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Outcome and complications of percutaneous nephrolithotomy for renal stones – Our institutional experience

Rajkumar Ramakrishnan[1], Senthilkumar Poovathai[2], Rajasekar Sundaram[3], Gopu Rakesh Vamsi[4], Sammohit Gulakavarapu[5], Vinayak Sangreshi[6]

[1]Associate Professor, [2,3]Assistant Professor, [4,5,6]Senior Resident, Department of Urology, Government Mohan Kumaramangalam Medical College and Hospital, Salem, Tamil Nadu, India

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ABSTRACT

Background: Percutaneous nephrolithotomy (PCNL) is the preferred treatment of choice for renal calculi. PCNL has evolved remarkably since the eighties when it was first described. PCNL is the treatment of choice for renal stones ≥2 cm. **Aims and Objectives:** Our aim is to observe the various surgical outcomes of different types of PCNL. **Materials and Methods:** It is an observational study conducted in our institute a total of 160 pts of renal stone disease who presented to the outpatient department were included in the study. All patients underwent PCNL either in supine or prone position. The parameters such as stone free rate, body mass index (BMI), stone size, operative time, length of stay (LOS), in hospital, and complications were observed. **Results:** There were no significant differences in stone size between supine and prone PCNL patients. The supine group had a higher mean BMI, shorter mean surgical time, shorter mean LOS, and higher stone free rate. Prone PCNL patients had a higher rate of overall complications. **Conclusion:** PCNL is one of the best modalities for renal stones management, with supine and modified supine PCNL demonstrating better results in obese patients, and may be considered by all surgeons performing PCNLs.

Key words: Renal stones; Supine percutaneous nephrolithotomy; Prone percutaneous nephrolithotomy; Surgical outcomes

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INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is the treatment of choice for renal stones ≥2 cm.[1] In the early years, large stones were treated with PCNL and smaller ones left for extracorporeal shockwave lithotripsy. The concepts have changed in context to miniaturization of instruments and advancements in energy and optics where even smaller stones are treated with PCNL with minimal morbidity and better stone clearance rates. It can be done either in prone or supine position. The Conventional prone position for PCNL is favored by a majority of urologists[2] due to familiarity with the procedure, larger surface area for choice of puncture site, and a potentially more direct approach to the kidney.[3] However, the prone position is associated with several anesthetic, surgical and positional disadvantages. Because of this, several other alternative positions are being used including complete supine, modified supine, or flank positioning.[4-9] as they offer advantages which include reduced ventilation and circulation difficulties, less radiation exposure to the surgeon, more direct renal puncture, and avoidance of repositioning the patient during the procedure.[4-10] In Valdivia position, the operative time is more and it also has a less stone clearance rate. The Barts modification of Valdivia position uses both X-ray and USG in combination. The modified supine position that combines a tilted supine position with lithotomy provides the additional benefit of allowing simultaneous retrograde access to the upper tracts. This gives a dual approach to large staghorn calculi and ureteric stones potentially

Address for Correspondence:
Dr. Rajasekar Sundaram, Assistant Professor, Department of Urology, Government Mohan Kumaramangalam Medical College and Hospital, Salem, Tamil Nadu, India. **Mobile:** +91-9443276786. **E-mail:** kavinyuvanraja@gmail.com

reducing the operative time, trauma to the patient, and increasing the stone free rate.[11] Major complications can either be related to access or stone removal.

Aims and objectives

In our study, we observed the demographic profiles of patients such as age, sex, body mass index (BMI), comorbidities, stone characteristics, and post-operative surgical outcomes such as duration of stay, stone free rates, and surgical complications.

MATERIALS AND METHODS

An observational study was conducted on those patients who presented to outpatient department with a diagnosis of renal stone diseases or eventually diagnosed as renal stone disease after evaluation, between time period of November 2020 and August 2022 at our institution were included in the study. All cases of recurrent renal stone disease, stone size <2 cm, inoperable cases, and pediatric age renal stones were excluded from the study. All the patients underwent either supine PCNL or prone PCNL depending on the patient comorbities and anatomical aspects such as obesity, pulmonary disease, calyceal anatomy, and also surgeons' choice.

