

SAFETY AND EFFICACY OF PERCUTANEOUS NEPHROLITHOTOMY IN THE SUPINE POSITION: A RETROSPECTIVE ANALYSIS OF 128 CASES

Harry Santhaseelan W¹, Karthikeyan S², Hariharan N³

Received : 02/08/2026
Received in revised form : 01/09/2026
Accepted : 13/09/2026

Keywords:

Supine PCNL; Percutaneous nephrolithotomy;
Nephrolithiasis;
Stone-free rate; Complications;
Retrospective study.

Corresponding Author:

Dr. Harry Santhaseelan W,
Email: drharryuro@gmail.com

DOI: 10.47009/jamp.2026.8.5.56

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (5); 358-364



¹Associate Professor, Department of Urology, Coimbatore Medical College Hospital, Coimbatore, Tamil Nadu, India.

²Senior Resident, Department of Urology, Stanley Medical College, Chennai, Tamil Nadu, India.

³Assistant Professor, Department of Urology, Coimbatore Medical College Hospital, Coimbatore, Tamil Nadu, India.

ABSTRACT

Background: Aims: To evaluate the safety and efficacy of supine percutaneous nephrolithotomy (PCNL) in terms of stone-free rate, complication profile, and perioperative outcomes in a consecutive retrospective cohort. **Study design:** Retrospective, single-centre, observational cohort study. **Place and Duration of Study:** Department of Urology, Coimbatore Medical College Hospital, Coimbatore, Tamil Nadu, India, over a 1-year study period. **Materials and Methods:** We analysed 128 consecutive patients who underwent supine PCNL for renal calculi. Demographic, stone, intraoperative, and postoperative variables were extracted from case records using a standardised proforma. Stone-free status was assessed on postoperative imaging on postoperative day 3, with final status confirmed at the 3-week follow-up visit. Complications were graded using the Clavien–Dindo classification. Continuous variables were compared using the independent-samples t-test and categorical variables using the chi-square or Fisher's exact test, as appropriate. **Results:** Mean patient age was 41.9 ± 11.9 years, with 77 (60.2%) male patients. Mean stone size was 25.1 ± 5.7 mm; 77 patients (60.2%) had multiple stones and 13 (10.2%) had staghorn calculi. A single tract was used in 102 patients (79.7%). Mean operative time was 70.3 ± 14.8 minutes. The overall stone-free rate was 89.8% (115/128), with 83 patients (64.8%) completely stone-free and 32 (25.0%) having clinically insignificant residual fragments. Blood transfusion was required in 6 patients (4.7%). Postoperative fever occurred in 21 patients (16.4%) and urosepsis in 5 (3.9%). Overall complication rate (Clavien–Dindo $\geq$ I) was 40.6%, with major complications ($\geq$ IIIa) in 6 patients (4.7%). Mean hospital stay was 2.8 ± 1.1 days. Stone-free rate did not differ significantly by stone size (<20 mm vs ≥ 20 mm, $P = .75$) or number of tracts (single vs multiple, $P = .92$). **Conclusion:** Supine PCNL is a safe and effective technique for the management of renal calculi, achieving a high stone-free rate with an acceptable complication profile and short hospital stay, supporting its use as a viable alternative to the prone approach.

INTRODUCTION

Percutaneous nephrolithotomy (PCNL) remains the gold-standard treatment for large-volume and complex renal calculi, including staghorn stones. Since its original description, PCNL has traditionally been performed with the patient in the prone position, which offers a wide surgical field and familiar anatomical orientation for percutaneous access. However, the prone position carries recognised limitations, including the need for intraoperative repositioning after cystoscopic retrograde catheter

placement, altered cardiopulmonary mechanics under general anaesthesia, and difficulty in managing the airway in patients with higher anaesthetic risk. The supine position for PCNL, first popularised by Valdivia Uribe et al. (1998) and subsequently modified by several groups — including the Galdakao-modified supine Valdivia (GMSV) technique (Ibarluzea et al., 2007) and the Barts “complete supine” technique (Karami & Gholamrezaie, 2004) — allows simultaneous antegrade nephroscopic and retrograde ureteroscopic access, avoids intraoperative repositioning, and may

