



OUTCOME AND COMPLICATIONS OF PERCUTANEOUS NEPHROLITHOTOMY (PCNL) AND GRADING OF COMPLEXITY OF PCNL PROCEDURE USING "GUY'S STONE SCORE": A TERTIARY CENTRE BASED OBSERVATIONAL STUDY

Urology

Dr Savjot Singh Narang

Senior Resident, Mch Urology, Dr S.N. Medical College, Jodhpur

Dr Gordhan Choudhary

Professor and Head of Department, Mch Urology, Dr S.N. Medical College, Jodhpur

Dr Jaydip Vachhani

Senior Resident, Mch Urology, Dr S.N. Medical College, Jodhpur

Dr Arshpreet Kaur Resident, DGO, Mohandai Oswal Hospital, Ludhiana

ABSTRACT

Objectives- To observe stone free rate and complications and their association with Guy's stone score in patients with renal stones undergoing PCNL at our institute. **Material and Method** – An observation study was performed in 150 patients who underwent PCNL from March, 2023 to February, 2025 in our institute. Data regarding various pre, intra and post operative parameters was collected and their association with Guy's stone score was assessed. **Results** – Guy's grading had significant impact on stone free rate and complication rate. Guy's grading was also found to be associated with mean operative time, hospital stay, Clavein Dindo complication grading and ancillary procedures. **Conclusion** – Guy's stone score accurately predicted stone free and complication rate. So, this study validated externally Guy's stone score.

KEYWORDS

PCNL, Guy's Stone Score, Clavein Dindo Classification, Stone Free Rate

INTRODUCTION

The lifetime prevalence of kidney stone disease is estimated at 1% to 15%, varying according to age, gender, race, and geographic location. A linear increase in the prevalence of kidney stones over the last several decades (Stamatelou et al., 2003), with the most recent prevalence estimate of 8.8% for the period 2007 to 2010. Higher prevalence of stone disease is found in hot, arid, or dry climates such as the mountains, desert, or tropical areas. There are various treatment options that includes non-invasive, minimally invasive, and invasive methods.

During the last two decades, the management of kidney stones has vastly changed. Prior to these modifications all the kidney stones were managed by open pyelolithotomy or nephrolithotomy which caused a significant morbidity for the majority of patient. Percutaneous Nephrolithotomy (PCNL) has now largely replaced open surgery as a safe and effective treatment for renal stones¹

It is now well recognized among surgeons that PCNL procedures have different degrees of complexity which affects stone clearance.

The "Guy's Stone Score" proposed by Thomas K and Smith et al^{2,3} is a valuable tool to stratify the complexity of PCNL procedures into four groups based on the stone burden and the anatomy of both patient and renal tract.

Grade I: Solitary stone in mid / lower pole or solitary stone in pelvis with simple anatomy

Grade II: Solitary stone in upper pole or multiple stones in patient with simple anatomy or solitary stone in patient with abnormal anatomy

Grade III: Multiple stones in a patient with abnormal anatomy or stones in a caliceal diverticulum or partial Staghorn calculus

Grade IV: Staghorn calculus or any stone in a patient with spina bifida/spinal injury.

- Classification of Surgical complications according to the Modified Clavien System⁴

Grade 1: Any deviation from the normal postoperative course without the need for pharmacologic treatment or surgical, endoscopic, and radiologic interventions. Allowed therapeutic regimens include drugs such as antiemetics, antipyretics, analgesics, diuretics, electrolytes, and physiotherapy.

Grade 2: Complications requiring pharmacologic treatment with drugs other than allowed for Grade 1 complications. Blood transfusions and total parenteral nutrition are also included.

Grade 3a: Intervention not under general anaesthesia

Grade 3b: Intervention under general anaesthesia

Grade 4: Life-threatening complications, urosepsis (including central nervous system complications) requiring intensive care unit stay

Grade 4a: Single-organ dysfunction (including dialysis)

Grade 4b: Multiorgan dysfunction

Grade 5: Death of the patient.

