Original Article

A prospective randomized study comparing recovery following anesthesia with a combination of intravenous dexmedetomidine and desflurane or sevoflurane in spinal surgeries

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Abstract

Background and Aims: Desflurane and sevoflurane are inhalational anesthetics which provide stable intraoperative hemodynamics and rapid emergence from anesthesia. Dexmedetomidine is an α2-agonist with sedative and hypnotic effects. We compared recovery following anesthesia with a combination of a continuous intravenous infusion of dexmedetomidine and desflurane or sevoflurane in cases of spine surgeries because no such data are available from India.

Material and Methods: It was a single-blind, prospective, randomized study. After institutional ethics committee approval, patients were randomly allocated to one of the two groups of fifty patients each. Group D received desflurane and Group S received sevoflurane, along with dexmedetomidine 0.5 μg/kg/h IV infusion for maintenance of anesthesia.

Results and Conclusions: Extubation time (ET) in Group D was shorter by 4.2 min than in Group S (10.1 ± 2.2 and 14.2 ± 1.3; $P = 0.004$). Postoperative recovery, postoperative analgesic, and antiemetic requirement between the groups were comparable The mean dial setting required to maintain the minimum alveolar concentration of 1 intraoperatively was 3.1 for desflurane and 0.7 for sevoflurane.

Keywords: Desflurane, dial setting, extubation time, minimum alveolar concentration, postoperative recovery, sevoflurane

Introduction

Spine surgeries require general anesthesia and the key anesthetic considerations are intraoperative hemodynamic stability as well as early recovery from anesthesia, for immediate postoperative neurological assessment.[1]

Desflurane and sevoflurane are inhalational anesthetic agents which offer advantages such as stable intraoperative hemodynamic course and rapid emergence from anesthesia.[2,3] They have very low blood/gas partition coefficient (0.4 and 0.7, respectively) which offers rapid induction and emergence from anesthesia. Hence, these anesthetic agents are suitable for spine surgeries.[4,5]

Dexmedetomidine is a α2-agonist with sedative and hypnotic properties and maintains an arousable state. With its use, better perioperative hemodynamic control, less respiratory depression, anxiolysis, analgesic-sparing effect, and reduced postoperative shivering are noted.[6,7] Hence, we conducted this study to compare recovery from anesthesia using dexmedetomidine along with desflurane or sevoflurane as an inhalational agent in cases of spine surgeries lasting for more than 3 h in regard to extubation time (ET) and recovery using Fast -track criteria [Table 1] and Aldrete criteria (AC). We also noted the antiemetic and analgesic

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requirement and mean dial setting for both the agents to maintain minimum alveolar concentration (MAC) of 1.

Material and Methods

It was a single-blind, prospective, randomized, study conducted in patients undergoing spine surgery from July 2014 to August 2015. After obtaining the institutional ethics committee approval (Letter No: IEC (II)/OUT/996/14) and written informed consent from the patients involved in the study, 100 patients (50 in each group) were recruited by closed envelope method.

Statistical analysis

Data were described in terms of mean (±standard deviation), frequencies, and percentages where appropriate. Comparison of quantitative variables was done using Student's *t*-test if samples were normally distributed (e.g., weight, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MAP), MAC, ET, and duration of surgery and anesthesia). Mann–Whitney U-test was used for non-normally distributed quantitative and ordinal data (e.g., fast-track and Aldrete scores). For categorical data, Chi-square test was performed (e.g., age). Fisher's exact test was used for analysis of sex, the American Society of Anesthesiologists (ASA) grade, and postoperative analgesic and antiemetic requirements. Pearson's correlation matrix was used to correlate HR and dial setting findings with SBP and DBP and MAC. $P < 0.05$ was considered statistically significant. All statistical calculations were done using computer programs Microsoft Excel 2007 and SPSS Statistics for Windows, Version 17.0. Chicago: SPSS Inc.

We accepted a Type I error of 0.05 and a Type II error of 0.80 for detecting a true difference. A 0.5 or greater difference in dependent variables was considered clinically significant. As a result, we calculated that minimum 49 patients are needed in each group.

Patients in the age group of 18-65 years belonging to ASA Grade 1 and 2 posted for spine surgery with expected surgical time >180 minutes were included in the study.

