Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2015; 3(5A):1845-1847 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Research Article

Utility of Hounsfield density of urinary stones in predicting the stone clearance rate for ESWL therapy

Dilip Kumar Pal[1], Anurag Puri[2]
[1]Professor & Head, Department of Urology, Institute of Post Graduate Medical Education & Research, Kolkata.
[2]Post Doctoral trainee, Department of Urology, Institute of Post Graduate Medical Education & Research, Kolkata.

***Corresponding author**
Prof. Dilip Kumar Pal
Email: urologyipgmer@gmail.com

Abstract: This study was conducted on one hundred and eight patients to determine the stone clearance rate with respect to NCCT –HU density of the stone**.** Various statistical measures were applied for assessing the predictability about the success of ESWL therapy for that stone's HUD. As per the final analysis of the study we can conclude that Hounsfield Unit Density bears significant relationship for predicting the success of ESWL therapy.
Keywords: Hounsfield unit, Urinary stone. Computed Tomography, Shock Wave Lithotripsy.

INTRODUCTION

Shock wave lithotripsy (SWL) was introduced in 1980 [1] and was adopted worldwide in 1984. It has become the primary and dominant procedure for treating patients with kidney stones. Non Contrast Computed Tomography of KUB region is a valuable asset in the urolithiasis management armamentarium. It helps in not only in assessing the stone size, location & number but also in character of the stone as estimated in the form of Hounsfield units. This study was aimed at assessing the stone clearance rate with respect to Hounsfield unit density.

SUBJECTS AND METHODS

This study was conducted on 108 adult patients (>18 yrs) with single radio-opaque renal stone (0.5-2cm) and treated for the first time. The time period was from March 2013 to November 2014. This was a prospective observational study to elucidate the stone clearance rate with respect to stone radio-density. Patients underwent a pre-treatment NCCT KUB (3-mm collimation width, Toshiba Astein 4, 4-slice multi-detector, 120 kV, 240 mA) prior to the study. Pre-treatment kidney, ureter and bladder (KUB) films & IVP were performed in all patients. Post treatment follow-up X-ray KUB films were used to monitor the fragmentation and clearance of fragments at 1 week, 1 month and 3 months period. Stone size was determined by the maximum diameter of the stone in any dimension as seen on plain X ray KUB films. The longest stone size by measurement on NCCT was used, and we measured stone density (HU) and location by using NCCT images. A single ESWL session (Dornier Compact Sigma with C-Arm) was administered to each patient - maximum of 3000 shock waves to a maximum of 16.0 kV increasing stepwise after every 200 shock waves. The dose being decided on the basis of the visualization of satisfactory stone fragmentation on fluoroscopy. Liberal fluid intake was advised to all the patients and was kept under close follow-up to look for even minor complications after the treatment. Successful outcome was defined as no stone or clinically insignificant residual fragments [CIRF (4mm or less)] as seen on X-ray plain KUB films taken at the end of three months. Unsuccessful outcome was defined as failure of fragmentation or incomplete clearance at three months. Serial monitoring of blood urea nitrogen and creatinine was also done.

Data were presented using frequencies and percentages and analyzed using standard statistical measures. A P- value less than 0.05 were considered statistically significant. Data were analyzed by standard statistical analytical tests which included Receiver Operative Curves, Logistic Regression, Univariate and multivariate analysis. Results of the study were compiled, tabulated and then compared with the known data and inferences were drawn.

RESULTS

The mean age of the patients was 36.2±8.69 years. The proportion of males to females was 66.67 % males and 33.33% females. Among 108 patients, 82 patients were included in the success group and 26 patients (%) in the failure group in terms of ESWL efficacy. So the overall success rate was 75.9%. The average stone size in the success group was 14.17 ± 2.914mm and the average stone size in the failure

group was 13.50± 3.625 mm (p=0.338). Hence, stone size, in the range 5-20mm was insignificant in terms of stone clearance. With regard to HU, the success group had values of 796.74± 132.308 and the failure group of 1089.46 ±253.795. The differences between the groups were statistically significant when compared with student's t-test ($p < 0.0001$). With regard to HUD, the success group had mean values of 58.098± 12.514and the failure group of 84.048 ± 16.481. The differences between the groups were statistically significant when compared with student's t-test ($p < 0.0001$).

