MODIFICATION OF GUY'S SCORING SYSTEM FOR POST PCNL PREDICTION OF STONE FREE RATE AND COMPLICATION RATE

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ABSTRACT

Background

Due to the wide variation in methods used by urologists to assess clinical and academic outcomes of PCNL, the SFR (Stone Free Rate) and complications can differ. Therefore, it is crucial to examine preoperative factors that influence these outcomes. To improve guidance for patients considering PCNL, nephrolithotomy scoring systems have been developed based on preoperative indicators, as inconsistent reporting of PCNL outcomes across different centres has been observed.

Objectives

To demonstrate the efficacy of integrating further possible patient and stone factors in this nephrolithmetry system provided, keeping the predictive value of this system as simple and reproducible as possible.

Patients and Methods

Data from one hundred consecutive cases of prone PCNL were collected after obtaining ethical approval. All cases were operated in Al-Sulaymaniyah Surgical Teaching Hospital and Shar Teaching Hospital between August 2021 and July 2022. Preoperative Guy's scoring was applied by two endo-urologist to categorize all patients into four grades. The data included patients' sociodemographic characteristics and stone parameters measured on preoperative non-contrast Computed tomography.

Results

The mean age of patients was 44.85 years. The distribution of Guy's stone score was as follows: G1=35 patients, G2=40 patients, G3=15 patients, and G4=10 patients. Tract length was <100mm in 51 cases and >100mm in 49 cases. Stone density was <1000 in 34 patients and >1000 in 66 patients. Postoperative residual stones were seen in 12 patients, and significant complications and blood transfusion were seen in 8 patients; all were more frequent with higher Guy's scores. We found a statistically significant correlation between more than 100mm tract length and high postoperative residual stone by Chi-square test P-value 0.01. In addition, we observed strong relation between tract length and postoperative complication rates, though statistically insignificant.

Conclusion

We suggest modifying Guy's stone score by adding an expected tract length of more than 100mm to predict a higher residual stone rate and complication rate. Tract length can be added to Guy's stone score and used as an upgrading factor by one grade whenever preoperative CT shows a tract length of more than 100mm.

Keywords: *Guy's stone score, stone-free rate, percutaneous nephrolithotomy, nephrolithmetry.*

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INTRODUCTION

Nephrolithiasis is the most common urinary tract disease; it affects young adults between the third and fourth decades of life. The disease affects 5%-15% of the population worldwide. The surgical treatment of nephrolithiasis has advanced substantially in recent years [1].

Percutaneous nephrolithotomy (PCNL) is the standard treatment modality in high-volume upper tract calculi [1,2]. According to most guidelines, PCNL applies to stones greater than two cm, staghorn calculi, stones occurring in kidneys with abnormal anatomy, and stones in complicated patient groups [2]. Although widely spread and minimally invasive, PCNL remains a major operation with the risk of significant complications and the risk of having postoperative residual stones [3,4]. Heterogeneity in reporting the outcome of PCNL, including different complications and postoperative stone-free state, had led to the invention of several nephrolithometry scoring systems [3,5].

The GUY'S stone score is one of the most widely used predictors of PCNL-related stone-free rate and complications [2,4]. The Guy's Stone scoring system involves four grade complexity (Grades 1, 2,3 and 4).This grading depends on the patient's medical history and non-contrast computed tomography (CT) parameters, including the number of stones, caliceal localization of the stone, and renal anatomical structure [2,4].

Several other factors may be important in determining the stone Free State and postoperative complications not included in Guy's stone score. Therefore, our study aims to demonstrate the efficacy of integrating further possible patient and stone factors in this nephrolithometry system, providing the predictive value of this system as simple and reproducible as possible.

MATERIALS AND METHODS

A prospective study was conducted between, August 2021 and July 2022, involving 100 patients who underwent elective PCNL in Al-Sulaymaniyah Surgical Teaching Hospital and Shar Teaching Hospital. Data collection was performed by a self-administrative method and by filling out a questionnaire to provide sociodemographic characteristics. Patients with ectopic kidneys, obstructed pyelonephritic kidneys, or transplanted kidneys and patients in the paediatric age group were excluded from the study.