The exclusion criteria were as follows:

1. Patients own refusal for participation in the study. 2. ASA Grade 3 and 4. 3. Age <18 and >65 years. 4. Emergency cases. 5. Patients with valvular heart disease, intracardiac shunts, hepatic or renal disease, severe pulmonary disease, chronic alcoholism, and drug abuse. 6. Body mass index >35. 7. Previous exposure of dexmedetomidine. 8. Patients on beta-blockers. 9. Conduction heart defects. 10. Pregnant and lactating mothers. 11. Intraoperative blood loss of >1500 ml.

Table 1: Fast track criteria

	Parameter	Score
Level of Consciousness	Awake and oriented	2
	Arousable with minimal stimulation	1
	Responsive only to tactile stimulation	0
Physical Activity	Able to move all extremities on command	2
	Some weakness in movement of extremities	1
	Unable to voluntarily move extremities	0
Hemodynamic Stability	Blood pressure <15% of baseline MAP value	2
	Blood pressure 15% >30% of baseline MAP value	1
	Blood pressure >30% of below baseline MAP value	2
Respiratory stability	Able to breathe deeply	2
	Tachypnea with good cough	1
	Dyspneic with weak cough	0
Oxygen Saturation	Maintains value >90% on room air	2
	Requires supplemental oxygen to maintain oxygen saturation >90%	1
	Saturation <90% with supplemental oxygen	0
Postoperative pain assessment	None or mild discomfort	2
	Moderate to severe pain controlled with IV analgesics	1
	Persistent severe pain	0
Postoperative Emetic Symptoms	None/mild nausea with no active vomiting	2
	Transient vomiting controlled with IV antiemetics	1
	Persistent moderate to severe nausea and vomiting	0
	Total Score	14

After preanesthetic evaluation and baseline investigations, a written informed consent was obtained from patients who fulfilled the inclusion criteria. Patients were taken to operation theatre. After securing intravenous access, standard monitoring was applied and during procedure an agent analyzer was utilized. All patients received injection midazolam (0.03–0.05 mg/kg) as premedication. Induction of anesthesia was accomplished with injection fentanyl (1–2 µg/kg), injection propofol (1–2 mg/kg) and injection vecuronium (0.1 mg/kg).

Anesthesia was maintained in group desflurane with desflurane + IV infusion of dexmedetomidine 0.5 µg/kg/h and in group sevoflurane with sevoflurane + IV infusion of dexmedetomidine 0.5 µg/kg/h in addition to oxygen 40% and nitrous oxide 60%.

Dexmedetomidine infusion was prepared as a concentration of 4 μg/ml in normal saline and administered at a constant rate of 0.5 μg/kg/h with infusion pump. Both the inhalational agents were titrated to maintain MAP above 60 mmHg and dial settings were adjusted to maintain stable hemodynamics. Target MAC of 1% was kept for both the agents.

The patients were ventilated with tidal volume of 6–8 ml/kg, respiratory rate of 8–12 breaths/min to maintain end‑tidal CO_2 between 30 and 35 mmHg.

Vital parameters such as HR, SBP, DBP, MAP electrocardiogram (ECG), oxygen saturation (SpO_2), MAC value, dial setting, and any untoward effects were recorded every 15 min during intraoperative period. If any episode of hypotension was observed, then inhalational agents were titrated but injection dexmedetomidine infusion was kept constant. Injection fentanyl 0.5 μg/kg was repeated every hourly for analgesia. Injection paracetamol 10 mg/kg was given for postoperative analgesia. Inhalational agents and dexmedetomidine infusion were stopped simultaneously just before the last stich of closure. Patients were reversed with injection neostigmine 0.05 mg/kg + injection glycopyrrolate 0.08 mg/kg.

The ET was noted from switching off of the inhalational agents and dexmedetomidine to the extubation of patients. Recovery scores were noted after extubation i.e. fast tract criteria and AC score at 5^{th} and 10^{th} min in the OR and at the 5^{th}, 15^{th} and 25^{th} min in postoperative recovery room during half an hour stay in PACU (Postoperative anesthesia care unit). When fast tract criteria score was ≥13 and AC score was ≥9, patients were discharged from PACU to ward.

After extubation till patient was in PACU, demand for pain relief was assessed by yes or no criteria and postoperative nausea and vomiting was noted in terms of present or absent, for 45 min after surgery. Any adverse effects if at all occurred were noted.

