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Original Research Article

Comparison Between Guys Stone Score and S.T.O.N.E Score in Patients Undergoing Percutaneous Nephrolithotomy

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Abstract

Background: This study was conducted to estimate the stone-free rates and complication rates in patients with different grades of Guy's stone score and S.T.O.N.E. nephrolithometry scores undergoing percutaneous nephrolithotomy, study the correlation between Guy's stone score and S.T.O.N.E. score and operative times, length of hospital stay and other selected outcomes, and compare the area under the curve for Guy's stone score and S.T.O.N.E. score for post-percutaneous nephrolithotomy outcomes.

Methods: This was a hospital-based prospective observational study conducted among 164 patients who underwent Percutaneous Nephrolithotomy (PCNL) in the Department of Urology, Government Medical College, Thiruvananthapuram, over a period of one year, after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

Results: The mean Guys stone score in the study population was 1.75 ± 0.95, whereas the mean S.T.O.N.E score was 7.45 ± 1.22. The overall complication rate in our study was 25.61%. The complication rates had a significant correlation with the Guys stone score ($p<0.0001$) as well as with the S.T.O.N.E. score ($p<0.0001$). There was a significant correlation between the Guys stone score and stone free rate ($p < 0.0001$) as well as between the S.T.O.N.E. score and stone free rate ($p < 0.0001$).

Conclusion: Both GSS and STONE scores are equally effective in predicting the success rate as well as complication rates associated with PCNL. Operative time and length of hospital stay also correlate with both scores studied. However, the fluoroscopy time does not correlate with either scoring systems used.

Keywords: Percutaneous Nephrolithotomy, Nephrolithometry Scoring Systems, Guy's Stone Score, S.T.O.N.E. Score.

Introduction

Percutaneous renal access was first described by Goodwin et al. when they used it for drainage of urine in a hydronephrotic kidney.[1] Fernstrom & Johansson (1976) were the first to describe percutaneous renal access for the purpose of removing a renal calculus.[2] Percutaneous nephrolithotomy (PCNL) has replaced open removal of renal calculi due to its superiority in terms of morbidity, convalescence, and cost. However, like any other surgical procedure, PCNL is not without complications.

Several preoperative nomograms have been proposed for the prediction of success rates and the risk of complications associated with PCNL. These include the Guy's Stone Score (GSS),[3] Clinical Research Office of the Endourological Society (CROES)[4] nomogram, S.T.O.N.E. score,[5] and Seoul National University Renal Stone Complexity.[6] The imaging modality of choice for stone disease at present is CT (Computed Tomography), and the GSS as well as the STONE score are based on CT findings. However, the superiority of one of these over the other has yet to be proven. Our study is a prospective study aimed at assessing Guy's score and the STONE score in predicting the success rates and risk of complications associated with PCNL. Guys Stone Score is as follows: Grade I - A solitary stone in the mid/lower pole with simple anatomy or a solitary stone in the pelvis with simple anatomy Grade II - A solitary stone in the upper pole with simple anatomy, multiple stones in a patient with simple anatomy or any solitary stone in a patient with abnormal anatomy Grade III - Multiple stones in a patient with abnormal anatomy or stones in a calyceal diverticulum or partial staghorn calculus Grade IV - Staghorn calculus or any stone in a patient with spina bifida or spinal injury

Aims and Objectives

To estimate the stone-free rates and complication rates in patients with different grades of Guy's stone score and S.T.O.N.E. nephrolithometry scores undergoing percutaneous nephrolithotomy. To study the correlation between Guy's stone score and S.T.O.N.E. score and operative times, length of hospital stay, and other selected outcomes. To compare the area under the curve for Guy's stone score and S.T.O.N.E. score for post-percutaneous nephrolithotomy outcomes

Methods

This was a hospital-based prospective observational study conducted among 164 patients who underwent Percutaneous Nephrolithotomy (PCNL) in the Department of Urology, Government Medical College, Thiruvananthapuram, over a period of one year, after obtaining clearance from the institutional ethics committee and written informed consent from the study participants. All patients above the age of 18 years with renal calculi undergoing PCNL who were willing to provide consent were included in the study. Patients with any renal anomalies, radiolucent calculi, previous history of any renal surgery on the affected side, chronic renal failure, heart disease, or spine abnormality were excluded from the study

Statistical Methods

Data was analyzed using Statistical Package for Social Sciences (SPSS) 25 Inc. Qualitative variables were expressed in proportion to their confidence interval. Stone-free rate and complication rate were expressed in proportion to their confidence interval. Quantitative variables were expressed in mean, standard deviation, and its confidence interval. Correlation analysis was done using Spearman's test. Correlation was expressed in terms of correlation coefficient. Receiver operating characteristic curves were drawn to assess the area under the curve for both scoring systems in predicting outcomes. A p value < 0.05 was considered statistically significant.

