DOI: 10.7860/JCDR/2025/80700.21930

Original Article

Anaesthesia Section

Comparison of the Outcomes between General Anaesthesia versus Combined Epidural and General Anaesthesia in Elective Lumbar Spine Surgery: A Randomised Control Study

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ABSTRACT

Introduction: The choice of anaesthesia technique in elective lumbar spine surgery significantly influences perioperative outcomes. While General Anaesthesia (GA) remains the standard approach for lumbar spine surgery, Combined Epidural and General Anaesthesia (CEGA) has gained attention for its potential benefits.

Aim: To compare intraoperative and postoperative outcomes of GA versus CEGA in patients undergoing elective lumbar spine surgery.

Materials and Methods: This randomised controlled trial was conducted in the Department of Anaesthesiology at a tertiary care centre, BLDE (Deemed to be University) Shri BM Patil Medical College, Hospital and Research Centre in Vijayapura, Karnataka, India, on 64 patients of American Society of Anesthesiologists (ASA) grade I and II scheduled for elective lumbar spine surgery from December 2023 to November 2024. Participants were randomly assigned to receive either GA (Group A) alone or CEGA (Group B). The parameters observed included intraoperative vitals, isoflurane requirement, total blood loss during the surgery, and postoperative parameters such as vitals, pain assessed by Visual Analogue Scale (VAS), the rescue analgesic used, and intraoperative and postoperative complications. The Chi-square test was used for data comparison between the groups.

Results: The mean ages were 40.34±11.05 years in Group A and 43.13±10.80 years in Group B. Preliminary results indicate that patients in the CEGA group experienced better intraoperative haemodynamic stability than those in the GA group. The inhalational anaesthetic requirement in CEGA (0.388±0.178) was significantly lower than in the GA group (0.782±0.278) ($p<0.05$). Intraoperative blood loss was higher in GA (387.5±101.6 mL) than in CEGA (138.75±37.22 mL) ($p<0.05$). In the postoperative period, the VAS score was higher in the GA group (4.43±0.58) than in the CEGA group (3.32±0.63) ($p<0.05$), and the time to first rescue analgesic requirement was significantly longer in the CEGA group (7.50±1.27 h) ($p<0.05$).

Conclusion: The use of CEGA in elective lumbar spine surgery appears to offer significant advantages over GA alone in terms of intraoperative isoflurane use, blood loss, and postoperative pain management, suggesting that CEGA may be the preferable anaesthetic technique for lumbar spine surgery. Further research with a larger sample size is recommended to validate these results.

Keywords: Intraoperative analgesia, Lumbar laminectomy, Lumbar discectomy, Neuroanaesthesia, Neuraxial, Postoperative pain

INTRODUCTION

Lumbar spinal disorders significantly contribute to morbidity and functional impairment. Worldwide, lumbar spine surgery is a crucial intervention, offering relief to many who suffer from lower back and lower extremity discomfort [1].

In the current era, advancements in surgical procedures involving the spine and spinal cord have significantly broadened the scope of treatment possibilities. With the rise in long-term back problems and advances in surgery, a broad spectrum of conditions, ranging from single level to complex multistage reconstructions, is now being effectively managed. Given advantages such as better patient tolerance, a secure airway, enhanced surgical field exposure with muscle relaxants, early postoperative assessment, and better management of intraoperative haemodynamic fluctuations, GA is commonly favoured for spinal surgeries. Nevertheless, it carries its risks, particularly for elderly patients and those with compromised cardiopulmonary conditions [2].

Epidural neuraxial anaesthesia is more frequently utilised as an adjunct to general or spinal anaesthesia for postoperative pain management. The strong sympathetic blockade achieved by intraoperative neuraxial anaesthesia enhances blood flow to the lower extremities, decreases the risk of hypercoagulability, and reduces the workload on the heart. Perioperative epidural analgesia, which combines low dose local anaesthetics with opioids, offers distinct advantages, primarily in terms of enhanced pain relief and reduction or elimination of systemic opioid use. Therefore, perioperative neuraxial analgesia may enhance early bowel movement, reduce respiratory complications, facilitate earlier mobilisation, and ultimately reduce the risk of thrombosis [3].

