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# A PROSPECTIVE STUDY OF GRADING THE COMPLEXITY OF PCNL PROCEDURES USING GUY'S STONE SCORE

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**ABSTRACT** **Background:** Kidney stones are formed in the urinary tract due to crystallization of chemical compounds in the urine. PCNL is a technique used to remove certain stones in the kidney or upper ureter that are too large for other forms of stone treatment such as ESWL or ureteroscopy. **Objectives** To determine the relationship between demographic information, procedural details, and surgical outcome of percutaneous nephrolithotomy (PCNL) based on the GSS and its consequences. **Methods** A total of 200 renal stone patients who underwent PCNL were examined and included in the study. PCNL was performed using conventional methods. Guy's Stone Score (GSS) was determined urographically at CT. During the study, demographic data, preoperative and intraoperative findings, and postoperative outcomes were recorded, and finally the data of all parameters were compiled and compared with the different levels of Guy's Stone Score. Complications were graded using the modified Clavien score. **Results** Mean stone burden, fluoroscopy time (sec), operation time (min), hospital stay (days), and number of punctures increased significantly with increasing Guy grade. The residual stone, fever, postop. Hematuria, postoperative urine leakage (< 12 hrs), hydrothorax and urosepsis complication were significantly increased in the higher Guy grade. **Conclusions** The overall complication rate was 35%. The higher the Guy's grade, the more punctures there were and the more complications occurred. The Guy's Stone score is a useful tool for preoperative tool for counselling of patients because it reliably predicts the outcome of PCNL.

**KEYWORDS :** Kidney stone, PCNL, Guy's stone score, Clavien-Dindo classification

## INTRODUCTION

An important issue in primary care is nephrolithiasis. Depending on the size and location of the stone, the presence of symptoms, and the percentage of kidney stones that require surgery, between 10 and 20 percent of all kidney stones require surgical removal. Significant advances have been made in the treatment of kidney stones over the past 20 years [1]. In the majority of patients, open pyelolithotomy or nephrolithotomy, which was previously used to treat kidney stones, was associated with significant morbidity. Open surgery has now been largely superseded by percutaneous nephrolithotomy (PCNL) as a safe and effective method for treating kidney stones [2].

Although PCNL is less invasive, it is a major procedure that carries a high risk of serious sequelae and does not always relieve patients of their stones. Postoperative fever (21-32%) and bleeding requiring blood transfusion (11.2-17.5%) are the most common complications associated with PCNL [3]. The outcome of PCNL has been predicted by a number of characteristics, including stone diameter, stone burden, stone placement, or concomitant hydronephrosis. However, these features are either not reproducible or not precise enough when used individually [4].

In recent years, surgeons have recognised that the complexity of PCNL treatments that affect stone removal varies. A standardised approach to predicting SFR after PCNL has obvious advantages. It would facilitate objective assessment of technical changes [5].

A scoring system that is fast, simple, reproducible, and has a good correlation with SFR and complication rate would be the perfect way to predict outcomes after PCNL.

As a result, numerous nephrolithometric scoring systems, such as the nephrolithometric nomogram and the Seoul Renal Stone Complexity Score, have been developed using preoperative information such as stone size, stone location, renal anatomy, and overall patient health to predict surgical outcome. All were found to have comparable predictive accuracy of stone-free rate (SFR).

The Guy's Stone Score (GSS), a newer method with high reproducibility, is a simple classification system that can be used to predict SFR and complications [6]. The validity and predictability of the GSS have been demonstrated [7]. The GSS uses intravenous urography/ CT urogram and abdominal imaging to predict the success rate after PCNL. The GSS divided PCNL into four grades of difficulty (grade I to IV) based on the non-contrast scanning variable CT and medical history [8]. Despite advances in surgical equipment and procedures, preoperative consultation and surgical planning are crucial for both patients and surgeons [9-11].

Prior to performing PCNL, there are a number of assessment schemes, including the GSS, which was found to be easy to use when first introduced and showed a good correlation with success rates and complications [12]. The aim of this study is to determine the relationship between demographic information, procedural details, and surgical outcome of PCNL based on the GSS and its consequences.