Results

Data from a hundred patients was analysed in the study. The demographic data of the patients in our study were comparable with respect to age, sex, 31 men in Group D and 30 men in Group S and weight and ASA status [Tables 2]. Mean dial setting required for desflurane group was 3.1±0.7 and for sevoflurane group was 0.7 ±0.2. ET was shorter for desflurane than for sevoflurane [Table 3]. Recovery from anesthesia assessed by fast tract criteria score and AC score was comparable in both the groups and the highest fast track criteria score of 14 and AC score of 10 were reached 5 min after transfer to PACU in both the groups. Ten percent of patients in desflurane group and 18% in sevoflurane group required antiemetics in postoperative period ($P = 0.249$). 10% of patients required analgesics in both the groups. Mean arterial pressures during the intraoperative period were stable and statistically similar in both the groups [Figure 1]. Fluctuations in terms of mean MAC were noted in both the groups after 2 h of surgery [Figure 2]. Bradycardia was noted in desflurane group at 45 and 60 min (63.8 ± 4.2 bpm and 66.6 ± 6.4 bpm and $P = 0.01$, 61.9 ± 2.9 bpm and 64.6 ± 5.7 bpm and $P = 0.004$, respectively). No adverse effects were noted with either of the agents.

Discussion

In our study, HR recordings showed bradycardia in group desflurane at 45 and 60 min interval intraoperatively. We observed statistically significant decrease in SBP variations in our study at 4h 15min, 5 h, and 7 h intervals. The DBP variations between the groups were comparable and no statistically significant difference was found. Similarly, in MAP recordings, no statistically significant differences were noted in our study implying that both the desflurane and sevoflurane are equally good in terms of hemodynamic stability.

Kaur *et al*. compared intraoperative hemodynamics and postoperative recovery characteristics of desflurane versus sevoflurane in morbidly obese patients undergoing laparoscopic bariatric surgery. They found that intraoperative MAP and HR did not differ between the two groups.[8]

Gergin *et al*. studied the hemodynamics, emergence, and recovery characteristics of sevoflurane with those of desflurane. Intraoperative changes in MAP and HR did not differ with both the agents.[9]

Jindal *et al*. studied the maintenance and emergence characteristics after anesthesia with sevoflurane or desflurane in female patients undergoing day‑care laparoscopic gynecological surgery. They found that SBP, DBP, and MAP were comparable between the groups.[10]

In our study, the HR, SBP, DBP, and MAP were compared at various intervals; slight decrease in HR with desflurane group and slight decrease in SBP with sevoflurane group were observed, but MAP was comparable in both groups.

Both sevoflurane and desflurane are currently used to produce balanced anesthesia to provide adequate intraoperative hemodynamic stability and are suitable for fast‑track neuroanesthesia.[11]

