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Assessing the effectiveness of spinal compared to general anesthesia in scheduled minimally invasive lumbar spine surgeries in a tertiary care hospital in Gujarat, India

Vanshita Patel, Ashish P Jain, Jay Pandya, Shivani Pancholi

Abstract

Background: Minimally invasive spine surgery (MIS) is increasingly preferred over traditional open surgery due to its advantages. Anesthesia choice plays a key role in surgical outcomes. This study compares spinal anesthesia (SA) and general anesthesia (GA) in patients undergoing scheduled MIS for lumbar spine conditions.

Methods: This prospective randomized study was conducted in Parul Sevashram Hospital, Parul University, Vadodara, Gujarat, between May 2024 and October 2024. The study included 34 ASA-1 and ASA-2 patients scheduled for one—or two-level MIS, divided into two groups: Group G (GA) and Group S (SA). Preoperative evaluation included demographics, lab tests, and imaging. Intraoperative monitoring covered heart rate, mean arterial pressure, and oxygen saturation. Postoperative assessments included blood loss, satisfaction scores, and complications.

Results: Spinal anesthesia (SA) showed better hemodynamic stability, reduced blood loss (67.5±19.8 ml in Group S vs 73.2±14.9 ml in Group G), and higher satisfaction scores. Surgery duration was shorter in the SA group (89.9±8.2 min in Group S vs 94±7.2 min in Group G), with fewer complications. PACU stay was significantly lower in Group S (134±17.2 min) compared to Group G (175±20.4 min). Postoperative analgesic requirement (Inj Butorphanol) was also less in Group S (5 mg vs 14 mg IV).

Conclusion: Spinal anesthesia is a safe and effective alternative to general anesthesia for MIS, offering better patient outcomes and satisfaction. This study supports the broader use of spinal anesthesia in suitable candidates to improve perioperative care.

Keywords: Spinal Anesthesia, Minimally Invasive Spine Surgery, Patient Satisfaction, Regional Anaesthesia, Prone Position, Hemodynamic Stability, India

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Background

Minimally invasive spine surgery (MIS) has revolutionized the approach to treating various spinal disorders, offering significant advantages over traditional open surgical techniques. Furthermore, MIS enhances cosmetic outcomes and facilitates early ambulation while preserving the integrity of normal anatomical structures, offering numerous advantages over conventional open surgical techniques [1,2,3]. MIS encompasses a range of procedures, including microdiscectomy, spinal fusion, and laminectomy, which are performed through smaller incisions, resulting in reduced tissue trauma, shorter recovery times, and less postoperative pain [4,5]. The evolution of these techniques has been accompanied by advancements in anesthesia, which is crucial for optimizing surgical outcomes and enhancing patient comfort [5]. The types of anesthesia utilized in MIS can be broadly categorized into general anesthesia (GA), regional anesthesia, and local anesthesia. General anesthesia involves the administration of systemic agents that induce unconsciousness and analgesia, allowing for complete patient immobility during surgery. While GA is widely used, it is associated with potential complications such as respiratory depression and prolonged recovery times [6.7]. Regional anesthesia, which includes spinal anesthesia (SA), epidural anesthesia, and combined spinal-epidural anesthesia (CSEA), has gained traction in recent years [8,9,10,11]. Local anesthesia, while effective for minor procedures, is generally not suitable for more extensive surgeries such as those performed in the lumbar spine due to the need for deeper and broader analgesia. In

contrast, spinal anesthesia has emerged as a preferred technique for many MIS procedures [6, 12, 13,14]. It involves the injection of a local anesthetic into the cerebrospinal fluid, providing profound analgesia and muscle relaxation in the lower body. The advantages of spinal anesthesia include predictable onset and duration, lower costs, minimal airway management, reduced intraoperative bleeding, and better hemodynamic stability [4,15,16]. The growing popularity of spinal anesthesia can be attributed to its favorable safety profile and effectiveness in managing pain during and after surgery [5,17]. Studies have shown that spinal anesthesia is associated with fewer complications compared to general anesthesia, such as reduced incidence of postoperative nausea and vomiting, lower blood loss, and shorter recovery times [5,6,18]. Furthermore, the ability of patients to remain awake and communicate during surgery can enhance their overall experience and satisfaction [4,16]. This study aims to evaluate the merits and drawbacks of spinal anesthesia versus general anesthesia in the context of minimally invasive lumbar spine surgery at a tertiary care hospital in Gujarat, India. We will evaluate peri-operative outcomes, including hemodynamic stability, postoperative pain levels, blood loss, complication rates, and patient and surgeon satisfaction. By systematically comparing these two anesthesia techniques, we hope to contribute valuable insights into the optimal anesthesia choice for MIS lumbar spine surgeries.