While GA remains the standard approach in lumbar spine surgeries, there is a growing body of evidence suggesting that CEGA may offer improved perioperative outcomes. However, many existing studies focus primarily on postoperative analgesia or individual parameters such as blood loss or opioid requirement, often without a comprehensive evaluation of both intraoperative and postoperative variables in a single randomised design [4-7].

This study aimed to assess the effects of GA and the combined epidural/GA technique on intraoperative inhalational agent use, postoperative rescue analgesic requirements, and complications related to the choice of anaesthesia following spine surgery.

MATERIALS AND METHODS

The present randomised, double-blinded clinical trial was conducted in the Department of Anaesthesiology at a tertiary care centre, BLDE

(Deemed to be University) Shri BM Patil Medical College, Hospital and Research Centre in Vijayapura, Karnataka, India, for a duration of one year, from December 2023 to November 2024, after approval by the Institutional Ethical Committee (BLDE(DU)/IEC/947/2023-24). The study is registered with the Clinical Trials Registry - India (CTRI) (CTRI/2023/11/060016).

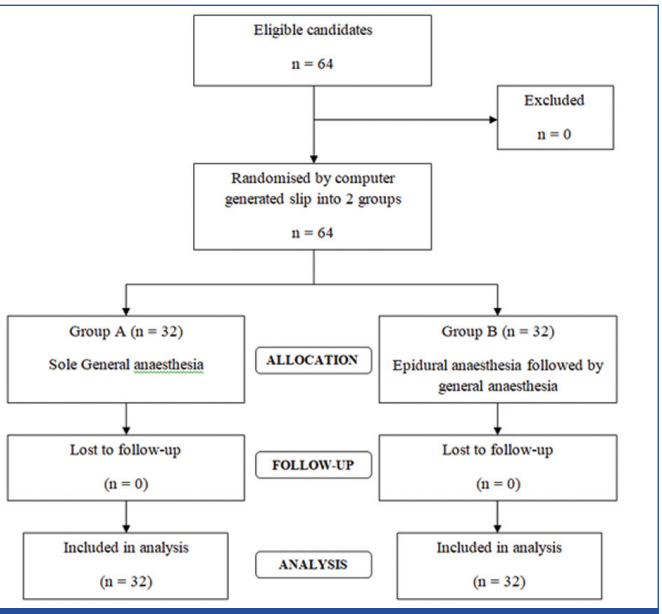
Sample size calculation: The sample size calculation was performed to achieve 90% power and a 5% significance level (two-sided) for detecting differences in the incidence of postoperative tachycardia, using a Chi-square test in G*Power version 3.1.9.4 software. The calculation was based on findings from a prior randomised clinical trial by Khajavi MR et al., which reported a significant reduction in tachycardia incidence between groups: 80% in the GA group and 30% in the combined epidural/GA group [4]. Assuming equal group sizes, the minimum required total sample size was calculated to be 46 participants (23 in each group). To ensure adequate power and account for possible dropouts, our study included a total of 64 participants (32 per group).

Inclusion criteria: Patients of either sex aged between 18-65 years with American Society of Anaesthesiologists (ASA) grade I or II posted for elective lumbar disc surgeries involving one or two levels were included in the study.

Exclusion criteria: Patients were excluded if they refused the procedure, if BMI exceeded 30, or if they had absolute contraindications to neuraxial anaesthesia such as systemic anticoagulation, systemic septicaemia, or local infection at the epidural site.

Study Procedure

All patients enrolled in this study underwent a thorough history taking, including past medical and surgical history and prior anaesthesia for surgery. The preoperative assessment also included a complete physical examination with recording of vital parameters (pulse rate, respiratory rate, blood pressure, height, weight and temperature) and examination of vital organ systems (cardiovascular, respiratory, central nervous and vertebral systems). An assessment of the airway was performed based on Mallampati grading and mouth opening to assess potential intubation difficulties, if any. Routine investigations included complete blood count, viral serology, and Electrocardiography (ECG). After explaining the risks and complications associated with the procedure, written informed consent was obtained to participate in the study. Patients were randomised using a computer generated randomisation schedule. On confirmation of nil per os status, enrolled patients were shifted to the operating theatre and the ASA standard monitors were connected. Baseline vital parameters were recorded [Table/Fig-1].



