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Outcome of PCNL- Success &Complications

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Abstract*: Percutaneous nephrolithotomy (PCNL) is now considered as the standard treatment for large and complex renal stones. The outcomes of PCNL can be interpreted in terms of success and complication rates. Recent attempts to report complication rates of PCNL have focused on stratifying them by severity by use of the Clavien Dindo grading system. The Guy's Stone Score (GSS) used to classify the burden of stones. This was a prospective study conducted by the department of Urology, NIMS hospital, Jaipur. In study of 508 PCNL cases, overall stone free status achieved in 88.72% of cases. Stone free status for GSS 1- 100%, GSS 2- 93.95%, GSS 3- 79.5%, GSS 4-39. In GSS 4 all cases were of staghorn calculus. Post- operative complications classified by the modified Clavien Dindo grading system. Fever was most common complication encountered (32.39%). Other frequent complications were haematuria requiring blood transfusion (24.88%), perinephrostomy urine leak (17.37%) and UTI requiring change of antibiotics (11.26%). Pneumothorax, post-operative JJ stent placement and clot retension requiring bladder wash were rare. Grade 4 and 5 complications were not encountered in our study.*

Keywords: *Clavien Dindo grading system (CD), complex renal stones, Guy's Stone Score (GSS), PCNL, Stone free status (SFS),*

I. Introduction

With the marked increase in the incidence and prevalence of renal stones, the use of percutaneous nephrolithotomy (PCNL) is now considered as the standard treatment for large and complex renal stones[1,2]

The outcomes of PCNL can be interpreted in terms of success and complication rates. "Success" is often defined as the absence of residual stone fragments under conventional X-ray or computed tomography (CT) or when clinically insignificant residual fragments (CIRF) are observed. Although large-series PCNL results have been reported in the literature, standardized evaluation of "complications" is lacking. Recent attempts to report complication rates of PCNL have focused on stratifying them by severity by use of the Clavien grading system. First proposed in 1992 and modified in 2004, the modified Clavien grading system has been validated in a cohort of 6,336 patients [3,4].The Guy's Stone Score (GSS) allow for objective assessment of kidney stones and predict outcomes of PCNL [5]. A multivariate analysis showed that the GSS was the only predictive factor of SFS as compared with stone burden, operating surgeon, weight, age, co-morbidity, and urine culture. Moreover, SFS correlated with increasing grade of GSS: I - 81%, II - 74.2%, III - 35%, and IV - 29%[6].

The present analysis of the database examined postoperative complications of the PCNL procedure using the modified Clavien classification system to find any correlation between the stone score and postoperative complications.

II. Material and Method

This was a prospective study conducted by the department of Urology, NIMS Hospital, Jaipur, India from August 2014 to June 2016. 508 patients with 514 renal units of 4-75 years of age were included in this study. Ethical clearance for this study was obtained from the Institutional Review Board. Co-morbidities such as renal insufficiency, diabetes, hypertension or cardiopulmonary diseases further increase the risk of complications and therefore patients with these problems were excluded from analysis [7,8]. Patient assessment included medical history, urine culture, renal function tests, intravenous urography (IVU), ultrasonography, and/or abdominal computed tomography (CT). Patient demographics, stone, and operative information were documented prospectively.

The stone burden was determined by radiographic studies, and stones were classified using the GSS as Guy's I, II, III and IV.[6] The score comprised four grades: Grade I, solitary stone in mid/lower pole or solitary stone in the pelvis with simple anatomy; Grade II, solitary stone in the upper pole or multiple stones in a patient with simple anatomy or a solitary stone in a patient with abnormal anatomy; Grade III, multiple stones in a patient with abnormal anatomy or stones in a caliceal diverticulum or partial staghorn calculus, and Grade IV, staghorn calculus or any stone in a patient with spina bifida or spinal injury.

