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Original Article

Percutaneous Nephrolithotomy in Supine Position in our Experience

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Abstract

Background: Percutaneous access to the kidney with the patient in supine position was described in 1998. Although not frequently used in Pakistan there is a constant effort to adopt the supine position, primarily because it offers certain advantages over prone position.
Objective: To present our experience in performing supine percutaneous nephrolithotomy and to compare our results with those reported in the international literature.
Study type, settings & duration: A retrospective study was conducted at Federal Government Polyclinic hospital Islamabad from January 2015 to January 2020.
Methodology: The medical records of 63 patients that underwent supine percutaneous nephrolithotomy were reviewed. The evaluated variables were: age, gender, body mass index, stone location and size, surgery duration, success rate, and complications.
Results: A total of 63 patients and 70 kidneys were treated. The mean age of the patients was 41.7 years (16-76) with predominance of males 37 (58%) while there were 26 (42%) females. Mean body mass index was 25 m^2 (18-34), mean stone size was 31 mm (12-80).Topography of the calculi was pelvic, 17 (24.2%); caliceal system; inferior 16 (22.8%), middle 3 (4.2%), superior 5 (7.14%). and mean duration of surgery was 80 min (30-160). The first intervention success rate was 90%, the second intervention success rate was 95%, and the complication rate was 11% (Clavien: I and II).
Conclusion: Supine percutaneous nephrolithotomy is safe and efficacious, with a high success rate, low complication rate, and undisputable advantages of anesthesia management.
Key words: Percutaneous nephrolithotomy, supine position, kidney stones, staghorn calculi.

Introduction

The first percutaneous nephrostomy was documented in 1865 by Tomas Hiller. In 1955 Goodwin et al.[1] reported their initial experience in percutaneous nephrostomy for the drainage of an infected hydronephrotic kidney. In 1976 Ferstrom and Johansson[2] reported percutaneous nephrostomy as a procedure to treat kidney stones. Few years later Alken et al[3] published their series of percutaneous extraction of calculi using an ultrasonic lithotripter. From then onwards the procedure has won great acceptance and its indications are well described.[4]

The percutaneous nephrolithotomy (PCNL) is usually carried out in prone position. Amongst many reasons one is easier access to the kidney being a retroperitoneal organ.[5] However, when this position is used, the major complications like hemorrhage and lesion to other organs have been reported in a 0.9-4.7%.[6] The PCNL in prone position is usually carried out in general anesthesia, so this position is associated with patient's incommodity and circulatory and ventilatory haphazards especially in obese patients.[7]

Various modifications in the position for PCNL have been reported in view of decreasing the morbidity and complications related to the procedure. These include reverse lithotomy, spine

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SH conceptualized the project. SAA did the data collection. SSA & NFC did the literature search and performed the statistical analysis. Drafting, revision & writing of manuscript were done by SH, EH, NU & AA. SSA & SH also performed the surgical procedure.

position, lateral decubitus, supine modified Valdivia Galdakao, Valdivia Barts modified and supine Bart's modified.[8]

These positions have been reported as safe and effective when compared to the conventional prone PCNL but they never went out to be very popular. The PCNL in supine conventional position and modified by Galdakao resulted to be good substitutes for prone position.[9] Theoretical advantages of supine position include; less radiation to the hands of surgeon by not having them in the operatory field, less surgical time, decreased risk of orthopedics and neurological complications, less liquid absorption, calculi drainage facilitation by gravity, less personnel required to accommodate the patient and easy access to respiratory track at any moment. The theoretical disadvantages of supine position include; increased real mobility, longer percutaneous track, collapsed renal cavity at every moment of surgery and difficult access to the superior calyx.[10] So this is very much clear that prone position is not the only way to perform PCNL and many urologist all over the world use supine position as an excellent alternative to prone position.[11] In Pakistan there are very few urologists who perform PCNL in supine position so we wanted to share our experiences and recommendations in this regard.

Methodology

A retrospective study was done at Federal Government Polyclinic hospital Islamabad and data of 63 patients who underwent PCNL in supine position from January 2015 to January 2020 was retrieved and analyzed. Data of the patients who had under gone percutaneous surgery for any other pathology like diversion nephrostomies, anterograde endopylotomy and mini PCNL were excluded.

All patients had intravenous urogramor non-contrast-enhanced spiral CT of the urinary tract to evaluate the stone location, burden and radiolucency. The stone burden was determined by measuring the longest diameter on the preoperative radiological investigations; if there were multiple calculi the burden was defined as the sum of the longest diameter of each stone.