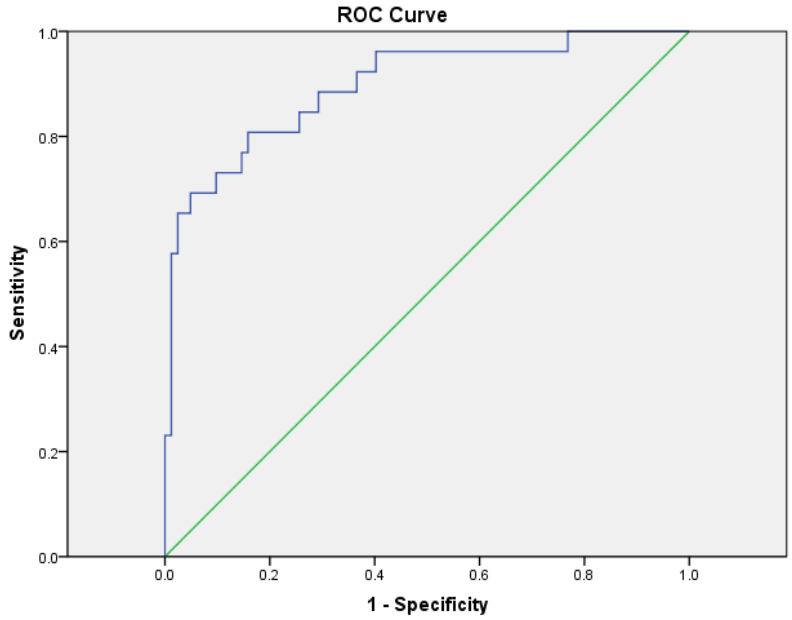

Fig.-1: Showing ROC Curve for Hounsfield Unit Density

Receptor-Operator Characteristic (ROC) curve analysis (Figure 1 & 2)was used to determine stone Hounsfield Unit Density (HUD) that best predicted a successful outcome and a cut off value of 71.605 HUD with sensitivity of 80.8% and specificity of 82.9 % were found (AUC: 0.896).$\chi^2 = 44.412$ and p value <0.0001

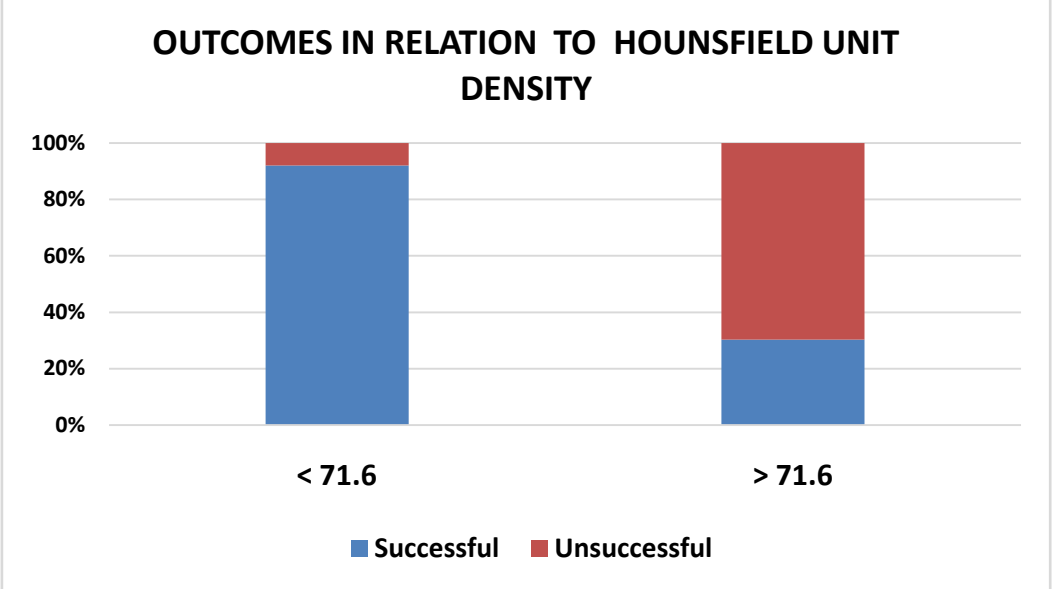

Fig.-2 : Shows outcomes in relation to Hounsfield unit density

DISCUSSION

Ouzaid *et al.* [2] with use of The Youden Index showed that a stone density of 970 HU represented the most sensitive (100%) and specific (81%) point on the receiver-operating characteristic curve. The stone-free rate for stones of <970 HU was 96% whereas it was only 38% for stones of ≥ 970 HU ($P < 0.001$). A linear relationship between the calculus density and the success rate of ESWL was identified. Torricelli *et al.* [3] also stated that the best outcomes

were found for patients with stones ≤10mm and ≤900 HU, and infundibular length ≤25mm.

