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Original Research Article

Factors Affecting the Outcome of Extracorporeal Shock Wave Lithotripsy in Stones of the Upper Urinary Tract

Selvan Ramamoorthy[1], A. Larif[2], B.Thiruvasagamani[3], S.K. Subhakanesh[4]

[1]M.Ch Postgraduate, Department of Urology, Government Tirunelveli Medical College, Tirunelveli, India
[2]Assistant Professor, Department of Urology, Government Tirunelveli Medical College, Tirunelveli, India
[3]Professor and HOD, Department of Urology, Government Tirunelveli Medical College, Tirunelveli, India
[4]Assistant Professor, Department of Urology, Government Tirunelveli Medical College, Tirunelveli, India

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Corresponding Author: Dr. Selvan Ramamoorthy
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Abstract:

Introduction: Urinary tract stone disease is a prevalent condition, and there are numerous treatment options available. ESWL is a safe, effective method to treat urinary lithiasis. ESWL is usually an outpatient procedure. The success rate in ESWL depends on stone location, size, number, and fragility as well as calyceal anatomy and patency of the urinary tract. ESWL as a modality was recommended for stones less than 2 cm in size. Based on this aim of our study is to investigate the effectiveness of ESWL in treating upper urinary tract stones under 2 cm in size and also to investigate the variables affecting ESWL in upper urinary tract stone treatment outcomes.

Methodology: We did this study as Single centre, Cross sectional study. Patients with upper urinary tract stones in the Department Of Urology, Tirunelveli Medical College Hospital, and Tirunelveli for period of 24 months, and our study included as many patients during the study period (100 patients). Patients of age group above 18 years irrespective of sex and patients with upper urinary tract stones less than 2 cm in size were included. Patients less than 18 years of age irrespective of sex, Non consenting patients, Upper urinary tract stones > 2cms ,pregnant women , with bleeding diathesis and with distal obstruction were excluded.

Results: In our study population in 74 patient's treatment with ESWL was success and in rest, 26 were failure, in our study, most commonly age range was from 30-35 years, with no impact on outcome. In our study population, 56 patients were male and rest 44 patients were female. Mean BMI was more in patients who had failure in outcome. Same with stone size and Hounsfield units. Higher the values of stone size, skin to stone distance, Hounsfield units poorer the outcome. Hydronephrosis was present in three patients. Number of sitting was once in 62 patients and twice in 38 patients.

Conclusion: From our study, we concluded that predictive factors taken separately couldn't identify all patients who are likely to benefit from ESWL and exclude those that will have an unfavourable outcome. A modern approach should be used combining various factors, including stone location, size, skin-stone distance, BMI, and stone density.

Keywords: ESWL, Stone, Renal, Upper Urinary Tract.

Introduction

Urinary tract stone disease is a prevalent condition, and there are numerous treatment options available. There are many different ways to treat urinary tract stone illness, which is a common problem. Up until the early 1980s, the only available treatments for urolithiasis were open surgery and various endoscopic techniques.

One to fifteen percent of people have stone sickness. Age, sex, and race all have an impact. Incidence for men starts to increase after the age of 20, peaks between the ages of 40 and 60, and then starts to fall. Incidence rates for women appear to peak in their late 20s and then decline to 1/1000/year by the time they are 50. The increased detection of asymptomatic stones seen with increased use and enhanced sensitivity of imaging investigations may be the cause of the recent rise in the incidence and prevalence of stone disease. [1] Christian Chaussay developed extracorporeal shock waves lithotripsy (ESWL) in 1980.

ESWL has been recognised as a minimally invasive treatment for a variety of urinary stone conditions since the middle of the 1980s. This completely changed how the stone illness was treated all across the world. Urinary lithiasis can be safely and effectively treated with ESWL. In most cases,

ESWL is an outpatient treatment. The location, size, number, and fragility of the stones, as well as the calyceal anatomy and urinary tract patency, all affect the success rate in ESWL. For stones less than 2 cm, ESWL was suggested as a modality. Given the high rate of treatment failures and the steinstrasse for larger calculi [2], this limit was established. In contrast to surgical methods, ESWL merely breaks apart the stone and leaves the urinary tract intact. After that, these pieces ought to pass out on their own [3].

This spontaneous passage might take a variety of lengths of time, and the pieces may clog the ureter, resulting in problems such renal failure, hydronephrosis, and renal colic. The use of Double -J stents has 13 contributed to successful stone passage and reduced post ESWL morbidity. Hence, the double–J–ureteric stent may be used in those patients having stones larger than 2.5cm [4].

ESWL frequently does not necessitate hospitalization. The success rate of ESWL is influenced by the calyceal anatomy, urinary tract health, and the location, quantity, size, and fragility of the stones. ESWL was recommended as a therapy for stones smaller than 2 cm.

This restriction was put in place because of the high risk of treatment failures and the requirement for bigger calculi. ESWL does not completely remove the stones from the urinary tract; instead, it only breaks them up, in contrast to surgical procedures. After that, these pieces ought to pass out on their own. This spontaneous transit can take a variety of lengths of time, and the pieces may cause renal failure, hydronephrosis, or renal colic. Based on this aim of our study is to investigate the effectiveness of ESWL in treating upper urinary tract stones under 2 cm in size and also to investigate the many variables affecting ESWL in upper urinary tract stone treatment outcomes.

Methodology

We did this study as Single centre, Cross sectional study. Patients with upper urinary tract stones in the Department Of Urology, Tirunelveli Medical College Hospital, and Tirunelveli for period of 24 months, and our study included as many patients during the study period (100 patients). Patients of age group above 18 years irrespective of sex and patients with upper urinary tract stones less than 2 cm in size were included. Patients less than 18 years of age irrespective of sex, Non consenting patients, Upper urinary tract stones > 2cms ,pregnant women , with bleeding diathesis and with distal obstruction were excluded.

