STONE score versus Guy’s Stone Score - prospective comparative evaluation for success rate and complications in percutaneous nephrolithotomy

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Abstract

Purpose: The aim of the current study was to compare Guy’s score and STONE score in predicting the success and complication rate of percutaneous nephrolithotomy (PCNL).

Materials and Methods: A total of 445 patients were included in the study between July 2015 and December 2016. The patients were given STONE score and Guy’s Stone Score (GSS) grades based on CT scan done preoperatively and intra- and post-operative complications were graded using the modified Clavien grading system. The PCNL were done by a standard technique in prone positions.

Results: The success rate in our study was 86.29% and both the GSS and STONE score were significantly associated with a success rate of the procedure. Both the scoring systems correlated with operative time and postoperative hospital stay. Of the total cases, 102 patients (22.92%) experienced complications. A correlation between STONE score stratified into low, moderate, and high nephrolithometry score risk groups (low scores 4–5, moderate scores 6–8, high scores 9–13), and complication was also found ($P = 0.04$) but not between the GSS and complication rate ($P = 0.054$).

Conclusion: Both GSS and STONE scores are equally effective in predicting success rate of the procedure.

Keywords: Percutaneous nephrolithotomy, renal, stone

INTRODUCTION

Renal stone is a major cause of patients’ presentation to urology clinics worldwide and Percutaneous nephrolithotomy (PCNL) has emerged as the treatment modality of choice for large and complex renal stones.[1,2] Like any other surgical procedures, this procedure is not without complications. Several preoperative nomograms have been proposed for prediction of success rates of PCNL and also for correlating with the complication rates to standardize the reporting of procedural success, interobserver reliability and aiding in training programs. These include Guy’s Stone Score (GSS),[3] Clinical Research Office of the Endourological Society (CROES) nomogram,[4] STONE score,[5] and Seoul National University Renal Stone Complexity.[6,7] Computed tomography (CT) scan has now emerged as a major imaging tool for evaluation of stone disease. Guy’s score
and STONE score based on CT scan have been externally validated, but the superiority of one over the other has not been ascertained yet. We conducted a prospective study to compare Guy’s score and STONE score in predicting the success and complication rate of PCNL.

MATERIALS AND METHODS

This prospective study was conducted in the Urology Department, SMS Hospital, Jaipur between July 2015 to December 2016. Ethical clearance was obtained from the institutional ethics committee, and all procedures performed in the study were in accordance with the 1964 Helsinki Declaration and its later amendments. All patients aged >18 years who underwent PCNL were included in the study after taking informed consent. Patients who had radiolucent renal calculi, any renal anomaly, previous history of any renal surgery on the affected side, chronic renal failure, heart disease, or spine abnormality were excluded from the study.

Preoperatively, the patients underwent routine investigations such as complete blood counts (CBCs), renal function tests (RFTs), coagulation profiles, urine culture, and non-contrast CT (NCCT) of kidney ureter bladder (KUB) (NCCT scan). GSS was assigned based on the NCCT images, and STONE Score parameters were reported by a senior radiologist of our Institute. PCNL was done by standard technique in the prone position.

GSS[3] used was 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 or 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.

The STONE Score[5] has been given in Table 1.

The demographic data of the patients, intra- and post-operative records were recorded in Excel Sheet. The complications were graded according to the Modified Clavien grading system[8] for PCNL. Operative time was defined as the time taken from the delineation of the PCS and up to the completion of the procedure. Fluoroscopy time was defined as the total time for which fluoroscopy was used during each procedure. All the patients were given preoperative intravenous antibiotics which were continued postoperatively. Postoperatively, the patients were given analgesics as and when needed. Routine blood investigations including CBC and RFT were done on the 2nd postoperative day along with a digital X-ray of KUB region to look for any residual fragment. The PCN tube was removed if there was no or clinically insignificant residual fragments (CIRFs)[9] on the X-ray. The procedure was considered to be successful if the patient had no residual fragments or had CIRFs which is defined as <4 mm, nonobstructing noninfectious, and asymptomatic residual fragments on X-ray KUB and ultrasonography done at the 4th week of follow up.

The statistical analysis was performed using SPSS version 20 IBM SPSS Statistics windows, Version 20.0. (Armonk, NY:IBM Corp.) and Student’s t-test and Chi-square test were used. The value of $P < 0.05$ was considered as statistically significant.

