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Efficacy of isoflurane versus sevoflurane in lumbar spinal surgery under general anesthesia

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Abstract

Background: This study have assessed the comparative efficacy of Isoflurane and Sevoflurane in terms of their intraoperative hemodynamic stability, recovery profile, postoperative complications, and stay length in the post-anesthetic care unit (PACU) to provide valuable insights into the choice of volatile anaesthetic agents for Decompression and Stabilization surgery due to Prolapse of Lumbar Intervertebral Disc (PLID) procedures in Bangladesh.

Methodology: With an analytical cross sectional study design, this research have conducted in Combined Military Hospital, Dhaka among 60 patients with decompression and stabilization surgery due to PLID under general anesthesia. Patients were randomly divided in to 2 groups, where Group A (30 patients) received Sevoflurane and Group B (30 patients) received Isoflurane.

Result: Systolic and diastolic blood pressure found to reduce in Isoflurane group from 15 minutes post-induction. Heart rate increased significantly in Isoflurane group from 30 minutes post-induction. Mean arterial pressure fluctuation was more prominent in Isoflurane group. Sevoflurane group demonstrated earlier recovery for airway reflex, eye opening, obeying commands, achieving orientation, and achieving Modified Aldrete Score of 9 or more. Sevoflurane group also exhibited significantly shorter stay in PACU discharge readiness and delayed first analgesic requirement compared to Isoflurane group. Incidence of complications, such as nausea, drowsiness, dizziness and airway hyperactivity was higher in Isoflurane group, but blurred vision, shivering, irregular pulse, and choking were exclusive to Sevoflurane group.

Conclusion: Sevoflurane provides better anesthesia with hemodynamic stability and allows for faster emergence and recovery with less complication compared to Isoflurane.

Keywords: Sevoflurane, isoflurane, hemodynamics, recovery, complication

Introduction

In anesthesia practice, it is desirable yet difficult to reduce the emergence time and time of recovery. Common factors impacting the emergence time are anaesthetic technique, duration of surgery and type of volatile anaesthetic used [1, 2]. Rapid emergence from general anesthesia (GA) is a desirable outcome which is needed for postoperative neurological examination intended to monitor for potential complications [3]. A rapid diagnosis and treatment of any postoperative complication can reduce the post-operative morbidity and mortality in these cases. Anaesthetics with reduced solubility and shorter duration of action facilitate swifter emergence and result in shorter postoperative stay compared to anaesthetics with higher solubility and longer duration of action that also tends to induce residual sedation and contribute to prolonged hospital stays [2, 4]. Sevoflurane and Isoflurane both pertain to the halogenated ether group of inhalational anesthetic agents, prescribed for the induction and maintenance of GA. In contrast to Isoflurane, Sevoflurane exhibits diminished blood solubility, results in expedited onset and offset, rendering the induction and recovery processes notably rapid when compared to Isoflurane [5]. At an equivalent fresh gas flow rate, Sevoflurane comes with a cost that is twelvefold higher than that of Isoflurane [6]. On contrary, despite of the lower cost of Isoflurane, it may increase overall expense if it causes extended emergence time and length of postoperative stay [7, 8]. Isoflurane and Sevoflurane represent the predominant volatile anesthetics utilized in surgical practice, yet their effectiveness needs to be justified against the comparative recovery process. This study aimed to compare the anaesthetic efficacy, postoperative recovery and postoperative complications of Isoflurane and Sevoflurane in spinal surgery.

Methodology

Study design and sample selection: This analytical cross-sectional study have been conducted in Combined Military Hospital, Dhaka on patients with PLID who were admitted in the hospital for Decompression and Stabilization surgery.

Assigning the patients in to study groups: Sixty patients, scheduled for Decompression and Stabilization surgery due to PLID have been enrolled in this study. Participants have been allocated into two groups with 30 patients in each group randomly. In Group A patients have received Sevoflurane, in Group B patients have received Isoflurane.

Ethical consideration: Ethical clearance have been undertaken from the Institutional Ethics Committee of Combined Military Hospital, Dhaka and informed written consent have been availed from the patient prior conducting the study.

