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Supine Percutaneous Nephrolithotomy (PNCL)-2 Years' Experience in a Tertiary Care Hospital

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ABSTRACT

Percutaneous Nephrolithotomy (PCNL) has basically substituted open surgery for managing large, complex renal stones. Supine PCNL provides multiple benefits compared to the prone position, yet its adoption in Pakistan remains limited. **Objective:** To evaluate the experience and outcomes of supine PCNL at a tertiary care hospital in Pakistan. **Methods:** This retrospective study included 113 patients (aged 3–74 years) who underwent PCNL at the Urology Unit of Baluchistan Institute of Nephro-Urology Quetta (BINUQ) between June 2021 and June 2023. Data on demographics, operative position (supine/prone), Extracorporeal Shock Wave Lithotripsy (ESWL) sessions, and postoperative hospital stay were retrieved from medical records. Descriptive statistics were analyzed using SPSS version 26. **Results:** Age of the patients was 32.68 ± 15.59 years. Among 113 patients, 63 (55.8%) were male, and 50 (44.2%) were female. Age distribution included 28 (24.8%) patients aged 3-20 years, 54 (47.8%) aged 21-40 years, 24 (21.2%) aged 41-60 years, and 7 (6.2%) aged 61-74 years. Right-sided PCNL was performed in 64 (56.6%) cases, while 49 (43.4%) involved the left kidney. A total of 82 (72.6%) patients experienced (Supine) PCNL, and 18 (15.9%) (Prone). The mean number of ESWL sessions was 0.24± 0.52, and the average postoperative hospital stay was 2.99 ± 1.85 days. **Conclusions:** Supine PCNL demonstrated favorable outcomes, including shorter hospital stays, effective stone removal, and reduced postoperative recovery time.This study supported the broader adoption of supine PCNL in clinical practice.

INTRODUCTION

Percutaneous Nephrolithotomy (PCNL), performed in the supine position, is widely used to largely replace open surgical removal of large renal complexes. Kidney stones represent a major urological challenge that has plagued humankind for centuries. Anyone with kidney stones requires intervention. At present, the primary treatment options for renal stones include Extracorporeal Shockwave Lithotripsy (ESWL), Percutaneous Nephrolithotomy (PCNL), Retrograde Intrarenal Surgery (RIRS), and open surgery. PCNL is typically advised for patients with staghorn calculi, kidney stones larger than 20 mm, or lower pole stones exceeding 15 mm [1, 2]. Initially, Percutaneous Nephrolithotomy (PCNL) was performed on patients in the supine position during renal excision due to concerns about spinal injury. Intravenous Pyelography (IVP) is a common imaging technique used during the early development of PCNL techniques for stone-containing disorders. At that time, modern imaging methods including ultrasonography or Computerized Tomography (CT) were not widely used. Consequently, surgeons performing early PCNL lacked a comprehensive understanding of the psychophysiological anatomy that is easily accessible to modern neurologists [3]. Consequently, surgeons performing early PCNL lacked a comprehensive understanding of the psychophysiological anatomy that is easily accessible to modern neurologists. As PCNL became more common, it became more clearly positional a horizontal position is not ideal for all patients, especially

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those who are severely obese. This obesity or breath detection problems added to the desire for ease of urinary access throughout retrograde and anterior series endoscopic procedures together led to a search for new sites for patients to undergo PCNL [4]. Major complications that initially led to primary PCNL in the prone position were actually less in the supine position. The incidence of retro-renal colon perforation was 1.9% versus 10% in prone PCNL compared with PCNL of a supine position, respectively [5]. In contrast to an earlier study proposed the hypothesis that there is a higher risk of spinal perforation in the supine position compared to the supine position. However, contemporary findings have contradicted this, contributing to a growing preference for supine PCNL. As a result, there has been a 20% increase in the use of supine PCNL since then [6]. This rise can be attributed to multiple factors, including enhanced surgical training, improved ergonomics, shorter operative times, lower complication rates, and better anesthetic control in the supine position. Several modifications in patient positioning have been proposed to reduce morbidity and complications. These include reverse lithotomy, spinal positioning, lateral decubitus, Valdivia-Galdakao, and Valdivia-Barts modifications [7]. When applied to supine PCNL, these modifications show promising results. For example, the Valdivia-Galdakao position allows simultaneous retrograde access, enhances anesthetic management, and has been associated with comparable or improved procedural success rates, reduced complication rates, and greater patient comfort compared to traditional prone approaches. Reverse lithotomy and lateral decubitus positions also facilitate better drainage and reduced surgical stress, contributing to a more favorable postoperative recovery experience [8]. While these newer positions are considered safer and more effective than traditional prone PCNL, the supine position has emerged as a viable alternative to the prone position [8, 9]. The idea that PCNL should be exclusively performed in the prone position has been widely dismissed, as many urologists worldwide now consider the supine position routine. Additionally, advancements in imaging techniques, such as real-time ultrasound and multi-slice CT scanning, have improved stone localization and access planning, while innovations in miniaturized and flexible surgical instruments have increased procedural safety and precision further encouraging the shift towards supine PCNL.

