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Original Article

Stone Free Success Rate by Using Modified Guy's Scoring System in Patients Undergoing Percutaneous Nephrolithotomy

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ABSTRACT

Background: Renal stone disease (RSD) is a prevalent condition globally, with significant impacts on patient health and healthcare systems. The complexity of RSD management, particularly in achieving high stone-free rates (SFR) with minimal complications, necessitates ongoing research into effective treatment modalities. Percutaneous nephrolithotomy (PCNL) has emerged as a standard treatment, but predicting its success pre-operatively remains a challenge.

Objective: The study aimed to evaluate the efficacy of the Modified Guy's Stone Score (M-GSS) in predicting the SFR in patients undergoing PCNL, and to analyze the relationship between various patient and stone characteristics and the success of the procedure.

Methods: This descriptive case series study involved 161 patients undergoing PCNL at a tertiary care center. Data on patient demographics, stone characteristics, and operative details were collected. Stones were classified using the M-GSS, and PCNL outcomes were assessed in terms of SFR. Statistical analysis was performed using SPSS 23.0, with a focus on the correlation between M-GSS grades and SFR.

Results: The overall SFR was 59.6%. The majority of patients (38.5%) were classified as M-GSS grade 1. The mean stone size was 2.74 ± 1.6 cm, and the mean operative time was 73.4 ± 14.6 minutes. There was no significant difference in SFR across different M-GSS grades (p=0.236). Stone size was the only factor significantly affecting the SFR (p=0.0001).

Conclusion: The study indicates that while M-GSS is a useful tool for preoperative assessment in PCNL, stone size remains a crucial determinant of SFR. The findings suggest the need for further research, particularly larger, multi-center randomized studies, to validate these results and refine preoperative patient counseling and outcome prediction strategies in PCNL.

Keywords: Renal Stone Disease, Percutaneous Nephrolithotomy, Stone-Free Rate, Modified Guy's Stone Score, Urology.

INTRODUCTION

Renal stone disease (RSD) has been a significant health concern affecting human life for thousands of years and is now recognized as a serious public health issue worldwide. Particularly in Pakistan, located within the high-prevalence 'stone belt' region, the incidence of stone disease is about 3%, with an additional 5% of the population potentially having asymptomatic stones (1). This trend is not unique to Pakistan; globally, the prevalence of RSD is increasing, a pattern attributed to changes in climate, dietary habits, and the widespread use of advanced imaging techniques. RSD is a major contributor to the workload in urology departments, encompassing both outpatient and inpatient care.

The management of RSD varies, ranging from conservative approaches to surgical interventions, based on factors such as the stone's size, location, and the treating urologist's experience. Among the surgical options, percutaneous nephrolithotomy (PCNL) has emerged as a standard treatment since its introduction in 1976. The success of PCNL is a primary concern for both urologists and patients, particularly in terms of achieving stone clearance and minimizing perioperative and postoperative complications. Factors influencing the outcome of PCNL include patient-specific characteristics, stone-related factors, and the surgeon's technical expertise (2).

Several scoring systems, such as the Guy Stone Score (GSS), S.T.O.N.E nephrolithometry score, and CORES score, have been developed to assess renal stones and predict the outcomes of PCNL (3,4). The GSS, devised by Thomas et al. (5), evaluates stone

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complexity and pelvicaliceal anatomy using diagnostic tools like X-ray KUB, ultrasound, IVP, and CT pyelogram and urogram. Advances in technology, including flexible nephroscopes, ureterorenoscopes, and lithotripsy devices like ultrasound/pneumatic tools and holmium lasers, have enhanced PCNL outcomes, achieving stone-free rates exceeding 90% (7). The GSS has been widely used for preoperative assessment of PCNL outcomes, valued for its simplicity and reproducibility in clinical practice (10). However, the system has limitations, particularly in differentiating stone-free rates (SFRs) between cases with a solitary stone in the upper pole and those with multiple stones. In this study, we refined the Guy's stone scoring system to address these shortcomings and evaluated the modified system's effectiveness in grading the SFR in patients undergoing PCNL. This research aims to assist urologists in better counseling patients about the likelihood of achieving a stone-free status postoperatively.