## MATERIALS AND METHODS:

This single-centre prospective observational study included a total of 200 patients undergoing PCNL between July 1, 2021, and January 31, 2023, at the Department of Urology, King George's Medical University, Lucknow. Ethical approval was obtained from the institutional ethics committee (ref no - XI-PGTSC - IIA/P5). Patients with kidney stones who underwent percutaneous nephrolithotomy (PCNL) were included. Patients who were not suitable for surgery, had bleeding diathesis, were at high cardiac risk, and had infection/sepsis were excluded.

All patients gave informed consent. A total of 200 renal stone patients were examined and included in the study. After determining anesthesiologic eligibility, patients were admitted for surgery based on indications. PCNL was performed using conventional methods. Based on radiological examinations, patients were divided into four categories of 'Guy's Stone Score' and the modified Clavien-Dindo system were used to evaluate the results [7,8]. A baseline CT urogram/intravenous urogram, urine cultures, radiographs, and USG KUB were performed in each patient. The largest stone diameter (measured in mm) on a KUB radiograph or CT urogram was designated as the stone load. A 5-Fr ureteral catheter was placed retrograde with a 30-degree and 20-Fr cystoscope in the lithotomy position under spinal/general anaesthesia (in paediatric patients), followed by implantation of a Foley catheter (size according to patient age). The patient is then placed in the prone position. Contrast/air was administered through the ureteral catheter to define the collecting system. Under C-arm fluoroscopy, all punctures were performed between the paraspinal line and the posterior axillary line using an 18-G needle and the bull's-eye approach [Figure 1]. A 0.035-inch terumo guidewire was then inserted with the puncture needle. The unobstructed flow of urine over the needle and the precise placement of the Terumo guidewire under C-arm guidance served to confirm calyceal puncture. A 10 mm skin incision was made at the puncture site. The guide wire remained in the system, but the puncture needle was removed. The Alken cannula was used to dilate the puncture tract, and then a guide wire was inserted through the Alken sheath. Alken's sequential metal dilators were then used to expand the tract over the guide rod to 28 Fr [Figure 1] and implant an Amplatz sheath. After removal of the guide rod and sequential dilators, the rigid nephroscope (Karl Storz-22Fr) was inserted through the Amplatz protective sheath. With the aid of a Swiss pneumatic lithoclast master, lithotripsy was completed as soon as the stone could be seen. Using forceps or water pressure itself, the fragments were extracted. Fluoroscopy was performed to confirm complete removal. After insertion of a 22 Fr percutaneous nephrostomy drain and removal of the Amplatz sheath, a double J stent was implanted. A 1-0-fixed silk percutaneous nephrostomy drain was placed. The patient was then transferred to the postoperative ward. After confirmation of complete stone clearance on the control radiographic KUB, the PCN was removed on the second postoperative day, and the Foley catheter was removed on the third postoperative day. Patients were discharged from the hospital with a DJ stent and instructions to return in two weeks. After two weeks, the DJ stent was removed under local anaesthesia.

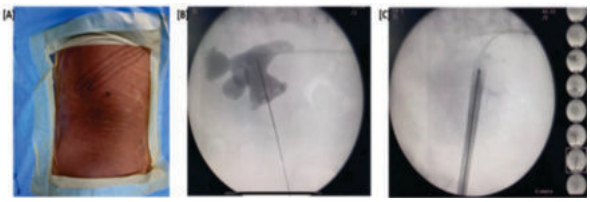

**Figure 1:** [A]Pucture site marked for Left infracostal puncture, [B] Picture Showing Lower Calyceal Puncture, and [C] Picture Showing PCNL Tract Dilatation under C-Arm Guidance

**Statistical Analysis:**

Statistical analysis was performed using SPSS version 23.0. Mean (standard deviation) and percentage (%) were used to present the data. Discrete variables were compared between groups using the independent t-test, while categorical variables were compared using the chi-square test. ANOVA was used to compare data from more than two groups. A p-value of 0.05 was considered significant.

**RESULTS:**

A total of 200 patients with kidney stones underwent PNCL. Patients were divided into 4 groups based on Guy's Stone Score. Of the 200 patients, a total of 111 (55.50%) were in grade I, 53 (26.50%) were in grade II, 25 (12.50%) were in grade III, and 11 (5.50%) were in grade IV.