This study aimed to share the experience of supine PCNL over two years at a tertiary care hospital, highlighting its outcomes and providing recommendations for broader use to improve patient care.

METHODS

This retrospective study was conducted on 113 patients who underwent Percutaneous Nephrolithotomy (PCNL) in the Urology Department of Baluchistan Institute of Nephro-Urology Quetta (BINUQ) over a six-month period following IRB approval (MED EDU/BINUQ No.328/29). Data from June 2021 to June 2023 were included retrospectively. Patients aged 3-74 years of either gender who underwent PCNL for kidney stones were enrolled. Patients undergoing percutaneous surgery for other conditions, such as diversion nephrostomy, antegrade endopyelotomy, or mini-PCNL, were excluded. Preoperative assessment involved intravenous urography or non-contrast-enhanced spiral CT to determine stone location and radiolucency. Patients with positive urine cultures received appropriate antibiotics 48 hours preoperatively, followed by an additional seven days of antibiotics postoperatively. Most surgeries were performed under spinal anesthesia. Sample size was calculated using OpenEpi version 3.01 (Open-Source Epidemiologic Statistics for Public Health). Assuming an expected complication rate of 10% from previous literature, with a 95% confidence level and 5% margin of error, the required minimum sample size was 138. However, due to limitations of retrospective data availability and inclusion criteria, a total of 113 cases fulfilling the eligibility criteria were included in the study.This shortfall is acknowledged and addressed in the limitations section, and future prospective studies are recommended to ensure adequate power. The sample size consisted of 113 patients, selected using non-probability consecutive sampling.This approach ensured all eligible patients during the study period were included, minimizing selection delays. However, it may introduce selection bias, which is acknowledged as a methodological limitation. Inclusion criteria were patients aged 3–74 years undergoing PCNL for kidney stones, irrespective of gender, while exclusion criteria encompassed patients undergoing percutaneous procedures for non-stone-related conditions, those with contraindications to PCNL, and cases with incomplete medical records. Written informed consent was obtained from all participants. Data collected included demographic details (age, gender), surgical position (supine or prone), Extracorporeal Shock Wave Lithotripsy (ESWL) sessions, and postoperative discharge day. Statistical analysis was performed using SPSS version 26. Normality of quantitative variables was assessed using the Shapiro-Wilk test. Quantitative variables, such as age, postoperative discharge day, and ESWL sessions, were expressed as mean and standard deviation, while qualitative variables, including gender, surgical position, and laterality of PCNL, were described as frequencies and percentages. All statistical analyses were conducted with a 95% confidence interval and a 5% level of significance.

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RESULTS

The study included 113 patients, with a mean age of 32.68 ± 15.59 years. The majority were male (63, 55.8%), while females comprised 50 (44.2%). The largest proportion of patients (54, 47.8%) belonged to the 21–40 years age group, followed by 28 (24.8%) in the 3–20 years range, 24 (21.2%) in the 41–60 years range, and 7 (6.2%) in the 61–74 years range. The mean discharge postoperative day (D/C POD) was 2.99 ± 1.85, and the mean Extracorporeal Shock Wave Lithotripsy (ESWL) sessions were 0.24 ± 0.52 (Table-1).

Table 1: Baseline Details of selected patients (n=113)

Variables	Value Frequency (%)/ Mean ± SD
Age (Years)	32.68 ± 15.59
Gender	
Male	63 (55.8%)
Female	50 (44.2%)
Age Group (Years)	
3-20	28 (24.8%)
21-40	54 (47.8%)
41-60	24 (21.2%)
61-74	7 (6.2%)
Discharge Postoperative Day (D/C POD)	2.99 ± 1.85
ESWL Session	0.24 ± 0.52

Regarding the surgical position, 82 patients (72.6%) underwent supine PCNL, while 18 (15.9%) had the procedure in the prone position (Figure 1).

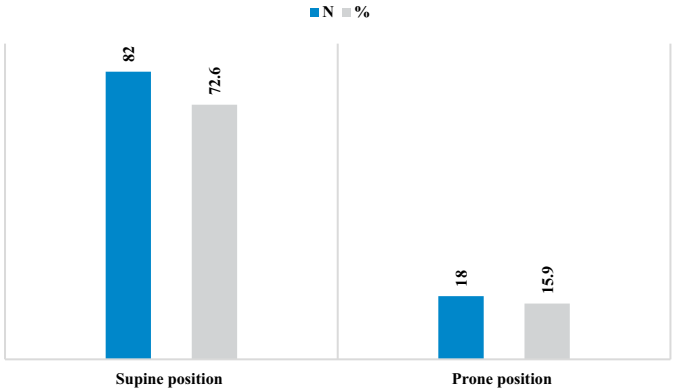

Figure 1: Supine/prone position (n=113) (Majority of patients underwent supine PNCL position as compared to prone PNCL position)

The laterality of the procedure revealed that right-side PCNL was performed in 64 patients (56.6%), compared to 49 (43.4%) who underwent left-side PCNL (Figure 2).