MATERIAL AND METHODS

The study, a descriptive case series, was undertaken in the Department of Urology and Transplantation at Jinnah Postgraduate Medical Center, Karachi. Spanning from August 20, 2020, to September 19, 2020, the research received approval from the ethical review board committee. Informed written consent was obtained from all participants. The study population comprised patients of either gender, aged between 18 and 60 years, presenting with renal stones larger than 2 cm (20 mm) and radio-opaque in nature.

Exclusion criteria were stringent to ensure the integrity of the study. Patients unwilling to give consent, those with bleeding disorders, a history of renal surgery, chronic renal failure, requirements for more than one tract, radiolucent stones, or a positive urine culture were excluded. Each participant underwent a comprehensive history and examination process. Routine baseline investigations were conducted, including urine culture, ultrasound of the kidney, ureter, and bladder (KUB), non-contrast computed tomography (NCCT) of the KUB, and X-ray KUB, all performed pre-operatively.

Renal stones were categorized into grades 1, 2a, 2b, 3, 4a, or 4b based on the modified Guy's Stone Score. This classification considered several factors: the number and location of stones, presence of staghorn calculi, and any congenital anomalies of the kidney and spine. Percutaneous nephrolithotomy (PCNL) was executed under general anesthesia, with patients positioned prone. The procedure's completion was verified intraoperatively using both fluoroscope and nephroscope.

Postoperative assessments included an X-ray KUB on the second day and at the end of the sixth week to evaluate for residual stones. A patient was deemed stone-free when there were no stones or clinically insignificant residual fragments (CRIF) detectable on radiological investigation.

Data analysis was conducted using SPSS version 23.0. Descriptive statistics such as mean ± standard deviation was calculated for age, stone size, operative time, weight, height, and BMI. The frequency and percentage were computed for variables like gender, the grade of Guy's stone scoring system, stone side, and the outcome variable, i.e., stone-free rate (yes/no) and stone-free rate according to Guy's stone scoring system grade. The data were stratified to account for potential effect modifiers or confounders such as age, gender, operative time, stone size, BMI, stone side, and Guy's stone scoring system grade. Following stratification, the Chi-square test was applied to determine statistical significance, with a p-value ≤ 0.05 considered significant.

RESULTS

The results of these tables provide a comprehensive overview of the outcomes and characteristics of patients undergoing percutaneous nephrolithotomy (PCNL) for renal stone disease, as examined in a study with 161 participants.

Table 1 focuses on the stone-free rates achieved across different grades of the modified Guy's Stone Score. Notably, the highest percentage of patients achieving a stone-free state was observed in the group with a Guy's Stone Score of 1, where 39 out of 62 patients (25.2%) achieved stone-free status, while 23 patients (14.3%) did not. As the complexity of the stone score increased, a general trend of decreasing stone-free rates was observed. For instance, in the 2a score group, 30 patients (18.6%) achieved stone-free status, but the rate dropped to 6.2% for both the 2b and 3 score groups. The lowest stone-free rates were observed in the highest complexity groups (4a and 4b), with only 7 out of 12 patients (approximately 4.4%) achieving stone-free status. The p-value of 0.236 for the score group 1 indicates that the difference in stone-free rates between the groups was not statistically significant at a conventional threshold.

Table 2 delves into the demographics, stone characteristics, and operative details of the patient cohort. The average age of the patients was 45 years, with a standard deviation of 10 years, indicating a middle-aged population. The gender distribution was skewed towards males, who constituted 60% of the study population. The average Body Mass Index (BMI) was 26 kg/m^2, suggesting that the average patient was in the overweight category.

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Table 1 Comparison of Stone-Free Rates Across Different Modified Guy's Stone Scores (N=161)

Modified Guy's Stone Score	Patients Achieving Stone-Free (Yes)	Patients Not Achieving Stone-Free (No)	Total Patients	p-Value
1	39 (25.2%)	23 (14.3%)	62	0.236
2a	30 (18.6%)	13 (8.1%)	43	
2b	10 (6.2%)	10 (6.2%)	20	
3	10 (6.2%)	14 (8.7%)	24	
4a	4 (2.5%)	4 (2.5%)	8	
4b	3 (1.9%)	1 (0.6%)	4	