reduce anaesthesia time and improve cardiopulmonary tolerance, particularly in obese or comorbid patients. Comparative series have suggested that supine PCNL achieves stone-free and complication rates broadly comparable to the prone approach, while offering these logistical and physiological advantages (Liu et al., 2010). Despite growing adoption, reported outcomes for supine PCNL vary across series depending on stone complexity, operator experience, and technique variant used. We report our retrospective experience with supine PCNL in 128 consecutive patients, with the objective of evaluating its safety (complication profile) and efficacy (stone-free rate) in real-world practice.

MATERIALS AND METHODS

2.1 Study design and setting

This was a retrospective, single-centre, observational cohort study conducted at the Department of Urology, Coimbatore Medical College Hospital, evaluating all consecutive patients who underwent supine PCNL for renal calculi over a 1-year study period. The study was approved by the Institutional Ethics Committee of Coimbatore Medical College Hospital [approval number and date to be inserted]; given its retrospective design, the requirement for individual informed consent was waived. The study is reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for cohort studies (von Elm et al., 2007).

2.2 Participants

All patients who underwent supine PCNL for renal calculi during the study period were eligible for inclusion. Exclusion criteria were: incomplete or unretrievable case records, PCNL performed for indications other than primary stone clearance, and cases converted to an alternative approach intraoperatively (unless outcome data were available). A total of 128 patients meeting these criteria were included in the final analysis (participant flow summarised in Figure 1).

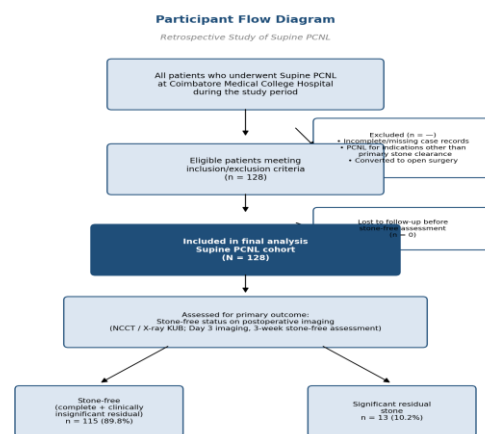


Figure 1: Participant flow diagram for the retrospective supine PCNL cohort (N = 128)

2.3 Preoperative evaluation

All patients underwent preoperative non-contrast computed tomography (NCCT) of the kidney–ureter–bladder (KUB) region or plain X-ray KUB with ultrasonography for stone localisation and sizing, along with routine haematological, renal function, and urine culture assessment. Stone complexity was graded using Guy's Stone Score (Thomas et al., 2011). Patients with positive preoperative urine cultures were treated with culture-specific antibiotics prior to surgery.

2.4 Surgical technique

All procedures were performed with the patient in a supine position (complete supine, Galdakao-modified supine Valdivia, or modified Valdivia–Barts variant, per surgeon preference and stone location), under fluoroscopic guidance for renal access. Tract dilation was performed to the size documented per case, and pneumatic lithotripsy was used for stone fragmentation. Number and site of percutaneous tracts, puncture calyx, and operative time were recorded prospectively in the operative notes and abstracted retrospectively for this analysis.

2.5 Outcome definitions

The primary outcome was stone-free status, assessed on postoperative imaging (NCCT or X-ray KUB) performed on postoperative day 3, with final stone-free status confirmed at the 3-week follow-up visit. Patients were classified as: complete stone-free (no visible residual fragment), clinically insignificant residual fragment (CIRF, residual fragment <4 mm), or significant residual fragment (≥4 mm). The overall stone-free rate was defined as the composite of complete stone-free and CIRF cases, in keeping with commonly used definitions in the PCNL literature. Secondary outcomes included operative time, haemoglobin drop, blood transfusion rate, postoperative fever, urosepsis, complications graded by the Clavien–Dindo classification (Dindo et al., 2004), length of hospital stay, need for auxiliary procedures (shock-wave lithotripsy [SWL] or

retrograde intrarenal surgery [RIRS]), and stone recurrence at follow-up (mean 3 months).

