e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(1); 254-260

Original Research Article

Guy's Stone Score in Percutaneous Nephrolithotomy. Is it Clinically Feasible?

Prasad C[1], Vishruth K Raj [2], Narendra S[3]

[1]Assistant Professor, Dept. of Urology, Adhichunchanagiri Institute of Medical Sciences, B G Nagara
[2]Assistant Professor, Dept. of Urology, SDUMC, Kolar
[3]Senior consultant Urologist, BGS Gleneagles global hospital, Kengeri, Bengaluru

Received: 25-10-2023 / Revised: 23-11-2023 / Accepted: 26-12-2023
Corresponding Author: Dr. Prasad C
Conflict of interest: Nil

Abstract:

Introduction: Since its introduction in 2011, Guy's stone score (GSS) has piqued the curiosity of endourologists worldwide. Aim of our study is to apply the score, along with the modified Clavien system to assess its clinical feasibility in predicting stone free and complication rates following PCNL.

Material and Methods: In our prospective study between September 2021 and August 2023, 164 patients with unilateral and 17 patients with bilateral stones underwent PCNL (Total 198 renal units). Patients grouped into 4 grades of GSS based on CT scan/IVU and intraoperative RGP findings. Standard PCNL performed in prone position. Data tabulated include calyx punctured, number of punctures, operating time, stone clearance, auxiliary procedures, complications as per Modified Clavien System and days of hospital stay. Stone clearance (absence of residual fragments or fragments <4mm) evaluated by post-op X ray KUB and USG at the time of discharge. Statistical analysis done using SPSS 21. Results obtained using Chi square and ANOVA tests and significance reported as p values.

Results: Operative time (mean of 101.1 min) and hospital stay (mean of 8.1 days) were highest with GSS IV, as also number of punctures and auxiliary procedures needed. Overall complication rate was 45.9 % with more severe complications seen in higher GSS grades. Final stone clearance rate was 100%, 100%, 94.9% and 85.2% in GSS I, II, III, IV respectively.

Conclusion: As envisioned, GSS is a practical, clinically applicable tool that predicts stone free and complication rates. It is extremely useful for pre-op counselling and deserves more widespread usage.

Keywords: Guy's stone score; Clavien complication grading; percutaneous nephrolithotomy; stone free rate; complication rate; hospital stay.

Introduction

Percutaneous nephrolithotomy (PCNL) is one of the urological surgeries to have undergone the most modifications, evolution and improvement. Extracting a renal stone through a percutaneous tract was first described in 1976 [1]. Since then, with the advancements in technology i.e. the miniaturisation of nephroscopes and progression of lithotripters and lasers, PCNL is employed worldwide as the primary treatment modality for large renal calculi. It is considered the treatment of choice for calculi greater than 2 cm [2], and has a stone clearance rate of greater than 90% [3].

Guy's stone score

Achieving complete clearance of the stone with the least number and severity of complications is the most ideal outcome in PCNL for both urologist and patient. But often this utopian scenario is not reached, either due to sheer stone burden (staghorn calculi for example) or abnormal anatomy of the pelvicalyceal system (PCS). With this in mind, there have been consistent efforts to develop preoperative scoring systems to predict the stone free and complication rates.

The two most widely used are the Guys Stone Score and the S.T.O.N.E nephrolithometry score.

Described by Thomas et al in 2011 [4], the GSS groups renal calculi into four grades based on the stone location, number and renal anatomy.

Table 1: Guy's Stone Score

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 S.T.O.N.E (Stone size, Tract length, Obstruction, Number of calyces retained, and Essence/ Hounsfield units) nephrolithometry score developed by Smith et al[5] in 2013 has also been studied.

Other less used scoring systems are the Clinical Research Office of the Endourological Society (CROES) nomogram [6] and the Seoul National University Renal Stone Complexity (S-ReSC) score [7]. The general consensus from these studies is that the GSS is easier and more practical to apply, hence we have used it in our study.

Modified Clavien grading (MCG) system

Though considered as an endoscopic minimally invasive procedure, PCNL can be fraught with complications ranging from simple persistent pain to severe bleeding to even sepsis and death. Minor complications in 25% and major complications in up to 7% patients will occur in PCNL [8].

There were a few early studies which associated stone location and type with the expected complication rate.

Michel et al [9] found significant correlation between stone size and complication rates. Starting out in a cohort study in 2004 [10], the Clavien- Dindo system was first described for general surgical procedures but soon made its way into urological practice.

