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# Surgical Outcome of Modified Supine versus Prone Percutaneous in Patient Undergoing PCNL

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## ABSTRACT

**Background:** Percutaneous nephrolithotomy (PCNL) is considered the preferred treatment option for kidney stones ≥ 2 CM in size. The conventional prone position for percutaneous nephrolithotomy (PCNL) is commonly preferred by urologists for several reasons. The modified supine position, which involves a tilted supine position combined with lithotomy, offers an additional advantage by enabling simultaneous retrograde access to the upper urinary tract. **Objective:** To compare the surgical outcome of modified supine versus prone percutaneous in patients undergoing percutaneous nephrolithotomy (PCNL) at a tertiary care hospital. **Study Design:** Randomized Control Trial. **Settings:** This study was conducted in inpatients in Section of Urology, Department of Surgery, SIUT Hospital Karachi Pakistan. **Duration:** Six months from November 2021 to April 2021. **Methods:** Patients diagnosed with renal calculi requiring PCNL as the treatment modality visited in section of urology, Sindh institute of urology and transplantation (SIUT) Karachi were included. The total of 186 Patients was randomly divided into two equal groups A (modified supine) and B (prone percutaneous) by envelop method. The primary outcome measures assessed were the duration of surgery and the stone clearance rate. The duration of surgery was defined as the time from the start of the procedure to its completion. All the information was collected through study proforma. **Results:** In this study 186 patients were divided randomly by envelop method into two equal groups A (modified supine) and B (prone percutaneous) to compare the surgical outcome of modified supine versus prone percutaneous. Mean age in modified supine group was 35.15±10.90 years and in prone percutaneous was 38.49±10.44 years. Duration of surgery was 45.34±6.31 and 72.60±9.83 minutes in modified supine versus prone percutaneous group respectively (P=0.001). The stone clearance rate was found to be 72 (77.42%) in modified supine group versus 76 (81.72%) was noted in prone percutaneous group and p value found to be non-significant (p= 0.467). Clearance rate of the stone was statistically insignificant according to age, gender and location of stone (p= >0.05). **Conclusion:** It is to be concluded that modified supine PCNL demonstrates less operative time compared to prone PCNL, the stone clearance rate remains similar. The choice of position should be made based on individual patient characteristics, surgeon experience, and institutional resources.

***Keywords:*** *Renal calculus, PCNL, Prone position, Supine position, Treatment outcomes.*

## INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is considered the preferred treatment for renal calculi that are large (>2cm) and complex in nature.[1,2] Usually, PCNL has commonly been conducted with the patient in the prone position. This approach has been favored by surgeons due to their familiarity with the technique, the ability to perform posterior calyceal puncture, a larger surface area for puncture, decreased risk of bowel injuries, and the potential for fewer complications.[2] Nevertheless, the

prone position presents certain disadvantages in terms of anesthesia, particularly in patients who are overweight, obese, or have limited cardio-pulmonary reserve.[1]

On the operating table, a vacuum beanbag fashioned like the letter C is used to support the patient in the modified supine position for (PCNL). The individual is given general anesthesia before the legs are placed in lithotomy. During this procedure, the ipsilateral hip of the individual is flexed, then the knee of the individual's contralateral leg becomes bent as well. The individual's opposite leg is pulled down and held in an expanded posture.[4] The modified supine position provides various benefits. Firstly, it reduces lung pressure for the patient throughout the procedure as they remain supine instead of being positioned prone.[4,5] Additionally, it offers the added advantage of enabling accessibility to the upper urinary tract in a retrograde direction simultaneously.[6]

Although due to its benefits related to cardiovascular, respiratory, and anesthesia considerations, the supine position is generally favored by anesthetists over the prone position.[7] The risk of accidental removal of the endotracheal tube during the transition to the prone position and limited access to the airway after positioning are concerns linked to the prone position. Additionally, the prone position poses a higher likelihood of nerve tension, musculoskeletal injuries, and increased ocular pressure leading to potential visual impairment.[7,8]

The aim of this study is to determine the surgical outcome in terms of duration of surgery and stone clearance rate of modified supine versus prone in patients with PCNL. Despite a limited amount of data comparing the modified supine position to the prone position, the existing literature does not provide a definitive consensus on which position is superior but we expect better stone clearance rate in less duration of surgery in modified supine position. Therefore, this study has been done to provide insights into the surgical outcomes of modified supine versus prone percutaneous nephrolithotomy, specifically in terms of the duration of surgery and the clearance rate of stones.