The study was conducted in the Department Of Urology, Tirunelveli Medical College and Hospital, Tirunelveli. ESWL was done using Dornier Compact Delta II (Electromagnetic Generator) Machine. Patients were followed up after 2 weeks and at 4 weeks, X-ray KUB and USG KUB were done to look for residual fragment. Calculi that are absent or less than 4 mm in size are regarded as clearance. SPSS Version 24.0 was used as statistical analysis.

Results

In our study of 100 patients, all patients had single stone. Most common site of stone in our study was lower calyx (n=28) followed by middle calyx (n=26) and pelvis (n=22). Stone was present in upper calyx in 18 patients and in upper ureter in 6 patients.

Table 1: Stone site

Stone Site	No of Patients (N =100)	Percentage
Lower Calyx	28	28%
Middle Calyx	26	26%
Pelvis	22	22%
Upper Calyx	18	18%
Upper Ureter	6	6%

In our study, population in 74 patient's treatment with ESWL was success and in rest, 26 were failure, in our study, most commonly age range was from 30-35 years, with no impact on outcome. In our study population, 56 patients were male and rest 44 patients were female. Mean BMI was more in patients who had failure in outcome. Same with stone size and Hounsfield units. Higher the values of stone size, skin to stone distance, Hounsfield units poorer the outcome. Hydronephrosis was present in three patients. Number of sitting was once in 62 patients and twice in 38 patients.

Table 2: Comparative statistics

Parameters	Success (N=74)	Failure (N=26)	Total (N=100)	P Value
Age In Years(Mean)	33.05 ± 14.7	34.46 ± 13.8	33.42 ± 14.2	0.13
Sex(Male/Female)	74 (40/34)	26(16/10)	100(56/44)	0.64
Body Mass Index	23.07±10.9	27.07±11.02	25.07± 11.65	0.012*
Hounsfield Units	724.05 ± 212.5	800.76 ± 263.6	762.42±241.65	0.04*
Stone Size	1.38 ± 0.26	1.56 ± 0.32	1.47	0.01*

Skin To Stone Distance	9.63	10.36	9.99	0.03*
Hydronephrosis	3	0	3	0.45
No Of Sitting (1/2)	62/12	0/26	62/38	0.001*

Discussion

The study was conducted in the Department Of Urology, Tirunelveli Medical College and Hospital, Tirunelveli in 100 patients. The ESWL procedure provides good treatment outcomes [5] with similar overall complication rates as for endourological procedures, such as retrograde ureteroscopy [5,6]. However, many factors, associated with stone characteristics and constitution of the patient, as well as technical aspects of ESWL, have been identified to influence treatment efficacy. [7,8] According to the literature, stone-free status after ESWL monotherapy for stones of size < 20 mm is 80–85% [9,10] as compared to 33–65% for stones > 20 mm [11]. Considering all these findings, ESWL is recommended for kidney calculi smaller than 20 mm [12]. These findings are in line with our results, where stone size was significantly associated with treatment outcomes and greater stone volume was detected in patients with ESWL failure.

The impact of patient's age on ESWL outcomes is debatable. Many studies have discussed factors affecting the outcome of ESWL, but only a few have considered age of any significance. Lower pole renal calculi provide a unique challenge when considering the ESWL procedure due to a lower stone clearance rate – 52–69% [13–15]. In our study, a considerably high number of patients underwent ESWL due to calculi in the lower calyx. Increased BMI could be an independent predictor for ESWL outcomes. Pareek et al [7] evaluated patients who underwent ESWL for a solitary renal stone. The stone-free patients had a significantly smaller mean BMI than patients with residual fragments. This was similar to our study results.

Skin-to-stone distance (SSD) is mostly calculated as the mean of the distances from the body surface to a targeted stone at 0°, 45°, and 90° angles on NCCT using radiographic calipers. Some authors have concluded that the SSD value is a more predictive parameter. Pareek et al [7] revealed that SSD (using a cutoff value of 10 mm) was a much more powerful predictor than BMI and hypothesized that the travelling of shock waves for longer distances is associated with attenuation of those shock waves. Similarly, Wiesenthal et al. reported that the cut-off value for SSD was 11 mm [16]. It has been noted in previous studies that failure of ESWL is related to greater SSD. Shinde et al reported that in their study the success group had a mean SSD of 103.9 ±21.3 mm while the mean SSD in the failure group was 111.6 ±22.4 mm. [17]

Stone attenuation value (SAV) is mostly measured by creating three regions of interest in three different views of the stone on the NCCT scan showing the stone in the largest dimension. It is presented by the mean values of defined stone regions in Hounsfield unit (HU) [14]. There is a conclusion that stones with higher density require a larger amount of shock waves. Furthermore, in 2013, Hameed et al [18] reported similar results and concluded that stones having > 1,350 HU require increased shock wave energy. In Wiesenthal's study and another by Wang, stones with > 900 HU were more likely to fail after ESWL [16]. The size of the stone is typically assessed by measuring the maximum length. However, kidney stones are irregular 3D structures and can have complex geometric shapes. El-Nahas claimed stone size as a predictive factor for disintegration of stones following ESWL [19]. Bandi et al analysed how stone volume predicts outcomes of ESWL [20].

Conclusion

From our study we concluded that predictive factors taken separately cannot identify all patients who are likely to benefit from ESWL and exclude those that will have an unfavourable outcome. A modern approach should be used combining various factors, including stone location, size, skin-stone distance, BMI, and stone density.

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