RESULTS

The total number of patients who were eligible for final analysis in our study was 445. The demographic data of the patients are been summarized in Table 2. The mean age of the patients in the study was 40.8 ± 8.72 years. Male:female ratio was 2.027, with 298 males and 147 females. The stones on the right accounted for 54.61% of all the cases and the stones on the left was seen in 45.31% of cases. The mean body mass index (BMI) of the patients in the study was 24.53 ± 1.52. The success rate in our study was 86.29%. The mean stone size (mm$^2$) in this study was 658.87 ± 399.56. The mean GSS was 1.82 ± 0.9 and the mean STONE score was 6.93 ± 2.1.

The STONE score was significantly higher for those with residual calculi (8.81 ± 2.50) as compared to those who were stone free (7.57 ± 1.88) with a $P = 0.0002$, whereas the GSS for those with residual calculi was 2.06 ± 0.94 in comparison to 1.58 ± 0.77 for those with complete clearance with the value of $P < 0.0001$. Thus, both the scoring systems had a good correlation in predicting the stone free rate of
PCNL [Table 3]. Patient status and stone free status with both the scoring systems are shown in Table 4. Logistic regression analysis showed odd’s ratio (OR) of the STONE score to be 0.77 (P = 0.001) and of GSS to be 0.56 (0.001), and both were significantly associated with stone free rates. Moreover, we observed that for every unit of increase in STONE score, the operative time increased by 8.1 min (P < 0.001) and for every unit of increase in GSS it increased by 9.9 min (P < 0.001). The length of stay increased by 0.58 days (P = 0.001) as compared to 0.84 days (P < 0.001) for every unit of rise in STONE score and GSS, respectively [Table 5]. On receiver operating characteristic curve, there was no significant difference in the area under the curve (AUC) for the Guy’s and STONEY scoring systems (0.739 [95% confidence interval (CI) 0.665–0.813] vs. 0.708 [95% CI 0.631–0.784]; P > 0.05) and both the scoring systems have good predictive rate for stone free status [Figure 1].

Intra- and post-operative complications were graded according to modified Clavien grading system.[3] Out of the total cases, 102 patients (22.92%) experienced complications. Grade 1 complication was seen in 44 patients, most common being postoperative nausea and vomiting followed by pain. Grade 2 complication was seen in 53 patients, of which 13 had nephrostomy site leakage for >12 h, 15 needed change of antibiotics due to infection, and 25 needed a blood transfusion. Grade 3a complication was seen in 3 patients of whom 2 needed a double J (DJ) stenting for persistent urinary leakage >24 h and 1 needed DJ stenting intraoperatively for pelvic perforation. Two patients developed Grade 3b complication and needed angiembolization for arteriovenous pseudoaneurysm. We did not come across any case of Grade 4 complication in our study, and there were no deaths among the patients up to 1 month of follow up.

A correlation between STONE score stratified into low, moderate, and high nephrolithometry score risk groups (low scores 4–5, moderate scores 6–8, high scores 9–13) and complication was also found (P = 0.04) but not between the GSS and complication rate (P = 0.054) [Tables 6 and 7].

**DISCUSSION**

Preoperative prediction of success rate and complications for PCNL has drawn the attention of the urologists
Table 6: Complication rate with STONE score stratified into groups

| Complication | Stone score | P   |
|--------------|-------------|-----|
|              | Low         | Moderate | High |     |
| Grade 1      | 15          | 16      | 13    | 0.04|
| Grade 2      | 8           | 18      | 27    |     |
| Grade 3a     | 0           | 0       | 3     |     |
| Grade 3b     | 0           | 0       | 2     |     |
| Grade 4a     | 0           | 0       | 0     |     |
| Grade 4b     | 0           | 0       | 0     |     |
| Grade 5      | 0           | 0       | 0     |     |

Table 7: Complication rate and Guy's Stone Score

| Variables | GSS I | GSS II | GSS III | GSS IV | P   |
|-----------|-------|--------|---------|--------|-----|
| Number of cases (%) | 218 (48.89) | 121 (27.19) | 72 (16.18) | 34 (7.64) | 0.054|
| Complication (%) | 53 (24.31) | 29 (23.96) | 8 (11.11) | 12 (35.29) |     |