The number of punctures and pole of puncture was determined on the size and location of the calculus. All PCNLs (supine and prone) had ureteric catheters placed during the procedure. Nephrostomies were inserted where ever necessary, but internal stents were placed in all patients.

Patient demographics were collected from scanned medical records. Maximum stone diameter was used to assess stone burden. All those who had secondary procedures during the same admission or later for stone clearance were defined as having residual stones. All patients had post-operative X-ray or computed tomography scans at 6 weeks to determine stone-free rates.

Measured data included patients age, sex, comorbities, BMI, stone size, operative time, length of stay (LOS) in hospital, and post-operative complications.

All the data were tabulated under the headings of supine and prone position PCNL, respectively, for ease of comparison and understanding the observations.

RESULTS

Similar characteristics were seen in both groups, but the patients who underwent supine PCNLs have a higher mean BMI (31 kg/m^2 vs. 28 kg/m^2, P=0.03) but had similar stone sizes (Table 1). While the stone locations and stone compositions between the two groups were similar, the majority of the Supine procedures (82.5%) had lower pole punctures compared to prone patients (65.2%) (Table 2).

The supine PCNL patients was on average 30 min shorter than the mean operation time of the prone PCNL patients (P<0.001) (Table 3). The stone free rate was significantly higher for the supine PCNL patients than for the prone PCNL patients (70% vs. 50%, P=0.005) with a significantly shorter mean LOS in hospital (P=0.005).

All prone PCNLs had intraoperative nephrostomies and internal stents placed, while in the supine PCNL patients, nephrostomies were placed based on the ease of puncture, stone clearance, amount of bleeding during the surgery, but stenting was done in all cases.

There was a higher rate of overall complications seen in the prone PCNL patients compared with the supine group (Table 4). However, for both groups, the rate of

Table 1: Patient characteristics

Characteristics	Prone position	Supine position
No of patients	92	68
Sex		
Male	66	46
Female	26	22
Age (years)	54.4±15.1	50.6±17.2
Body mass index (kg/m^2)	28.0±7.2	31.0±9.2
Comorbities	8	2
Stone burden (mm)	22.8±12.8	22.9±13.5

Table 2: Stone characteristics and puncture sites

Variable	Supine (n=68)	Prone (n=92)
Puncture site		
Lower pole	56 (82.35)	60 (65.2)
Upper pole	6 (8.8)	8 (8.69)
Middle pole	5 (7.2)	22 (24)
Diverticular	1 (1.4)	2 (2.17)
Stone location		
Lower pole calculus	54	58
Upper pole calculus	6	8
Renal pelvic calculus	8	12
Multiple calyceal stones	4	8
Partial staghorn	4	2
Complete staghorn	3	5
Diverticular stones	1	2

Table 3: Surgical outcomes

Variable	Prone position	Supine position	P-value
Operation time (min)	121±49.5	91±45.5	<0.001
Length of stay (d)	3.0±2.8	2.0±2.1	0.005
Stone free rates (%)	50	70	0.00

Values are presented as mean±standard deviation unless otherwise indicated

Table 4: Postoperative complications

Complication	Prone position	Supine position
Total complications	9 (19.5)	5 (12.8)
Sepsis	4 (8.6)	2 (5)
Transfusions	1 (2.1)	1 (2.5)
Postoperative anaemia not requiring transfusion	2 (4.3)	1 (2.5)
Urine leak	1 (2.1)	1 (2.5)

complications was relatively low, with 9 total complications (19.5%) for the prone group and 5 total (12.8%) for the supine group. Sepsis occurred in 4 patients (8.6%) in the prone group and 2 patients (5%) in the supine group, and there was a urine leak (urinoma requiring stenting or percutaneous drainage) for one patient in both the groups. Blood transfusions were required for one patient in each group, with post-operative anemia not requiring transfusion occurring in both groups, with 2 patients (4.3%) and 1 patient (2.5%), respectively.