[Table/Fig-1]: Consolidated Standards of Reporting Trials (CONSORT) flow diagram.

Group A (GA): Participants in Group A received intravenous premedication consisting of glycopyrrolate 0.2 mg, ondansetron 4 mg, and midazolam 1 mg, followed by induction with propofol 2-3 mg/kg, fentanyl 100 µg, and atracurium 0.5 mg/kg. Intubation was performed with an appropriately sized endotracheal tube, and anaesthesia was maintained with nitrous oxide/oxygen (N_2O/O_2) and isoflurane.

Group B (CEGA): Participants in Group B were first administered epidural anaesthesia in the sitting position with an 18G Tuohy needle after confirmation of the epidural space. A single-shot injection of 20 mL of 0.25% bupivacaine (45 mg) and fentanyl 25 µg (0.5 mL) in 20 mL distilled water was administered at or below the surgical level [8]. Following the epidural administration, the patient was made supine, and GA was carried out as described above, except that fentanyl 75 µg was administered intravenously during induction, as 25 µg had already been added in the epidural shot, to avoid bias toward opioid administration and to maintain a constant total opioid dose between groups.

Method and blinding: Allocation was computer generated, and sealed envelopes were prepared by an independent anaesthesiologist. Both the enrolled patient and the anaesthesiologist performing the procedure were blinded to the plan of anaesthesia. The chief anaesthesiologist opened the envelopes just before the procedure, while the data collectors, postoperative care nurses, and patients remained blinded to the assignment.

Intraoperative monitoring: Intraoperative parameters {Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), isoflurane use, and blood loss} were recorded every five minutes for the first 30 minutes, then every 15 minutes thereafter. The Bispectral Index Score (BIS) was maintained at 40-60 to guide isoflurane administration. All surgeries were performed by the same surgeon.

Management of intraoperative events: Intraoperative hypotension (MAP <65 mmHg) was treated with intravenous ephedrine 5 mg boluses to a maximum of 30 mg; if hypotension persisted, intravenous phenylephrine 100 µg bolus was administered. In the event of bradycardia (HR <60 bpm), intravenous atropine 0.6 mg was given. Intraoperative blood loss was recorded at the end of the surgery by measuring collected blood in the suction apparatus and summing the volumes absorbed by fully soaked 10×10 cm gauzes (12 mL) and 30×30 cm gauzes (100 mL).

Reversal and recovery: Reversal of anaesthesia was achieved with neostigmine 2.5 mg and glycopyrrolate 0.5 mg after spontaneous breathing resumed, followed by extubation. Patients were transferred to the Post Anaesthesia Care Unit (PACU) with standard monitoring. A modified Aldrete score ≥ 9 allowed transfer to the ward, where heart rate, blood pressure, pain scores, and postoperative complications were monitored. Rescue analgesia (diclofenac 75 mg intramuscular) was administered when the Visual Analog Scale (VAS) was ≥7 or on demand. Postoperative vitals, VAS scores, first rescue analgesia requirement, and postoperative complications such as Postoperative Nausea and Vomiting (PONV) and Catheter-Related Bladder Disturbances (CRBD) were monitored in both groups.

STATISTICAL ANALYSIS

Data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) (version 20). Results are presented as mean±SD, counts, percentages, and figures. ANOVA was used for normally distributed continuous variables, while the Kruskal-Wallis test was used for non-normally distributed variables. The Chi-square test compared categorical variables between the two groups. A p-value <0.05 was considered significant, with all tests two-tailed.

RESULTS

1 **Age, gender and ASA grade distribution:** No significant differences were observed between groups regarding

demographic characteristics (age, sex, and ASA grade) [Table/Fig-2].

2 **Intraoperative heart rate:** Heart rate remained stable and comparable between groups from intubation up to 10 minutes (p>0.05). Group B had a significantly lower heart rate than Group A from 10 minutes to 120 minutes after intubation (p<0.05). The greatest difference was observed between 90 and 120 minutes. At 90 minutes, the heart rate was 84.97±12.64 bpm in Group A (CI 79.63-90.31) and 72.88±8.05 bpm in Group B (CI 70.10-75.66), i.e., about 10-12 bpm lower in Group B compared with Group A [Table/Fig-3].