Methods

Study design and sampling strategies

A prospective randomized study was conducted from May 2024 to October 2024, at Parul Sevashram Hospital, Parul University, Vadodara, Gujarat, India.

Inclusion and exclusion criteria

Consenting patients aged 18-65 years, and ASA physical status classification of ASA-1 and ASA-2, posted for one to two-level lumbar spine surgery were included in this study. Exclusion Criteria included patients with contraindications to spinal anesthesia (e.g., patient's refusal, infection at the injection site, coagulopathy), patients requiring prolonged surgical procedures or having a history of previous spine surgery, and patients with significant comorbidities (e.g., severe cardiovascular or respiratory diseases).

Sample size calculation

The findings of a prior study served as the foundation for the data analysis. Based on a population Standard Deviation (σ) of 0.8, 80% power, and 0.05% Alpha error, the sample size was determined. The sample size calculation formula for a two-group comparative study is shown below:

$k = n_2 / n_1 = 1$

$n_1 = (\sigma_1^2 + \sigma_2^2 / K) (z_1\text{-}\alpha/2 + z_1\text{-}\beta)^2 / \Delta^2$

$n_1 = (4.2^2 + 4.2^2 / 1) (1.96 + 0.84)^2 / 4^2$

$n_1 = 17, n_2 = K * n_1 = 17$

Where, $\Delta = |\mu_2 - \mu_1|$ = absolute difference between two means

σ_1, σ_2 = variance of mean #1 and #2

n_1 = sample size for group #1

n_2 = sample size for group #2

α = probability of type I error (usually 0.05)

β = probability of type II error (usually 0.2)

z_1 = critical Z value for a given α or β

k = ratio of sample size for group #2 to group #1

A total sample size of 34 patients was calculated using this formula, equally divided into 2 groups of 17 patients each.

Preoperative assessment

Before surgery, each patient underwent a comprehensive preoperative evaluation to review medical history, and comorbidities, and conduct a physical exam. Radiological imaging, such as MRI, CT scans, X-rays, and chest X-rays, was performed to assess the lumbar spine and guide the surgical approach. Routine laboratory tests, including blood count, coagulation profile, and renal function tests, were conducted to ensure surgical fitness. Informed consent was obtained after explaining the study, anesthesia techniques, risks, and benefits. Patients were kept nil-by-mouth (NPO) for 8 hours before surgery.

Procedures

On the day of surgery, the following protocols were followed:

Premedication: In the pre-op recovery room, one IV line (18G) was inserted, and preloading with injection of Ringer's lactate (8ml/kgIV) started. All patients received premedication 30 minutes before transfer to the operating room, which included: Inj. Glycopyrrolate 0.2 mg IV, Inj. Ondansetron 4 mg IV, Inj. Midazolam 1-2 mg IV, inj. Ceftriaxone 30mg/kg IV was given as per the hospital protocol. Patients were assigned to one of two groups using a sealed envelope method. Upon arrival in the operating room, patients were connected to a multichannel monitor to continuously assess vital signs, including heart rate (HR), mean arterial pressure (MAP), ECG, and peripheral oxygen saturation (SpO2).

Patient Groups: The patients were divided into two groups:

1. **Group G:** Patients who underwent surgery under General Anaesthesia (GA).
2. **Group S:** Patients who underwent surgery under Spinal Anaesthesia (SA).