Results

Table 1: Association of Stone Free/Non Stone Free Status with Guy's Score

Complications (Clavien Dindo)	Guy's Score 1 (n=87)	Guy's Score 2 (n=43)	Guy's Score 3 (n=22)	Guy's Score 4 (n=12)	Total	P-Value
0	73 (83.91%)	30 (69.77%)	19 (86.36%)	0(0%)	122(74.39%)	<.0001*
1	10 (11.49%)	6(13.95%)	2 (9.09%)	2(16.67%)	20 (12.20%)	
2	2 (2.30%)	6(13.95%)	1 (4.55%)	8(66.67%)	17 (10.37%)	
3a	1 (1.15%)	0(0%)	0(0%)	1 (8.33%)	2 (1.22%)	
3b	0(0%)	0(0%)	0(0%)	1 (8.33%)	1 (0.61%)	
4	1 (1.15%)	1 (2.33%)	0(0%)	0(0%)	2 (1.22%)	
Total	87 (100%)	43 (100%)	22 (100%)	12 (100%)	164 (100%)	
Association of Complications (Clavien Dindo) with Guy's Score						
Stone Free/Non Stone Free	Guy's Score 1 (n=87)	Guy's Score 2 (n=43)	Guy's Score 3 (n=22)	Guy's Score 4(n=12)	Total	P-Value
Non stone free	2 (2.30%)	7(16.28%)	4(18.18%)	9(75%)	22 (13.41%)	<.0001*
Stone free	85 (97.70%)	36 (83.72%)	18 (81.82%)	3(25%)	142(86.59%)	
Total	87 (100%)	43 (100%)	22 (100%)	12 (100%)	164 (100%)	

Fisher's exact test

Proportion of patients with grade of complications according to modified Clavien classification: -1, 3a, 3b was significantly lower in Guy's score 1, 2 and 3 as compared to 4. (1: -11.49%, 13.95% and 9.09% vs. 16.67% respectively, 3a: - 1.15%, 0% and 0% vs. 8.33% respectively, 3b: - 0%, 0% and 0% vs. 8.33% respectively). Proportion of patients without complications was significantly higher in Guy's score 1 and 3 as compared to 2 and 4. (83.91%, 86.36% vs. 69.77%, 0% respectively). Proportion of patients with grade of complications according to modified Clavien classification: -2 was significantly higher in Guy's score 4 as compared to 1, 2 and 3. (2: -66.67% vs. 2.30%, 13.95% and 4.55% respectively). (p-value <0.0001)

Stone free rate was significantly higher in Guy's score 1, 2, 3 as compared to 4. (stone-free rate: -97.70%, 83.72%, 81.82% vs. 25% respectively). Non stone free rate was significantly higher in Guy's score 4 as compared to 1, 2 and 3. (non-stone-free rate: - 75% vs. 2.30%, 16.28% and 18.18% respectively). (p-value <0.0001).

