



A STUDY OF PERCUTANEOUS NEPHROLITHOTOMY (PCNL) AND GRADING OF COMPLEXITY OF PCNL PROCEDURES USING "GUY'S STONE SCORE"

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ABSTRACT **INTRODUCTION** : Percutaneous Nephrolithotomy (PCNL) has now largely replaced open surgery as a safe and effective treatment for renal stones.

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 renal tract.

AIM & OBJECTIVE: 1) To study the indications for PCNL and to assess the outcome of procedure in patients with renal stones. 2) To study the grading and complexity of PCNL procedures using "Guy's Stone Score".

METHODS AND MATERIALS:

SOURCE OF DATA : Patients undergoing PCNL. **STUDY DESIGN:** Prospective study. **PERIOD OF STUDY:** From May 2020 to June 2021 .

SAMPLE SIZE: 50 .

RESULTS : Stone free rate (SFR) was 87.5% for patients with Guy's stone Grade I , 22.2% for Grade II, 16.7% for Grade III and 0% for Grade IV. Hence it can be noted that as the Guy's stone grade increased the stone free rate decreased.

CONCLUSION : The Guy's stones score predicted the stone free rates correctly with higher Guy's stones score needing ancillary procedures mainly in the form of extracorporeal shock wave lithotripsy for stone clearance.

KEYWORDS :

INTRODUCTION

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 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.

AIM & OBJECTIVE:

- To evaluate patients with renal stones at our institution.
- To study the indications for PCNL and to assess the outcome of procedure in patients with renal stones.
- To study the grading and complexity of PCNL procedures using "Guy's Stone Score".

MATERIALS AND METHODS

Study Design: Prospective study.

Duration: May 2020 to June 2021.

Setting: Meenakshi Medical College Hospital & Research Institute, Kanchipuram

METHODOLOGY:

50 patients with symptomatic renal stones presenting to Urology OPD are evaluated and included in the study after informed consent. The indications for surgery are studied and patient is taken up for the same after anesthetic fitness. PCNL is done using standard techniques. The complexity of procedure is graded using radiological studies and the outcome assessed based on "Guy's Stone Score" and modified Clavien system.

RESULTS

50 patients underwent PCNL during the period May 2020 to June 2021.

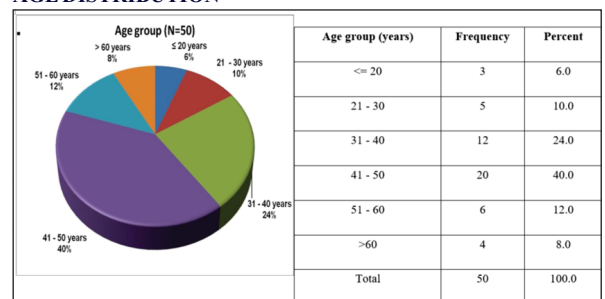
There were 25 males and 25 females, According to Guy's stone score grade I, II, III, IV there were 32, 9, 6 & 3 patients respectively.

Grade I patients had solitary pelvic, lower or middle calyceal calculus.

Grade II, 5 patients had multiple calculi, 3 patients had upper pole calculus and 1 patient had a horseshoe kidney with solitary calculus .

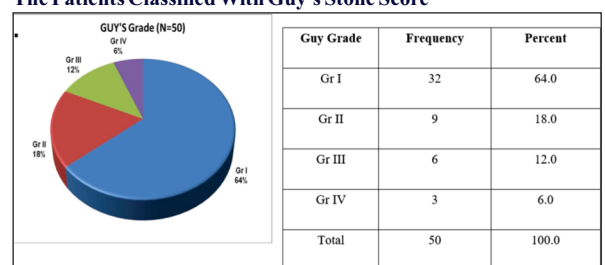
All Grade III patients had partial staghorn calculus while Grade IV patients had a complete staghorn calculus.

AGE DISTRIBUTION



Gender was equally distributed in our series with 25 patients each noted in the male and female categories. Mean age of the study group was 42.48 years with a minimum of 11 years and maximum of 70 years.

The Patients Classified With Guy's Stone Score



The commonest Guy's stone score grade noted in our study was Grade I (64%). This was followed by Grade II (18%) and Grade III (12%). The least number of patients in the study belonged to Grade IV (6%).

COMPLICATIONS AFTER PCNL

Complications	Percent
Bleeding	52
Fever	32
RFT Increase	4
Pleura injury	4
Sepsis	8

Complications were noted in 50% (25 patients) of the population studied. Among the complications, the most commonly noted one was bleeding (52%) followed by fever (32%). Sepsis was noted in 8% of the patients of which one person died in the post operative period in the whole series.