2.6 Statistical Analysis

Data were extracted from case records using a standardised data-collection proforma and analysed using [statistical software, e.g., SPSS v.XX / Python]. Continuous variables are expressed as mean $\pm$ standard deviation and compared using the independent-samples t-test. Categorical variables are expressed as number (percentage) and compared using the chi-square test or Fisher's exact test as appropriate. A P value $< .05$ was considered statistically significant. Pre-specified subgroup comparisons of stone-free rate were performed by stone size (<20 mm vs ≥ 20 mm) and by number of percutaneous tracts (single vs multiple).

RESULTS

3.1 Baseline demographic and stone characteristics

A total of 128 patients were included in the final analysis (Figure 1). The mean age was 41.9 ± 11.9 years (range 22–60), with 77 patients (60.2%) male and 51 (39.8%) female. Mean BMI was 32.0 ± 2.3 kg/m². A comorbidity was present in 115 patients (89.8%): diabetes mellitus alone in 38 (29.7%), hypertension alone in 38 (29.7%), and both in 39 (30.5%). Mean stone size was 25.1 ± 5.7 mm; stones were located in the renal pelvis in 83 patients (64.8%), calyceal locations in 32 (25.0%), and were staghorn calculi in 13 (10.2%). Multiple stones were present in 77 patients (60.2%). Guy's Stone Score was III or IV (complex) in 90 patients (70.3%). Full baseline and stone characteristics are summarised in Table 1.

Table 1: Baseline demographic and stone characteristics (N = 128)

Parameter	Value
Age, years (mean $\pm$ SD)	41.9 $\pm$ 11.9
Sex, n (%) — Male	77 (60.2)
Sex, n (%) — Female	51 (39.8)
BMI, kg/m ² (mean $\pm$ SD)	32.0 $\pm$ 2.3
Comorbidity — None	13 (10.2)
Comorbidity — Diabetes mellitus	38 (29.7)
Comorbidity — Hypertension	38 (29.7)
Comorbidity — DM + HTN	39 (30.5)
Side — Right	64 (50.0)
Side — Left	64 (50.0)
Stone size, mm (mean $\pm$ SD)	25.1 $\pm$ 5.7
Stone burden — Single	51 (39.8)
Stone burden — Multiple	77 (60.2)
Location — Renal pelvis	83 (64.8)
Location — Calyceal	32 (25.0)
Location — Staghorn (complete/partial)	13 (10.2)
Guy's Stone Score — I	12 (9.4)
Guy's Stone Score — II	26 (20.3)
Guy's Stone Score — III	77 (60.2)
Guy's Stone Score — IV	13 (10.2)
Hydronephrosis grade — None/Grade 0	25 (19.5)
Hydronephrosis grade — Grade I	14 (10.9)
Hydronephrosis grade — Grade II	76 (59.4)
Hydronephrosis grade — Grade IV	13 (10.2)
Preoperative DJ stent, n (%)	10 (7.8)
Preoperative urine culture — Sterile	113 (88.3)
Preoperative urine culture — Positive (treated before surgery)	15 (11.7)

3.2 Procedural and intraoperative outcomes

The complete supine position was used in 96 patients (75.0%), GMSV in 20 (15.6%), and the modified Valdivia–Barts variant in 12 (9.4%). A single percutaneous tract was sufficient in 102 patients (79.7%), while two and three tracts were required in 19 (14.8%) and 7 (5.5%) patients respectively. Mean tract size was 24.0 ± 0.6 Fr. All procedures were

performed under fluoroscopic guidance with pneumatic lithotripsy. Mean operative time was 70.3 ± 14.8 minutes. Mean haemoglobin drop was 0.4 ± 0.5 g/dL, and blood transfusion was required in 6 patients (4.7%). Full procedural details are shown in Table 2, and the distribution of supine position variants and the number of percutaneous tracts used are illustrated in Figure 2.

