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Original Research Paper

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TREATMENT OUTCOMES OF EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY FOR URINARY CALCULI

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ABSTRACT ESWL is considered as a standard treatment for renal calculi less than 20 mms, but the outcome of this therapy depends on different factors including stone composition, stone location, pelvicalyceal anatomy and stone size. This study was conducted to assess the treatment outcomes of patients undergoing ESWL for renal calculi and the factors influencing it. This was a descriptive study conducted in the Department of Urology, Government Medical College,Thiruvananthapuram. The study period was one year and 150 patients were enrolled. Overall success rate of ESWL in our study was 76.7%. Regarding the treatment outcomes our study concluded that the overall success rate of ESWL is 76.7%. But factors like lower calyceal location, skin to stone distance >10 cm, density > 950 HU and size >1.5 cms are associated with failure of fragmentation by ESWL.

KEYWORDS : Urolithiasis, Lithotripsy, ESWL

INTRODUCTION

Urolithiasis is a disease known since ages. Stones maybe formed anywhere in the genito urinary tract. It mainly affects men but the incidence in females is on the rise(1). Extracorporeal Shock Wave Lithotripsy (ESWL) is used for most of the renal stones especially those with size range of 10-20 mm[1]. The success rate of this treatment modality is in the range of 60-90% in various series[1-3]. The main advantage of ESWL is that it offers the least invasive treatment. The outcome of ESWL treatment depends on many factors including stone site, size, composition and the presence of obstruction or infection[4,5]. Preoperative urinary tract imaging is required in all patients before any surgical intervention, to assess stone size, location, characteristics, and anatomical abnormality. Non Contrast Computerized Tomography(NCCT) is used as the imaging modality of choice for urinary stones. In previous studies the NCCT attenuation value of urinary calculi has been investigated as a method to predict the outcome of ESWL[6]. NCCT visualizes almost all renal stone and has sensitivities and specificities of greater than 95%, which is considerably better than any other imaging modality, even at low dose protocols and across all body habitus. In addition, NCCT has the advantage of demonstrating three dimensional anatomic information about the kidney and adjacent organs, relevant treatment strategy considerations such as skin-to-stone distance, and stone density characteristics to guide the treatment choices.

Aim of the study

To estimate the treatment outcomes and factors influencing it among patients with renal calculi undergoing ESWL in Department of Urology, Government Medical College, Thiruvananthapuram.

Methodology

Study Design: Descriptive study.
Study Setting: Department of Urology, Government Medical College, Thiruvananthapuram.

Study Population: Patients presenting with Renal calculi to Urology OPD at MCH, Thiruvananthapuram for a period of 1 year extending from April 2017-March 2018.

Study Subjects: Patients presenting to Urology OPD at MCH, Thiruvananthapuram with Renal calculi of size 5mm to 20mm and are willing for ESWL.

Exclusion Criteria

1. Patients who are not willing to give consent for the study.
2. Patients of age less than 18 years
3. Patients with abnormal renal function
4. Patients with major renal abnormalities
5. Patients with urinary tract infection

StudyPeriod: For a period of 1 year extending from 1st April 2017 to 31st March 2018.

Sampling: Consecutive sampling
Sample size: N= $4PQ/d^2$, P= 40%, Q=60%, d= 20% relative precision; d =8
N= 150

Study Variables
1. Stone size
2. Stone location
3. Stone density (as measured by Hounsfield Units [HU]) by NCCT
4. Skin to stone distance (SSD) measured by NCCT

Outcome- success - <5 mm residual fragment after 6 weeks.
Data analysis
1. Data entered in Excel sheet
2. SPSS software used for analysis of data

RESULTS

Total 150 patients were recruited for the study. Majority of the patients (79.4%) were of 30-60 years age group. Of the 150 patients, 113 were males (75.3%) with mean age of 45 years. Urinary stone sizes ranged between 7mm -20mm mms of which 56(37.3 %) were located in the lower calyx, 44(29.3%) in the pelvis and rest 50 (33.4%) were located in other sites (i.e.13 in upper calyx(8.7%),24 in middle calyx(16%), 13 in upper ureter(8.7%). In 81 (54%) patients stones were located on the right side. The skin to stone distance was <10 cm in 76 (50.7%) cases. The success rate of ESWL was 115(76.7%). Success rate according to stone location was least in the lower pole stones

and maximum in the upper calyx and upper ureter stones (Table 1). Other factors contributing to successful ESWL in our study were low skin to stone distance and low stone density. Skin stone distance <10cm and stone density<920HU has the maximum success rate (Table 2).

