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Original Research Article

Supine versus Prone PCNL: A Single Centre Experience

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Abstract

Objectives: To compare the operative times, length of hospital stay, complication rate and stone free rate between patients undergoing supine PCNL and prone PCNL.

Materials and Methods: A prospective observational study was conducted in our institution, involving 199 patients over a period of two years from 2019 to 2021. These patients were divided into two groups with 99 patients undergoing supine PCNL group and 100 patients undergoing standard PCNL group. The inclusion criteria included the presence of a renal calculus larger than 2.0 cm. Exclusion criteria included bleeding disorders, pregnancy, high risk for general anaesthesia. The measured data included number of punctures, operative time, fluoroscopy time, duration of hospital stay, complication rate and stone free rate.

Results: Supine PCNL is associated with reduced operative times, compared to prone PCNL, with a p-value of <0.0001. However, there is no difference between the two procedures with respect to fluoroscopy time, blood loss, complication rate, stone free rate and length of hospital stay.

Conclusions: Supine PCNL is an effective modality for the treatment of renal calculi with the added advantages of reduced operative time as well as simultaneous retrograde access, compared to prone PCNL. Larger scale studies are required for evaluating the advantages and drawbacks of the supine position with respect to the prone position for PCNL.

Keywords: Percutaneous Nephrolithotomy, Prone Percutaneous Nephrolithotomy, Supine Percutaneous Nephrolithotomy.

Introduction

Percutaneous access to the kidney was first described by Goodwin et al, when they used it to drain a hydronephrotic kidney [1]. Ever since the first instance of successful treatment of renal stones via a nephrostomy tract in 1976 [2], percutaneous nephrolithotomy has largely replaced the open removal of renal calculi, due to its superiority in terms of morbidity, convalescence & cost. Traditionally PCNL was done in the prone position [3]. This position allowed access to the renal collecting system via Brodel's avascular plane, however it was associated with hazards such as accidental extubation during positioning, impaired ventilation & compromised circulation [4] . Dr. Josè Gabriel Valdivia Urìa was the first to perform percutaneous renal surgery in the supine position [5]. This position permits better airway control & cardiovascular control, and allows better access for

resuscitative measures [6]. An added advantage is easier patient positioning, without the need for repositioning [7]. Others include a reduced risk of colonic injury & infection [8-11]. A reduced risk of fluid imbalance [6] & better drainage of stone fragments [7,12] are also seen in the supine position. The supine position does have its share of disadvantages such as hypermobility of the kidney [12], limited distensibility of the renal collecting system & reduced working space. Presently there is a paucity of literature comparing prone and supine PCNL. This study was done to compare the two techniques in terms of operative duration, complication rate & stone free rate.

Materials & Methods

An observational study was conducted in our institution after obtaining ethical committee clearance, over a period of two years from 2019 to 2021. The study included 200 patients of whom 100 individuals underwent PCNL in the prone position whereas 99 patients had undergone supine PCNL.

All cases were done under general anaesthesia

Patients undergoing prone PCNL were initially positioned in dorsal lithotomy and cystoscopy was done followed by retrograde ureteric catheterisation. The position was then changed to prone and the rest of the procedure was carried out

Those in the supine PCNL group were placed in the Galdakao-Modified Supine Valdivia position with the entire procedure being done in this position. The flank to be operated is elevated by 20-30 degrees using pillows and sheets, with the ipsilateral leg being kept extended & the contralateral leg being flexed and abducted.

Figure 1: Positioning for Supine PCNL – 1

Figure 2: Positioning for Supine PCNL – 2

In both groups, the target calyx was chosen by the operating surgeon in such a way as to ensure maximum clearance via a single tract. However multiple punctures were required in some cases. The tract size was determined by the size of the target calyx and its infundibulum, which determined the choice between standard PCNL and mini PCNL. Pneumatic lithotripter was used for all cases.

