

Supine Versus Prone Percutaneous Nephrolithotomy : An Early Experience

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ABSTRACT

Background : Percutaneous Nephrolithotomy (PCNL) is a minimally invasive procedure and the gold standard for kidney stone larger than 2cm. Since it was first introduced PCNL has been carried out in the prone position. In 1987, Valdivia Uria became the first to introduce PCNL in supine position. Since then, many researchers have compared the superiority of supine of PCNL with traditional prone PCNL. We aimed to compare the surgical outcomes of supine versus prone PCNL in private hospital.

Materials and methods: This study was a retrospective study conducted in Chattogram Metropolitan Hospital from January 2000 to February 2021. Total 52 patients underwent PCNL, in which 26 were performed in supine position and 26 performed using prone position. All data of both procedures were collected and statistically analyzed to compare between both groups.

Results: In demographic characteristics of both groups male was predominate (69.2 vs 57.7). Both the groups were similar in terms of stone characteristics. There was no significant statistical difference in mean operative time (61.34 min vs 80.58min) blood transfusion (46.2% vs 53.8) stone clearance (96.2% vs 100%) and hospital stay (1-2 day vs 1-2). No major complications were observed.

Conclusion: Although there was no significant difference of outcomes between two groups, PCNL in supine position is safe and it offers potential advantages of better ureteral access, patient handling, simultaneous retrograde and antegrade access, dependent track, easier air way control by anaesthesiologist.

Key words: Percutaneous nephrolithotomy; Prone; Supine.

Introduction

Percutaneous Nephrolithotomy (PCNL) is a minimally invasive and standard procedure for treatment of large renal stones. Originally, PCNL was performed in the prone position due to concerns that other positions increased risk of inadvertent colon injury during percutaneous puncture of the kidney. Majority of urologists are familiar with prone position due to large surface area and direct approach to the kidney. But prone position is associated with several anaesthetic, logistic and surgical disadvantage. In 1987 Valdivia Uria described that PCNL could be performed in the supine position and using preoperative CT scan for patients evaluation,

demonstrated similar outcomes and complication for PCNL performed in the supine position with potential advantages in term of ergonomics and the administration of anaesthesia¹.

Supine PCNL is technically feasible. It has several advantages to patients, urologist and anaesthesiologist. It gives stone free rates and a low incidence of organ injury comparable to those in standard prone PCNL². In complete supine PCNL many complications were in the lower clavian grades and major complications were rare³. Patient positioning in PCNL does not seem to impact the rates of success or severe complications. However complete supine position is associated with a shorter surgical time⁴. Supine percutaneous nephrolithotomy is a safe, minimally invasive procedure with high success rates and low morbidity for simple and complex kidney stones⁵. It also has the advantage of lower blood loss, shorter operative and anaesthetic time. The supine PCNL is also more cost effective. In cases with multiple renal stone with a stone size of more than 2cm, supine PCNL has been proved to be superior to prone PCNL in regards to operative period and hospital stay⁶. Modified supine percutaneous nephrolithotomy has significantly lower total cost, operative cost compared to prone percutaneous nephrolithotomy⁷. PCNL performed in the prone or in the complete supine position in obese patients presents similar outcomes.

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The supine decubitus position has the advantages of significantly shorter operative time and hospital stay. Obesity does not affect the outcome and postoperative complications in patient who undergo complete supine PCNL. One disadvantage of the sheath angle in supine position is that the collecting system may be more difficult to distend and this may require greater amounts of fluid irrigation to perform adequate endoscopic evaluation of the collecting system. Though prone position remains the dominant position for PCNL, the use of supine PCNL is increasing—20% of all PCNLs entered into the Global PCNL study of the Clinical Research Office of the Endourological Society were performed in the supine position. In many centre of our country started supine PCNL although adequate data are not available. The aim of this study to evaluate the outcomes of PCNL in two different position.

Materials and methods

This study was a retrospective study conducted in Chattagram Metropolitan hospital from January 2020 to February 2021. Total 52 patients underwent PCNL, in which 26 were performed in the supine position and 26 performed using prone position. Before commence the study necessary permission was obtained for proper authorities.

Inclusion criteria

The patients with following characteristics will be included-

- Patients age 18 years or more
- Stone size 2cm to 4 cm
- Normal renal function.