3 **Intraoperative blood pressure and MAP:** At all time points post-induction, SBP, DBP, and MAP were consistently lower in Group B than in Group A [Table/Fig-4]. At multiple time points, Group B patients had more stable and controlled intraoperative blood pressure compared with Group A (p<0.05).

4 **Bispectral index monitoring:** The p-value was significant (p<0.05) during the first 45 minutes of surgery, suggesting that Group B patients (Mean 50.00±2.69; CI 48.97-51.03) had greater anaesthetic depth in the early duration of surgery compared with Group A (Mean 51.75±2.69; CI 50.71-52.79) [Table/Fig-5]. This can be attributed to the synergistic action of epidural anaesthesia.

5 **Isoflurane requirement:** The mean highest isoflurane concentration in Group A was 1.041% at 10 minutes and gradually decreased over time. In Group B, the highest mean concentration was 0.688% at 10 minutes and decreased thereafter. At 120 minutes, there was a significant difference: Group A 0.622% (CI 0.4884-0.7556) vs Group B 0.275% (CI 0.2247-0.3253) (p<0.05) [Table/Fig-6]. The mean value of inhalational anaesthetic agents required in CEGA (0.388±0.178) was significantly lower than in the GA group (0.782±0.278) (p<0.05).

6 **Total amount of blood loss:** The mean blood loss was 387.50±101.60 mL in Group A and 138.75±37.22 mL in Group B, a predominantly lower value in Group B. The p-value was<0.001, indicating a highly significant difference in blood loss between the groups.

7 **Postoperative vitals:** Group B showed significantly lower SBP, DBP, and MAP in the early postoperative period up to 12 hours compared with Group A (p<0.05). By 24 hours, blood pressure was similar between the groups (p>0.05). These findings suggest that epidural anaesthesia provides hemodynamic stability in the immediate postoperative period [Table/Fig-7].

8 **VAS score and analgesic requirement:** In the postoperative period, the VAS score was higher in the GA group (4.43±0.58) than in the CEGA group (3.32±0.63) (p<0.001) [Table/Fig-8]. The duration (in hours after surgery) to the first rescue analgesic requirement was significantly longer in the CEGA group (7.50±1.27 h) compared with the GA group (1.00 h) (p<0.05).

Parameters		Group A (n=32)	Group B (n=32)	Chi-square test value	p-value
Age (years)		40.34±11.05	43.13±10.80	2.796	0.731
Gender	Male	16 (48.5%)	17 (51.5%)	0.063	0.802
	Female	16 (51.6%)	15 (48.4%)		
ASA	I	24 (75%)	23 (71.87%)	0.080	0.777
	II	8 (25%)	9 (28.12%)		

[Table/Fig-2] Demographic data of both the groups.
Data were presented as mean and standard deviation or as number and percentage
P <0.05 is considered significant.

Heart rate (bpm)	Group A (Mean±SD)	Group A (CI)	Group B (Mean±SD)	Group B (CI)	Mann-Whitney test	p-value
5 min	83.19±13.441	(78.34, 88.04)	86.63±14.606	(81.36, 91.90)	462.500	0.506
10 min	95.75±17.177	(89.13, 102.37)	86.38±15.723	(81.27, 91.49)	352.500	0.032*
15 min	92.56±15.195	(86.72, 98.40)	81.19±12.504	(76.65, 85.73)	300.000	0.004*
20 min	91.63±14.573	(85.87, 97.39)	79.81±11.674	(75.59, 84.03)	244.000	<0.001*
25 min	89.03±14.499	(83.28, 94.78)	78.78±13.015	(73.88, 83.68)	292.500	0.003*
30 min	87.53±15.134	(81.84, 93.22)	78.81±12.458	(74.16, 83.46)	301.500	0.005*
45 min	86.84±13.598	(81.29, 92.39)	76.72±10.199	(72.92, 80.52)	270.000	0.001*
60 min	85.75±13.498	(80.24, 91.26)	75.13±8.515	(72.04, 78.22)	256.500	0.001*
75 min	85.84±12.796	(80.42, 91.26)	73.84±8.188	(70.98, 76.70)	219.000	<0.001*
90 min	84.97±12.635	(79.63, 90.31)	72.88±8.051	(70.10, 75.66)	211.000	<0.001*
105 min	82.69±14.120	(76.73, 88.65)	72.31±8.326	(69.56, 75.06)	243.000	<0.001*
120 min	84.09±12.172	(79.64, 88.54)	74.00±8.160	(70.38, 77.62)	250.500	<0.001*

