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Supine versus prone percutaneous nephrolithotomy: Surgeon and anesthesiologist perspective. Can agile supersede traditional?

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ABSTRACT

Background: Percutaneous nephrolithotomy (PCNL) is the most common surgical procedure for the removal of renal stone of size >2 cm. It has evolved over the years both in terms of surgical technique and plan of anesthesia. The procedure is performed most commonly in the prone position. This position provides edge in offering greater anatomical feasibility due to the posterior retroperitoneal position of kidneys. Supine position bestows several perks over prone in terms of better access to patient's airway, lower cardiopulmonary complications, better patient comfort, repositioning issues addressal along with convenient access to the patient by anesthesiologist in case of untoward medical emergency. **Aims and Objectives:** The primary aim to compare the safety and efficacy of prone versus supine PCNL. The objective was to compare the two techniques in terms of Visual Analog Scale Score, patient satisfaction rate, stone-free rate, procedure time (calculated from placement of ureteric catheter to skin closure), overall complication rate. **Materials and Methods:** This prospective randomized study of 80 patients was conducted at our institute from December 2022 to June 2023. Institutional Ethical Committee clearance was sought and the inclusion criteria were all adult patients aged between 16 and 65 years with single renal, upper ureteric calculus of size 10–25 mm with ASA physical status 1 and 2 having normal renal function and a sterile urine culture. **Results:** All the patients completed the study and there were no dropouts. Male/female ratio, age, and stone size were comparable in both the groups. The mean time taken in supine PCNL was 48.3 min and in prone PCNL was 68.7 min, which was significant. **Conclusion:** Supine PCNL is a safe and efficacious procedure for renal stone disease in the selected group of patients with results comparable to prone PCNL, having additional advantages like less time-consuming, better upper calyceal access through lower calyx, less radiation exposure to surgeon's hand, overcoming positional difficulties of prone position, simultaneous accessibility for performing flexible ureteroscopy and more convenient airway access to anesthesiologist and better pain scores.

Key words: Supine nephrolithotomy; Prone nephrolithotomy; Retroperitoneal kidneys; Ureteroscopy

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INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is the most common surgical procedure for the removal of renal stone of size >2 cm.[1] It has evolved over the years both in terms of surgical technique and plan of anesthesia. The procedure is performed most in prone position. This position provides edge in offering greater anatomical feasibility due to the posterior retroperitoneal position of kidneys.[2] This position holds a significance in view of greater access to posterior calyces through the Brodel's avascular plane thereby

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avoiding renal hemorrhage, peritoneal breach, and better surgical maneuvering.

Conventionally, to visualize the perirenal anatomy, especially position of colon in relation to kidney intravenous pyelogram, was the standard investigation of choice. Nowadays, computed tomography (CT) scan has given us freedom to try other positions such as supine PCNL. CT scan provides us the precise anatomical details of kidney; the perirenal structures especially the location of colon contingent to kidney thus decreasing the chances of intraoperative complications. The technicalities of surgery have also improved in terms of availability of flexible nephroscopy which allows better access to calyces even in supine position.[3]

Supine position bestows several perks over prone in terms of better access to patient's airway, lower cardiopulmonary complications, better patient comfort, repositioning issues addressal along with convenient access to the patient by anesthesiologist in case of untoward medical emergency. As far as urologist is concerned, the position is better ergonomically and it allows for effortless endoscopic combined intrarenal surgery approach.[4,5]

Advantages of supine PCNL are less time as there is no need to reposition the patient, less exposure of radiation to surgeon's hand, better stone removal without pressure as the stone comes out in gravity dependent system in supine PCNL, and beside surgeon is more comfortable as he can sit and perform the surgery. The disadvantages with the supine PCNL are difficult upper calyceal puncture and difficult ureteric access.[6,7]

Considering the paucity of literature, this study was conducted with the primary aim to compare the safety and efficacy of prone versus supine PCNL. The objective was to compare the two techniques in terms of Visual Analog Scale (VAS) Score, patient satisfaction rate, stone-free rate, procedure time (calculated from placement of ureteric catheter to skin closure), and overall complication rate. Post-operative analgesic requirement, drop in hemoglobin postoperatively, and position-related complications.

