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ORIGINAL ARTICLE

SUCCESS RATE & COMPLICATIONS OF PCNL IN NEPHROLITHIASIS PATIENT AT HASAN SADIKIN GENERAL HOSPITAL

Lambok Kevin Stein¹, Ferry Safriadi²

¹Urology Department Padjajaran University, Hasan Sadikin General Hospital, Bandung,
West Java, Indonesia

²Urology Consultant of Urology Department Padjajaran University, Hasan Sadikin
General Hospital, Bandung, West Java, Indonesia

*Corresponding author : Lambok Kevin Stein, Urology Department Padjajaran
University, Hasan Sadikin General Hospital, Bandung, West Java, Indonesia, email :
lambokkevinstein2@gmail.com

ABSTRACT

Background and Aim: Percutaneous Nephrolithotomy (PCNL) has become the standard management for kidney stones, offering high success rates despite its invasiveness. However, PCNL entails risks, including complications such as infection and bleeding. This study aims to evaluate the complications and success rates of PCNL in nephrolithiasis patients, providing essential insights for clinical decision-making. **Methods:** This observational study at Hasan Sadikin General Hospital assessed patients undergoing Percutaneous Nephrolithotomy for nephrolithiasis. Data collection included demographic details, stone parameters, and postoperative complications, with statistical analysis performed to identify associated factors. **Results:** the study conducted at the Urology Department of RSHS Bandung from January to December 2023 revealed an incidence of 80 nephrolithiasis cases. Predominantly, 67.5% of patients were male, with the majority falling in the age group above 50 years (63.7%). Multiple stones were the most common (55%), with stone sizes ≥ 1.5 cm prevalent in 95% of cases. Left-sided stones (43.75%) were most frequent, followed by right-sided (36.25%) and bilateral stones (20%). Hydronephrosis complications were present in 36.25% of cases. Stone clearance was 100% in GSS grade 1 cases, while GSS grade 4 cases exhibited the lowest stone clearance rate at 45.45%. **Conclusion:** This study reveals significant insights into nephrolithiasis demographics, stone characteristics, and postoperative outcomes. Male predominance, multiple stones, and high rates of stone clearance and postoperative complications, particularly in Guy's score 2 cases, highlight the need for tailored management strategies and further research in this field.

Keywords: Complication, Nephrolithiasis, Percutaneous Nephrolithotomy, Success Rate

TINGKAT KEBERHASILAN DAN KOMPLIKASI PCNL PADA PASIEN NEFROLITIASIS DI RS HASAN SADIKIN BANDUNG, INDONESIA

ABSTRAK

Latar Belakang dan Tujuan: Percutaneous Nephrolithotomy (PCNL) telah menjadi standar manajemen untuk batu ginjal, menawarkan tingkat keberhasilan yang tinggi meskipun invasif. Namun, PCNL memiliki risiko, termasuk komplikasi seperti infeksi dan pendarahan. Studi ini bertujuan untuk mengevaluasi komplikasi dan tingkat keberhasilan PCNL pada pasien nefrolitiasis, memberikan wawasan penting untuk pengambilan keputusan klinis. **Metode:** Studi observasional di Rumah Sakit Umum Hasan Sadikin menilai pasien yang menjalani Percutaneous Nephrolithotomy untuk nefrolitiasis dengan analisis deskriptif. **Hasil:** Total sampel terdiri dari 80 kasus nefrolitiasis. Secara dominan, 67,5% pasien adalah laki-laki, mayoritas berusia di atas 50 tahun (63,7%). Batu multiple paling umum (55%), dengan ukuran batu $\geq 1,5$ cm dominan pada 95% kasus. Batu di sisi kiri (43,75%) paling sering, diikuti oleh batu di sisi kanan (36,25%) dan bilateral (20%). Komplikasi hidronefrosis hadir pada 36,25% kasus. Komplikasi postoperatif, masuk dalam kategori Clavien I, dengan kasus Guy's Score 2 menyumbang 37,5% dari komplikasi tersebut. Perlu dicatat, tidak ada kasus komplikasi Skala Clavien II atau IV yang diamati. **Kesimpulan:** Dominasi laki-laki, adanya batu multiple, dan tingkat tinggi stone clearance dan komplikasi postoperatif, terutama pada kasus Guy's score 2, menyoroti perlunya strategi manajemen yang disesuaikan dan penelitian lebih lanjut di bidang ini.

