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ORIGINAL ARTICLE

Modified supine versus prone percutaneous nephrolithotomy for renal calculi.

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ABSTRACT… Objective: To find out the best position in the practice of PCNL. **Study Design:** Randomized Controlled Trial. **Setting:** Department of Urology, AFIU, Rawalpindi. **Period:** August 2020 to January 2021. **Methods:** A total of 164 adult (20-70 years) patients of either gender undergoing percutaneous nephrolithotomy for single renal calculus with size >20 mm through single puncture access were included. Patients with staghorn stone, recurrent stone, PUJO, pyonephrosis and bleeding disorder were excluded. In group A patients, modified supine PCNL was done while in group B patients, prone PCNL was done. Operative time was noted by the researcher himself with the help of stopwatch. All patients were followed by researcher himself for assessment of complications and drop in hemoglobin levels. Postoperatively patients were evaluated for stone free rate. Hospital stay was noted. **Results:** In my study, stone free rate after supine PCNL was found in 66 (80.49%) patients and after prone PCNL in 45 (54.88%) patients (p-value = 0.0001). Complications rate after modified supine PCNL was found to be 8.54% patients and after prone PCNL was 20.73% (p-value = 0.027). In my study, mean operative time in supine PCNL was 86.12 ± 9.33 minutes and in prone PCNL was 110.80 ± 13.35 minutes. Mean hospital stay in supine PCNL was 1.77 ± 0.79 days and in prone PCNL was 2.49 ± 0.81 days. Mean drop in hemoglobin levels was 0.82 ± 0.24 g/dl vs 1.77 ± 0.24 g/dl respectively (p-value = 0.0001). **Conclusion:** This study concluded that mean operative time, hospital stay, drop in hemoglobin and complications are less while stone free rate is high after modified supine PCNL as compared to prone percutaneous nephrolithotomy.

Key words: Complications, Percutaneous Nephrolithotomy, Supine Position.

INTRODUCTION

The incidence of nephrolithiasis is approximately 10–15%.[1] The minimally invasive methods including percutaneous techniques have replaced the traditional open surgery. Urolithiasis has affected humanity since time times.[2-4] It has even been discovered in Egyptian mummies.[5]

The recurrence rate of renal calculi is 50% across various geographic regions and ethnic group.[6] The innovative treatment options such as extracorporeal shock waves lithotripsy (ESWL), retrograde intrarenal surgery (RIRS), percutaneous nephrolithotomy (PCNL), and laporoscopic ureterolithotomy are currently used for management of renal stones.[7]

Renal stones larger than 2 cm should be managed by percutaneous nephrolithotomy (PCNL).[8] The minimally invasive methods are also suitable for the management of benign and malignant disorders.[9] The percutaneous access was first initiated by radiologists in 1954.[10]

The prone position for PCNL is favored due to larger surface area, familiarity with the procedure and potentially more direct access to the kidney.[11]

In order to reduce morbidity within the local population this study was conducted. It will evaluate the effects of modified supine PCNL vs prone PCNL.

METHODS

The study was conducted for six months after approval from the institutional ethical review committee of the Armed Forces Institute of Urology (AFIU) URO-2019-118-1043. The cohort size was

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164 i.e. 82 in each group, taking complications rate after modified supine PCNL as 9.0% and after prone PCNL as 23.2%.[10] The sampling technique was non-probability, consecutive sampling.

All adult patients aged 20 to 70 years, irrespective of gender, undergoing percutaneous nephrolithotomy for a single renal calculus larger than 20 mm via single puncture access meet the inclusion criteria. Patients with staghorn stones, recurrent stones, pregnancy, pelvic kidney, pelvi-ureteric junction obstruction, pyonephrosis, sepsis, and bleeding disorders (INR >1.2) are among the exclusion criteria.

Informed consent was taken from each patient. Age, gender, BMI, hypertension, diabetes mellitus, and other demographic information were recorded. Patients were divided in two groups; group A underwent modified supine PCNL, while group B underwent prone PCNL. A double J stent was placed in both groups.
The data was analyzed via SPSS version 25.0.