DISCUSSION

This is an observation study conducted in a single institution. We observed a shorter operative time in the supine PCNL patients compared with the prone PCNL patients. This 30-min difference can be explained by not repositioning the patient (and time for repainting and redraping), as well as the modified supine position facilitating dual access to the area, assisting with stone clearance, and saving time.[11] Our observations are consistent with those of a recent meta-analysis of PCNL positioning by Liu et al.,[12] where the supine position was found to have a mean reduction of 25 min when compared with the prone position. However, the evidence for shorter operating time is not entirely in favor of the modified supine position, with a prospective and randomized study by Wang et al.,[13] reporting lower operation times in their prone group, as compared to modified supine.

We observed that the PCNLs performed in the supine position had a significantly higher stone-free rate. our higher stone-free rate in supine position may include the possibility of simultaneous anterograde and retrograde stone removal in the supine position, and the effect of gravity-induced stone clearance.[11] Simultaneous antegrade and retrograde access which is an advantage of the modified supine position also gives dual access to large stag horn calculi as well as ureteric calculi provides better stone clearance in a single procedure

The modified supine PCNL patients stayed on average a day shorter in hospital than the prone patients with most other studies showing no significant differences between the two groups.[2,12] One of the main reasons for shorter hospital stay in supine PCNLs is because a proportion of the supine PCNLs was done with no nephrostomies, while the traditional prone PCNLs all had nephrostomies, which delayed discharge from hospital. Increased BMI is one of the risk factors for renal calculi and associated with reduced stone-free rates.[14] The majority of complications post PCNL are minor.[15] Minor complications include fever and nephrostomy leak.[16]

The prone position is associated with increased risk of post-operative visual loss,[17] direct pressure injuries, and peripheral nerve damage, particularly to obese patients.[10] A study by Mazzucchi et al.,[18] found that the complete supine position offers significantly shorter operative times and post-operative LOS in hospital, when performed in obese patients.

Our observational study found significantly higher overall complication rates in the prone position compared with the modified supine position but transfusion rates were similar between the two groups. The meta-analysis by Liu et al.,[12] which also found no significant difference in complication rates between their modified supine and prone cohorts.

Limitations of the study

One of the main limitations of this study is, it is an observational study. Its results cannot be generalized to the population, we could not suggest a hypothesis or nullify a hypothesis based on this study. A further limitation of this study was the learning curve associated with the supine position, as most surgeons were already familiar with the prone position for PCNL, but may not have had the same practice in the modified supine or supine position and thus the surgeon's experience or skills and inter surgeon variability could exist and could have an effect on the results. In addition, we did not adjust for stone characteristics such as hardness (stone composition), locations (renal pelvis, upper calyx, and lower calyx), and multiplicity (single or multiple stones) may have also had an influence on the operation time. We recommend that this study to be undertaken as a randomized and controlled trial with multi-institutional involvement in future.

CONCLUSION

This is an observation study comparing the various types of PCNL stating PCNL as one of the best modalities for renal stone clearance with supine and modified supine PCNL demonstrating better results in obese patients, and may be considered by all surgeons performing PCNLs.

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Authors' Contributions:
RR, SKP- Concept and design of the study and prepared first draft of manuscript; **RS and GRV-** Interpreted the results; reviewed the literature; and manuscript preparation; S**G and VS-** Concept, coordination, statistical analysis and interpretation, preparation of manuscript, and revision of the manuscript.

Work attributed to:
Government Mohan Kumaramangalam Medical College Hospital, Salem - 636 002, Tamil Nadu, India.

Orcid ID:
Dr. Rajkumar Ramakrishnan - https://orcid.org/0000-0001-7206-487X
Dr. Senthilkumar Poovathai - https://orcid.org/0000-0003-4062-3029
Dr. Rajasekar Sundaram - https://orcid.org/0000-0002-4314-1589
Dr. Gopu Rakesh Vamsi - https://orcid.org/0000-0002-2629-2262
Dr. Sammohit Gulakavarapu - https://orcid.org/0000-0001-5002-0008
Dr. Vinayak Sangreshi - https://orcid.org/0000-0003-2477-7562

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