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Original Article

Supine versus Prone Percutaneous Nephrolithotomy: A Single-Unit Retrospective Comparative Cohort from a Sri Lankan Tertiary Centre

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Abstract

Introduction: Percutaneous nephrolithotomy (PCNL) is commonly used to treat renal stones larger than 2 cm. Prone PCNL is widely used, but supine PCNL is also used in many centres. Published studies suggest that supine PCNL may reduce operative time while achieving similar stone clearance. Local comparative data from Sri Lanka are limited.

Methods: We retrospectively reviewed 47 consecutive PCNL procedures performed between July and October 2025 by one urologist at the National Hospital of Sri Lanka. The main outcome was operative duration. Other outcomes were stone-free rate, intraoperative complications, transfusion, postoperative fever or infection, length of hospital stay, and re-intervention within 30 days. Continuous outcomes were compared using the Mann-Whitney U test and categorical outcomes using Fisher's exact test.

Results: There were 20 supine and 27 prone procedures. Supine PCNL was associated with a 23-minute reduction in mean operative duration compare to prone position (71.0 ± 12.0 vs 94.0 ± 14.6 min; $p < 0.001$). Stone-free rates were 75.0% and 77.8%, respectively. No statistically significant differences were found in intraoperative complications, bleeding requiring intervention, transfusion, postoperative fever or infection, length of stay, or re-intervention. The small sample size limits conclusions about these outcomes.

Conclusion: Supine PCNL was associated with a shorter operative duration in this single-centre study. No statistically significant differences in stone-free rate or other measured outcomes were detected. Larger prospective studies are needed to assess these findings further.

Keywords: Percutaneous nephrolithotomy, supine, prone, renal stones, operative duration

Introduction

Kidney stone disease is common worldwide and is an important cause of urological illness. Percutaneous nephrolithotomy (PCNL) is a standard treatment for large renal stones, particularly those larger than 2 cm (1,2). The burden of stone disease is also important in South Asia, including Sri Lanka (3,4). Since Fernström and Johansson first described percutaneous nephrolithotomy in 1976, prone PCNL has become the standard treatment option for large and complex renal stones (3,4).

For most of that history, prone has been the default position. It offers a familiar posterior working field and a wide arc of calyceal access. It also carries a cost: ventilatory compromise, awkward airway access, a vulnerable brachial plexus and cervical spine during positioning, and – when combined with retrograde stenting – a mandatory intraoperative flip (5). Valdivia's original supine technique (1987, refined 1998) and its later Galdakao modification eliminated the flip and permitted simultaneous antegrade and retrograde work: endoscopic combined intrarenal surgery, or ECIRS (6,7,8). Contemporary meta-analyses report broadly comparable stone-free rates between the two positions with a mean operative time advantage of 10-22 minutes favouring supine (9,10,11),

and the CROES Global PCNL Study (n=5803) reached the same conclusion at scale (12,13).

This study compared operative duration, stone-free rate and perioperative outcomes between supine and prone PCNL in a Sri Lankan tertiary hospital.

Methods

Setting and design

We conducted a retrospective observational cohort study at the National Hospital of Sri Lanka, Colombo, a tertiary urology center. All PCNL procedures performed by a single urologist between 1 July and 31 October 2025 were included.

Patient selection

Adults aged 18 years or older who underwent elective PCNL for renal stones were eligible. We excluded simultaneous bilateral procedures, PCNL performed with an open or anatrophic operation, patients with anatomical abnormalities that prevented standard positioning (such as horseshoe or ectopic kidney), and records without documented operative position. A total of 47 procedures were included: 20 supine and 27 prone.

Position selection and technique

The operating surgeon selected the position based on body habitus, stone location, cardiorespiratory status and, for supine cases, availability of a theatre setup suitable for ECIRS. Supine patients were placed in modified lithotomy with the opposite flank elevated by approximately 25-30°. Prone patients were positioned using standard chest and pelvic supports.