A preoperative sterile urine culture was mandatory and patients with a positive culture were treated for 48 h before PCNL, and the treatment continued for 7 days afterwards. A third-generation cephalosporin was given as prophylaxis to patients with a sterile culture at the time of surgery, and was continued for 48 h afterwards. The majority of patients were operated in spinal anesthesia.

The definition for staghorn calculi was as follows: partial (just in one major calyx and renal pelvis), complete (two or more major calyx and renal pelvis). In case of multiple stones the topographical position was determined by the largest one.

Instead of using complex positions, patients were accommodated in simple supine position but with the slight modification of adjusting the operation site at the very edge of OT table. Irrigation pump was used in majority patients.

The procedure began with the patient in the lithotomy position, with insertion of an open-tip 7–8 F ureteric catheter, using a 22 F cystoscope. The operative duration was calculated from the time of ureteric catheter insertion until the final suture on the skin.

After inserting the ureteric catheter, the patient was placed supine with the ipsilateral arm secured to the chest. Under fluoroscopic guidance an 18 G needle was used to puncture the collecting system. Unlike in the prone position, the needle must remain almost horizontal or slightly inclined upward towards the operating table. We marked the puncture site, which lies at the level of the posterior axillary line under the level of the 12th rib, targeting the lower posterior calyces.

A 0.9 mm (0.038 inch) guidewire was inserted, followed by dilatation of the tract upto 28 Fr, followed by the insertion of a 30 F Amplatz sheath.

After tract dilatation we used a 27 F nephroscope with a ballistic energy source for stone disintegration.

The volume of irrigate used and the duration of fluoroscopic exposure were recorded at the end of the procedure. Hemodynamic changes and any need for transfusion were evaluated and recorded during the first 24 h after surgery.

A radiological examination was used to assess stone clearance on the first day after surgery, with either a plain film of the abdomen or CT of the urinary tract.Stone clearance was defined as no stone or clinically unsignificant stone particles less than 0.4mm post operatively. Perioperative complications were classified according to the modified Clavien grading system : Grade 1, any deviation from the normal postoperative course but with no need for pharmacological, surgical, endoscopic, or radiological intervention; Grade 2, complications requiring pharmacological treatments or blood transfusions; Grade 3, complications requiring surgical, endoscopic, or radiological intervention with no (grade 3a) or with (grade 3b) general anesthesia; Grade 4, life-threatening complications requiring a stay in an intensive care

unit (grade 4a, single organ; grade 4b, multi-organ dysfunction); Grade 5, death.

A retrospective chart review was done. Data was collected from hospital archives and was analyzed using SPSS 21.0 R software.

The Ethical approval was obtained from Ethical Review Board of Federal Government Polyclinic Hospital, Islamabad.

Results

Data of 63 patients and 70 kidneys was included. Total 45(64%) patients were symptomatic patients according to the criteria of American society of Anesthesia. ASA 1: 43(68.2%), ASA 2: 14 (22.2%), ASA3: 6 (9.5%). Patients with previous treatment like ESWL or URS: 29 (41.4%) (Table-1).

Table 1: Perioperative variables.

Patients(n)/total surgeries done(n)	63/70
Age, median range (years)	41 (16-76)
Mean (SD)	38.8 (14)
Sex M/F (n)	37/26
Side of calculi R/L/Bilateral	29/34/7
ASA 1/2/3, n (%)	43(68.2)/14(22.2)/6(9.5)
BMI, m^2 of body surface	25.1 (18-34)
Mean (SD)	30.2 (6.9)
	< 25: 33 (47.1%)
	25-30: 24 (34.2%)
	> 30: 13 (18.5%)
Previous treatment n (%)	29(41.4)

Table 2: Calculi specific variables.

Position of calculi n (%)	Pelvic: 17 (24.2), calicial: inferior 16 (22.8) mid 3 (4.2), superior 5 (7.14)
Concomitant ureteric calculi n (%)	4(5.7)
Concomitant vesical calculi n (%)	1(1.5)
Bilateral calculi n (%)	7(10)
Calculus size mm (range)	31(12-80)
Mean (SD)	32.2 (4.3)

Table 3: Procedural results.

Punctured calix	
Inferior n (%)	55(78.1)
Middle n (%)	7 (10)
Superior n (%)	3 (4.2)
Inferior and Middle n (%)	5 (7.1)
Surgical time min (range)	80 (30-160)
Mean (SD)	81.3 (18.4)
Clearance rate n (%)	65 (92.8)
Complications n (%)	8 (11.4)

Calculi specific variables and procedural outcomes are shown in Table-2 and Table-3 respectively. Drain tube was never placed. Ureteric catheter was left in all the patients. Mean post op hospital stay was 01 day. Complications were reported in 8 (11.4%) patients. While transfusion was given in 02 (3.2%) patients and incidence of urosepsis 6 (9.5%) and urinary fistula was 0 (0.0%).

