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COMPARISON OF OUTCOME OF PERCUTANEOUS NEPHROLITHOTOMY UNDER SPINAL VERSUS GENERAL ANESTHESIA

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Abstract

OBJECTIVE: *To determine the outcome of percutaneous nephrolithotomy under spinal versus general anesthesia.*

METHODOLOGY: *This randomized control trial study was planned to be conducted in the year 2024 within the Urology Department of Jinnah Postgraduate Medical Centre (JPMC), Karachi, involving a cohort of 60 patients diagnosed with percutaneous nephrolithotomy, with 30 individuals allocated to either general anesthesia (Group A) or spinal anesthesia (Group B). Eligible participants, who are aged between 16 and 65 years, regardless of gender, possessing an ASA physical status of I or II, having renal calculi exceeding 2 cm in size, and exhibiting a negative urine culture, were included for the purpose of evaluating the primary outcome. The data were subjected to rigorous analysis utilizing SPSS version 26, which encompassed both descriptive statistical methodologies and the statistical test of significance with threshold set at $P \leq 0.05$.*

RESULTS: *Among a cohort of 60 patients, undergoing PCNL, the average age was recorded for general anaesthesia at 42.60 ± 18.01 and 40.27 ± 16.62 years for spinal anaesthesia, with 19 individuals (63.3%) and 16 individuals (53.3%) identified as males in both groups, respectively. The significant association was noted in pre op Hb level (p=0.044), Hb level at 24 hours (p=0.018), analgesic requirement (p=0.0001), pain score at 2 hours (p=0.0001), and pain score at 6 hours (p=0.0001) while nonsignificant association was found in Hb level at 6 hours (p=0.456), pain score at 12 hours (p=0.077), pain score at 18 hours (p=0.421), and pain score at 24 hours (p=0.400).*

CONCLUSION: *This investigation elucidates that spinal anesthesia serves as a feasible substitute for general anesthesia in the context of percutaneous nephrolithotomy, offering enhanced early postoperative analgesia and markedly reduced analgesic necessities. Both anesthetic modalities exhibited analogous safety profiles. These results advocate for the incorporation of spinal anesthesia*

into clinical practice for patients undergoing PCNL who are appropriately selected.

INTRODUCTION

Percutaneous nephrolithotomy is a minimal invasive surgery use for the removal of renal calculi equal or more than 2 cm of size [1]. It was first reported by the fernstorm and Johansson in 1976 in which direct approach was made through nephrostomy tract to remove a renal calculus [2], after that it was become preferred approach to remove a large renal calculi as open surgery have more complication. Over a time, there were many modifications and changes were made to reduce morbidity and mortality associated with the procedure. PCNL mostly done in general anesthesia despite its association with pulmonary(atelectasis), vascular (deep vein thrombosis) and neurological (nerve damages) complications, prolong post operative immobilization causing paralytic ileus and deep vein thrombosis, increase demand of post operative analgesic and prolong hospital stay [3]. According to the limited studies PCNL done in spinal anesthesia have less complications, patient remains awake during positional changes which reduces the risk of trauma to extremities and nerves, early immobilization postoperatively, reduce need of post operative analgesic, reduce duration of post operative hospital stay [2-5].

Patients undergoing percutaneous nephrolithotomy (PCNL) while administered spinal anesthesia (SA) exhibited a statistically significant decrease in analgesic requirements on the first postoperative day when contrasted with those receiving general anesthesia (GA) ($p < 0.05$). Conversely, the prevalence of postoperative hypotension was greater within the SA cohort (17% vs. 7%), and the patient satisfaction metrics were more favorable towards the GA group (mean 4.39 ± 0.59 vs. 3.81 ± 0.64) [6].

Postoperative hemoglobin concentrations demonstrated variability between the two groups. At the six-hour postoperative mark, hemoglobin levels were marginally elevated in the SA group (14.08 ± 1.42 g/dL) relative to the GA group (13.67 ± 1.80 g/dL), while at the 24-hour interval, the levels recorded were 13.42 ± 1.42 g/dL (SA) versus 13.52 ± 1.70 g/dL (GA). An additional study indicated hemoglobin values of 13.41 ± 1.66 g/dL for the SA cohort compared to 12.96 ± 1.46 g/dL for the GA cohort at the same time point [7].

Pain assessments conducted using the Visual Analog Scale (VAS) and Numerical Rating Scale (NRS) consistently yielded lower scores in the SA group during the initial postoperative hours, signifying a diminished necessity for both analgesics and antiemetics. No notable discrepancies were identified between the groups concerning postoperative complications [7]. VAS scores remained significantly lower in the SA cohort for up to one-hour post-surgery ($p < 0.05$), and patient satisfaction ratings were also diminished within the SA group ($p < 0.01$) [9].