Exclusion criteria

The patients with following characteristics will be excluded-

- Renal congenital anomalies, lower urinary tract stone or stricture
- Patients with single kidney
- Renal malformation
- Anatomical abnormality that hampers patient positioning, i. e scoliosis
- Pregnancy
- Chronic kidney disease
- Coagulopathies.

Aims, objectives, procedures, risks and benefits of the study were explained to the patients. Written informed consent was taken from each patient. Routine preoperative work up - detailed history, physical examination and laboratory investigation like complete blood count, Urine R/M/E & C/S, S. creatinine, Blood sugar, Grouping and cross matching, USG, IVU, Chest X-ray, ECG, were done in all patients. Patients were monitored in the per-operative and postoperative period for Access time, Operative time (Minute) Mean blood loss (Hb gm/dl), Stone clearance rate, Per-operative complications

(Excessive bleeding, pelvi-calyceal system injury, colon injury) post-operative complications (Fever, Urinary extravasations, urinoma) and duration of hospital stay (Days).

The modified supine PCNL was performed using a sand bag under the shoulder. Under general anaesthesia patient was placed in dorsal lithotomy position with the ipsilateral hip flexed with a flexed knee and the contralateral leg is abducted and supported in an extended position. The ipsilateral arm is supported with flexed elbow over the chest. Initially urethrocystoscopy was performed and 5Fr open ended ureteric catheter placed in the upper ureter or kidney. Then retrograde pyelography and desired calyceal puncture were performed under fluoroscopic guidance using 18 gauge needle. A 0.035 hydrophilic guide wire was inserted and passed into the ureter or coiled in collecting system. Tract dilatation was completed with single shoot fascial dilator. After positioning 24 Fr Amplatz sheath, rigid nephroscope was inserted into pelvicalyceal system. Lithotripsy was done by ultrasonic / pneumatic lithotriptor and after that fragment was removed. Stone clearance was confirmed by fluoroscopy. After placing the 5 Fr D-J stent closure of wound done without nephrostomy tube. The urethral catheter was removed after 24-48 hours. Stitch was removed on 10th POD and checked for wound infection, leakage. Cystoscopic removal of D-J stent was done after 3-4 weeks.

In prone PCNL group, urethrocystoscopy was performed in dorsal lithotomy position under general anaesthesia. Placing the ureteric catheter patient was turned in prone with putting a bridge under his chest and pelvis. Rest of the procedure was same as supine position.

Results

Table I : Baseline demographic characteristics of the patients stratified by study groups

Variables		Supine (n=26)	Prone (n=26)	p value
Age	Mean ±SD	50.58±8.14	49.58±6.38	0.624*
	Range	28-70	36-61	
Sex	Male	18 (69.2)	15 (57.7)	0.388†
	Female	8 (30.8)	11 (42.3)	

Data were expressed as frequency (Percentage) if not mentioned otherwise. p value was obtained from *Independent sample t test or †Chi-square test.

Age ranged from 28 to 70 years in the study with a mean age of 50.58±8.14 and 49.58±6.38 years respectively in supine position and prone position group. There was male predominance in both groups. Both the groups were comparable in terms of distribution of age and sex (Table I).

Table II : Baseline clinical characteristics of the patients stratified by study groups

Variables		Supine (n=26)	Prone (n=26)	p value
Symptoms	Fever	0 (0)	0 (0)	NA
	Pain	12 (46.2)	11 (42.3)	0.710†
	Hematuria	1 (3.2)	0 (0)	0.313†
	Pyuria	0 (0)	0 (0)	NA
Comorbidity	HTN	5 (19.2)	6 (34.6)	0.211†
	DM	6 (34.6)	6 (34.6)	1.0†
	COPD	1 (3.2)	0 (0)	0.313†
	CRF	0 (0)	0 (0)	NA
Previous surgery	Open	3 (11.5)	1 (3.8)	0.298†
	PCNL	0 (0)	0 (0)	NA
	URS	0 (0)	1 (3.8)	0.313†
	ESWL	0 (0)	0 (0)	NA

Data were expressed as frequency (Percentage). p value was obtained from †Chi-square test. NA: Not Applicable.

Pain was the commonest symptom in both groups and no patients had fever or pyuria in either of the two groups. HTN and DM were the commonest comorbidity. Few patients had previous history of surgery [Open and URS (Ureteroscopy)]. However, there was no significant difference between two groups in terms of the distribution of these baseline clinical characteristics.