Procedural technique- All PCNL procedures were performed in a teaching environment using the same technique under general anaesthesia and spinal anaesthesia. At first, patient placed in lithotomy position and retrograde access was obtained with ureteric catheter over guide wire. Then ureteral catheter was secured to a Foley catheter. The patient was repositioned prone with adequate padding under the pressure points of the head, chest, knees, and feet. Percutaneous access was obtained at the time of surgery by the operating urologist in all 514cases. Based on the stone location, size, burden, and pelvicalyceal anatomy, the site of calyceal entry and number of access tracts were chosen at the procedure's commencement. The architecture of the collecting system was delineated by contrast infused through the ureteral catheter with the patient prone. Two images are captured: One in the anterior-posterior plane and another in 30-degree lateral images. A bull's-eye technique was used to gain access directly into the centre of the papilla of the chosen calyx, once the patient was placed in the prone-flexed position. Once intrarenal access is obtained, guide wire is placed and the tract is sequentially dilated from 8F to 30Funder fluoroscopic guidance, and access into the collecting system is confirmed by rigid nephroscopy. Once access was gained, pneumatic lithotripter was used to fragment the stone. Tri-radiate forceps were used to render the patient stone free. For adult tract size 24-30 Fr &24 Fr tract for children was used..4.5Fr/5.5Fr double J stent placed in situ after procedure, every calyx was checked at the end of the procedure, residual stones were either within papillae or small and inaccessible via the available tract or tracts, where it was considered unreasonable to insert an additional tract. 16/20/24FR Nephrostomy tube kept in situ after procedure. Postoperatively, the nephrostomy tube was removed after 24-48 hours.

All patients were under antibiotic prophylaxis. Fever of >100° F was considered significant. Serum creatinine levels, blood counts and X-ray kidneys, ureters, and bladder were obtained in all patients postoperatively. If complete stone clearance was documented and the urine was not significantly hematuric, the nephrostomy tube was removed. After 12 h, if there was no urine leak from the nephrostomy site the urethral catheters was removed. DJ stent was removed after 2 to 3 weeks.

All patients were then followed up attwo week and at one month after discharge from the hospital. The PCNL procedure was considered successful if the patient was either stone-free or had any clinically significant residual stones (CIRFs), defined as <4 mm, non- obstructive, non-infectious, and asymptomatic residual fragments [9].

We assessed the age, sex, stone complexity score according to GSS, need for multitract, supra/sub costal access, stone free rate, operative duration, postoperative complications using the modified Clavien grading system, number of transfusion and hospital stay.

III. Statistical analysis

The data were entered into an Excel™ (Microsoft, Redmond, WA) database and analyzed with an EPI-Info statistical software package. Stone free status (figure 1) and complication rates of various GSS grades [Table 4] were compared using the chi-square test. *P* value < 0.05 was considered statistically significant.

IV. Results

In our final analysis of study of 508 PCNL cases, the patients' characteristics are shown in Table 1. Overall stone free status achieved in 88.72% of cases. Distribution of cases according to Guy's stone score is depicted in Table 2. Stone free status for GSS 1- 100%, GSS 2- 93.95%, GSS 3- 79.5%, GSS 4-39.13% shown in Figure 1. In GSS 4 all cases were of staghorn calculus (23 cases).

Table 1: Demographic variables

1	Number of patients	508
2	Renal units	514
3	Age mean (range)	34.3years (4 – 76 years)
4	M : F	2.14 : 1 (346/162)
5	Laterality (%)	Right – 59.92% (308) Left – 40.08% (206)
6	Puncture site (%)	Upper – 62.06% (319) Mid – 24.12% (124) Lower – 13.81 (71)
7	Multiple puncture (%)	20.04% (103)
8	Supracostal puncture	19.06% (98)
9	Bilateral pcnl in same sitting	6
10	Mean operating time (range)	83minutes (35 to 190 minutes)
11	Mean hospital stay (range)	3.5 days (2- 10 days)
12	Overall stone free status (%)	88.72%
13	Overall complications	In 111 patients (21.8%)

