Original Article

Effect of skin to stone distance on non-contrast computed tomography and mean attenuation value on the performance of shock wave lithotripsy in kidney stone disease

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Objective: To determine mean skin to stone distance (SSD) for successful disintegration of renal stones in patients undergoing shock wave lithotripsy (SWL) for the treatment of renal stone.

Methodology: This descriptive cross-sectional study was conducted at the department of Urology, Sindh Institute of Urology and Transplantation, Karachi. A total number of 91 patients having stone size > 4 mm was included in the study. Mean SSD was measured using NCCT before treatment with SWL. Data analysis was carried out using SPSS version 20.0.

Results: Out of 91 patients, there were 59 (64.8%) male and 32 (35.2%) females. The mean age of patients was 45.75 ± 10.03 years. Mean duration of kidney stone disease was 8.28 ± 4.21 months. Mean size of kidney stone was 12.95 ± 3.24 mm. Mean SSD was 70.72 ± 6.01 mm. Complete stone disintegration occurred in 84 (92.3%) patients while it was unsuccessful in seven (7.7%) patients. Mean SSD in patients with complete stone disintegration was 69.52 ± 4.45 mm and was 94.71 ± 2.28 in patients with unsuccessful stone disintegration ($p < 0.001$).

Conclusion: Mean SSD was 69.52 ± 4.45 mm in patients with successful stone clearance. SSD was higher in overweight to obese patients as compared to the normal weight patients.

Keywords: Shock wave lithotripsy, non-contrast computed tomography, skin to stone distance, renal stone.

INTRODUCTION

Kidney stone is a common and costly disease.[1] Approximately 10% of the population is affected by kidney disease and this rate is increasing.[2] Shock wave lithotripsy (SWL) is a non-invasive, safe and an efficient method for the treatment of kidney stones and is now considered as a first-line treatment for stones size less than 20 mm.[3] The success rate of SWL is about 80 – 90%.[4] Since the advent of non-contrast computed tomography (NCCT), it has become the preferred diagnostic modality for renal calculi because of its rapidity and high accuracy relative to previous intravenous pyelography (IVP).[5] NCCT provides reliable information regarding stone size, location, number and total stone burden, and stone to skin distance (SSD).[6]

Several studies have assessed the connection between the information taken from NCCT regarding the medical field such as skin to stone distance (SSD).[7] SSD has been identified as important factors in the success of SWL.[8,9] In a previous study SSD was 78.3 ± 13.33 mm in patients who underwent successful disintegration of stones using SWL and SSD was 92.0 ± 14.00 mm in patients with residual stones.[10] We conducted this study to evaluate the mean SSD in patients with successful disintegration of renal stones using SWL.

METHODOLOGY

This descriptive cross-sectional study was carried out at department of Urology, Sindh Institute of Urology and Transplantation Karachi from November, 2020 to April 2021. Sample size was calculated using WHO formula and came to be 91 patients. Non probability, consecutive sampling technique was used. Patients having age 20 – 75 years, stone size > 4 mm and duration of renal stone disease < 2 years were included in the study. Patients with urinary tract infections on urine examination before surgery, having blood coagulation disorders diagnosed during routine lab reports before the procedure, with ureteral stricture, neurogenic bladder, or polycystic kidney on ultrasound were excluded. The study was approved by the institution.

NCCT was performed on all patient for confirmation of stones, and for measurement of stone size and for

measurement of mean SSD within one week before All the gathered information was collected on a predesigned Proforma.

Statistical Analysis: Data were analyzed on SPSS version 20. Post stratification independent sample t-test was applied to see the effect of effect modifiers on SSD taking $p < 0.05$ as significant.

RESULTS

Out of 91 patients, there were 59 (64.8%) males and 32 (35.2%) females. Mean age was 45.75 ± 10.03 years (range 23 – 72). Mean duration of kidney stone disease was 8.28 ± 4.21 months (range one to 20 months). Mean size of kidney stone was 12.95 ± 3.24 mm (range 6.0 to 20.0 mm). Most of the patients were of having normal body mass index (BMI). The mean BMI of study participants was 26.17 ± 4.08 kg/m^2 (range 15.97 – 37.03 kg/m^2). Mean SSD in patients was 70.72 ± 6.01 mm (Table 1).

