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Free Flank Modified Supine Percutaneous Nephrolithotomy for Management of Primary Renal Stones

Esam Abdelgawad[1*], Khaled M. Abdelhalim[1], Hassan A. Abdelwahab[1], Mohamed Bakr[2], Ahmed M. Kadry[1]

1. Urology Department, Faculty of Medicine, Suez Canal University, Egypt
2. Urology Department, Faculty of Medicine, Port Said University, Egypt

Corresponding author: Esam Abdelgawad, **Telephone:** +201501599744**,**
ORCID: 0000-0003-2055-4791, **E-mail:** esam76u@gmail.com

ABSTRACT

Background: Prone percutaneous nehprolithotomy (PCNL) is associated with patient inconvenience, circulatory and ventilatory impediment. **Objective:** The aim of the current study is to evaluate the outcome of percutaneous nephrolithotomy in the free flank modified supine position (FFMSP) regarding the operation duration, hospitalization time, and the effectiveness and safety.

Patients and methods: From January 2020 to June 2021, 60 patients (36 males and 24 females) with renal stones underwent PCNL procedure in FFMSP. Descriptive statistics, puncture site, numbers of punctures, operative time, stone free rate, bleeding, modified Clavien grade of complication, re-treatment rate, additional procedures and hospitalization time were presented. **Results:** Multiple stones were in 53% of the cases, the stone distribution was mainly in the inferior calyces and/or the pelvis of the kidney. Positive history of renal surgery was reported by 70% of cases. The site of puncture was mainly through the inferior calyx in 83% of cases, 23% of the cases were in need for two punctures, 26% were in need for re-treatment, mean duration of operation was 89.67 (SD 25.2) minutes, mean hospitalization time was 8.3 (SD 6.32) days and the patient's ratio who were free from stones was 86%. The average need for an additional procedure was 20%. The complication grade according to Calvien Dindo classification is mainly grades 2,3A and 4B. **Conclusions:** The supine position is effective with average operation duration; however, it has a high complication rate, an increased need for additional procedures, a re-treatment rate, a long hospital stay and an increased rate for blood transfusion.

Keywords: Supine position, free flank modified supine position, Stone free rate, Descriptive study, Suez Canal University.

INTRODUCTION

After **Goodwine *et al.,*** firstly described the percutaneous kidney access in the prone position, the earliest case of percutaneous extraction of stone was reported. Since then prone percutaneous nehprolithotomy (PCNL) has been popularly recognized procedure and its indications were well described [1,2]. Recently, PCNL is best indicated for management of bulky kidney stones, hard stones difficult to crash, or stones occurring in anomalous kidneys [3,4].

Historically, PCNL has been carried out in the prone position since it was believed to be a harmless access to the kidney allowing puncture of the posterior calyces through Brodel's line with minimal parenchymal bleeding and avoiding peritoneal and visceral injuries [5,6]. The prone PCNL position causes limitation of the respiratory movement therefore, is not suitable for all patients [7]. In the prone position during PCNL, there is reduction of the lung compliance caused by limitation of the chest and diaphragmatic movement due to increased abdominal pressure. There is also a lowering of cardiac output. All of these make difficult challenges to the anesthetist [8].

Marked increased body weight, impaired status of the cardiopulmonary system, and skeletal deformities may cause great challenges to the operator and the anesthetist [9] .The increasing rate of PCNL maneuvers together with increased experience has encourage the urologists to alter the prone position to get better results and conquer these difficulties [10].

In 1998, **Valdivia *et al.,*** was the first urologist to perform supine PCNL, reporting many advantages for the patients at high anesthetic risk [11].

There are many benefits for positioning the patients in supine position, which is easier and less time consuming because there is no need to convert the patient position from lithotomy to prone. The supine position gives easy control and accessibility to the airway and is safer for patients with impaired function of the cardiopulmonary system and patients with morbid obesity who need long procedure [12].