The MCG system was used to classify and grade complications specific to PCNL and the same was validated in 2008 by Teflecki et al [11].There have been a few iterations of the system but the MCG system applied in our study is the same used by Mandal S et al [12] and is as follows:

Table 2: Modified Clavien complication grading (MCG)

Clavien grade	Complication
I	Fever, Pain, Transient increase in creatinine, Postoperative nausea and vomiting, Transient hearing loss secondary to prophylactic amikacin
II	Nephrostomy site leakage for > 12 hours, Blood transfusion, Episode of fast atrial fibrillation, Infection requiring additional antibiotics
IIIa	Double-J stent placement for urine leakage >24 hours, Double-J stent placement for UPJ/Pelvis injury, Stent migration, Urinoma, Pneumothorax, Retention and colic due to blood clots, Perirenal hematoma
IIIb	Ureter-bladder stone, Arteriovenous fistula, Calyx neck stricture secondary UPJ stenosis, Intra-operative bleeding/pus requiring quitting the operation
IVa	Neighbouring organ injury, Myocardial infarction

IVb	Urosepsis
V	Death

The objective of the study was to apply the GSS in our patients and assess its correlation with the number of punctures needed, operating time, stone clearance, any auxiliary procedures needed, days of hospital stay, intra and post-operative complications as per the MCG and stone free rate.

Material and methods

Between September 2021 and August 2023, 164 patients with unilateral stones and 17 patients with bilateral stones who underwent PCNL at our institution were included in the study. The total number of renal units operated on was 198. Appropriate ethical clearance was granted by the institutional ethical committee.

The inclusion criteria for the study was all patients with renal calculi >2cm, patients with renal calculi >1.5 cm with unfavourable parameters for ESWL such as an abnormal anatomy or HU >1000. The exclusion criteria were paediatric patients (<14 years), those with diabetes, hypertension, renal insufficiency, coagulopathies, cardiopulmonary disease or history of previous PCNL on the ipsilateral side. Comorbidities increase complication rates in PCNL [13], hence these patients were excluded, so as to keep the complications purely related to the GSS.

All patients were properly worked up before surgery and demographic details entered into a specially created proforma for the study. Patients were counselled about PCNL, as well as explained about the study they were being included in, and full informed consent was taken.

Preoperatively complete blood counts with coagulation profiles, renal function tests, urine culture, ultrasound KUB, X ray KUB and contrast CT scan were done in all patients. Patients were grouped into the four grades of GSS based on pre-operative imaging and intraoperative retrograde pyelography performed through a 5Fr ureteric catheter inserted cystoscopically.

Patient shifted to prone position and standard PCNL was performed with percutaneous access obtained by the urologist with the help o fluoroscopic guidance. After initial needle puncture into pre-planned appropriate calyx with an 18G needle and deployment of guidewire, Alken's needle was deployed followed by a central rod and using Amplatz dilators the tract was dilated to 28 or 30Fr depending on the stone burden.

Amplatz sheath was introduced, and lithotripsy carried out using pneumatic Swiss lithoclast with a 24Fr rigid nephrscope. At the end of the procedure stone clearance was confirmed with nephroscopy and C-arm. Antegrade DJ stenting was done if required. 20 Fr Nephrostomy tubes were inserted in all cases. If no stent was deployed, the ureteric catheter was left in situ. Post operatively IV antibiotics were given to all patients. Along with haemoglobin and serum creatinine, X ray KUB was done on post op day 1. If there were no significant residual stones and haematuria was not severe, the nephrostomy tube was removed and once the leak from nephrostomy site subsided the per urethral Foleys's catheter was removed. If there was incomplete clearance, relook PCNL was performed through the same puncture after 2-3 days or through an additional puncture as needed. Stone clearance was also confirmed in all patients at the time of discharge with ultrasound KUB, particularly in radiolucent stone formers. Patients were followed up at one week and one-month post op. DJ stent was removed at the end of 4 weeks. Patients, who needed extracorporeal shock wave lithotripsy (ESWL) to clear residual stones, underwent the same before stent removal. PCNL was considered a success if patient had no residual stones or had clinically insignificant residual non-obstructive fragments <4mm. [14]

The proforma of each patient was then updated with the intra op details like calyx punctured, number of punctures, the operating time, whether the stone was cleared in the first or second session or if there was incomplete clearance. Details of any auxiliary procedures, hospital stay and Clavien graded complications were also noted. Patients with bilateral stones were tabulated as two separate procedures.