Outcomes

The primary outcome was operative duration, measured from the start of cystoscopy to closure of the flank puncture. Secondary outcomes were stone-free status, intraoperative complications, transfusion, postoperative fever or infection, length of hospital stay and re-intervention within 30 days. Stone-free status was defined as no residual fragment of 4 mm or larger on kidney, ureter and bladder (KUB) X-Ray radiography performed 24-48 hours after surgery. Post-operative fever was defined as a temperature of 38°C or higher within 48 hours. Re-intervention included auxiliary shockwave lithotripsy, laparoscopic pyelolithotomy or repeat PCNL within 30 days.

Statistical analysis

Given the modest subgroup sizes we used non-parametric methods throughout. Continuous variables are reported as mean ± SD and compared with the Mann-Whitney U test. Categorical variables are reported as counts with percentages and compared with Fisher's exact test. Two-sided $p<0.05$ was taken as significant. Analyses were performed in IBM SPSS Statistics 29 (IBM Corp., Armonk, NY).

Results

Cohort characteristics

The study included 47 procedures: 20 supine and 27 prone. The groups had similar recorded baseline characteristics, including age, sex, body mass index, stone size, side of the stone, obstruction, comorbidities, serum creatinine and baseline haemoglobin (Table 1). The mean largest stone size was approximately 3.4-3.5 cm in both groups.

Primary outcome – operative duration

Mean operative duration was 71.0 ± 13.6 minutes in the supine group and 94.0 ± 14.2 minutes in the prone group, a difference of 23 minutes (Mann-Whitney U test, $p<0.001$; Figure 1). The reported 95% confidence interval for the difference was 15-31 minutes. After the first four supine cases were excluded in a sensitivity analysis, the reported difference remained 19 minutes ($p<0.001$).

Secondary outcomes

No statistically significant differences were found in the secondary outcomes (Table 2). Intra-operative complications occurred in 2/20 (10.0%) supine cases and 6/27 (22.2%) prone cases. Bleeding requiring intervention occurred in no supine cases and four prone cases. Transfusion was required in no supine cases and one prone case. Stone-free rates were 75.0% and 77.8%, respectively. Postoperative fever or infection, length of stay and re-intervention rates were also similar. Because the number of events was small, these results do not establish that the two positions have equivalent safety or effectiveness.

Table 1. Baseline characteristics by position

Variable	Supine (n=20)	Prone (n=27)	p
Age, years (mean ± SD)	54.2 ± 12.8	55.3 ± 13.5	0.74
Male sex, n (%)	13 (65.0)	17 (63.0)	1.00
BMI, kg/m² (mean ± SD)	22.7 ± 3.1	22.9 ± 3.2	0.83
Stone size – largest, cm	3.4 ± 1.1	3.5 ± 1.2	0.72
Right-sided stone, n (%)	11 (55.0)	15 (55.6)	1.00
Obstruction as indication, n (%)	12 (60.0)	16 (59.3)	1.00
≥ 1 co-morbidity, n (%)	10 (50.0)	15 (55.6)	0.77
Serum creatinine, mg/dL	1.09 ± 0.28	1.11 ± 0.30	0.82
Baseline Hb, g/dL	11.8 ± 1.4	11.7 ± 1.5	0.71