The intrarenal pressure is maintained low due to the fact that the tract is horizontal or inclined downwards, which may enhance the natural clearance of stone particles. Both **Le Roy *et al.*** and **Hopper *et al***. found only 2% of the patients to have a retro renal colon in supine position, which elevated to 10% when prone [13,14]. **Shoma *et al.*** studied a total of 130 patients who were operated by PCNL in a prospective and nonrandomized study in both prone and supine; found that the stones were cleared in 84 and 89% of patients respectively [15]. PCNL in the supine position can be used safely and effectively as the prone procedure [15].

Supine PCNL is a head to head alternative to the standard prone position [16]. More prospective, randomized multi-institutional studies are needed to prove the efficacy and safety of both procedures. Moreover, recognition and

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documentation of complications of both techniques will assist in choosing the best strategy for different patients [17]. The aim of the current study is to evaluate the outcome of percutaneous nephrolithotomy in the free flank modified supine position (FFMSP) regarding the operation duration, hospitalization time, and the effectiveness and safety.

PATIENTS AND METHODS

A prospective one-arm clinical trial including 60 patients with kidney stones was operated with PCNL in the FFMSP. They were evaluated for safety, efficacy, hospitalization time, re-treatment rate or additional procedure and the time of the operation. The study was accomplished at the Urology Department, Suez Canal University Hospital in Ismailia and Port Said University. Patients were assigned to the treatment modality and were enrolled in the effectiveness and safety analysis after fulfilling the inclusion criteria.

A subcostal access, to avoid extensive manipulation, was performed for single or multiple kidney stones by single tract through the lower or middle calyx; stone diameter more than 2 cm. Stone size was measured from on preoperative radiology films and in case of multiple stones size was measured as the sum of the larger diameter of each stone. Patients with anomalous kidneys, uncontrolled bleeding disorder, staghorn stones and pregnant were excluded from the study.

General anesthesia was conducted for all procedures. Cystoscopy was done in the supine position and a 6 French open tip ureteric catheter was inserted, thereafter a retrograde study performed and documented. The catheter was fixed to a Foley`s catheter 14 French at the end of this step.

A FFMSP was supported with a 3-L irrigation bag below the shoulder on the same side with ipsilateral upper limb bent over the chest and the ipsilateral leg was kept straight over the flexed other one (**Figure1**).

Figure 1: Supine position for percutaneous nephrolithotomy.

After skin preparation, puncture on or medial to the posterior axillary line subcostally was done by the urologist. After pelvi-calyceal system opacification using the ureteric catheter, Fluoroscopic guidance used to gain access and guide dilatation of the pelvi-calyceal system. Routinely the posterior calyx was punctured unless with anteriorly located calyceal stones. All cases were accessed through the lower calyx. However, no upper calyceal access was performed.

Attempt to pass the wire to the ureter was made but not working every time. Alken Coaxial Metal dilators were used to dilate the tract. After telescopic coaxial dilatation, a 30-Ch Amplatz sheath was introduced, permitting the usage of a 26 F nephroscopy. After stabilization of the tract and visualization of the stones by nephroscope, stones were fragmented with Swiss Lithoclast machine and stone particles removed by forceps. At finalizing the procedure a twenty-eight French Nelaton catheter was used as a nephrostomy and removed at postoperative day 2 or 3 when clear urine is noticed.

Operation time (defined as duration between start of anaesthesia induction to fixation of the PCN), SFR, blood loss and hospital stay were noted, as were any major perioperative complications. A KUB x ray or spiral CT was done on day 1 postoperatively to assess the stone clearance and patients were considered free from stones when no stones or residual fragments < 4 mm was visualized and if so; the urethral and ureteric catheters were removed followed by the nephrostomy on postoperative day 2 when urine was clear. If there was a residual stone > 1 cm the patient would be planned for 2nd look PCNL one week later.

Ethical Approval:

Suez Canal University's Ethics Board approved the study, and each study participant provided written informed permission. This research was done in compliance with the Declaration of Helsinki, which is the World Medical Association's code of ethics for human studies.