Kata kunci: Komplikasi, Nefrolitiasis, Percutaneous Nephrolithotomy, Tingkat Keberhasilan

Introduction

Nephrolithiasis is a urological disorder with a considerable morbidity rate, potentially leading to fatal kidney failure.¹ Its prevalence in the United States has risen from approximately 3% in 1980 to 10% in 2010, while in Indonesia, it affects 6 per 1,000 individuals, making it the third most common urological condition. Individuals aged 30-50 years are most vulnerable to kidney stones, with males being more affected than females.²⁻³ While not all kidney stone episodes require treatment, surgical intervention is necessary when stones are symptomatic, causing obstruction, infection, or jeopardizing kidney function.

Percutaneous Nephrolithotomy (PCNL) has emerged as the preferred method for removing kidney stones, especially those larger than 20 mm, complex stones, or stones resistant to other treatments.^{1,5-6} Despite its effectiveness, PCNL accounts for only 5% of stone-related procedures due to its invasive nature, higher complication rates, and technical demands compared to other methods like ureteroscopy or Extracorporeal Shock Wave Lithotripsy (ESWL). PCNL is associated with various complications ranging from mild, such as fever or nephrostomy tube leakage, to severe, including organ injury, pleural injury, bleeding, and infection.^{1,7-8}

Understanding the success rates and complications of PCNL is crucial for clinicians in selecting the appropriate surgical approach. The modified Clavien complication scale is an effective tool for assessing complication levels. Furthermore, Guy's score system aids in educating patients about stone-free rates and surgical prognosis.⁹ PCNL boasts the highest stone-free rate and lower rates of additional procedures and retreatment compared to ESWL or other methods.^{4,9} A study in Bandung

involving 174 patients reported a PCNL stone-free rate (SFR) of 94.7% in the prone position and 91.3% in the supine position.¹⁰ Another study reported SFRs ranging from 85 to 93%.⁵ Thus, this study was purposed to assessing the complications and success rates of PCNL in nephrolithiasis patients.

Methods

This study employed a descriptive observational research design, utilizing a cross-sectional approach where data collection and measurement occurred at a single time point. The research was conducted at the Department of Urology, Hasan Sadikin General Hospital in Bandung, from January 2023 to December 2023. Inclusion criteria encompassed all cases scheduled for PCNL who were willing to participate in the study by signing the informed consent form. Exclusion criteria consisted of cases converted to open surgery, cases with radiolucent stones, pregnant women, individuals with comorbidities and bleeding disorders, and those unwilling to participate in the study.

The minimum sample size was calculated using the formula for Estimating a Population Proportion with Specified Absolute Precision with estimated sample minimum needed was 72 samples. The subjects included in this study were all patients diagnosed with nephrolithiasis who met the inclusion criteria and were scheduled to undergo PCNL at the Hospital. Laboratory tests, including creatinine, bleeding time, clotting time, and urine culture, were conducted. Radiological evaluation was performed using various imaging modalities such as Kidney Ureter and Bladder X-ray (KUB), Intravenous urography (IVU), computed tomography intravenous urogram (CT IVU), ultrasonography, or Non-Contrast Computerized Tomography (NCCT) when necessary.

