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Utility of S.T.O.N.E. score to predict stone free rates in patients with renal and ureteral stones

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Abstract
Background: Surgical treatments are evolving and flexible Ureterorenoscopy (f-URS) has been shown to outperform extracorporeal shockwave lithotripsy (ESWL) and percutaneous Nephrolithotomy (PCNL) in a number of indications. The present study was conducted to assess S.T.O.N.E. score in patients with renal and ureteral stones.
Materials and Methods: 82 cases of ureteral and renal stones were recruited. The S.T.O.N.E. score consists of 5 stone characteristics size, topography (location of stone), obstruction, number of stones present and evaluation of Hounsfield Units. Each component is scored on a 1-3 point scale.
Results: Out of 82 patients, males were 52 and females were 30. SFR were found to be correlated to S.T.O.N.E. score. As S.T.O.N.E. Score increased, the SFR decreased.
Conclusion: The features of S.T.O.N.E. score are relevant in predicting SFR with URS. Size, location, and degree of hydronephrosis were statistically significant factors.

Keywords: hydronephrosis, renal stones, S.T.O.N.E

Introduction

The prevalence of stone disease is increasing worldwide. The total cost of treating stones in the US currently exceeds five billion dollars annually. With this increase in incidence and the cost of healthcare continuing to rise, new approaches to stone disease may be necessary [1]. The prevalence and incidence of renal and ureteral lithiasis are increasing worldwide.

Surgical treatments are evolving and flexible ureterorenoscopy (f-URS) has been shown to outperform extracorporeal shockwave lithotripsy (ESWL) and percutaneous nephrolithotomy (PCNL) in a number of indications [2]. Extra-corporeal shockwave lithotripsy (ESWL) is the present mainstay of treatment for intra-renal and proximal ureteral stones ≤ 1cm in diameter due to its relatively low complication rate and high success rate [3]. Current guidelines from American Association of Urology (AUA) recommend ESWL as the first treatment option for proximal ureteral calculi. This depends mainly on the size, number and location of the stones. ESWL is a minimally invasive technique but often requires several procedures. PCNL seems to be the most successful but is the most invasive procedure [4]. F-URS also gives excellent results and is associated with a low complication rate. Furthermore, f-URS is a safe and efficient option in specific populations such as obese patients. Multiple studies have examined the predictive factors associated with ESWL outcomes as well as nomograms to predict stone free rates (SFR) [5]. The present study was conducted to assess S.T.O.N.E. score in patients with renal and ureteral stones.

Materials and Methods

The present study was conducted among 82 cases of ureteral and renal stones of both genders. All were informed regarding the study and their written consent was obtained. Inclusion criteria consisted of consecutive patients with ureteral and renal stones with preoperative non-contrast computed axial tomography (CT-KUB). Data related to patients such as name, age, gender etc. was recorded. The S.T.O.N.E. score consists of 5 stone characteristics size, topography (location of stone), obstruction, number of stones present and evaluation of Hounsfield Units. Each component is scored on a 1-3 point scale. In cases with multiple calculi, the stone with the highest grade for each feature was recorded. The S.T.O.N.E. Score was applied to 82 rigid and flexible ureteroscopies performed. Stone free was defined as absent of stone fragments or fragments ≤ 2 mm post URS after endoscopic inspection and real time fluoroscopy imaging. If combined endoscopic visualization and fluoroscopy was sub-optimal, a CT scan was obtained postoperatively to confirm stone free status. A logistic model was applied to evaluate our data for stone free rates (SFR). Results thus obtained were subjected to statistical analysis. p value less than 0.05 was considered significant.

Table 1: S.T.O.N.E. Score

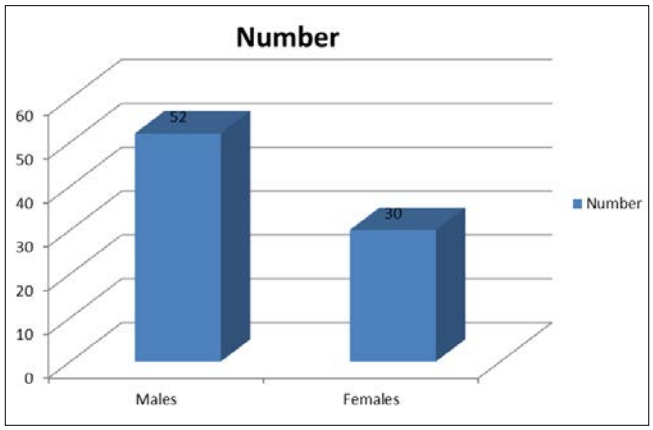
Feature	1 pt.	2 pt.	3 pt.
(S)ize	< 5mm	5-10mm	> 10mm
(T)opography	Distal to Mid-Ureter	Proximal Ureter through Mid and Upper Pole	Lower Pole
(O)bstruction	Preoperative Stent or No Hydronephrosis	Grade 1-2	Grade 3-4
(N)umber of stones	1 stone	2 stones	≥ 3stones
(E)valuation of HU	< 750HU	750-1000HU	> 1000HU

Results

Table 2: Distribution of Patients

Total- 82		
Gender	**Males**	**Females**
Number	52	30

Table I, graph I shows that out of 82 patients, males were 52 and females were 30.



