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Efficacy of Spinal Anesthesia Versus General Anesthesia for Single-Level Microdiscectomy at POF Hospital, Wah Cantt

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ABSTRACT

Existing studies show varying results regarding the outcomes of single-level lumbar microdiscectomy under spinal anesthesia and general anesthesia, leaving uncertainty about their relative benefits. **Objective:** To compare the outcomes of spinal anesthesia versus general anesthesia in single-level microdiscectomy. **Methods:** This quasi-experimental study was conducted at the Department of Neurosurgery, POF Hospital, Wah Cantt. A total of 60 male and female patients with lumbar disc herniation with single-level microdiscectomy under spinal and general anesthesia were compared for outcomes in terms of surgery time, post-anesthesia care unit time, intraoperative blood loss, dural tear, post-operative pain, and hospital stay. **Results:** The mean age of the participants was 49.65 ± 7.43 years, and participants aged more than 45 years were 37 (61.7%), while the majority of the patients were female, n=32 (53.3%). The mean operative time with spinal anesthesia was 71.0 ± 4.30 minutes versus 88.00 ± 4.21 minutes with GA ($p<0.001$). Mean PACU time spent by patients with spinal and general anesthesia was 1.50±0.63 days and 2.03 ± 0.85 days, respectively ($p=0.008$). Mean hospital stay of patients with spinal was 2.57 ± 0.63 days versus 3.67 ± 0.80 days with general anesthesia ($p<0.001$). Dural tears were observed in patients (3.3%) with spinal versus 02 patients (6.6%) with general anesthesia ($p=0.643$). **Conclusions:** Spinal anesthesia was associated with better perioperative outcomes than general anesthesia in patients who underwent lumbar microdiscectomy when assessed in terms of operative time, PACU time, and hospital stay.

INTRODUCTION

Lumbar spine surgery is one of the most common procedures performed nowadays. Microdiscectomy is done for symptomatic lumbar disc herniation, and there is also a growing trend toward the microendoscopic technique to decrease blood loss, ligamentous structural integrity, decrease operative time, and shorten hospital length of stay [1]. Lumber spine surgery, such as microdiscectomy, can be performed using various anesthetic techniques. It can be performed under spinal (SA) as well as general anesthesia (GA) [2]. Surgical outcome after lumbar surgery also depends on anesthesia type; therefore, several studies have compared general versus spinal anesthesia in terms of perioperative complications, hemodynamic parameters, operative time, anesthesia, and recovery time [3]. Anesthesia selection involves a shared decision among the surgeon, the anesthetist, and the patient. General anesthesia is preferred more often due to provider familiarity, patient acceptance for prolonged surgery, and airway security in the prone position [4]. Spinal anesthesia offers benefits over general anesthesia, including rapid onset, reduced intraoperative blood loss, decreased surgical and post-anesthesia care time, fewer thrombotic events, lower pulmonary complications, and diminished post-operative

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cognitive decline [3]. Understanding the benefits, drawbacks, level of patient satisfaction, and affordability of SA vs. GA in microdiscectomies is necessary for the best possible surgical use [5]. Numerous studies indicate that spinal anesthesia could be better than general anesthesia, with fewer perioperative problems, improved cardiovascular metrics, economic viability, and shorter operating, anesthesia, and recovery durations [6]. The distinct biophysical characteristics of spinal and general anesthesia have an impact on the outcomes of lumbar microdiscectomy surgery. Although general anesthetics provide stable placement in prone posture, safe airway management, and ideal muscular relaxation, it is linked to greater systemic opioid doses, longer recovery durations, and higher rates of postoperative nausea and vomiting. On the other hand, sympathetic blocking provided by spinal anesthesia maintains hemodynamic stability, minimizes intraoperative blood loss by reducing epidural venous plexus congestion, and permits direct neurological input during nerve root manipulation. However, there are several possible drawbacks to spinal anesthesia, such as the possibility of insufficient surgical anesthesia necessitating conversion, the difficulty of preserving hemodynamic stability during prone placement, and patient concern during awake positioning [3, 4]. In a study, post-operative pain (VAS) between groups was comparable, time of surgery (time to enter in OT to incision) (GA vs. SA; 30.22 ± 8.21 minutes vs. 15.55 ± 7.12 minutes) and average hospital stay (GA vs. SA; 3.05 ± 0.67 days vs. 1.61 ± 0.55 days) were significantly higher among GA group when compared to SA group ($p<0.05$), while insignificant differences was seen in blood loss (GA vs. SA; 40.23 ± 10.45 ml vs. 30.22 ± 11.21 ml; $p=0.552$) and dural tear (GA vs. SA; 4% vs. 4%; $p=1.000$) [1]. In another study, at 24 hours postoperatively, the mean VAS score was 3.24±1.06 in the spinal group and 3.93±1.02 in the general anesthesia group ($p<0.01$) [7].