Aims and objectives

The primary aim to compare the safety and efficacy of prone versus supine PCNL. The objective was to compare the two techniques in terms of Visual Analog Scale Score, patient satisfaction rate, stone-free rate, procedure time (calculated from placement of ureteric catheter to skin closure), overall complication rate.

MATERIALS AND METHODS

This prospective randomized study of 80 patients was conducted at our institute from December 2022 to June 2023. Institutional Ethical Committee clearance was sought and the inclusion criteria were all adult patients aged between 16 and 65 years with single renal, upper ureteric calculus of size 10–25 mm with ASA physical status 1 and 2 having normal renal function and a sterile urine culture. The immunocompromised patients, chronic kidney disease patients, renal abnormality patients (ectopic, horseshoe kidney) with bleeding disorders, and pregnant patients were excluded from the study. Any change in the surgical plan leads to exclusion from the study. A detailed history and physical examination of the patients meeting our inclusion criteria was done. The baseline blood profile and radiological investigations were noted. Any comorbidity was noted separately.

Patients were randomly divided into two groups based on computer-generated random numbers, out of which 40 underwent supine PCNL and 40 underwent prone PCNL under spinal anesthesia. The location and stone burden were comparable in both the groups. The measured data included VAS score (A 10 cm scale with markings from 1 to 10 was, used and patients were explained about this scale before surgery),[8] patient satisfaction rate (Rate of 1–5, with 1 being least satisfied and 5 fully satisfied)[8] surgical time, drop in hemoglobin, stone clearance rate, post-operative analgesic requirement, complication rate both surgical and anesthesia related.

In the supine PCNL group, after giving spinal anesthesia, patients were positioned into Galadko modified Valdevia position.[8] After painting and draping, cystoscopy was done and ureteric catheter was placed over guidewire and fixed with Foley's catheter. Retrograde pyelography (RGP) was done and fluoroscopy-guided renal puncture was done posterior to posterior axillary line. Guidewire was placed and then tract dilatation was done using a renal amplatz dilator. Amplatz sheath was placed. Nephroscopy was done, stone was identified, fragmented with pneumatic lithotripter, and removed. A 5fr double J (DJ) catheter stent was placed. Amplatz sheath removed and tract site sutured.

In prone PCNL group, after giving spinal anesthesia, patients were placed into lithotomy position. Painting and draping were done and cystoscopy-guided ureteric catheter placed over guidewire. Ureteric catheter was fixed with Foley's catheter. After turning the patient in the prone position, RGP was done and fluoroscopy-guided renal puncture was done. Guidewire was placed and then tract dilatation was done using renal amplatz dilator.[8] Amplatz sheath was placed. Nephroscopy was done, stone identified, fragmented with a pneumatic lithotripter, and removed. A 5fr DJ stent was placed. Amplatz sheath removed and tract site sutured. X-ray exposure time was noted in all the patients. The total procedural time was defined as the

estimated time between the applications of ureteric catheter to skin closure. Any complications (anesthesia and surgery related) intraoperatively and postoperatively were noted. Post-operative hemoglobin, X-Ray, and ultrasound kidney, ureter, and bladder were done to detect any residual stone and any extravasation or hematoma. VAS score and patient satisfaction rate were noted 6 h after surgery.

RESULTS

All the patients completed the study and there were no dropouts. Male/female ratio, age, and stone size were comparable in both groups as shown in the (Table 1).

DISCUSSION

In our study, supine PCNL had almost the same efficacy for stone-free rate as compared with prone PCNL which is comparable with other studies in the literature. In our study, time taken in supine PCNL (measured from placement of ureteric catheter to skin closure) was significantly less as compared to prone PCNL. Patients are supine group experienced less pain postoperatively as compared to prone group. Post-operative surgical complications like requirement of post-operative blood/urosepsis/visceral injury and anesthesia-related complications such as airway-related complications, high spinal, and hemodynamic instability were more in the prone group as compared to supine group in our study.

Supine PCNL has been the procedure of choice for renal stone clearance of size more than 2 cm since historical times. It has evolved over the years both in terms of surgical technique and procedure of anesthesia. The procedure is performed traditionally in a prone position due to anatomical feasibility due to posterior retropharyngeal location of the kidney, avascular plane of Brodel, and dilated collecting system due to gravitational effect on the irrigating fluid. The prone position also offers an enormous range of nephroscope excursions. The studies are also of the view that large staghorn calculus can be removed much better in a prone position that allows better access to the upper calyceal system.[9,10]

Prone PCNL was first introduced in 1976 and after 9 years in 1987, supine PCNL was introduced by Valdivia et al.[11] In spite of this, the surgeons are reluctant till date to prefer supine position over prone for PCNL due to time-tested advantages and hence the results of prone position that according to them can never be transcended.