Statistical analysis:

Statistical Package for Social Sciences (SPSS) version 20 for Windows® (IBM SPSS Inc., Chicago, IL, USA) was used to code, process, and analyze the obtained data. Using the Shapiro Walk test, the distribution of the data was examined for normality. Frequencies and relative percentages were used to summarize qualitative data. Mean and standard deviation (SD) were used to express quantitative data. The difference between two or more groups of qualitative variables was calculated using Chi square test ((χ2)) and Fisher's exact test. Quantitative data from two separate groups were compared using the independent samples t-

test/Mann Whitney test (for parametric and non-parametric data, respectively). For non-parametric data, Spearman's correlation test was applied to examine the si.

RESULTS

A total of 60 patients were involved in the study (36 males and 24 females). Table 1 summarizes the demographic and preoperative data of the included patients. The stone distribution was mainly in the inferior calyx or/plus the renal pelvis.

Table 1: Demographic and preoperative characteristics of studied patients.

Variable	Mean	SD	Percent (%)
Total patients.	60		100
M/F ratio	36/24		60/40
Age in years	46.30	12.774	
BMI	29.70	3.984	
Past Surgical History	18/60		30
Preoperative HB (g/dl)	12.63	1.475	
Stone length (mm)	30.07	7.948	
Multiple Stones/total	32/60		53%

Postoperative evaluation with KUB or spiral CT revealed a stone-free rate of 86.6% after the 2nd look. The mean time of operation was 89.67 (SD 25.289) minutes. The site of puncture was mainly through the lower calyx in 83% of cases, twenty three percent of cases were in need for two punctures, twenty six percent were in need for re-treatment, mean admission time was 8.30 (SD 6.320) days, the average need for auxiliary procedure was 20% in form of ESWL or DJ plus ESWL, the complication category was mainly in form of grades 2, 3A and 4B and the need for blood transfusion was 13.3% (**Table 2**).

Eight (13.3%) patients were in need for ESWL. No cases of abdominal or pleural injuries were reported. In our study, there were 4 (6.5%) cases of intra-operative bleeding managed conservatively with blood transfusion, intravenous fluids and clamping the nephrostomy, the procedure was aborted for a 2nd look. There were four cases of post-operative bleeding managed conservatively. In our study, there were four cases of sepsis, all were diabetic and with impaired kidney function. All were managed conservatively with IV fluids, antibiotics and drainage of the kidney (**Table 2**).

Table 2: Perioperative parameters of included patients.

Free flank modified supine position (FFMSP)	
Multiple punctures	**14/60**
Operative time (min)	**89.67**
2nd look PCNL	**16/60**
SFR %	**86.6%**
Blood transfusion	**8/60**
Hospital stay	**8.30**
Auxiliary procedure	**12/60**
Complications	
Bleeding	**8/60**
Pleural injury	**0**
Visceral injury	**0**
Pelvic perforation	**2/60**
Failed access	**6/60**
Sepsis	**4/60**

DISCUSSION

Currently, PCNL is the main line for treating bulky renal stones, hard stones resistant to ESWL, or stones in anomalous kidneys [3,4].

Usually, PCNL has been carried out in the prone position as it was supposed to be safe for approaching the kidney posteriorly to puncture a posterior calyx through the avascular Brodel"s line without significant trauma to renal tissue or surrounding organs [5,6]. Morbidly obese patients with cardiac or pulmonary problems and patients with skeletal deformities are challenges for both the surgeon and the anesthetist [9].

The increased confidence with higher rates and experience with prone PCNL procedures pushed the urologists towards more modifications to enhance the outcome of the technique [10].

Valdivia and collaborators were the first to popularize PCNL with the patient supine in their study of 557 individuals. They demonstrated that there was no injury to the colon because it moves away from the kidney when the patient is prone as opposed to supine, and they came to the conclusion that the supine position has a number of benefits, including free ventilation and a shorter turnaround time after inducing anesthesia [11].