Single-level lumbar microdiscectomy is commonly performed under either spinal or general anesthesia, yet existing studies report conflicting outcomes regarding operative time, recovery profile, and complications, leaving uncertainty about the optimal technique. Most available evidence is derived from diverse settings with varying surgical and anesthetic protocols, limiting applicability to routine neurosurgical practice. Additionally, there is a dearth of direct comparable data from regional institutions. In order to close this data gap and promote sensible anesthetic choice, the study compared the perioperative results of spinal and general anesthesia for single-level microdiscectomy.

METHODS

This quasi-experimental study was conducted at the Department of Neurosurgery, POF Hospital, Wah Cantt, during the period 2nd September 2025 till 1st February 2026, after taking approval from the institutional research review board vide no. IRB/POFH/05-2025/NEURO-SURG/01 on 16th May 2025. Male and female patients aged 18 to 60 years diagnosed with lumbar disc herniation were enrolled. Patients with a prior history of intervention for lumbar disc herniation, blood dyscrasias, immune-compromised patients, and referred patients handled at other centers were excluded. Lumbar disc herniation was diagnosed with an MRI of the lumbar spine showing localized displacement of the disc material beyond the normal margins of the intervertebral disc space. The outcomes were assessed in terms of: 1) Surgery time: The duration in minutes from entry into the operating theatre till completion of skin closure. 2) PACU time: The total time in days the patient spends in the Post Anaesthesia Care Unit (PACU) from arrival after surgery until discharge to the ward. 3) Blood loss intra-operatively (ml): The total volume of blood lost during the surgery, measured in milliliters, calculated from suction canisters (after subtracting irrigation fluid) and estimated swab loss. 4) Dural tear: Any intraoperative accidental breach of the dura mater. 5) Postoperative pain: Measured using the patients' reported Visual Analogue Scale (VAS) that ranges from 0 to 10. 6) Hospital stays: The total duration in days in the hospital from the time a patient is admitted for surgery till discharge. Using Open Epi software, the sample size was determined to be 60 (30 in each group), with a 95% confidence level, 80% power, taking a mean hospital stay (GA vs. SA) of 3.05 ± 0.67 days vs. 1.61 ± 0.55 days [1]. Participants who met the eligibility parameters were recruited after approval from the hospital's ethical and research department. Every patient provided written informed consent. Age, gender, BMI (kg/m2), pain duration, and comorbidities were noted. Patients were assigned to either the general anesthesia (GA) or spinal anesthesia (SA) group depending on their preferences and the anesthetist's judgment. The anesthesiology staff provided uniform preoperative education to all patients about the advantages and disadvantages of both SA and GA, comprising an overview of the specifics of the procedure, anticipated recovery periods, and possible complications. To ensure procedural uniformity, the same neurosurgeon and team conducted each procedure. All surgeries were performed using the Zeiss OPMI Pentero operative microscope in the prone position on a Wilson frame, and the surgical technique was a typical posterior midline incision. The most often encountered levels were L4-L5, although they varied from L3-L4 to L5-S1. Using OT time logs, the duration of the procedure was recorded from the time the patient arrived in the operating room until the skin repair concluded. Patients were sent to the Post Anaesthesia Care Unit (PACU) following surgery, and the number of days they

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spent there until they were discharged was noted. Intraoperative blood loss was calculated by measuring the volume collected in the suction canister after subtracting the irrigation fluid used, and estimating blood soaked in surgical sponges as per standard practice. The occurrence of dural tear during surgery was documented as yes or no based on the operative notes. Postoperative pain was assessed using the Visual Analogue Scale (VAS), measured in centimeters, and recorded at predefined time intervals during the postoperative period. Total hospital stay was calculated in days from the date of admission to the date of discharge after surgery. All data were collected systematically in a structured proforma immediately post-surgery and during the hospital stay, and later entered into an electronic database for analysis.