Research procedure: Patients aged between 25-50 years old, of both gender, possessing an American Society of Anesthesiologists (ASA) physical status of 1 or 2 have been included in the study. Patients remained excluded if they have been found with ASA grade III and IV, receiving any medications that may affect vascular tone (e.g., vasoactive drugs, such as calcium channel blockers or angiotensin receptor blockers), having cardiovascular or peripheral vascular disease (e.g., diabetic vasculopathy or Raynaud’s disease), under any medications that may affect sympathetic or parasympathetic tone (e.g., beta blockers or anticholinergic medications), having any neurological or psychiatric diseases, including history of, or treatment for,

substance abuse, anxiety, or depression or patients anticipated to have difficult airway. Each patient undergone standard pre-anesthetic assessment. Consequent to standard anaesthetic preparation and maintenance, patients were administered the volatile agents according to the predetermined group allocation. Isoflurane and Sevoflurane both have been used in 0.8 to 1.2 MAC to maintain the depth of anesthesia. Five minutes prior to induction of anaesthesia, baseline SBP, DBB, MAP, and HR values (pre-induction data) have been recorded in the conscious state. Each patient was put on standard monitoring by multi parameter monitor comprising of body temperature, non-invasive blood pressure (NIBP), pulse oximetry (SpO₂), end-tidal carbon dioxide (EtCO₂), heart rate (HR) and like 3-lead electrocardiogram (ECG), non-invasive blood pressure (NIBP), pulse oximeter, BIS (Bispectral index) sensor, and BIS monitor A-2000T M monitoring was applied and patient’s awake/baseline BIS parameters were recorded.

Data collection and analysis: All the data have been collected in a preformed questionnaires. Categorical findings have been compared with Chi-square test after adjusting with Fisher’s exact test and continuous variables have been compared using independent sample t test. A ‘p’ value less than 0.05 have been considered significant. Data entry and analysis have been done using SPSS (Statistical Package for Social Science) for windows version 22.0.

Results

The sample of the present study presented with comparable demographic and clinical features ($p>0.05$) (Table-1).

Table 1: Comparison of presenting features of the respondents among Group A and Group B (N=60)

Features			Group-A (Sevoflurane) n ₁ =30	Group-B (Isoflurane) n ₂ =30	p value
Age		Mean ± SD	41.53 ± 5.41	44.63 ± 6.05	0.403 ^a
Gender	Male	N (%)	22 (73.33%)	24 (80.0%)	0.542 ^b
	Female	N (%)	8 (26.67%)	6 (20.0%)	
BMI		Mean ± SD	24.77 ± 2.37	24.16 ± 3.20	0.248 ^a
Comorbidities	DM	N (%)	4 (13.33%)	3 (10.0%)	0.660 ^b
	HTN	N (%)	2 (6.67%)	4 (13.33%)	
ASA grade	I	N (%)	24 (51.1%)	23 (48.9%)	0.754 ^b
	II	N (%)	6 (46.2%)	7 (53.8%)	
Pulse		Mean ± SD	81.30 ± 6.13	79.60 ± 10.79	0.197 ^a
SBP		Mean ± SD	122.67 ± 7.96	123.00 ± 10.95	0.163 ^a
DBP		Mean ± SD	77.17 ± 3.64	77.83 ± 5.20	0.473 ^a

^a denotes, p value reached from independent sample t test

^b denotes, p value reached from Chi-square test after adjusting with Fisher’s test as required

The intraoperative hemodynamics at different time intervals showed that SBP and DBP both were lower from 15 min onwards induction in the Isoflurane group (Group B)

compared to the Sevoflurane group (Group A) ($p<0.05$) (Figure-1).