We conducted a prospective clinical trial on 60 patients to measure the effectiveness of PCNL in the free flank modified supine position in patients with renal stones (pelvic or calyceal) in terms of the amount of time required for surgery, the length of hospital stay, safety (complication rate), and effectiveness (stone-free rate) of both methods. Our patients who met the inclusion requirements were given the therapy modality, presented with symptomatic single or multiple renal stone (pelvic or calyceal) more than 2 cm in largest diameter that can be accessed subcostally through a single percutaneous tract.

In contrast to **Valdivia *et al.***, **De Sio *et al.,*** and **Neto *et al.,*** who selected the anterior axillary line, in our experience, we selected the posterior axillary line as the site of skin puncture (but their nephrostomy tract was created by a radiologist) [11,18,19].

In order to reduce bleeding, we favored a posterior calyx puncture, as described by **Shoma *et al.*, De Sio *et al.,*** and **Neto *et al.*** [15,18,19]. **Valdivia *et al.*** on the other hand, favoured the anterior calyx [11] as a modification of the original Valdivia uria position, we preferred the free flank position by placing a 3 liter bag as a water cushion under the ipsilateral shoulder because it offers enough working space for puncture, dilatation, multiple tracts, and maneuverability of the system with the nephroscope, similar to that of **Cormio *et al***., and **Desoky *et al.*** [20,21].

No residual stone was deemed to have a stone-free rate if its diameter exceeded 4 mm. About 86.6% of participants had no stones, which is comparable to **De Sio *et al***. The supine group, according to **Shoma *et al***. had 89% stone-free rate [15,18]. **Desoky *et al.*** reported that the group that was supine had 84.6% stone-free [21]. **Falahatkar *et al.*** noted a 77.5% stone-free rate for the group that was supine [22]. Our procedure took 89.6 minutes, compared to the 43 minutes described by **De Sio *et al.*** for the supine group [18]. **Falahatkar *et al.*** stated a mean operating time of 74 minutes for supine patients, which is consistent with our findings.

In our study, the average hospital stay was 8.3 days. For the supine group, **Shoma *et al.*** reported an average hospital stay of 2.5 days [15]. For the supine group, **Falahatkar *et al.*** observed a mean hospital stay of 3.3 days [22]. Blood transfusion rates for the supine group were 13.3%, which is similar to **Jones *et al.,*** **Seguru *et al.,*** and **El-Kenawy *et al.*** [23,24,25]. About 20% of patients who were lying down received transfusions, according to **Falahatkar *et al.*** [22].

In contrast to studies by **Shoma *et al.*, Di Sio *et al.,*** and **Falahatkar *et al.,*** there were no incidences of visceral or colonic injury reported in our study [15,18,22].

In our study, there were 6 reported cases of failed puncture which were converted to the prone position, 2 in the same session and 4 cases in a 2nd session which may be due to our early experience in the supine technique and this was like the study of **Amon *et al.*** which reported a similar number of failed puncture in the supine group [26].

Our investigation, like those of **Shoma *et al.*, Di Sio *et al.,*** and **Falahatkar *et al.*** and **Amon *et al.,*** found no cases of pleural damage [15,18,22,26]. In our analysis, there are 2 cases of renal pelvic perforation due to repeated puncture attempts that were conservatively treated for 5 days with PCN and ureteric catheter. **Di Sio *et al.*** reported no occurrences of renal pelvic perforation while **Shoma *et al.*, Falahatkar *et al.*, Amon *et al.,*** and **Shoma *et al.,*** reported 2 cases of renal pelvic perforation in the supine group [15,18,22,26].

Four (6.5%) cases of intra-operative bleeding in our study were conservatively treated with blood transfusion, intravenous fluids, and nephrostomy clamping before the treatment was stopped for a second opinion. Four post-operative bleeding instances were treated conservatively. While **Shoma *et al.*** reported 5 cases of acute bleeding in the supine group (9%), **Falahatkar *et al.*** reported 8 cases in the supine group, and **Amon *et al.*** stated 3 cases in the supine group, **Di Sio *et al.*** reported no incidents of bleeding [15,18,22,26].