The mean age of patients in grade I was 35.97, in grade II 35.02, in grade III 36.76, and in grade IV 45 years. The percentages of men and women were 66.67% and 33.33%, respectively, in grade I, 66.04% and 33.96%, respectively, in grade II, 72.00% and 28.00%, respectively, in grade III, and 54.55% and 45.45%, respectively, in grade IV. The percentages for left and right were 54.05% and 45.95% in grade I, 35.85% and 64.15% in grade II, 32.00% and 68.00% in grade III, and 63.64% and 36.36% in grade IV, respectively. The age, and sex of the stone were comparable between the different Guy grades (Table 1).

**Table 1: Association of age, gender and side of stone with different Guy Grade**

| | | Guy Grade | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Grade I (n=111) | | Grade II (n=53) | | Grade III (n=25) | | Grade IV (n=11) | | p-Value |
| | | Mean | ±SD | Mean | ±SD | Mean | ±SD | Mean | ±SD | |
| Age (years) | Mean±SD | 35.97 | ±13.17 | 35.02 | ±11.32 | ±36.76 | 11.52 | 45.00 | ±10.55 | 0.110 |
| Gender (n,%) | Male | 74 | 66.67% | 35 | 66.04% | 18 | 72.00% | 6 | 54.55% | X2=1.05 |
| | Female | 37 | 33.33% | 18 | 33.96% | 7 | 28.00% | 5 | 45.45% | p=0.789 |
| Side (n,%) | Left | 60 | 54.05% | 19 | 35.85% | 8 | 32.00% | 7 | 63.64% | X2=8.34 |
| | Right | 51 | 45.95% | 34 | 64.15% | 17 | 68.00% | 4 | 36.36% | p=0.039 |

The mean stone burden was 24.47±3.40 mm for grade I, 25.79±3.52 mm for grade II, 33.92±2.66 mm for grade III, and 44.36±2.77 mm for grade IV. Mean fluoroscopy time (sec) was 160.69±3.15 sec for grade I, 173.34±7.10 sec for grade II, 217.20±4.58 sec for grade III, and 236.00±3.58 sec for grade IV. Mean operative time (min) for grade I was 79.19±8.62, for grade II 83.11±8.50, for grade III 100.00±7.36, and for grade IV 117.00±7.28. 100% of patients in grade I and >had only 1 puncture, and 100% of patients in grade IV had 1 puncture. The percentages of 1 and > 1 puncture were 88.68% and 11.32% in grade II and 64.0% and 36.00% in grade III, respectively. Mean hospital stay (days) was 5.08±0.90 for grade I, 6.08±1.48 for grade II, 6.08±1.48 for grade III, and 8.36±1.75 for grade IV. Mean hospital stay (days) increased significantly with increasing Guy grade. Mean stone burden, fluoroscopy time (sec), operation time (min), hospital stay (days), and number of punctures increased significantly with increasing Guy grade (Table 2)

**Table 2: Association of mean Stone burden with different Guy Grade**

| | Guy Grade | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Grade I (n=111) | | Grade II (n=53) | | Grade III (n=25) | | Grade IV (n=11) | | p-Value |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | |
| Stone burden (mm) | 24.47 | 3.40 | 25.79 | 3.52 | 33.92 | 2.66 | 44.36 | 2.77 | <0.001 |
| Flouroscopy time(secs) | 160.69 | 3.15 | 173.34 | 7.10 | 217.20 | 4.58 | 236.00 | 3.58 | <0.001 |
| Operative Time (min) | 79.19 | 8.62 | 83.11 | 8.50 | 102.00 | 7.36 | 117.0 | 7.28 | <0.001 |
| No. of Puncture | | | | | | | | | |
| 1 | 111 | 100.00 | 47 | 88.68 | 16 | 64.00 | 0 | 0.00 | <0.001 |
| >1 | 0 | 0.00 | 6 | 11.32 | 9 | 36.00 | 11 | 100.00 | |
| Hospital stay (days) | 5.08 | 0.90 | 6.08 | 1.48 | 7.96 | 1.83 | 8.36 | 1.75 | <0.001 |

