

Comparison of balanced anesthesia in spine surgery with dexmedetomidine added to sevoflurane and dexmedetomidine added to desflurane on recovery profile



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ABSTRACT

Background: Spine surgery is challenging to anesthesiologist due to various factors. It is important to provide intraoperative hemodynamic stability, clear surgical field and a conscious, and pain free comfortable patient post-operative. Sevoflurane and desflurane provide rapid recovery. Dexmedetomidine provides sedation, stable, hemodynamics and analgesia. Dexmedetomidine has become an integral part of balanced anesthesia along with inhalational anesthetics in spine surgery. **Aims and Objectives:** Our study was done to compare recovery profile of sevoflurane and desflurane with dexmedetomidine and compare total dose of dexmedetomidine required in both the groups. **Materials and Methods:** Sixty ASA I-II patients undergoing spine surgery were randomly divided into two groups: Group A – Sevoflurane + Dexmedetomidine and Group B – Desflurane + Dexmedetomidine. Postoperatively, time to eye opening and extubation time was measured. The patient was shifted to post-anesthesia care unit (PACU) 10 min after extubation. Fast-track criteria (FTC) score was assessed for 1 h post-extubation in PACU. **Results:** Mean time to eye opening in Group A: 13.07 ± 2.08 min which was significantly longer than in Group B: 9.17 ± 2.23 min ($P < 0.05$). Similarly, mean extubation time was shorter in Group B than in Group A, 12.77 ± 2.50 min versus 17.83 ± 2.68 min, respectively ($P < 0.05$). FTC score was significantly higher in Group B as compared to Group A at all times ($P < 0.05$), except at 60 min, when it was similar ($P = 1.000$). Discharge criteria from PACU in all patients were achieved at 15 min in Group B, while in Group A, it was achieved at 30 min. **Conclusion:** We found that desflurane and dexmedetomidine combination is superior to sevoflurane and dexmedetomidine in time to eye opening and extubation time. Higher post-anesthesia recovery score (FTC score) is seen in desflurane/dexmedetomidine group than sevoflurane/dexmedetomidine group.

Key words: Balanced anesthesia; Sevoflurane; Desflurane; Dexmedetomidine; Fast-track criteria

INTRODUCTION

Spine surgery poses challenge to the anesthesiologist due to significant blood loss, prolonged anesthesia, surgery in prone position, and acute post-operative pain management. The challenge to the anesthesiologist is to provide clear surgical field with reduced intraoperative blood loss while ensuring adequate oxygenation to the brain and spinal cord.

This can be achieved by providing “balanced anesthesia” which includes balance of agents and techniques be used to produce the different components of anesthesia, that is, analgesia, amnesia, muscle relaxation, and abolition of autonomic reflexes with maintenance of homeostasis.¹

Dexmedetomidine has been increasingly used in spine surgery as a part of balanced anesthesia for its sympatholytic,

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anesthetic sparing, and hemodynamic stabilizing properties and thus providing optimal surgical condition.² It has a hypnotic effect through action on α_2 receptors in the locus ceruleus and analgesic properties through receptor stimulation on the spinal dorsal horn. Dexmedetomidine has also been used in neurosurgical procedures involving neurophysiologic monitoring. Cortical evoked potentials amplitudes and latencies were minimally affected when using dexmedetomidine intraoperatively when patients underwent spine surgery.³

Inhaled anesthetics, sevoflurane and desflurane, have low blood gas partition coefficients (0.65 and 0.45, respectively) and, therefore, share the advantage of faster onset and offset of anesthesia as compared with older inhaled anesthetics and are thus suitable for fast-track neuroanesthesia.⁴

Balanced anesthesia with intraoperative infusion of dexmedetomidine with inhalational anesthetics provide satisfactory intraoperative conditions with improved hemodynamic stability and decreased post-operative pain level.²

Due to the increasing use of this combination in spine surgery, this study was done with a purpose to compare the recovery profile of sevoflurane and desflurane using fast-track criteria (FTC),⁵ when given as a part of balanced anesthesia along with intraoperative infusion of dexmedetomidine in both the groups. Total dose requirement of intraoperative dexmedetomidine was also measured in both the groups.

Aims and objectives

Study was done to compare sevoflurane and desflurane, in presence of dexmedetomidine as intraoperative infusion, with respect to:

- i. Time to eye opening
- ii. Extubation time
- iii. Post anesthesia recovery score (Fast Track Criteria Score)
- iv. Total dose requirement of intraoperative dexmedetomidine.