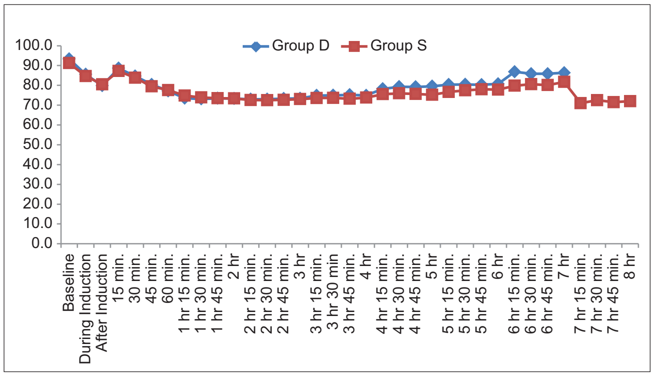

Figure 1: Mean arterial blood pressure in study groups

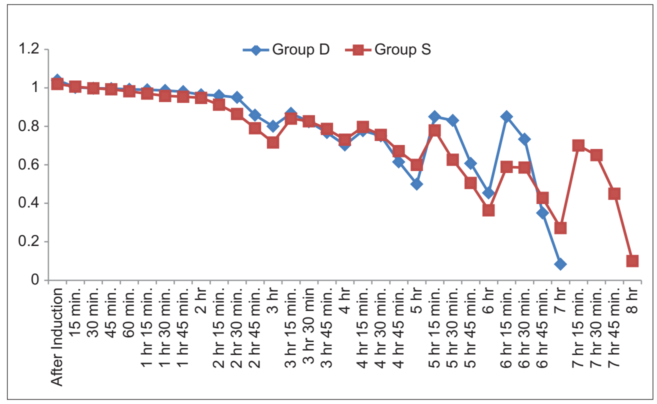

Figure 2: Minimum alveolar concentration in study groups

Table 2: Age distribution in study population

Age group (years)	Group		Total, *n* (%)
	D, *n* (%)	S, *n* (%)	
<30	13 (26.0)	19 (38.0)	32 (32.0)
31-40	16 (32.0)	16 (32.0)	32 (32.0)
41-50	13 (26.0)	12 (24.0)	25 (25.0)
51-60	6 (12.0)	3 (6.0)	9 (9.0)
>60	2 (4.0)	0	2 (2.0)
Total	50 (100.0)	50 (100.0)	100 (100.0)

Chi-square test, P=0.38

Table 3: Mean extubation time (Student's *t*-test)

Variables	Group	*n*	Mean±SD	*P*
Extubation time (min)	S	50	14.2±1.3	0.004
	D	50	10.1±2.2	
Duration of surgery (min)	S	50	256.6±75.2	0.92
	D	50	255.1±66.0	
Duration of anesthesia (min)	S	50	297.5±88.1	0.81
	D	50	293.7±74.7	

SD=Standard deviation

A study by Dexter *et al*. concluded that with desflurane, ET was shortened by 20%–25% and desflurane is a more economical option as it reduces the intraoperative stay by reducing ET on table and better AC and FTC scores after surgery.[12] In some studies evaluating spinal surgery patients, it was reported that sevoflurane and opioid combination or desflurane and opioids combination were appropriate techniques in neuroanesthesia for spine surgery.[13,14]

Results of our study were predictable by having ET of 10.1 for desflurane as compared to sevoflurane which is 14.2, which is 4.1 min earlier, as per the same fact that desflurane has a low solubility compared to sevoflurane.

The mean FTC and AC scores between the groups were comparable stating that both the agents are comparable for postoperative recovery. We found the postoperative requirement of antiemetics to be similar in both the groups.

Massad *et al*. evaluated the effect of adding dexmedetomidine to a balanced technique on postoperative nausea and vomiting. The total incidence of postoperative nausea and vomiting decreased significantly in the dexmedetomidine group.[15]

We found that only 10% of patients required postoperative analgesics in both the groups. These findings may be attributed to the use of demedetomidine in both the groups in our study. Dexmedetomidine is a $\alpha 2$ receptors agonist and brings about dual neurological effects by acting on locus coeruleus with hypnotic effect and analgesic properties through receptor stimulation on the spinal dorsal horn.[16] It may prove especially helpful during major spinal surgery because it reduces anesthetic and analgesic requirements and is associated with lesser respiratory depression.[17]

Dexmedetomidine may be a safer option for analgesia over opioids for intraoperative as well as postoperative pain relief.[18]

In our study, we observed that to maintain intraoperative MAC, the mean dial settings required for desflurane group was 3.1 and for sevoflurane group was 0.7. We also observed that there were similar fluctuations in terms of mean dial settings and MAC in both the groups after 2 h of duration during surgery. No adverse effects were noted during surgery with both the agents.

When dexmedetomidine is used in spinal surgery patients intraoperatively, the need for analgesics during the postoperative period is less.[19] Postoperative rescue analgesia requirements were same in both Group D and Group S in our study. Similarly, postoperative antiemetic requirement was also statistically insignificant in our study, probably showing that for these two parameters both inhalation agents are comparable to each other. The results of our study are supported by the existing medical literature.

Strength and limitations of the study

The strength of the present study lies in its prospective design as there are very few prospective studies to assess the efficacy and safety of desflurane and sevoflurane with dexmedetomidine for spinal surgeries. In our study, since dexmedetomidine was used along with 60% nitrous oxide, MAC value of desflurane and sevoflurane did not exceed 1 MAC and patients were hemodynamically stable perioperatively with this MAC.

The limitation of our study is that limited representation of patient population, as it was a single center study. The generalizability of such findings is limited by inclusion of patients undergoing spinal surgery (lasting for more than 3 h) and ASA I and II category patients only.

Clinical trials with larger sample size and employing multiple parameters of assessment of anesthesia and in the setting of different surgical procedures need to be done.

