Original Article

A prospective, randomized comparison of standard prone position versus flank-free modified supine position in percutaneous nephrolithotomy: A single-center initial experience

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Abstract

Background: Percutaneous nephrolithotomy (PCNL) is the first choice for treatment of large renal stone >2 cm. The prone position is the classical position preferred by most surgeons. Aiming to improve patient anesthesia and surgery-related inconveniences of the prone position, Valdivia *et al*., 1987, described the performance of PCNL with the patient in the supine position. Hence, we aimed to study the safety and efficacy of flank-free modified supine position in PCNL compared to the standard prone position.

Patients and Methods: This is a prospective randomized study for 60 patients with large renal stones planned for PCNL operation during the period from November 2017 to May 2019. Patients were divided into two groups (30 patients each group): Group A – patients underwent PCNL in the prone position and Group B – patients underwent PCNL in the modified flank supine position. Patients' demographics, stone size, Hounsfield unit with intraoperative details as fluoroscopy time, operative time, and complications were recorded. Postoperatively, need for or not to blood transfusions, hospital stay, stone-free status, and postoperative complications were assessed.

Results: There was no statistically significant difference between the prone and supine positions regarding stone size (4 cm vs. 4.5 cm, $P = 0.16$), Hounsfield unit (940 HU vs. 955 HU, $P = 0.78$), body mass index (31.2 kg/m^2 vs. 32.5 kg/m^2, $P = 0.49$), fluoroscopy time (6.9 min vs. 7.3 min, $P = 0.5$), operative time (89.5 min vs. 90.4 min, $P = 0.9$), residual stones (10% vs. 20%, $P = 0.8$), and hospital stay (45.6 h vs. 48.6 h, $P = 0.5$). Fever occurred in 3.3% of cases in each group and urine leakage observed in one patient with prone position. No blood transfusion was needed in both the groups.

Conclusions: PCNL in the modified supine position proved to be a safe and effective choice compared to the prone position for adult patients with large renal calculi.

Keywords: Percutaneous nephrolithotomy, prone position, supine position

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INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is the treatment of choice in large renal calculi (>2 cm) based on acceptable low morbidity and superior outcomes.[1] In 1976, PCNL was established as a procedure performed in the prone position. Prone PCNL became widely popularized and totally replaced open renal stone surgery, emerging as the standard operation and exclusive position for two decades.[2] Aiming to improve patient anesthesia and surgery-related inconveniences of the prone position, Valdivia *et al*., 1998, described the performance of PCNL with the patient in the supine position.[3] Supine PCNL enables a single positioning throughout the entire operation, easier patient ventilation, protection of the patient from positional injuries, more convenient access to the patient by the anesthesiologist, an improved ergonomic environment for the surgical urologist (who may be seated while operating), and an easy endoscopic combined intrarenal surgery approach if needed.[4] According to the potential advantages of the supine position over the prone position for PNL, we aimed to study the safety and efficacy of flank-free modified supine position in PCNL compared to the standard prone position.

PATIENTS AND METHODS

This is a prospective randomized study including 60 patients admitted to Menoufia University Hospital with large renal stones planned for PCNL operation during the period from November 2017 to May 2019. Patients were divided into two groups each 30 patients: Group A (patients underwent PCNL in the prone position) and Group B (patients underwent PCNL in the modified flank-free supine position). All patients signed written informed consent, and approval of the study protocol was obtained by the Ethical Scientific Committee. Our method of randomization is by the electronic method. Inclusion criteria include renal stones >2 cm. Exclusion criteria are uncorrectable coagulopathy, active urinary tract infection, and pediatric patients.

All patients were assessed preoperatively by routine laboratory investigations (e.g., complete blood count, serum creatinine, liver and coagulation profile, urine analysis, and urine culture) and radiological evaluation with plain abdominal X-ray, abdominal ultrasonography, and noncontrast spiral computed tomography. Culture-positive patients were treated preoperatively.

Prophylactic 1 g ceftriaxone I.V. was given at induction of anesthesia. Cystoscopy was done with the patient in the lithotomy position to evaluate the urethra and the bladder, then applying the ureteric catheter of 6F.