Table 2: Association of Stone Free/Non Stone Free with S.T.O.N.E Score

Complications (Clavien Dindo)	S.T.O.N.E Score 6 (n=42)	S.T.O.N.E Score 7 (n=53)	S.T.O.N.E Score 8 (n=34)	S.T.O.N.E Score 9 (n=23)	S.T.O.N.E Score 10 (n=12)	Total	P-Value
0	32 (76.19%)	44 (83.02%)	26(76.47%)	20(86.96%)	0(0%)	122 (74.39%)	<.0001*
1	8(19.05%)	5 (9.43%)	2 (5.88%)	2 (8.70%)	3(25%)	20 (12.20%)	
2	2 (4.76%)	3 (5.66%)	5(14.71%)	0(0%)	7(58.33%)	17 (10.37%)	
3a	0(0%)	0(0%)	0(0%)	1 (4.35%)	1 (8.33%)	2(1.22%)	
3b	0(0%)	0(0%)	0(0%)	0(0%)	1 (8.33%)	1(0.61%)	
4	0(0%)	1 (1.89%)	1 (2.94%)	0(0%)	0(0%)	2(1.22%)	
Total	42 (100%)	53 (100%)	34 (100%)	23 (100%)	12 (100%)	164(100%)	
Association of Complications (Clavien Dindo) with S.T.O.N.E Score							
Stone Free/Non Stone Free	S.T.O.N.E Score 6 (n=42)	S.T.O.N.E Score 7 (n=53)	S.T.O.N.E Score 8 (n=34)	S.T.O.N.E Score 9 (n=23)	S.T.O.N.E Score 10 (n=12)	Total	P-Value
Non stone free	1 (2.38%)	4 (7.55%)	7(20.59%)	1 (4.35%)	9(75%)	22 (13.41%)	<.0001*
Stone free	41 (97.62%)	49 (92.45%)	27 (79.41%)	22 (95.65%)	3(25%)	142(86.59%)	
Total	42 (100%)	53 (100%)	34 (100%)	23 (100%)	12 (100%)	164 (100%)	

Fisher's exact test

Proportion of patients without complications was significantly higher in S.T.O.N.E score 6 (76.19%), 7 (83.02%), 8 (76.47%), 9 (86.96%). Proportion of patients with grade of complications according to modified Clavien classification 1 was significantly higher in S.T.O.N.E score 6 (19.05%), 10 (25%). Proportion of patients with grade of complications according to modified Clavien classification 2 was significantly higher in S.T.O.N.E score 10 (58.33%). Proportion of patients with grade of complications according to modified Clavien classification 3a was significantly higher in S.T.O.N.E score 9 (4.35%), 10 (8.33%). Proportion of patients with grade of complications according to modified Clavien classification 3b was significantly higher in S.T.O.N.E score 10 (8.33%). (p-value <0.0001).

Non-stone-free rate was significantly higher in S.T.O.N.E score 10 (75%). Stone-free rate was significantly higher in S.T.O.N.E score 6 (97.62%), 7 (92.45%), 8 (79.41%), and 9 (95.65%). (p-value <0.0001).

Table 3

Variables	GUYS Score	S.T.O.N.E Score
Area under the ROC Curve (AUC)	0.829	0.768
Standard Error	0.0467	0.0547
95% Confidence Interval	0.763 to 0.883	0.696 to 0.830
P-Value	<0.0001	<0.0001
Cut-off	≤1	≤7
Sensitivity (95% CI)	59.86% (51.3 -68.0%)	63.38% (54.9 -71.3%)
Specificity (95% CI)	90.91% (70.8 -98.9%)	77.27% (54.6 -92.2%)
PPV (95% CI)	97.7% (91.9 - 99.7%)	94.7% (88.1 - 98.3%)
NPV (95% CI)	26% (16.6 - 37.2%)	24.6% (15.1 - 36.5%)
Diagnostic Accuracy	64.02%	65.24%

Receiver Operating Characteristic Curve of Guy's Score and S.T.O.N.E Score for Predicting Stone Free Rate

Variables	Operative Time (minutes)	Fluoroscopy Time (minutes)	Length of Hospital Stay (days)
Guy's Score			
Correlation coefficient	0.279	-0.007	0.475
P value	0.0003	0.930	<0.0001
S.T.O.N.E Score			
Correlation coefficient	0.399	-0.026	0.731
P value	<0.0001	0.740	<0.0001

Correlation of Guy's Score and S.T.O.N.E Score with Operative Time (minutes), Fluoroscopy Time (minutes) and Length of Hospital Stay (days).

Pearson correlation coefficient

GUYS score had a 95%CI of 0.763 to 0.883 for stone free rate which is excellent. The discriminatory power of S.T.O.N.E score (AUC 0.768; 95% CI: 0.696 to 0.830) was acceptable. Among both parameters, GUYS score was the best predictor of stone-free rate at cutoff point of ≤1 with 82.90% chances of correctly predicting stone-free rate.

S.T.O.N.E score had sensitivity of 63.38% followed by Guy's score (59.86%). Also, Guy's score had a specificity of 90.91% followed by S.T.O.N.E score (77.27%). The highest positive predictive value and negative predictive value were found in Guy's score (97.70%, 26% respectively). There is always a trade-off between sensitivity and specificity (any increase in sensitivity will be accompanied by a decrease in specificity), so we choose that variable as the best combination of sensitivity and specificity that gives the maximum predictive value, so overall, Guy's score was the best predictor of stone-free rate.