MATERIALS AND METHODS

This prospective randomized controlled study was conducted at Jaslok Hospital and Research Centre, Mumbai after approval from the Scientific and Ethical Committee and after obtaining written informed consent from the patients. Sixty ASA I-II patients aged 18–65 years undergoing elective lumbar spine surgery with more than 1½ h of anesthesia were divided

into two groups of 30 each: Group A – Sevoflurane + Dexmedetomidine and Group B – Desflurane + Dexmedetomidine. Patients with lung pathology, ischemic heart disease and various types of heart blocks, on beta-blocker therapy, morbid obesity, drug abuse, chronic alcoholic were excluded from the study. Randomization was done using computer generated non-sequential numbers. All patients were investigated and thorough pre-anesthetic assessment was done. After checking for NBM status and attaching standard monitors, patients were premedicated with inj. Glycopyrrolate 4 mcg/kg iv, inj. Midazolam 0.02 mg/kg iv and inj. Fentanyl 2 mcg/kg iv. Anesthesia was induced with inj. Propofol 2 mg/kg iv and inj. Vecuronium 0.1 mg/kg iv. After 3 min of ventilation with 100% O₂, direct laryngoscopy was performed and endotracheal intubation accomplished. Inj. Dexamethasone 0.2 mg/kg was given after intubation. Anesthesia was maintained with sevoflurane volume 1–3% in Group A and with desflurane volume 2–4% in Group B with nitrous oxide 50% in oxygen with fresh gas flow of 2 L/min. Both inhalational anesthetics were subsequently titrated and adjusted to maintain expired concentration up to 1.2 MAC for both sevoflurane and desflurane. Along with inhalational anesthetics, dexmedetomidine infusion was started at 0.2 mcg/kg/h. Titration of dexmedetomidine was done from 0.2 mcg/kg/h up to 0.7 mcg/kg/h to maintain mean arterial pressure between 65 and 90 mm Hg. Lungs were mechanically ventilated to maintain an end tidal CO₂ concentration to 35–40 mm Hg. The patient was turned to prone position on the standard operation table and a pair of chest rolls was placed between the chest of the patient and table. Eyes and pressure points were protected adequately. Inj. Vecuronium was given to maintain TOF count of one to two intraoperatively. At the end of the surgery, once surgical draping was removed, dexmedetomidine infusion and inhalational anesthetics were stopped and we went on full fresh gas flows of 100% oxygen. Inj. Ondansetron 4 mg iv and inj. Paracetamol 1 gm iv were given 15 min before completion of the surgery. Surgical incision was infiltrated with inj. Bupivacaine 0.25% in the dose of 1.5 mg/kg. Neuromuscular blockade was reversed with inj. Neostigmine 0.05 mg/kg iv and inj. Glycopyrrolate 8 mcg/kg iv. Once the TOF ratio of 0.90 was achieved and once patient was responding to commands, all patients were extubated. After discontinuation of anesthetic agent, time to eye opening and extubation time was measured. The patient was shifted to post-anesthesia care unit (PACU) 10 min after extubation. FTC score (Table 1) was assessed for 1 h post-extubation in PACU. Post-operative nausea and vomiting were treated with inj. Metoclopramide 10 mg iv. Rescue analgesia with inj. Diclofenac 75 mg

iv was given in the presence of VAS score >5 for pain. Discharge criteria from PACU included FTC score ≥ 13 .

Statistical analysis

Qualitative data were represented in form of frequency and percentage. Association between qualitative variables was assessed by Chi-Square test with continuity correction for all 2x2 tables and Fisher's exact test for all 2x2 tables, where P-value of Chi-square test was not valid due to small counts. Adjacent row data of more than 2x2 tables were pooled and Chi-square test reapplied in case more than 20.0% cells having expected count less than 5. Quantitative data were represented using mean \pm standard deviation and median and interquartile range. Analysis of quantitative data between the two groups was done using unpaired t-test if data passes "Normality test" and by Mann-Whitney U-test if data fails "Normality test." Results were graphically represented where deemed necessary. SPSS Version 17 was used for analysis and Microsoft Excel for graphs. $P < 0.05$ was considered statistically significant.

RESULTS

Sixty adult, ASA I/II patients undergoing elective lumbar spine surgery, were enrolled into the study. They were randomized into two groups of 30 each. Group A received

combination of sevoflurane and dexmedetomidine, while Group B received combination of desflurane and dexmedetomidine. Both the groups were comparable with regards to demographic data, duration of anesthesia, and pre-operative hemodynamic variables (Tables 2-4).