Table 2: Procedural and intraoperative parameters (N = 128)

Parameter	Value
Supine position variant — Complete supine	96 (75.0)
Supine position variant — GMSV	20 (15.6)
Supine position variant — Modified Valdivia–Barts	12 (9.4)
Number of tracts — Single	102 (79.7)
Number of tracts — Two	19 (14.8)

Number of tracts — Three	7 (5.5)
Tract size, Fr (mean $\pm$ SD)	24.0 $\pm$ 0.6
Puncture calyx — Inferior	85 (66.4)
Puncture calyx — Middle	30 (23.4)
Puncture calyx — Superior	13 (10.2)
Guidance for puncture — Fluoroscopy	128 (100)
Lithotripsy device — Pneumatic	128 (100)
Operative time, min (mean $\pm$ SD)	70.3 $\pm$ 14.8
Preoperative Hb, g/dL (mean $\pm$ SD)	13.5 $\pm$ 0.6
Postoperative Hb, g/dL (mean $\pm$ SD)	13.1 $\pm$ 0.8
Hb drop, g/dL (mean $\pm$ SD)	0.4 $\pm$ 0.5
Blood transfusion required, n (%)	6 (4.7)

Figure 2. Type of procedure (N = 128)

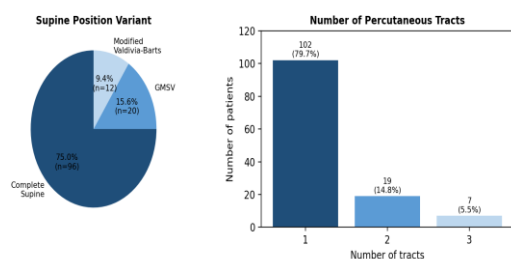


Figure 2: Type of procedure (N = 128)

3.3 Stone-free rate and complications

The overall stone-free rate was 89.8% (115/128): 83 patients (64.8%) were completely stone-free and 32 (25.0%) had clinically insignificant residual fragments (<4 mm). Thirteen patients (10.2%) had significant residual fragments (≥ 4 mm), of whom 9 (7.0%) underwent SWL and 4 (3.1%) underwent

RIRS as auxiliary procedures, achieving eventual clearance. Postoperative fever occurred in 21 patients (16.4%) and urosepsis in 5 (3.9%), all managed successfully with intravenous antibiotics and supportive care. Using the Clavien–Dindo classification, 76 patients (59.4%) had no complications (Grade 0), 38 (29.7%) had Grade I, 8 (6.3%) had Grade II, and 6 (4.7%) had Grade IIIa complications requiring an auxiliary intervention; no Grade IIIb or higher complications, and no mortality, occurred in this series. The overall complication rate (Grade $\geq$ I) was 40.6%, with a major complication rate (Grade $\geq$ IIIa) of 4.7%. Mean hospital stay was 2.8 ± 1.1 days. At a mean follow-up of 3 months, stone recurrence was noted in 11 patients (8.6%). Outcome and complication data are summarised in Table 3, with the distribution of complications by Clavien–Dindo grade shown in Figure 3 and the overall stone-free rate illustrated in Figure 4.

Table 3: Stone-free rate, complications, and postoperative outcomes (N = 128)

Parameter	Value
Stone-free status — Complete stone-free	83 (64.8)
Stone-free status — CIRF (<4 mm)	32 (25.0)
Stone-free status — Significant residual (≥ 4 mm)	13 (10.2)
Overall stone-free rate*, n (%)	115 (89.8)
Postoperative fever, n (%)	21 (16.4)
Urosepsis, n (%)	5 (3.9)
Clavien–Dindo — Grade 0 (no complication)	76 (59.4)
Clavien–Dindo — Grade I	38 (29.7)
Clavien–Dindo — Grade II	8 (6.3)
Clavien–Dindo — Grade IIIa	6 (4.7)
Overall complication rate (Grade $\geq$ I), n (%)	52 (40.6)
Major complication rate (Grade $\geq$ IIIa), n (%)	6 (4.7)
Hospital stay, days (mean $\pm$ SD)	2.8 $\pm$ 1.1
Auxiliary procedure — None	115 (89.8)
Auxiliary procedure — SWL	9 (7.0)
Auxiliary procedure — RIRS	4 (3.1)
Follow-up duration, months (mean $\pm$ SD)	3.0 $\pm$ 0.0
Stone recurrence at follow-up, n (%)	11 (8.6)