Data collection involved gathering relevant demographic and clinical information from medical records, including age, gender, stone size and location, comorbidities, intraoperative details, postoperative outcomes, and complications. Stone size and location were determined based on radiographic findings and classified using the Guy's Stone Score (GSS). Postoperative evaluation was performed using KUB X-ray on the first day post-operation. Stone clearance (<4mm) and absence of significant hematuria indicated

the potential removal of the nephrostomy tube after 48-72 hours post-operation. Removal of the Foley catheter was considered if no urinary leakage was detected from the nephrostomy site after 48 hours post-operation. Data processing included data checking, coding, entry, processing, and normalization. Basic data such as age, gender, GSS score, postoperative stone clearance, and operation duration were collected. Statistical analysis was performed using SPSS 22 to identify factors associated with PCNL success and complications.

Results

The study focused on the characteristics of gender, age, stone count, stone size, stone location, and hydronephrosis, conducted over a period of 1 year from January 2023 to December 2023 at the Department of Urology, Hasan Sadikin General Hospital, Bandung. The sample consisted of 80 individuals. The sample comprised patients diagnosed with nephrolithiasis who underwent Percutaneous Nephrolithotomy (PCNL) at Hasan Sadikin General Hospital, Bandung, between January 2023 and December 2023, and who met the inclusion and exclusion criteria. The General Characteristics are presented in Table 1.

Table 1. General Characteristics of the Study

Variables	n (%)	Mean
Gender		
Male	54(67,5)	(-)
Female	26 (32,5)	
Age		
1. 18-29 Years	3(3,8)	
2. 30-39 Years	5(6,25)	
3. 40-49 Years	21(26,3)	52,85
4. > 50 Years	51(63,7)	
Stone Count		
- Single	36 (45)	
- Multiple	44 (55)	
Stone Size		
- <1,5cm	4(5)	
- ≥1,5cm	76(95)	
Stone Burden	88,196	
Stone Location		
- Right	29 (36,25)	
- Left	35 (43,75)	
- Bilateral	16(20)	
Hydronephrosis		
- Present	29(36,25)	
- Absent	51 (63,75)	
BMI		
Underweight	2 (1,25%)	
Normoweight	49 (61,25%)	23.57
Overweight	24 (30%)	
Obesitas	5 (6,25%)	
Stone Composition		
Urea		31,52
Creatinine		2
Calcium		5,015
Phosphate		5,60
Uric Acid		5,67

The incidence of nephrolithiasis at the Urology Department of RSHS Bandung from January 2023 to December 2023 was recorded as 80 cases. Based on this data, out of the total of 80 patients, the majority, comprising 54 individuals (67.5%), were male, while 26 patients (32.5%) were female. The majority of respondents belonged to the age

group above 50 years, totaling 51 patients (63.7%), followed by the age group of 40-49 years with 21 individuals (26.3%), and the age group of 18-29 years with 3 individuals (3.8%).

The data also revealed that the most common stone count was multiple stones, with 44 patients (55%). The majority of cases, 76 patients (95%), had stone sizes ≥ 1.5 cm. The most common stone location was on the left side (35 patients / 43.75%), followed by the right side (29 patients / 36.25%), and bilateral (16 cases / 20%). In this study, 29 patients (36.25%) were found to have hydronephrosis complications.

The Postoperative success is examined by comparing Guy's Stone Score (GSS) with stone clearance and presented in Table 2.

Table 2. Postoperative success by comparing GSS with stone clearance

No.	Grade	N %	Stone clearance
1	1	19 (23,75)	100
2	2	30 (37,5)	66,67
3	3	20 (25)	85
4	4	11 (13,75)	45,45

From this study, it is evident that the entirety of GSS grade 1 cases exhibited a stone clearance rate of 100%. The lowest stone clearance prevalence, at 45.45%, was observed in GSS grade 4 cases. In this study, postoperative complications were meticulously categorized according to the Clavien Scale, a comprehensive grading system widely utilized for surgical complications assessment. The detailed classification of these

complications can be found in Table 3, providing a comprehensive overview of the postoperative outcomes observed in the study cohort.