Thus we conclude that with concurrent use of continuous infusion of dexmedetomidine for spinal surgeries (lasting for more than 3 h), both desflurane and sevoflurane provide comparable intraoperative hemodynamic stability recovery from anesthesia, and postoperative analgesia and antiemesis.

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Conflicts of interest

There are no conflicts of interest.

References

1. Raw DA, Beattie JK, Hunter JM. Anaesthesia for spinal surgery in adults. Br J Anaesth 2003;91:886-904.
2. Janet M, Vlymen V, White PF Outpatient Anesthesia. Miller RD 5th Edition. 2000. p. 2225.
3. Joshi GP. Inhalational techniques in ambulatory anesthesia. Anesthesiol Clin North America 2003;21:263-72.
4. Heavner JE, Kaye AD, Lin BK, King T. Recovery of elderly patients from two or more hours of desflurane or sevoflurane anaesthesia. Br J Anaesth 2003;91:502-6.
5. Rörtgen D, Kloos J, Fries M, Grottke O, Rex S, Rossaint R, *et al.* Comparison of early cognitive function and recovery after desflurane or sevoflurane anaesthesia in the elderly: A double-blinded randomized controlled trial. Br J Anaesth 2010;104:167-74.
6. Farag E, Argalious M, Sessler DI, Kurz A, Ebrahim ZY, Schubert A. Use of a(2)-agonists in neuroanesthesia: An overview. Ochsner J 2011;11:57-69.
7. Lewis SR, Nicholson A, Smith AF, Alderson P. Alpha-2 adrenergic agonists for the prevention of shivering following general anaesthesia. Cochrane Database Syst Rev 2015; Issue8. Art. No.:CD011107.
8. Kaur A, Jain AK, Sehgal R, Sood J. Hemodynamics and early recovery characteristics of desflurane versus sevoflurane in bariatric surgery. J Anaesthesiol Clin Pharmacol 2013;29:36-40.
9. Gergin S, Cevik B, Yildrim G. Sevofluranre versus desflurane: Hemodynamic parameter and recovery characteristics. Internet J Anaesthesiol 2009;9(1).
10. Jindal R, Kumra VP, Narani KK, Sood J. Comparison of maintenance and emergence characteristics after desflurane or sevoflurane in outpatient anaesthesia. Indian J Anaesth 2011;55:36-42.
11. Rampil IJ, Lockhart SH, Zwass MS, Peterson N, Yasuda N, Eger EI nd, *et al.* Clinical characteristics of desflurane in surgical patients: Minimum alveolar concentration. Anesthesiology 1991;74:429-33.
12. Dexter F, Bayman EO, Epstein RH (2010) Statistical modeling of average and variability of time to extubation for meta-analysis comparing desflurane to sevoflurane. Anesth Analg 110: 570-580.
13. Hayashi H, Kawaguchi M, Abe R, Yamamoto Y, Inoue S, Koizumi M, *et al.* Evaluation of the applicability of sevoflurane during post-tetanic myogenic motor evoked potential monitoring in patients undergoing spinal surgery. J Anesth 2009;23:175-81.
14. Bala E, Sessler DI, Nair DR, McLain R, Dalton JE, Farag E. Motor and somatosensory evoked potentials are well maintained in patients given dexmedetomidine during spine surgery. Anesthesiology 2008;109:417-25.
15. Massad IM, Mohsen WA, Basha AS, Al-Zaben KR, Al-Mustafa MM, Alghanem SM. A balanced anesthesia with dexmedetomidine decreases postoperative nausea and vomiting after laparoscopic surgery. Saudi Med J 2009;30:1537-41.
16. Mantz J, Josserand J, Hamada S. Dexmedetomidine: New insights. Eur J Anaesthesiol 2011;28:3-6.
17. Gurbet A, Basagan-Mogol E, Turker G, Ugun F, Kaya FN, Ozcan B. Intraoperative infusion of dexmedetomidine reduces perioperative analgesic requirements. Can J Anaesth 2006;53:646-52.
18. Arain SR, Ruehlow RM, Uhrich TD, Ebert TJ. The efficacy of dexmedetomidine versus morphine for postoperative analgesia after major inpatient surgery. Anesth Analg 2004;98:153-8.
19. Turgut N, Turkmen A, Gökkaya S, Altan A, Hatiboglu MA. Dexmedetomidine-based versus fentanyl-based total intravenous anesthesia for lumbar laminectomy. Minerva Anestesiol 2008;74:469-74.