Discussion

The advantages of supine position are well documented and includes surgical and anesthesia advantages, decreased surgical time and low complication risk rate by change of position[1-3] This position offers many advantages to the anesthesiologist especially in obese patients and patients with high surgical risk.[4-6] Any invasive procedure like central line catheter, cardiac defibrillation or re intubation is much easier in supine position as compared to the prone.[7-10]

The estimation of operative time is controversial. When exactly the surgery starts and what is the hall mark of ending the surgery is both well-defined.[11] In a recent meta-analysis Liu et al. demonstrated a reduction of time upto 28% in supine position when compared to the prone position, in a group of 389 patients.[12] Mean operative times of 85 and 98 min were reported by Valdivia et al. and Falahatkar et al. respectively. Hoznek et al. reported a mean (range) operative duration of 123 (50–245) min.[13,14]

In another study by de Sio et al. where a comparison between prone and supine position has been done , mean operative time in supine group was 74.7±25.1 min and less than prone group (106.87±17.5) with a significant statistical difference ($p < 0.0001$).[15]

We had mean surgical time of 80 min, which was similar to some serial studies. However over priority per se was not to decrease the surgical time.

Some authors do insist the ultrasound guided puncture and in some cases under vision by flexible URS. We in our experience just used fluoroscopy with very good results.

Recently an article was published by de Sio et al.[15] where they had studied 170 patients; n=48 with mid calyx approach and n=122 with inferior calyx approach. These authors found similar results in stone clearance, time of surgery and complications in each group. In our study 55 (78.1 %) patients were approached by inferior calyx, 7(10%) by middle, 3 (4.2%) by superior and 5 (7.1%) by inferior and middle calyx and we also did not find any significant difference in terms of stone

clearance, surgical time and complications in these groups.

We used in our cases pneumatic lithotripsy. It is worth mentioning here that holmium laser have its own advantages over pneumatic lithotripsy but its high cost and low availability is a major hurdle in its use and it also takes more time for stone clearance. A meta-analysis by Chen et al. in this regard showed that compared with Holmium laser, pneumatic lithotripsy significantly reduced the mean operative time (weighted mean difference = -11.52, 95% CI -17.06 to -5.99, $p < 0.0001$) and increased the early stone-free rate (OR 2.69, 95% CI 1.91-3.78, $p < 0.00001$) and the delayed stone-free rate (OR 2.12, 95% CI 1.40-3.21, $p= 0.0004$).[16]

According to literature the risk of gut perforation in supine position is present. In prone position there is a posterior and lateral displacement of gut due to abdominal compression offered by the operation table but this advantage is not present in supine position, however in our experience we have never come across any event of gut perforation. It could be concluded that possibility of colonic perforation decreases in supine as compared to lateral approach of prone position because air in the colon lifts the gut up in supine position while it displaces the colon more posteriorly in prone position. The best way to decrease this risk of gut perforation is combine real time ultrasound and fluoroscope during puncture.[17]

Another study involving 12 patients (17.1%) with stag horn calculi with significant stone burden, average size of 68(55-80) mm was conducted by Falahatkar et al. included also 12 patients (22%).[18-20] Seven patients with stag horn calculi were included in the study conducted by Hoznek at al.[21] Neto et al. included 9 such patients in their study.[22]

The rate of stone clearance in our study was 93%. Similar results were reported by Valdivia et al. Nour at al. reported 91% of success rate.[21] Other authores like Neto et al. reported 70.5% of success rate.[22]

Something worth mentioning here is the group of patients with staghorn calculi has the least stone clearance rates with most complications observed. Some publications of PCNL even excluded patients with staghorn calculi due to special characteristics of this group.[23]

We did not use post-operative drain. Post-operative drain is used to guarantee the hemostasis, prevent urine extravasation and renal healing. There is no set protocol of how to select the size of nephrostomy tube.[25] However there is increased evidence that small diameter tube is well tolerated and has decreased risk of post-operative fistula formation.[26] In our study nephrostomy tube was not used except in couple of patients where we were expecting 2nd stage PCNL because nephrostomy tube is counter productive and has more disadvantage than its benefits. The rest were left without it due to less stone burden, no trans operative bleed or by not having any residual stone suspicion.

In our experience supine position for PCNL is very effective and versatile technique especially in simultaneous treatment of middle or lower track pathology with low complication rate, easy management and very good stone clearance rates. Only limitation of supine PCNL is upper pole calculi specially with intra renal calyceal system.

Conflict of interest: None declared.

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