Patients at Group A were placed in the standard prone position [Figure 1] and patients at Group B were placed in the modified supine position with the legs extended and the ipsilateral leg crossed over the contralateral leg [Figure 2]. A cushion was placed below the ipsilateral flank to provide a 30° inclination. The ipsilateral arm was over the thorax, and the contralateral arm was used for intravenous infusion.

The retrograde evaluation by contrast administration through the ureteric catheter was done to determine the patency of the ureter and plan the appropriate calyx to puncture. PCNL puncture site was done at the posterior axillary line by an 18G needle and access according to the desired calyx under fluoroscopic guidance. A 0.038" guidewire was introduced through the access needle and placed in the urinary tract. The tract dilatation was done using Alkan serial dilators. A 30 Fr Amplatz sheath was introduced over the dilators to the renal collecting system. A 26 Fr nephroscope was introduced and pneumatic lithotripsy was used to disintegrate the stone. Stone fragments were extruded using stone grasping forceps. At the end of the procedure, an 18 Fr nephrostomy tube and double J 6/26 were fixed. The nephrostomy tube was removed if the ureter was patent and the 2nd look PNL for residual stones was not necessary.

Intraoperative details as fluoroscopy time, operative time, complications, and need for or not to blood transfusion were recorded.

Hospital stay was considered. Stone-free status was assessed by plan abdominal X-ray and ultrasound with required auxiliary procedures. Furthermore, any postoperative complications were reported.

Figure 1: Patients at Group A placed in the standard prone position

Results were tabulated and statistically analyzed using a personal computer using SPSS v. 21 (SPSS Inc., Chicago, IL, USA). Statistical analysis was done using descriptive and analytical data. A value of $P < 0.05$ was considered statistically significant.

RESULTS

Patients' demographics are reported in Table 1. There was a statistically insignificant difference between the prone and supine positions in PNCL regarding patient weight, height, body mass index (BMI), and previous surgery ($P > 0.05$).

The stone size in the prone group was in the range of 2.5–8 cm with mean 4 ± 1.2 cm and Hounsfield unit range between 540 and 1400. In the supine group, the stone size was in the range 2.7–8.1 cm with mean 4.5 ± 1.5 cm and Hounsfield unit range between 570 and 1300. The most common site of renal stone was pelvis and lower calyx in the prone group (36.6%) and pelvis in the supine group (46.6%). The stone size had no statistically significant difference in both the groups [Table 2]. This indicates good matching between the two groups.

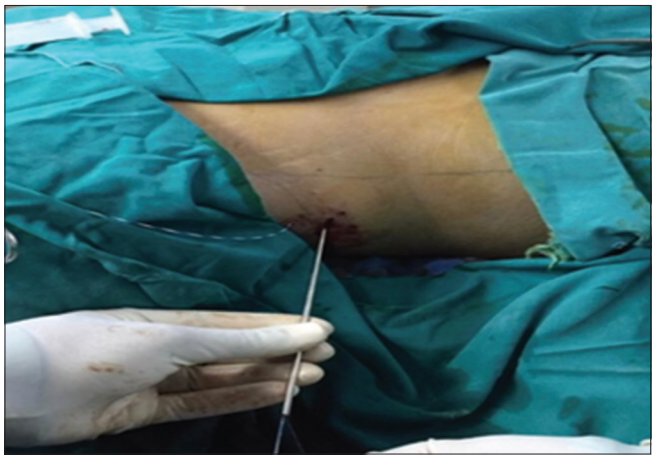

Figure 2: Patients at Group B placed in the modified supine position

The mean fluoroscopy time was 6.9 ± 2.4 min in the prone position and 7.3 ± 2.6 min in the supine position, while the mean operative time was 89.5 ± 27.6 min in the prone position and 90.4 ± 30.5 min in the supine position with no statistically significant difference between both positions regarding fluoroscopy time and operative time ($P > 0.05$).

Regarding postoperative evaluation, the mean hospital stay was 45.6 ± 14.2 h (range: 36–96 h) in the prone position and 48.6 ± 19.8 h (range: 36–120 h) in the supine position, which was insignificant.

Fever occurred in 3.3% of cases in each group. One patient with urine leakage (3.3%) was recorded in the prone group. There was no need of blood transfusion in any cases of both the groups.