Anesthesia administration

In Group G, following three minutes of pre-oxygenation, a standardized general anesthetic induction was initiated with: Inj. Fentanyl 1.5 mcg/kg IV and Inj. Propofol 2 mg/kg IV. Intubation was performed using a flexometallic endotracheal tube after achieving adequate muscle relaxation with Inj. Rocuronium (0.6 mg/kg IV; 7 mm for females, 8 mm for males). Ventilation adequacy was confirmed via chest auscultation and capnography. Anesthesia was maintained with 1.0% to 2.0% Sevoflurane in 40% to 70% oxygen, within. Rocuronium infusion for continuous muscle relaxation (0.3mg/kg/hour IV). A Foley catheter was inserted, and the patient was positioned prone with appropriate padding, and face and eye care to prevent pressure injuries. The Surgeon marked the surgical site under C-Arm guidance, and incision time was noted. Vitals were monitored and noted throughout the surgery. At the end of the procedure, inj. Lignocaine 2% 10ml was infiltrated in subcutaneous tissue for pain relief. After bandaging, the patient was positioned supine, and extubation was performed after thorough suctioning and reversal with inj. Sugammadex 2mg/kg IV when recovery was confirmed by the reappearance of the second twitch (T2) in the TOF (Train-of-Four) monitoring. Spontaneous breathing and response to commands were assessed before transferring the

patient to the post-anesthesia care unit (PACU), where the patient's out time was recorded. In Group S patients were given spinal anesthesia. Upon arrival in the operating room, the patient was positioned prone, and the neurosurgeon confirmed the operating site. Concurrently, the patient received intravenous fluids, specifically Ringer's lactate (500ml), before spinal anesthesia was administered. Markings were performed under C-Arm guidance, and the patient was positioned laterally flexed with their back painted with 10% povidone-iodine solution. Local infiltration with 2% lidocaine [0.5-2ml] was attempted subcutaneously. A 25G spinal (Quincke-Babcock) needle was introduced via lumbar puncture into the subarachnoid space between the L3-L4/L4-L5 vertebral spaces under sterile conditions, one level above or below the planned surgical site as determined by the surgeon (Figure-1). Following the observation of cerebrospinal fluid flow, Inj. Hyperbaric bupivacaine (H) 0.5% [3.4-3.6 ml] + inj. Dexmedetomidine [5mcg] was injected intrathecally. The patient was then placed in the supine position to verify the adequacy of the block level typically achieving T6-T8 dermatomes, as nociception inhibition was ruled out by the pain stimulation pin-prick method.

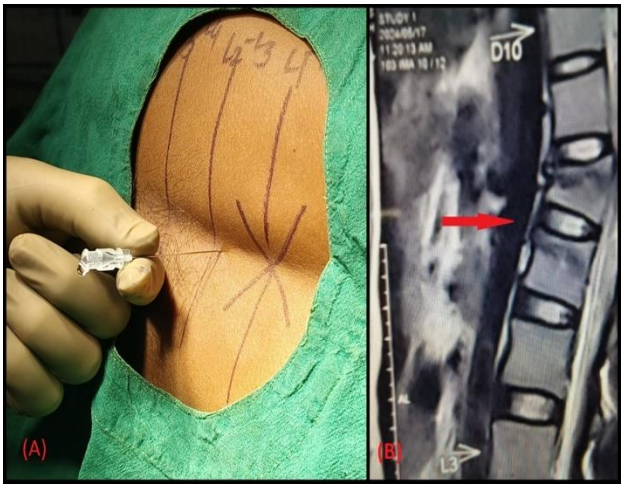

Figure 1:(A) SA being administered in lateral position(L2-L3). (B) Scan showing incision site in red.

Foley's catheterization was performed, and the patient was carefully repositioned prone from the transport stretcher to the Operating table with Wilson frame. The head was placed on a foam pillow and the arms were positioned in a "Superman" position. Oxygen supplementation via O2 Mask 2L/min, and sedation was maintained with an infusion of inj. propofol [25-50mcg/kg/min] + inj. dexmedetomidine [25-50mcg/kg] until the end of the surgery. Spo2 levels were thoroughly monitored throughout the surgery. After surgery, drugs were discontinued, and the patient was turned from prone to supine and carefully shifted to the PACU. Throughout the surgery, if needed, bradycardia [heart rate less than 60 bpm] was corrected with inj. Glycopyrrolate [0.1-0.2mg/kg] and Hypotension (systolic blood pressure less than 100 mmHg) with intravenous fluids management, crystalloid fluid with inj. Phenylephrine [15-20mcg/kg IV], and nausea or vomiting with inj. ondansetron [60mcg/kg IV]. If the patient desaturates, (in Group-S), with SpO2<90%, supplemental oxygen was provided with a non-rebreather mask, (NRBM). We had planned, if desaturation continued, BiPAP support with reverse Trendelenburg position would be provided.21? As a last resort, if saturation deteriorates, the surgeon will stop the surgery, the patient will be repositioned supine and airway management will be attempted. Such patients would be excluded from our study. No such incidents happened in our study.