RESULTS

The supine position in PCNL was initially performed by Valdivia Uria et al.[12] Kumar et al. reviewed five different variations of the supine positions.[13] The Galdakao-modified Valdivia supine position has several advantages such as minimal effects on the patient's circulatory and respiratory systems, easy anesthetic monitoring, simultaneous retrograde access and no need for patient repositioning.[14-15]

Jones MN et al. demonstrated that the mean operating time for a modified supine percutaneous nephrolithotomy (PCNL) was 93.0 ± 45.5 minutes while for prone PCNL was 123.0 ± 49.5 minutes. The stone clearance after prone PCNL was 50% whereas it was 70% after supine PCNL.[16] Melo PA et al.17 exhibited mean operating time for modified supine PCNL was 120.85 ± 49.49 minutes, while for prone PCNL was 123.48 ± 45.14 minutes. For modified supine PCNL, the mean hemoglobin level drop was 1.97 ± 1.22 g/dl, while for prone PCNL, it was 2.34 ± 1.39 g/dl. The stone-free status for modified supine PCNL was 35%, while 37.4% after prone PCNL. Complications after modified supine PCNL were reported in 9.0% of patients, in contrast to 23.2% of patients after prone PCNL.[17]

In our study, stone free rate after supine PCNL was found in 66 (80.49%) patients and after prone PCNL in 45 (54.88%) patients (p-value = 0.0001). Complications rate after supine PCNL was found to be 8.54% patients and after prone PCNL was 20.73% (p-value = 0.027). In my study, mean operative time in supine PCNL was 86.12 ± 9.33 minutes and in prone PCNL was 110.80 ± 13.35 minutes. Mean hospital stay in modified supine PCNL was 1.77 ± 0.79 days and in prone PCNL was 2.49 ± 0.81 days. Mean drop in hemoglobin levels was 0.82 ± 0.24 g/dl vs 1.77 ± 0.24 g/dl respectively (p-value = 0.0001).

DISCUSSION

In 1976. Fernstrom and Johansson described percutaneous nephrolithotomy (PCNL).[18] For large kidney stones, PCNL has become the gold standard of treatment. The prone position was once considered the only way to access the kidney. The other position increases the risk of colonic and vascular injury.

In 1987, Valdivia Urìa and colleagues[19] explained the advantages of supine PCNL. In Valdivia study, 19.7% of patients had surgery in the supine position while 80.3% in the prone position. Within this study, 66 patients (80. 49%) were stone-free following supine PCNL, whereas 45 patients (54. 88%) achieved stone-free status after prone PCNL (p-value = 0. 0001).

Puncture Site	Group A (n=82)		Group B (n=82)		Total (n=164)	
	Frequency	%age	Frequency	%age	Frequency	%age
Upper	47	57.32	47	57.32	94	57.32
Middle	14	17.07	19	23.17	33	20.12
Lower	21	25.61	16	19.51	37	22.56

Table-I. Distribution of patients according to puncture site in both groups.

		Group A (n=82)		Group B (n=82)	
		Stone Free Rate		Stone Free Rate	
		Yes	No	Yes	No
Age (years)	20-45	59	12	39	29
	46-70	07	04	06	08
Gender	Male	44	12	32	24
	Female	22	04	13	13
Size (mm)	21-30	29	09	13	16
	>30	38	07	31	21
BMI (kg/m^2)	≤27	24	07	17	16
	>27	42	09	28	21
Side	Right	39	13	29	25
	Left	27	03	16	12
Puncture site	Upper	36	11	26	21
	Middle	12	02	10	09
	Lower	18	03	09	07

Table-II. Stratification of stone free rate with respect to age, gender, size of stone, BMI, side affected and puncture site.

		Group A (n=82)		Group B (n=82)	
		Complications		Complications	
		Yes	No	Yes	No
Age (years)	20-45	05	66	15	53
	46-70	02	09	02	12
Gender	Male	04	52	14	42
	Female	03	23	03	23
Size (mm)	21-30	04	33	03	27
	>30	03	42	14	38
BMI (kg/m^2)	≤27	03	28	08	25
	>27	04	47	09	40
Side	Right	03	49	11	43
	Left	04	26	06	22
Puncture site	Upper	06	41	07	40
	Middle	00	14	04	15
	Lower	01	20	06	10

Table-III. Stratification of complications with respect to age, gender, size of stone, BMI, side affected and puncture site.

Following the modified supine PCNL, the complication rate was 8. 54% and after prone PCNL, the complication rate escalated to 20. 73% (p value = 0. 027).

In our study, the average operative time for modified supine PCNL was 86.12 ± 9.33 minutes, while for prone PCNL, it was 110.80 ± 13.35 minutes. The average length of hospital stay for modified supine PCNL was 1.77 ± 0. 79 days, while for prone PCNL it was 2.49 ± 0.81 days. The average decrease in hemoglobin levels for supine PCNL was 0. 82 ± 0.24 g/dl, compared to 1.77 ± 0.24 g/dl, respectively.