Table 1: Skin to stone distance (mm).

Mean	**70.72**
Standard Deviation	6.01
Minimum	63.0
Maximum	90.0

Table 2: Effect of age groups on SSD.

Skin to Stone Distance (mm)	**Age Group (20 – 47 Years)**	**Age Group (48 – 75 Years)**	**p-value**
Mean	71.14	70.25	0.48
Standard Deviation	6.04	6.02	

Table 3: Effect of gender on SSD.

Skin to Stone Distance (mm)	**Male**	**Female**	**p-value**
Mean	70.55	71.03	0.72
Standard Deviation	6.00	6.10	

There was no effect of age on SSD and there was statistically insignificant difference in between the groups ($p = 0.48$) (Table 2). The mean SSD was 70.55 ± 6.00 mm in males and 71.03 ± 6.10 mm in females and p value was 0.72, which was statistically insignificant (Table 3). Effect of duration of disease on SSD was insignificant (Table 4).

Table 4: Effect of duration of disease on SSD.

Skin to Stone Distance (mm)	**Duration of Disease (1 – 9 Months)**	**Duration of Disease (10 – 20 Months)**	**p-value**
Mean	70.93	70.16	0.58
Standard Deviation	6.17	5.63	

DISCUSSION

Currently in Pakistan, the use of NCCT has become common due to its accuracy and convenience, although it should be noted that IVP techniques linger in broad use for the diagnosis of urinary calculi.[11] Although IVP has conservatively been broadly used as an effective diagnostic method, its use have several adverse effects such as contrast side effects, preparation, NPO time, and total test duration.[12] IVP images can be disturbed by bony structures and bowel gas.[13,14] Additionally, IVP can derive only a limited amount of information from a radiolucent stone.

NCCT has been used previously as the first-line technique for stone evaluation, and this practice is becoming common. It is one of the most precise diagnostic tools for the detection of renal stones.[15,16] Also, it not only provides information about the stone itself, but also plenty of information about abnormalities of the organs and urinary tract (e.g., renal mass, duplicated ureter, bladder mass, gallbladder stone, pancreatitis, appendicitis, diverticulitis of large intestine). Recently, NCCT has been evaluated for use not only for the diagnosis of stones but also for the prediction of ESWL treatment results, which is analyzed by use of various metrics such as mean attenuation value and SSD.[17]

In present study, we calculated mean SSD in patients who underwent ESWL. The results showed that SSD was a significant predictor of the outcome of SWL. Mean SSD in patients with complete stone disintegration was 69.52 ± 4.45 mm and 94.71 ± 2.28 in patients with unsuccessful stone disintegration ($p < 0.001$. According to a study by Elawady et al, the SSD of the stone-free group was markedly lower than the SSD of the residual stone group ($p < 0.01$). In their study, the mean SSD in patients with successful disintegration of renal stones was 81.2 ± 17.4 mm versus 115.3 ± 18.9 mm in patients with unsuccessful stone disintegration and they concluded that the efficacy

of ESWL drops substantially when SSD exceeds 100 mm.[18]

In the study of Mannil et al the mean SSD was 78.25 ± 12.15 mm in patients with successful stone clearance after ESWL treatment.[19] In the study of Elbaset et al the mean SSD was higher as compared to our study and was 114.5 mm in patients with successful stone clearance after ESWL.[20] In our study, we did stratification of age, gender, BMI, duration of disease and stone size to determine the effect of confounder variables on skin to stone distance. In our study, there was significant effect of BMI on SSD and SSD was significantly high in overweight to obese patients (BMI < 25.0 kg/m^2).

CONCLUSION

The mean skin to stone distance was 69.54 ± 4.45 mm in patients with successful stone clearance. We found that mean SSD ≤ 90 mm was a stronger predictor of stone clearance after ESWL in patients with kidney stone disease.

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