Journal of Cardiovascular Disease Research
ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 12, 2025

PREDICTORS OF OUTCOME IN SUPINE PCNL – A RETROSPECTIVE OBSERVATIONAL STUDY IN A TERTIARY CARE CENTRE

1. Karunamoorthy R, MCh (Urology), Professor and Head of the department
2. Vetrichandar S, MCh (Urology), Associate Professor
3. Manikandan M, MCh (Urology), Assistant Professor
4. Deepan M M, MCh (Urology)
5. Arun kumar P, MCh (Urology), Assistant Professor
6. Natarajan V, MCh (Urology), Assistant Professor
7.Karthikeyan S, MCh (Urology), Assistant Professor

Department and Institution

Department of Urology, Government Stanley Medical College,
Chennai, 600010

Corresponding Author

Dr Deepan M M,
602, Rajendra apartments, Secretariat colony,
Barakka road, kilpauk, Chennai 600010, Tamil Nadu

ABSTRACT

Introduction

Supine percutaneous nephrolithotomy (PCNL) has become a widely accepted alternative to the traditional prone technique because it offers superior anaesthetic access, reduced repositioning time, and easier simultaneous retrograde instrumentation. However, determinants of stone-free rate and morbidity in supine PCNL are less clearly defined.

Objectives: The study aims to identify the pre-operative and intra-operative factors predicting stone clearance and complications following supine PCNL in a tertiary-care centre.

Materials and Methods:

A retrospective analysis was performed on 209 patients who underwent supine PCNL between January 2023 and December 2024 at Government Stanley Medical College, Chennai. Demographic parameters, stone characteristics, Guy's Stone Score (GSS), tract number, tract location, tract size, operative time, and postoperative outcomes were documented. Stone-free status (≤4 mm residual fragments) and postoperative complications graded by the Modified Clavien-Dindo system constituted the primary outcomes. Univariate and multivariate logistic regression analyses were applied. Statistical significance was defined as $p < 0.05$.

Results:

The Mean age of the patients was 48.1 ± 12.6 years. The male and female ratio was 1.2:1. The Mean operative time recorded was 83.4 ± 25.2 min. The Overall stone-free rate (SFR) was 74.2%. Stone-free rates for GSS I–II and GSS III-IV were 87.1% and 51.4% respectively ($p < 0.001$). The Overall complication rate was 21.5%, with minor complications accounting for 17.2 % and major complications accounting for 4.3% respectively, according to the modified Clavien-Dindo classification. Multivariate analysis showed that GSS III–IV (OR 0.29; $p < 0.001$), stone size > 2 cm (OR 0.47; $p = 0.002$), and operative time > 90 min (OR 0.51; $p = 0.014$) predicted lower Stone free rates, while GSS III–IV (OR 2.21; $p = 0.009$), operative time > 90 min (OR 2.07; $p = 0.018$), and multiple tracts (OR 2.14; $p = 0.027$) predicted complications.

Conclusion:

Stone complexity, stone size, operative time, and tract number are independent predictors of outcome in supine PCNL in our study. A careful Preoperative assessment using Guy's Stone Score optimises surgical planning and reduces morbidity, improving outcomes following supine PCNL.

Keywords: Supine PCNL; Guy's Stone Score; Stone-free rate; Complications; Outcome predictors.

INTRODUCTION

Percutaneous nephrolithotomy (PCNL) remains the treatment of choice for renal stones > 2 cm in size and staghorn calculus. PCNL was traditionally performed in the prone position, but the approach has several disadvantages such as restricted anaesthetic access, hemodynamic variation on turning, and longer operative time when retrograde manipulation is required.

Valdivia first described the supine position in 1987, and since then, the technique has evolved through various modifications such as the Galdakao-modified Valdivia position, which allows simultaneous antegrade and retrograde procedures (endoscopic combined intrarenal surgery, ECIRS). The supine position offers ergonomic advantages, safer airway control, less cardiopulmonary compromise, and shorter turnover times.

Despite these benefits, published data on predictors of success and complications in supine PCNL remain limited. Most predictive studies originate from prone series or global multicentric analyses such as the CROES PCNL Study Group. The Guy's Stone Score (GSS) is one of the most validated systems to stratify stone complexity, yet few Indian studies have correlated GSS with outcomes in the supine setting.

Our study analyses 209 consecutive supine PCNL procedures performed in a tertiary-care academic hospital. The data were collected and analysed to determine factors affecting stone-free rate (SFR) and complications, with emphasis on Guy's stone score (GSS), stone size, tract number, and operative time. The results provide insight into outcome prediction and quality improvement for centres transitioning to the supine approach.