Table 3. Postoperative complications according to the Clavien Scale

	Clavien I	Clavien II	Clavien III	Clavien IV
<i>Guy's</i>	22,5	-	1,25	-
<i>Score 1</i>				
<i>Guy's</i>	37,5	-	-	-
<i>Score 2</i>				
<i>Guy's</i>	25	-	-	-
<i>Score 3</i>				
<i>Guy's</i>	13,75	-	-	-
<i>Score 4</i>				

Based on Table 3, the majority of cases experienced postoperative complications classified as Clavien Scale I. Among these, the majority of cases with postoperative complications classified as Clavien I were those with a Guy's Score of 2, accounting for 37.5%. Additionally, 1.25% of cases with Guy's Stone Score 1 experienced postoperative complications classified as Clavien III. No cases of postoperative complications classified as Clavien II or Clavien IV were found.

Discussion

Age plays a significant role in the occurrence of nephrolithiasis, with the highest incidence observed in individuals aged 50-60 years globally, particularly among males.⁵ This observation aligns with our study findings, where the majority of cases were over 50 years old (63.7%). The prevalence shift towards older age groups may be attributed to various factors such as occupation and lifestyle choices. Notably, obesity (BMI ≥ 30 kg/m²) significantly increases the incidence of nephrolithiasis in the elderly, possibly due to heightened levels of uric acid nephrolithiasis in obese individuals. While most of our

patients had a normal BMI, approximately 36.25% of cases had a BMI above the normal range, suggesting a correlation between BMI and nephrolithiasis occurrence. Additionally, increased excretion of calcium, oxalate, and uric acid in urine elevates the risk of calcium kidney stone formation, as evidenced by the biochemical profile found in our study.¹¹

The gender disparity in nephrolithiasis is notable, with a prevalence two to three times higher in men than in women globally.¹¹ This trend is consistent with research findings, including studies in Korea and NHANES data from the United States.¹¹ However, the prevalence gap between men and women seems to be narrowing over time, with continuous increases observed in female prevalence across various studies and annual cycles.¹¹ Our study's findings contribute to this understanding, highlighting a stable male prevalence but a rising female prevalence, particularly among those under 60 years old. The role of estrogen in reducing kidney stone recurrence in postmenopausal women underscores the importance of hormonal factors in nephrolithiasis development.¹²

Our study also sheds light on the distribution of stone characteristics, with multiple stones being the most prevalent (44%) and the majority of cases having stone sizes ≥ 1.5 cm. Left-sided stones were more common than right-sided ones, and hydronephrosis was present in 36.25% of cases. Stone clearance rates varied across Guy's Stone Score (GSS) grades, with GSS grade 1 cases achieving a 100% stone clearance rate. However, the lowest stone clearance prevalence (45.45%) was observed in GSS grade 4 cases, indicating the influence of stone complexity on treatment outcomes.

The adoption of standardized assessment systems, such as GSS and S.T.O.N.E. nephrolithometry, is crucial for predicting treatment outcomes and guiding patient counseling. These systems facilitate uniform reporting and comparison between different surgical techniques and institutions.¹³ Despite the significance of stone complexity in treatment outcomes, our study¹ did not find a significant relationship between stone complexity and postoperative complications, consistent with previous research findings. Moving forward, further investigation into the predictive value of assessment systems and their impact on treatment outcomes is warranted to enhance clinical decision-making in nephrolithiasis management.

Thomas et al. found that GSS has good reproducibility, with good inter-rater agreement. Several researchers have reported a strong correlation between GSS and stone-free rates. Thomas et al., who proposed the GSS, reported success rates of 81%, 72.4%, 35%, and 29% for GSS 1, 2, 3, and 4, respectively. Other authors have reported stone-free rates ranging from 93.9% to 100% for GSS 1, 85.71% to 97% for GSS 2, 90.17% to 100% for GSS 3, and 60% to 77.77% for GSS 4. Overall success rates ranging from 62% to 97.73% have been given¹ in different studies validating the GSS.¹⁴