Perioperative observations

In this study, various parameters were meticulously measured, including Patient-In time, Induction Time, entry-to-incision time (T-entry), Surgery start-end Time, Total Duration of surgery (T-total), Bandaging-to-exit time (T-exit), PACU Transfer-Time, PACU stay. Intraoperative vital signs, specifically Mean Arterial Pressure (MAP), Heart Rate (HR), and Oxygen Saturation (SpO2), were monitored sequentially at preinduction (T0), immediately post-induction (T1), and then every 30-minute interval (T30, T60, T90, T120, T150). "T-last" was the final reading before shifting the patient to PACU. Blood loss was estimated by calculating the volume of suctioned blood from the surgical field and gauze mops, with each mop accounting for 10ml. Urine output was recorded.

Postoperative management

All patients underwent thorough observation in the Post-anaesthesia Care Unit (PACU) for signs of hemodynamic instability, and potential complications, (which included nausea and vomiting, hypotension, bradycardia, and respiratory depression). Pain levels were assessed using a Visual Analog Scale (VAS) at 60 and 120 minutes, with scores exceeding 4 indicating significant discomfort, which was managed with intravenous Butorphanol at a dosage of (1mg IV). The total dose administered within the first 12 hours was documented. The overall satisfaction of both the surgeon and the patient was assessed and noted as yes or no.

Discharge from PACU towards

In Group G, patients will be discharged from the PACU if they are conscious and exhibit no pain, nausea, vomiting, or hemodynamic instability. In Group S, patients will be discharged from the PACU when they exhibit no pain, nausea, or vomiting, and demonstrate at least two segments of regression in the spinal block. This will conclude our investigation.

Statistical Analysis and Method

Data will be presented as mean ± SD or number (percent). Age, weight, height, maximum blood pressure and heart rate changes, duration of surgery, duration of recovery stay, and blood loss will be compared between two groups using Student's t-test. Sex, ASA physical status, patient and surgeon satisfaction, postoperative analgesic use, and complication rates will be assessed by chi-square test. P-value < 0.05 was considered statistically significant. All statistical analyses will be done using SPSS ver.25, https://www.graphpad.com, and Microsoft Excel.

Results

The results of this study were presented in three tables, summarizing demographic data, intraoperative monitoring of vital parameters, and perioperative observations related to the outcomes of spinal anesthesia (Group S) and general anesthesia (Group G). Table 1 shows Patient Characteristics According to groups. The demographic data indicates that both groups were

comparable in terms of gender distribution, mean age, mean BMI, ASA classification, and the number of operated levels. Specifically, Group G consisted of 8 males and 9 females, while Group S had 9 males and 8 females, with no significant difference (p = 0.73). The mean age was 48.3 ± 7.8 years for Group G and 46.2 ± 8.3 years for Group S (p = 0.45).

The mean BMI was 23.8 ± 2.9 kg/m² for Group G and 24.5 ± 3.2 kg/m² for Group S (p = 0.51). ASA classification showed no significant difference between the groups, with 11 ASA-I and 6 ASA-II patients in Group G compared to 12 ASA-I and 5 ASA-II patients in Group S (p = 0.71). The operated levels were also similar, with 13 single-level surgeries in Group G and 15 in Group S, and 4 double-level surgeries in Group G compared to 2 in Group S (p = 0.36).