MATERIALS AND METHODS

Study design and setting

This was a retrospective observational study conducted at the Government Stanley Medical College, Chennai. All patients who underwent supine PCNL for renal stones between January 2023 and December 2024 were included. Informed consent was obtained from patients preoperatively. The Study protocol was approved by the local ethical committee.

Patient selection

A total of 209 patients (113 men, 96 women) aged 18–70 years were analysed.

Inclusion criteria

Solitary or multiple renal calculi > 15 mm in size treated by primary supine PCNL.

Exclusion criteria

combined procedures (ECIRS or URS), previous PCNL or open nephrolithotomy, paediatric and pregnant patients.

Pre-operative evaluation

All patients underwent standard evaluation, including detailed history, physical examination, hemogram, serum creatinine, coagulation profile, urine culture, and CT urography. Stone complexity was graded using the Guy's Stone Score (GSS I–IV) as per Thomas et al. (2011). Pre-operative antibiotics were administered based on culture sensitivity. Anticoagulants were withheld 5–7 days prior.

Operative technique

All procedures were performed under general anaesthesia in the Flank free Oblique Modified supine lithotomy position. The patient was placed supine with the ipsilateral flank elevated and rotated 30° towards the contralateral side using a wedge under the ipsilateral flank, the ipsilateral leg extended, and the contralateral leg flexed to 90°. This creates a flank-free zone, improving access for puncture. This also allowed simultaneous retrograde access if required.

Ureteric catheterisation was performed with a 5 Fr open-ended catheter for retrograde opacification. Under fluoroscopic guidance, calyceal puncture was achieved using an 18-gauge needle and guidewire placement into the ureter was achieved. The tract was dilated using Amplatz dilators up to 26 Fr, and a corresponding Amplatz sheath was introduced.

Stone fragmentation was achieved with a standard rigid nephroscope and EMS lithoclast master. Fragments were retrieved using graspers or suction. Stone clearance was confirmed fluoroscopically at the end of the procedure. A nephrostomy tube (22 Fr) was placed for drainage in most cases. A double J stent was placed in all cases.

Preoperative data collected were Stone size (mm) and burden (cm^2), Stone density (Hounsfield Units), Guy's stone score (I–IV)

Intraoperative data recorded were the number of tracts, tract location (subcostal or supracostal), Tract size (French), Operative time (from puncture to sheath removal in minutes) and Intraoperative complications (bleeding, extravasation, pleural injury, colon injury) that occurred.

Post-operative care

Haemoglobin and creatinine were measured on postoperative day 1. Analgesics and antibiotics were administered as per protocol. Nephrostomy

was removed after 48 hours if the urine was clear. The drain site was monitored to detect urinary leak. Discharge was usually on day 3–4.

Outcome definitions

Stone-free status (SFR): No residual stones > 4 mm on X-ray KUB or CT within 4 weeks.

Complication: Any deviation from the normal post-operative course is graded as per the modified Clavien-Dindo classification. Major complication was defined as Clavien grade ≥ III.

Statistical analysis

Data were entered into Microsoft Excel and analysed using SPSS version 26. Continuous variables were expressed as mean ± SD; categorical variables were expressed as percentages. The χ^2 test or Fisher's exact test was used for categorical comparisons. The student's t-test compared means. Variables with $p < 0.10$ on univariate analysis were entered into binary logistic regression to determine independent predictors for stone-free status and any complication. Odds ratios (OR) with 95 % confidence intervals (CI) were calculated. A $p < 0.05$ was considered significant.

RESULTS

Demographic profile

Of the 209 patients included, 113 were male, and 96 were female (M : F = 1.2:1). Mean age was 48.1 ± 12.6 years (range 18–70 years). The right kidney was affected in 111 (53.1 %) and the left in 98 (46.9 %). Average stone size was 22.4 ± 8.7 mm; 27.3 % of stones measured > 2 cm. Mean stone density on CT was 1085 ± 246 HU. According to the Guy's Stone Score (GSS), 136 (65.1 %) cases were GSS I–II and 73 (34.9 %) were GSS III–IV. Comorbidities included diabetes in 62 (29.7 %), hypertension in 47 (22.4 %), and chronic kidney disease in 9 (4.3 %).