There were 4 sepsis cases in our study, all of which had diabetes and decreased renal function. All of them received conservative treatment, including intravenous fluids, antibiotics, and kidney drainage. Moreover, one case of intra-operative contrast intravasation during opacification of the pelvicalyceal system as a result of traumatic ureteric catheterization complicated by post-operative contrast nephropathy and delayed contrast excretion in a diabetic patient with impaired kidney function was treated conservatively with intravenous fluids guided by central venous pressure after fixation of the central line.

In our study, the re-treatment rate (2nd look PCNL) was 26.7%. Re-treatment rates for the supine group were reported to be 7.5% by **Shoma *et al.*** in 2002 [15] 10% of the supine group underwent another treatment, according to **Desoky *et al.*** (2013). The increased number of patients with multiple stones and hydronephrotic kidneys with stone migration to calyces inaccessible to the rigid nephroscope through the same route may be the cause of the study's higher re-treatment rate [21].

In our study, 20% of patients required an auxiliary operation (ESWL, double J, or URS). A total of 8 individuals (or 13.3%) required ESWL. About 7.7% of patients in the supine group required an auxiliary operation, according to **Desoky *et al.*** [21]. According to **Rana *et al.,*** 16% of patients in the supine group required an additional procedure (ESWL or double J + ESWL) [27].

The relatively small patient populations, selection of stones larger than 2 cm, and exclusion of staghorn stones and calyceal stones that can't be accessible with a single puncture are all limitations of our study. Due to the short duration of the trial and lack of patient follow-up, residual fragments equal to or less than 4 mm were not examined for their potential to serve as the starting point for future stone recurrence. There was no relationship between the operative time, pneumatic lithotripsy effectiveness, residual fragment rate, or stone composition.

Additionally, there was no prior experience with the supine approach, and this study included our first instance. According to the study's findings, FFMSP PCNL has significant limitations and should be used

when prone positioning is contraindicated in risky patients. Every effort should be exerted to improve the technical facilities, instrumentation and to broaden the indications of supine PCNL minimizing the hazards of prone positioning of the patient.

CONCLUSIONS

The FFMSP PCNL approach's stone-free rate and operating time for renal pelvic or calyceal stones addressed through a single percutaneous path were generally acknowledged. The average rate of re-treatment, average requirement for auxiliary operations, average number of punctures required, average drop in post-operative hemoglobin, average rate of blood transfusion, average length of hospital stay, and average complication rate were all high. There is no link between the supine technique and pleural or colonic damage.

Since the side of the bed prevents lateral nephroscope excursions, we do not view difficult stones needing several punctures as a good rationale for the supine posture. Adequate training in the various PCNL methods and procedures is a crucial issue that requires specific attention.