The significant positive correlation was seen between Guy's score and operative time (minutes) and length of hospital stay (days), with correlation coefficients of 0.279, 0.475 respectively. No correlation was seen between Guy's score and fluoroscopy time (minutes) with a correlation coefficient of -0.007.

Significant positive correlation was seen between S.T.O.N.E score and operative time (minutes) and length of hospital stay (days) with correlation coefficients of 0.399, 0.731 respectively. No correlation was seen between S.T.O.N.E score and fluoroscopy time (minutes) with a correlation coefficient of -0.026.

Table 4: Multivariate Linear Regression to Assess Effect of Guy's Score and S.T.O.N.E Score on Length of Hospital Stay (days)

Variables	Beta Coefficient	Standard Error	P-Value	Lower Bound (95%)	Upper Bound (95%)
Guy's Score	6.049	1.638	0.0003	2.815	9.284
S.T.O.N.E Score	6.734	1.216	<0.0001	4.332	9.135
Univariate Linear Regression to Assess Effect of Guy's Score and S.T.O.N.E Score on Operative Time					
Variables	Beta Coefficient	Standard Error	P-Value	Lower Bound (95%)	Upper Bound (95%)
Guy's Score	3.271	1.671	0.0521	-0.029	6.572
S.T.O.N.E Score	5.783	1.300	<0.0001	3.216	8.350
Multivariate Linear Regression to Assess Effect of GUYS Score and S.T.O.N.E Score on Operative Time					
Variables	Beta Coefficient	Standard Error	P-Value	Lower Bound (95%)	Upper Bound (95%)
Guy's Score	0.675	0.098	<0.0001	0.481	0.869
S.T.O.N.E Score	0.808	0.059	<0.0001	0.691	0.925
Univariate Linear Regression to Assess Effect of Guy's Score and S.T.O.N.E Score on Length of Hospital Stay (days)					
Variables	Beta Coefficient	Standard Error	P-Value	Lower Bound (95%)	Upper Bound (95%)
Guy's Score	0.333	0.078	<0.0001	0.179	0.487
S.T.O.N.E Score	0.711	0.061	<0.0001	0.591	0.831

On performing univariate regression, Guy's score, S.T.O.N.E score were significant factors affecting operative time (minutes). With the increase in GUYS score, S.T.O.N.E score by 1, operative time (minutes) significantly increased by 6.049, 6.734 minutes respectively.

On performing multivariate regression, S.T.O.N.E score was an independent significant factor affecting operative time (minutes). With the increase in S.T.O.N.E score by 1, operative time (minutes) significantly increased by 5.783 minutes.

On performing univariate regression, Guy's score, S.T.O.N.E score were significant factors affecting the length of hospital stay (days). With the increase in Guy's score, S.T.O.N.E score by 1, length of hospital stay (days) significantly increased by 0.675, 0.808 days respectively.

On performing multivariate regression, Guy's score, S.T.O.N.E score were significant independent factors affecting length of hospital stay (days). With the increase in Guy's score, S.T.O.N.E score by 1, length of hospital stay (days) significantly increased by 0.333, 0.711 days respectively.

Table 5: Multivariate Logistic Regression to Assess Effect of Guy's Score and S.T.O.N.E Score on Stone Free Rate

Variables	Beta Coefficient	Standard Error	P-Value	Odds Ratio	Odds Ratio Lower Bound (95%)	Odds Ratio Upper Bound (95%)
GUYS score	0.783	0.191	<0.0001	2.187	1.504	3.181
S.T.O.N.E score	0.441	0.149	0.003	1.555	1.162	2.081
Univariate Logistic Regression to Assess Effect of Guy's Score and S.T.O.N.E Score on Complications						
Variables	Beta Coefficient	Standard Error	P-Value	Odds Ratio	Odds Ratio Lower Bound (95%)	Odds Ratio Upper Bound (95%)
GUYS score	0.659	0.206	0.001	1.933	1.291	2.896
S.T.O.N.E score	0.239	0.166	0.151	1.269	0.917	1.757
Multivariate Logistic Regression to Assess Effect of Guy's Score and S.T.O.N.E Score on Complications						
Variables	Beta Coefficient	Standard Error	P-Value	Odds Ratio	Odds Ratio Lower Bound (95%)	Odds Ratio Upper Bound (95%)
GUYS score	-1.323	0.261	<0.0001	0.266	0.160	0.445
S.T.O.N.E score	-0.869	0.207	<0.0001	0.419	0.280	0.629
Univariate Logistic Regression to Assess Effect of Guy's Score and S.T.O.N.E Score on Stone Free Rate						
Variables	Beta Coefficient	Standard Error	P-Value	Odds Ratio	Odds Ratio Lower Bound (95%)	Odds Ratio Upper Bound (95%)
GUYS score	-1.010	0.276	0.0003	0.364	0.212	0.626
S.T.O.N.E score	-0.506	0.237	0.032	0.603	0.379	0.959