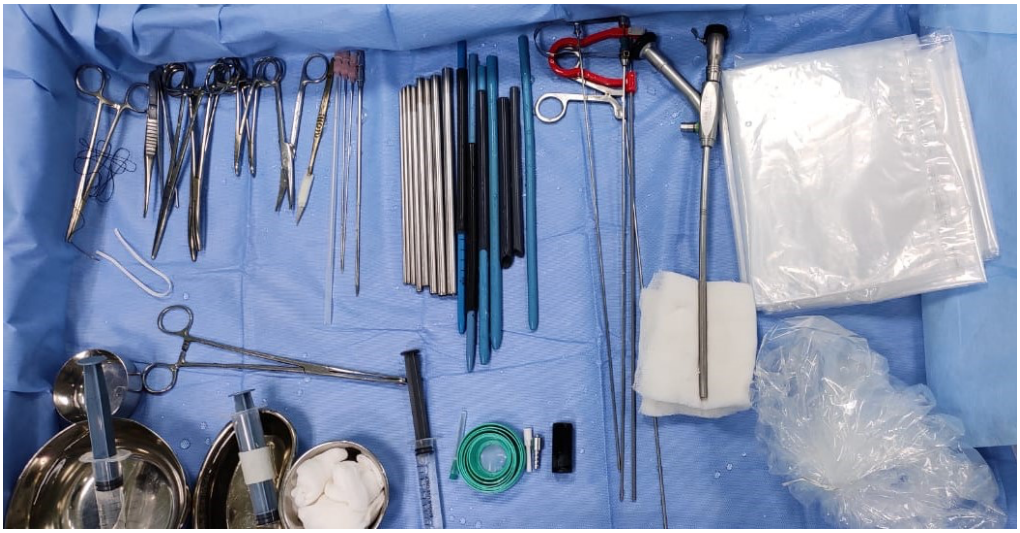

Figure 3: Instruments used for PCNL

The collected data included the age, gender, BMI, stone size, operative time, number of punctures, fluoroscopy time, complication rate & stone free rate. The presentation of the Categorical variables was done in the form of number and percentage (%). On the other hand, the quantitative data with normal distribution were presented as the means ± SD. The following statistical tests were applied for the results:

1. The comparison of the variables which were quantitative and normally distributed in nature were analysed using independent t test.

2. The comparison of the variables which were qualitative in nature were analysed using Chi-Square test. If any cell had an expected value of less than 5 then Fisher's exact test was used. The data entry was done in the Microsoft.

EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, version 25.0.

For statistical significance, p value of less than 0.05 was considered statistically significant.

Results

Table 1: Comparison of baseline characteristics between supine and prone position

Baseline characteristics	Supine(n=99)	Prone(n=100)	Total	P value
Gender				
Female	46 (46.46%)	47 (47%)	93 (46.73%)	0.94†
Male	53 (53.54%)	53 (53%)	106 (53.27%)	
Age(years)	50.67 ± 10.33	49.24 ± 12.02	49.95 ± 11.2	0.37‡
Body mass index(kg/m²)	25.32 ± 1.49	25.58 ± 1.71	25.45 ± 1.61	0.249‡

‡ Independent t test, † Chi square test

Table 2: Comparison of stone characteristics between supine and prone position.

Stone characteristics	Supine(n=99)	Prone(n=100)	Total	P value
Stone side				
Left	37 (37.37%)	54 (54%)	91 (45.73%)	0.019†
Right	62 (62.63%)	46 (46%)	108 (54.27%)	
Stone size(mm²)	749.85 ± 205.22	713.22 ± 175.11	731.44 ± 191.09	0.177‡
CT density (HU)	1008.04 ± 160.64	1076.45 ± 171.26	1042.42 ± 169.16	0.004‡

‡ Independent t test, † Chi square test

Table 3: Comparison of intra-operative parameters between supine and prone position.

Intra-operative parameters	Supine(n=99)	Prone(n=100)	P value
Number of punctures			
1	72 (70.15%)	69 (70.85%)	0.672†
>1	27 (28.85%)	31 (29.15%)	
Tract length (mm)	93.31 ± 7.91	92.8 ± 5.55	0.598‡
Operative time (minutes)	60.19 ± 13.58	89.12 ± 16.6	<.0001‡
Fluoroscopy time (minutes)	20.06 ± 5.6	20.88 ± 4.9	0.274‡
Estimated blood loss(Hemoglobin drop(g/dL))	2.03 ± 0.77	2.22 ± 0.89	0.119‡

‡ Independent t test, † Chi square test

Table 4: Comparison of outcome between supine and prone position.

