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Original Article

Prone Versus Modified Supine Position in Percutaneous Nephrolithotomy: A Prospective Cohort Study

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ABSTRACT

Aims and objectives: the present study was conducted to compare prone versus modified supine position in percutaneous nephrolithotomy.

Material and methods: The present study is a prospective cohort study conducted in Department of Surgery in Gandhi Medical College and Hamidia Hospital, Bhopal from December 2020 to October 2022. All the patients presenting with renal calculi of size more than 1.5cm or less than 1.5cm with history of failed ESWL or retrograde lithotripsy were included in the study.

Results and Conclusion: A total of 30 patients with a median age of 46 years were studied, 15 (50%) underwent PCNL in prone position and 15 (50%) in supine position. There were no significant differences in gender, age, body mass index, stone location, stone size and the presence of hydronephrosis between the two groups. Time from anaesthesia pre-medication to first attempt to puncture the kidney was significantly lower in supine groups compared to the prone group (32.67mins vs 44.67mins, $p<0.05$).There was no significant difference in the outcome variables, namely, post-op hemoglobin, days of hematuria, VAS effort score, pain or length of hospital stay. Thus, Modified Supine position allows a reduction in the time needed to position the patient and in the effort sustained by professional nurses, if compared to the prone position. These benefit sallow an optimization of the available resources with economic implications.

Key Words: PCNL , supine , prone , pyelolithotomy, modified supine position

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INTRODUCTION

Nephrolithiasis is the most common pathology of urinary system, affecting as much as 12% of the global population annually[1]. In patients presenting with non-functioning or poorly functioning kidney, renal stone is one of the common causes[2] for which Percutaneous nephrolithotomy (PCNL) is the preferred modality of treatment.

Fernstrom and Johannson in 1976 published their first report of PCNL by the name of 'percutaneous pyelolithotomy' where they described extraction of stone under radiological control in prone position[3]. Due to the anatomical considerations, such as, the location of kidney to dorsal surface and the obscuring of the kidney with bowel and other organs, the logical approach to access kidneys is the prone position[4]. Since then, several modifications of this technique were devised, such as reverse lithotomy for females, prone split leg for antegrade and retrograde access or prone flexed positions for decreasing patient morbidity and increased safer access [5–8]. However, these positions were associated with severe complications such as cervical spine injury and/or ocular ischemia[9]. In the year 1987, Valdivia Uria et al proposed supine position instead of prone for the procedure[10]. Supine position is theoretically safer for cardiac patients, leads to easier identification of the upper calyx and can be used for retrograde procedures simultaneously. Although this position allows better airway access, it was associated with lesser Stone Free Rate (SFR)[11] and increased chances of bowel injury.

In 2007, Ibarluzea et al, described Galdako-modified Valdivia position[12]. Its advantages were listed to be greater flexibility in stone manipulation, use of combined or subsequent retrograde and percutaneous access and avoidance of the need of patient repositioning. Besides these advantages, Galdako-modified Valdivia position also provides a comparable Stone Free Rate (SFR).

Despite of the several researches comparing supine with prone position for PCNL, the results are still inconclusive and a common consensus has yet to be reached. Further, cursory search for treatment of nephrolithiasis, particularly comparing

the positional aspects of surgical approaches as applied to Indian population is essentially missing to the best of our knowledge. Our study shall help in generating key evidence required for clinicians for the treatment of kidney stone disease.

METHODOLOGY

The present study is a prospective cohort study conducted in Department of Surgery in Gandhi Medical College and Hamidia Hospital, Bhopal from December 2020 to October 2022. The approval from Institute Ethics Committee was obtained for this study. All the patients presenting after the date of commencement were included in the study.

All the patients presenting with renal calculi of size more than 1.5cm or less than 1.5cm with history of failed ESWL or retrograde lithotripsy were included in the study. We excluded the patients with pregnancy, active urinary tract infection, coexisting renal disease, bleeding disorder or in whom surgery was contraindicated. Patients with renal calculi in more than one calyx as confirmed by non-contrast CT scan were also excluded from the study.

All the patients were explained the study in the language of their understanding and those consenting for the study were recruited. Patients were initially screened with X-ray KUB and Ultrasound KUB followed by CT KUB. Blood samples for Hb levels were drawn both pre- and post-surgery. Patients underwent PCNL in supine and prone position in an alternate manner. Recruitment was stopped once the sample size for the study, that is, 30 patients (15 in each group: supine and prone) was achieved.

Surgical procedure:

After induction, cystoscopy is done in lithotomy position and ureteric stent/catheter is placed and renal C-arm guidance. Patient is then repositioned into Supine or Prone position respectively.