The data was entered into an ExcelTM (Microsoft, Redmond, WA) spread sheet and analysed using SPSS 21. Results were obtained using the Chi square and ANOVA tests and significance reported as p values.

Results

After exclusion, the total number of PCNLs performed in the study was 198. Out of this number, 54% (n=106) were male and 46% (n=92) were female. The age group between 31-40 years was the most frequently affected in our study (21.2%, n=42), followed by 41-50years, (20.7%, n=41). The least frequency of cases was seen in the extremes of age groups i.e. <20 and >71 years (6.6%, n=13 in each). 60% (n=119) had right sided stones and 40% (n=79) had left sided stones. The most preferred calyx for puncture was the inferior calyx (62.1%, n=123), followed by the middle calyx (43.9%, n=87) and the superior calyx (29.8%, n=59). As per GSS stratification, the cases were GSS I (25.3%, n=50), GSS II (41.4%, n=82), GSS III (19.7%, n=39) and GSS IV (13.6%, n=27). The largest number of patients had GSS II stones.

The results with respect to number of punctures (table 3), the operating times (table 4), the initial stone clearance rates (table 5), the auxiliary procedures needed (table 6), the hospital stay (table 7), the final stone free rates (table 8), and complications (tables9 and 10) and their association and significance with GSS are detailed below. The final stone free rate was 100% in GSS I, 100% in GSS II, 94.9% in GSS III and 85.2 % in GSS IV. Complications occurred in 91 patients and overall complication rate was 45.9%.

Table 3: GSS and number of punctures

Guys stone score		Number of punctures					
		1		2		3	
		Count	N %	Count	N %	Count	N %
	Grade I	50	100.0	0	0	0	0
	Grade II	70	85.4	12	14.6	0	0
	Grade III	12	30.8	25	64.1	2	5.1
	Grade IV	3	11.1	16	59.3	8	29.6

Chi-square Test, P<0.0001

Table 4: GSS and mean operating time in minutes

Guy's stone score		Operating time	
		Mean	SD
	Grade I	34.06	9.62
	Grade II	46.13	11.55
	Grade III	78.18	22.19
	Grade IV	101.11	22.98

P<0.0001, ANOVA Test

Table 5: GSS and initial stone clearance

Guy's stone score		Stone Clearance					
		First session		Second session		Incomplete clearance	
		n	%	n	%	n	%
	Grade I	48	96.0	2	4.0	0	0
	Grade II	73	89.0	9	11.0	0	0
	Grade III	16	41.0	15	38.5	8	20.5
	Grade IV	3	11.1	13	48.1	11	40.7

Chi-square test, P<0.0001

Table 6: GSS and auxiliary procedures

Guy's stone score		Auxiliary procedures							
		Nil		ESWL		URSL		URSL+ESWL	
		n	%	n	%	n	%	n	%
	Grade I	50	100.0	0	0	0	0	0	0
	Grade II	82	100.0	0	0	0	0	0	0
	Grade III	31	79.5	4	10.3	3	7.7	1	2.6
	Grade IV	16	59.3	7	25.9	2	7.4	2	7.4

P<0.001

Table 7: GSS and hospital stay in days

Guy's stone score		Hospital stay	
		Mean	SD
	Grade I	2.48	.93
	Grade II	3.27	1.40
	Grade III	6.49	2.00
	Grade IV	8.15	3.27

P<0.0001, ANOVA

Table 8: GSS and final stone clearance

Guy's stone score		Final Stone free rate			
		Complete		Incomplete	
		n	%	n	%
	Grade I	50	100.0%	0	0
	Grade II	82	100.0%	0	0
	Grade III	37	94.9%	2	5.1
	Grade IV	23	85.2%	4	14.8

Chi-square test, P=0.01

Table 9: Complications as per Clavien grading

Modified Clavien grade		Count	Total N %
	MCG1	47	23.7%
	MCG2	26	13.1%
	MCG3a	36	18.2%
	MCG3b	8	4.0%
	MCG4a	8	4.0%
	MCG4b	2	1.0%
	MCG5	1	.5%
	Total	91	100.0%