Table 1- Site wise distribution of success of ESWL

Site	N	% of reduction in size ater 6 weeks		p
		Mean	sd	
Upper	13	88.0	12.6	<0.001
Middle	24	74.0	33.9	
Lower	56	51.1	38.7	
Upper ureter	13	78.7	18.2	
Pelvis	44	74.0	27.1	

Table 2- Distribution of success of ESWL based on skin to stone distance

Distance	N	% of reduction in size ater 6 weeks		p
		Mean	sd	
<10 cm	76	80.1	25.4	<0.001
>10 cm	74	53.7	36.4	

DISCUSSION

ESWL is considered as a standard treatment for renal calculi less than 20 mms, but the outcome of this therapy depends on different factors including stone composition, stone location, pelvicalyceal anatomy and stone size. Our study showed calculi less than 15mm are best suitable for ESWL.

Joseph et al[2] suggested that stones with CT attenuation value of greater than 950 Hounsfield units and 7500 shockwaves failed to achieve fragmentation. Similar to Joseph et al, the results of this study clearly reveals that stones with densities exceeding 950 Hounsfield units are difficult to fragment.

Gupta et al[6] showed that the worst outcome of ESWL was in patients with calculus densities of more than 750 Hounsfield units and diameters of more than 11mm, and their clearance rate was only 60%. However, contrary to Gupta et al, this study revealed that stone diameters of up to 15 mms may still (depending on stone density) respond successfully to ESWL treatment. Even though the results of this study have identified both stone density and size as significant contributors to ESWL treatment success rate, it also revealed that stone density is the determinant factor of treatment success for stone sizes of 15 mms or smaller.

In our study, the success of ESWL treatment is almost always guaranteed when the CT attenuation value is less than 920 Hounsfield units, while, at the same time, treatment failure is almost certain when the CT attenuation value exceeds 1343.5 HU. Stone densities in the range of 920-1343.5HU may, or may not, respond successfully to ESWL treatment.

To date, few clinical studies have compared the stone density with the outcome of ESWL in vivo. In a study of 30 patients, Joseph et al found that patients with calculi of less than 500 Hounsfield units had complete clearance and required a median of 2500 shockwaves, patients with calculi of 500-1000 Hounsfield units had a clearance rate of 86% and required a median of 3390 shockwaves, and patients with calculi of more than 1000 Hounsfield units had a clearance rate of 55% only and required a median of 7300 shockwaves. Study by Joseph et al based on 65 patients, showed that stones with densities less than 500 Hounsfield units have 94% clearance rate and required a median of 2800 shockwaves, patients with stone densities of 500-1000 Hounsfield units have 76% clearance rate and required a median of 3700 shockwaves, and patients with stone densities more than 1000 Hounsfield units have 42% clearance rate and required a median of 7800 shockwaves.

Pareek et al[7] correlated calculus density with stone clearance in their study of 100 patients. They concluded that patients with residual calculi had a mean calculus density of more than 900 Hounsfield units. However, they did not correlated the calculus density with fragmentation. The results of this study concurs with Pareek et al's results in that stone clearance is unlikely when stone density exceeds 1000 Hounsfield units. The results of this study supports those of Joseph et al in that CT stone density has a positive correlation with the number of shockwaves needed for fragmentation. Also, the results of this study concurs with the results of previous studies, that stone location has a significant effect on fragmentation success and clearance with lower calyceal stones have less success rates compared to other locations.

In conclusion, ESWL treatment outcome is strongly, but inversely, dependent on stone density. Stones with CT densities of 950 Hounsfield units or less undergo successful treatment requiring lesser number of shock waves and sessions. Large stones more than 1.5 cm and lower calyceal location are resistant to ESWL.

CONCLUSION

This study concludes that the overall success rate of ESWL is 76.7%. But factors like lower calyceal location, skin to stone distance >10 cm, density > 950 HU and size >1.5 cms are associated with failure of fragmentation by ESWL. So with proper patient selection the outcome of ESWL can be increased.

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