

Safety and Efficacy of Spinal Anaesthesia in Percutaneous Nephrolithotomy: Our Experience

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Abstract

Background: Percutaneous nephrolithotomy (PCNL) is the preferred treatment for large or complex renal calculi. Although general anaesthesia (GA) has traditionally been used, spinal anaesthesia (SA) is increasingly recognized as a safe and effective alternative, offering hemodynamic stability, reduced analgesic requirements, and shorter recovery time.

Objective: To assess the safety, efficacy, and perioperative outcomes of spinal anaesthesia in patients undergoing PCNL in a tertiary care centre.

Methods: This retrospective observational study included 250 adult patients who underwent PCNL under SA between January and October 2023. Data regarding demographic profile, intraoperative hemodynamic variations, postoperative pain (VAS scores), complications, and satisfaction levels were collected and analyzed using descriptive and inferential statistics.

Results: The mean age was 35 ± 18 years; average calculus size 32.2 ± 9.8 mm. Mean operative duration was 90 ± 37.8 min. Sensory and motor recovery occurred at 145 ± 18.6 min and 116.8 ± 18.6 min, respectively. Hypotension occurred in 14%, headache in 2%, and no pleural punctures were observed. Mean patient and surgeon satisfaction scores were 4/5 and 3/5, respectively. Stone clearance was achieved in 92% of cases.

Conclusion: Spinal anaesthesia for PCNL provides excellent surgical conditions with fewer complications, high satisfaction, and comparable efficacy to GA [4-6]. It represents a cost-effective and safe alternative, particularly suitable for resource-limited settings.

Keywords: Percutaneous Nephrolithotomy, PCNL, Spinal Anaesthesia, Regional Anaesthesia, Renal Calculi, Postoperative Analgesia, Haemodynamic Stability, Urological Surgery.

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Introduction

Percutaneous nephrolithotomy (PCNL) remains the gold standard for managing large renal calculi (>20 mm) and stones resistant to shock wave lithotripsy (SWL) [1]. While GA has been conventionally employed due to airway control and patient positioning requirements, spinal anaesthesia (SA) has emerged as a viable option, particularly in high-risk or resource-limited settings [2-4].

SA offers several advantages including reduced intraoperative blood loss, lower incidence of postoperative nausea and vomiting, shorter recovery time, and improved postoperative analgesia [2,3]. Recent studies have confirmed its safety and feasibility in prone-position PCNL [1,2]. Nevertheless, concerns regarding hypotension and limited control over patient movement still prevent

universal acceptance. Recent systematic reviews confirm similar stone-free rates and safety profiles between SA and GA, though SA is associated with less pain and shorter hospital stay [3,4,6].

Materials and Methods

This retrospective observational study was conducted in the Department of Anaesthesiology, Parul Institute of Medical Sciences & Research (PIMSR), Vadodara, between January and October 2023, after ethics approval (PUIECHR/2023/Anes/PCNL-SA/07).

A total of 250 adult patients (ASA physical status I–III) undergoing PCNL under SA were included.

Inclusion Criteria: Patients aged 18–65 years, renal calculi >20 mm, fit for SA.

Exclusion Criteria: Coagulopathy, spinal deformities, severe cardiopulmonary disease, pregnancy. Anaesthetic technique: Under aseptic precautions, spinal anaesthesia was administered at the L3–L4 interspace using 3 mL of 0.5% hyperbaric bupivacaine and 25 µg fentanyl. Adequate sensory blockade (T6–T8) was ensured before prone positioning [1,2,5,6].

Monitoring included ECG, pulse oximetry, and non-invasive BP. Hypotension (SBP <90 mmHg) was treated with IV fluids and ephedrine 6 mg boluses; bradycardia (HR <60 bpm) with atropine 0.6 mg IV.

Pain was assessed via Visual Analog Scale (VAS) at 1, 2, 4, 6, 12, and 24 hours postoperatively. Rescue analgesia: Tramadol 50 mg IV for VAS ≥4. Satisfaction was rated 0–5 for both surgeon and patient. Data were analyzed with SPSS v28; $p < 0.05$ considered significant.

Results

Mean age: 35 ± 18 years; male:female ratio 156:94; average stone size 32.2 ± 9.8 mm. ASA status I/II/III = 96/124/30. Mean operative duration: 90 ± 37.8 min. Recovery sensory 145 ± 18.6 min; motor 116.8 ± 18.6 min. Stone clearance: 92%; hospital stay: 2.6 ± 0.9 days.

Hemodynamics: MAP remained within $\pm 15\%$ of baseline; hypotension 14%, bradycardia 4%—all corrected. No pleural puncture or major anaesthetic complications occurred [2,3,6].

Pain and satisfaction: Mean VAS 1h=2.8, 6h=3.6, 24h=1.9. Analgesic requirement 80 ± 25 mg tramadol. Patient satisfaction 4/5; surgeon satisfaction 3/5.

Discussion

Our study reaffirms that spinal anaesthesia is a safe and effective alternative for PCNL. Hemodynamic stability was well maintained, with hypotension

(14%) and bradycardia (4%) comparable to global reports [1,3,4]. Stone-clearance rate (92%) and short hospitalization parallel findings by Borzouei et al. [4] and Ghodsi et al. [6]. Postoperative analgesic needs were minimal, supporting prior RCTs [1,3].

Comparative studies such as Singh et al. (2013) [1], Kuzgunbay et al. (2014) [2], and Rachman et al. (2023) [3] report similar hemodynamic safety and recovery outcomes. Ghodsi et al. (2018) [6] demonstrated economic benefits of SA. Recent studies (2023–2025) show expanded use of SA for supine and mini-PCNL, with low complication rates [7,8].

Thus, SA provides optimal surgical conditions and patient comfort, while minimizing postoperative morbidity and cost.

Conclusion

Spinal anaesthesia is a reliable, efficient, and patient-friendly anaesthetic option for PCNL. It ensures stable hemodynamics, excellent pain control, and rapid recovery, making it a superior choice in suitable patients, especially in resource-limited settings [3,6,7].

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