Table 1: Patient characteristics according to groups (N=34)

Variables	Categories	Group G (n=17)	Group S (n=17)	P- Value
Gender	Male	8	9	0.73 NS
	Female	9	8	
Age	Mean age (Years)	48.3±7.8	46.2±8.3	0.45 NS
BMI	Mean BMI (kg/m2)	23.8±2.9	24.5±3.2	0.51 NS
ASA Class	ASA-I	11	12	0.71 NS
	ASA-II	6	5	
Operated levels	Single level	13	15	0.36 NS
	Double levels	4	2	

Values represent the number of patients or mean ± SD unless indicated otherwise. (NS: Not significant)

Table 2 presents the intraoperative monitoring of vital parameters. Preoperatively, there were no significant differences in heart rate (HR), mean arterial pressure (MAP), and oxygen saturation (SpO2) between the two groups. However, significant differences were observed post-induction (T1), where Group G had a higher HR (103 ± 7.1 bpm) compared to Group S (92 ± 8.7 bpm, p = 0.003), and a higher MAP (98.7 ± 8.4 mmHg) compared to Group S (89 ± 8.8 mmHg, p = 0.025). Throughout the intraoperative period, Group S consistently demonstrated lower HR and MAP values at various time points (T30, T60, T90, T120, T150, and T. last), indicating better hemodynamic stability compared to Group G. SpO2 levels remained stable in both groups, although Group S showed a significant decrease at T30, T60, and T90.

Table 2: Intraoperative monitoring of vital parameters (N=34)

Parameter	Vital	Group G n=17)	Group S (n=17)	p Value
Pre-operative (Baseline)	**HR (bpm)**	95.1±7.3	97.3±8.7	0.81 NS
	MAP (mmHg)	90±7.5	91±8.2	0.71 NS
	SpO2 (%)	99±0.6	99±0.75	1.0 NS
T0 (Preinduction)	**HR (bpm)**	98.7±8.2	95.4±8.1	0.24 NS
	MAP (mmHg)	93.1±7.3	96±8.6	0.29 NS
	SpO2 (%)	99±0.6	99±0.5	1.0 NS
T1 (1st reading after induction)	**HR (bpm)**	103±7.1	92±8.7	**0.003**
	MAP (mmHg)	98.7±8.4	89±8.8	**0.025**
	SpO2 (%)	99±0.6	99±0.7	1.0 NS
T30	**HR (bpm)**	95.1±6.8	80±8.1	**0.0001**
	MAP (mmHg)	96±8.7	82±8.4	**0.001**
	SpO2 (%)	99±0.4	98.6±0.5	**0.01**
T60	**HR (bpm)**	94.1±8.1	78±8.6	**0.0001**
	MAP (mmHg)	97±8.4	80±9.9	**0.001**
	SpO2 (%)	99±0.2	98±1.7	**0.02**
T90	**HR (bpm)**	93.7±8.1	79.2±8.2	**0.0001**
	MAP (mmHg)	99.6±8.7	83.9±9.5	**0.0001**
	SpO2 (%)	99±0.7	98±1.6	**0.015**
T120	**HR (bpm)**	97.7±8.4	84.2±6.9	**0.0001**
	MAP (mmHg)	96.6±8.5	88.9±7.5	**0.08**
	SpO2 (%)	99±0.7	98±1.6	**0.001**
T150	**HR (bpm)**	99.7±8.7	89.2±7.2	**0.015**
	MAP (mmHg)	98.6±8.8	92.9±8.2	0.65 NS
	SpO2 (%)	99.5±0.7	98.2±1.1	**0.0003**
T. last	**HR (bpm)**	103.7±7.8	89.2±8.2	**0.00010**
	MAP (mmHg)	106.5±8.8	95.9±9.2	**0.0017**
	SpO2 (%)	99.5±0.7	98.5±1.1	**0.003**

Values are in (mean ± SD) unless indicated otherwise. (NS: Not significant)

Table 3 outlines the perioperative observations. The time from entry to incision was significantly shorter in Group S (29 ± 8.2 minutes) compared to Group G (45.1 ± 6.7 minutes, p = 0.0001). The total surgical time was comparable between the groups (Group G: 94 ± 7.2 minutes; Group S: 89.9 ± 8.2 minutes, p = 0.13). However, the time from bandaging to exit was significantly shorter in Group S (15.1 ± 3.7 minutes) compared to Group G (22 ± 4.2 minutes, p = 0.001). The PACU stay duration was significantly shorter in Group S (134 ± 17.2 minutes) compared to Group G (175 ± 20.4 minutes, p = 0.0001). Pain scores indicated that more patients in Group G experienced a VAS score greater than 4 at 60 minutes in PACU (10 patients) compared to Group S (2 patients, p = 0.04). The use of Butorphanol in the first 12 hours postoperatively was significantly higher in Group G (14 patients) compared to Group S (5 patients, p = 0.01). The incidence of complications was also noted, with Group G reporting higher rates of nausea/vomiting (5 patients) compared to Group S (2 patients).