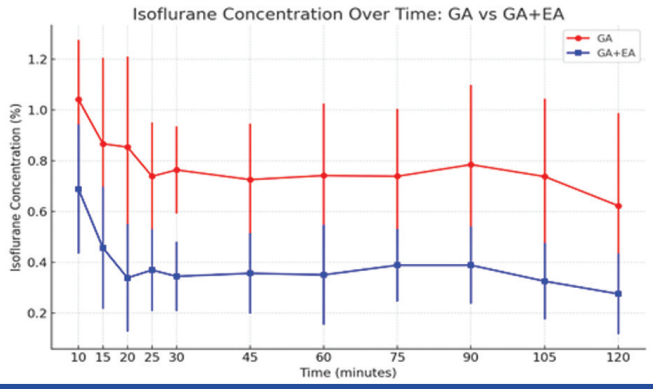
[Table/Fig-3]: Intraoperative Heart rate comparison between both groups.
GA: General anaesthesia; EA: Epidural anaesthesia; SD: Standard deviation; CI: Confidence interval; *statistically significant as p-value is less than 0.05

MAP (mmHg)	Group A (Mean±SD)	Group A (CI)	Group B (Mean±SD)	Group B (CI)	Mann-Whitney test	p-value
5 min	79.59±9.497	(76.16, 83.02)	74.69±9.110	(71.41, 77.97)	376.500	0.067
10 min	86.84±13.323	(81.17, 92.51)	72.41±12.160	(67.94, 76.88)	178.000	<0.001*
15 min	78.53±10.039	(75.02, 82.04)	66.91±9.610	(62.92, 70.90)	209.500	<0.001*
20 min	74.47±7.624	(71.83, 77.11)	66.16±8.211	(63.34, 68.98)	241.000	<0.001*
25 min	71.69±8.623	(68.82, 74.56)	67.81±8.213	(64.97, 70.65)	383.000	0.083
30 min	72.56±8.036	(69.70, 75.42)	66.94±4.550	(65.36, 68.52)	313.500	0.007*
45 min	75.31±8.686	(72.52, 78.10)	68.28±6.259	(66.08, 70.48)	250.500	<0.001*
60 min	74.66±12.838	(69.08, 80.24)	67.31±6.860	(65.42, 69.20)	319.500	0.010*
75 min	74.31±10.639	(69.94, 78.68)	69.75±4.522	(68.15, 71.35)	342.500	0.022*
90 min	77.53±12.485	(72.82, 82.24)	70.06±4.852	(68.26, 71.86)	297.500	0.004*
105 min	76.41±11.562	(71.93, 80.89)	70.75±5.035	(68.63, 72.87)	310.500	0.007*
120 min	79.31±11.577	(74.77, 83.85)	71.59±6.652	(68.99, 74.19)	270.500	0.001*

[Table/Fig-4]: Comparison of mean arterial pressure.
GA: General anaesthesia; EA: Epidural anaesthesia; SD: Standard deviation; CI: Confidence interval; *statistically significant as p-value is less than 0.05

Bispectral index	Group A (Mean±SD)	Group A (CI)	Group B (Mean±SD)	Group B (CI)	Mann-Whitney test	p-value
5 min	-	-	-	-	-	-
10 min	58.31±1.447	(57.79, 58.83)	55.63±3.170	(54.49, 56.77)	189.500	<0.001*
15 min	55.50±2.514	(54.64, 56.36)	52.53±3.213	(51.39, 53.67)	218.500	<0.001*
20 min	53.44±3.172	(52.30, 54.58)	50.88±3.077	(49.76, 51.99)	270.000	0.001*
25 min	51.97±2.694	(50.95, 52.99)	50.63±2.406	(49.70, 51.56)	356.500	0.034*
30 min	51.88±2.240	(50.93, 52.83)	50.47±2.328	(49.66, 51.28)	347.500	0.025*
45 min	51.75±2.688	(50.71, 52.79)	50.00±2.688	(48.97, 51.03)	334.500	0.015*
60 min	51.47±2.874	(50.40, 52.54)	50.69±2.533	(49.77, 51.61)	460.000	0.478
75 min	52.25±3.654	(50.96, 53.54)	52.16±2.490	(51.29, 53.03)	498.000	0.850
90 min	53.41±3.425	(52.19, 54.63)	53.88±2.837	(52.88, 54.88)	479.000	0.655
105 min	55.16±2.852	(54.13, 56.19)	55.28±3.304	(54.15, 56.41)	489.000	0.755
120 min	57.19±1.712	(56.54, 57.84)	57.06±3.482	(55.78, 58.34)	444.500	0.358