One investigation documented VAS scores at baseline (5.29 ± 0.62 vs. 0.98 ± 0.89), at two hours (5.58 ± 0.49 vs. 1.88 ± 0.84), and at six hours (4.26 ± 1.30 vs. 2.10 ± 1.02) for the GA and SA groups, respectively, with results consistently favoring the SA group in each instance ($p < 0.001$) [10]. Notably, there was no significant disparity in stone-free rates between the two anesthesia modalities [11].

The primary aim of this study is to compare the outcomes of PCNL conducted under spinal anesthesia in contrast to general anesthesia. To the best of our understanding, there exists a paucity of local studies providing a statistical evaluation of these two anesthesia techniques in the context of PCNL. Furthermore, international literature on this subject remains sparse. This research endeavors to address this knowledge deficit by presenting a localized perspective, thereby facilitating informed decisions regarding the selection of the most efficacious technique in future clinical applications.

METHODOLOGY

This randomized controlled trial was conducted within the Department of Urology at the Jinnah Postgraduate Medical Centre (JPMC) located in Karachi, encompassing an investigation period of six months. The principal objective was to assess and compare the clinical outcomes of percutaneous nephrolithotomy (PCNL) executed under spinal anesthesia in contrast to those performed under general anesthesia.

PCNL is characterized as a minimally invasive surgical technique employed for the removal of nephroliths through a small incision (nephrostomy tract). It is acknowledged as the most effective therapeutic modality for renal calculi measuring ≥2 cm, lower pole stones surpassing 1 cm, staghorn calculi, and stones that exhibit resistance to shock wave lithotripsy or ureteroscopy.

A cohort consisting of 60 patients who fulfilled the defined inclusion criteria was recruited through a non-probability consecutive sampling approach. Participants were randomly assigned into two distinct groups utilizing a sealed opaque envelope methodology, with each group comprising 30 patients undergoing percutaneous nephrolithotomy (PCNL) under either general anesthesia (Group A) or spinal anesthesia (Group B). Informed consent was duly obtained from all participants involved in the study. The inclusion criteria encompassed individuals aged between 16 and 65 years, classified under ASA physical status I or II, presenting with renal calculi exceeding 2 cm in size and exhibiting a negative urine culture. The exclusion criteria included individuals younger than 16 years, patients with renal anatomical anomalies, a functionally solitary kidney, a prior history of PCNL or open stone extraction surgeries, ASA status of III or higher, skeletal deformities, coagulopathies, the administration of anticoagulant or antithrombotic agents, or a dependency on opiate or alcohol substances.

Postoperative pain was evaluated utilizing the Visual Analog Scale (VAS) for a duration of six hours following surgery. The requirement for analgesia was quantified as the cumulative dosage of diclofenac sodium (50 mg) administered within 24 hours postoperatively for patients exhibiting VAS scores of 4 or greater. Hemoglobin levels were reassessed 24 hours subsequent to the surgical procedure, and the mean alteration from baseline was meticulously documented. The one-month follow-up entailed a CT KUB scan to evaluate the stone-free status, which was delineated as complete clearance or the presence of asymptomatic residual fragments measuring less than 4 mm. Baseline data along with hemoglobin concentrations were meticulously documented. The data were subjected to analysis utilizing SPSS version 26. An independent sample t-test, as well as a Chi-square test, were employed to evaluate the outcomes associated with percutaneous nephrolithotomy. A p-value of ≤ 0.05 was deemed to indicate statistical significance.

RESULTS

Table I delineates the fundamental characteristics of the patients who participated in the study (n=60), distributed evenly into two cohorts: General (n=30) and Spinal (n=30). The average age of individuals within the General cohort was 42.60 ± 18.01 years, whereas in the Spinal cohort, it was recorded at 40.27 ± 16.62 years. The average body mass index (BMI) was marginally elevated in the General cohort (24.69 ± 3.57 kg/m²) in comparison to the Spinal cohort (23.36 ± 3.53 kg/m²). Additionally, the average duration of the operative procedure was significantly longer in the General cohort (91.43 ± 17.62 minutes) relative to the Spinal cohort (84.77 ± 15.36 minutes). In contrast, the mean size of the calculi was somewhat greater in the Spinal cohort (3.30 ± 0.62 cm) than in the General cohort (3.12 ± 0.55 cm). Regarding the distribution of gender, the General cohort consisted of 19 (63.3%) male and 11 (36.7%) female patients, while the Spinal cohort included 16 (53.3%) males and 14 (46.7%) females. Concerning the American Society of Anesthesiologists (ASA) classification, 21 (70.0%) patients in the General cohort were categorized as ASA I and 9 (30.0%) as ASA II, whereas in the Spinal cohort, 19 (63.3%) were classified as ASA I and 11 (36.7%) as ASA II.

