VOLUME - 12, ISSUE - 07, JULY - 2023 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Urology

PREDICTIVE FACTORS OF THE OUTCOME OF EXTRACORPOREAL SHOCKWAVE LITHOTRIPSY FOR UPPER TRACT UROLITHIASIS

Santosh R Patil — Associate Professor, Department of Urology, Shri BM, Patil Medical College, Hospital and Research Centre, Vijayapura

Vinay S Kundargi — Professor, Department of Urology, Shri BM, Patil Medical College, Hospital and Research Centre, Vijayapura

Saurabh Thakkar — Senior Resident, Department of Urology, Shri BM, Patil Medical College, Hospital and Research Centre, Vijayapura

ABSTRACT Extracorporeal Shock Wave Lithotripsy (ESWL) is one of the treatment options for renal and upper ureteric calculus; however, the outcome depends on multiple factors. Our study aims to evaluate the factors that may influence ESWL outcomes in Indian patients with upper urinary tract calculi. Between 2018 and 2020, a total of 300 adult patients who underwent ESWL for renal and upper ureteral calculus sizing 5 to 20 mm were included in the study program. Patients with 2 calculi, the presence of distal ureteric obstruction and renal anomalies were excluded. The clinical outcome of ESWL was assessed by factors like site, size, location and density. After statistical analysis, a p-value ≤0.05 was taken as the level of significance. The overall success rate was 79.3%. A statistically significant association was found between the size, density of the calculus and presence of stents and clearance rate whereas no significant association was found with the number and the location of the calculi. ESWL should be considered a primary treatment modality in patients with calculi size ≤10 mm, and density ≤ 1000 HU in renal & upper ureter. It is important to consider these factors like stone size, density and location before planning the treatment.

KEYWORDS : ESWL, renal calculi, ureteric calculi, DJ stent,

INTRODUCTION

Urolithiasis affects approximately 1500 to 2000 people per million inhabitants in developed countries[1]. The surgical treatment of stone disease has evolved from open surgical techniques to minimally invasive techniques and non-invasive techniques like Extracorporeal Shock Wave Lithotripsy (ESWL)[2].

ESWL is a non-invasive method for the treatment of urinary tract calculus in adults, and its discovery led to a complete change in the therapeutic strategy for urolithiasis[1]. ESWL has replaced other treatment techniques and becomes a preferred treatment modality for the majority of urinary calculi of <2 cm in the upper urinary tract[3]. The success rate is in the range of 60-90% in various series[4,5]. However, the outcome of ESWL treatment depends on many factors including, stone size, site, composition and the presence of obstruction or infection[6,7]. This study was conducted to determine the factors influencing the success of ESWL in renal and upper ureteric calculi in a tertiary care centre.

METHODS

Between 2018 and 2020, a total of 345 patients undergoing ESWL for ureteral and renal calculus with the longest diameter of 5 to 20 mm were evaluated. All patients who had upper ureteral or renal calculus (up to 2 calculi) evaluated with X-ray KUB (KIDNEY URETER BLADDER) and NCCT (NON-CONTRAST COMPUTERIZED TOMOGRAPHY) were included. Exclusion criteria were the presence of multiple ureteral or renal calculi, anatomically solitary kidney or any other congenital abnormality, renal insufficiency, or previous ureteral surgery. 300 patients fulfilling the criteria and who willingly participated were included after obtaining consent. Before the treatment, the size, location and density of the calculus were evaluated by NCCT. The maximum dimension of the calculus was either the longitudinal or the transverse diameter, whichever had the highest value measured. The average NCCT attenuation value as the representative HU was measured by drawing a region of interest smaller than the stone in the image showing the calculus in the largest dimension. Urine analysis and renal function tests were performed in all patients before ESWL. A detailed history and clinical examination of the patients were done.

All patients were treated using ESWL Lithotripter Dornier Compact Alpha 125 (Ultrasound based). Patients were given a maximum of three sittings, two weeks apart between two sittings. All patients who had calculus of size >10 mm underwent DJ stenting before ESWL. Each session has been completed either after the application of a total of 3000 shock waves or until the stone was completely disintegrated. The degree of shock wave power delivered during ESWL was recorded as 1 to 6 and the shock wave frequency was 60/minute.

Patients were evaluated one week after each session with X-ray KUB and repeat treatment was performed if there were residual stone fragments. The maximal session number for a patient to say that the stone was resistant to ESWL was 3. All patients underwent NCCT after 2 weeks following the last lithotripsy session, and success was defined as the absence of any residual calculus. The presence of residual calculi after 3 sittings of ESWL was labelled as a failure of treatment, and they were managed with other modalities of treatment.

Data were analyzed using Statistical package for social sciences (SPSS) version 2.0 and a chi-square test was done to assess the association between the two parameters. A p-value < 0.05 is considered statistically significant.