All patients were assessed by taking a full medical history and physical examination. Also, relevant haematological and biochemical investigations were done preoperatively. All patients had a definitive preoperative diagnosis of sizeable stones by abdominal CT. All patients were classified into a specific Guy's stone score using non-contrast computed tomography by two experienced endo-urologic surgeons. Figure.1-A All PCNLs were performed in a prone position under either general or spinal anaesthesia. All patients received prophylactic intravenous antibiotics at induction. Standard percutaneous access was achieved through the relevant calyx, and punctures were done under fluoroscopic guidance using an 18-G coaxial needle (Cook Medical Inc., Bloomington, IN, USA). A 20-Fr nephoscope (Karl-Storz, Tuttlingen, Germany) was used through an Amplatz sheath. Stones were fragmented using a pneumatic lithotripter (NidhiLith, Nidhi Medical Systems, and Delhi, India). A second or third puncture was done in the same fashion when needed.

Several patient parameters were assessed as potential predictors of postoperative complications and stone-free state; these include stone size and number, stone density and radiolucency, patient BMI, tract length (stone centre to skin distance at 0,45 and 90), number of tracts, preoperative renal function, the type of anaesthesia, and history of open renal surgery or previous treatment with ESWL.

Stone Free State was assessed at a 3-week follow-up, using a combination of abdominal X-ray and renal sonography. Patients were regarded as stone-free when they had no detectable stone or clinically insignificant residual fragments (≤3 mm in size, asymptomatic and non-infectious, and sterile urine culture). Complications were classified according to the Clavien-Dindo system for all patients and distributed according to Guy's score of the patients. Figure.1-B.

Statistical analysis

Data was collected and coded. The collected data were reviewed and analyzed using the Statistical Package for Social Sciences (SPSS version 23). Descriptive statistics as; frequency and percentage were calculated. Measures of central tendency and dispersion around the mean were used to describe continuous variables. For the categorical variable, chi-square was used with a 95% confidence interval to determine significant associations between categorical dependent and independent variables; the p-value was considered significant if it was less than 0.05.

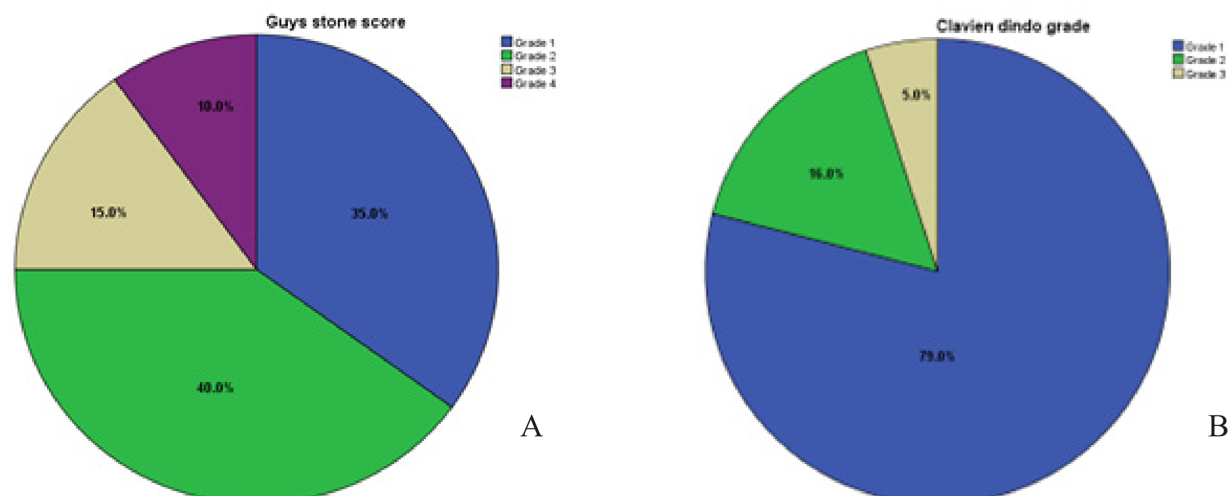

Figure 1. A- Distribution of the cases according to Guy's stone score. B- Distribution of the postoperative complications according to Clavien-Dindo grade.

