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Original Research Article

Safety and outcomes of percutaneous nephrolithotomy in the supine position: a single-centre experience

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ABSTRACT

Background: The technique of percutaneous nephrolithotomy (PCNL) was initially introduced by Fernström and Johansson in 1976, with the patient positioned in the prone position. Valdivia's study showed that PCNL performed in the supine position had comparable results and complications to PCNL performed in other positions, while also offering potential benefits in terms of ergonomics and anesthesia administration

Methods: A prospective interventional study was conducted at Narayana medical college and hospital, a tertiary care centre in Nellore, AP, India between January 2023 to May 2024. Patients with sepsis, blood coagulation abnormalities, bifid pelvicalyceal system, pediatric population were excluded

Results: The median operative duration was 85.59±12.733 min, and the median duration of X-ray exposure was 12 min. The mean (SD) volume of irrigant fluid was 32.9 liter. One puncture in 73 (89.0%) while 9 (11%) needed two punctures. the mean (SD) reduction in hemoglobin level was 0.8±0.13 mg/dl, with no patients requiring a transfusion. 77 patients had no or <3 mm residual fragments, resulting in a stone free rate of 93.9%. of the five patients with residual stones. There were complications in 13 patients (15.85%); 6 (7.31%) had a persistent urine leak for >24 h after nephrostomy removal

Conclusions: Despite the statistically insignificant results, the outcomes were obviously improved and demonstrated to be comparable to other facilities, with a high stone-free rate and low complications, and post-op length of hospital stay. As a result, the efficacy and safety of supine PCNL in our center were confirmed.

Keywords: Supine, Staghorn, PCNL

INTRODUCTION

The technique of PCNL was initially introduced by Fernström and Johansson in 1976, with the patient positioned in the prone position.[1] Initially, PCNL was carried out with the patient in prone position in order in order to reduce any possible risk of accidental injury to the colon when puncturing the kidney. During the time when the original PCNLs were conducted, intravenous pyelography was the standard form of imaging for stone disease. Modern imaging techniques like ultrasound or computerized tomography (CT) were not commonly used back then. As a result, the surgeons who performed early PCNLs did not have access to the same knowledge of peri-renal anatomy that is easily accessible to modern urologists. In 1987, Valdivia proposed that PCNL could be carried out with the patient lying on supine position and using pre-operative CT scans for patient assessment. Valdivia's study showed that PCNL performed in the supine position had comparable results and complications to PCNL performed in other positions, while also offering potential benefits in terms of ergonomics and anesthesia administration.[2,3] Despite these benefits, supine PCNL has not acquired the trust of urologists in general. The study aims at the outcomes of supine PCNL.

A prospective interventional study was conducted at Narayana medical college and hospital, a tertiary care centre in Nellore, Andhra Pradesh, India, between January 2023 to May 2024. after taking approval from the institute ethics committee (IEC). Convenience sampling method was adopted.

Inclusion criteria

Patients (aged 18-70 years) with renal stones and giving informed consent were included.

Exclusion criteria

Seps is, blood coagulation abnormalities, previous history of ipsilateral laparoscopy or open renal/abdominal surgery, multiple calyceal calculi requiring multiple punctures, bifid pelvicalyceal system, pediatric population were excluded from study.

The preoperative assessment comprised of a detailed medical history, thorough clinical examination, and standard laboratory tests. All patients had intravenous urography (IVU) or non-contrast-enhanced spiral CT of the urinary tract in order to assess the precise location, size, and radiolucency of the stones. The stone burden was assessed by measuring the maximum diameter of the stones on the preoperative radiological scans. In cases where there were several stones, the burden was calculated as the total of the longest diameter of each stone. A sterile urine culture before surgery was required, and patients with a positive culture received 48 hours of treatment before PCNL. The treatment was then continued for 7 days after the procedure. Patients with a sterile culture at the time of surgery were administered a third-generation cephalosporin as prophylaxis. The administration of the medication was continued for 48 hours following the procedure. The surgery proceeded by placing the patient in the lithotomy position and inserting a 5-6 F ureteric catheter with an open tip using a 17 F cystoscope. The duration of the operation was determined by measuring the time from when the ureteric catheter was inserted until the nephrostomy tube was secured to the skin.

