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SUPINE PERCUTANEOUS NEPHROLITHOTOMY UNDER SPINAL ANAESTHESIA: AN EFFECTIVE APPROACH

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ABSTRACT

Background: *PCNL is considered as minimal invasive procedure for the management of renal stones. Supine PCNL is getting popularity day by day and can be performed under spinal anaesthesia.*

Aim: *To demonstrate the safety and efficacy of supine PCNL performed under spinal anaesthesia.*

Method: *It is a retrospective study. From 1st January 2020 to 31st December 2023, 90 patients were included in the study. Outcome measures were operation duration, stone clearance, hospital stay and postoperative complication.*

Results: *Among these 90 patients, male patients were 55 (61.1%) and female patients were 35 (38.9%). The mean age of these patients was 39.7 ± 12.4 years and size of stone was 2.6 ± 0.8 cm. Single stone was present in 76 (84.44%) while 14 (15.55%) have multiple stones. Majority of stones, 68 (75.55%), were present in renal pelvis and calyces. The mean time for surgery was 65 ± 2.9 minutes and stay in hospital was 2.88 ± 0.44 days. Stone clearance rate was 87.77%. Fever was observed in 8 (8.88), spinal headache in 8 (8.88%), hypotension in 6 (6.66%), nausea and vomiting in 5 (5.55%) patients. Significant haematuria was noted in 5 (5.55%) patients where blood transfusion was required.*

Conclusion: *Supine PCNL under spinal anaesthesia is equally safe and effective approach to manage renal stones which are larger than 2 cm in size and also it is cost effective.*

KEYWORDS: *Spinal Anaesthesia, Staghorn Calculus, Supine Position, Percutaneous Nephrolithotomy, Treatment Outcome*

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INTRODUCTION

Urolithiasis has varying frequency and geographic distribution globally. Central Europe, the Mediterranean, Scandinavian countries, the British Isles, Australia, a tiny segment of China, Malaysia, the West Indies, and Pakistan are areas with a significantly high incidence of calculi. Nephrolithiasis, or urolithiasis, is a significant global health issue due to its increasing incidence and recurrence rates.[1] The prevalence varies from 1% to 5% in Asia, 7% to 13% in North America, and 5% to 9% in Europe. Approximately 12% of the global population, encompassing all ages, genders, and ethnicities, is impacted by urinary stones. While it was previously established that men were more predisposed to nephrolithiasis than women, this disparity is currently diminishing. The prevalence of nephrolithiasis has significantly increased in several Asian countries, including Japan (from 4.3% to 9.0%), South Korea (from 3.5% to 11.5%), China (from 4% to 6.4%), and Thailand (from 1.4% to 16.9%).[2]

The Asian continent is believed to be the area with the highest prevalence of stones in individuals. The incidence of urolithiasis in the global adult population is approximately 10% during a lifetime. Individuals aged 20 to 50 are predominantly impacted, and the patient population has been increasing in recent years.[3] The increasing frequency of stone illness imposes a substantial burden on healthcare systems and associated expenses in resource-rich countries, particularly as obese and diabetic people exhibit a higher propensity for developing urolithiasis.[4] Approximately 25% of people with urolithiasis will require active intervention, while around 50% of individuals with kidney stones may experience symptoms, including renal discomfort. Individuals with kidney stones may potentially encounter more severe complications, including intractable pain, infection, hematuria, diminished renal function, and end-stage renal disease. In patients from whom the initial stone was successfully extracted, 50% of these individuals would thereafter develop another stone within five years.[5]

For the management of kidney stones over 2cm, percutaneous nephrolithotomy (PCNL) is the preferred procedure due to its less invasive nature.[6] PCNL is advised for more resilient stones that are refractory to extracorporeal shock wave lithotripsy (ESWL).[7] Most urologists prefer to conduct PCNL in the prone posture.[8] A significant number of urologists favor the supine position due to its advantages over the prone position, including simultaneous access to the ureter, the ability to reach stones located at the upper pole via puncture in the lower pole, and the reduced challenges posed to anesthetists in obese patients.[9]

