ORIGINAL ARTICLE

Our Experience with Flank-free Modified Supine Percutaneous Nephrolithotomy

Mufti Mahmood Ahmed[1], Nasir Hamid Bhat[2], Irshad Ahmad Kumar[3], Fayaz Ahmad Najar[4]

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Abstract

Objective: The objective of this study was to evaluate the safety profile and efficacy of "flank-free modified supine position (FFMS)" approach for percutaneous nephrolithotomy (PCNL).

Materials and methods: This study was conducted in the Department of General Surgery over 4-year period from August 2016 to August 2020 on 50 patients after institutional ethical clearance.

Results: The patients in our study were in the range of 21–65 years with mean age of 35.9 SD 9.85 years. Approximately, 62% of patients were males and right kidney was involved in 54%. The mean stone size of our study group was 17.3 SD 1.81 mm with a range of 14.2–21 mm. Pelvic stones were found in 28 (56%) of patients and majority of our patients, i.e., 88% were symptomatic of their disease. The mean operative time in our study was 83.62 SD 16.95 with range of 60–115 minutes. Nephrostomy was placed *in situ* in 84% patients. There was no operation related mortality in our study. The mean hospital stay of our patients was 3.7 SD 1.15 days. Out of total 50 patients, success was achieved in 45 (90%) patients as 6% required auxiliary treatment and 4% was converted to prone position.

Conclusion: Thus, in our study we found that FFMS PCNL surgery is a safe and an effective means of intrarenal access with high success rate and with acceptable morbidity and complications.

Keywords: Flank-free, Nephrolithiasis, Percutaneous nephrolithotomy.

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Introduction

Urinary stone disease has plagued humanity for generations. Shattock (1950) reported the earliest kidney stone found in an Egyptian corpse from a tomb that dates to around 4400 BC.[1] While the first therapeutic percutaneous nephrostomy was actually carried out by Thomas Hillier in 1865, it is often credited to Goodwin and companions (1955).[2]

A crucial criterion for percutaneous entry into the urinary tract collecting system is a requirement for intrarenal or intraureteral surgical intervention. The treatment modalities include percutaneous nephrolithotomy (PCNL), endopyelotomy, and endoureterotomy, as well as the management of calyceal diverticula and hydrocalyces, and the antegrade ureteroscopic approach for the treatment of sizable ureteral stones. In addition, this procedure encompasses the percutaneous removal of urothelial tumors, as well as the seldom seen therapy of fungal bezoars. Instillation of therapeutic agents directly may also be an indication for upper urinary tract access. This includes the use of chemolysis for the dissolution of urinary calculi and the use of intracavitary topical therapy for the treatment of urothelial cancer. The key procedural components of these techniques are skillfully attaining access, effectively controlling postoperative drainage, and avoiding or treating complications associated with percutaneous access.[3]

The prone position offers various benefits, such as a substantial surface area for the site of puncture, more room for instrument manipulation, unrestricted instrument movements, and the possibility of several entry points. Nevertheless, there are several drawbacks associated with this approach. One such disadvantage is the discomfort experienced by patients' post-surgery due to the prone position, which exposes their bodies to increase the pressure points throughout the procedure. Additionally, this technique often results in longer operative times and poses a higher risk of complications related to pressure points, as well as circulatory and respiratory difficulties. This risk is particularly pronounced in patients who are morbidly obese, kyphotic, or debilitated.[4]

The use of the supine posture for PCNL was first documented by Valdivia et al.[5] The authors proposed that elevating the colon away from the kidney may reduce the risk of retro-renal colon injury. Moreover, the supine posture offers many advantages, such as the ease of patient care, efficient draining of Amplatz-Sheath, and improved management of the airway.[5]

Additional benefits include reduced cardio-circulatory or ventilatory dysfunction and enhanced surgical efficiency. Furthermore, the surgeon will maintain a comfortable seated position during the procedure. The reduction of X-ray exposure is achieved by the use of a puncture and dilatation technique for creating a nephrostomy route that is perpendicular to the body, so ensuring that the operator's hands are kept away from the

[1–4]Department of General Surgery, Government Medical College, Srinagar, Jammu and Kashmir, India

Corresponding Author: Irshad Ahmad Kumar, Department of General Surgery, Government Medical College, Srinagar, Jammu and Kashmir, India, Phone: +91 7006122289, e-mail: irshadahmadkumar@gmail.com

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fluoroscopic field.[6] However, a significant limitation of the supine position is the lack of enough space for a potential third tract, which limits its suitability for cases with Staghorn calculi.[7] Hence, in order to address this challenge, a modification was delineated for the supine position, resulting in the development of a novel posture referred to as the "flank-free modified supine position (FFMS)."[8]

The primary objective and aims of this research were to evaluate the well-being profile and effectiveness of this technique in PCNL.