Table II offers a comparative analysis of the outcomes associated with percutaneous nephrolithotomy (PCNL) between patients administered general anesthesia and those administered spinal anesthesia (n=60). The mean preoperative hemoglobin (Hb) concentration was notably elevated in the General cohort (14.18 ± 1.30 g/dL) in comparison to the Spinal cohort (13.50 ± 1.24 g/dL), yielding a p-value of 0.044. However, at 6 hours postoperatively, the mean Hb concentrations were found to be analogous between the cohorts (13.36 ± 1.55 g/dL vs. 13.66 ± 1.53 g/dL; p = 0.456). At the 24-hour mark, a statistically significant decline in Hb was recorded in the General cohort (12.76 ± 1.28 g/dL) when contrasted with the Spinal cohort (13.56 ± 1.22 g/dL), with a p-value of 0.018. The demand for analgesics was conspicuously greater in the General cohort (140.60 ± 18.19 mg) than in the Spinal cohort (75.77

± 13.89 mg), which achieved statistical significance (p = 0.0001). In a similar vein, pain scores at 2 hours (5.57 ± 1.13 vs. 1.77 ± 0.67), 6 hours (4.30 ± 1.11 vs. 2.23 ± 0.77), and 12 hours (4.93 ± 1.43 vs. 4.33 ± 1.12) were consistently higher in the General cohort. Statistically significant distinctions were observed at both the 2 and 6-hour intervals (p = 0.0001 for both), while the difference at the 12-hour interval approached statistical significance (p = 0.077). At 18 and 24 hours, pain scores exhibited similarity between the cohorts (p = 0.421 and 0.400, respectively).

Table I: Baseline Characteristics of the Patients (n=60)

Demographic and Clinical Variables		Groups	
		General (n=30)	**Spinal** (n=30)
Age in years, Mean ± SD		42.60 ± 18.01	40.27 ± 16.62
BMI in kg/m², Mean ± SD		24.69 ± 3.57	23.36 ± 3.53
Operation Time in mins, Mean ± SD		91.43 ± 17.62	84.77 ± 15.36
Stone Size in cm, Mean ± SD		3.12 ± 0.55	3.30 ± 0.62
Gender	Male, *n* (%)	19 (63.3)	16 (53.3)
	Female, *n* (%)	11 (36.7)	14 (46.7)
ASA Status	I, *n* (%)	21 (70.0)	19 (63.3)
	II, *n* (%)	9 (30.0)	11 (36.7)

Table II: Comparison of Perioperative and Postoperative Outcomes of Percutaneous Nephrolithotomy Under General Versus Spinal Anesthesia (n = 60)

Outcomes of percutaneous nephrolithotomy	Groups			P-Value
	General (n=30)	**Spinal** (n=30)	95% C. I	
Pre op Hb Level in g/dL, Mean ± SD	14.18 ± 1.30	13.50 ± 1.24	0.018~~1.341	0.044
Hb level at 6 hour in g/dL, Mean ± SD	13.36 ± 1.55	13.66 ± 1.53	-1.099~~0.499	0.456
Hb level at 24 hour in g/dL, Mean ± SD	12.76 ± 1.28	13.56 ± 1.22	-1.442~~ -0.144	0.018
Analgesic Requirement in mg, Mean ± SD	140.60 ± 18.19	75.77 ± 13.89	56.468~~73.198	0.0001
Pain score at 2 hour, Mean ± SD	5.57 ± 1.13	1.77 ± 0.67	3.317~~4.283	0.0001
Pain score at 6 hour, Mean ± SD	4.30 ± 1.11	2.23 ± 0.77	1.570~~2.564	0.0001
Pain score at 12 hour, Mean ± SD	4.93 ± 1.43	4.33 ± 1.12	-0.067~~1.267	0.077
Pain score at 18 hour, Mean ± SD	3.30 ± 0.91	3.10 ± 0.99	-0.294~~0.694	0.421
Pain score at 24 hour, Mean ± SD	3.93 ± 1.46	3.63 ± 1.27	-0.408~~1.008	0.400