The patient is positioned laterally on the table, and the flank is gently raised using a small bolster to achieve a slight rotation. The PCNL side leg is positioned horizontally on one side of the operating bed, without the need of a stirrup. A single stirrup is used to support the opposite leg. A fluoroscopic guide was employed to puncture the collecting system using an 18 G needle. In contrast to the prone posture, it is necessary for the needle to be maintained in an approximately horizontal orientation or slightly tilted upwards towards the operation table. The puncture site was identified and noted at the level of the posterior axillary line, below the 12th rib. Our focus was typically the lower calyx, but in certain cases, we also aimed for the middle calyx if it was accessible via the window.

A 0.032 guidewire was placed, followed by dilatation of the tract using metallic telescopic dilators (Alkan's dilators), and then the placement of an 18 F Amplatz sheath. Following the widening of the tract, we utilized a 12-18F nephroscope equipped with a pneumatic energy source to break down the stone. In all cases, a double-J stent and nephrostomy drain were inserted. The amount of irrigant utilized and the length of time the patient was exposed to fluoroscopy were documented upon completion of the procedure.

The haemodynamic alterations and necessity for transfusion were assessed and documented within the initial 24 hours following the surgical procedure. On the first day after surgery, a radiological examination was performed to evaluate the removal of stones. This examination involved either taking a simple film of the abdomen or conducting a CT scan of the urinary tract. The perioperative problems were categorized based on the revised Clavien grading scale. The SPSS software version 23 was used to analyze the data, which were shown in tables.

RESULTS

The median operative duration was 85.59±12.733 min, and the median duration of X-ray exposure was 12 min. The mean (SD) volume of irrigant fluid was 32.9 L. One puncture was used to enter the collecting system in 73 (89.0%) while 9 (11%) with a staghorn stone needed two punctures. Any reduction in haemoglobin level, and the vital signs, were recorded; the mean (SD) reduction in haemoglobin level was 0.8±0.13 mg/dl, with no patients requiring a transfusion. In our practice we remove the nephrostomy tube pod 1 or pod 2, and in the absence of a urine leak and/or fever, we remove the ureteric catheter 24 h after nephrostomy tube removal. Complete clearance of stone was defined as no residual fragment greater than 3 mm at the end of 3rd-month.

The 77 patients had no or <3 mm residual fragments, resulting in a stone free rate of 93.9%. of the five patients with residual stones, two (2.44%) were treated by a second PCNL through the already present nephrostomy tract and three (3.65%) were treated by RIRS and were rendered stone free. All patients were stone free at 3rd month follow-up. There were complications in 13 patients (15.85%); 6 (7.31%) had a persistent urine leak for >24 h after nephrostomy removal and they were managed conservatively, the 12 had grade 2 complications, with 9 (10.97%) having a fever of >38 C, who responded to antibiotics and antipyretics. Five 02 (2.44%) 2nd PCNL, 03(3.65%) RIRS patients needed an auxiliary endoscopic procedure under anaesthesia. There was no case of organ injury or fistula (urinary or vascular).

Table 1: Demographic characteristics.

Variables	Values
Age (in years)	
Mean age	49.32±11.032
Gender	
Male: female	47:35
BMI (kg/m^2)	
Mean BMI	25.17±2.312
Co-morbidities	
Diabetes	16 (21.33%)
Cardiovascular disease (including hypertension)	25 (33.33%)
Respiratory problem	5 (6.66%)
Obesity	7 (9.33%)
Stone burden (mm^2)	266.146±172.430
Type of stone	
Pelvic	27 (32.93%)
Stag horn	22 (26.82%)
Calyceal	26 (31.71%)
Upper ureteral	7 (8.54%)
Side of surgery	
Right	49 (59.75%)
Left	33 (40.25%)
Pre-operative hydronephrosis	13 (15.85%)

Table 2: Perioperative outcomes.