- Residual calculus is defined as any calculus of >4mm left after procedure

AIM

To observe stone free rate and complications in patients with renal stones undergoing PCNL

OBJECTIVES

Primary Objective

- To determine stone free rate in patients with renal stones undergoing PCNL at our institution

Secondary Objective

- To determine incidence of complications according to Modified Clavien System in patients with renal stones undergoing PCNL at our institution
- To determine any association of Guy's Stone Score with stone free rate and complications in patients with renal stones undergoing PCNL at our institution

MATERIAL AND METHODS

Study Design: Mixed design observational study

Study Setting: The study will be conducted in a urology department of MDM Hospital Jodhpur, Rajasthan.

Study Duration: two years (March 2023 – February 2025)

Study Population: The study was conducted among the patients with renal stones undergoing PCNL admitted in urology department of our hospital. The study inclusion criteria is given below:

Inclusion Criteria

- Patients aged 18 years and above of either gender with renal stones undergoing PCNL at our Institute.

Exclusion Criteria

- Patients whose detail records are not available.
- Pregnant females

Sample Size

Sample size was calculated at 95% confidence interval to verify an expected 62% proportion of stone free rate as reported by Thomas K et al³ and taking 10% relative allowable error. Sample size was calculated using the formula for sample size for estimation of proportion –

$$n = \frac{(Z_{1-\alpha/2})^2 P (1-P)}{E^2}$$

Where,
Z = Standard normal deviate for 95% confidence interval (taken as 1.96)
P= Expected proportion of stone free rate (taken as 62% as reported by Thomas K et al¹)
E= relative allowable error (taken as 10%)
Sample size was calculated to be to be minimum 234 subjects, which was rounded off to 250 patients of renal stones undergoing PCNL.

Randomization - not applicable
Blinding - not applicable

METHODOLOGY

All relevant blood and urine investigations were done. Ultrasound abdomen and pelvis, Plain X-ray kidney, ureter, and bladder (KUB) were done at initial visit. For all the patients CT (NCCT KUB/CT Urogram) was performed to determine stone burden, defining complexity and renal anatomy. Patients were given Guy's Stone Score according to the CT scan. Operative complications were graded using the Modified Clavien Dindo Classification.

All the patients underwent PCNL under general anaesthesia. Patients were shifted to lithotomy position and ureteric catheter(5fr) was placed. After that patients were shifted to prone position and C-arm guided puncture was taken with the help of 18-gauge needle. Dilatation was done with help of guidewire 0.035 inch and amplatz dilators. An amplatz sheath (28F-30F) was placed after dilatation. Stone fragmentation was done with the help of pneumatic lithotripter and holmium laser. If needed, another puncture was made. Double J stent was placed at end of procedure. An external ureteral catheter was left in situ if patient was planned for re-look PCNL or if DJ was not placed. 24 Fr nephrostomy tube was placed into pelvis or punctured calyx in most cases.

Post operative day 1, physical examination and Xray KUB was performed. If complete clearance and urine was not significantly hematuric, nephrostomy was removed on POD 1. In case of external ureteral catheter if no urine leak was present after 12 hrs from nephrostomy site, then foleys catheter and ureteral catheter was removed on POD2 and patient was discharged. If urine leak persisted for >24 hrs than DJ stent was placed. DJ stent if placed was removed after 3-4 weeks. For significant residual calculus and any pathological finding (hematoma, collection, hydronephrosis) NCCT was performed and patient was planned for ancillary procedure.

Age, gender, calculus size, operative time, pre- and postoperative changes in hemoglobin, complications, blood transfusions, VAS pain score, and hospitalization time was noted and evaluated. All patients were followed up at 1 week and 1 month after discharge from hospital.

RESULTS

In our study, out of total 250 patients 145 were males and 105 females. Mean age of patients was 42.38 years. Stone clearance rate was 94%. Mean operative time was 85 mins. 28%,44%,23.2% and 4.8% patients fell into GSS I, GSS II, GSS III and GSS IV category. Overall complication rate was 32.4%. The results reveal that GSS III and GSS IV patients have higher complication rate i.e. 60.34% and 83.3% respectively. However, overall Grade 1,2 and 3a complications were more common i.e. 39.5%, 27.16% and 17.28% respectively. The stone clearance rate was also observed to be higher in GSSI and GSS II.