Table III : Baseline stone characteristics of the patients stratified by study groups

Stone parameters		Supine (n=26)	Prone (n=26)	p value
Size, cm	Mean ±SD	2.89±0.44	2.90±0.49	0.996*
	Site			
	Right	15 (57.7)	15 (57.7)	1.0†
	Left	11 (42.3)	11 (42.3)	
Number	Single	21 (80.8)	24 (92.3)	0.202†
	Multiple	5 (19.2)	2 (7.7)	
Location	Pelvis	17 (65.4)	18 (69.2)	0.848†
	Lower calyx	14 (53.8)	9 (34.6)	
	Middle calyx	4 (15.4)	4 (15.4)	
	Upper calyx	1 (3.8)	1 (3.8)	

Data were expressed as frequency (Percentage) if not mentioned otherwise. p value was obtained from *Independent sample t test or †Chi-square test.

Both the groups were similar in terms of the preoperative stone characteristics (Table III).

Table IV : Per-operative characteristics of the patients stratified by study groups

Parameters		Supine (n=26)	Prone (n=26)	p value
Duration of operation	Mean ±SD	61.34±10.91	80.58±16.39	<0.001*
	Bleeding			
	No	5 (19.2)	2 (7.7)	0.293†
	Yes	21 (80.8)	24 (92.3)	
Need blood transfusion	No	14 (53.8)	12 (46.2)	0.579†
	Yes	12 (46.2)	14 (53.8)	
Injury to other organ	No	26 (100.0)	26 (100.0)	NA
	Yes	0 (0)	0 (0)	

Data were expressed as frequency (Percentage) if not mentioned otherwise. p value was obtained from *Independent sample t test or †Chi-square test.

Mean operation time was significantly lower in the patients underwent PCNL in supine position compared to the patients who had PCNL in prone position (61.34±10.91 minutes versus 80.58±16.39, p <0.001). Per-operative bleeding and blood transfusion was needed in proportionately higher proportion in patients who underwent PCNL in supine position compared to the patients had PCNL in prone position but the differences were not statistically significant. There was no incidence of organ injury during operation in the study.

Table V : Post-operative events of the patients stratified by study groups

Variables		Supine (n=26)	Prone (n=26)	p value
Hemorrhage	No	26 (100.0)	26 (100.0)	NA
	Yes	0 (0)	0 (0)	
Urine leakage	No	26 (100.0)	24 (92.3)	0.149†
	Yes	0 (0)	2 (7.7)	
Stone clearance	Complete	26 (100)	25 (96.2)	0.313†
	Residual	0 (0)	1 (3.8)	
Length of hospital stay, day	Median			0.998*
	(Range)	1 (1-2)	1 (1-2)	
Urinary tract infection	No	25 (96.2)	24 (92.3)	0.164†
	Yes	1 (3.8)	2 (7.7)	

Data were expressed as frequency (Percentage) if not mentioned otherwise. p value was obtained from *Mann Whitney U test or †Chi-square test.

No major complications were observed in present study. Hundred percent of the patients who underwent PCNL in prone position had 100% stone clearance rate but 1 patient (3.8%) of PCNL in supine position group had residual stone following PCNL. However, the difference was not statistically significant.

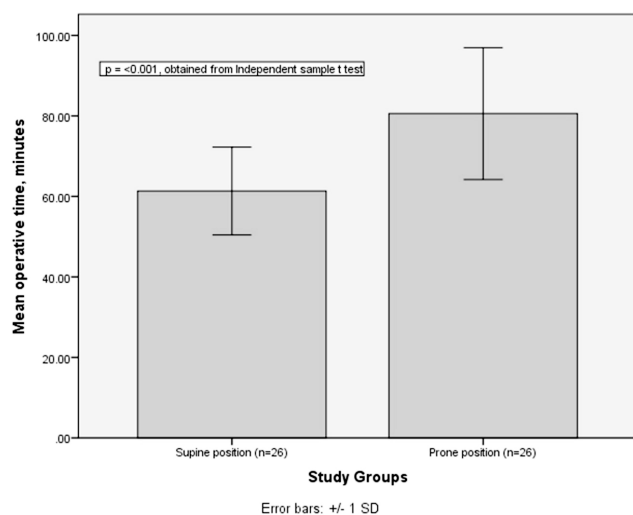


Figure 1: Comparison of mean operation time in both groups

Mean operation time was significantly lower in the patients underwent PCNL in supine position compared to the patients of PCNL in prone position (61.34±10.91 minutes versus 80.58±16.39, $p < 0.001$).