All the data were entered and processed by using SPSS version 26.0. Qualitative variables like gender and dural tears were presented as frequencies and percentages. Quantitative variables like age, BMI, surgery time, PACU time, blood loss intra-operatively, post-op pain (VAS), and Hospital stay were presented as Mean ± S.D. Surgery time, PACU time, Blood loss intra-operatively, post-op pain (VAS), and Hospital stay were compared between groups by t-test, and dural tear by Chi-square test. Data were stratified for gender, age, and BMI. A $p \leq 0.05$ was considered significant.

RESULTS

The mean age of the participants was 49.65 ± 7.43 years. Participants aged more than 45 years were 37 (61.7%), while the majority of the patients were female, n=32 (53.3%). A BMI more than 24.0kg/m2 was recorded in 32 patients (53.3%). Mean surgery time, hospital stay, and post-operative VAS score were 79.50 ± 9.55 minutes, 3.12 ± 0.90 days, and 3.95 ± 1.03, respectively. There were no statistically significant differences between the SA and GA groups at baseline. Age (p=0.275) and BMI (p=0.540) were comparable between the two groups. Similarly, the distribution of gender was nearly identical, with each group comprising 14 males (46.7%) and 16 females (53.3%) (χ^2=0.067, p=0.796) (Table 1).

Table 1: Baseline Characteristics and Descriptive Statistics of Study Participants (n=60)

Variable	Subgroup	Overall (n = 60)	SA (n = 30)	GA (n = 30)
Age (Years)	Mean ± SD	49.65 ± 7.44	48.60 ± 7.54	50.70 ± 7.28
	≤ 45 years, n (%)	23 (38.3%)	–	–
	> 45 years, n (%)	37 (61.7%)	–	–
Gender, n (%)	Male	28 (46.7%)	14 (46.7)	14 (46.7)
	Female	32 (53.3%)	16 (53.3)	16 (53.3)
BMI (kg/m^2)	Mean ± SD	24.30 ± 1.36	24.19 ± 1.36	24.41 ± 1.37
	≤ 24.0, n (%)	28 (46.7%)	–	–
	> 24.0, n (%)	32 (53.3%)	–	–
Surgery Time (min)	Mean ± SD	79.50 ± 9.56	–	–
PACU Time (Days)	Mean ± SD	1.77 ± 0.79	–	–
Hospital Stays (Days)	Mean ± SD	3.12 ± 0.90	–	–
Blood Loss (ml)	Mean ± SD	260.00 ± 23.07	–	–
Postoperative Pain (VAS)	Mean ± SD	3.95 ± 1.03	–	–

Dural tears were observed in one patient (3.3%) with spinal anesthesia versus 02 patients (6.6%) with general anesthesia (p value 0.643). The mean operative time with spinal anesthesia was 71.0 ± 4.30 minutes versus 88.00 ± 4.21 minutes with general anesthesia (p<0.001). Mean PACU time spent by patients with spinal and general anesthesia was 1.50±0.63 days and 2.03 ± 0.85 days, respectively (p=0.008). Mean hospital stay of patients with spinal anesthesia was 2.57±0.62 days versus 3.67 ± 0.80 days with general anesthesia (p<0.001). The p-values for the difference in blood loss and postoperative pain VAS in spinal versus general anesthesia were <0.001 and <0.001, respectively (Table 2).