Descriptive data of patients (n=250)		
Mean Age (years)		42.38 (Range 18-78)
Male/Female		145/105
Stone clearance		235 (94%)
Mean operative time		85 mins
Mean Hb drop		1.2 mg/dl
Mean VAS pain score		5.7
Classification of calculus		
GSS I		70(28%)
GSS II		110(44%)
GSS III		58(23.2%)
GSS IV		12(4.8%)
Grade	Complications	Number
Grade I		32
	Fever	25
	Transient Creatinine rise	7

Grade of complications	GSS I (n-70)	GSS II (n-110)	GSS III (n-58)	GSS IV (n-12)	Total (n-250)
Grade 1	5 (15.6%)	11 (34.37%)	15(46.87%)	1(3.1%)	32 (39.5%)
Grade 2	2 (9%)	10 (45.45%)	9 (40.90%)	1 (4.54%)	22 (27.16%)
Grade 3a	1 (7.14%)	7 (50%)	5 (35.71%)	1 (7.14%)	14 (17.28%)
Grade 3b	-	-	3 (50%)	3 (50%)	6 (7.4%)
Grade 4a	-	-	2 (50%)	2 (50%)	4 (4.9%)
Grade 4b	-	-	1 (33.33%)	2 (66.67%)	3 (3.7%)
Grade 5	-	-	-	-	0
Total	8 (11.42%)	28 (25.45%)	35 (60.34%)	10 (83.3%)	81 (32.4%)

Guy's Stone Score	Stone Clearance rate	Mean number of punctures
GSS I (n-70)	70 (100%)	1.15
GSS II (n-110)	100 (90.90%)	1.89
GSS III (n-58)	59 (86.2%)	2.2
GSS IV (n-12)	6 (50%)	2.8
Total	235 (94%)	2.01

DISCUSSION

Despite high success rate, PCNL involves serious complications such as blood loss, adjacent organ injuries and life-threatening infections. Various studies divided complications into major and minor which was not standardised. Modified Clavien grading is more objective and reproducible, allows better quality assessment and comparison of results between various studies.

Overall complication rate in our study was 32.4%. Mandal et al⁵ reported complication rate of 41.7%. Sfoungaristos et al⁶ and Jaipuria et al⁷ reported complication rate of 37.9% and 29% respectively.

The results of complications and stone free rate of our study were comparable to other studies as mentioned in tables.

Grade 1,2 and 3a are considered minor complications which form major component i.e. 83.94% of total as they were managed conservatively or under local anaesthesia

Clavien Grade	Ours study	Mandal et al ⁵	Sfoungaristos et al ⁶
Grade 1	39.5%	18.7%	53.53%
Grade 2	27.16%	43.8%	24.24%
Grade 3a	17.28%	15.1%	22.22%
Grade 3b	7.4%	6.4%	-
Grade 4a	4.9%	2.1%	-
Grade 4b	3.7%	1.4%	-
Grade 5	0	0.3%	-

Stone free rate in	Our Study	Mandal et al ⁵	Sfoungaristos et al ⁶	Thomas et al ⁸	Jaipuria et al ⁷
GSS I	100%	100%	96.8%	81%	96.1%
GSS II	90.90%	74%	91%	72%	81.4%
GSS III	86.2%	56%	71.7%	35%	77.2%
GSS IV	50%	0%	46.2%	29%	59%

CONCLUSION

Overall complications were more in GSS III and GSS IV groups in all studies and stone free rates were higher in GSS I and GSS II groups
Guys stone score is helpful in predicting stone free rates and complications in patients undergoing PCNL

Acknowledgement

The author would like to thank all co-authors who provided their clinical experience and knowledge.

Financial Support and Sponsorship: - Nil

Conflicts of Interest:- There are no conflict of interest.

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