Discussion

Patients with kidney stone diseases were evaluated by history, clinical examination & necessary investigations like CBC, Urine R/M/E & Culture Sensitivity, X-ray Chest P/A view, serum creatinine, ECG, RBS, USG of KUB and IVU. Total 52 patients were selected after fulfilling the inclusion and exclusion criteria. On the basis of personal judgement, patients were divided into two groups- supine (26) and prone (26) group considering position of kidney, stone size & location, condition of pelvicalyceal system. Percutaneous nephrolithotomy done. Patients were followed up during early post operative period (1st visit), at 7th POD (2nd visit) and at one month (3rd visit). On follow up visit, each patient was evaluated by history, clinical examination and investigation. The study findings were analyzed and compared.

The mean age of the patients was 50.58 years (SD-8.14) in supine group and 49.58 years (SD-6.38) in prone group. The age of the patients of both group were compared, which was statistically not significant ($p > 0.05$). Male predominate in both groups, which were 69.2% and 57.78% in supine and prone group respectively.

Cases with nearly equal size stone burden was included in both groups. The mean size of the stone in supine group was 2.89cm (SD 0.44) and in prone group was 2.90cm (SD 0.49). The size of the stone in both groups were analysed and found no statistical significant difference ($p > 0.05$).

Per-operative bleeding requiring blood transfusion, in supine group 12 (46.57%) cases required blood transfusion and in prone group 14 cases (53.8%) required blood transfusion. A study has reported blood transfusion rate upto 17.5%⁸. In another study reported transfusion rate 13.8% in supine group and 13.6% in prone group⁹. Higher rate of transfusion was observed in our series. This was due to failure in obtaining appropriate access, staghorn stone.

The mean (±SD) operation time was noted 64.34(±10.91) minutes in supine group and 80.58(±16.39) minutes in prone group. This result was similar to the study where they found that shorter operative time in supine position¹⁰. This shorter operative time may be due to no need for repositioning, repeat draping as well as re-scrubbing and gowning. Another study showed that supine position offers significant shorter operative time and post operative hospital stay¹¹.

Out of 26 cases in supine group complete stone clearance was found in 26 (100%) cases and out of 26 cases of prone group, complete stone clearance was found in 25 (96.2%) cases. Residual stone were recorded in 1 cases of prone group and no cases in supine group. Considering p-value complete stone free rate was not statistically significant. Similar study reported that there was no statistical significant difference in stone clearance between two groups¹². But several studies showed that higher stone clearance in supine position due to possibility of simultaneous antegrade and retrograde access, and the effect of gravity induced stone clearance with the help of water flow through the ureteric catheter.

In evaluating the post operative hospital stay, we have done all the supine PCNL without nephrostomy, where we used nephrostomy in few cases of prone PCNL that delayed discharge from hospital. In such caeses hospital stay was higher. But hospital stay in both group was almost similar and not statistically significant. Study conducted by Jones et al reported that higher stone clearance and shorter hospital stay in supine group.

In this study all procedures were performed in a single setting under general anaesthesia. Regarding complications there were urinary tract infection, hematuria, and fever. Out of 26 patients of supine group, 1 (3.8%) and in prone 2(7.7) patients developed fever that was treated by appropriate antibiotic. In prone group 2(7.7) developed urine leakage on 1st POD had managed by

reposition of D-J stent. Neither of the patient developed wound infection or wound dehiscence. All but those who had complications, recovered uneventfully. Another study showed that complications rate is lower in supine group that is statistically significant¹³.

Another study found that no significant difference in number of puncture, stone free rate, frequency of blood transfusion, hospital stay and complications between supine and prone groups PCNL¹⁴.

Conclusion

Despite being a safe surgical intervention, PCNL is not exempted from potential complications, which can arise at any stage of procedure: patient positioning, renal puncture, tract dilatation, intraoperative manipulation, stone fragmentation and postoperative management. Besides being the majority of them minor, they can be kept to a minimum in experienced hands with the development of new techniques and improved technologies. Concerning complications, the modified Clavien classification seems to be worldwide accepted and increasingly used by urologists to define their procedure related complications.

Disclosure

All the authors declared no competing interest.

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