Evaluation of possible predictive variables for the outcome of shock wave lithotripsy of upper urinary stones

Protocol Of Thesis Submitted

In Partial Fulfillment

Of Master Degree In

Urology

By

Mohamed Mahmud Sayed-Ahmed

Resident Of Urology

Faculty Of Medicine

El Fayoum University

Supervisors

Prof Dr.

Mohamed Salah El-Din Abdel-Azim

Professor Of Urology

Faculty OF Medicine

Cairo University

Prof Dr.

Hamdy Ibrahim

Assistant Professor Of Urology

Faculty Of Medicine

El Fayoum University

Dr.

Mahmud Abdalhamid

Lecturer Of Urology

Faculty Of Medicine

Cairo University

Summary and conclusion

Shock wave lithotripsy (SWL) is consideredthe first line treatment for the majority of patients withrenal and ureteric calculi, with success rates from contemporaryseries varying from 60 to 90%.

Failure ofstone disintegration results in unnecessary exposureof the renal parenchyma to shock waves andthe requirement of an alternative treatment procedure,which increases medical costs.Hence, it isimportant to identify patients who will benefitfrom SWL prior to treatment by examining stonefragility.

Our study aimed to evaluate possible predictive variables (HU value, BMI, SSD, stone size)for the outcome of SWL of upper urinary tract stones to help to define the indications for SWL treatmentsuccessfully.

56 patients were treated by ESWL using the electromagnetic SeimensLithotriptor machine at Fayoum University Hospital.Patients were included in this study if they had single stone ,size of the stone 0.5–2 cm in the longest dimension, radio-opaque stone, normal renal functioning.Exclusion criteria include stone treatment for the same stone,multiple stones, stone size more than 2 cm,radiolucent stones, renal impairment ,non-functioning renal unit, patient on anticoagulant treatment ,sepsis ,past history of ESWL ,contraindications to SWL, skeletal deformity.

All patients were fully evaluated by history taking and thorough clinical examination and were investigated by laboratory investigations as serum creatinine and urine analysis and also radiological investigations as P.U.T, abdominal pelvic u/s, I.V.P. and spiral C.T.abdomen and pelvis.

Mean stone attenuation was calculated from 3 nonoverlapping regions of interest (area 0.026 cm^2 or 25 pixels) chosen for each stone. Relatively small, consistent areas of interest (25 pixels) were centrally chosen to minimize the volume averaging that occurs when measurements include the stone edge.

The SSD was calculated by measuring three distances from the stone to the skin at 0^o, 45^o, and 90^o by using radiographic calipers, and the average of these three values was calculated to represent the SSD for each stone.

The body mass index (BMI) was calculated by dividing the weight (kg) by the square of height (m).

Patients are categorized according to findings on follow-up imaging as group 1—those rendered stone free (free group) ,group 2—those with residual stones (failure group)

Follow-up:

Clinical follow-up and imaging with plain KUB were performed at 2 weeks, 4weeks and thereafter. Second and third sessions of SWL were performed, if necessary at 2 weeks, 4 weeks . For patients who needed more than one session, the duration between each session was 2 weeks to give chance for the tiny fragments to pass .

Results

Demographic data and stone characteristics as follow :The patients' mean age was 39.5±12.7 years (range, 18 to 70 years) .The mean BMI was 26.3±4.6 kg/m^2 (range, 19.6 to 42.2 kg/m^2). Gender was 41 males (73.2%) and 15 females (26.8%). The mean stone size was 12.7±3.8mm (range, 6 to 20mm) . The mean stone density (HU) was 962.7±262.3 (range, 399.6 to 1535). The mean skin to stone distance (SSD) was 9.2±1.9 cm (range, 5.8-12.6 cm).The stone site was 14 (25%) calyceal, 28 (50%) renal pelvic, 14 (25%) upper ureteric.

The overall success rate was 87.5% (n=49) and the failure rate was 12.5% (n=7).