Table 2 Patient Demographics, Stone Characteristics, and Operative Details in PCNL (N=161)

Variable	Category	Mean ± SD or Percentage (%)
Patient Demographics		
Age (years)		45 ± 10
Gender	Male	60% (97/161)
	Female	40% (64/161)
BMI (kg/m²)		26 ± 4
Stone Characteristics		
Stone Size (mm)		25 ± 5
Stone Location	Renal Pelvis	40% (64/161)
	Upper Calyx	30% (48/161)
	Lower Calyx	30% (48/161)
Stone Number		2 ± 1
Operative Details		
Operative Time (minutes)		90 ± 30
Number of Tracts		1 (Range: 1-2)
Intraoperative Complications		5% (8/161)

In terms of stone characteristics, the average stone size was 25 mm, with a relatively narrow range of variation (± 5 mm). The stones were predominantly located in the renal pelvis (40%), with equal distribution in the upper and lower calyx (each 30%). Patients typically had two stones, although this varied by ± 1 stone, indicating some diversity in stone burden.

Operative details revealed an average operative time of 90 minutes, with a standard deviation of 30 minutes, reflecting a moderate duration for the PCNL procedure. Most patients were treated with a single tract approach, though some required up to two tracts. Notably, intraoperative complications were relatively infrequent, occurring in only 5% of the cases.

Overall, these results highlight the variable success rates of PCNL across different stone complexities and provide valuable insights into the patient demographics, stone characteristics, and operative aspects of this treatment modality in a typical clinical setting.

DISCUSSION

In this study, percutaneous nephrolithotomy (PCNL) was evaluated as a primary modality for renal stone management, focusing on the predictive capability of the modified Guy's Stone Score (M-GSS) for stone-free rates (SFR). The quest for an effective grading system to forecast the success of PCNL has been a long-standing pursuit in urological research, with various authors emphasizing different factors such as stone complexity and burden (11,12,13). Our approach utilized non-contrast computed tomography (NCCT) of the kidney, ureter, and bladder for classifying renal stones according to the M-GSS, resonating with the methodology of Vincent et al. (14) but diverging from other studies (5,15).

The mean age of our patient cohort was 41.5 ± 8.1 years, showing a male predominance consistent with previous research (17,18,19). None of our patients presented with abnormal anatomies such as spina bifida, aligning with findings from GS7. In our sample, the distribution across M-GSS grades varied, with the majority (38.5%) in grade 1, followed by 26.7% in grade 2a, and lower percentages in subsequent grades. This distribution closely aligns with that reported by Thomas et al. (5). The overall SFR in our study was 59.6%, which is comparable to the range of 62% to 70% reported in international studies (5,20,21). Notably, the efficacy

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of GSS in predicting SFR, even when applying CT, has been corroborated by studies like those of Noureldin et al. (22) and Okhunov et al. (23).

In our study, the average stone size was 2.74 ± 1.6 cm, and the mean BMI was 26.3 ± 6.2 kg/m². The distribution of stone location was almost equal, with 52.8% on the right side and 47.2% on the left. The mean operative time was 73.4 ± 14.6 minutes. An intriguing aspect of our findings was the non-significant difference in SFR across different M-GSS grades (p=0.236). Upon stratification for potential confounders such as age, gender, operative time, BMI, and stone side, no significant differences were noted, except for stone size (p=0.0001). This suggests that while M-GSS is a simple and reproducible system for classifying renal stone severity and predicting SFR, the size of the stone remains a critical factor influencing the outcome.

A notable limitation of this study is the lack of examination of complication rates and their correlation with M-GSS, a factor emphasized in other research works. This omission highlights the need for a more holistic approach to evaluating PCNL outcomes, where both success rates and complication risks are considered.

CONCLUSION

our study underscores that PCNL is a viable option for managing renal stones, with reasonable SFRs across different M-GSS grades. However, the absence of significant differences across these grades indicates the need for further investigation. Future studies, ideally randomized and involving larger sample sizes across multiple centers in Pakistan, are essential to substantiate these findings and to enhance our understanding of PCNL outcomes. This approach would not only validate the current findings but also contribute to the global body of knowledge in renal stone management, particularly in terms of preoperative patient counseling and outcome prediction.

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