Materials and Methods

The current hospital-based prospective research was undertaken at the Department of General Surgery, Govt. Medical College, Srinagar, after permission from the local Ethical Committee (Approval No. 134/ETH/GMC/ICMR). The research included a cohort of 50 functioning renal units, which were recruited between August 2016 and August 2020. The research comprised patients who were above the age of 20 and had renal pelvic, diverticular, and complicated inferior calyx stones. Patients who were excluded from the study included those who were under the age of 20 or had renal abnormalities, full staghorn calculus, stone load in the upper calyx, active infection, renal function less than 15% of global function, uncorrected coagulopathy, or were pregnant.

The patients had first evaluation in the Outpatient Department (OPD) prior to being scheduled for surgery. Upon admission, a comprehensive patient history was obtained, including the presenting complaints, duration of symptoms, past medical history, particularly pertaining to prior surgical procedures, as well as any concurrent conditions such as chronic illnesses and medication use.

A comprehensive physical examination was conducted, with specific attention given to the individual's physique, height, and weight, followed by a thorough assessment of various bodily systems. A comprehensive assessment of the abdomen was conducted for every patient. Every patient or caretaker received a comprehensive explanation of the nature of the treatment in a language that they could comprehend. Additionally, signed informed consent was acquired from each patient prior to the surgical intervention. Several essential investigations were conducted, including the kidney function test, urine culture, coagulogram, ultrasonography, X-ray KUB, intravenous urography (IVU), and CT/CECT, TC99 in selected instances.

Operative Technique

Following the administration of general anesthesia, the first procedural stage included the use of cystoscopy and retrograde ureteric catheterization to provide percutaneous intrarenal access. The procedure of rigid cystoscopy was performed on the patient while they were positioned in the dorsal lithotomy posture. Following the insertion of a 5F ureteric catheter into the relevant ureter, a Foley catheter was then introduced and both catheters were fastened together using a silk tie in order to minimize the risk of displacement of the ureteric catheter during patient repositioning. The ureteric catheter was connected to an intravenous extension tube, which was then carefully positioned inside the operating area on the same side of the body. This facilitated the administration of retrograde contrast media throughout the course of the process. Upon completion of the initial phase, the individual was positioned in the FFMS posture. This was achieved by providing appropriate support using a cushion, such as a 3-liter water bag or sand bag adjusted based on the individual's body mass, under the shoulder on the same side. The arm on the same side was positioned over the thorax, while the leg