RESULTS

In this study, the overall success rate was found to be 79.3% (238/300). On assessing the association between age, gender and the clearance of calculi there was no statistically significant association. (Table 1)

Table 1: Success rate concerning age and gender

Variables	Calculi cleared		Calculi not cleared		p -value
	Frequency	Percentage	Frequency	Percentage	
Age in Years					
18-30	33	13.9	9	14.5	0.469
31-40	109	45.8	26	41.9	
41-50	71	29.8	23	37.1	
51-60	24	10.1	3	4.8	
61-70	1	0.4	1	1.6	

Gender					
Male	143	60.1	31	50.0	0.152
Female	95	39.9	31	50.0	

On assessing the association between various morphological parameters of calculi like the size of the calculus, number of calculi, density, presence of stents and location of calculi with the clearance rate, a statistically significant association was found between size and density of the calculus and presence of stents. The clearance rate of calculus in the lower pole calyx was less though it was not statistically significant in the present study. (Table 2)

Table 2: Success rate concerning morphology and location of calculus

Variables	Calculi cleared		Calculi not cleared		p -value
	Frequency	Percentage	Frequency	Percentage	
Size of the stone					
5-10 mm	118	49.6	8	12.9	<0.001 *
10-15 mm	78	32.8	36	58.1	
15-20 mm	42	17.6	18	29.0	
Number of Stone					
Single	181	76.1	40	64.5	0.066
Multiple	57	23.9	22	35.5	
Density (HU)					
<500 HU	85	35.7	7	11.3	<0.001 *
500-1000 HU	125	52.5	19	30.6	
1000-1500 HU	28	11.8	36	58.1	
Stent					
Yes	121	50.8	54	87.1	<0.001 *
No	117	49.2	8	12.9	
Location					
Upper calyx	74	31.1	15	24.2	0.237
Middle calyx	59	24.8	18	29.0	
Lower calyx	80	33.6	26	41.9	
Pelvis	69	29.0	24	38.7	
Upper ureter	10	4.2	1	1.6	

*Significant

In the present study, 13.4% of cases showed clearance with the first ESWL sitting, whereas 42% and 44.5% of cases required two and three ESWL sittings, respectively to clear the calculus. (Figure 1)

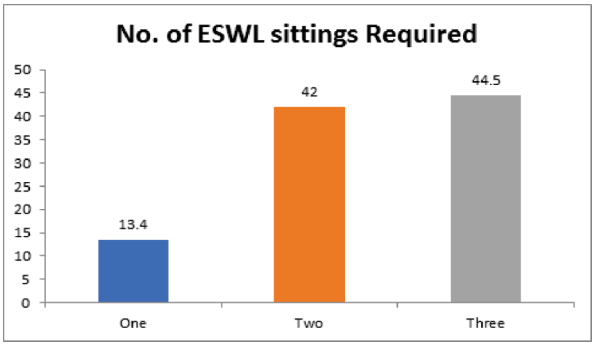

Figure 1: Number of ESWL sittings required for clearance of calculi

DISCUSSION

Nielson et al[8] in their study reported that the success rate after the initial ESWL procedure was 69%, which increased to an overall success rate of 93% after repeated treatment. The overall efficacy of ESWL for nephrolithiasis depends mainly on stone size, location, stone composition, patient habitus and performance of ESWL. Huseyin et al[9] reported that the overall rate of success of ESWL was found to be 82.6% with a complication rate of 5.8%. Age, gender, stone size, stone location and stone opacity were not predictive factors for additional treatment after ESWL. Badawy et al[10] reported that the overall success rate for renal and ureteral calculi was 83.4 and 58.46%, respectively with repeating intervention for the removal of stones was 4% in the renal group and 28% in the ureteral group. Renal colic was reported in 10% of treated cases and repeated vomiting was reported in 5% of cases.

Jeong et al[11] reported that 84.4% of the cases with renal stones were successfully treated within three ESWL sessions. In their study, cases with multiple stones and large stone sizes were significantly found to have decreased success rates within three ESWL sessions. Panchal et al[12] showed that the overall success of ESWL was 82%. The final success of ESWL for sites like the ureter, pelvis, mid or upper and lower calyx was 94.1%, 84%, 85.7% and 58% respectively. For stone density 751-1000 HU, 22.2% of patients required ≥2 sessions to achieve stone-free status, which was found to be statistically significant.

Marhoon et al[13] conducted a study and reported that the treatment success rate was 74% for renal stones and 88% for ureteric stones with complications in 38.5% of patients with renal stones and 39.4% of patients with ureteric stones. Also, they stated that factors found to have a significant effect on complete stone clearance were serum creatinine and the number of shockwaves. Khan et al[14] in their study reported that lower infundibular length and width are significant anatomical factors in determining stone clearance following ESWL treatment of lower calyceal stones and these should be assessed before planning the treatment for lower calyceal stones.

CONCLUSION

Our study concludes that ESWL has a high clearance rate and on assessing the factors influencing the success, it was found that the size and the density of the calculus and the presence of stent were the factors found to be associated with better stone-free rates whereas the number and the location of the calculus do not play any role in the clearance. Hence it is important to consider these factors before planning the treatment.

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