In cases of prone group, patient is put in prone position with supports placed either under the thorax and abdomen or at either side from shoulder to pelvis. Brachial plexus injury is prevented by positioning the elbow and shoulder carefully and padding all the pressure points.

For Supine Position, we used Galdakao-modified Valdivia position. This is an intermediate supine-lateral position, achieved by placing rolled supports or bolsters to raise the flank. The ipsilateral leg is extended and the contralateral one is abducted and flexed.

Percutaneous needle puncture is made in the loin to reach renal pelvis via kidney, following which guide wire is placed. Graduated dilators are passed to widen the track, through which nephroscope is passed. After pelvicalyceal system is identified under fragmentation, stone is removed using graspers and/or suction.

We calculated time from anesthesia to first attempt to puncture the kidney, time from first puncture to valid access and duration of the surgery. Duration of hospital stay(days), hematuria, pain, VAS effort score, fever, and recurrence within one month of surgery were also noted.

STATISTICAL ANALYSIS

The data was analyzed with the help of R software version 4.2.0. Chi-squared test and Fisher's exact test was used to compare the proportion in categorical variables. Mann-Whitney U and student's T or Welch's two sample T test was used to compare the non-normally and normally distributed continuous variables, respectively. p-values below 0.05 were considered statistically significant.

OBSERVATION AND RESULTS

This study consists of 15 patients in each group with a mean age of 46yrs in prone group and 42yrs in modified supine group. There were no significant differences between gender distribution, stone size (max diameter in mm), laterality and presence of hydronephrosis among the prone and supine group. The median stone size for prone PCNL group was 22mm (IQR 19-28) and for supine group was 25mm (IQR 22-32) with a p value of 0.3.

The average time from start of anesthesia to first attempt to puncture the kidney in supine position was 37.67mins (median- 40mins) and in prone group was 44.67 mins (median- 45mins). Although the avg time being lower in supine group, the difference between the 2 groups was not statistically significant (p=0.2).

The median time from first attempt to puncture the kidney to creation of valid access in both the groups was 10 mins. Mean time being 13 mins in Prone group and 12.2 mins in Supine group.

We also compared the total length of surgery. The median length of surgery in prone group was 120 minutes as compared to 100 minutes in the supine group. The difference in durations though present was not significantly different, p=0.081.

We used VAS scale to evaluate effort put by nursing staff in positioning the patient. The median in the prone group was 3 (IQR: 2-3) and in the supine group it was 2 (IQR: 2-2). This difference between the two positions was not statistically significant (p=0.058). Blood loss intraoperatively was calculated as difference between pre and post op Hb, measured from the same laboratory. We did not find any statistically significant difference between the 2 groups.

Post operatively, we compared the mean duration of hematuria between the 2 groups, incidence of pain that required additional analgesics, incidence of fever, total length of surgery and stone free rate observed at 30-days follow up. (Table 3)The median duration of hematuria in prone group was three days and that in supine position group was two days. This difference was not statistically significant, (p=0.4).Five patients in prone position and six in supine position reported pain, the proportional difference was not statistically significant(p=0.7). Fever was observed in five patients in the prone group and six patients in the supine position group. There was no significant difference between the mean stay between the two groups (p=0.2). The median duration of stay in prone group was seven days and for the supine position group, it was six days.

The stone-free rate (SRF) in both the groups was observed to be 100% at the 30-days follow up.

Table 1: Basic characteristic of patients who underwent PCNL in the prone and modified supine positions

	Prone group	Modified supine group	P value
Total patients	15	15	
Mean age, yr.(range)	46 (3-51)	42 (27-54)	0.8
M:f ratio	10:5	8:7	0.5
Stone size (mm)	22 (19-28)	25 (22-32)	0.3
Laterality: left/right	7:8	11:4	0.14

Table 2: Intraoperative characteristics of patients who underwent PCNL in the prone and modified supine positions

	Prone group	Modified supine group	p value
Time from start of anesthesia to first attempt to kidney puncture (median, IQR) in mins	45.00 (40.00-47.50)	40.00 (30.00-45.00)	0.2
Time from 1stpuncture to creation of valid access (median, IQR) in mins	10.00 (10.00-15.00)	10.00 (10.00-15.00)	0.8
Total length of surgery (median, IQR) in mins	120 (98-135)	100 (90-115)	0.081
Hb loss	1.82	1.47	0.065
Vas effort score	3	2	0.058

Table 3: Postoperative characteristics of patients who underwent PCNL in the prone and modified supine positions

	Prone group	Modified supine group	P value
Duration of Hematuria(days)	3.00 (1-4)	2.00 (1.5-3)	0.4
Incidence of pain	5	6	0.7
Incidence of fever	4	1	0.3
Total length of hospital stay (days)	7 (5.5-8)	6(5-7)	0.2
Stone free rate	0	0	

DISCUSSION

Percutaneous nephrolithotomy or PCNL is one of the preferred choices of treatment for renal calculi. Over the years, several modifications and alterations of the technique has made it more efficient and less risky. However, the question about superiority of one position of PCNL over another is still a matter of debate.