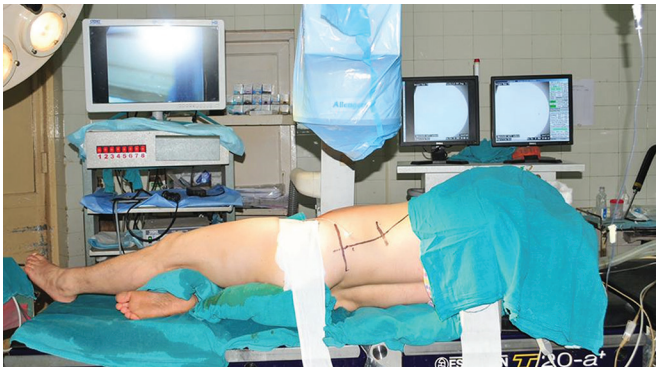

Fig. 1: Position of patient

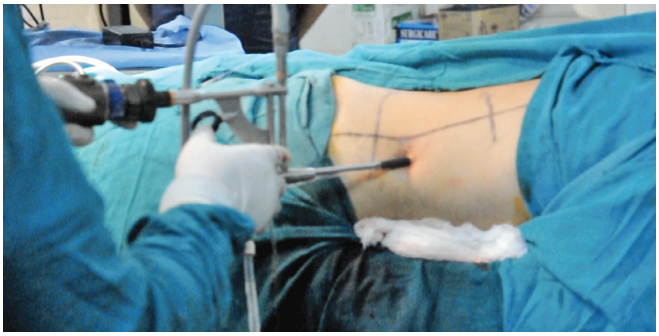

Fig. 2: Introduction of nephroscope

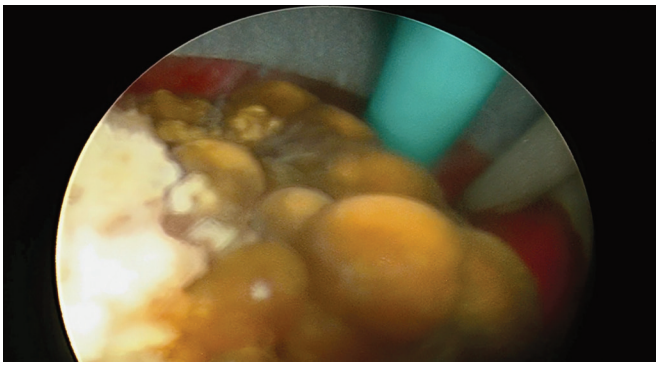

Fig. 3: Endoscope view of stone

on the same side was extended and crossed over the flexed leg on the opposite side (Fig. 1). The procedure included obtaining renal access by means of the posterior axillary line and the tract was dilated over Terumo guidewire up to the required Amplatz diameter for the introduction of the nephroscope (standard/mini) as shown in Figure 2. The LithoClast was introduced to fragment the stones (Fig. 3) and the fragments were removed through the Amplatz sheath. Following the conclusion of the surgery, a nephrostomy tube was inserted. Postoperatively an X-ray KUB was done to check for [Double J (DJ) Stent] position and clearance. All the patients were strictly monitored in postoperative period and follow-up for a period of 4 weeks (First, Second, and Fourth week). The data were recorded and analyzed using SPSS V 20.

Results

The participants included in our research ranged in age from 21 to 65 years, with a mean age of 35.9 SD 9.85 years. Table 1 displays

Table 1: Age distribution of study patients

Age (years)	*Frequency*	*Percentage*
20–29	15	30
30–39	16	32
40–49	15	30
50–59	4	8
Total	50	100
Mean SD (Range) = 35.9 SD 9.85 (21–59)		

Table 2: Distribution of study patients as per stone size (mm)

Stone size	*Frequency*	*Percentage*
14–15.9	9	18
16–17.9	20	40
18–19.9	13	26
≥20	8	16
Total	50	100
Mean SD (Range) = 17.3 SD 1.81 (14.2–21)		

Table 3: Distribution of study patients as per location of disease

Renal stone disease	*Frequency*	*Percentage*
Pelvic stones	28	56
Upper calyx stones	0	0
Lower calyx stones	14	28
Pelvic + lower calyx stones	8	16
Total	50	100

the distribution of patients across different age groups. The largest proportion, at 32% of the total, is within the age range of 30–39 years. Subsequently, the age group of 40–49 years accounts for 30% of the patient population. The study observed that a majority of patients, that is 62%, were identified as males. Additionally, it was found that 54% of the patients had involvement of the right kidney. The average stone size observed in our research cohort was 17.3 SD 1.81 mm, ranging from 14.2 to 21 mm. Table 2 reveals that a significant proportion of patients, that is 40%, had stone sizes within the range of 16–17.9 mm.

Table 3 shows the presence of pelvic stones in 28 patients, accounting for 56% of the total sample. Additionally, lower calyx stones were seen in 14 individuals, representing 28% of the sample.

The vast majority of patients, that is 88%, had symptoms related to their condition. The average duration of the surgical procedure in our research was 83.6 SD 16.95 minutes. The range of operating times observed was from 60 to 115 minutes. A nephrostomy was inserted *in situ* in 84% of the patients, with a mean length of 2.1 days (SD 0.35) ranging from 2 to 3 days.

The assessment of postoperative pain was conducted using the visual analogue scale (VAS) score. The patients were explained the VAS scoring system and then were asked to read their pain depending on the severity. Scores were calculated at postoperative day of 1st, 2nd, and 3rd. The average VAS score for pain in our research was 4.07 on day 1, 2.73 on day 2, and 1.67 on day 3; the average consumption of Tramadol (in milligrams) was 236.0 SD 120.81. There was no operation-related mortality in our study.

Table 4: Distribution of study patients as per complications

Complication	*No.*	*Percentage*
Hemorrhage	1	2
Pelvic perforation	1	2
Colonic injury	0	0
Pleural injury	0	0
Converted to prone	2	4
Postop fever	2	4
Need of auxiliary treatment	3	6
Delayed hematuria	1	2
Total	10	20

The average duration of hospitalization for our patients was 3.7 SD 1.15 days. Approximately, 52% of the patients had a hospital stay ranging from 2 to 3 days. Need of auxiliary treatment was the major complication in 3 (6%) patients, followed by conversion to prone position and postoperative fever, in 2 (4%) patients each as shown in Table 4. Out of total 50 patients, success was achieved in 45 (90%) patients as 6% required auxiliary treatment and 4% were converted to prone position.

Discussion

In order to address the challenges associated with the prone position, many adaptations have been documented, such as the prone split-leg position, reverse lithotomy posture, and lateral decubitus. However, the popularity of these modifications has diminished with time.[9,10]

The supine posture has several benefits. Firstly, it reduces the tediousness of the process, making it more acceptable for the patient. This, in turn, may enable the use of lower amounts of anesthetics. Additionally, there is quicker access to the airway, which may be especially beneficial for patients with reduced cardiopulmonary function or those undergoing lengthy procedures. Consequently, making it a safer option in certain clinical scenarios. Moreover, in cases where it is deemed necessary, the use of the supine posture enables the simultaneous implementation of PCNL and ureteroscopy as a means of effectively controlling intricate stone disease.[10] The safety of this approach has been shown in obese people as well.[11]

Our research included a sample size of 50 patients. The statistical analysis included examining many factors like age, gender, disease laterality, symptomatology, stone size, mean surgical time, nephrostomy status, success rate, complications, postoperation discomfort, and hospital stay.

