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Complications and Outcome of Percutaneous Nephrolithotomy (PCNL) procedures in our Institution: An Observational Study

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Abstract

Aim and Background: Percutaneous Nephrolithotomy (PCNL) is the primary treatment in renal stones more than 2 cms, staghorn calculi and diffult stone to fragment with ESWL. Outcome of stone disease with PCNL was studied here.

Materials and Methods: A prospective observational study was done in our institution to find the PCNL outcome/complications in relation to Guy's Stone Score (GSS). Statistical analysis was done by using Fisher's Exact Test, and ANOVA accordingly. P Value of <0.05 was considered significant.

Results: Total 50 PCNL were done. There were 25 males and 25 females. The mean age was 42.48 years. The mean stone burden average was 2.882 cm with a minimum of 2.5 cm and a maximum of 4 cm. Total complications noted was 25 (50%), but most were managed conservatively.

As the GSS score increases the residual stones, complications, operation time and length of hospital stay also increases (P Value <0.05).

Conclusion: Increase in GSS associated with increase in residual, complications, operation time and length of hospital stay.

Keywords: Percutaneous Nephrolithotomy; Complications; Outcome.

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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) is the primary modality to treat patients with large stones size more than 2 cms, obstructing kidney stones (e.g., staghorn calculi) or stones with composition resistant to fragmentation with extracorporeal lithotripsy. PCNL has now largely replaced open surgery as a safe and effective treatment for renal stones.[1]

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., 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.[2,3]

Materials and Methods

A Prospective observational study was done in Department of Urology, Government Mohan Kumaramangalam Medical College Hospital, Salem, during February 2017 to March 2019. Main objectives were to study the outcome of PCNL procedure in patients with renal stones and to study

the grading & complexity of PCNL procedures using "Guy's Stone Score".

Patients with renal stone undergoing surgery-Percutaneous nephrolithotomy in our department were included into the study. Patients not fit for surgery including bleeding diathesis, high cardiac risk, and infection/ sepsis were excluded.

The indications for surgery are studied and patient is taken up for the same after anaesthetic 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.

Guy's Stone Score (GSS)

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.

The complications were graded and stratified using Modified Clavien grading. (Grade 4a and 4b that is life threatening complications sepsis, organ injury,intensive care are commonly Graded 4 in our study).

Modified Clavien grading

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 anesthesia

Grade 3b: Intervention under general anesthesia

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.

Stone outcome, Complications, Operative time and Length of hospital stay were analysed.

Statistical analysis was done by using Fisher's Exact Test, and ANOVA accordingly. P Value of <0.05 was considered significant.

Results

Total 50 patients underwent PCNL during the study period. There were 25 males and 25 females. Lowest Age of Patient was 11 years and highest was 70 years.The mean age was 42.48 years. The meanstone burden average was 2.882 cm with a minimum of 2.5 cm and a maximum of 4 cm.

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.

In 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.

There was total of 25 complications noted in the 50 patients studied. Residual stones that are defined as those of size more than 4 mm were noted in 19 patients. These patients had to undergo ancillary procedures for stone clearances.

We usually did only a single puncture which were mostly subcostal. We did supracostal puncture in one patient who developed pleural injury who needed intercostal drainage and intensive care for recovery.

Fever was the presenting complaint in 8 patients; bleeding requiring only blood transfusion was seen in 11 patients and 2 patients needed open conversion for tackling the hemorrhage.A transient raise in serum creatinine was noted in one patient, which recovered with conservative management. Sepsis was seen in 2 patients who needed Intensive Care. 1 patient recovered after intensive care. 1 patient died of sepsis and associated cardiovascular condition (decreased Left ventricular function) in

the whole series [Figure.1].

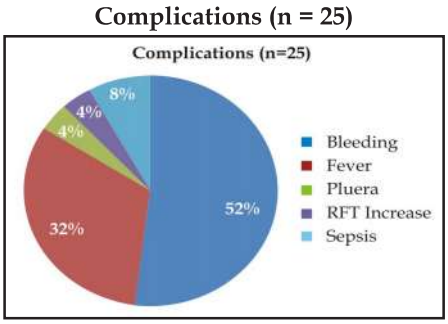

Fig. 1: Complications after PCNL

Residual stone was found in 19(38%) of paptients. Ancillary procedure was required in 18 of the 19 patients. 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. 5 cm). Re look nephroscopy was required in two patients and in two patients conversion to open procedure was done.