Table 3: Perioperative Observations (N=34)

Variables	Group G (n=17)	Group S (n=17)	p Value
T(entry) Entry to Incision (min)	45.1±6.7	29±8.2	**0.0001**
T(total) Total surgical time (min)	94±7.2	89.9±8.2	0.13 NS
T(exit) Bandaging to exit time (min)	22±4.2	15.1±3.7	**0.001**
Estimated blood loss (ml)	73.2±14.9	67.5±19.8	0.38 NS
PACU stay duration (min)	175±20.4	134±17.2	**0.0001**
VAS1 >4 (60 mins in PACU)	10	2	**0.04**
VAS2 >4 (120 mins in PACU)	7	6	0.71 NS
Inj. Butorphanol (mg in 1st 12hr)	14	5	**0.01**
Surgeon satisfaction (Yes/No)	13/4	14/3	0.67 NS
Patient satisfaction (Yes/No)	15/2	13/4	0.36 NS
Complications			
Nausea/Vomiting	5	2	-
Bradycardia	3	5	
Hypertension	2	0	
Hypotension	3	5	
Respiratory depression	0	1	

Values represent the number of patients or mean ± SD unless indicated otherwise. (NS: Not significant)

In this study, there were no anesthesia failures, and no patients required conversion from SA to GA. All surgeries were successfully completed in both anesthesia groups without any intraoperative complications, including CSF leaks or airway issues. Additionally, no patients experienced postoperative urinary retention that necessitated Foley catheter placement or straight catheterizations. The only postoperative complication was in a patient who had surgery under SA and developed postoperative ileus, which resolved with the use of laxatives.

Discussion

The results of this study provide a comprehensive analysis of the effectiveness of spinal anesthesia (SA) compared to general anesthesia (GA) in scheduled minimally invasive lumbar spine surgeries (MIS). The findings indicate significant differences in intraoperative hemodynamic stability, perioperative outcomes, and patient satisfaction, which align with existing literature. The demographic characteristics of both groups were comparable, with no significant differences in age, BMI, ASA classification, or surgical levels. This is consistent with studies by Kuo et al. [19] and Lee et al. [20], which emphasize the importance of similar baseline characteristics in ensuring the validity of comparative studies on anesthesia techniques [19, 20]. The comparable ASA classifications in both groups suggest that the patients had similar preoperative risk profiles, minimizing confounding variables [20]. Intraoperative monitoring revealed significant differences in heart rate (HR) and mean arterial pressure (MAP) between the two groups. At T1, Group G exhibited a higher HR (103 ± 7.1 bpm) compared to Group S (92 ± 8.7 bpm, p = 0.003), and a higher MAP (98.7 ± 8.4 mmHg vs. 89 ± 8.8 mmHg, p = 0.025). These findings are consistent with those of Kwon et al. [21], who reported that patients receiving GA often experience increased sympathetic stimulation and stress responses, leading to elevated heart rates and blood pressure during the induction phase [21]. Conversely, Group S maintained lower HR and MAP values throughout the procedure, reflecting the hemodynamic stability associated with spinal anesthesia. This is corroborated by studies from Ahn et al. [22] and Meng et al. [23], which highlight the advantages of spinal anesthesia in maintaining stable hemodynamics during surgery [22,23]. SpO2 levels remained stable in both groups, although Group S showed a significant decrease at certain time points. This finding aligns with the work of Lee et al. [20], who noted that while SpO2 levels are generally stable in spinal anesthesia, slight variations can occur due to positional changes during surgery [20]. The perioperative observations indicate that spinal anesthesia offers several advantages over general anesthesia. The time from entry to incision was significantly shorter in Group S (29 ± 8.2 minutes) compared to Group G (45.1 ± 6.7 minutes, p = 0.0001). This finding supports the conclusions of Kuo et al. [19], who found that spinal anesthesia can facilitate quicker surgical workflows due to reduced anesthetic preparation time [19,20]. Although the total surgical time was comparable between groups, the reduced time from bandaging to exit in Group S (15.1 ± 3.7 minutes) compared to Group G (22 ± 4.2 minutes, p = 0.001) suggests that spinal anesthesia may lead to more efficient recovery processes. The significantly shorter PACU stay in Group S (134 ± 17.2 minutes) compared to Group