*Overall stone-free rate = complete stone-free + clinically insignificant residual fragment.

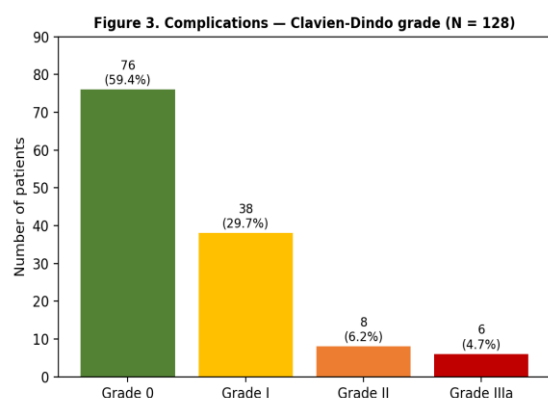


Figure 3: Complications — Clavien–Dindo grade (N = 128)

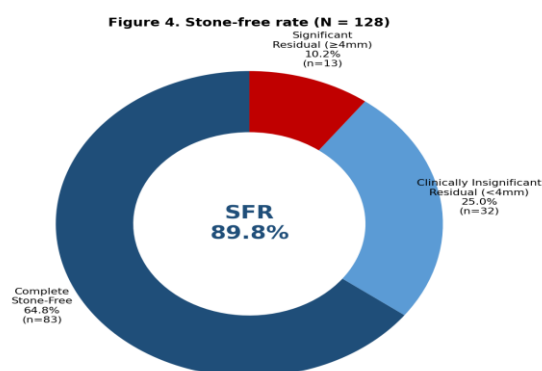


Figure 4: Stone-free rate (N = 128)

3.4 Subgroup Analyses

Stone-free rate did not differ significantly between patients with stones <20 mm (26/30, 86.7%) and those with stones ≥20 mm (89/98, 90.8%; $P = .75$), nor between patients requiring a single tract (91/102, 89.2%) versus multiple tracts (24/26, 92.3%; $P = .92$). Operative time was numerically shorter in the multiple-tract group (67.5 vs 71.0 minutes), but this difference was not statistically significant ($P = .33$). These comparisons are summarised in Table 4 and illustrated in Figure 5. Stone-free rate also showed a numerical increase with increasing Guy's Stone Score, from 83.3% (10/12) in Score I to 92.3% (12/13) in Score IV (Figure 6). The risk differences for these subgroup comparisons, with 95% confidence intervals, are presented as a forest plot in Figure 7.

Table 4: Subgroup comparisons of stone-free rate and operative time

Comparison	Group A	Group B	P value
Stone-free rate by stone size	<20 mm: 26/30 (86.7%)	≥20 mm: 89/98 (90.8%)	.75
Stone-free rate by tract number	Single tract: 91/102 (89.2%)	Multiple tracts: 24/26 (92.3%)	.92
Operative time by tract number, min (mean)	Single: 71.0	Multiple: 67.5	.33

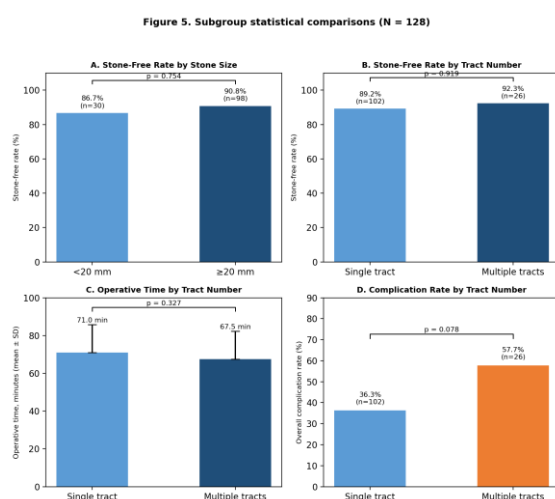


Figure 5: Subgroup statistical comparisons (N = 128)