## METHODS

This randomized Control trial was conducted at Section of Urology, Department of Surgery, SIUT Hospital, Karachi Pakistan. Duration of the study was Six months from November 021 to April 2021.

By using non-probability consecutive sampling technique, sample size was calculated as per reference (8): Sample size of 186 cases each group consisting of 93. Power of the test: 80%, Confidence Interval (CI): 95%

Patient aged between 18 and 60 years, either gender, patients who have given informed consent to participate in the study, >2cm renal pelvis or upper/mid pole stone, >1.5cm lower pole stone and CT KUB from our institute were included in the study.

Patient with already Percutaneous nephrostomy in place, BMI >35, pregnancy, bleeding disorders, untreated urinary tract infection and patient having psychiatric illness was excluded from the study.

The study was carried out following the approval of the Hospital Ethical Committee, and all the data was collected after obtaining informed consent from the patients involved. The interventions were performed with the administration of general anesthesia. The procedures were conducted by surgeons who had a minimum of 5 years of experience. Baseline demographics including BMI, Age, gender, laterality, stone size and location was recorded. All the patients were divided in two groups. The patients were assigned to either the modified supine position or the prone position based on the surgeon's preference and availability of equipment. The modified supine position involved using a C-shaped vacuum beanbag on the operating table, while the prone position involved placing the patient in a prone position on the operating table. The primary outcome measures assessed were the duration of surgery and the stone clearance rate. The duration of surgery was defined as the time from the start of the procedure to its completion. The stone clearance rate was determined based on postoperative imaging, such as X-rays or computed tomography scans, to assess the complete removal of renal calculi.

All the information was collected through study proforma and analysis of data was done by using SPSS version 26.

## RESULTS

In this study 186 patients were studied. Mean age in modified supine group was 35.15±10.90 years and in prone percutaneous was 38.49±10.44 years. Mean serum creatinine in modified supine group was 1.14±0.44 mg/dl and in prone percutaneous 1.14±0.53 mg/dl. Mean size of stone in modified supine group was 2.61±0.38 cm and in prone percutaneous 2.66±0.83 cm. Mean duration of stone in modified supine group was 4.87±1.56 month and in prone percutaneous 4.56±1.61 month. Mean BMI in modified supine group was 27.58±2.98 kg/m2 and in prone percutaneous 26.92±2.53 kg/m$^2$. Out of all 63 (67.7%) male and 30 (32.3%) female was enrolled in modified supine group and 67 (72%) male and 26(28%) female were included in prone percutaneous group, and location of stones presented in table.1

**Table 1: Descriptive statistics of demographic and clinical characteristics (n=186)**

| Variables | | Study groups | | p-value |
|---|---|---|---|---|
| | | Modified supine | Prone percutaneous | |
| **Age (years)** | | 35.15 ± 10.90 | 34.89 ± 10.44 | 0.872 |
| **Serum creatinine level** | | 1.14 ± 0.443 mg/dl | 1.14 ± 0.53 mg/dl | 0.981 |
| **Stone size (cm)** | | 2.61 ± 0.38 | 2.66 ± 0.83 | 0.359 |
| **Disease duration (months)** | | 4.87 ± 1.56 | 4.56 ± 1.61 | 0.182 |
| **BMI [Kg/m2]** | | 27.58 ± 2.98 | 26.92 ± 2.53 | 0.105 |
| **Gender** | Male | 63 (67.7%) | 67 (72.0%) | 0.457 |
| | Female | 30 (32.3%) | 26 (28.0%) | |
| **Location of stone** | Lower pole | 12 (12.90%) | 14 (15.05%) | 0.001 |
| | Mid pole | 12 (12.90%) | 19 (20.43%) | |
| | Pelvis | 50 (53.76%) | 36 (38.71%) | |
| | Upper pole | 19 (20.43%) | 24 (25.81%) | |

