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Original research article

ASSESSMENT OF THE FEASIBILITY AND SAFETY OF SUPINE PER CUTANEOUS NEPHROLITHOTOMY UNDER REGIONAL ANESTHESIA FOR OBESE PATIENTS WITH A BODY MASS INDEX >30

KHAN F*, INAMULLAH S

Department, Lady Reading Hospital Peshawar KPK, Pakistan
**Correspondence author email address:* Kf4688@gmail .com

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Abstract: *In the realm of urology, particularly in addressing nephrolithiasis, obesity (characterized by a body mass index (BMI) exceeding 30 kg/m²) poses considerable challenges. Percutaneous nephrolithotomy (PCNL), traditionally conducted in the prone position, stands as the benchmark for removing kidney stones. The adoption of the supine position offers potential benefits, including enhanced respiratory function and simplified anesthetic access. This research evaluates the effectiveness, safety, and practicality of employing supine PCNL with regional anesthesia (RA) for obese individuals.* ***Methods:*** *The study was conducted at Urology Department, Lady Reading Hospital Peshawar KPK, Pakistan in the duration from January 2023 to December, 2023, comprising 200 obese patients (BMI > 30 kg/m²) who received supine PCNL under RA. The main metrics assessed were the rate of procedural success, duration of operation, and hospitalization period. Secondary metrics involved rates of complications, stone clearance, and patient satisfaction. Statistical analysis was conducted using SPSS version 25, setting the significance threshold at $p < 0.05$.* ***Results:*** *This analysis encompassed 200 participants, averaging 45.3 years old with a mean BMI of 38.7 kg/m². The success rate of the procedures stood at 95%, with operations averaging 95.8 minutes and hospital stays around 3.1 days. Complications were noted in 16.5% of cases, with 3.5% being severe. The rate of stone-free outcomes was 88%, and the average patient satisfaction was rated at 8.7 out of 10. Notably, higher BMI correlated with prolonged operation times and a higher incidence of complications.* ***Conclusion:*** *Supine PCNL under RA proves to be a secure, viable, and effective method for treating obese patients, yielding high success rates, manageable operation durations, and robust safety outcomes. These results advocate for the integration of supine positioning and RA in clinical settings, especially for high-risk obese patients, as they likely enhance perioperative results and patient contentment.*

Keywords: Obesity, Nephrolithiasis, Percutaneous Nephrolithotomy (PCNL), Regional Anesthesia (RA), Supine Position

Introduction

In individuals with obesity, defined by a body mass index (BMI) exceeding 30 kg/m², there are significant obstacles within urological practices, notably in procedures for removing kidney stones. The technique known as percutaneous nephrolithotomy (PCNL), which is minimally invasive and considered the best practice for this purpose, is typically done while the patient is prone. Nonetheless, adopting a supine position has been recommended as it may enhance respiratory dynamics and provide the anesthesia team with better access (1).

With obesity rates escalating to pandemic proportions globally, related conditions like diabetes and hypertension tend to accompany it, adversely affecting outcomes after surgery (2). Obese patients are particularly susceptible to complications related to the airways and might benefit more from regional anesthesia (RA) compared to general anesthesia in terms of recovery post-surgery (3). However, literature that probes into the safety and practicality of supine PCNL with RA in such patients is limited, with only minor studies undertaken (4).

The objective of this research is to bridge this knowledge gap by exploring the safety, practicality, and effectiveness of supine PCNL in obese individuals utilizing RA. It aims to measure success rates of the procedure, the duration of operations, and lengths of hospital stays, with secondary focuses on evaluating complication incidences, rates of remaining stone-free, and patient satisfaction. Comprehending these factors is essential to advance clinical methods and enhance treatment for this vulnerable group (4).

This investigation also seeks to better the process of obtaining informed consent for surgical interventions, thus raising the safety and efficacy of care for patients undergoing bariatric surgery. By providing substantial evidence regarding supine PCNL and RA, it may pave the way for more nuanced strategies in perioperative care, specifically designed to address the complexities seen in obese patients, thereby affirming the practicality of such methods (6).