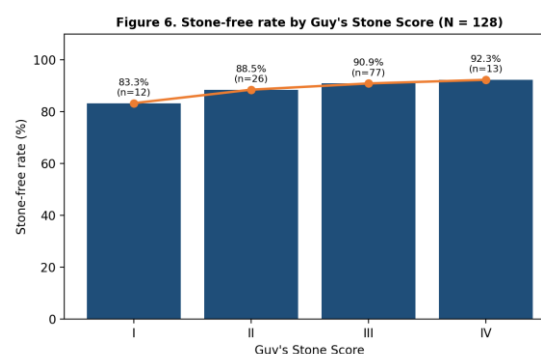


Figure 6: Stone-free rate by Guy's Stone Score (N = 128)

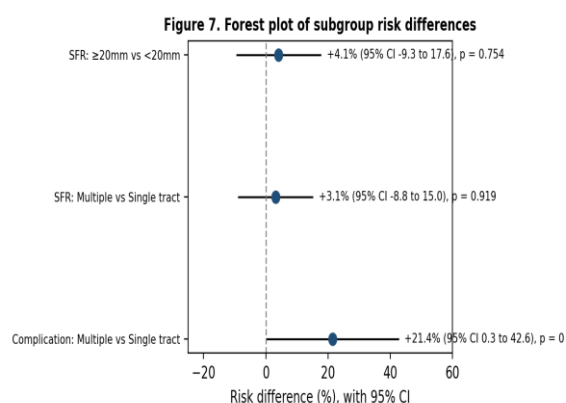


Figure 7: Forest plot of subgroup risk differences

DISCUSSION

In this retrospective series of 128 consecutive patients, supine PCNL achieved a high overall stone-free rate of 89.8%, with an acceptable complication profile (overall complication rate 40.6%, largely Clavien–Dindo Grade I–II; major complications in only 4.7%) and a short mean hospital stay of 2.8 days. These findings are broadly consistent with the published supine PCNL literature, which reports stone-free rates typically in the range of 80–95% and major complication rates below 10%, supporting the reproducibility of the technique outside the original describing centres (Liu et al., 2010).

The stone-free rate did not differ significantly by stone size or number of tracts in our cohort, suggesting that supine PCNL can achieve comparable clearance in more complex stone burdens when multiple tracts are used, without a proportional increase in operative time. This is consistent with the rationale for supine positioning, which permits simultaneous multi-tract access without repositioning, potentially offsetting the added complexity of multiple tracts seen in prone-position series (Ibarluzea et al., 2007).

The complication profile in our series — predominantly low-grade fever and self-limiting Grade I–II events, with urosepsis in under 4% of patients — is comparable to reported prone PCNL series, and supports existing evidence that the supine position does not compromise safety while offering the described anaesthetic and positioning advantages, particularly relevant for patients with higher BMI or cardiopulmonary comorbidity, both of which were common in our cohort (mean BMI 32.0 kg/m²; comorbidity present in 89.8%).

These results should be interpreted in the context of several limitations, discussed below.

4.1 Limitations

- Retrospective, single-centre design without a concurrent prone-PCNL comparator arm, limiting direct comparative conclusions between positions.

- Outcome assessment (stone-free status) was not performed by a blinded independent assessor, which may introduce observer bias inherent to retrospective imaging review.
- Follow-up was limited to a mean of 3 months; longer-term recurrence and functional outcome data were not available.
- Surgeon experience and case selection (e.g., preferential use of a particular supine variant for specific stone locations) could not be fully accounted for and may confound outcome comparisons.
- As with all retrospective analyses, missing or incompletely documented variables in a minority of records could not be recovered, and unmeasured confounders cannot be excluded.