Table 10: Correlation of GSS with complications

Modified Clavien grade		Guy's stone score grade				
		1	**2**	**3**	**4**	**P value**
	MCG1	6	17	20	4	<0.0001
	MCG2	0	4	14	8	<0.0001
	MCG3a	2	3	13	18	<0.0001
	MCG3b	0	2	1	5	0.001
	MCG4a	0	0	3	5	<0.0001
	MCG4b	0	0	0	2	0.005
	MCG5	0	0	0	1	0.1

Discussion

One of the most difficult urological surgeries to predict success is those done for stone disease, especially PCNL. We are no appreciable distance closer in answering the two most pertinent questions that every stone patient asks us in the OPD – will this surgery completely clear my stones and what are the risks with this procedure. More importantly in the era of documentation and medicolegal issues these answers assume a lot more significance.

Hence a lot of time and effort has gone into developing preop systems to predict both clearance and complication rates in PCNL. Authors such as Michel [9], Tefeckli [11], de la Rosette [15] and Thomas [4] have all done admirable work in this regard but the Guy's score by Thomas et al [4] in 2011 has been the most studied. It has been claimed to correlate intimately with the stone clearance and complication rates. With the proven and validated Clavien system now being used to grade complications in a variety of urological and non-urological procedures, it provides the easiest practically applicable complication grading tool. So a combination of the GSS and the MCG systems has been used to prospectively study the clinical usefulness of the GSS in our study. The definition of stone free rate in our study is the same as used by Vincenti et al [16] i.e. the absence of residual fragment or asymptomatic fragment of ≤4mm. Partial staghorn calculi were defined as pelvic stones extending into at least two calyces.

Abnormal anatomy was defined as those affecting the kidney (such as an ectopic or malrotated kidney) or the PCS (such as uretero-pelvic junction obstruction or duplex systems) or both. These were the important points of confusion in other studies similar to our own. Cases with comorbidities were excluded from our study as the aim was to find the true correlation of the GSS with clearance and complications without confounding variables.

This was based on the study of the Charlson comorbity index in 2012 by Unsal et al [17]. As seen clearly in the results tables, there was a strong correlation between the GSS grade and the stone free rates. GSS grades I and II had a 100% clearance whereas GSS III and IV had lower clearance (94.9% and 85.2% respectively), confirming the findings of Thomas [4], Mandal [12], Vincenti [16], and RK Sinha [18] that higher the GSS, poorer the clearance. The overall complication rate in our study was 45.9%, ranging between the high of Thomas [4] (52%) and low of Vincenti [16](18.7%). A reason for the higher rate in our study can be attributed to the fact that ours being a teaching hospital, a majority of the PCNLs were performed by residents in training. And it is well known and established in studies by de la Rosette [15] and Tanriverdi [19] that a higher number of complications will be encountered during the learning phase of PCNL. Complications MCG 1 and 2 are minor and MCG 3, 4 and 5 are considered major [9]. As seen clearly in our study, higher GSS was associated significantly with higher grade of MCG complication. MCG 4a, 4b and 5 complications were only seen in GSS 3 and 4 stones. The only MCG 5 complication was with a GSS 4 stone. One of the better features of our study is the finding that GSS correlates statistically significant with the number of punctures needed ($p<0.001$), the mean operating times ($p<0.0001$), the hospital stay ($p<0.0001$) and the auxiliary procedures needed ($p<0.001$). The higher the GSS, the more the above parameters. This is not well established in other studies. USG was used in all patients to assess stone clearance; hence no radiolucent

stones were missed.

The limitation in our study was that although the GSS and MCG stratification was done by a single person, the PCNL itself is performed by multiple surgeons including residents.

The comparison of our data with similar studies is detailed in the table below.

Table 11: Comparison with published literature

	Thomas et al [4]	Mandal et al [12]	Vincenti et al [16]	Sinha RK et al [18]	Ingimarsson et al [20]	Present study
SFR % GSS 1	81	100	97.2	93.9	95	100
SFR % GSS 2	72.4	96.9	86.5	85.71	97	100
SFR % GSS 3	35	100	90.5	90.17	95	94.9
SFR % GSS 4	29	60	74.5	77.77	75	85.2
Overall SFR%	62	97.3	87.7	90.14	90	96.9
Complication rate %	52	41.7	18.7	40.1	37	45.9

Conclusion:

The Guy's stone score is a highly practical, easily applicable and reproducible tool which has great clinical benefit. Apart from preoperative counselling of patients, planning of PCNL and prediction of complications and stone free rates, it can also be used for planning and self-evaluation of PCNL learning progress, comparing results between urologists/institutes and maybe even between variations of PCNL techniques. It most definitely deserves more widespread usage.