Residual stones were observed among three patients (10%) with prone position and six patients (20%) in the supine position, which was insignificant ($P = 0.8$). The auxiliary procedures were reported in all patients with residual stones. In the prone group, all three patients (100%) underwent shockwave lithotripsy (SWL), while in the supine group, four patients (66.7%) underwent SWL and the remaining 2 cases (33.3%) underwent 2nd look PCNL [Table 3].

Table 1: Patient demographics

Parameter	Position in PNCL, mean±SD (range)		*t*-test	*P*
	Prone (*n*=30)	Supine (*n*=30)		
Age (year)	47.67±8.82 (30.00-65.00)	47.40±7.89 (29.00-65.00)	0.12	0.90 (NS)
Weight (kg)	88.93±12.11 (75.00-140.00)	94.53±23.67 (67.00-155.00)	1.15	0.25 (NS)
Height (cm)	170.73±3.56 (165.00-178.00)	170.90±5.07 (164.00-185.00)	0.14	0.88 (NS)
BMI	31.21±5.48 (25.20-49.40)	32.55±8.98 (23.20-57.60)	0.70	0.49 (NS)
Parameter	**Position in PNCL**		χ^2	*P*
	Prone (*n*=30), *n* (%)	Supine (*n*=30), *n* (%)		
Sex				
Male	20 (66.67)	21 (70.0)	0.077	0.781 (NS)
Female	10 (33.33)	9 (30.0)		
Previous surgery				
No	21 (70.0)	23 (76.67)	FET=2.43	0.49 (NS)
Yes	9 (30.0)	7 (23.33)		
Open	3 (10.0)	2 (6.67)		
JJ	3 (10.0)	4 (13.33)		
SWL	2 (6.67)	0 (0.0)		
PNL	0 (0.0)	1 (3.33)		
URS	1 (3.33)	0 (0.0)		

BMI: Body mass index, SD: Standard deviation, *t*: Independent *t*-test, FET: Fisher's exact test, NS: Nonsignificant, PCNL: Percutaneous nephrolithotomy, JJ: Double big tail catheter, SWL: Shockwave lithotripsy, URS: Ureteroscopy, PNL: Percutaneous nephrolithotripsy

Table 2: Preoperative evaluation

Preoperative evaluation	Position in PNCL, mean±SD (range)		*t*-test	*P*
	Prone (*n*=30)	Supine (*n*=30)		
Size of stone (cm)	4.05±1.21 (2.50–8.00)	4.56±1.51 (2.70–8.10)	1.42	0.16 (NS)
Hounsfield unit	940.43±208.28 (540–1400)	955.00±192.78 (570–1300)	0.28	0.78 (NS)
Preoperative evaluation	**Position in PNCL**		**FET**	***P***
Site of stone	**Prone (*n*=30), *n* (%)**	**Supine (*n*=30), *n* (%)**		
Pelvis	9 (30.0)	14 (46.67)	13.41	0.02*
Pelvis and lower calyx	11 (36.67)	5 (16.67)		
Stag horn	3 (10.0)	5 (16.67)		
Pelvis and upper calyx	5 (16.67)	0 (0.0)		
Pelvis and middle calyx	1 (3.33)	6 (20.0)		
Lower and middle calyx	1 (3.33)	0 (0.0)		

*Significant. PCNL: Percutaneous nephrolithotomy, SD: Standard deviation, *t*: Independent *t*-test, FET: Fisher's exact test, NS: Nonsignificant

Table 3: Postoperative auxiliary procedures and outcome

Parameter	Position in PNCL		χ^2	*P*
	Prone (*n*=30), *n* (%)	Supine (*n*=30), *n* (%)		
Auxiliary procedures				
No	27 (90.0)	24 (80.0)	4.42	0.049*
Yes	3 (10.0)	6 (20.0)		
SWL	3 (100.0)	4 (66.7)		
PCNL	0 (0.0)	2 (33.3)		
Hospital stay (h), mean±SD (range)	45.60±14.23 (36.00–96.00)	48.60±19.84 (36.0–120)	*t*=0.673	0.504 (NS)
Postoperative complications				
Fever				
No	29 (96.66)	29 (96.66)	0.00	1.00
Yes	1 (3.33)	1 (3.33)		
Hemorrhage				
No	30 (100)	30 (100)	NA	NA
Yes	0 (0.0)	0 (0.0)		
Urine leakage				
No	29 (96.66)	30 (100)	1.026	0.301
Yes	1 (3.33)	0 (0.0)		