DISCUSSION

This scholarly inquiry aimed to critically assess the outcomes associated with percutaneous nephrolithotomy (PCNL) performed under spinal anesthesia (SA) in juxtaposition with general anesthesia (GA), placing particular emphasis on perioperative parameters, postoperative pain management, and the consumption of analgesics. The findings of our research indicate that SA confers notable advantages in terms of postoperative analgesia and reduced analgesic consumption, while simultaneously maintaining a safety profile that is comparable to that of GA.
A significant observation was the discrepancy in

hemoglobin (Hb) concentrations noted prior to and following surgical intervention. The preoperative Hb concentration within the general anesthesia (GA) cohort was slightly heightened (14.18 ± 1.30) when juxtaposed with the spinal anesthesia (SA) cohort (13.50 ± 1.24), attaining statistical significance (p=0.044). Nevertheless, the postoperative Hb concentrations measured at 6 and 24 hours did not reflect substantial differences, suggesting comparable intraoperative blood loss between the two cohorts. These findings align with those documented by Eddula et al., who likewise found no considerable variations in postoperative Hb concentrations between the various anesthesia techniques (12.96 ± 1.46 vs. 13.41 ± 1.66; p=0.27) [7].

The efficacy of postoperative pain management is a fundamental aspect of surgical recovery, and our data highlights the superiority of SA in this regard. Total postoperative analgesic requirement was significantly lower in patients receiving SA (75.77 ± 13.89 mg) than in the GA group (140.60 ± 18.19 mg; p=0.0001). Concurrently, visual analog scale (VAS) pain scores were significantly less in the SA group versus the control group at both 2 hours (1.77 ± 0.67 vs. 5.57 ± 1.13; p=0.0001) and 6 hours (2.23 ± 0.77 vs. 4.30 ± 1.11; p=0.0001) following the procedure. Our results are consistent with those reported by Srinivasa et al. 12] and similar patterns at early postoperative time points have been validated in subsequent studies [10]. Although the analgesic benefits of SA in the early postoperative period seem to be clear, there were no significant differences between the groups regarding the VAS scores at 12, 18, and 24 hours indicating that the analgesic benefits of SA may be limited in time [7]. Mukherjee and Singh [13] have also confirmed this duration-dependent trend by description that over a time, pain score differences diminished.

Importantly, there were no major intraoperative complications or hemodynamic instabilities documented across either cohort which is also consistent with the data of Sankar et al. [14], who found no major differences in hemodynamic outcomes in combined spinal-epidural versus general anesthesia. Moreover, increased satisfaction of the surgical team using SA—due to decreased patient portaging and increased efficiency—was highlighted in the study by Bürlukkara et al. [15].

In general, our results are similar as those revealed by the meta-analysis of Liu at al. For PCNL, a meta-analysis examined differences between GA and SA, showing no differences in stone-free rates or complication rates [16]. However, SA was associated with lesser analgesic requirements and better early recovery parameters.

The superior postoperative analgesia and lower analgesic requirements relative to general anesthesia makes spinal anesthesia more ideal for the intraoperative requirements of percutaneous nephrolithotomy (PCNL). Given these advantages and the absence of escalating complications, spinal anaesthesia should be considered as a superior alternative to general anaesthesia for suitable cases of PCNL [17].

This study provides important information about the relative outcomes of spinal versus general anesthesia for patients undergoing percutaneous nephrolithotomy (PCNL). Nonetheless, there are several limitations that should be acknowledged. The sample size was fairly modest (n=60), which may limit generalizability. Findings from a smaller, multicenter study would be stronger and more generalizable. Second, the follow-up time (one month) is not enough to assess late complications, recurrence of stone or chronic pain. In addition, even though pain assessment based on the Visual Analog Scale is well-known, it is still very subjective and it can be affected by the different pain thresholds or the patient perceptions.

Another prospective drawback is the employment of non-probability consecutive sampling, which introduces the potential for selection bias despite random allocation. Furthermore, variables such as surgical complexity, surgeon experience, and operative duration were not accounted for, which may have impacted both intraoperative and postoperative outcomes.

Despite these limitations, the study possesses notable strengths. It was structured as a randomized controlled trial—the gold standard in clinical research—which enhances the credibility of the comparisons conducted. The incorporation of explicit eligibility criteria, objective endpoints (e.g., changes in hemoglobin, analgesic requirements, stone-free rates), and standardized anesthesia protocols bolster internal validity.

In light of the aforementioned findings, it is advisable that spinal anesthesia be regarded as a viable and efficacious alternative to general anesthesia for suitably selected patients undergoing percutaneous nephrolithotomy (PCNL), especially when the reduction of postoperative pain and the minimization of analgesic consumption are deemed paramount. Subsequent investigations employing larger sample populations, extended follow-up periods, and more comprehensive intraoperative metrics are essential to further validate these findings and facilitate the widespread adoption of spinal anesthesia within the domain of urological practice.