The average age of participants in our research was 35.9 SD 9.85 years. Majority of our patients, i.e., 16 (32%) belonged to age group of 30–39 years. Comparable age groups were studied by Desoky et al.,[8] Nour et al.,[12] and Miçooğulları et al.[13] with mean age of 40.8, 38.8, and 41.8 years, respectively.

In this conducted research, it was observed that 31 individuals, accounting for 62% of the whole sample, were identified as males, while 19 individuals, representing 38% of the total sample, were identified as females. Comparable results of gender distribution were shown by Wang et al.[14] with 66% were identified as men while 34% were identified as females, resulting in a male to female ratio of 8:4. In our study, 27 (54%) patients had stones on right side while as 23 (46%) had it on left side. Comparable results were shown

by Neto et al.[15] who reported that 40 and 38 of their patients had stones on right and left sides; In their research, Wang et al.[14] also documented the presence of stone laterality, with 31 patients exhibiting right side stones and 29 patients exhibiting left side stones. In our study, average stone was 17.3 SD 1.81 mm. A total of 20 (40%) of our study patients had 16–17.9 mm stone size, followed by 13 (26%) patients with stone size of 18–19.9 mm. A stone size of 14–15.9 mm was seen in 9 (18%) patients while as ≥20 mm stone was observed in 8 (16%) patients.

Out of 50 patients studied, pelvic stone was seen in 28 (56%) patients, 14 (28%) patients had lower calyx stone while as 8 (16%) patients had pelvic + lower calyx stones.

In our study, mean operative time was 83.62 SD 16.95 minutes with range of 60–115 minutes. Abdel-Mohsen et al.[16] and Valdivia et al.[5] reported the mean operating duration of 88 and 85 minutes, respectively. In our study, 2.1 days was the mean duration of nephrostomy with range of 2–3 days. Comparable results were shown by the study of Tefekli et al.[17] with mean duration of nephrostomy 2.4 days.

The assessment of postoperative pain in our research was conducted using the VAS score. The patients were explained the VAS scoring system and then were asked to read their pain depending on the severity. Scores were calculated at postoperative day of 1st, 2nd, and 3rd. The average VAS pain scores observed in our research were 4.07 on day 1, 2.73 on day 2, and 1.67 on day 3; the average consumption of Tramadol (in milligrams) was 236.0 SD 120.81.

In our study, overall complication rate was 20%. Wang et al.[14] and Abdel-Mohsen et al.,[16] in their study showed overall complication rate of 28.3, 20.5, and 17.9%, respectively. Three patients needed auxiliary treatment for residual stones. Extracorporeal shock wave lithotripsy (ESWL) was used in two patients who presented with residual stones larger than 4 mm located in an anatomically challenging calyx. The patient, who had a remaining stone measuring 8 mm in the upper calyx, had spontaneous passage of the stone prior to undergoing ESWL. Two patients were converted to prone PCNL due to difficulty in stone access. Two patients with fever >38°C responded to antibiotics and antipyretics. One patient with delayed hematuria was managed conservatively and does not require blood transfusion. The other less common complications observed in our study were hemorrhage (1, 2%), pelvic perforation (1, 2%) who too were responded to conservative management.

In the conducted research, the average duration of hospitalization was found to be 3.7 days SD 1.15 days. Majority of our patients, i.e., 26 (52%) needed hospitalization for 2–3 days. Comparable results of hospital stay were shown by Hoznek et al.[18] and Falahatkar et al.[19] with mean hospital stays of 3.4 and 3.2 days, respectively.

In a study by Perrella et al., no difference in success rate was observed between various positions of PCNL.[20] In our study, overall success rate was 90%. Wang et al.,[14] Falahatkar et al.,[19] and De Sio et al.,[21] have demonstrated a success rate 88.7, 80.0, and 77.5%, respectively. In our study, the stone size was the only factor determining the success rate of the patient who underwent PCNL. In follow-up, there was no operative-related mortality recorded.

Conclusion

Therefore, our research demonstrates that the use of FFMS PCNL surgery is a reliable and efficient method for achieving intrarenal access. This approach has shown a high rate of success and is associated with an acceptable level of morbidity and complications.

Orcid

Irshad Ahmad Kumar https://orcid.org/0000-0002-6451-5535

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