**Table 2b: post-hoc tukey test.**

| | Stone burden (mm) | | Flouroscopy time(secs) | | Operative Time (min) | | Hospital stay (days) | |
|---|---|---|---|---|---|---|---|---|
| Stone burden (mm) | Mean Difference | Sig. | Mean Difference | Sig. | Mean Difference | Sig. | Mean Difference | Sig. |
| Grade I vs Grade II | -1.32 | 0.083 | -12.65 | <0.001 | -3.92 | 0.028 | -0.996 | <0.001 |
| Grade I vs Grade III | -9.45 | <0.001 | -56.51 | <0.001 | -22.81 | <0.001 | -2.877 | <0.001 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Grade I vs Grade IV | -19.90 | <0.001 | -75.31 | <0.001 | -37.81 | <0.001 | -3.283 | <0.001 |
| Grade II vs Grade III | -8.13 | <0.001 | -43.86 | <0.001 | -18.89 | <0.001 | -1.881 | <0.001 |
| Grade II vs Grade IV | -18.57 | <0.001 | -62.66 | <0.001 | -33.89 | <0.001 | -2.287 | <0.001 |
| Grade III vs Grade IV | -10.44 | <0.001 | -18.80 | <0.001 | -15.00 | <0.001 | -0.405 | 0.813 |

The overall complication rate was 35%. The frequency of residual stones was 0% for grade I, 20.75% for grade II, 40.00% for grade III, and 81.82% for grade IV. The incidence of fever was 12.61% for grade one, 22.64% for grade II, 32.00% for grade III, and 36.36% for grade IV. The frequency of postoperative hematuria was 11.71% in grade I, 16.98% in grade II, 56.00% in grade III, and 81.82% in grade IV. The frequency of blood transfusion was 1.80% in grade I, 7.55% in grade II, 44.00% in grade III, and 63.64% in grade IV. The incidence of postoperative urine leakage (< 12 hrs) was 6.31% in grade I, 9.43% in grade II, 24.00% in grade III, and 36.36% in grade IV. The incidence of hydrothorax was 0.0% in grade I and grade II, 12.00% in grade III, and 0.0% in grade IV. The incidence of urosepsis was 0.0% in grade I, 0.0% in grade II, 4.00% in grade III, and 9.09% in grade IV. In addition, residual stone, fever, postop. Hematuria, postoperative urine leakage (< 12 hrs), hydrothorax and urosepsis complication were significantly increased the higher the Guy grade was (Table 3).

**Table 3: Association of Complication with different Guy Grade**

| | | Guy Grade | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Grade I (n=111) | | Grade II (n=53) | | Grade III (n=25) | | Grade IV (n=11) | | p-Value |
| | | n | % | n | % | n | % | n | % | |
| Complication | Yes | 29 | 26.13 | 17 | 32.08 | 15 | 60.00 | 9 | 81.82 | <0.001 |
| | No | 82 | 73.87 | 36 | 67.92 | 10 | 40.00 | 2 | 18.18 | |
| Residual stone | Yes | 0 | 0.00 | 11 | 20.75 | 10 | 40.00 | 9 | 81.82 | <0.001 |
| | No | 111 | 100.00 | 42 | 79.25 | 15 | 60.00 | 2 | 18.18 | |
| Fever | Yes | 14 | 12.61 | 12 | 22.64 | 8 | 32.00 | 4 | 36.36 | 0.040 |
| | No | 97 | 87.39 | 41 | 77.36 | 17 | 68.00 | 7 | 63.64 | |
| RFT increase | Yes | 5 | 4.50 | 4 | 7.55 | 0 | 0.00 | 1 | 9.09 | 0.478 |
| | No | 106 | 95.50 | 49 | 92.45 | 25 | 100.00 | 10 | 90.91 | |
| Postop. Hematuria | Yes | 13 | 11.71 | 9 | 16.98 | 14 | 56.00 | 9 | 81.82 | <0.001 |
| | No | 98 | 88.29 | 44 | 83.02 | 11 | 44.00 | 2 | 18.18 | |
| Blood transfusion | Yes | 2 | 1.80 | 4 | 7.55 | 11 | 44.00 | 7 | 63.64 | <0.001 |
| | No | 109 | 98.20 | 49 | 92.45 | 14 | 56.00 | 4 | 36.36 | |
| Wound infection | Yes | 4 | 3.60 | 3 | 5.66 | 2 | 8.00 | 1 | 9.09 | 0.714 |
| | No | 107 | 96.40 | 50 | 94.34 | 23 | 92.00 | 10 | 90.91 | |
| Post op urine leakage(<12 hrs) | Yes | 7 | 6.31 | 5 | 9.43 | 6 | 24.00 | 4 | 36.36 | 0.003 |
| | No | 104 | 93.69 | 48 | 90.57 | 19 | 76.00 | 7 | 63.64 | |
| Hydrothorax | Yes | 0 | 0.00 | 0 | 0.00 | 3 | 12.00 | 0 | 0.00 | <0.001 |
| | No | 111 | 100.00 | 53 | 100.00 | 22 | 88.00 | 11 | 100.00 | |
| Urosepsis | Yes | 0 | 0.00 | 0 | 0.00 | 1 | 4.00 | 1 | 9.09 | 0.011 |
| | No | 111 | 100.00 | 53 | 100.00 | 24 | 96.00 | 10 | 90.91 | |
| Death | Yes | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | - |
| | No | 111 | 100 | 53 | 100 | 25 | 100 | 11 | 00 | |