GSS: Guy's Stone Score

We prospectively compared two of the nomograms Guy’s score and STONE score based on preoperative CT scans. There are some differences in these two scoring systems. In Guy’s score, the parameters included are a number of stones, the location of the stone (calyces involved), abnormal anatomy, the presence of partial or complete staghorn stones and spinal injury/bifida. However, it does not include stone size, which in itself is a major predictor of the success rate of PCNL. Moreover, partial staghorn definitions are variable among many groups and hence can add to variability in reporting of outcomes of PCNL. The STONE score, on the other hand, includes Stone size (mm²), tract length (mm), hydronephrosis or obstruction, Number of involved calyces, and stone density or Essence (Hounsfield units). Although a number of calyces involved is included in STONE score, it does not take into consideration the stone location as done by Guy’s score. Our study intended to find whether these differences affect the predictive value of these scoring systems.

The success rate in our study was 86.29%. The success rate correlated with Guy’s score (P < 0.0001) and STONE score overall (P = 0.0002). Moreover, the success rate also correlated significantly with the stone size (P = 0.0003) and the number of calyces (P < 0.00001) involved.

Thomas et al.[8] found GSS to have good reproducibility, with the good inter-rater agreement. Several investigators have found a good correlation between GSS and stone-free rate.[8,12] Thomas et al. who had proposed GSS reported 81%, 72.4%, 35%, and 29% success rate for GSS 1, 2, 3, and 4, respectively. Other authors have reported 93.9%–100%[8,13,14] stone-free rates for GSS1, 85.71% to 97%[8,13-15] for GSS 2, 90.17%–100%[8,13-15] for GSS 3, and 60%–77.77%[8,13-15] for GSS 4. Overall success rate has been given as 62%–97.73%[8,13-15] in different studies while validating GSS. In a retrospective study by Kumsar et al.[16] to compare GSS and STONE score the stone-free
rate was 90%, 96%, and 34% in GSS 1, 2, and 3 groups, respectively. Few authors have also found GSS based on CT scan to be effective in predicting success rate of PCNL.[14,15] Okhunov et al. gave the STONE score very recently, and retrospective studies[17,18] have validated it for predicting success rate of PCNL. Only one prospective study has also supported this.[19]

Labadie et al.[20] in their retrospective comparative study has found both the low GSS and STONE score to be significantly associated with stone-free rate (P = 0.002 and 0.004), and also both the systems to have a correlation with blood loss and length of stay. The AUC in their study was 0.634 (95% CI 0.566–0.702) for GSS and 0.670 (95% CI 0.602–0.738) for STONE score. In another retrospective study,[20] the AUC was 0.74 (95% CI 0.66–0.82) for GSS and 0.63 (95% CI 0.54–0.72) for STONE score, and good correlation was found between the scoring systems and stone free rate. The AUC for the Guy’s and STONE scoring systems in our study was 0.739 [95% CI 0.665–0.813] vs. 0.708 [95% CI 0.631–0.784]; (P > 0.05) and both the scoring systems have a good predictive rate for stone free status.

We applied NCCT KUB for the calculation of both STONE score and GSS and found both to be good predictors of the success rate of PCNL. In addition, both the scores are good predictors of operative time and length of postoperative hospital stay. STONE score in our study correlated with complication rate when the scores were grouped as mild, moderate, and severe, whereas the GSS did not correlate significantly with the complication rate. Vicentini et al.[14] and Mandal et al.[8] found a correlation between GSS and complication rate, but Thomas et al.[3] and Noureldin et al.[20] did not find so.

Preoperative nomograms can prove to be very helpful tools meant for preoperative prediction of success rate and complication rate of any procedure. For a nomogram to be ideal it 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 which would help in unifying reporting for research, training purposes and also for proper patient counseling. PCNL though a very novel technique, is not free of complications,[22] so a proper nomogram is always a requirement. GSS can be 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 though expensive and is associated with much higher radiation exposure but the advantages of CT scan in stone disease needs no mention. GSS can be helpful at places where CT scan facility is not available, for example, in developing and underdeveloped countries.

The strength of our study was it is a prospective study with a good number of patients. The limitation of our study was that it was a single center study.

CONCLUSION

Preoperative nomograms can prove as a valuable tool for proper patient counseling about the stone-free rate and complications associated with PCNL. Both GSS and STONE scores are equally effective in predicting success rate of the procedure. Further, large scale multicenter prospective studies can help in determining the role of these nomograms in predicting complication rates and whether there is need to develop new nomogram combining these scores for better stone characterisation.

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Conflicts of interest

There are no conflicts of interest.

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