On performing univariate regression, Guy's score, S.T.O.N.E score were significant risk factors of complications. With the increase in Guy's score, S.T.O.N.E score, risk of complications significantly increases with an odds ratio of 2.187(1.504 to 3.181), 1.555(1.162 to 2.081) respectively.

On performing multivariate regression, Guy's score was a significant independent risk factor of complications. With the increase in Guy's score, risk of complications significantly increases with adjusted odds ratio of 1.933(1.291 to 2.896).

On performing univariate regression, Guy's score, S.T.O.N.E score were significant factors of stone-free rate. With the increase in Guy's score, S.T.O.N.E score, chances of stone-free rate significantly decrease with an odds ratio of 0.266(0.160 to 0.445),

0.419(0.280 to 0.629) respectively.

On performing multivariate regression, Guy's score, S.T.O.N.E score were significant independent factors of stone free rate. With the increase in Guy's score, S.T.O.N.E score, chances of stone-free rate significantly decrease with adjusted odds ratios of 0.364(0.212 to 0.626), 0.603(0.379 to 0.959) respectively.

Discussion

Percutaneous nephrolithotomy is considered the first-line treatment for renal calculi larger than 2 cm and for staghorn calculi. In spite of its minimally invasive nature, PCNL is not without complications. Various nephrolithometry scoring systems help in proper preoperative counselling prior to PCNL. Both Guy's Stone Score (GSS) and S.T.O.N.E. nephrolithometry score have been validated as predictors of stone-free status.[3,8,9] However, there is a paucity of data as to the superiority of one of these systems over the other. Thus, the objective of the present study was to estimate the stone-free rates and complication rates in patients with different grades of Guy's stone score and S.T.O.N.E. nephrolithometry scores, undergoing percutaneous nephrolithotomy. The secondary objectives were: To study the correlation between Guy's stone score and S.T.O.N.E. score and operative times, length of hospital stay and other selected outcomes to compare the area under the curve for Guy's stone score and S.T.O.N.E. score for post-percutaneous nephrolithotomy outcomes The presentation of the categorical variables was done in the form of numbers and percentages (%). On the other hand, the quantitative data were presented as the means ± SD and as medians with the 25th and 75th percentiles (interquartile range). The following statistical tests were applied to the results: The association of the variables, which were qualitative in nature, was analysed using Fisher's exact test as at least one cell had an expected value of less than 5. Receiver operating characteristic curve was used to determine the cutoff point of Guy's score and S.T.O.N.E score for predicting complications and stone-free rate. Pearson correlation coefficient was used for correlation of Guy's score and S.T.O.N.E score with operative time (minutes), fluoroscopy time (minutes) and length of hospital stay (days).

Univariate and multivariate linear/logistic regression was used to assess the effect of GUYS score and S.T.O.N.E score on various outcomes. The data entry was done in the Microsoft EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver 25.0. For statistical significance, a p-value of less than 0.05 was considered statistically significant.

A total of 164 patients were included in the study. In the study, the mean age of the study population was 50.18 ± 11.5 years. The rise in kidney stone prevalence is a global phenomenon. Data from five European countries, Japan, and the United States have shown that the incidence and prevalence of stone disease have been increasing over time around the world.[10] The incidence has been increasing across all age groups as well.[11]