Variables	Values
Operative time	
Mean operative time (minutes)	85.59±12.733
Puncture site	
Upper	Nil
Mid polar	Nil
Lower	80 (97.56%)
Multiple	02 (2.44%)
Location of access	
Above 12th rib	
Below 12th rib	Below 12th rib=82 (100%)
Number of puncture tracts	
One	73 (89.0%)
Two	9 (11%)
Three />3	Nil
Stone free rate	80 (97.56%)
Haemoglobin drops (mg/dl)	0.8±0.13
Blood transfusion required (units)	Nil
Fever	9 (10.97%)
Port site infection	Nil
Urinary tract infection	7 (8.54%)
Enteric fistula/visceral injury/ perforation	Nil
Postoperative tract leaks 24 hr	6 (7.31%)
Renal injury	Nil
Pleural injury/ hydrothorax	Nil
Post nephrostomy drain leak	1 (1.22%)
Pain (according to VAS) (mean)	
12 hours postoperative	6.5±0.7
24 hours postoperative	4.4±0.4
48 hours postoperative	2.1±0.3

Continued.

Variables	Values
Analgesic	
Not required at all	Nil
Required - After 12 hr	Given to all
-After 24 hr	43 (52.43%)
-After 48 hr	19 (23.17%)
->48 hr	9 (10.97%)
Mean duration of hospital stays (days)	4.18±0.93
Auxiliary procedure	
2nd PCNL	02 (2.44%)
RIRS	03 (3.65%)

Table 3: Previous studies comparison.

Variables	Patients	Mean operative time	Stone free rates	Post op stay	Complications minor	Complications major
Our study	82	94.2	93.9	4.1	12	1
Safriadi et al[11]	175	90.97	91.3	9.66	-	0
Joshi[12]	114	69.89	80.77	-	14	3
Srinivas et al1[3]	112	70	75.5	8.64	10	1
Nualyong et al[14]	73	51.83	79.4	8.68	12	4
Wang et al[15]	66	51.83	98.48	8.6	2	1
Sohil et al[16]	54	134.9	91	4.6	12	3

DISCUSSION

Valdivia et al presented the first study on the viability of PCNL in supine patients. However, it wasn't until 1998 that the same authors reported their 10-year experience with PCNL in supine patients.[4] This technique was then reintroduced. Several studies found that supine PCNL is effective and safe for treating most kidney stones.[5-7] The supine position provides various advantages. General anesthesia is safer, eliminates the need for patient repositioning, and allows surgeons to perform while sitting. The surgeon's exposure to X-rays during the procedure is reduced as their hands are not in the fluoroscopic field and stone fragments can be readily cleaned. Accessing the lower calyx usually allows for easy access to the superior and middle calyx, unless at a sharp angle. Stone clearance requires minimal extra penetration. According to Sofer et al supine position provides easier access to the superior calyx than prone position.[8] In a randomized investigation of 38 patients with upper calyceal stones, Soliman et al found that supine PCNL had a higher stone clearance rate than prone PCNL.[9]

A recent study found that supine PCNL is more effective for removing lower calyceal stones and has less problems.[10] The supine position allows for simultaneous antegrade and retrograde treatments to remove migrating stones. In this study, seven patients (8.54%) had upper ureteric stones, which were fractured or pushed back enters the kidney and withdrawn percutaneously without altering the Position of the patient. This is useful in settings such as ours. when flexible ureteroscopes and lasers are not widely available. Ergonomically, supine PCNL benefits both the urologist and anesthesiologist.

Limitations

All patients had their inferior calyx perforated, none of the patients had their upper calyx accessible percutaneously, which may be a limitation of this approach. The careful use of flexible nephroscopes can help to alleviate this problem to some extent. Although previously documented, supra-costal and upper calyceal punctures were not performed in the current investigation.

CONCLUSION

Our findings indicated that supine PCNL results improved over time. Despite the statistically insignificant results, the outcomes were obviously improved and demonstrated to be comparable to those of other facilities, with a high stone-free rate and low complications, as well as a fast operation time and post-operative length of hospital stay. As a result, the efficacy and safety of supine PCNL in our center were confirmed. Nephroscopy becomes more difficult as it reduces the fullness of the collecting system and causes it to collapse. However, maintaining low pressures within the renal cavities may be beneficial in reducing fluid absorption.

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