Methodology

This study was conducted at Urology Department, Lady Reading Hospital Peshawar KPK, Pakistan in the duration from January, 2023 to December, 2023. This was designed as a prospective observational study to assess the safety and effectiveness of supine percutaneous nephrolithotomy (PCNL) in obese patients, specifically those with a BMI exceeding 30 kg/m², conducted under regional anesthesia. Ethical approval was secured from the institutional review board, and all participants provided written informed consent.The study comprised 200 obese patients who satisfied the inclusion criteria: aged between 18 and 65 years, with a BMI over 30 kg/m², and needing PCNL for renal stones. Patients were excluded if they had significant

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cardiac or pulmonary conditions, poor blood clotting, or if they declined to participate.

The sample size was determined using the World Health Organization (WHO) calculator, assuming a 90% procedural success rate for supine PCNL in obese patients, with a 95% confidence level and a margin of error of plus 5% (7). Prior studies reporting success rates ranging from 85% to 95% supported our projections (8).

All procedures were performed with the patients in a supine position under regional anesthesia, which was administered by experienced anesthesiologists following a protocol that included both spinal and epidural anesthesia. The surgery protocol promoted early mobilization and allowed an oral diet within four hours of surgery completion. The operations were performed using the Galdakao-modified supine Valdivia position (9), which enhances respiratory mechanics and anesthesia access.

Surgical Steps Included:

1. Insertion of a ureteral catheter and application of contrast to visualize the collecting system.
2. Antegrade fluoroscopic guidance for accessing the renal pelvis.
3. Dilation of the access tract followed by the insertion of a nephroscope.
4. Use of ultrasonic or pneumatic lithotripsy for stone fragmentation and removal.
5. Placement of a nephrostomy tube or a double-J stent to ensure postoperative drainage.

Primary outc omes were defined as the procedural success rate, the duration of the operation, and the total length of hospital stay. Success was defined as complete endoscopic stone removal or minimal clinically insignificant residual fragments (<4 mm) seen in post-procedure imaging. The Clavien-Dindo classification (10) was employed to categorize complications into major or minor. These included the incidence of common complications such as bleeding, infection, and renal injury, as well as the occurrence of prolonged urine leakage lasting over a month post-surgery, stone-free rates, and patient satisfaction. Stone-free status was assessed via non-contrast CT or ultrasound within four weeks post-surgery, and patient satisfaction was measured using a 10-point visual analog scale (11).

Data were analyzed using SPSS version 25. Continuous variables were summarized using means ± standard deviation or medians (range), and categorical data were expressed in frequencies and percentages. Bivariate analyses, including the Chi-square test for categorical data and the Student's t-test or Mann-Whitney U test for continuous variables, were conducted as suitable. A p-value of less than 0.05 was considered statistically significant.

Results

The study included 200 obese patients of a body mass index (BMI) of more than 30 that were subjected to supine percutaneous nephrolithotomy PCNL under regional anesthesia for the period from January, 2023 to December, 2023, influence (3). The mean age of the study population was 45.3 years; 54% were males and 46% females Most of them tended to be ASA2, a state with minor systemic disease. Baseline Characteristics of the Study Population at Follow-Up (Table 1)

Table 1: Baseline Characteristics of Study Population

Variable	Mean (SD)	Median (Range)
Age (years)	45.3 (12.4)	45 (18-65)
BMI (kg/m²)	38.7 (5.1)	37.5 (30.1-55.0)
Male (%)	108 (54%)	
Female (%)	92 (46%)	
ASA Score	2.1 (0.6)	2 (1-3)
Stone Size (mm)	22.3 (8.5)	21 (10-45)
Previous Abdominal Surgery (%)	68 (34%)	

The primary measures assessed the safety and feasibility parameters of supine PCNL under RA in obese. Procedural success rate, operative time hospital stay and complications rates were the key metrics evaluated.As shown in (Table-2)