*Significant. PCNL: Percutaneous nephrolithotomy, SWL: Shockwave lithotripsy, *t*: Independent *t*-test, NS: Nonsignificant, SD: Standard deviation, NA: Not available

DISCUSSION

PCNL is the standard treatment option for large (>2 cm) renal stones. The prone position is the preferred position by most surgeons. The supine position was developed for PCNL and offered many advantages.[3]

Our study shows that there was no statistically significant difference between the prone and supine positions regarding BMI, previous surgery, and stone size ($P > 0.05$). These results agreed with Wang *et al*., who compared the efficacy and safety of PCNL in the prone and modified supine positions.[5]

In the current study, there was no statistically significant difference between the prone and supine positions regarding operative time ($P > 0.05$). Our result was not similar to Valdivia *et al*. study, reported in the largest prospectively recorded database of patients undergoing PCNL (5775 patients) between 2007 and 2009, with shorter operation times in the prone than in the supine group (87.7 vs. 90.1 min), but the differences between them did not reach a significant difference.[6] Our results are also not in accordance with the findings of other urologists as Giusti *et al*., who reported that the mean time between the first kidney puncture and the creation of a valid access was longer in the supine group than that in the prone group but with no statistical significance.[7] Jones *et al*. found a shorter operative time in the supine group compared with the prone group.[8] Sohail *et al*. (2017) also demonstrated the same results which disagree with our study.[9] We attributed this mainly to many factors such as different characteristics of stones, instruments, or techniques, as well as different definitions of operative time among included studies.

In the current study, the mean fluoroscopy time was 6.9 ± 2.4 min in the prone position and 7.3 ± 2.6 min in the supine position, but there was no statistically significant difference between the prone and supine positions ($P > 0.05$). Our results are in accordance with Abdel-Mohsen *et al*. (2013), who compared the technical aspects, operative time, safety, and effectiveness of PCNL in the supine position versus the standard prone position.[10] They found no significant difference between

the studied groups in fluoroscopy time and patients' outcome. Ozdemir *et al.* (2019), in contrast to our results, compared the outcomes of supine and prone miniaturized percutaneous nephrolithotomy (m-PNL) in the treatment of renal stones and found that the fluoroscopy time in supine m-PNL was significantly shorter than the prone m-PNL group (3.0 ± 1.7 min vs. 4.9 ± 4.5 min, $P = 0.01$).[11]

We noticed a shorter hospital stay in the prone position (45.60 ± 14.23 h) than in the supine position (48.60 ± 19.84 h), but the differences between them did not reach a statistically significant level ($P > 0.05$) which agreed with Al-Dessoukey *et al.*, and Valdivia *et al.*, who showed no significant difference between both positions on hospitalization time.[6,12]

Postoperative complications may occur including urinary leakage, pleural effusion, sepsis, bleeding, fever, and injury to visceral organs. In the current study, fever occurred in 3.3% of cases in each group and urine leakage in the patient with prone group but with no statistically significant difference ($P > 0.05$) which agreed with De Sio *et al.*, who showed similar overall complication rates in both the supine and prone groups.[13] Results from meta-analysis showed insignificant difference between the two groups regarding postoperative complications.[14]

No blood transfusion was needed in both the groups. However, Falahatkar *et al.* found that the transfusion rate was higher in the supine (27.5%) than in the prone (7.5%) group.[15] Differences between studies may be due to different transfusion thresholds between different centers.

Residual stones were observed among three patients (10%) with prone position and six patients (20%) in the supine position, which was insignificant ($P = 0.8$). These results agree with Falahatkar *et al.*, and Liu *et al.*, who did not find any difference between the two positions regarding residual stones (odds ratio: 0.95; 95% confidence interval: 0.70–1.27; $P = 0.73$),[4,16] while Yuan *et al.*, and Zhang *et al.*, found a statistically significant difference in favor of the prone position.[14,17]

Large-volume trials are needed to confirm these findings.

CONCLUSIONS

PCNL in the modified supine position proved to be a safe and effective choice compared to the prone position for adult patients with large renal calculi.

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Conflicts of interest
There are no conflicts of interest.

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