TOTAL NUMBER OF RESIDUAL CALCULUS AFTER PCNL

		Guy Grade								Total	
		Gr I		Gr II		Gr III		Gr IV		N	%
Residual Stones	No	28	87.5	2	22.2	1	16.7	0	0	31	62.0
	Yes	4	12.5	7	77.8	5	83.3	3	100.0	19	38.0
Total		32	100.0	9	100.0	6	100.0	3	100.0	50	100.0

As there is increase in GUY's Grade, Residual Stones Increase

Stone free rate (SFR) was 87.5% for patients with Guy's stone Grade I, 22.2% for Grade II, 16.7% for Grade III and 0% for Grade IV. Hence it can be noted that as the Guy's stone grade increased the stone free rate decreased.

ANCILLARY PROCEDURES TO MANAGE RESIDUAL STONES

Ancillary	Frequency	Percentage
ESWL	14	78
Re look nephroscopy	2	11
Open	2	11

Ancillary procedure was required in 18 of the 19 patients with residual stones. One patient died of sepsis in the post operative period. Of the 18 patients, 14(78%) underwent ESWL as the fragments were deemed small (less than 1.5cm). Re look nephroscopy was required in two patients and in two patients conversion to open procedure was done.

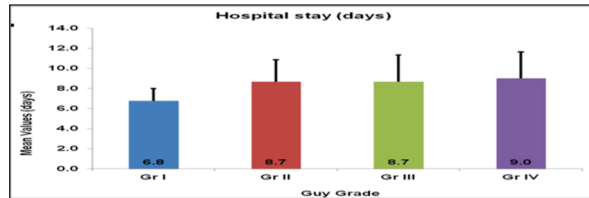
THE MEAN AGE, STONE BURDEN, HOSPITAL STAY & OPERATING TIME

	Age	Hospital stay (days)	Stone burden	OP time (mins)
N	50	50	50	50
Mean	42.48	7.46	2.882	88.40
Std. Deviation	12.512	1.919	.4931	19.416
Minimum	11	6	2.5	70
Maximum	70	12	4.0	140
1 st Quartile	33.75	6.00	2.500	77.50
Median	44.00	7.00	2.700	80.00
3 rd Quartile	50.00	8.00	3.000	90.00

The mean age in the study group was 42.48 years. The average duration of hospital stay was 7.46 days (range of 6 to 12 days). The stone burden average was 2.882 cm with a minimum of 2.5 cm and a maximum of

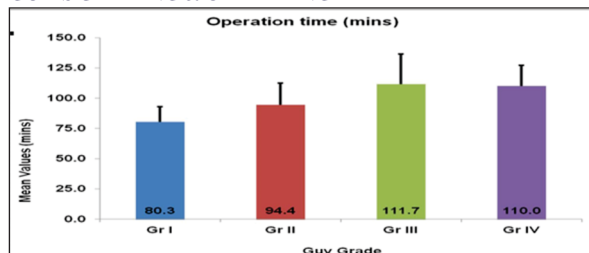
4cm. The mean operating time was 88.40 minutes (range of 70 to 140 minutes).

GUY'S GRADING AND MEAN HOSPITAL STAY



The mean hospital stay was 6.8 days for Guy's Gr I, it increased with Guy's Gr II 8.7 days and 9 days for Guy's Gr IV

GUY'S GRADING & OPERATING TIME



The mean operating times were 80.3 mins for Guy's Gr I, 94.4 mins for Guy's Gr II, 110 mins for Guy's Gr III and 110 mins for Guy's Gr IV

Clavien Grade		Guy Grade								Total	
		Gr I		Gr II		Gr III		Gr IV		N	%
None	1	7	21.9	2	22.2	0	0	0	0	9	18.0
	2	3	9.4	1	11.1	3	50.0	2	66.7	9	18.0
	3b	1	3.1	2	22.2	0	0	1	33.3	4	8.0
	4	0	0	1	11.1	1	16.7	0	0	2	4.0
	5	0	0	0	0	1	16.7	0	0	1	2.0
Total		32	100.0	9	100.0	6	100.0	3	100.0	50	100.0

Minor Complications like fever & Bleeding Common in Guy's Gr I & II.

Major Complications like sepsis, Death was seen in Guy's Gr III & IV.

There is a trend towards major complications with increasing Guy's grades

Test For Significance Of Guy's Grading With Residual Stones, complications, ancillary Procedures & Clavien Grades

Chi-Square Tests (Fisher's Exact Test)	Value	P-Value
Residual stone * Guy Grade	24.542	0.001
Complications * Guy Grade	30.930	0.001
Ancillary * Guy Grade	7.497	0.863
Clavien * Guy Grade	29.820	0.863

Guy's Grading had significant impact on stone free rate & complication rate. Significant if P<0.05.