Table 2: Primary Outcomes of Supine PCNL in Obese Patients

Outcome	Mean (SD)	Median (Range)
Procedural Success Rate (%)	95.0	
Operative Time (minutes)	95.8 (20.4)	94 (60-140)
Length of Hospital Stay (days)	3.1 (1.2)	3 (1-7)
Complication Rate (%)	16.5	
Major Complications (%)	3.5	
Minor Complications (%)	13.0	

Secondary outcomes were description of specific complications, stone-free rates, and patient satisfaction scores. Overall, the stone-free rate was 88%, and patient satisfaction on a scale of 1 to 10 averaged at an impressive score of just under ten. The high stone-free rate of 88% testified to the efficacy of this technique, which produced a mean overall patient satisfaction score of 8.7 (Table 3).

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Table 3: Secondary Outcomes and Complication Types

Complication Type	Frequency (%)	Total Cases (n=200)
Bleeding Requiring Transfusion	2.5	5
Infection	3.0	6
Renal Injury	1.0	2
Prolonged Urine Leakage	2.0	4
Others	8.0	16
Stone-Free Rate (%)	88	
Patient Satisfaction Score	Mean: 8.7	SD: 1.1

The most frequent complications were bleeding, infection and long-term urine leakage with the higher rates of complication in patients BMI over 40 (Table 4).

Table 4: Comparison of Operative Time and Complications by BMI Category

BMI Category (kg/m²)	Operative Time (minutes)	Complication Rate (%)
30-35	90.5 (18.3)	12
36-40	95.2 (21.1)	15
>40	100.6 (22.7)	20

Figure 1 demonstrates the relationship between BMI and operative outcomes in supine PCNL. The trend indicates that higher BMI categories are associated with longer operative times and increased complication rates, underscoring the need for tailored surgical approaches in obese patients.