Table 2: Comparison of Outcomes Between SA and GA (n=60)

Outcome Variables	Group (n=30)	Mean ± SD	Mean Difference (95% CI)	Cohen's d	p-value
Surgery Time (min)	SA	71.00 ± 4.30	-17.00 (-19.20 to -14.80)	-3.96	<0.001
	GA	88.00 ± 4.22			
PACU Time (days)	SA	1.50 ± 0.63	-0.53 (-0.92 to -0.14)	-0.70	0.008
	GA	2.03 ± 0.85			
Hospital Stay (days)	SA	2.57 ± 0.63	-1.10 (-1.47 to -0.73)	-1.51	<0.001
	GA	3.67 ± 0.80			
Blood Loss (ml)	SA	242.00 ± 11.57	-36.00 (-43.47 to -28.53)	-2.55	<0.001
	GA	278.00 ± 16.69			
Postoperative Pain (VAS)	SA	3.50 ± 0.82	-0.90 (-1.38 to -0.42)	-0.96	<0.001
	GA	4.40 ± 1.04			

In the subgroup analysis, surgical time was consistently shorter in the SA group, with the most pronounced

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difference observed in patients ≤45 years (69.50 ± 3.80 vs 86.20 ± 3.90 minutes, p<0.001). Blood loss was also significantly lower with SA, with the greatest reduction seen in patients with BMI ≤24.0 kg/m^2 (238.00 ± 10.50 vs 273.00 ± 15.20 ml, p<0.001) (Table 3).

Table 3: Stratified Analysis of Surgical Outcomes by Age, Gender, and BMI (n=60)

Stratification Variables	Subgroup	Outcome Variable	SA (Mean ± SD)	GA (Mean ± SD)	t-test p-value
Age (Years)	≤45 Years (n=23)	Surgery Time (min)	69.50 ± 3.80	86.20 ± 3.90	<0.001
		PACU Time (days)	1.30 ± 0.48	1.80 ± 0.63	0.012
		Hospital Stay (days)	2.30 ± 0.48	3.40 ± 0.70	<0.001
		Blood Loss (ml)	238.00 ± 10.20	272.00 ± 14.5	<0.001
		Postop Pain (VAS)	3.20 ± 0.63	4.10 ± 0.88	0.001
	>45 Years (n=37)	Surgery Time (min)	72.10 ± 4.10	89.20 ± 4.00	<0.001
		PACU Time (days)	1.65 ± 0.67	2.20 ± 0.89	0.015
		Hospital Stay (days)	2.75 ± 0.64	3.85 ± 0.81	<0.001
		Blood Loss (ml)	245.00 ± 11.80	282.00 ± 17.1	<0.001
		Postop Pain (VAS)	3.70 ± 0.80	4.60 ± 1.02	0.001
Gender	Male (n=28)	Surgery Time (min)	70.50 ± 4.10	87.50 ± 4.30	<0.001
		PACU Time (days)	1.45 ± 0.52	2.00 ± 0.82	0.014
		Hospital Stay (days)	2.50 ± 0.52	3.60 ± 0.74	<0.001
		Blood Loss (ml)	245.00 ± 12.30	282.00 ± 17.8	<0.001
		Postop Pain (VAS)	3.40 ± 0.70	4.30 ± 0.95	0.001
	Female (n=32)	Surgery Time (min)	71.40 ± 4.20	88.40 ± 4.10	<0.001
		PACU Time (days)	1.55 ± 0.68	2.06 ± 0.86	0.011
		Hospital Stay (days)	2.63 ± 0.67	3.73 ± 0.82	<0.001
		Blood Loss (ml)	239.00 ± 10.80	275.00 ± 15.9	<0.001
		Postop Pain (VAS)	3.60 ± 0.84	4.50 ± 1.08	0.001
BMI	≤24.0 kg/m^2 (n=28)	Surgery Time (min)	70.20 ±4.00	87.80 ± 4.20	<0.001
		PACU Time (days)	1.40 ± 0.52	1.95 ± 0.76	0.009
		Hospital Stay (days)	2.45 ± 0.51	3.55 ± 0.69	<0.001
		Blood Loss (ml)	238.00 ± 10.50	273.00 ± 15.2	<0.001
		Postop Pain (VAS)	3.30 ± 0.67	4.20 ± 0.92	0.001
	>24.0 kg/m^2 (n=32)	Surgery Time (min)	71.80 ±4.30	88.20 ± 4.10	<0.001
		PACU Time (days)	1.60 ± 0.67	2.10 ± 0.88	0.013
		Hospital Stay (days)	2.68 ± 0.68	3.78 ± 0.84	<0.001
		Blood Loss (ml)	246.00 ± 11.90	283.00 ± 17.3	<0.001
		Postop Pain (VAS)	3.70 ± 0.82	4.60 ± 1.05	0.001