References:

1. Fernstrom I, Johansson B. Percutaneous pyelolithotomy: a new extraction technique. Scand J Urol Nephrol. 1976; 10:257–9.
2. Preminger GM, Assimos DG, Lingeman JE, et al. AUA guideline on management of staghorn calculi: diagnosis andtreatment recommendations. J Urol. 2005; 173(6):1991–2000
3. Turk C, Knoll T, Petrik A, et al. Guidelines on urolithiasis. Eur Assoc Urol. 2010:1-106.
4. Thomas K, Smith NC, Hegarty N, et al. The Guy's Stone Score- grading the complexity of percutaneous nephrolithotomy procedures. Urology. 2011; 78:277–281.
5. Okhunov Z, Friedlander J.I, George A.K, et al. S.T.O.N.E. nephrolithometry: novel surgical classification system for kidney calculi. Urology. 2013; 81:1154–1159.
6. Smith A, Averch TD, Shahrour K et al. A nephrolithometric nomogram to predict treatment success of percutaneous nephrolithotomy. J Urol. 2013; 190:149–156.
7. Jung J.W., Lee B.K., Park Y.H., et al. Modified Seoul National University Renal Stone Complexity score for retrograde intrarenal surgery. Urolithiasis. 2014; 42:335–340.
8. Preminger GM, Assimos DG, Lingeman JE, et al. Chapter 1: AUA guideline on management of staghorn calculi: diagnosis and treatment recommendations. J Urol. 2005; 173:1991–2000.
9. Michel MS, Trojan L, Rassweiler JJ. Complications in percutaneous nephrolithotomy. Eur Urol. 2007; 51:899-906.
10. Dindo D, Demartines N, Clavien PA et al. Classification of surgical complications: a new proposal with evaluation in a cohort of a 6336 patients and results of a survey. Ann Surg. 2004; 240:205–213.
11. Tefekli A, Ali-Karadag M, Tepeler K et al. Classification of percutaneous nephrolithotomy complications using the modified Clavien grading system: looking for a standard. Eur Urol. 2008; 53:184–190.
12. Mandal S, Goel A, Kathpalia R et al. Prospective evaluation of complications using the modified Clavien grading system, and of success rates of percutaneous nephrolithotomy using Guy's Stone Score: a single-centre experience. Indian J Urol. 2012; 28:392–398.
13. Duvdevani M, Nott L, Ray AA, et al. Percutaneous nephrolithotripsy in patients with diabetes mellitus. J Endourol. 2009; 23:21-6.
14. Muslumanoglu AY, Tefekli A, Karadag MA, et al. Impact of percutaneous access point number and location on complication and success rates in percutaneous nephrolithotomy. Urol Int. 2006; 77:340-6.
15. de la Rosette JJ, Zuazu JR, Tsakiris P, et al. Prognostic factors and percutaneous nephrolithotomy morbidity: A multivariate analysis of a contemporary series using the Clavien classification. J Urol. 2008; 180:2489-93.
16. Vicentini FC, Marchini GS, Mazzucchi E, et al. Utility of Guy's Stone Score based on computed tomographic scan findings for predicting percutaneous nephrolithotomy outcomes. Urology. 2014; 83:1248–1253.
17. Unsal A, Resorlu B, Atmaca AF, et al. Prediction of morbidity and mortality after percutaneous nephrolithotomy by using the Charlson Comorbidity Index. Urology 2012; 79:55-60.
18. Sinha RK, Mukherjee S, Jindal T, et al. Evaluation of stone-free rate using Guy's Stone Score and assessment of complications using modified Clavien grading system for percutaneous

nephro-lithotomy. Urolithiasis 2015; 43:349–353.
19. Tanriverdi O, Boylu U, Kendirci M, et al. The learning curve in the training of percutaneous nephrolithotomy. Eur Urol. 2007; 52:206.
20. Ingimarsson JP, Dagrosa LM, Hyams ES et al. External validation of a preoperative renal stone grading system: reproducibility and inter-rater concordance of the Guy's Stone Score using preoperative computed tomography and rigorous postoperative stone free criteria. Urology. 2014; 83:45–49.