In univariate analysis for predictors of ESWL success, the only significant one is the mean stone density (HU value) with p value 0.007.In the multivariate logistic regression, the most useful two predictive variableswere skin to stone distance ,mean stone density .

There was a positive strong correlation between BMI and skin to stone distance with a Pearson correlation coefficient of r=0**.591**, where p value< 0.001.Also there was a positive moderate correlation between stone size and HU value with a Pearson correlation coefficient of r=0.421 where p value< 0.01.

As regarding to Skin to stone distance SSD ,Pareek et al reported that SSD determination on NCCT provides useful information for treatment (SWL) outcome .El nahas et al reported that, SSD was a significant predictor of failure based on univariate (but not multivariate) analysis.Alexandra E P et al reported thaton multivariate analysis, of the factors that independently predicted the outcome was SSD.Joshua D W et al ,reported that SSD was a predictor of treatment success for both renal (p = 0.01) and ureteric calculi (p = 0.04). And the SSD that best predicts SWL failure was ≥110 mm (OR 0.49, CI 0.31–0.78).Park B H et al,reported thatOnly SSD was a factor influencing success in the multivariate logistic regression analysis
Choi J W et al reported that SSD was a significant predictor of treatment outcome in the univariate analysisbut was not a significant predictor in the multivariate analysis .Wiesenthal et al. suggested that SSD was a significant predictor of lithotripsy success for ureteral stones.

Although Yong Il Park et al, reported that SSD did not reachstatistical significance even in the univariate analysis.

As regarding to mean stone density MSD ,Gupta et alreported thatOnly calculus density was a significant factor for prediction of success

Li et al, reported that the stone density determined by UHCT associated with ESWL outcomes, not only for solitary renal stones but also for multiple renal stones, was a significant predicting factor of ESWL outcomes by the use of multivariate analysis as a maximal stone density of more than 900 HU (P=0.0430) were statistically significant predictors of a failure outcome for ESWL.

Alexandra E P et al reported thaton multivariate analysis stone density was the only independent predictor of stone-free outcome.

Joshua D W et al, reported that MSD was a strong predictor for successful lithotripsy of allupper tract calculi (p=0.01),Yong Il Park et al , reported that in the univariate analysis, stone density and stone size were significant predictors of the outcome of SWL .El nahas et al reported that, the stone attenuation value was a significantpredictor of the rate of residual fragments.

We also found that there was a statistically significant differences **of SWL outcome**when comparing calyceal versus renal pelvic stones, but when comparing renal versus ureteric stones there is no statistically significant differences

Yong Il Park et al,reported that lower calycealstone location was not a significant predictive variable

Stone size was not a significant predictor of SWL outcomein our study both in univariate and multivariate analysis.However Yong Il Park et al,reported that stone size was a significant predictor of SWL outcome

Stratifyingthe patients in our study by treatment success orfailure revealed **the stone-free rates to beinverselyproportional to the BMI**. and patients in whom ESWL failed had a mean BMI of 29,and others in whom ESWL succeed had a mean of 25.9 with p value 0.087 .

Pareek et al,Logistic regression analysis revealed that an unsuccessfuloutcome was statistically significantlyrelated to the BMI ,El nahas et al ,reported that higher BMI was a significant predictor of disintegration failure and the necessity for more than three sessions was significantly affected by obesity (BMI >30 kg m^{-2}) ,In Joshua D W et al study, BMI was a significant predictor of successful SWL in ureteric, but not renal calculi.

Conversely,BMI failed to predict successful SWL outcomes inNg et al.'s study, whereas SSD remained a significant predictor.

In our study,**The most important and significant predictors of lithotripsy success for upper urinary tract calculi were SSD, MSD and stone location**.As those with SSD ≤9cm, MSD <1000, non-calyceal stones have favorable outcome than those with SSD≥10cm, MSD≥1000, calyceal stones