Table 2: Distribution of cases according to GSS

Grade	Categorization	Number of renal units	Percentage (%)
I	A solitary stone in the mid/lower pole, or renal pelvis with simple anatomy	148	28.79
II	A solitary stone in the upper pole with simple anatomy, multiple stones in a patient with simple anatomy, or any solitary stone in a patient with abnormal anatomy	182	35.40
III	Multiple stones in a patient with abnormal anatomy, stones in a calyceal diverticulum, or partial staghorn calculus	161	31.30
IV	Staghorn calculus or any stone in a patient with spina bifida or spinal injury	23	4.47

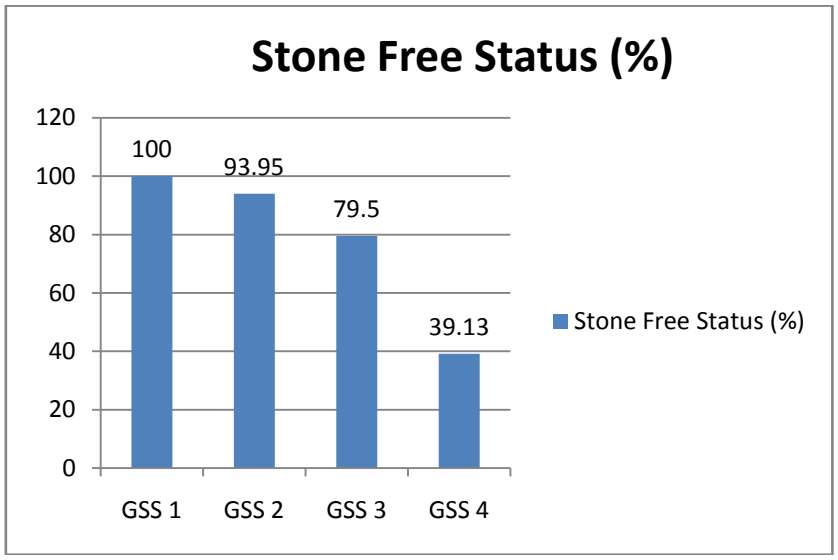

Figure 1: Stone free status (in percent) achieved in Guy's stone score (GSS) group 1-4 respectively.

Table 3 list post operative complications classified by the modified Clavien Dindo grading system. Total of 213 of complications experienced in 111 patients (21.8% of cases). Fever was single most common complication encountered (32.39%). Other frequent complications were hematuria requiring blood transfusion (24.88%), perinephrostomy urine leak (17.37%) and UTI requiring change of antibiotics (11.26%). Pneumothorax, post-operative JJ stent placement and clot retension requiring bladder wash were rare but serious complications comprising 14.60% of total complications. Need of Angioembolisation was seen in only one patient. Grade 4 and 5 complications were not encountered in our study.

Table 3: Distribution of post operative complications according to modified Clavien-Dindo grading system.

GRADE	COMPLICATIONS	NUMBER (213)	PERCENTAGE (%) of patients
I	Fever	69	13.58
II	Perinephrostomy urine leak	37	7.28
	Blood transfusion	53	10.43
	UTI requiring change of antibiotic	24	4.72
III A	Bleeding requiring angioembolisation	1	0.19
	Pneumothorax requiring chest tube insertion	13	2.56
III B	Post operative JJ stent placement for urine leak	9	1.7
	Retention due to blood clots	7	1.38

Relationship between modified claviendindo grading system and Guys' stone score:

Occurrence of different grades of complication encountered in patients with total cases in various GSS were compared and computed (See table 4).Overall complications were more for GSS 3 and GSS 4 (P<0.05).

Table 4: Comparison of complications in various Guys' stone score.

CD Grade	Total complications	GSS 1 (n=148)	GSS 2 (n=182)	GSS 3 (n=161)	GSS 4 (n=23)
Grade 1	69	3	12	40	17
Grade 2	114	1	33	62	18
Grade 3A	14	-	1	5	8
Grade 3B	16	1	4	6	5

Guys' stone score significantly predicts the outcome of PCNL in terms of Stone free status and complications. As Guys' stone score increases, SFS decreases and complications increase.