Table 1. Baseline Demographic, Stone and Operative Characteristics

Variable	Category	n (%)
Age (years)	Mean ± SD	48.1 ± 12.6
Sex	Male	113 (54.1)
	Female	96 (45.9)
Side	Right	111 (53.1)

	Left	98 (46.9)
Stone Size	≤2 cm	152 (72.7)
	>2 cm	57 (27.3)
HU (Density)	≤1200	139 (66.5)
	>1200	70 (33.5)
GSS	I–II	136 (65.1)
	III–IV	73 (34.9)
Number of Tracts	Single	176 (84.2)
	Multiple	33 (15.8)
Access Type	Subcostal	190 (90.9)
	Supra costal	19 (9.1)
Operative Time	≤90 min	124 (59.3)
	>90 min	85 (40.7)
Overall SFR	—	155 (74.2%)
Overall Complications	—	45 (21.5%)

Operative parameters

Single-tract access was used in 176 (84.2%) cases, and multiple tracts were used in 33 cases (15.8%). Subcostal access accounted for 190 cases (90.9%), while 19 cases (9.1%) were supra costal. Mean operative time was 83.4 ± 25.2 min (range 40–140 min). Intraoperative bleeding requiring transfusion occurred in 9 (4.3 %). No visceral injuries were recorded.

Post-operative outcomes

The average haemoglobin drop was 0.91 ± 0.64 g/dL. Mean hospital stay was 7.2 ± 1.2 days. The stone-free rate (SFR) overall was 74.2 % (155/209). Stone-free rate for GSS I–II was 87.1 % and for GSS III–IV was 51.4 % ($p < 0.001$).

Complications:

Complications occurred in 45 cases (21.5 %). Minor complications (Clavien I–II) such as postoperative fever, blood transfusion, PCN site urinary leak, and Transient elevation of serum creatinine occurred in 36 cases (17.2%). Major complications (Clavien III–V) such as pneumothorax, urinary extravasation, subcapsular hematoma, pseudoaneurysm, nephrocutaneous fistula, and sepsis occurred in 9 cases (4.3%). There were no mortalities.

Table 2. Univariate Analysis of Factors Affecting Stone-Free Rate and Complications

Variable	Comparison	SFR (%)	p-value	Complications (%)	p-value
Sex	Male vs Female	75.2 vs 73.6	0.48	19.4 vs 22.0	0.52
Side	Right vs Left	75.6 vs 73.4	0.77	20.7 vs 21.3	0.66
Stone Size	≤ 2 vs >2 cm	**82.4 vs 58.8**	**<0.001**	17.0 vs 26.2	0.09
HU (Density)	≤1200 vs >1200	75.1 vs 69.8	0.18	18.0 vs 27.1	0.22
GSS	I–II vs III–IV	**87.1 vs 51.4**	**<0.001**	**17.6 vs 30.1**	**0.012**
Number of Tracts	Single vs Multiple	75.1 vs 69.6	0.21	**17.2 vs 32.4**	**0.024**
Access Type	Subcostal vs Supra costal	75.5 vs 68.4	0.52	19.4 vs 28.5	0.19
Operative Time	≤90 vs >90 min	**82.3 vs 58.7**	**<0.001**	**15.3 vs 30.2**	**0.014**

Multivariate analysis showed that GSS III–IV (OR 0.29; p < 0.001), stone size > 2 cm (OR 0.47; p = 0.002), and operative time > 90 min (OR 0.51; p = 0.014) predicted lower SFR, while GSS III–IV (OR 2.21; p = 0.009), operative time > 90 min (OR 2.07; p = 0.018), and multiple tracts (OR 2.14; p = 0.027) predicted complications.

Table 3. Multivariate Logistic Regression for Predictors of Stone-Free Rate and Postoperative Complications

A. PREDICTORS OF STONE-FREE RATE

Variable	Adjusted OR	95% CI	p-value
GSS III–IV	**0.29**	0.16–0.46	**<0.001**
Stone Size >2 cm	**0.47**	0.26–0.72	**0.002**
Operative Time >90 min	**0.51**	0.29–0.88	**0.014**

HU >1200	0.91	0.52–1.58	0.66
Multiple Tracts	0.83	0.46–1.41	0.32
Sex	1.10	0.68–1.78	0.65
Side	1.03	0.61–1.69	0.89
Access Type	1.21	0.50–2.71	0.61