The mean body mass index was 25.43 ± 1.61 kg/ m2. Multiple studies have shown that the prevalence and incidence of stone disease directly correlate with weight and body mass index (BMI) in both sexes, although the magnitude of the association is greater in women than in men.[12] Obesity and weight gain were independent risk factors for incident stone formation.[13] 51.22% of the study population were male. Earlier literature suggested that men were two to three times more likely to be affected by stone disease.[14] However, recent data suggests that this gap in incidence between genders is narrowing.[15] The mean Guy's stone score in the study population was 1.75 ± 0.95, whereas the mean S.T.O.N.E score was 7.45 ± 1.22. The overall complication rate in our study was 25.61%. Of these, 12.2% were minor complications such as postoperative pain, fever and transient derangement of renal function parameters. 10.37% were grade 2 complications, such as haemorrhage requiring blood transfusion and fever requiring antibiotic change. We had 2 instances of misplaced double J stents requiring endoscopic repositioning (Grade 3a), 1 instance of bleeding that required angioembolization (Grade 3b) & 1 instance of postoperative myocardial infarction. This is consistent with available studies, which have quoted a major complication rate of around 7% and a minor complication rate of around 25% associated with PCNL.[16] The complication rates had a significant correlation with the Guy's stone score (p <0.0001) as well as with the S.T.O.N.E. score (p<0.0001). The percentage of patients who were stone free was 85.59% whereas 13.41% had residual calculi. Stone free rates were 97.7%, 83.72%, 81.82% and 25% for GSS 1,2,3, and 4 respectively. There was significant correlation between the Guy's stone score and stone free rate ($p < 0.0001$). A prior study (Thomas et al.) observed that the Guy's stone score had good reproducibility as well as good correlation with stone free status.[3] They reported 81%, 72.4%, 35%, and 29% success rate for GSS 1, 2, 3, and 4, respectively. Other authors have reported 93.9%–100% stone-free rates for GSS1, 85.71% to 97% for GSS 2, 90.17%–100% for GSS 3, and 60%–77.77% for GSS 4. Overall success rate has been given as 62%–97.73% in different studies while validating GSS.[17,18] In a retrospective study by Kumsar et al. to compare GSS and STONE score the stone-free rate was 90%, 96%, and 34% in GSS 1, 2, and 3 groups, respectively. While assessing the stone free status among patients with different S.T.O.N.E. scores, the non- stone free rate was significantly higher in S.T.O.N.E score 10 (75%). Stone free rate was significantly higher in S.T.O.N.E score 6 (97.62%), 7 (92.45%), 8 (79.41%), 9 (95.65%). There was a significant correlation between the S.T.O.N.E. score and stone-free rate ($p < 0.0001$). The S.T.O.N.E. score is a more recent nephrolithometry system and certain studies have validated it for the predicting success rate of PCNL.[19] A significant positive correlation was seen between Guy's score and operative time (in minutes), length of hospital stay (days) with correlation coefficient of 0.279, 0.475 respectively. No correlation was seen between GUYS score and fluoroscopy time (minutes) with a correlation coefficient of -0.007. A significant positive correlation was seen between S.T.O.N.E score and operative time (minutes), length of hospital stay (days) with a correlation coefficients of 0.399, 0.731 respectively. No correlation was seen between S.T.O.N.E score and fluoroscopy time (minutes) with a correlation coefficient of -0.026. Labadie et al., in their retrospective comparative study, found both the low GSS and STONE scores to be significantly associated with stone-free rate ($P = 0.002$ and 0.004), and both systems to have a correlation with blood loss and length of stay.[20] Preoperative nomograms are tools meant for preoperative prediction of success rate and complication rate of any procedure. An ideal nomogram should be easy to apply, should have good interobserver reproducibility and should correlate with the success and complication rate of the procedure. The best scoring system would be one that would help in uniform reporting for research, training purposes and also for proper patient counselling. PCNL though a minimal access technique, is not free of complications, so a proper nomogram would be beneficial. GSS can equally be applied based on a simple X-ray and RGU or an IVU beside CT scan whereas STONE score is based only on CT scan. CT scan despite its cost and associated radiation exposure, has definite advantages in the evaluation of stone disease. GSS can be helpful in places where CT scan facilities are not available, such as in underdeveloped countries. The strength of the present study is its prospective nature and the patient volume included. The limitation of our study was that it was a single center study.

Conclusion

Preoperative nomograms may serve as valuable tools for proper patient counselling about the stone-free rate and complications associated with PCNL. Both GSS and STONE scores are equally effective in predicting the success rate as well as the complication rates associated with PCNL. Operative time and length of hospital stay also correlate with both scores studied. However, the fluoroscopy time does not correlate with either scoring system used. Further, large-scale multicenter prospective studies can help in determining the role of these nomograms and whether there is a need to develop new nomogram combining these scores for better stone characterisation.

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