Typically, both prone and supine positions are utilized for percutaneous nephrolithotomy (PCNL) under general anaesthesia.[10] General anaesthesia is less cost-effective and has greater hazards than spinal anaesthesia, particularly in patients with comorbidities.[11] The induction of general anaesthesia poses challenges in patients with chronic lung disease, cardiovascular disorders, and morbid obesity.[12] Conversely, spinal anesthesia is both safe and cost-effective. Spinal anesthesia results in reduced postoperative discomfort and is the preferred approach among anaesthetists.[13] In the majority of centers, supine PCNL is conducted under general anesthesia; however, some centers, particularly in countries with adverse socioeconomic situations, favor spinal anesthesia. Our research will augment the existing data to advocate for the application of spinal anesthesia in supine PCNL, particularly in patients for whom general anaesthesia is impractical.

MATERIAL AND METHOD

It is a retrospective study in which record data of all patients operated during 1st January 2020 to 31st December 2023 who fulfil the inclusion criteria were included in the study and their data was analysed retrospectively. This study was conducted at Social Security Teaching Hospital, Lahore. Approval was taken from hospital ethical committee to access the data and conduct the research. The reference number of ethical committee approval letter was 17/24 dated 01-07-2024. Data of all adult patients above 18 years of age with renal stone larger than 2cm, whose stones are resistant to ESWL, or those patients who don't want ESWL were included in the study. The pregnant female patients, patients suffering from active UTI or infection in any part of body, allergic to contrast and with coagulopathies were excluded from the study. Moreover, the patients who could not understand the procedure or refused for spinal anaesthesia were also excluded from the study. Patients with kyphoscoliosis and spine deformities were also excluded from study. The location, size and density of stone was assessed on CT-IVU or CT scan without contrast. Injection Bupivacain was injected between L3 and L4 lumber vertebra by using 25 G spinal needle. Needle prick test was done to confirm the effect of anaesthesia after waiting five to ten minutes of induction of spinal anaesthesia. After confirming the effect of anaesthesia, the patient was put in Trendelenburg position.

A 6 Fr ureteric catheter was inserted through cystoscope and anchored with Foleys catheter. Contrast was used to outline the collecting system of effected kidney and select the puncture site. Chiba needle was used to puncture the desired calyx. A guide wire was inserted and tract dilated by Alkin dilators. Amplatz sheath was placed to perform the procedure. Stone was identified and fragmented by pneumatic lithoclast. Stones were washed or pulled out by grasper or forceps. After satisfactory clearance of stone, a Double J (DJ) stent was placed in all patients. On first post operative day, the Foleys catheter was removed while DJ catheter was removed after 2 to 4 weeks depending upon residual stones. The outcome measures were complications of procedure such as operative time, post operative complications such as haematuria, fever, spinal headache, hypotension, nausea and vomiting were recorded and presented for analysis. Frequencies of these outcome measures were (Quantitative data) calculated by using SPSS version 22.0

RESULTS

Total 90 patients were included in the study. The mean age was 39.7 $\pm$ 12.4 years. Among these 55 (61.1%) patients were male and 35 (38.9%) were female. Single stone was present in 76 (84.44%) while multiple stones were present in 14 (15.55%) patients. The mean stone size was 2.6 + 0.8 cm. Regarding site of the stones, 68 (75.55%) had stone in pelvis and calyces, 16 (17.77%) had renal pelvic stones and in 6 (6.66%) in calyces only. As mentioned in table 1. The mean operative time was 75 $\pm$ 2.9 minutes and total hospital stay was 2.88 $\pm$ 0.45 days. In 79 (87.77%) patients the stones were completely removed. Regarding the post operative complications, 23 (25.55%) patients developed fever and 13 (14.44%) patients required blood transfusion. Among complications due to spinal anaesthesia, 8 (8.88%) developed spinal headache, 6 (6.66%) developed hypotension and 5 (5.55%) patients complained of nausea and vomiting. As mentioned in table 2.