In comparison for duration of surgery mean± standard deviation was 45.34±6.31 and 72.60±9.83 minutes in modified supine versus prone percutaneous group respectively (P=0.001). The stone clearance rate was found to be 72 (77.42%) in modified supine group versus 76 (81.72%) was noted in prone percutaneous group (p= 0.467). Table.2

**Table 2: Mean duration of surgery and stone clearance rate (n=186)**

| Variables | | Study groups | | p-value |
|---|---|---|---|---|
| | | Modified supine | Prone percutaneous | |
| Duration of surgery | | 45.34 ± 6.31 minutes | 72.60 ± 9.8 minutes | 0.001 |
| Stone clearance | Yes | 72 (77.42%) | 76 (81.72%) | 0.467 |
| | No | 21 (22.58%) | 17 (18.28%) | |

Clearance rate of the stone was statistically insignificant according to age, gender and location of stone (p= >0.05). Table.3

**Table 3: Clearance of stone in accordance to age, gender and location of stone (n=186)**

| Variables | | Stone clearance | Study groups | | p-value |
|---|---|---|---|---|---|
| | | | Modified supine | Prone percutaneous | |
| Age groups | 18-35 years | Yes | 34 (34%) | 45 (45%) | 0.054 |
| | | No | 14 (14%) | 07 (7%) | |
| | >35 years | Yes | 38 (44.18 %) | 31 (36.04 %) | 0.304 |
| | | No | 7 (8.14 %) | 10 (11.64 %) | |
| Gender | Male | Yes | 50 (38.46 %) | 55 (42.31 %) | 0.694 |
| | | No | 13 (10 %) | 12 (9.23 %) | |
| | Female | Yes | 22 (39.28 %) | 8 (14.28 %) | 0.511 |
| | | No | 21 (37.5 %) | 5 (8.92 %) | |
| Location of stone | Lower pole | Yes | 7 (26.92 %) | 5 (19.23 %) | 0.695 |
| | | No | 6 (23.08 %) | 8 (30.77 %) | |
| | Mid pole | Yes | 6 (19.35 %) | 6 (19.35 %) | 0.470 |
| | | No | 12 (38.71 %) | 7 (22.59 %) | |
| | Pelvis | Yes | 50 (58.14 %) | 36 (41.86 %) | N/A |
| | | No | 00 | 00 | |
| | Upper pole | Yes | 9 (20.93 %) | 22 (51.16 %) | N/A |
| | | No | 10 (23.25 %) | 2 (4.65 %) | |

## DISCUSSION

PCNL is a minimally invasive procedure used for the treatment of large kidney stones. Traditionally, it is performed with the patient in the prone position. However, a modified supine position has been proposed as an alternative approach. This study aims to compare the outcomes of modified supine PCNL with the conventional prone PCNL technique among cases undergoing the procedure. In this study there was significant shorter duration of surgery in the modified supine group 45.34±6.31 compared with the prone group 72.60±9.83 (p=0.001).

In the comparison of this study Jones MN *et al*[4] reported that the surgical duration shorter significantly in patients undergoing modified supine PCNL. In the line of this series Perrella R *et al*[9] also observed that the supine position resulted in the significant shorter surgical duration (117.9±39.1 minutes) compared to the prone position (147.6±38.8 minutes) (p=0.001). Our findings were also supported by the Mulay A *et al*[10] as the mean duration of the surgical procedure from the initial

position in the supine PCNL was noted 72.24 minutes and in prone PCNL was seen 88.12 minutes (p=0.001). Nevertheless, the evidence supporting the shorter operating time linked to the modified supine position is not entirely conclusive, as indicated by a prospective randomized study conducted by Wang *et al*.[11] The modified supine position allows for the more direct renal access, which can facilitate easier access to the targeted stone. This can potentially reduce the time required for stone removal and other surgical steps. It is important to note that while multiple studies showed the shorter operative times in the modified supine position for PCNL, further research and randomized controlled trials are needed to establish a more definitive conclusion and to account for variations in patient characteristics, surgeon experience, and surgical techniques.