[Table/Fig-5]: Bispectral index over time (GA vs GA+EA).
GA: General anaesthesia; EA: Epidural anaesthesia; SD: Standard deviation; CI: Confidence interval; *statistically significant as p-value is less than 0.05



[Table/Fig-6]: Line graph showing the isoflurane usage in both groups.

Time point	Parameter	Group A (Mean±SD)	Group B (Mean±SD)	Mann-Whitney Test	p-value
2nd h	SBP	130.53±7.25	113.91±6.50	63.000	<0.001*
	DBP	84.09±7.42	71.94±4.70	82.000	<0.001*
	MAP	98.38±6.16	85.75±4.81	69.500	<0.001*
6th h	SBP	122.19±6.76	113.69±8.27	237.500	<0.001*
	DBP	77.63±6.60	71.25±4.89	236.000	<0.001*
	MAP	91.47±5.81	85.19±5.16	227.500	<0.001*
12th h	SBP	120.06±8.09	114.69±9.21	347.500	0.023 *
	DBP	76.69±7.10	72.69±4.99	357.500	0.026 *
	MAP	88.84±6.96	86.38±6.53	418.000	0.201
24th h	SBP	120.25±8.69	117.13±7.43	404.000	0.128
	DBP	75.84±6.18	73.88±6.20	437.000	0.271
	MAP	88.38±5.84	86.91±5.30	429.500	0.254

[Table/Fig-7]: Comparison of SBP, DBP and MAP among both the groups.
GA: General anaesthesia; EA: Epidural anaesthesia; SD: Standard deviation; *statistically significant as p-value is less than 0.05

9 **Complications:** Hypotension was significantly more common in patients receiving epidural anaesthesia in addition to GA, whereas PONV and CRBD were more frequent in those receiving GA alone (p<0.05). The incidence of bradycardia was not significant (p=0.387) [Table/Fig-9].

Hence, the choice of anaesthetic technique should consider these potential complications to optimise patient outcomes.

DISCUSSION

Lumbar spine surgeries often require positioning the patient in the prone position. Traditionally, GA has been favored because it secures the airway and prevents movement or awareness during prone positioning. Although GA remains common, several studies have suggested regional anaesthesia may offer advantages [9-12]. Concerns about delayed nerve injury assessment and hematoma formation have limited widespread use, but evidence supports benefits of regional techniques in lumbar spine surgery [5,10-12].

VAS score	Group A (Mean±SD)	Group B (Mean±SD)	Mann Whitney Test	p-value
2nd hour	6.53±0.621	4.47±0.761	29.000	<0.001*
6th hour	5.00±0.672	4.13±0.833	225.000	<0.001*
12th hour	3.38±0.492	2.59±0.615	202.000	<0.001*
24th hour	2.81±0.535	2.09±0.296	173.000	<0.001*

[Table/Fig-8]: VAS Score comparison
GA: General anaesthesia; EA: Epidural anaesthesia; SD: Standard deviation; * statistically significant as p-value is less than 0.05

Complications	Group A (n=32)	Group B (n=32)	p-value
Hypotension	9 (28.13%)	22 (68.75%)	0.002*
Bradycardia	6 (18.75%)	10 (31.25%)	0.387
PONV	15 (46.88%)	4 (12.5%)	0.005*
CRBD	16 (50.0%)	2 (6.25%)	<0.001*

[Table/Fig-9]: Comparison of complications in both the groups.
*statistically significant as p-value is less than 0.05

An ideal anaesthetic method should provide rapid onset and recovery, maintain optimal intraoperative hemodynamic stability, and potentially reduce the need for blood transfusions. Additionally, anaesthetic considerations should aim to minimise postoperative pain and analgesic use, as well as nausea and vomiting, to facilitate early discharge from the PACU [13,14]. This study highlights the advantages of adding epidural anaesthesia to GA by demonstrating improved intraoperative hemodynamic stability, reduced inhalational anaesthetic requirements, and an uneventful postoperative period. No significant differences were observed between the groups in age, gender, or ASA classification (p>0.05), indicating compatibility. This is in line with Attari MA et al., who reported age in Group SA as 42.1±3.1 years and in Group GA as 45.1±2.9 years [15].