Table 1: General characteristics

Total Number of Patients	90	
Gender	M: 55 (61.1%)	F: 35 (38.9%)
Age	39.7 $\pm$ 12.4 years	
Site of Stone	Pelvis and calyces: 68 (75.55%).	Renal Pelvic: 16 (17.77%). Calyces: 6 (6.66%)
Size of Stone	2.6 $\pm$ 0.8 cm	
Number of Stones	Single: 76 (84.44%).	Multiple: 14 (15.55%)

Table 2: Data of Surgical Procedure and Complications

First attempt to access stone	79 (87.77%)	Multiple attempts: 11 (12.22%)
Inferior calyceal puncture	63 (70 %)	
Residual stone	Less than 5mm: 5 (5.55%). More than 5mm: 6 (6.66)	
Operation Time	65 ± 2.9 minutes	
Hospital stay	2.88 ± 0.45 days	
Complications: • **Haematuria:** • **Fever:** • **Spinal Headache:** • **Hypotension:** • **Nausea, Vomiting:**	 5 (5.55%) 8 (8.88%) 8 (8.88%) 6 (6.66%) 5 (5.55%)	

DISCUSSION

PCNL is the preferred and most prevalent method for the management of renal calculi above 2 cm in size.[14] In PCNL, numerous urologists regard the supine position as a safer and more effective alternative to the prone position.[15] The benefits of supine PCNL include reduced surgical duration, diminished risk of neuromuscular injuries, fewer necessary operating personnel, and, most importantly, fewer anesthesia-related complications.[16] General anaesthesia can be hard for anaesthetists due to patient comorbidities, which may result in clinically significant fluid absorption and electrolyte imbalance.[17] Consequently, spinal anesthesia is regarded as a secure form of anaesthesia in these instances. The choice of anesthesia is crucial, as surgeons prioritize the prompt and seamless recovery of their patients.

In our study, supine percutaneous nephrolithotomy was performed on 90 patients under spinal anesthesia. In 79 patients (87.77%), the calyces were pierced on the first attempt, however in 11 patients (12.22%), many tries were required. Of the 90 patients, 63 (70%) underwent lower calyceal puncture, which is consistent with earlier investigations. In our study, the stone clearance rate following the initial procedure was 87.77% (79 patients), which is comparable to another similar study reporting a clearance rate of 87%. This rate is within the range identified by systematic reviews and meta-analyses, which is between 69.6% and 95%.In the remaining 11 patients (12.22%), 5 patients (5.55%) had residual stone sizes less than 4mm, which is clinically inconsequential, whereas 6 patients (6.66%) had pieces larger than 5mm and were recommended for ESWL. These residual rates are comparable to those in similar research. [18]

In percutaneous nephrolithotomy (PCNL), the predominant complication is hemorrhage.[19] The mean preoperative hemoglobin level was 12.6 ± 1.45 mg/dl, while the postoperative level was 11.4 ± 1.53 mg/dl. Five individuals (5.55%) necessitated blood transfusions, comparable to other studies reporting rates of 4% and 2.5%. Another postoperative consequence was fever. In our study, 8 patients (8.88%) experienced mild to high-grade fever, which was treated with antipyretics and antibiotics. This value aligns with findings from other investigations.[20] In accordance with the Clavien categorization of postoperative complications, the problems seen in our research ranged from grade I to grade II

Our study aimed to determine the role of spinal anesthesia in supine percutaneous nephrolithotomy (PCNL). All patients underwent surgery under spinal anesthesia, which demonstrated a comparable stone clearance rate, fewer postoperative problems, and reduced operative time.

CONCLUSION

Spinal anaesthesia an effective, safe and cost-effective technique for supine PCNL. It has high stone clearance rate, less operative time, less analgesia required and few minor complications. Above all, can be given in patients who are unfit for general anaesthesia.

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