V. Discussion

For large and complex kidney stones PCNL is an important surgical intervention, and its success depends on several variables. Some of these can be predicted before surgery, i.e., stone burden and upper tract anatomy,but success also depends on surgical experience [10].

Several scoring systems have been developed for predicting the SFS after shock-wave lithotripsy, retrograde intrarenal surgery and PCNL [11,12].The Guy's stone score (GSS) includes stone number, location, presence of staghorn stones and abnormal anatomy to determine differentgrades, and it was reported that the SFS declinedwith increasing grades of complexity[13].

de la Rosette et al.,Desai et al., Mishra et al., Winfield et al., and Salaby et al. showed that stone-free rate was 75.7%, 82.5%, 72.7%, 86% & 74.8% respectively[2, 14-17**].** In our study overall stone free status(SFS) was 88.72%, of that GSS 1- 100%, GSS 2-93.95%, GSS 3- 79.5% and GSS 4- 39.13%. Hence, GSS fairly predicted the SFS after PCNL as in previous studies done by Thomas K et al [5] and also by Mandal S et al [13].

Outcome of PCNL requires not only success rate but also complication rates. To compare overall complication rates and the severity of complications, a standard grading system has been adopted. Tefekli et al first adopted the modified Clavien classification system to stratify complications of PCNL in 2007. In their series of 811 PCNLs, Tefekli et al reported overall complications in 29.2% patients [18].The CROES PCNL Global Study obtained data from 5803 patients at 96 study centers in Europe, Asia, North America, South America, and Australia for the total database. Clavien scores were collected for 5724 (98.6%) patients, of whom 1175 (20.5%) patients experienced one or more complications [2]. Overall complications were evident in 21.8% of patients in our study which is almost similar to previous studies.

Out of 213 complications 85.9% of our complications were grade 1 & 2 (minor) and rest 14.1% complications were grade 3 a & b (major). CROES study also showed that approximately 80% of complications were minor and only 20% were major [2].

Fever was single most frequent complication encountered in our study i.e. 13.58% of patients.Factors predisposing to fever after PCNL include preexisting untreated UTI, infected urinary stones, duration of surgery (< 90 min), amount and pressure of irrigation fluid.In the literature, fever is reported in up to 32% of cases after PCNL [19]. Both the AUA and EAU guidelines recommend antibiotic prophylaxis for all patients who are undergoing
PCNL [20, 21].

Among Grade 2 complications haematuria requiring blood transfusion was the top complication comprising of 10.43% of patients.Perhaps the most significant complication of PCNL, bleeding requiring transfusion has been reported to have an incidence as high as 23% [22]. In the CROES study, transfusion was administered in 5.7% of patients [19]. Bleedingcan occur in every step of PCNL from percutaneous access to tract dilation to stone disintegration [23]. Another reason for this higher transfusion rate could be a lower baseline haemoglobin level and consequently a lower reserve and threshold for transfusion.

Other grade 2 complication was transient peri-nephrostomy urine leak (7.28%). This complication was managed by simpledressing only.UTI requiring change of antibiotics seen in 4.72% of patients, urine samples were sent for culture and sensitivity and were found to be resistant to empirical antibiotic coverage.

Pneumothorax was noted in 13 cases (2.56%), all were supra-costal puncture. When the supracostal approach is performed, therisk of pneumothorax or pleural effusion requiring
drainage is 4% to 12% [24].Angio- embolization to control haematuria was required in only 1 patient.

Post- op JJ stent placement and cystoscopic colt evacuation for retension were noted in 1.7% and 1.38% of cases respectively. Both the procedures are routinely done under general anaesthesia in our set up, so considered as grade 3B complications. These major complications were marginally higher compared to CORES study [19]. Grade 4 and 5 were not noted in our study.

VI. Conclusions

Prior to surgery, patients should be provided with the most accurateinformation about their estimatedSFS and risk of complications.Categorizing of patients according to Guys' stone score (1- IV) helps urologist appropriatelycounsel patients regardingtheir likely postoperative clinicaloutcome and, in complex scenarios,refer patients to tertiary centers.

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