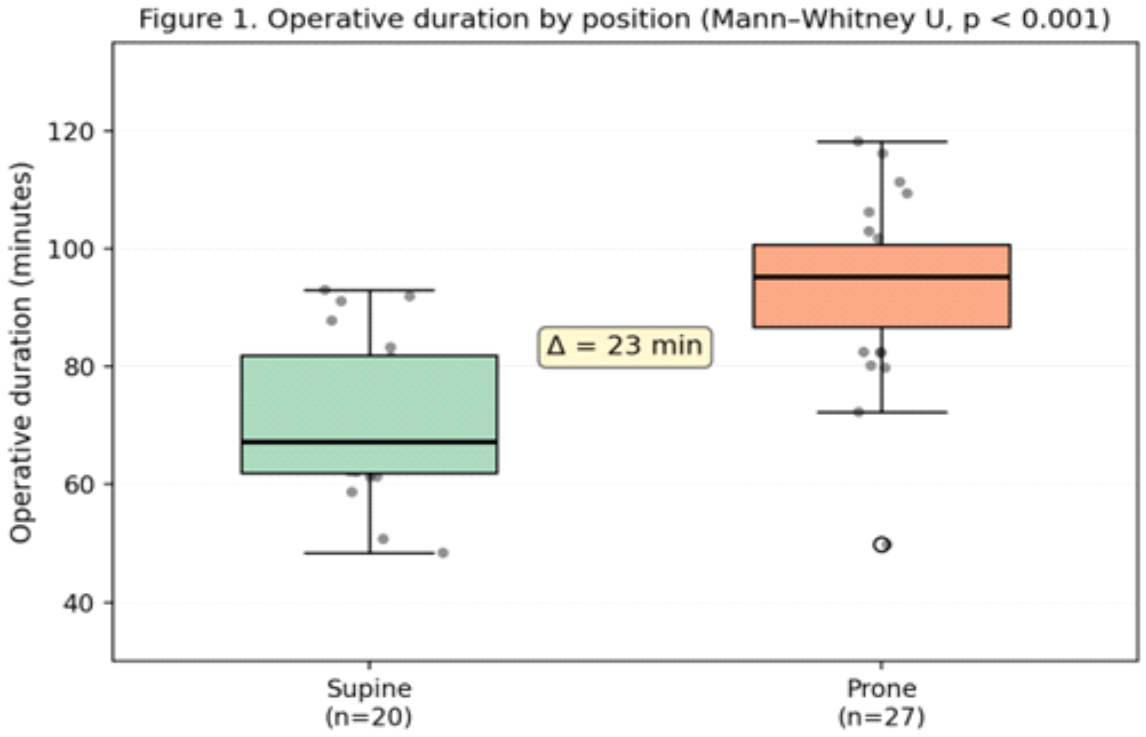


Figure 1. *Operative duration by position. Boxes show median and IQR; whiskers extend to 1.5 × IQR. Individual case values overlaid.*

The results of the secondary outcome comparisons are shown in Table 2 and Figure 2.

Table 2. Peri-operative outcomes by position

Outcome	Supine (n=20)	Prone (n=27)	p
Operative duration, min	71.0 ± 13.6	94.0 ± 14.2	< 0.001
Stone-free rate, n (%)	15 (75.0)	21 (77.8)	1.00
Any intra-op complication, n (%)	2 (10.0)	6 (22.2)	0.44
Bleeding requiring intervention	0 (0)	4 (14.8)	0.13
Retropulsion / auxiliary tract	2 (10.0)	2 (7.4)	1.00
Transfusion, n (%)	0 (0)	1 (3.7)	1.00
Post-op fever / infection, n (%)	2 (10.0)	3 (11.1)	1.00
LOS, days (mean ± SD)	2.4 ± 0.7	2.4 ± 0.6	0.61
Re-intervention within 30 d, n (%)	0 (0)	2 (7.4)	1.00