Clavien dindo grade 1 complication was 16.22% in GSS grade I, 18.87% in GSS grade II, 0 in GSS grade III and 18.18% in grade IV. Grade 2 complication was in 9.01% in grade I, 9.43% in grade II, 36% in grade III and 45.45% in grade IV. Grade 3 complication was 0 in grade I, 1.89% in grade II, 20% in grade III and 9.09% in grade IV. Grade 4 complication was 0 in grade I and II, 4% in grade III and 9.09% in grade IV. There was no grade 5 complication in any of the GSS grades. Modified clavien dindo complication grades were significant different in different Guy grades(Table 4).

The frequency of ESWL, Relook PCNL, Angioembolisation, ICD placement and no were 0.00%, 0.000%, 0.000%, 0.000%, and 100.00% in grade I, 13.210%, 7.550%, 1.890%, 0.000%, and 77.360%, in grade II, 20.000%, 8.000%, 8.000%, 12.000%, and 52.000% in grade III, and 54.550%, 18.180%, 9.090%, 0.000%, and 18.180% in grade IV, respectively. Moreover, the frequency of ESWL, Relook PCNL, Angioembolisation, ICD placement were significantly more in grade III and grade IV as compared to grade I and grade II (Table 4).

**Table 4: Association of Modified clavien dindo grade and Ancillary procedure with different Guy Grade**

| | | Guy Grade | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Grade I (n=111) | | Grade II (n=53) | | Grade III (n=25) | | Grade IV (n=11) | | p-Value |
| | | n | % | n | % | n | % | n | % | |
| Modified clavien dindo grade | 1 | 20 | 16.22 | 10 | 18.87 | 0 | 0.00 | 2 | 18.18 | X2=29.25 p<0.001 |
| | 2 | 10 | 9.01 | 5 | 9.43 | 9 | 36.00 | 5 | 45.45 | |
| | 3 | 0 | 0.00 | 1 | 1.89 | 5 | 20.00 | 1 | 9.09 | |
| | 4 | 0 | 0.00 | 0 | 1.89 | 1 | 4.00 | 1 | 9.09 | |
| | 5 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | |
| | NA | 82 | 73.87 | 36 | 67.92 | 10 | 40.00 | 2 | 18.18 | |
| Ancillary procedure | ESWL | 0 | 0.00 | 7 | 13.21 | 5 | 20.00 | 6 | 54.55 | X2=95.32 p<0.001 |
| | Relook PCNL | 0 | 0.00 | 4 | 7.55 | 2 | 8.00 | 2 | 18.18 | |
| | Angioembolisation | 0 | 0.00 | 1 | 1.89 | 2 | 8.00 | 1 | 9.09 | |
| | ICD placement | 0 | 0.00 | 0 | 0.00 | 3 | 12.00 | 0 | 0.00 | |
| | Nil | 111 | 100.00 | 41 | 77.36 | 13 | 52.00 | 2 | 18.18 | |

## DISCUSSION:

In this study, most patients (55.5%) had grade I, followed by grade II (26.50%) as grade III (12.50%), and least had grade IV (5.50%).An earlier study by Ferdian et al. (2020), reporting on GSS classification, found that 37.4% of patients had grade I, 32.8% had grade II, 14.1% of patients had grade III, and the rest had GSS grade IV. According to Jain et al (2020), 38% of students were in grade 1, 21% in grade 2, 28% in grade 3, and 13% in grade 4. Similar results were found in other studies (Khalil M, Sfoungaristos S), in which grade 1 was the most common (37% and 35.6%, respectively) and grade 4 the least common (13% and 10%, respectively).