Al –Assmy *et al.* [4] found that there was significant positive correlation at 120-kV, 80-kV, and dual-energy CT values between stone density and number of shock waves required for complete fragmentation. Stones with HU >1000 required statistically significant higher number of shock waves. Failure of disintegration was observed by El Nahas *et al.* [5] in 15 patients (12.5%). The only significant predictor of residual fragments was stone density ($p<0.001$). Gupta *et al.* [6] found a linear relationship between the calculus density and number of ESWL sessions required. Of patients with calculi of < or = 750 HU, 41 (80%) needed three or fewer ESWL sessions and 45 (88%) had complete clearance. The best outcome was in patients with calculus diameters of < 1.1 cm and mean densities of < or = 750 HU; 34 (83%) needed three or fewer ESWL sessions, and the clearance rate was 90%.

In our study, we found using ROC analysis, a cut off value of 939 HU. Successful outcome was seen in 93.33% patients in the <939 group and 32 % in patients with stones of more than 939 HU ($p < 0.0001$). This is similar to the studies mentioned above. However, Patel *et al.* [7] and Pareek *et al.* [8] did not find HU to be an important predictor of stone clearance. Magnuson et al [9] found that the overall mean Hounsfield density value for stone-free compared to residual stone groups were significantly different (93.61 vs. 122.80 $p < 0.0001$). They determined by receiver operator curve (ROC) that HDV of 93 or less carries a 90% or better chance of stone freedom following ESWL for upper tract calculi between 5-15mm.

In our study, on ROC analysis, a cut off value of 71.605 HUD with sensitivity of 80.8% and specificity of 82.9 % was found. Below this there was a success rate of 92 % and above this there was a success rate of 43.48% and the difference was statistically significant ($p <0.001$). This clearance was analogous to the above mentioned study. The difference in the HUD is mainly because of the stone size consideration as the previous study had stone size range of 5-15 mm which would make HUD greater in comparison to our study where many stones were more than 15mm.

REFERENCES

1. Chaussy C, Brendel W, Schmiedt E. Extracorporeally induced destruction of kidney stones by shockwaves. Lancet, 1980; 2: 1265-68.
2. Ouzaid I, Al-qahtani S, Dominique S, Hupertan V, Fernandez P, Hermieu JF, Demas V, Ravery V *et al.* Use of Hounsfield units to optimise care for kidney stones: NewYouk Urology Specialists. BJU Int. 2012; 110(11 Pt B):E438-42.
3. Torricelli FC, Marchini GS, Yamauchi FI, Danilovic A, Vicentini FC, Srougi M, Monga M, Mazzucchi E *et al.* Impact of renal anatomy on shock wave lithotripsy outcomes for lower pole kidney stones: results from a prospective multifactorial analysis controlled by computed tomography scan. J Urol. 2015; 193(6): 2002-7.
4. el-Assmy A, Abou-el-Gahr ME, el-Nahas AR, Refaie HF, Sheir KZ; Multidetector computed tomography: role in determination of urinary stones composition and disintegration with extracorporeal shock wave lithotripsy--an in vitro study. Urology. 2011; 77(2):286-90.
5. El-Nahas AR, Ibrahim HM, Youssef RF, Sheir KZ; Flexible ureterorenoscopy versus extracorporeal shock wave lithotripsy for treatment of lower pole stones of 10-20 mm. BJU Int. 2012; 110(6): 898-902.
6. Gupta NP, Ansari MS, Kesarwani P, Kapoor A, Mukhopadhyya S; Role of computed tomography with no contrast medium enhancement in predicting the outcome of extracorporeal shock wave lithotripsy for urinary calculi. BJU Int 2005; 95(9): 1285-8.
7. Patel T, Kozakowski K, Hruby G, Gupta M; Skin to stone distance is an independent predictor of stone-free status following shockwave lithotripsy. J Endourol. 2009; 23(9):1383-5
8. Pareek G, Hedican SP, Lee FT Jr, Nakada SY. Shock wave lithotripsy success determined by skin-to-stone distance on computed tomography. Urology. 2005; 66(5): 941-4.
9. Magnuson WJ, Tomera KM, Lance RS; Hounsfield unit density accurately predicts ESWL success. Alaska Med. 2005; 47(2): 6-9.