The mean operating time overall for all GUY grades was 88.4 min. The mean operating times were 80.3 mins for Guy's Gr I and 110 mins for Guy's Gr IV (Figure. 2)

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 (Table. 1 & 2).

Table. 1: Guy's Grading and Modified Clavien Grading Correlation.

		Guy Grade								Total	
		Gr I		Gr II		Gr III		Gr IV			
		N	%	N	%	N	%	N	%	N	%
Clavien Grade	None	21	65.6	3	33.3	1	16.7	0	.0	25	50.0
	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**

Table. 2: Test For Significance Of Guy's Grading With Residual, Complications, Ancillary Procedures & Clavien.

Chi-Square Tests (Fisher's Exact Test)	Value	P-Value
Residual * 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 with P value of <0.05.

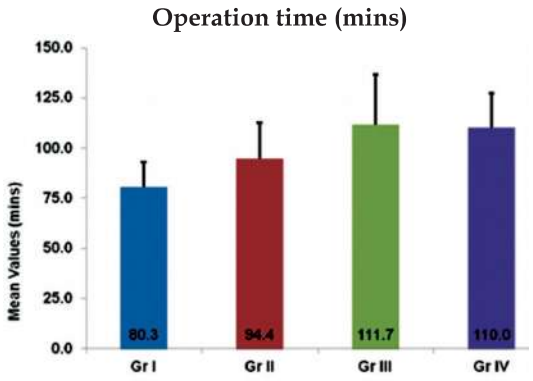

Fig. 2: GSS vs operation time.

The average duration of hospital stay was 7.46 days (range of 6 to 12 days). 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 (Figure. 3). As the GSS grade increase the number of days hospital stay also increase, which was statistically significant (Table.2).

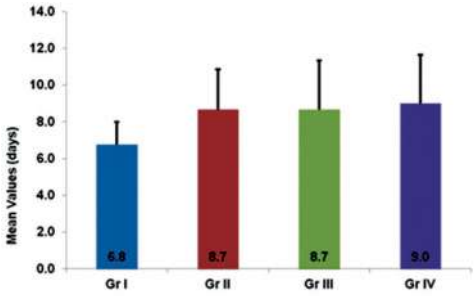

Fig.3: GSS Vs Hospital stay.

Table. 3: One way ANOVA to compare mean Hospital stay between Guy Grades.

Variables	Guy 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	

Table 4: One way ANOVA to compare mean Operation times between Guy Grades.

Variables OP time (mins)	Guy Grade	N	Mean	Std. Dev	P-Value
	Gr I	32	80.31	12.822	0.001
	Gr II	9	94.44	18.105	
	Gr III	6	111.67	24.833	Signiflcant

Gr IV	3	110.00	17.321
Total	50	88.4	19.416

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

Discussion

In spite of the high success rates, serious complications such as blood loss adjacent organ injuries and life threatening infections can occur during percutaneous renal surgery. In a large study 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% 30. Modified Clavien grading system has been shown to be reliable tool for more objective outcome comparisons.[4,5]

The overall complications rate of 50% was seen in our patients. Which is much higher than reported larger studies. That is 20.5 %. However in comparison to similar prospective study by,they had an overall complication rate of 41.7% which is comparable to our study.[6,7]

One reason for this could be the procedures were performed during the learning curve of surgeons. Another reason could be the prospective nature of study.[8]

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 hospital. Blood transfusion was done if the haemoglobin level was below 8 gm percentage.[9,10,11]

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 surgery.[12]

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.

As in previous study by Thomas et al., 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 is was statistically significant with $P < 0.001$.[2,3]

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. These findings were comparable with other studies done in other countries and in India.[13-17]

The main strength of the study is the prospective nature of the study.The limitations of the present study are the small sample size.

Conclusion

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 GSS 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.

GSS correlated well with the modified clavien system of grading for perioperative complications.

The GSS 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.

As the GSS increase operative time and length of hospital stay also increased.

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