In our study, the mean age of patients who received PCNL was 36.32 years. Mandal (2012) also found that the mean age of patients was 38.29 years. The results of another study by Kumar et al. (2018) showed that the average age of patients was 40.8 + 8.72 years. In

studies conducted in India, Jain et al. (2020) found that the average age of patients was 43.52 years, and Jaipuria et al. (2016) found that the average age of patients was 44.5 years.

In this study, there were 66.5% male patients and 33.5% female patients, a ratio of 2:1. Similarly, Kumar et al. (2018) found that there were 298 males and 147 females, giving a male-to-female ratio of 2.027. According to Jain et al. (2020), the male-to-female ratio was 2:1. According to Ferdian et al. (2020), males accounted for the majority of cases (55.56%).

In this study, the majority of patients (82%) underwent single puncture surgery. There were significantly more punctures with increasing gradient. According to Jain et al (2020), only a single calyx puncture was performed in 64% of patients. However, some patients require more than one puncture due to the structure of the pelvis and calices and stones in different calices. According to Guy's Stone Score, more punctures are performed as the severity of kidney stones increases (p 0.0001). In all three studies (Sfoungaristos et al., 2015; Ingmarsson et al., 2015; and Thomas et al., 2011), a single procedure was performed in the majority of patients.

In our study, mean fluoroscopy time (in seconds) increased significantly with increasing grade. Similarly, Ferdian et al. reported a mean fluoroscopy time of 155.17 ± 110.036 s or about 2-3 minutes in the simple group (I, II) and 188.92 ± 123.806 s or about 3 minutes in the complex group (III,IV) [73]. Another study reported that fluoroscopy time was 10.25 ± 6.34 min for GSS I, 12.07 ± 7.10 min for GSS II, 14.87 ± 7.85 min for GSS3, and 17.23 ± 8.46 min for GSS4 ($P < 0.001$). Moreover, the mean fluoroscopy time increased significantly with increasing GSS grade (I- IV), similar to our study. In contrast, Vollstedt et al. (2019) found no correlation between GSS grade and fluoroscopy time. The reason for the increase in fluoroscopy time with increasing GSS grades may be attributed to the increase in operating time, the difficulty of guiding the guidewire into domes with higher stone loads, and the need for more punctures with increasing GSS grades.

In this study, the mean operative time (min) increased significantly with higher Guy grades. This could be due to greater stone load and increasing stone complexity with increasing GSS grades (I- IV). Similarly, one study reported that surgical time increases with increasing grade (I- IV). The operation time for GSS I, GSS II, GSS III, and GSS IV were 69.5 min, 111.4 min, 128.2 min, and 153.9 min, respectively. Another study showed that gross and total operation time increased as the patient's GSS grade increased. In a meta-analysis, the mean duration of PCNL operation was 167 min, and the analysis test showed a strong correlation between GSS grade and PCNL operation time. The mean and range of operation time appeared to increase with increasing Guy's Stone score ($p < 0.001$). Compared with grade IV (127.31 min), the mean operation time for grade I is 72.97 min.

In this study, blood transfusions were much more common in grades III and IV than in grades I and II, respectively. Similarly, one study reported that changes in GSS score were significantly related to the amount of blood transfusions required. According to one study, there were no discernible differences in the number of blood transfusions required between GSSs, suggesting that blood loss was most likely related only to stone composition.

The higher blood transfusion rates in our study in complex stones (III-IV) compared with simple stones can be explained by more severe injury to the pelvicalyceal system with higher stone burden, more frequent postoperative hematuria, longer operative time, and higher number of punctures in complex stones compared with simple stones. In addition, some patients required repeated punctures, resulting in transfusion of blood for reconstruction.

In this study, the overall complication rate was 35%. Moreover, the complication rate was higher for complex stones (III, IV) than for simple stones (I, II). Several previous studies also support this finding, with complication rates of 77%, 37.9%, 38%, and 32%. In another study, the overall complication rate was 41.7%, slightly higher than in our study.