CONCLUSION

Supine PCNL is a safe and effective technique for the management of renal calculi, including complex and multiple stone burdens, achieving a high stone-free rate with a favourable complication profile and short hospital stay in this series of 128 cases. These findings support the continued use and wider adoption of supine PCNL as a viable alternative to the conventional prone approach, particularly in patients with higher anaesthetic or cardiopulmonary risk. Prospective, comparative studies with longer-term follow-up are warranted to further define its role relative to prone PCNL.

Acknowledgements

No funding was received for this study. The authors declare the role of the funding agency, if any, in the study design, data collection, analysis, interpretation, or writing of the manuscript is not applicable.

Competing Interests

Authors have declared that no competing interests exist.

Authors' Contributions

Author Harry Santhaseelan W designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author Karthikeyan S managed the data acquisition and literature searches. Author Hariharan N managed the analyses of the study and critically revised the manuscript. All authors read and approved the final manuscript.

Consent

Not applicable. This was a retrospective observational study based on review of existing case records; no identifiable patient data or images are presented, and no direct patient contact or intervention was undertaken for the purpose of this study.

Ethical Approval

All authors hereby declare that all experiments have been examined and approved by the Institutional Ethics Committee, Coimbatore Medical College Hospital and have therefore been performed in accordance with the ethical standards laid down in

the 1964 Declaration of Helsinki. Given the retrospective design, the requirement for individual informed consent was waived by the ethics committee.

Data Availability

The dataset analysed during the current study is available from the corresponding author on reasonable request.

REFERENCES

1. Dindo, D., Demartines, N., & Clavien, P. A. (2004). Classification of surgical complications: A new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Annals of Surgery*, 240(2), 205–213. <https://doi.org/10.1097/01.sla.0000133083.54934.ae>
2. Ibarluzea, G., Scoffone, C. M., Cracco, C. M., Poggio, M., Porpiglia, F., Terrone, C., Astobietta, A., Camargo, I., Gamarra, M., Tempia, A., Valdivia Uria, J. G., & Scarpa, R. M. (2007). Supine Valdivia and modified lithotomy position for simultaneous antegrade and retrograde endourological access. *BJU International*, 100(1), 233–236. <https://doi.org/10.1111/j.1464-410X.2007.06960.x>
3. Karami, H., & Gholamrezaie, H. R. (2004). Totally tubeless percutaneous nephrolithotomy in supine position. *Journal of Endourology*, 18(7), 651–654. <https://doi.org/10.1089/end.2004.18.651>
4. Liu, L., Zheng, S., Xu, Y., & Wei, Q. (2010). Systematic review and meta-analysis of supine versus prone position percutaneous nephrolithotomy. *Journal of Endourology*, 24(12), 1941–1946. <https://doi.org/10.1089/end.2010.0292>
5. Thomas, K., Smith, N. C., Hegarty, N., & Glass, J. M. (2011). The Guy's stone score—grading the complexity of percutaneous nephrolithotomy procedures. *Urology*, 78(2), 277–281. <https://doi.org/10.1016/j.urology.2010.12.026>
6. Valdivia Uria, J. G., Valle Gerhold, J., López López, J. A., Villarroya Rodriguez, S., Ambroj Navarro, C., Ramirez Fabian, M., Rodriguez Ortiz, A., & Aranda Lassa, J. M. (1998). Technique and complications of percutaneous nephroscopy: Experience with 557 patients in the supine position. *Journal of Urology*, 160(6 Pt 1), 1975–1978. [https://doi.org/10.1016/S0022-5347\(01\)62213-7](https://doi.org/10.1016/S0022-5347(01)62213-7)
7. von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., & Vandenbroucke, J. P. (2007). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *Lancet*, 370(9596), 1453–1457. [https://doi.org/10.1016/S0140-6736\(07\)61602-X](https://doi.org/10.1016/S0140-6736(07)61602-X)