CONCLUSION

This investigation elucidates that spinal anesthesia serves as a feasible substitute for general anesthesia in the context of percutaneous nephrolithotomy, offering enhanced early postoperative analgesia and markedly reduced analgesic necessities. Both anesthetic modalities exhibited analogous safety profiles. These results advocate for the incorporation of spinal anesthesia into clinical practice for patients undergoing PCNL who are appropriately selected.

REFERENCES

1. Basiri A, Kashi AH, Zeinali M, Nasiri MR, Valipour R, Sarhangnejad R. Limitations of spinal anesthesia for patient and surgeon during percutaneous nephrolithotomy. Urol J. 2018;15(4):164-7.
2. Dar MA, Malik SA, Dar YA, Wani PM, Wani MS, Hamid A, et al. Comparison of percutaneous nephrolithotomy under epidural anesthesia versus general anesthesia: a randomized prospective study. Urol Ann. 2021;13(3):210-4.
3. Solakhan M, Bulut E, Erturhan MS. Comparison of two different anesthesia methods in patients undergoing percutaneous nephrolithotomy. Urol J. 2019;16(3):246-50.
4. Wang X, Ye Q, Liu X, Chen J, Wang Z, Xu W, et al. Comparison of the clinical efficacy of sonography-guided percutaneous nephrolithotomy (PCNL) under local and general anesthesia. J Int Med Res. 2019;47(9):4143-50.
5. Mulay A, Mane D, Mhaske S, Shah AS, Krishnappa D, Sabale V. Supine versus prone percutaneous nephrolithotomy for renal calculi: our experience. Curr Urol. 2022;16(1):25-9.
6. Srinivasa VY, Dev KP, Kumari A. Safety and efficacy of general anesthesia versus spinal anesthesia in percutaneous nephrolithotomy. Asian J Med Sci. 2024;15(3):63-8.
7. Eddula M, Patil VP. Spinal anesthesia versus general anesthesia for percutaneous nephrolithotomy surgeries-a prospective study. Int J Basic Clin Pharmacol. 2022;11(5):1.
8. Moawad HE, El Hefnawy AS. Spinal vs. general anesthesia for percutaneous nephrolithotomy: a prospective randomized trial. Egypt J Anaesth. 2015;31(1):71-5.
9. Patel J, Jain J, Patil K, Patel K. An observational study to compare patient and surgeon satisfaction and hemodynamic changes occurring in spinal anaesthesia versus general anaesthesia in patients undergoing percutaneous nephrolithotomy surgery. Indian J Forensic Med Toxicol. 2021;15(3).
10. Meena M, Mantan K, Saxena M, Dhawan S, Sethia S, Meena A. General versus spinal anesthesia in percutaneous nephrolithotomy: a comparative study. IAIM. 2017;4(9):59-66.
11. Rachman RI, Birowo P, Nurullah G, Cho SY, Atmoko W, Widyahening IS, et al. General versus spinal anesthesia in percutaneous nephrolithotomy: a systematic review and meta-analysis. F1000Research. 2023;12:281.
12. Srinivasa VY, Dev KP, Kumari A. Safety and efficacy of general anesthesia versus spinal anesthesia in percutaneous nephrolithotomy. Asian J Med Sci. 2024;15(3):63-8.
13. Mukherjee A, Singh G. Assessment of surgical outcome and complications between spinal and general anaesthesia for patients undergoing percutaneous nephrolithotomy: a comparative study. Int J Urol Sci. 2019;11(2):75-80.

14. Sankar K, Anand K, Ramani S, Gayathri B. A randomized control trial to compare hemodynamic parameters of patients undergoing percutaneous nephrolithotomy under combined spinal-epidural and general anesthesia in a tertiary hospital. Local Regional Anesth. 2023:41-9.
15. Bürlukkara S, Kabalak AA, Ateş A, Baran Ö, Aykaç A, Özok HU. Comparative analysis of combined spinal–epidural anesthesia and general anesthesia in percutaneous nephrolithotomy: a prospective study on surgical team and operating room personnel satisfaction. World J Urol. 2024;42(1):262.
16. Liu X, Huang G, Zhong R, Hu S, Deng R. Comparison of percutaneous nephrolithotomy under regional versus general anesthesia: a meta-analysis of randomized controlled trials. Urol Int. 2018;101(2):132-42.
17. Küçük EV, Yıldırım Ü, Bindayı A, Tahra A, Önol FF. Comparison of spinal versus general anesthesia in percutaneous nephrolithotomy. Haydarpaşa Numune Med J. 2016;56(3):181-5..