In our study, the complication rate decreased with increasing grade. Moreover, complications were most common in grade 1. Our result was supported by several previous studies that found that the complication rate decreased with increasing grade. Only Mandal et al. reported grade 2 complications, which occurred in most patients.

In our study, most complications were minor, i.e., modified clavien grade 1 and 2, which were treated conservatively. Moreover, the different types of complications such as fever, RFT rise, postoperative hematuria, wound infection, postoperative urine leakage (< 12 hrs), hydrothorax, urosepsis and death were 19.00%, 5.00%, 22.50%, 5.00%, 11.00%, 1.50%, 1.00% and 0.00% respectively. In addition, postoperative hematuria, fever, urine leakage (< 12 hrs) were significantly more frequent in grades III and IV compared with grades I and II. RFT increase and wound infections were more frequent in grade IV but not significantly different. Hydrothorax was observed in only 3 patients with GSS grade III, which was treated with an ICD intraoperatively in 1 patient and in 2 patients at LA on the 1st POD. Urosepsis occurred in 1 patient with grade III and in 1 patient with grade IV. Both patients were treated in the ICU with higher antibiotic administration, ionotropic support, and other supportive measures. No death was observed in any of the grades during our study.

Jain et al (2020), Sfoungaristos et al, and Thomas et al had comparable results in terms of complications. In all three studies, grade 4 and 5 complications did not occur. Jaipuria et al. had grade 4A complications (0.33%), grade 4B complications (0.16%), but no grade 5 complications. Ingimarsson et al. had 4% grade 4 complications but no grade 5 complications. Mandal et al. had grade 4A (2.1%), grade 4B (1.4%), and grade 5 (0.3%). Most studies had at most one grade 1 complication, as did we, with the exception of Mandal et al. with grade 2 complications.

Jain et al (2020) showed that fever (15%) was the most common complication, similar to other studies such as Mandal et al (15%) and Thomas et al (13%). Jaipuria et al. had the lowest number of patients with fever at 2.64%. In the Thomas et al. study, 5% of patients had pain, whereas in our study it was 2%. In the study of Thomas et al, two percent of patients had urinary retention, while it was only one percent in our study. Leakage at the nephrostomy site was most common in the study by Mandal et al. (10.1%) and least common in the current study (2%). Five percent in the Thomas et al. study and one percent in the Jaipuria et al. study (2020) had gallbladder injury and 1.6% in the Jaipuria et al. study had colon injury. Mandal et al. had a mortality rate of 0.3% and Jaipuria et al. of 0.16% MODS. Jain et al (2020) also found no patient who had MODS / death.

In this study, no additional procedure was performed for grade I. The frequency of ESWL, relook PCNL, angioembolization, and ICD insertion was significantly higher in grade III and grade IV than in grade I and grade II. Jain et. al.72 reported additional procedures in 10% of patients, Thomas K et. al.8 in 24% of patients, and Khalil M et. al. in 21% of patients.69

In our study, the mean hospital stay (days) was 5.08±0.90 for grade I, 6.08±1.48 for grade II, 7.96±1.83 for grade III, and 8.36±1.75 for grade IV. With increasing Guy grade, the average hospital length of stay (days) increased significantly. According to Jain et al (2020), the average hospital stay for Sfoungaristos S (5.90 2.11) was slightly shorter at 4.34 days. When comparing different studies, the percentage of residual stone ranged from 10% to 38%. In Ingimarsson, the percentage was the lowest (10%), in Thomas K the highest (38%), and in the present study it was 15%. Compared with other studies, the fewest additional interventions were required in this study (10%). A maximum of 24% additional interventions were required in Thomas K9. In addition, Khalil M. (21%) and Jaipuria J. (16.3%) required additional interventions. Hospital stay was 2.3 days. The length of stay was the same for all classes according to Ferdian et al (2020).

## CONCLUSION:

We concluded that the mean stone burden, fluoroscopy time (sec), operation time (min), hospital stay (days), and number of punctures increased significantly with increasing Guy grade. The overall complication rate was 35%. The residual stone, fever, postop. Hematuria, postoperative urine leakage (< 12 hrs), hydrothorax and urosepsis complication were significantly increased the higher the Guy grade.

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