Outcome	Supine(n=99)	Prone(n=100)	Total	P value
Complications (Clavien Dindo)				
0	80 (80.81%)	69 (69%)	149 (74.87%)	0.28*
1	10 (10.10%)	13 (13%)	23 (11.56%)	
2	8 (8.08%)	14 (14%)	22 (11.06%)	
3a	1 (1.01%)	1 (1%)	2 (1.01%)	
3b	0 (0%)	1 (1%)	1 (0.50%)	
4	0 (0%)	2 (2%)	2 (1.01%)	
Stone free				
No	5 (5.05%)	8 (6.5%)		0.399†
Yes	94 (94.95%)	92 (93.5%)		
Length of hospital stay(days)	4.54 ± 1.13	4.68 ± 1.15		0.387‡

‡ Independent t test, * Fisher's exact test, † Chi square test

We observed that there was not much difference between the supine group & the prone group in terms of age, gender & body mass index. The mean stone size in the supine PCNL group was 749.8 mm^2 whereas that in the prone PCNL group was 713 mm^2. There was no significant difference in the number of patients who required more than a single puncture, between the two groups with 27 patients in the supine group and 31 patients in the prone group having undergone more than one puncture. The complexity of the stone load was also similar in both groups with the majority of patients having renal pelvic calculi 89% in the supine group & 87% in the prone group. Only 2% of patients in the supine group & 3% of those in the prone group had upper calyceal calculi. A significant difference was noted in the total operative time, with a mean time of 60.19 minutes in the supine group & 89.12 minutes in the prone group. There were no significant differences between the two groups in terms of postoperative complications, stone free rate & duration of hospital stay.

Discussion

PCNL is the procedure of choice for the treatment of patients with renal calculi larger than 2.0 cm. Various modifications have been incorporated into the technique since it was first adopted. The present study includes 199 patients and compares the outcomes between supine PCNL and prone PCNL. The mean age of patients in the supine PCNL group was 50.67 years and 49.24 years in the prone PCNL group. The p-value was insignificant. Several studies have demonstrated a male predilection for the development of urolithiasis [13,14]. Our study had a greater number of males with 53.27% subjects being men. The peak incidence of urolithiasis occurs in the fourth to fifth decades of life [13]. This is also reflected in the mean age of the study population. The mean stone size was 749.8 mm^2 in the supine PCNL group & 713 mm^2 in the prone PCNL group, with no statistically significant difference between the 2 groups. The mean haemoglobin loss in the supine group was 2.03 gm/dl, whereas it was 2.22 gm/dl in the prone group, with the difference being statistically insignificant. However, a recent meta-analysis concluded that blood loss is higher following prone PCNL [15]. There was no significant difference with respect to the number of punctures required between the two groups, with more than a single puncture being required for 27 patients in the supine group and 31 patients in the prone group. The p-value was 0.67. There were 5 patients in the supine group and 8 patients in the prone group who had residual stone fragments. However, there was no significant difference in the stone-free rates between the two groups, with a p-value of 0.39. A study by Wu et al. states that there is no difference in the stone free rates between supine and prone PCNL [16]. However certain authors have reported a higher stone free rate with prone PCNL too [15]. There was a significant difference in terms of operative time between the two groups. The supine PCNL group had faster operative times. The p-value was <0.0001. This has been observed in multiple studies as well [17,18]. There was no significant difference in fluoroscopy time between the two groups, with a p-value of 0.27. Some studies have observed a lack of difference in fluoroscopy times [19], whereas others have observed reduced fluoroscopy times with supine PCNL [20]. The complication rates between the supine PCNL group and the prone PCNL group were similar with a p-value of 0.28. This correlates with multiple studies [15,20]. There was no significant difference in the duration of hospital stay as well, with the mean duration being 4.58 days in the supine group and 4.68 days in the prone group, with a p-value of 0.38. The study by Yuan et al. made similar observations [15]. Pneumatic lithoclast was used for stone fragmentation in all cases. Fragments were

retrieved using alligator forceps as well as stone baskets. One of the major advantages of supine PCNL over prone PCNL was the ability to ensure simultaneous retrograde access into the ureter and the pelvicalyceal system.

The limitations of the current study include:

1. The limited sample size.
2. Lack of long-term follow-up.
3. Lack of inclusion of paediatric Patients.
4. Other modified supine positions were not studied.

Conclusion

Supine PCNL is associated with reduced operative times, compared to prone PCNL. However, there is no difference between the two procedures with respect to fluoroscopy time, blood loss, complication rate, stone free rate and length of hospital stay. Hence supine PCNL is an effective modality for the treatment of renal calculi with the added advantages of reduced operative time as well as simultaneous retrograde access, compared to prone PCNL. Larger scale studies are required for evaluating the advantages and drawbacks of the supine position with respect to the prone position for PCNL.

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