The mean time to eye opening in Group A was 13.07 ± 2.08 min, which was significantly longer than in Group B which was 9.17 ± 2.23 min ($P < 0.05$). Similar to the time to eye opening, the mean extubation time was shorter in Group B than in Group A, 12.77 ± 2.50 min versus 17.83 ± 2.68 min, respectively ($P < 0.05$) (Graph 1).

In our study, FTC score was significantly higher in Group B as compared to Group A at all times ($P < 0.05$), except at 60 min, when it was similar ($P = 1.000$). Discharge criteria from PACU in all patients were achieved at 15 min in Group B while in Group A, it was achieved at 30 min (Graph 2).

Total dexmedetomidine required in Group A was 39.03 ± 17.99 micrograms (mcg), while in Group B was 40.47 ± 11.47 mcg, which was statistically insignificant ($P = 0.363$).

The analgesic effects of dexmedetomidine have been demonstrated in numerous studies. The prevalence of

Table 1: Fast-track criteria

	Score
1.Level of consciousness	
Awake and oriented	2
Arousable with minimal stimulation	1
Response only to tactile stimulation	0
2.Physical activity	
Able to move all extremities on command	2
Some weakness in movement of extremities	1
Unable to voluntarily move extremities	0
3.Hemodynamic stability	
Blood pressure <15% of baseline MAP value	2
Blood pressure 15-30% of baseline MAP value	1
Blood pressure >30% below baseline MAP value	0
4.Respiratory stability	
Able to breathe deeply	2
Tachypnea with good cough	1
Dyspneic with weak cough	0
5.Oxygen saturation status	
Maintains saturation >90% on room air	2
Requires supplemental oxygen to maintain saturation >90%	1
Saturation <90% with supplemental oxygen	0
6.Post-operative pain assessment	
None or mild discomfort	2
Moderate to severe pain controlled with IV analgesics	1
Persistent severe pain	0
7.Post-operative emetic symptoms	
None or mild nausea with no active vomiting	2
Transient vomiting or retching	1
Persistent moderate to severe nausea and vomiting	0
Total score	14

Table 2: Association among the cases with respect to gender

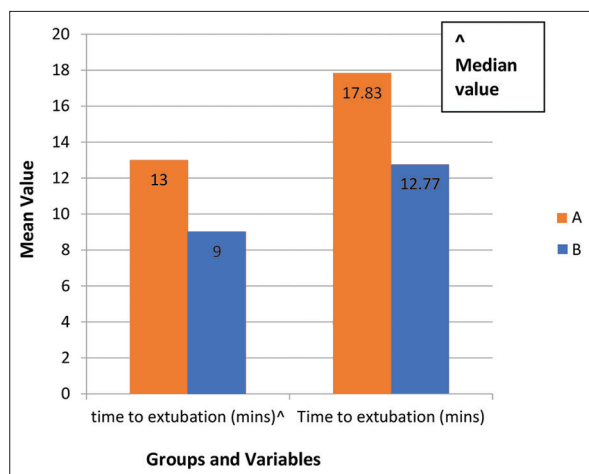
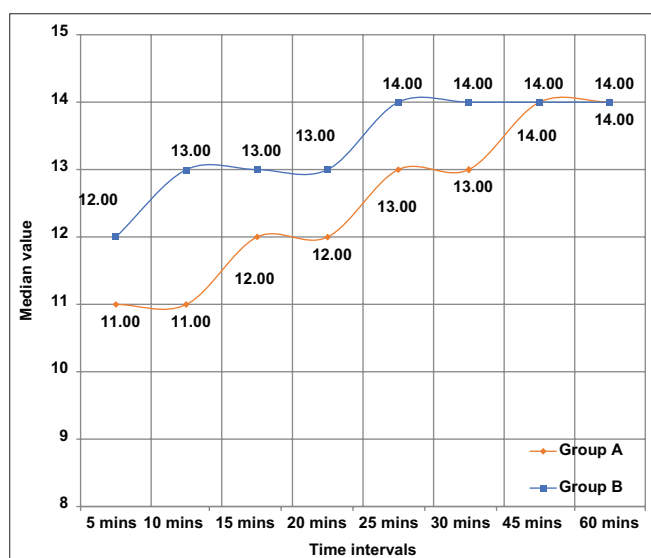
Gender	Group		Total
	A	B	
Female			
No.	14	15	29
%	46.7%	50.0%	48.3%
Male			
No.	16	15	31
%	53.3%	50.0%	51.7%
Total			
No.	30	30	60
%	100.0%	100.0%	100.0%
Chi-square tests	Value	Df	P-value
Pearson Chi-square	0.067	1	0.796
Continuity correction	0.000	1	1.000