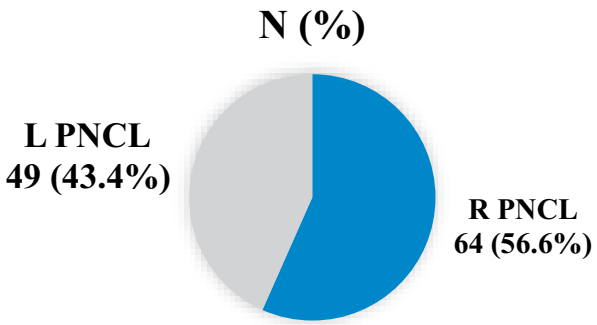

Figure 2: R/L PNCL (majority of patients underwent R-PNCL (56.6%) as compared to 43.4% L-PNCL)

DISCUSSION

The primary focus of the present study was to investigate the experience of PNCL in the supine position. There was a notable increase in outcomes compared to other sites. These included higher rates of stone removal, lower complications, shorter operative time, and a decreased postoperative hospital stay. These included higher rates of stone removal, lower complications, shorter operative time, and a decreased postoperative hospital stay. Therefore, the efficacy and safety of recumbent PCNL were confirmed. The supine position is greatly advantageous and includes benefits such as reduced operative time and fewer complications [10, 11]. Invasive procedures such as deflation or reintubation are more easily performed in the supine position compared to the prone position [12-14]. An earlier study reported that lying flat on the floor carries the risk of intestinal perforation. In the prone position, the uterus moves laterally due to abdominal compression from the operating table, providing a safety advantage, but this advantage is absent in the supine position. Even so, in this experience, any issues with cervical perforations. To mitigate intraoperative risks during supine PCNL utilized real-time fluoroscopic guidance throughout the procedure to confirm access and guide tract dilation. In some cases, ultrasonography was also used, particularly for anterior calyceal puncture or obese patients. These imaging modalities improved visualization, helped avoid adjacent organ injury, and enhanced procedural accuracy. The use of these precautions and imaging techniques positively influenced outcomes by reducing complication rates and improving stone clearance efficiency. The precise tract access facilitated by fluoroscopy likely contributed to the reduced operative time and shorter postoperative hospital stay observed in the cohort. It can be assumed that the tumor is less likely to perforate in the lumbar spine compared to a normal longitudinal approach because the air in the lumbar spine causes more spinal displacement, which can lead to greater spinal injury. The most effective strategy to reduce the risk of closure is to combine real-time ultrasound and fluoroscopy during the procedure [15].

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Although the prone position is considered the standard for PCNL, its limitations have become increasingly apparent as the practice has become more widely accepted, especially due to concerns about anesthesia in severely obese or high-risk patients. Increased interest in, and the subsequent increase in the use of, urethral anterior-grade retrograde endoscopic techniques is continuously improving the effectiveness of retrograde intra-renal surgery, leading to an increase in the demand for PCNL [16]. Several folded instruments were developed to minimize the limitation of placing patients on the abdomen alone. These innovations are aimed at increasing comfort, improving ventilation and circulation, and reducing the chances of compression injury [17, 18]. Furthermore, these devices this offers the added advantage of slightly flexing the patient's waist, thus extending the operation laterally. To overcome these challenges, a side-by-side position was introduced for PCNL. The 'Barts method' combines the advantages of posterior positioning with the possibility of unidirectional advanced endoscopy [19]. Numerous investigations on PNCL reported better outcomes of supine PNCL in terms of lower complications, higher stones removal, and shorter hospitalization against prone PNCL [20, 21]. The poor prognosis of prone PNCL included lower patient's satisfaction, increased awareness, and higher surgical visual acuity. The assessment of stone removal and risk of recurrence were done during follow-up after supine PNCL [22]. An earlier study compared the supine PNCL with prone position with certain modifications provided unique benefits of improved stone removal efficiency, surgical effectiveness, and lower postoperative complications [23]. Another study introduced Barts method offering extra advantages for complete endomandibular treatment in single-step. Modified tubeless PNCL in vertical position supported alternate option for stone characteristics [24]. While the findings suggest the supine PCNL may be advantageous in terms of operative time, complication rates, and recovery, the absence of a direct comparative analysis with the prone position limits the strength of this conclusion. This study was observational and did not include a control group of patients undergoing prone PCNL. Therefore, statistical comparisons between positions (e.g., chi-square tests for categorical variables and t-tests for continuous variables) could not be conducted. This limitation is acknowledged, and recommended that future studies adopt a randomized or matched cohort design to compare both approaches directly and apply statistical significance testing with p-values and confidence intervals.

CONCLUSIONS

Supine PCNL has shown better outcomes in terms of lower hospital stay, effective stone removal, and discharge postoperative day. It has been observed that supine PNCL emerged as advantageous method in terms of safety, effectiveness, and patient comfort against prone PNCL. As a result, a validation of the efficacy and safety of supine PCNL has been confirmed.

Authors Contribution

Conceptualization: RA
Methodology: SA, RA
Formal analysis: MJ
Writing, review and editing: SA, RA, HMK, AU
All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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