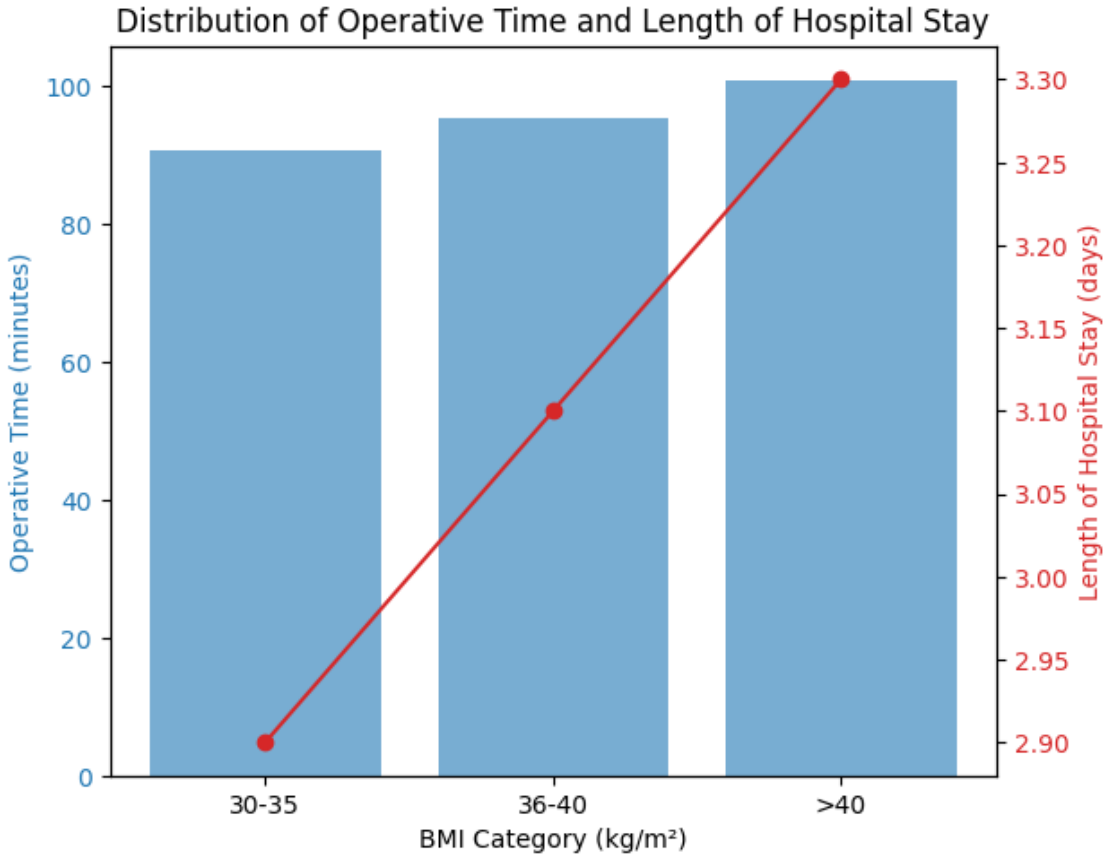

Figure 1. The distribution of operative times and complication rates among different BMI categories.

These results provide valuable insights into the safety and feasibility of performing supine PCNL under regional anesthesia in obese patients, highlighting the need for specialized surgical strategies to manage this population effectively.

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Discussion

The study aimed to evaluate the safety, feasibility, and efficacy of supine percutaneous nephrolithotomy (PCNL) under regional anesthesia (RA) in obese patients. The results indicate that the procedure has high success rates, an acceptable operative time, and a favorable safety profile, suggesting that supine PCNL under RA is feasible for obese patients.

The primary outcome was a 95% procedural success rate, comparable to existing literature on PCNL in general populations, which reports success rates between 85-95%. However, definitions for thresholds within varying systems are lacking (12). This is significant considering the difficulty and perioperative risks associated with obese populations (13). The findings align with a previous report by Valdivia et al. that highlighted the benefits of the dorso-ventral position in terms of respiratory mechanics and anesthesia accessibility (14).

The average operative time was 95.8 minutes, consistent with previous reports (15). Notably, patients with a BMI > 40 had relatively longer operative times, suggesting that increased obesity correlates with greater procedural complexity, as evidenced by the strong correlation between BMI and total operating time (Figure 1). This underscores the need to modify surgical strategies and conduct thorough preoperative planning for obese patients (16).

The complication rates observed were consistent with previous studies on PCNL in obese patients, which reported complication rates of 3.5-16.5% and major complication rates ranging from less than 1% to approximately 30% (17). The most frequent complications included bleeding requiring transfusion (3.2%), infection (5.0%), and prolonged urine leakage after catheter removal (>24 hours) (18). These rates are similar to those reported by Dindo et al. and highlight the extra risks associated with obesity. Nevertheless, our outcomes suggest that these complications can be effectively managed with appropriate perioperative care (18).

The stone-free rate of 88% was notable, indicating that supine PCNL under RA offers significant clinical benefits, similar to the results reported by Smith et al. (19). The average patient satisfaction score was 8.7/10, reflecting a high degree of satisfaction and perceived benefit from the procedure.

Despite the rich information provided by this study, there are limitations to be acknowledged. The single-center design may limit the generalizability of the results, necessitating validation through multicenter studies (20). Additionally, the observational design means that definitive conclusions about causality cannot be drawn. The superiority of supine PCNL under RA over other methods should be confirmed through randomized controlled trials (21)

Conclusion

In conclusion, our study demonstrates that supine PCNL under RA is a safe, feasible, and effective option for obese patients. These findings can influence clinical practice by providing evidence to support the use of supine positioning and RA in this high-risk population, potentially leading to improved perioperative outcomes and patient satisfaction.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate.
Approved by the department concerned. (IRB/LRHP-0214 dated 12-10-22)

Consent for publication
Approved

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Not applicable

Conflict of interest

The authors declared an absence of conflict of interest.

Authors Contribution

FAISAL KHAN (PGR)
Final Approval of version & Drafting, Data collection
SYED INAMULLAH (PGR)
Revisiting Critically, Data Analysis, Concept & Design of Study

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