Table 3: Comparison of age, BMI, and duration of anesthesia between Group A and Group B

Variables	Group	Mean	Standard deviation	t-value	P-value
Age (years)	A	51.77	9.66	-0.082	0.935
	B	51.97	9.32		
BMI (kg/m ²)	A	25.36	3.35	-0.405	0.687
	B	25.71	3.21		
Duration of anesthesia (min)	A	144.50	21.15	-0.090	0.929
	B	145.00	22.05		

Table 4: Comparison of pre-operative (pre-op) values of hemodynamic variables between Group A and Group B

Variables	Group	Mean	Standard deviation	Median	Interquartile range	t-value	P-value
Pre-operative HR	A	85.43	11.88	83.00	16.25	-1.414	0.163
	B	89.40	9.76	90.00	13.25		
Pre-operative SBP	A	139.90	13.74	138.00	20.00	0.553	0.582
	B	137.80	15.60	134.50	22.00		
Pre-operative DBP	A	82.10	8.58	80.00	8.50	1.401	0.166
	B	79.20	7.41	81.00	7.50		
Pre-operative MAP	A	101.07	9.53	100.50	11.25	-1.125	0.261
	B	98.07	9.86	98.50	10.25		

**Graph 1:** Comparison of time to eye opening and extubation between Group A and Group B**Graph 2:** Comparison of FTC score at various time intervals between Group A and Group B

consuming analgesic drug was 30.0% in Group A and 33.3% in Group B and was comparable in both the groups ($P=1.000$). The incidence of post-operative nausea and vomiting was 10.0% in both Group A and Group B ($P=1.000$).

DISCUSSION

Spine surgery is challenging to anesthesiologists in many ways. Patient needs to be hemodynamically stable intraoperative and pain free, comfortable, and conscious post-operative. Both sevoflurane and desflurane used in balanced neuroanesthesia provide adequate intraoperative stability and are suitable for fast-track neuroanesthesia. Dexmedetomidine is helpful during spine surgery as it has hypnotic effect and analgesic properties with no respiratory depression and reduces anesthetic and analgesic requirements.

In our study, we found that Group B (desflurane/dexmedetomidine group) had significantly faster eye opening, extubation time, and recovery profiles than in Group A (sevoflurane/dexmedetomidine group).

Demographic data, duration of anesthesia, and pre-operative hemodynamic variables were comparable in both the groups.

The mean time to eye opening in Group A was 13.07 ± 2.08 min, which was significantly longer than in Group B which was 9.17 ± 2.23 min ($P < 0.05$). Similarly, the mean extubation time was shorter in Group B than in Group A, 12.77 ± 2.50 min versus 17.83 ± 2.68 min, respectively ($P < 0.05$).

Keles et al.,⁶ found that extubation time in Group (D+D) (5.9 ± 2.4) min was shorter than that in Group (S+D) (8.3 ± 3.9) min. Similarly, in our study, the mean extubation time was shorter in Group B (desflurane/dexmedetomidine) than in Group A (sevoflurane/dexmedetomidine). In our study, extubation time was more in both the groups compared to this, which may be due to difference in study population.

Patil et al.,⁷ studied 100 patients undergoing spinal surgeries and found that extubation time in Group D (10.1 ± 2.2) was shorter by 4.2 min than in Group S (14.2 ± 1.3).

Singh and Vansola⁸ reported D+D group had significantly faster extubation time (8.7 ± 1.22) than S+D group (12.33 ± 2.8).

Nithya et al.,⁹ concluded that both time taken for eye opening and extubation time was shorter in Group D+D than Group S+D in patient undergoing supratentorial tumor surgery.

Strum et al.,¹⁰ compared post-operative recovery after desflurane versus sevoflurane anesthesia in morbidly obese adults (body mass index ≥ 35 kg/m²) who underwent gastrointestinal bypass surgery through an open laparotomy. Time to eye opening was 9.9 ± 4.5 min in desflurane group and 18.5 ± 8.7 min in sevoflurane group, while extubation time was 14.2 ± 8.0 min in desflurane group and 25.5 ± 12.0 min in sevoflurane group.

Dexter et al.,¹¹ did meta-analysis of 29 randomized controlled trials through 2008 comparing extubation times with desflurane and sevoflurane and concluded that desflurane reduces the average extubation time and the variability of extubation time by 20–25% relative to sevoflurane and stated that extubation time is shorter by 20–25% in desflurane group.