In patients ≤45 years, dural tear occurred in 0.0% of the SA group versus 8.3% in the GA group (p=0.442), while in those >45 years, rates were 5.0% and 5.6%, respectively (p=0.735). Similarly, no significant differences were observed based on gender or BMI, with dural tear rates ranging from 0.0-6.3% in the SA group and 6.3-7.7% in the GA group (all p>0.05) (Table 4).

Table 4: Stratified Analysis of Dural Tear by Age, Gender, and BMI (n=60)

Stratification Variables	Subgroup	Dural Tear	SA (n, %)	GA (n, %)	Total (n, %)	Test	p-value
Age (years)	≤45 (n=23)	Yes	0 (0.0%)	1 (8.3%)	1 (4.3%)	Fisher's Exact	0.442
		No	10 (100%)	11 (91.7%)	21 (95.7%)		
	>45 (n=37)	Yes	1 (5.0%)	1 (5.6%)	2 (5.4%)	Fisher's Exact	0.735
		No	19 (95.0%)	17 (94.4%)	36 (94.6%)		
Gender	Male (n=28)	Yes	0 (0.0%)	1 (7.1%)	1 (3.6%)	Fisher's Exact	0.483
		No	14 (100%)	13 (92.9%)	27 (96.4%)		
	Female (n=32)	Yes	1 (6.3%)	1 (6.3%)	2 (6.3%)	Fisher's Exact	0.763
		No	15 (93.8%)	15 (93.8%)	30 (93.8%)		
BMI (kg/m^2)	≤24.0 (n=28)	Yes	0 (0.0%)	1 (7.7%)	1 (3.6%)	Fisher's Exact	0.467
		No	13 (100%)	12 (92.3%)	25 (96.4%)		

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	>24.0 (n=32)	Yes	1 (5.9%)	1 (6.3%)	2 (6.3%)	Fisher's Exact	0.751
		No	16 (94.1%)	15 (93.8%)	31 (93.8%)		

