

PROSPECTIVE CLINICAL COMPARATIVE STUDY OF "STONE SCORING SYSTEMS" FOR PREDICTIVE OUTCOME IN PERCUTANEOUS NEPHROLITHOTOMY (PCNL) SURGERY" IN A TERTIARY CARE HOSPITAL, CHENNAI, INDIA

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Abstract

Background: The incidence of kidney stone disease has markedly increased during past two decades the world over. With this dramatic increase in stone disease incidence and prevalence the use of Percutaneous Nephrolithotomy (PCNL) to treat a large stone burden has continued to increase. **Materials and Methods:** A prospective, observational, comparative study on 294 patients was conducted in the Department of Genito-urinary Surgery at Saveetha Medical College Chennai over a period of two years from March 2019 to Feb 2021. The patients with renal stone presented to OPD undergoing PCNL fulfilling inclusion and exclusion criteria were included. **Result:** Cases were categorised as per Stone Scoring System used. Guy's Stone Score (GSS) into four Grades (Grade 1, 2, 3, 4), S.T.O.N.E. score into three Grades (Grade 1- score 5, 6; Grade 2: score 7, 8; Grade 3: score 8-13), CROES nomogram into four Grades (Grade 1: score 70-129, Grade 2: score 130-169, Grade 3: score 170-219, Grade 4: score >220). Out of total 294 cases of Renal Stones, 86 cases (29.25%) that underwent PCNL had previous history of surgical intervention, 35 cases (11.9%) had CKD status, and Urine was sterile in 198 cases (67.3%). As regards laterality, left sided stones noted in 182 cases (61.9%) while 112 cases (38.09%) had right sided stone pathology. The mean S. Creatinine was 1.38 mg±0.74 (SD) mg/dl. Mean stone burden was 1232.5 mm²±1024.3mm² (SD). **Conclusion:** The systemic use of any of the scoring system is dependent on surgeon preference which only partially solves the problem. Further research is needed to identify if anyone is superior to others with regards to clinical usefulness and predictive accuracy.

INTRODUCTION

The incidence of kidney stone disease has markedly increased during past twodecadesthe world over. With this dramatic increase in stone disease incidence and prevalence the use of Percutaneous Nephrolithotomy (PCNL) to treat a large stone burden has continued to increase. Despite continuous refinements in surgical techniques and technology the overall complication rate of PCNL remains higher.^[1,2] Our institute being a tertiary care centre, caters to a large number of urolithiasis cases, more over this region is known as stone rich belt in India. Since the advent of endo-urolithiasis procedures and advances in endoscopic and lithotripsy technologies PCNL is a well-established minimal invasive treatment modality for the management of all kinds of renal calculi (Solitary, multiple, calyceal,

semi-stag or stag-horn calculi of different sizes). The stone burden and density, positional distribution, calyceal and anatomical complexity, degree of hydronephrosis and secondary changes demonstrates to play an important role in outcome of PCNL.^[3] The Stone Free Rate (SFR) is the primary clinical outcome after PCNL and has been variously reported to be from 56% to 76%.^[4] However; comparison between multiple studies is difficult for two reasons.

1. There is no uniform grading system to categorize stone complexity.
2. Definition and way of assessment of stone clearance is not standardized.^[5]

Although PCNL is considered as a minimally invasive procedure, it has risk of significant complications and does not always render the patient stone free. Guidelines are available for the indications for PCNL and the Clavien system has

been modified for grading of the complications.⁶ Furthermore, there is no universally accepted grading system of stone complexity to ensure an appropriate comparison among studies. The existence of a validated user-friendly stone score would assist in comparing outcomes and potentially aid in advising patients regarding the likelihood of a “Stone Free” outcome postoperatively.

Aim and Objective

Primary outcome

1. To evaluate and compare the ability of different stone scoring systems the Guy's score, S.T.O.N.E. nephrolithometry and the CROES nomogram to predict stone free rates after PCNL.

Secondary Outcome

1. To assess practicability and uniformity of stone scoring system which is less complicated, user friendly, reproducible and well accepted.
2. To evaluate the ability of the scoring systems to predict peri-operative and postoperative complications and stone free rates within 30 days of procedure

MATERIALS AND METHODS

A prospective, observational, comparative study on 294 patients was conducted in the Department of Genito-urinary Surgery at Saveetha Medical College, Chennai over a period of two years from March 2019 to Feb 2021. The patients with renal stone presented to OPD undergoing PCNL fulfilling inclusion and exclusion criteria were included.