In this study the mean age in modified supine group was 35.15±10.90 years and in prone percutaneous was 38.49±10.44 years, 63 (67.7%) male and 30 (32.3%) female were enrolled in modified supine group and 67 (72%) male and 26(28%) female were included in prone percutaneous group, and findings regarding stone locations were corelated with the study by Jones MN *et al*[4].

In this study the stone clearance rate in the modified supine group was 77.42% (72 out of 93 cases), while in the prone percutaneous group, it was 81.72% (76 out of 93 cases). However, there was no statistically significant difference in stone clearance rates between the two groups (p > 0.05). Consistently Desoky EA *et al*[12] reported that the comparison between the two groups did not show any statistically significant differences in terms of the stone-free rate, with 89.3% in the modified supine group and 88.9% in the prone group (p > 0.05). In the comparison of our findings Rehan M *et al*[13] also reported that rates of clearance of stone were equivalent across the both study groups, with 82% in the modified supine group and 80% in the prone group, and the difference was not statistically significant (P=0.856).

In accordance to a meta-analysis when the stone-free rate was analyzed collectively, it was discovered to be considerably greater when measured in the position of lying prone.[14] This could be attributed to the reason that in such position, the lumbar region becomes visible, enabling the use of multiple puncture sites and facilitating easier access to the upper pole of the kidney. Additionally, the working area is larger, providing ample space for maneuvering instruments.[14,15] On the other hand Falahatkar S *et al*[16] observed that the modified supine percutaneous nephrolithotomy (PCNL) demonstrates almost similar operative times, stone-free rates, and hospital stays when compared to prone PCNL. In the study by Mazzucchi E *et al*[17] reported that the stone-free rates among individuals who got the surgery in the prone and supine positions were 83% and 78%, respectively.

According to the Jones MN *et al*[4] the PCNL procedures were conducted on patients with more complex stones and higher risk profiles. The study did not employ a randomized design, which may introduce selection bias and affect the comparability of the two groups. Conducting the study at a single center may limit the generalizability of the results to other healthcare settings or populations. The experience and proficiency of surgeons performing the PCNL procedures may differ, which could influence the surgical outcomes and introduce a confounding factor. It is important to consider these limitations when interpreting the results of the study and to exercise caution in applying them to clinical practice. In order to give greater confidence information on the differences between modified supine and prone PCNL surgery, it is necessary to conduct additional well-organized, randomized controlled and the large sample size studies.

## CONCLUSION

As per the study conclusion, modified supine position may be considered as a viable alternative to the traditional prone position in patients undergoing PCNL, especially in cases where minimizing operative time is a priority. The shorter operative time associated with the modified supine position can potentially lead to reduced patient discomfort, improved surgical efficiency, and better utilization of healthcare resources. However, it is important to note that there is no significant difference in the stone clearance rate between the two positions, indicating that they are similarly effective in achieving successful removal of renal stones. Although the choice of position should be made based on individual patient characteristics, surgeon experience, and institutional resources.

## LIMITATIONS

Limited sample size and single centre study.

## SUGGESTIONS / RECOMMENDATIONS

It is worth mentioning that further research is needed to fully understand the potential advantages and limitations of the modified supine position in PCNL. Future studies should include larger sample sizes, randomized controlled designs, and longer follow-up durations to provide more robust evidence on the comparative effectiveness and safety of the two positions.

## CONFLICT OF INTEREST / DISCLOSURE

None.

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