B: PREDICTORS OF COMPLICATIONS

Variable	Adjusted OR	95% CI	p-value
GSS III–IV	**2.21**	1.18–3.84	**0.009**
Multiple Tracts	**2.14**	1.09–3.76	**0.022**
Operative Time >90 min	**2.07**	1.10–3.45	**0.018**
Stone Size >2 cm	1.31	0.74–2.12	0.18
HU >1200	1.41	0.72–2.27	0.23
Sex	1.18	0.61–1.89	0.58
Side	1.08	0.58–1.92	0.71
Access Type	1.31	0.41–3.04	0.28

DISCUSSION

Our data demonstrate that Guy's Stone Score (GSS), stone size, operative time, and number of tracts are the most important determinants of both stone-free rate and complications in supine PCNL. Overall SFR was 74.2 % and major complication rate was 4.3 % in our study, which closely matches data from global literature.

Guy's Stone Score relevance

GSS incorporates anatomy, number, and distribution of stones. Higher scores (III–IV) reflect staghorn or multiple calyceal stones requiring multiple tracts and prolonged manipulation, explaining lower clearance and higher morbidity. Our study confirms GSS as an independent predictor of both stone-free rate and complications (OR 0.29 for SFR, OR 2.21 for complications).

Stone size:

Stones greater than 2 cm require longer fragmentation time and have a greater likelihood of residual burden. They also more commonly necessitate secondary procedures. In our study, stone size greater than 2 cm independently predicted a lower stone-free rate (OR 0.47)

Operative time and tract number

Longer procedures (> 90 min) were associated with residual fragments (OR 0.51) and postoperative complications (OR 2.07). This is probably due to prolonged irrigation and increased intrarenal pressures, tissue trauma, bleeding and operative fatigue. Multiple tracts improved access but significantly increased postoperative complications (OR 2.14). This is because each additional tract causes more parenchymal trauma and bleeding risk.

Supine versus prone approach

Multiple studies have shown comparable results between supine and prone PCNL. Supine PCNL provides easier patient positioning, improved anaesthetic safety and simultaneous retrograde access. Our study shows that outcomes depend primarily on stone complexity rather than patient positioning.

Complications profile

Complications occurred in 45 cases (21.5 %). Minor complications occurred in 36 cases (17.2 %) and were conservatively managed. Major complications occurred in 9 cases (4.3%). One case of pneumothorax occurred, which required ICD insertion. Urinary extravasation occurred in 3 cases, which were managed by PCD insertion. Pseudoaneurysm of the renal artery occurred in 3 cases, which were managed by angioembolisation. Sepsis occurred in 2 cases requiring ICU admission. These major complication rates are within the accepted 3–6 % range reported globally. No visceral or vascular injuries occurred, highlighting the safety of the supine technique in experienced hands.

Clinical implications

Routine calculation of GSS pre-operatively allows better surgical planning and patient counselling. For GSS III–IV stones, anticipating longer operative time,

staged procedures, or combined ECIRS may optimise outcomes. Limiting tracts and maintaining operative time < 90 min can significantly reduce morbidity.

CONCLUSION

In this single-centre experience of 209 supine PCNLs, Stone-free rates were 74.2 % and major complications were 4.3 %. Independent predictors of residual stones were higher GSS, stone > 2 cm, and operative time > 90 min. Predictors of complications were higher GSS, longer operative time, and multiple tracts. Stone complexity primarily determines results and not the patient's position. Incorporating Guy's Stone Score into pre-operative evaluation and limiting operative time and number of tracts improve safety and clearance in supine PCNL.

REFERENCES

1. De la Rosette JJMCH et al. CROES PCNL Global Study: Complications and Their Impact. Eur Urol. 2012; 62(2): 246–255.

2. Falahatkar S et al. Supine PCNL: A New Standard? J Endourol. 2014; 28(6): 613–618.

3. Thomas K et al. The Guy's Stone Score — A New Scoring System for PCNL. J Endourol. 2011; 25(1): 1–8.

4. Michel MS et al. Complications in Percutaneous Nephrolithotomy: A Review of Management and Prevention. Eur Urol. 2007; 51: 899–906.

5. Okeke Z et al. Supine Percutaneous Nephrolithotomy: Comparative Outcomes and Predictive Factors. BJU Int. 2012; 109: 980–983.

6. Tefekli A et al. Classification of Percutaneous Nephrolithotomy Complications Using Modified Clavien System: A Single Centre Experience. J Urol. 2008; 180: 2489–2493.

7. Manohar T et al. Supine Percutaneous Nephrolithotomy in Complex Staghorn Stones: Outcome and Predictive Factors. Indian J Urol. 2019; 35(3): 201–208