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REFERENCES

1. **Goodwin W, Casey W, Woolf W (1955):** Percutaneous trocar (needle) nephrostomy in hydronephrosis. JAMA., 157:891-4.
2. **Skolarikos A, Alivizatos G, de la Rosette J (2005):** Percutaneous nephrolithotomy and its legacy. Eur Urol., 47:22-8.
3. **Tiselius H, Ackermann D, Alken P, Buck C, Conort P, Gallucci M (2001)**: European Association of Urology Working Party on Lithiasis. Guidelines on urolithiasis. Eur Urol., 40:362-71.
4. **Preminger G, Assimos D, Lingeman J, Nakada S, Pearle M, Wolf J (2005):** chapter 1: AUA guideline on management of staghorn calculi: diagnosis and treatment recommendations. J Urol., 173:1991-2000.
5. **Wolf J, Clayman R (1997):** Percutaneous nephrolithotomy: what is its role in 1997? Urol Clin North Am., 24:43-58.
6. **Alken P, Hutschenreiter G, Gunther R, Marberger M (1981):** Percutaneous stone manipulation. Urology, 125:463-6.
7. **Michel M, Trojan L, Rassweiler J (2007):** Complications in nephrolithotomy. Eur Urol., 51:899-906.
8. **Papatsoris A, Masood J, El-Hussein T, Maan Z, Saunders P and Buchholz P (2009):** Improving Patient Positioning to Reduce Complications in Prone Percutaneous Nephrolithotomy. J Endourol., 23:831-2.
9. **Zhou X, Gao X, Wen J, Xiao C (2008):** Clinical value of minimally invasive percutaneous nephrolithotomy in the supine position under the guidance of real-time ultrasound: report of 92 cases. Urol Res., 36:111-4.
10. **De la Rosette J, Tsakiris P, Ferrandino M, Elsakka A, Rioja J, Preminger G (2008)**: Beyond prone position in percutaneous nephrolithotomy: a comprehensive review. Eur Urol., 54:1262-9.
11. **Valdivia Uria JG, Valle Gerhold J, Lopez Lopez JA *et al.* (1998):** Technique and complications of percutaneous nephroscopy: experience with 557 patients in the supine position. J Urol., 160:1975-8.
12. **Feng M, Tamaddon K, Mikhail A, Kaptein J, Bellman G (2001):** Prospective randomized study of various techniques of percutaneous nephrolithotomy. Urology, 58:345-50.
13. **Hopper K, Sherman J, Luethke J, Ghaed N (1987):** The retrorenal colon in the supine and prone patient. Radiology, 162:443-6.
14. **LeRoy A, Williams J, Bender C, Segura J, Patterson D, Benson R (1985):** Colon perforation following percutaneous nephrostomy and renal calculus removal. Radiology, 155:83-5.
15. **Shoma A, Eraky I, El-Kenawy M *et al.* (2002):** Percutaneous nephrolithotomy in the supine position: technical aspects and functional outcome compared with the prone technique. Urology, 60:388-92.
16. **Ng M, Sun W, Cheng C, Chan E (2004):** Supine position is safe and effective for percutaneous nephrolithotomy. J Endourol., 18:469-74.
17. **Tefekli A, Karadag M, Tepeler K *et al.* (2008):** Classification of percutaneous nephrolithotomy complications using the modified Clavien grading system: looking for a standard. Eur Urol., 53:184-90.
18. **De Sio M, Autorino R, Quarto G *et al.* (2008):** Modified supine versus prone position in percutaneous nephrolithotomy for renal stones treatable with a single percutaneous access: a prospective randomized trial. Eur Urol., 54:196-203.
19. **Neto E, Mitre A, Gomes C, Arap M, Srougi M (2007):** Percutaneous nephrolithotripsy with the patient in a modified supine position. J Urol., 178:165-8.
20. **Cormio L, Annese P, Corvasce T, De Siati M, Turri F, Lorusso F *et al.* (2007):** Percutaneous nephrostomy in supine position. Urology, 69:377-80.
21. **Desoky E, Kamel M, Zayed A, Salem E *et al*. (2013):** Free flank modified supine vs prone position in percutaneous nephrolithotomy: a prospective randomized trial. Arab J Urol., 11:174-8.
22. **Falahatkar S, Moghaddam A, Salehi M *et al.* (2008):** Complete supine percutaneous nephrolithotripsy comparison with the prone standard technique. J Endourol., 22:2513-7.
23. **El-Kenawy M, El-Kappany H, El-Diasty T *et al.* (1992):** Percutaneous nephrolithotomy for renal stones in over 1000 cases. Br J Urol., 69:470-5.
24. **Jones D, Russel G, Kellett M *et al.* (1990):** The changing practice of percutaneous stone surgery: review of 1000 cases 1981–1988. Br J Urol., 66:1-5.
25. **Seguru J, Patterson D, LeRoy A *et al.* (1985):** Percutaneous removal of kidney stones: review of 1,000 cases. J Urol., 134:1077-81.
26. **Amon Sesmero J, Del Valle Gonzalez N, Conde Redondo C *et al.* (2008):** Comparison between Valdivia position and prone position in percutaneous nephrolithotomy. Actas Urol Esp., 32:424-9.
27. **Rana A, Bhojwani J, Junejo N *et al.* (2008):** Tubeless PCNL with Patient in Supine Position: Procedure for all Seasons?-with Comprehensive Technique. Urology, 71(4):581.