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RESULTS

From August 2021 to July 2022, one hundred patients underwent standard-prone PCNL. The mean age of patients was (44.85± 13.83) years. The gender distribution was closely equal; 52 (52%) were males, and 48 (48%) were females, with an average BMI of 25.2. Forty-four cases (44%) were affected by a single stone, 23 cases (23%) had two stones, and more than two stones in the remaining patients (33%). The size of the stones was between 10 to 20 mm in 60% of the cases, greater than 20 mm in 37 cases (37%), and the size was smaller than 10 mm in only 3 cases. PCNL was conducted on the right side in 61 cases (61%) and on the left in 39 patients. Blood transfusion was performed in only eight cases (8%). Further patient demography characteristics are described in ,Table (1).

The distribution of Guy's stone score was as follows: G1=35 patients, G2=40 patients, G3=15 patients, and G4=10 patients. Tract length was <100mm in 51 cases and >100mm in 49 cases. The stones were radiolucent in 41 cases and radio-opaque in 59 cases, Table 1.

Patients' anatomical and stone parameters were not evaluated, which were originally tested in Guy's stone scoring system (stone number, stone calyceal location, and patient with abnormal anatomy). However, additional variables like stone size, stone density, number of tracts, tract length, type of anaesthesia, and other variables are shown in, Table (1).

Residual stones were compared according to different patients and stone criteria in all Guy's stone scores. Residual stones were more in patients with more than 100mm tract lengths in G2 and G4 Guy's scores. Although residual stones were more frequent in G4 with tract length >100mm, it was statistically insignificant, possibly due to a small number of cases with G4 stones.

Residual stones were statistically significant in G2 with tract length >100mm P-value 0.01, Table (2).

Significant complications (Clavein-Dindo grade 3 and more) happened in 8 cases, out of which six patients had a tract length of more than 100mm; these data were statistically insignificant mostly because of the small volume of our data, Table (3).

Other parameters like PCNL laterality, age group, type of anaesthesia, stone density and the number of tracts were assessed. They were statistically not significantly affected by postoperative residual stones or complications.

Table 1. The distribution of patient demographic characteristics, Guy's stone scoring and Clavien complication grades.

	Frequency	Percent
Age group (Years) Mean ± S.D (44.30 ± 13.83)		
19 - 45	54	54.0
46 - 65	35	35.0
≥ 66	11	11.0
Gender		
Male	53	53.0
Female	47	47.0
Stone number		
One	45	45.0
Two	55	55.0
Stone size		
< 10 mm	4	4.0
10 mm - 20 mm	62	62.0
> 20 mm	34	34.0
PCNL laterality		
Right	61	61.0
Left	39	39.0
<100 mm	51	51.0
≥ 100 mm	49	49.0
Stone Density		
< 1000 HU	34	34.0
≥ 1000 HU	66	66.0
Clavien Dindo grade		
Grade 1	79	79.0
Grade 2	16	16.0
Grade 3	5	5.0
Guys stone score		
Grade 1	35	35.0
Grade 2	40	40.0
Grade 3	15	15.0
Grade 4	10	10.0

Table 2. Postoperative residual stones are distributed according to the tract length for each guy's scoring grade.

Tract length		Postoperative residual stone		Total	P-value
		Positive	Negative		
(Grade 1)	<100 mm	1(50.0)	20(60.6)	21(60.0)	1.000
	≥ 100 mm	1(50.0)	13(39.4)	14(40.0)	
(Grade 2)	<100 mm	0(0.0)	18(54.5)	18(45.0)	0.011
	≥ 100 mm	7(100.0)	15(45.5)	22(55.0)	
(Grade 3)	<100 mm	0 (0.0)	8(53.3)	8(53.3)	
	≥ 100 mm	0 (0.0)	7(46.7)	7(46.7)	
(Grade 4)	<100 mm	0(0.0)	4(57.1)	4(40.0)	0.200
	≥ 100 mm	3(100.0)	3(42.9)	6(60.0)	

Table 3. Distribution of postoperative complication according to tract length for each guy's scoring grade.