In our study, FTC score was significantly higher in Group B as compared to Group A at all times ($P < 0.05$), except at 60 min, when it was similar ($P = 1.000$). Discharge criteria from PACU in all patients were achieved at 15 min in Group B while in Group A, it was achieved at 30 min.

Keles et al.,⁶ found that Group (D+D) had a higher FTC score than did Group (S+D) at all times. In all the patients, targeted discharge points were achieved at the 25th min in PACU.

Singh and Vansola⁸ concluded that $FTC > 13$ was achieved earlier in D+D group (15 min) than in S+D group (20 min).

White et al.,¹² in their study, compared FTC score between the two groups once on leaving operating room (OR) and found that sevoflurane group had median FTC score of 13, while desflurane group had median FTC score of 14.

Total dexmedetomidine required in both the groups were comparable. Total dexmedetomidine requirement in Group A was less than in Group B but was statistically insignificant ($P = 0.363$).

Keles et al.,⁶ found that the amount of dexmedetomidine required in both the groups were comparable, similar to our study.

Singh and Vansola⁸ concluded that dexmedetomidine requirement in D+D group was more compared to S+D group.

Similarly, Nithya et al.,⁹ had higher requirement of dexmedetomidine dose in desflurane group.

Keles et al.,⁶ observed that post-operative analgesic use in group (D+D) is statistically less than that in group (S+D). While in our study, analgesic consumption was 30.0% in Group A and 33.3% in Group B, which was statistically insignificant ($P = 1.000$).

Similarly, studies Patil et al.,⁷ and Singh and Vansola,⁸ observed that analgesic requirement in both the groups were comparable.

Ozkose et al.,² in their study, observed significant difference between requirement of analgesic between dexmedetomidine and control group, Thus, it is emphasized that when dexmedetomidine is used in spine surgery patients intraoperative, the need for analgesics during the post-operative period is less.

The incidence of post-operative nausea and vomiting was 10.0% in both Group A and Group B ($P = 1.000$).

Patil et al.,⁷ observed that 10% in Group D and 18% in Group S required antiemetics in post-operative period.

Massad et al.,¹³ evaluated the effect of adding dexmedetomidine to a balanced technique on post-operative nausea and vomiting after elective diagnostic laparoscopic surgeries. The total incidence of post-operative nausea and vomiting decreased significantly in the dexmedetomidine group.

Keles et al.,⁶ in their study, observed that the incidence of post-operative vomiting was 22.0% in Group (D+D) and 12.0 % in Group (S+D) ($P = 0.18$).

In our study, the incidence of antiemetic consumption was 10.0% in both Group A and Group B ($P = 1.000$). We considered that the low rates we found were due to the standard application of antiemetic regimen just before the surgery ended.

Limitations of the study

1. Findings of our study can't be generalized as it was done in a limited representation of patient population (single center study done in patients undergoing spine surgery)
2. Blinding was not possible in our study as the same person was operating the vaporizer and observing for data
3. BIS monitoring was not done to measure the depth of anesthesia in both desflurane and sevoflurane group, thereby altering awakening time from anesthesia.

CONCLUSION

Our study was done to evaluate, in which combination out of sevoflurane/dexmedetomidine and desflurane/

dexmedetomidine is better with respect to extubation time and post-operative recovery profile and we conclude that;

1. Desflurane and dexmedetomidine combination is superior to that of sevoflurane and dexmedetomidine in time to eye opening and extubation time
2. Higher post-anesthesia recovery score, that is, FTC score is seen in desflurane/dexmedetomidine group than sevoflurane/dexmedetomidine group
3. There is no significant difference between the two groups with respect to total dose of intraoperative dexmedetomidine required.

Thus, our study strengthens the knowledge that recovery profile is better in desflurane group compared to sevoflurane group even when given as a part of balanced anesthesia along with intraoperative dexmedetomidine infusion. Hence, the use of balanced anesthesia with desflurane and dexmedetomidine infusion for spine surgeries provides satisfactory intraoperative conditions with improved hemodynamic stability and decreased post-operative pain level, along with faster recovery profile. Should be incorporated in frequent clinical use. Still needs clinical trials with larger sample size.

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Authors Contribution:

RNC- Conducted study, concept, coordination, reviewed literature; **NJC**- Statistical analysis and interpretation, prepared first draft of manuscript; **AAP**- Design of study, prepared manuscript and revision of the manuscript

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