The heart rate remained consistently lower in Group B (GA+EA) compared with Group A (GA alone) from 10 minutes post induction onward, with statistically significant differences (p<0.05). At 10 minutes, the mean heart rate was 95.75±17.18 bpm in Group A and 86.38±15.72 bpm in Group B (p=0.032). The lower heart rate in Group B can be attributed to the sympathetic blockade provided by epidural anaesthesia, which helps maintain haemodynamic stability and reduces stress responses during surgery. Similarly, Khajavi MR et al., observed that the mean intraoperative heart rate was notably higher in Group A than in Group B, with an increased incidence of bradycardia in the latter. This may be attributed to variations in the local anaesthetic dosage used in their study [4]. By contrast, Suryavanshi VS et al., showed no statistically significant HR difference between the CEGA group and the GA group during the initial first hour post-induction [16].

Regarding SBP and DBP, these were significantly lower in Group B at multiple time points post induction ($p<0.05$). The MAP was also significantly lower in Group B at multiple time intervals post-induction, indicating better perfusion stability with epidural anaesthesia. Previous studies have noted that intraoperative MAP was significantly lower in the CEGA group compared with the GA group (Pan YS et al., and Tikuisis R et al.,) [17,18].

Isoflurane concentration was significantly reduced in the CEGA group ($p<0.05$), highlighting an anaesthetic-sparing effect, in line with Khajavi MR et al., and Casati et al., who reported about a 35% reduction in isoflurane use with epidural anaesthesia [4,6].

This study reported lower blood loss in Group B (138.75±37.22 mL) compared with Group A (387.50±101.60 mL) ($p<0.001$), demonstrating high significance. This aligns with observations from Matheson D, who stated that combined epidural and GA was markedly superior in controlling bleeding compared with GA with a mixture of nitrous oxide and pethidine/fluothane [19]. Similarly, Greenbarg PE et al., found that epidural anaesthesia reduced intraoperative bleeding ($p<0.05$), IV opioid use, and urinary retention in lumbar spine surgeries [20].

Pain assessment revealed significantly lower VAS scores for 24 hours, in agreement with Sale HK et al., (2016), who reported reduced pain in CEGA groups, especially in the first six hours [21]. The time to first postoperative analgesic administration was significantly longer in the CEGA group (Group B: 7.50±1.27 hours) versus Group A (1.00 hour), attributed to epidural fentanyl. Cherng CH et al., (2005) found that fentanyl with ropivacaine enhances sensory and motor blockade, while its nociceptive pathway blockade reduces pain and opioid requirements [22,23]. Additionally, CEGA reduced PONV, consistent with Demirel CB et al., (2003) and Jellish WS et al., (1996) [7,9].

Limitation(s)

The major drawbacks were that the present study was restricted to ASA I-II patients. Secondly, epidural administration can be difficult in obese patients and in those with a calcified spine. Accidental injury to the ligamentum flavum during lumbar spine surgery can lead to complications that may affect the efficacy of epidurally administered drugs, thus affecting the study outcome.

CONCLUSION(S)

This study concludes that combined epidural anaesthesia with GA provides superior intraoperative haemodynamic stability, reduces blood loss (resulting in a drier surgical field), lowers inhalational anaesthetic requirements during elective lumbar spine surgeries, and reduces postoperative VAS scores. Further studies with larger sample sizes and assessment of long-term postoperative outcomes are warranted to reinforce these findings and guide future anaesthetic protocols.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: May 24, 2025
- Manual Googling: Jul 18, 2025
- iThenticate Software: Jul 18, 2025 (10%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **May 22, 2025**
Date of Peer Review: **Jun 14, 2025**
Date of Acceptance: **Jul 18, 2025**
Date of Publishing: **Nov 01, 2025**