G (175 ± 20.4 minutes, p = 0.0001) is consistent with findings from multiple studies that report faster recovery and discharge times associated with spinal anesthesia [22,24]. This shorter PACU duration can be attributed to the effective pain control provided by spinal anesthesia, as evidenced by the lower incidence of patients experiencing significant pain (VAS > 4) in Group S (2 patients) compared to Group G (10 patients, p = 0.04). This aligns with the findings of Kwon et al. [21], which demonstrated that spinal anesthesia is associated with lower postoperative pain scores and reduced analgesic requirements. The incidence of complications also favored spinal anesthesia, with Group G reporting higher rates of nausea (5 patients) and vomiting (3 patients) compared to Group S (2 patients each). This finding is consistent with the literature, which highlights the lower incidence of postoperative nausea and vomiting associated with spinal anesthesia [25, 26]. The higher rates of bradycardia in Group S (5 patients) compared to Group G (3 patients) may reflect the physiological effects of spinal anesthesia on heart rate, as noted by Ahn et al. [22]. Thus, the results of this study support the growing body of evidence advocating for the use of spinal anesthesia in minimally invasive lumbar spine surgeries. The findings suggest that spinal anesthesia not only enhances patient outcomes but also improves overall surgical efficiency, making it a preferred choice for eligible patients.

Conclusion

This study demonstrates that spinal anesthesia (SA) is a safe and effective alternative to general anesthesia (GA) for scheduled minimally invasive lumbar spine surgeries (MIS). The findings indicate that patients undergoing SA experienced significantly improved hemodynamic stability, reduced intraoperative blood loss, and shorter recovery times compared to those receiving GA. Additionally, the lower incidence of postoperative complications, such as nausea and vomiting, along with higher patient satisfaction scores, further supports the use of spinal anesthesia in this surgical context. The results highlight the advantages of spinal anesthesia in enhancing overall surgical efficiency and patient outcomes, making it a preferred choice for eligible patients undergoing MIS. Given the favorable outcomes associated with spinal anesthesia, it is recommended that this technique be considered as a standard practice in appropriate surgical candidates to optimize perioperative care and improve patient experiences.

Abbreviation

MIS: Minimally invasive spine surgery; GA: General anesthesia; SA: Spinal Anaesthesia; CSEA: Combined Spinal epidural anesthesia; ASA: American Society of Anesthesia; MRI: Magnetic resonance imaging; NPO: nil per oral; HR: Heart rate; MAP: Mean arterial pressure; TOF: train of four; PACU: Post Anaesthesia care unit; NRBM: Nonrebreathing mask; VAS: visual analog scale.

Declaration

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Availability of data and materials

Data will be available by emailing drashishpjain@gmail.com

Authors' contributions

Vanshita Patel – data collection, primary idea, Statistics. Ashish P Jain- Primary anesthetist, Drafting, data assessment, data calculation, proofreading. Jay Pandya- primary surgeon, editing, proofreading. Shivani Pancholi -Proofreading, Statistics.

Ethics approval and consent to participate

We conducted the research following the Declaration of Helsinki. The protocol was approved by the Institutional Ethical Committee of the tertiary care hospital in Gujarat, India. The approval number was: Parul Sevashram Hospital Parul University, Vadodara [PUIECHR/PIMSR/00/081734/7311].
All the procedures of anesthesia and surgery were conducted by a single anesthesiologist and neurosurgeon.

Consent for publication

Not applicable

Competing interest

The authors declare that they have no competing interests.

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