Previously, it was thought that chances of colonic injury are more in the supine position but now it has been postulated that in supine position, the colon floats away from the surgical incisional site (most common posterior axillary line).[12] Availability of better diagnostic modalities with time, like CT scan, has added to precise planning beforehand and lead to triumph over the complications.

There are some serious concerns of PCNL in a prone position that cannot be sent to coventry. The cardiovascular changes include obstruction of inferior vena cava and potential risk of thrombosis. Apart from this, changing position from supine to prone can cause central and peripheral nerve injuries (e.g. Brachial plexus injury) including pressure injuries. The flow in carotid and vertebral arteries can also be affected. Ocular problems in the form of corneal abrasion, blindness due to optic nerve ischemia, and increase in globe pressure can occur. Even anesthesia becomes a laborious task and not to forget the army of people required to turn the patient from supine to prone especially if the patient is of high body mass index. This is grueling both for surgeon and anesthesiologist. Anesthesia implications include airway concerns, confirming the

Table 1: Demographic profile

Parameter	Supine (n=40)	Prone (n=40)	P-value
Male/Female	22/18	26/14	0.768
Age (Mean age in years)	36.8±1.75	38.2±1.12	0.564
Stone size (mm)	19.5	22	0.912
Mean time (min)	**48.3±2.34**	**68.7±1.87**	**<0.001**
Complete stone clearance	85%	90%	0.499
Drop in HB	0.56	0.64	0.261
No. of punctures single/multiple	38/2	34/6	0.675
Surgical complications (Requirement of post-operative blood/urosepsis/visceral injury)	0/2/0	1/3/0	0.345
VAS score	**2**	**3**	**<0.001**
Patient satisfaction rate	5	4	0.845
Anesthesia related complication (airway, high spinal, hemodynamic instability)	0/1/2/0	1/3/6/0	0.134
Position related complication	Nil	Nil	-

HB: Hemoglobin, VAS: Visual Analog Scale. Bold values are highly significant

appropriate tube position, escalation of depth of anesthesia, and avoiding abdominal pressure.[12]

In contrast to it, the demerits of supine position, namely, decreased access to calyceal system, more mobility of kidney, have all been addressed one way or the other by modifying the position or surgical technique. There is a momentous reduction in radiation exposure to surgeon in supine PCNL due to a significant reduction in operative time in the supine group and less direct radiation exposure. It is time we move away from prone to supine PCNL not only in obese patients but also in all patients having indication of PCNL. A technique that marginalizes itself in difficult situation can definitely do wonders in normal situation.[8]

In our study, supine PCNL had almost the same efficacy for stone-free rate as compared with prone PCNL which is comparable with other studies in the literature. In a study done by Mulay et al., in 2022, the stone-free rate in supine PCNL was 92% and 88% in prone PCNL.[8] In a study done by Gupta et al., supine PCNL had 100% stone clearance.[13]

In our study, time taken in supine PCNL (measured from placement of ureteric catheter to skin closure) was significantly less as compared to prone PCNL. This correlates well with the study done by Mulay et al.[8] The drop in hemoglobin was statistically significant in the study done by Mulay et al. This is in contrast to our study in which the drop in hemoglobin was statistically insignificant. Patients are supine group experienced less pain postoperatively as compared to the prone group. Post-operative surgical complications such as requirement of post-operative blood/urosepsis/visceral injury and anesthesia-related complications such as airway-related complications, high spinal, and hemodynamic instability were more in the prone group as compared to the supine group in our study.

Limitations of the study

(1) A long-term follow-up was not conducted in our study. (2) The sample size is less hence results cannot be generalized. (3) The study did not include pediatric patients.

CONCLUSION

Supine PCNL is a safe and efficacious procedure in terms of less surgical time and less VAS scores in selected group of patients with results comparable to prone PCNL, having additional advantages to anesthesiologist in terms of avoiding prone positioning and its associated complications. The supine PCNL can be a choice for future PCNL surgeries.

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