Inclusion Criteria

1. Patients more than 18 years of age.
2. Renal stone in pelvicalyceal system on CT
3. BMI up to 30 kg/m²

Exclusion Criteria

1. Obese patient population - Body Mass Index (BMI) greater than 30 kg/m²

2. Pediatric patient population less than 18 years of age
3. Pregnant, lactating, mentally ill patients and patients with major co-morbid conditions
4. History of prior surgery on ipsilateral kidney, nephrostomy tube or stent placement in ipsilateral kidney

RESULTS

In all these 294 cases of present study, three Stone Scoring Systems evaluated were: 1. Guy's Stone Score (GSS), 2. S.T.O.N.E. Score 3. CROES Nomogram were compared in each & every patient to establish feasibility, reproducibility, reliability and superiority for assessing their relative predictive value for Stone Free Rates (SFR) and overall surgical outcomes, based upon our observations and results.

Cases were categorised as per Stone Scoring System used. Guy's Stone Score (GSS) into four Grades (Grade 1, 2, 3, 4), S.T.O.N.E. score into three Grades (Grade 1- score 5, 6; Grade 2: score 7, 8; Grade 3: score 8-13), CROES nomogram into four Grades (Grade 1: score 70-129, Grade 2: score 130-169, Grade 3: score 170-219, Grade 4: score >220). The Demographics (Age, Sex and BMI) and Clinical characteristic (Laterality, previous surgery, CKD Status, associated UTI, S. Creatinine and Stone burden), Peri-operative parameters (Operative Time(OT), Estimated Blood Loss(EBL), Length of Hospital Stay(LOS)) were analysed and complications were Graded according to modified Clavien classification. The correlation of all these factors were undertaken in each and every scoring system to assess overall comparable predictive outcome.

Table 1: Demographic characteristic (n- 294)

| Variables | Outcome | |
|-----------------------------|-----------------------------|--------------------------------------|
| Age (years) | Mean 46.43 Range: 18-82 | ±SD 24.27 |
| Sex- Male (No. %) Female | 200 94 | 68.03% (Sex ratio 31.97% M:F=2.1) |
| BMI (Kg/m ²) | Mean 24.32 Range:18.5-30 | ±SD 2.78 |

As regards age distribution majority of cases were in their productive years of life with mean age of 46.43± 24.27 years. 200 males (68.03%) and 94 females (31.97%) fulfilled the study inclusion criteria. Mean BMI of cases was 24.32±2.78 kg/m² [Table1].

Table 2: Clinical Characteristic (n- 294)

| Variable | Number | %/SD |
|---------------------------------|---------------------------------|------------------|
| Previous surgery | 86 | 29.25% |
| CKD | 35 | 11.91% |
| Sterile Urine Culture | 198 | 67.35% |
| Laterality RT= LT= | 112 182 | 38.09% 61.91% |
| S Creatinine (mg/dl) | 1.38(Mean) Range-0.65-3.9 | 0.74(±SD) |
| Stone Burden (mm ²) | 1232.59(Mean) Range-120-4688 | 1024.35(±SD) |

Out of total 294 cases of Renal Stones, 86 cases (29.25%) that underwent PCNL had previous history of surgical intervention, 35 cases (11.9%) had CKD status, and Urine was sterile in 198 cases (67.3%). As regards laterality, left sided stones noted in 182 cases (61.9%) while 112 cases (38.09%) had right sided stone pathology. The mean S. Creatinine was 1.38 mg±0.74 (SD) mg/dl. Mean stone burden was 1232.5 mm²±1024.3mm² (SD) [Table 2].

Table 3: Guy's Stone Scoring System (n- 294)

| Variables | N | % |
|-------------------|-----|-------|
| Guy score Grade 1 | 66 | 22.4 |
| Grade 2 | 133 | 45.23 |
| Grade 3 | 44 | 14.96 |
| Grade 4 | 51 | 17.34 |

It is evident from table 3 analysis that Guy's Scoring System (GSS) cases were divided into four Grades: - Grade 1: 66(22.4%) cases, Grade 2: 133(45.23%), Grade 3: 44(14.96%) and Grade 4: 51(17.34%) cases. Majority of cases were in Grade 2(45.23%) and least no. of cases 44(14.96%) noted in G 1 [Table 3].

Table 4: S.T.O.N.E scoring System (n- 294)

| Variables | N | % |
|------------------------|-----|-------|
| S.T.O.N.E Grade 1(5-6) | 42 | 14.28 |
| Scoring Grade 2 (7-8) | 148 | 50.34 |
| Grade 3(9-13) | 104 | 35.37 |

STONE scoring divided into three Grades (Score 5 and 6 assigned as Grade 1- 42(14.28%) cases, Score 7 and 8 as Grade 2- 148(50.34%) cases and score 9 to 13 were assigned as Grade 3- 104(35.37%) cases). Majority of cases 148(50.34%) were in Grade 2 and least no. of cases 42(14.28%) were in Grade 1 [Table 4].