		Clavien Dindo grade			Total	P-value
		Grade 1	Grade 2	Grade 3		
(Grade 1)	<100 mm	20(64.5)	1(33.3)	0(0.0)	21(60.)	0.254
	≥ 100 mm	11(35.5)	2(66.7)	1(100.0)	14(40.)	
(Grade 2)	<100 mm	13(43.3)	3(37.5)	2(100.0)	18(45.)	0.380
	≥ 100 mm	17(56.7)	5(62.5)	0(0.0)	22(55.)	
(Grade 3)	<100 mm	6(46.2)	2(100.0)	0(0.0)	8(53.3)	0.467
	≥ 100 mm	7(53.8)	0(0.0)	0(0.0)	7(46.7)	
(Grade 4)	<100 mm	4(80.0)	0(0.0)	0(0.0)	4(40.0)	0.071
	≥ 100 mm	1(20.0)	3(100.0)	2(100.0)	6(60.0)	

Abbreviations: P.C.N.L.: percutaneous nephrolithotomy; CT: computed tomography; E.S.W.L.:shock wave lithotripsy; SFR: stone free rate

DISCUSSION

Despite having a success rate, percutaneous renal surgery is associated with several significant risks, including blood loss, damaging neighbouring organs, and serious fatal infections [6]. The need for clear preoperative counselling led to the invention of several nephrolithmetry scoring systems based on preoperative radiologic parameters [2]. These instruments are beneficial in planning the surgery and patient counselling and allow the comparison of outcomes between different institutions [1].

The ideal nephrolithmetry technique should be simple to practice regarding the patient's characteristics and preoperative imaging findings. There needs to be an agreement on considering and choosing a scoring system as an ideal approach. Comparing and upgrading the current scoring systems is crucial to promote and giving visions to future studies that aim to create acceptable new instruments [7].

One important system that Thomas et al. developed is Guy's scoring system (GSS) to predict PCNL SFR and complications [5,8]. The GSS is a simple and validated system that can classify renal stones into four grades regarding location, stone number, atypical anatomy, and the presence of staghorn stones. However, this system has some weak points, such as the inability to determine the size, composition, tract length and

number, and density of the stones, which have a remarkable impact on the outcome of surgery [9,10].

Several studies, alongside the original study by Thomas et al., have demonstrated that GSS was strongly associated with SFR. On the other hand, another study criticized GSS for being substantially linked with high estimated blood loss and length of hospital stay (LOS) [6,8].

We noticed a significant correlation between tract length and postoperative residual stones by comparing several patient and stone parameters. Thomas et al., who designed Guy's score, put a cut of 100mm for tract length between obese and non-obese patients and found no significant correlation with the stone-free rate (SFR) [4]. We used the same cut-off and found a significant correlation between tract length greater than 100mm and postoperative SFR P-value of 0.01. Aghamir et al. found that tract length, stratified as <8, 8-12, and >12cm, has been associated with 100%, 83%, and 50% success rates, respectively [11]. Although Zeph Okeke et al. put the tract length as one of their designed lithometer, namely the (STONE) nephrolithometer, they found no association between SFR and tract length [12].

Our study saw significant complications and blood transfusion in 8 patients (8%). Although statistically insignificant, we noticed that patients with a track length of more than 100mm (6 patients) and a high Guy's score constitute 75% of patients with major complications and blood transfusion. De la Rosette et al. evaluated the outcome of 3709 patients stratified by BMI. The study showed significantly lower SFR and major complications in obese and super-obese patients. These findings support the effect of tract length on PCNL outcome [13].

Conclusion: Patients' weight reflected as PCNL tract length is important in predicting the stone-free rate and postoperative complication rate. We suggest modifying Guy's stone score by adding an expected tract length of more than 100mm as a predictive factor of a higher residual stone rate and complication rate. The Guy score will be upgraded by one grade each time the expected tract length is more than 100mm for each grade. Further study with more patients is needed before establishing this modification.

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