In another study, the average operating time for prone PCNL was found to be 123.0 ± 49.5 minutes, while for modified supine PCNL it was 93.0 ± 45.5 minutes. Seventy percent of patients achieved a stone-free status after supine PCNL, with 50% achieving it after prone PCNL.[20]

The mean operating time in another study for modified supine PCNL was 120.85 ± 49.49 minutes, whereas for prone PCNL was 123.48 ± 45.14 minutes.[21] The mean hemoglobin level drop for supine PCNL was 1.97 ± 1.22 g/dl and for modified supine PCNL was 2.34 ± 1.39 g/dl. Following modified supine PCNL 35.0% of patients had a stone-free rate, and 37.4% following prone PCNL. Complications rate after modified supine PCNL was found to be 9.0% patients and after

prone PCNL was 23.2%.[21]

As compared to the prone group, we found that the modified supine group had a shorter operating time. This 30-minute difference can be explained by the modified supine posture, which allows for both retrograde and antegrade access to the kidney, aids in the removal of stones, and saves time by avoiding repositioning the patient (and thus repeating preparation, draping, staff rescrubbing, and gowning).

Our results are consistent with a recent meta-analysis of PCNL positioning by Liu et al[22], which found that the supine position reduced the mean operative time in comparison to the prone position by 25 minutes. With a prospective randomized study by Wang et al.[23] reporting less operative time in the prone position than in their modified supine group, the evidence for shorter operating time is not totally in favor of the modified supine position. The Wang et al.[23] study also included patients with a significantly lower mean BMI than our study, though this may have an effect on the effectiveness and success of the surgery due to familiarity with the supine position.

We found that PCNLs carried out in the modified supine posture had a notably higher stone-free rate. Our findings were similar with the study conducted by De Sio et al.[24] Although the vast majority of these cases would have been in the full supine position, Valdivia et al.[25] found that the stone-free rates were significantly higher for the prone group (77% vs. 70.2%) than for the supine group.

Other studies also support the prone position.[26] The higher stone free rates (SFR) in the supine position can be explained for simultaneous anterograde and retrograde stone removal in supine PCNL as well as the impact of gravity-induced stone clearance.[27]

Falahatkar et al.[28] included individuals with partial and complete staghorn stones in their RCT. Similar patient and stone characteristics were observed in the prone and supine PCNL groups. The supine group showed comparable stone free rates (SFRs) and a shorter operating time. More patients in the supine group needed blood transfusions than those in the prone group (27.5% vs. 7.5%), even though the two groups' complication rates were comparable.

The most recent RCT was carried out by Al-Dessoukey et al.[29] compared the safety and efficacy of prone and supine PCNL and described how they affected anesthetic parameters. The results demonstrated that supine PCNL had significantly shorter operating times and hospital stays, as well as similar SFRs and complication rates to the earlier RCTs. Furthermore, the supine PCNL had less of an impact on the respiratory and cardiovascular systems, which may benefit those who suffer from respiratory or cardiac disorders.

Three meta-analyses comparing prone and supine PCNL.[30-32], indicated that both prone and supine PCNL provided same results in terms of stone-free rates (SFRs), rates of complications, and duration of hospital stay. 32–33 The SFRs for prone PCNL were 83.4% and 81. 6%, while for supine PCNL were 84.5% and 83.5%. Short operating times were observed during supine PCNL.

In their meta-analysis, Zhang et al.[34] found that the prone position had significantly higher SFRs than the supine position (77.3% vs. 72.9%). They suggested that the increased number of studies and the differences in the stone-free evaluation of studies were the reasons why the results were different from those of earlier meta-analyses.[34]

A study by Yuan et al revealed the higher rate of stone clearance in prone PCNL as compared to supine PCNL. On the other hand, a shorter operating time and fewer blood transfusions were linked to the supine position. While the difference in the length of hospital stay and complications were same.[33]

Prone and supine PCNL are equally effective in attaining a high stone-free rate. However, supine PCNL is associated with less blood loss, shorter operating time and less drop in hemoglobin levels. Additionally, supine PCNL results in lower

overall costs as well as lower costs for anesthesia and disposable surgical equipment.[34]

CONCLUSION

In our study, modified supine PCNL was better in terms of duration of surgery, hospital stay, drop in hemoglobin level and complications. In order to reduce patient morbidity, it is recommended that patients undergoing percutaneous nephrolithotomy be routinely treated with modified supine PCNL.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Musab Umair Khalid	Substantial contribution to conception or design design of the work or the acquisition, analysis, or interpretation of data for the work.	
2	Badar Murtaza	Substantial contribution to conception or design of the work.	
3	Adnan Ali	Drafting of the work or revising it critically for important tntellectual content.	
4	Aneela Shabbir	Final approval of the version to be published.	
5	Chaudhary Ammar Bashir	Agreement to be accountable for all aspects of the work in ensuring that questions related to accuracy.	
6	Muhammad Nouman Khan	Integrity of any part of the work are appropriately investigated and resolved.	