Table 5: Stone free v/s non stone free per GSS grading (n- 294)

| GSS | Total cases | Stone Free | Non Stone Free | Chi Test | p value |
|-------------|-------------|-------------|----------------|----------|---------|
| GSS Grade 1 | 66 | 66(100%) | 0(0%) | 191.76 | <0.01* |
| Grade 2 | 133 | 122(91.72%) | 11(8.2%) | | |
| Grade 3 | 44 | 13(29.54%) | 31(70.45%) | | |
| Grade 4 | 51 | 2(3.92%) | 49(96.07%) | | |
| Total= | 294 | 203(69.03%) | 91(30.97%) | -- | -- |

Statistically significant

Three different scoring systems were undertaken in present study. In Guy's Scoring System (GSS), cases were divided into four Grades. Grade 1: comprised of total 66 cases, all cases were stone free (100% success). Grade 2: comprised of total 133 cases, out of these 122 (91.72%) cases were stone free while 11(8.2%) were non stone free. Grade 3: comprised of total 44 cases, out of them 13 (29.54%) cases were stone free while 31(70.45%) were non stone free. Grade 4: comprised of 51 cases out of these 49(96.07%) were non stone free and only 2(3.9%) cases were stone free [Table5].

DISCUSSION

For large and complex renal stones, Percutaneous Nephrolithotomy (PCNL) has emerged as a well-established standard treatment of choice. It is a minimally invasive procedure providing high success rate and safety profile. PCNL is also associated with variable outcomes based upon renal anatomy, number of stones, involvement of calices, stone burden, complexity and other predictors. Various Stone Scoring Systems have come into practice. To Validate and assess predictive nomograms which can significantly add to preoperative treatment planning and patient counselling. Based on imaging devices Stone Free Rate(SFR) after PCNL confirms treatment outcomes.

The Guy's Stone Score (GSS) per grading was developed by Thomas K et al (2011).^[6,7,8] to predict SFR based on stone complexity; Ingimarson et al (2014).^[11,12] validated the GSS, higher the grade will be associated with decrease SFR. Okhunov Z et al

(2013).^[9] noted quantitative scoring system the S.T.O.N.E.(Stone-Tract length-Obstruction-Number of involved calices-Essense of stone density) nephrolithometry was devised on Computed Tomography (CT) findings to predict stone free rate in renal stone cases. It was developed to standardize academic reporting and to predict PCNL outcome. The Clinical Research Office of the Endourological Society (CROES) nomogram scoring system was proposed by Smith et al (2013).^[10,13,14] for PCNL success. They collected data on consecutive patients at 96 centres globally during the period Nov 2007 to Dec 2009 and reported this multicentric study on 2806 cases in renal stone diseases. Labadie K et al. (2014).^[23,24,25] compared GSS, STONE and CROES nomogram respectively. Seoul National University Renal Stone Complexity(S-ReSC) score by Joeng C'W (2013).^[15,16] considers the distributional complexity of calculi & assigned a score for SFR. These are some of the prognostic stone scoring

systems in practice at different centres to predict SFR and outcome of each scoring systems.

GSS score determination requires only assessing renal imaging which can be done at centres where CT is not available.^[17] It is the most reasonable alternative to the S.T.O.N.E. scoring system. GSS is associated with predicting complications.^[18] It is comparatively less cumbersome. S.T.O.N.E. scoring is determined by using CT imaging hence can be easily applied during pre-operative planning and patient counselling. S.T.O.N.E. Nephrolithometry is the most comprehensive scoring system, simple to implement in daily practice, easy to remember on an account for a simple acronym and generates reproducible results with minimal subjectivity.^[19,20] The CROES nomogram requires information such as clinical load; require assessment of radio graphical and patient characteristics followed by calculating the score on the nomogram.^[21,22]

These scoring systems have only developed in the past decades, thus more studies are required to validate the findings of original studies and assess the applicability in various population. Presently, scoring systems rely heavily on data obtained from imaging characteristics for surgical planning. Technological advances will enable more detailed assessment of anatomical features, improve peri-operative planning by evaluating the abnormal caliceal distribution and stone characteristic will provide opportunity to modify or create new scoring systems.²⁵ However, clinical scoring of patients before PCNL is still a novel concept and increase in experience and information from use of scoring systems might result in creation of a unified system that incorporates the strength of each of the currently available scoring systems.

CONCLUSION

Our current analysis has established that the evaluated scoring systems are equally accurate in predicting SFR after single PCNL procedure. This finding corroborates with previously reported similar studies in predictive accuracy of scoring system in small cohorts. There is a more clear distinction between risk groups when using S.T.O.N.E score and CROES nomogram than GSS. The GSS is not an independent predictor of post-operative complications. A higher STONE score predicts a longer operative time. The CROES nomogram initially did not assess the ability to predict post-operative complications. However, both GSS and CROES nomogram scoring systems were predictive of EBL, OT and overall complications. We were unable to identify any scoring system which has been superior when compared to others with regards to predicting the SFR. The systemic use of any of the scoring systems is dependent on surgeon preference which only partially solves the problem. Further research is needed to identify if anyone is superior to

others with regards to clinical usefulness and predictive accuracy.

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