In a retrospective study by Kumsar et al. comparing GSS and S.T.O.N.E., stone-free rates¹ were 90%, 96%, and 34% in the GSS 1, 2, and 3 groups, respectively. Some authors have also found GSS based on CT scan to be effective in predicting the success rates of PCNL. Okhunov et al. recently introduced the STONE score, and retrospective studies have validated it in predicting PCNL success rates. Only one prospective study also supported this.¹⁴

Labadie et al. in their retrospective comparative study found that low GSS and STONE scores were significantly associated with stone-free rates ($P = 0.002$ and 0.004), and both systems also correlated with blood loss and length of hospital stay. Both assessment systems have good predictive value for stone-free status.^{15,16}

In our study the majority of cases experienced postoperative complications at the Clavien I scale. Most cases experiencing postoperative complications at the Clavien I scale were GSS 2 cases, at 37.5%. There were 1.25% of cases with GSS 1 experiencing postoperative complications at Clavien III scale. No cases of postoperative complications at the Clavien II or Clavien IV scales were found. According to a study by Shaheem et al., complications after PCNL measured based on the significantly modified Clavien Dindo scale were associated with GUY stone scores (p-value 0.007) and STONE scores (p-value 0.005).¹⁷

Thomas et al. in their initial study did not find a relationship between GSS and PCNL complications. Nouredin et al. showed that GSS and S.T.O.N.E scores were not associated with intraoperative complications. Vicentini et al. demonstrated in their study that GSS was associated with post-PCNL complications. Singla et al. in their study showed a weak relationship between all three assessment systems and modified Clavien Dindo scores.^{14,17}

Both the GSS and STONE nephrolithometry assessment systems are equally effective with AUCs of 0.68 and 0.72, respectively, in predicting SF status. The research shows that STONE and GSS scores demonstrate a positive correlation with perioperative complications. The study has a lower overall complication rate measured with the modified Clavian scale compared to Thomas et al. with an overall complication rate of

52% and Okhunov et al. with 21% overall complication rates. The determined results from the global CROES PCNL study show an overall SFR of 75.5% and a complication rate of 20.5%. Blood transfusion requiring bleeding is the most common complication observed in the study and seen in 3.1% of patients, lower than the 5.7% transfusion rate reported in the CROES study.¹⁸

² Guy Stone Score (GSS) is a simple and reliable tool for predicting success rates. GSS is mainly used in kidney, ureter, bladder (KUB), and intravenous urography (IVU) films to predict success rates after PCNL. Several studies have reported the use of computed tomography scans to estimate GSS for greater accuracy. CT scans are used as preoperative examinations in stone patients, enhancing the accuracy of stone and kidney anatomy and collection system information. Vicentini and colleagues used the Guy's Stone Score (GSS) to predict percutaneous nephrolithotomy outcomes in the supine position based on preoperative computed tomography scans in 155 kidney cases. They confirmed the usefulness of the GSS tool based on CT findings in accurately evaluating kidney stone-related surgical outcomes and complications.¹⁸

² Lojanapiwat et al. affirm that GSS based on KUB and intravenous urography is a valuable tool in predicting outcomes and complication rates after PCNL via the upper pole. Direct success rates, operation time, tubeless rate (uncomplicated procedure rate), and major complications differ significantly in each GSS group.¹⁸ Research shows that plain KUB and intravenous urography are equally useful in informing GSS score classification assessments as CT scans. The results of the Lojanapiwat et al. study show a correlation of GSS levels with PCNL outcomes via upper pole access and complications in a large number of patients.¹⁸

Conclusion

In conclusion, Male predominance of PCNL patient was observed, comprising 67.5% of the study population, and the majority of cases occurred in individuals aged over 50 years. Multiple stones were the most common stone burden, while stone sizes ≥ 1.5 cm were prevalent. Left-sided stones were more common than right-sided or bilateral ones. Postoperative complications, mainly classified as Clavien scale grade I, were prevalent.

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