL sessions as the failure to clear up stone after 3 and 5 consecutive sessions was 7.4% and 3.4% respectively. In study by Abdel-Khalek M et al. the failure to clear up the stones after three consecutive sessions of ESWL was recorded in 7.3% (18).

In conclusion, extracorporeal shockwave lithotripsy is a good choice for the treatment of upper urinary tract stones. It is the only noninvasive therapy option and can be performed without anesthesia in an outpatient setup with greater patient acceptance. The success rate is not significantly affected by number and location. Immediate stone-free rate cannot be achieved in all patients after ESWL, and some patients may need repeated treatment.

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