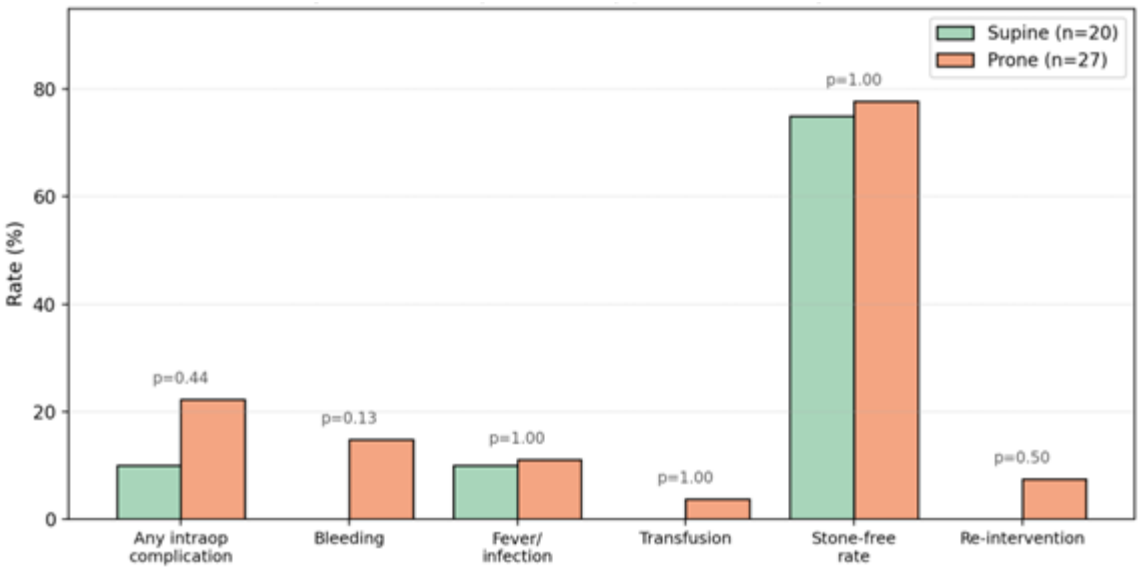


Figure 2. *Secondary outcomes by position. All comparisons non-significant (Fisher's exact test).*

Discussion

The main finding of this study was that operative duration was shorter in the supine group than in the prone group, with a mean difference of 23 minutes. No statistically significant differences were detected in stone-free rate or the measured perioperative outcomes. This finding is in line with previous studies and reviews, which have generally reported similar stone-free rates between the two positions and shorter operative times in some supine PCNL cohorts (9-14). However, differences in patient selection, stone complexity, surgical technique and the method of caclulation of operative duration may affect comparisons between studies.

There are several possible reasons for the shorter operative duration associated with supine PCNL. The supine position avoids the need to turn the patient from lithotomy to prone when retrograde

access is required. It also allows antegrade and retrograde procedures to be performed simultaneously when ECIRS is used. In addition, the more horizontal working axis in the supine position may promote the drainage of stone fragments and irrigation fluid, reducing the need for repeated instrument passes and irrigation cycles (7,8). These features may reduce some steps during surgery. However, this study did not measure positioning time or the duration of each stage of the procedure. It is therefore not possible to determine how much each factor contributed to the observed difference.

The stone-free rates were 75.0% in the supine group and 77.8% in the prone group. These results are similar to those reported in previous comparative studies (9-13,18). However, the small sample size means that a clinically important difference cannot be ruled out. Stone-free status was assessed using KUB radiography within 24-48 hours after surgery. This method may miss some residual fragments and is less sensitive than non-contrast CT. The reported rates should therefore be interpreted with this limitation in mind. Although fewer bleeding events were recorded in the supine group, the study was too small to show whether this difference reflects a true difference between positions.

The results may be relevant to urological services in Sri Lanka, where operating theatre time is limited. A shorter procedure could potentially improve theatre use, but this study did not measure total theatre time, room turnover or the number of additional cases that could be performed. Any benefit to service capacity remains a possibility rather than a proven outcome. The choice of position should depend on the patient, stone features, available equipment and the experience of the surgical team. Supine PCNL may be a useful option for selected patients when the team has suitable training and resources.

Limitations

This study has several limitations. Its retrospective design and non-random selection of position may have introduced bias. The groups may have differed in factors that were not recorded or analysed, including stone complexity and the number or type of access tracts.

Supine cases were more common later in the study period as the surgeon adopted the technique. Although the difference in operative duration remained after the first four supine cases were excluded, this analysis cannot fully rule out an effect of increasing experience or changes in workflow. The small sample size limits the ability to detect differences in uncommon complications. The use of KUB radiography to assess stone clearance may have missed residual fragments. Finally, the study was performed by one surgeon at one centre, so the findings may not apply to all hospitals or surgeons.

Conclusion

In this single-centre study, supine PCNL was associated with a shorter operative duration than prone PCNL. No statistically significant differences were detected in stone-free rate or the other measured outcomes. The study does not establish that the two positions are equally safe or effective. Larger prospective studies involving several centres, with clear definitions of operative time, detailed information on stone complexity and more sensitive postoperative imaging, are needed.

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