DISCUSSION

Spinal anesthesia (SA) offers substantial and statistically noteworthy benefits over general anesthesia (GA) in several postoperative domains, according to the direct comparison carried out in this study. Our results show that SA is the best anesthetic technique suited to this commonly performed neurosurgical procedure since it is linked to a more effective surgical technique, a better post-operative recovery profile, and improved satisfaction for patients. The most striking finding was the significant reduction in operative time with SA (71.0 ± 4.3 min vs. 88.0 ± 4.2 min; p<0.001). Published research on spinal anesthesia for spinal surgery consistently emphasizes its effectiveness. Similar reduced operating room durations for lumbar discectomy under SA were observed in a study, attributing this to the removal of time for GA emergence and airway management [8]. This is further corroborated by a recently published study, which demonstrated the importance of spinal anesthesia in increasing surgical facility throughput by confirming that operational time is consistently decreased in lumbar spine surgeries [9]. Under SA, deep muscle relaxation may facilitate surgical exposure, perhaps reducing the requirement for additional anesthetic medications and cutting down on dissection duration. Beyond operational effectiveness, the SA group's recovery trend was noticeably quicker. Patients under SA had a decrease of an entire day in overall hospital stay and a substantially shorter PACU stay. The rationale for SA in an Enhanced Recovery After Surgery (ERAS) program for spine surgery is based on this finding. Neuraxial anesthesia for lumbar spine procedures was often linked to a shorter hospital stay, according to a review by Liu *et al.* [10]. They cited earlier ambulation, better pain management, and less post-operative nausea and vomiting (PONV) as associated variables. An important benefit is being able to mobilize promptly without experiencing severe dizziness or PONV, which are frequent aftereffects of GA. Early ambulation was attained far more quickly in the SA group, which directly affected discharge readiness, according to research by Jaafarpour *et al.* [11]. Another important advantage of SA is its excellent pain control characteristic. Both statistically and clinically, the SA group's post-operative VAS ratings were considerably lower. This is consistent with the physiological explanation that SA's remnant sensation blocking offers a defensive palliative benefit in the early post-operative phase. A randomized controlled trial by Sekerak *et al.* directly compared SA and GA for lumbar disc surgery and found not only lower early post-operative pain scores in the SA group but also a significantly reduced requirement for rescue opioids [12]. Effective analgesia with less systemic opioid use directly contributes to lower rates of sedation, ileus, and respiratory depression, thereby accelerating recovery. This is corroborated in a study where patients under SA had a significantly lower total morphine consumption in the first 24 hours post-operation [13]. The much lower intraoperative bleeding in the SA group was an intriguing and possibly clinically relevant outcome. Arteriolar dilation occurs in the lower limbs because of sympathetic block triggered by SA; however, Ye *et al.*'s description of the simultaneous decrease in central venous pressure and the formation of a less congested epidural venous plexus probably results in a drier operative area and more accurate hemostatic control [14]. In microdiscectomy, where total disc component removal and nerve root preservation depend heavily on good visibility, this can be especially helpful. Surgeons claimed a better visual field under SA than under GA, according to recent research by Yang *et al.* that used surgical field grading systems to give quantitative measurements [15]. In terms of complications, the SA group had a lower rate of dural tear, but the disparity failed to be statistically significant. Given the small total number of incidents, this is probably a Type II mistake. Importantly, in the case of a nerve root or dural sac proximity, the existence of a conscious patient under SA offers prompt feedback, which may enable the surgeon to modify technique and prevent a complete rupture. It is still a potential advantage of awake spine surgery under SA that needs more research in bigger cohorts, even if our evidence is not strong enough to support it [16]. Additionally, an upward trajectory toward decreased cumulative complication rates with SA was seen in a systematic study by Liu *et al.* but they also demanded more reliable data on surgical problems. Ghaith *et al.* demonstrated a significant shift toward non-GA techniques for lumbar spine surgeries, particularly in outpatient clinics, in a comparative study assessing the changes in anesthetic technique [17, 18]. SA lowers postoperative pain and the requirement for analgesics in the PACU after spinal lumbar surgery, according to a meta-analysis. Without affecting blood pressure, heart rate, or urine output, it is associated with both greater patient satisfaction and a lower incidence of PONV [19]. Kilic *et al.* reported improved perioperative effects, significantly lower anesthetic costs, and a quicker return to work, confirming the economic viability of SA [20].

Due to its observational, single-center methodology, this study has several limitations. Even though the groups were almost equal in size, the non-randomized patient

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distribution raises the possibility of selection bias. Although the sample size was acceptable for key continuous outcomes, it was inadequate to make definitive inferences on uncommon surgical issues such as dural tears or neurologic deficits following surgery. The likelihood of residual confounding by unmeasured covariates and biased selection of anesthesia type cannot be completely ruled out, even if stratified analysis was used to account for measured confounders. It is recommended that future large-scale, randomized controlled trials confirm these results and investigate how they affect patient satisfaction and long-term functional outcomes.

CONCLUSIONS

In contrast to general anesthesia, spinal anesthesia was associated with a superior outcome profile in individuals undergoing single-level lumbar microdiscectomy. It enabled the procedure to proceed more quickly, reduced blood loss, offered better analgesia after surgery, and encouraged a much quicker recovery and immediate discharge. These advantages were in coherence with the aims of contemporary ERAS protocols and value-driven neurosurgical treatment. SA should be given serious consideration and made available as the primary anesthetic method for qualified patients, considering this data.

Authors' Contribution

Conceptualization: HA
Methodology: HA
Formal analysis: MA, SA
Writing and Drafting: HA, SA
Review and Editing: HA, MA, SA

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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