One way ANOVA to compare mean Operation times between Guy Grades

Variables	Guy Grade	N	Mean	Std. Dev	P-Value
OP time (mins)	Gr I	32	80.31	12.822	0.001 significant
	Gr II	9	94.44	18.105	
	Gr III	6	111.67	24.833	
	Gr IV	3	110.00	17.321	
	Total	50	88.40	19.416	

Operating Time were minimal in low grades and increased with higher grades it was significant with $P < 0.05$

One way ANOVA to compare mean Hospital stay between Guy's Grades

Variables	Guy's Grade	N	Mean	Std. Dev	P-Value
Hospital stay (days)	Gr I	32	6.75	1.244	0.004 significant
	Gr II	9	8.67	2.179	
	Gr III	6	8.67	2.658	
	Gr IV	3	9.00	2.646	
	Total	50	7.46	1.919	

GUY's Grading had significant impact on the hospital stay with P value of 0.004.

(Significant since $P < 0.05$).

DISCUSSION

In spite of the high success rates, serious complications such as blood loss, adjacent organ injuries and lifethreatening infections can occur during percutaneous renal surgery. In a large study⁴ retrospective analysis of complications reported minor complications like fluid extravasation 7.2 % transfusion 11.2 – 17.5 % and fever 21.0 – 32.1 %, whereas major complications were septicaemia 0.3-4.7 % and colonic or pleural injury 0.03-3.1 %⁴. Modified Clavien grading system has been shown to be reliable tool for more objective outcome comparisons⁵. (Graefen M et al).

The overall complications rate of 50% was seen in our patients. Which is much higher than reported larger studies. That is 20.5 % (Rosette J et al)⁶. However in comparison to a similar prospective study by (Mandal S et al),⁷ they had an overall complication rate of 41.7% which is comparable to our study.

One reason for this could be the procedures were performed during the learning curve of surgeons⁸. Another reason could be the prospective nature of study. Complications of grade II severity was the most common.

Bleeding requiring blood replacement was most common individual complication, observed in 26 % of patients. This may be due to the poor body reserve of the low socio economic group of patients presenting to our hospital⁹. Blood transfusion was done if the haemoglobin level was below 8 gm percentage or as clinically assessed.^{10,11}

Open conversion was done to manage bleeding in 2 patients. Fever in the postoperative period was the second common complication seen in 16 % patients. Fever usually subsided with oral medication. Factors predisposing to fever after PCNL, include preexisting untreated urinary tract infection, infected urinary stones, duration of surgery¹².

Pleural injury was seen in one patient who had supracostal puncture which was managed by intercostal drainage and intensive care for few days.

Two patients had severe sepsis one recovered after intensive care, the other patient could not be revived. He died of sepsis superadded with cardiovascular complication. Septicemia can occur as a result of infection introduced via the access to the kidney or if the stones are infected^{6,7}.

Though the number of complications might seem to be high in our study however most of complications are minor, that is modified clavien grades 1 & 2 only, which were managed conservatively.

Stone free rate and Guy's stone score Grades (GSS)

As in previous study by Thomas et al.,^{2,3} the GSS precisely predicted the Stone Free Rate after PCNL. The stone free rate for GSS Grade I is 87.5% for Grade II is 22.2 %, Grade III 16.7% and Grade IV 0 %. This was statistically significant with $P = 0.001$. The complications rates were also minor, modified clavien grades 1 & 2 in majority of patients having low Guy's Stone score. There was a trend towards major complications as the GSS Grade increased.

The mean operating time for GSS Grade I 80 min and Grade IV is 110 min.

The mean hospital stay was also significantly low 6.8 days in GSS Grade I & 9 days in GSS Grade IV.

The main strength of the study is the prospective nature of the study.

The limitation of the present study is the small sample size.

CONCLUSION

In this study involving a relatively lesser number of cases from a tertiary care and resident training institute, the complication rates after PCNL was around 50 % mainly because of the learning curve in doing a new procedure. Most of the complications were minor which were treated conservatively.

The Guy's stones score predicted the stone free rates correctly with higher Guy's stones score needing ancillary procedures mainly in the form of extracorporeal shock wave lithotripsy for stone clearance.

Guy's stones score correlated well with the modified clavien system of grading for perioperative complications.

The Guy's stone score is easy to use and reproducible. It can be used as an objective and reliable method for describing the complexity of PCNL predicting the stone free rate, and stratifying cases between surgeons of different experience and reporting results.

Conflict of interest - None declared.

Source of Funding - None.

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