Graph I: Distribution of patients

The overall SFR in the entire cohort was 80.49%. A total of 12 patients were diagnosed with residual stones intra-operatively and another 4 patients were found to have residual stones on postoperative CT.

Table 2: Assessment of S.T.O.N.E. score

S.T.O.N.E. score	Number	S.T.O.N.E. score	Rounded score
5	1	99%	100%
6	3	97%	100%
7	13	94%	100%
8	20	91%	92%
9	12	86%	88%
10	10	77%	78%
11	12	65%	68%
12	8	56%	58%
13	2	42%	46%
14	1	30%	32%
15	0	20%	24%

Table II shows that SFR were found to be correlated to S.T.O.N.E. score. As S.T.O.N.E. Score increased, the SFR decreased.

Discussion

Nephrolithiasis is a common ailment affecting approximately 1 in 11 Americans, and its rates are increasing. Many patients have small stones that pass spontaneously; this process can be accelerated with medical expulsive therapy, primarily α-blockade [6]. The majority of patients who are unsuccessful with α-blockade are treated with minimally invasive procedures such as shock wave lithotripsy (SWL) and ureteroscopy (URS) [7]. The present study was conducted to assess S.T.O.N.E. score in patients with renal and ureteral stones.

In present study, out of 82 patients, males were 52 and females were 30. Rubenstein *et al* [8]. Saw a stone free rate of 78 and 54% for patients with and without pre-stenting respectively. They have accounted for the pre-stenting effect by incorporating this into the obstruction score. The obstruction score was further graded by a modified Society for Fetal Urology score in order to quantify the severity of hydronephrosis. There are few grading systems objectively quantifying hydronephrosis.

We found that SFR were found to be correlated to S.T.O.N.E. score. As S.T.O.N.E. Score increased, the SFR decreased. Molina *et al* [9]. in their study the S.T.O.N.E. score consists of 5 stone characteristics: size, topography (location of stone), obstruction, number of stones present and evaluation of Hounsfield Units. Each component is scored on a 1-3 point scale. The S.T.O.N.E. Score was applied to 200 rigid and flexible ureteroscopies performed. A logistic model was applied to evaluate our data for stone free rates (SFR). SFR were found to be correlated to S.T.O.N.E. Score. As S.T.O.N.E. Score increased, the SFR decreased with a logical regression trend ($p < 0.001$). The logistic model found was SFR=1/(1+e^(-z)), where z=7.02-0.57*Score with an area under the curve of 0.764. A S.T.O.N.E. Score ≤ 9 points obtains stone free rates > 90% and typically falls off by 10% per point thereafter.

Kacker *et al* [10]. Reported a statistical difference between successful and unsuccessful ESWL (675.29 versus 1075.00, respectively). This trend has been observed in URS but without statistical significance. A study found that stones successfully treated by URS had a mean of 858 HU while stones that were unsuccessfully treated had a mean of 1115 HU. Stone composition increasing density and hardness may prolong OR time.

Gonzalez *et al* [12]. in their study 1054 ureteroscopic procedures were performed. Holmium: yttrium-aluminum-garnet laser lithotripsy was necessary in 41 (32.8%) patients. The mean stone size was 11.93 ± 8.2 mm, with a mean stone burden of 83.7 ± 67.66 mm^2. The mean number of stones was 3.59 ± 3.57. Twenty-six (20.8%) patients had a stone burden ≥100 mm^2, and 99 (79.2%) a stone burden <100 mm^2. The overall stone-free rate after a single procedure of fURS was 74.4%. In the remaining 32 patients with residual stones, the mean stone burden dropped from 123.24 ± 84.36 mm^2 to 56.28 ± 52.53 mm^2. The stone-free rate in patients with a stone burden ≥100 mm^2 was 65.4% and 79.5% in patients with a stone burden <100 mm^2, respectively. Complications have been recorded in seven (5.6%) patients, including urinary tract infection in four, ureteral perforation in one, and hematuria in two patients. No major complications occurred. All patients were treated conservatively.

The shortcoming of the study is small sample size.

Conclusion

Authors found that the features of S.T.O.N.E. score are relevant in predicting SFR with URS. Size, location, and degree of hydronephrosis were statistically significant factors.

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