Prone Position for PCNL has been the standard of care since its initiation[13]. Familiarity with the procedure, more direct approach to kidney, lesser risk of bowel injury, and relatively avascular plane for kidney puncture are some of the reasons behind it[14]. Despite, prone position has several disadvantages, mainly due to anesthesiologic reasons, including respiratory and circulatory difficulties, especially in case of obese patients and patients with cervical spine injury. Inability of patients to tolerate prolonged surgery and difficulty in changing the mode of anesthesia if patient requires urgent intraop intubation are few others[4].

Our present study compares this Prone Position with Galdako-Modified Valdivia Supine Position. The major advantage of position is the overall reduced intra-operative time[15] which is consistent with the findings of *De Sio M*

and team(16). They have reported a significantly lower operative time in the supine group as compared to prone position group (48 min vs 68 min; p<0.001). Similar results were reported in a recent meta-analysis of PCNL position by Liu et al[17]. In our study, we observed a difference of 20 minutes in the median values of total operative time between the two groups, with additional 20 minutes to achieve prone position, however it was not statistically significant. The reason behind it could be the small sample size in our study.

This reduced total intraoperative time is attributed to the time saved in repositioning the patient into prone position. Mean time from anesthesia to first puncture in our study was reported to be lower in the supine group (37.67(supine) vs 44.67mins(prone), p=0.8). The statistical test employed in our study might be affected by the outlier of 60 minutes in the supine group. Giusti and De Lisa (2020) have reported a significantly (p<0.001) lower mean anesthesia to first puncture time in the supine group (17.85 minutes) as compared to prone group (31.56 minutes)[18]. The same authors also reported no significant difference between the mean duration of valid access from first puncture between the supine (5.78 minutes) and prone (5.55 minutes) groups (p=0.6) which is in accordance to our study. It can be concluded that time from anesthesia to puncture is lesser in supine position, owing to lack of requirement for positional adjustments, rescrubbing, and draping[19], which also explains the difference in VAS effort score between the 2 groups (3 in prone group vs 2 in supine group).

Other benefits of Galdakao-modified Valdivia supine position, include availability to approach the target both anterograde and retrograde, less patient handling and better tolerance of procedure for patients with pulmonary and cardiovascular diseases. Hence this modified Supine Position is also considered safer for obese patients. Further supine position provides better access to airway in case the need arises to switch from spinal or regional anesthesia to general anesthesia[12]. Last but not the least, supine position provides better angle for clearance of residual stone fragments[20].

A comparison of the 2 positions of PCNL done by Valdivia et al, using database from Clinical Research Office of the Endourological Society (CROES), found higher stone free rates in the prone group (77%) as compared to supine group (70.2%), although majority case in supine group were done in complete supine position[13]. Galdakao modified Valdivia supine position is considered an improvement from the complete supine position in this aspect. A recent study published by Perrella R and group [21], reported SFR of 55.4% in the supine and 50% in prone position group (p=0.057) at 90-day follow-up. In the current study Stone Free Rate (SFR) was 100% in both the groups at 30 days follow up, which is also a significant improvement from previous studies.

We also monitored the patient post-operatively. There was no significant difference between the incidence of pain and fever (infection), duration of hematuria and length of hospital stay in the two groups of patients. A study by Sohail N et al in 2017 has also reported comparable incidences of post-operative complications in patients operated in either position[22]. Similarly, another recent Indian study by Mulay A et al in 2022 also reports that the differences in the incidences of pain and fever in patients operated in prone or supine positions are not significantly different[23].

One of the main limitations of this study is non-randomization of the patients between the two groups that could introduce selection bias. We have tried to minimize this limitation by alternatively allocating patients between the two groups. Additionally, the sample size of the study is not sufficient for ascertaining the power of the study for extrapolation. The study has also not been adjusted for differences in the stone characteristics such as hardness, location, and multiplicity, which might have influenced the operating time.

CONCLUSION

Our study demonstrates that Modified Supine and Prone position for PCNL are comparable and equally effective. Given the lesser operative time required in Galdakao-modified Valdivia Supine position and advantages in terms of instillation of general anesthesia, modified supine position becomes an ideal replacement for traditional prone position of PCNL.

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