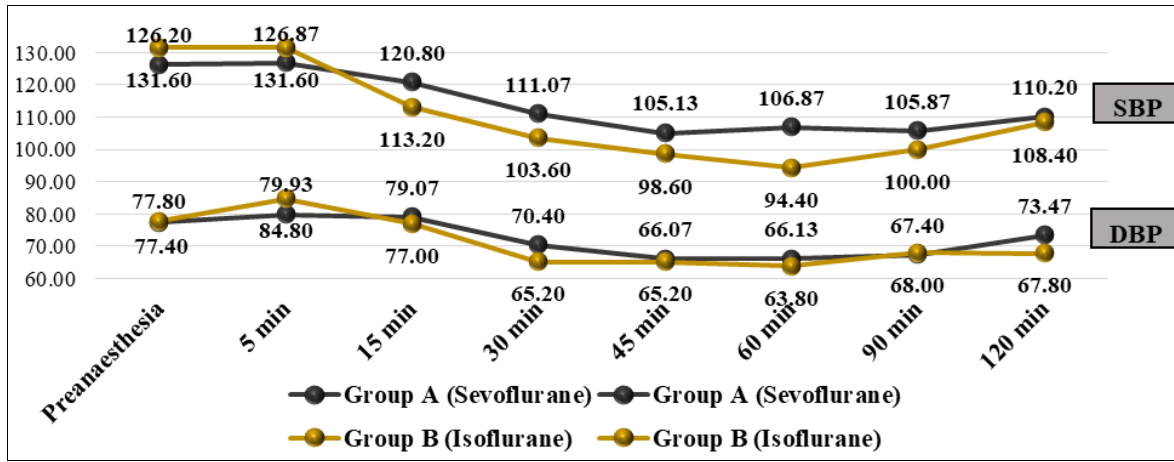


Fig 1: Comparison of changes in intraoperative systolic and diastolic blood pressure group A and Group B (N= 60)

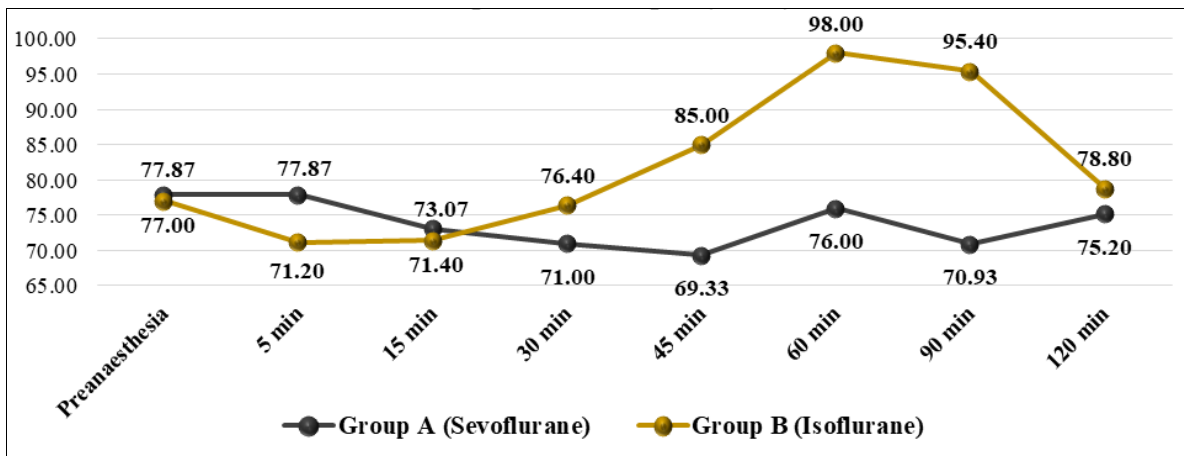


Fig 2: Comparison of changes in intraoperative Heart rate among group A and Group B (N= 60)

From 30 minutes following induction, the heart rate found to increase in the Isoflurane group (Group B), which was statistically significantly different from the changes in the Sevoflurane group (Group A), where the changes in heart rate was relatively steady ($p < 0.05$) (Figure-2). The

fluctuation of MAP was more prominent in the Isoflurane group (Group B) compared to Sevoflurane group (Group A) and the difference among the groups was statistically significant at the readings of 15 min, 60 min, 90 min and 120 minutes following induction ($p < 0.05$) (Figure-3).

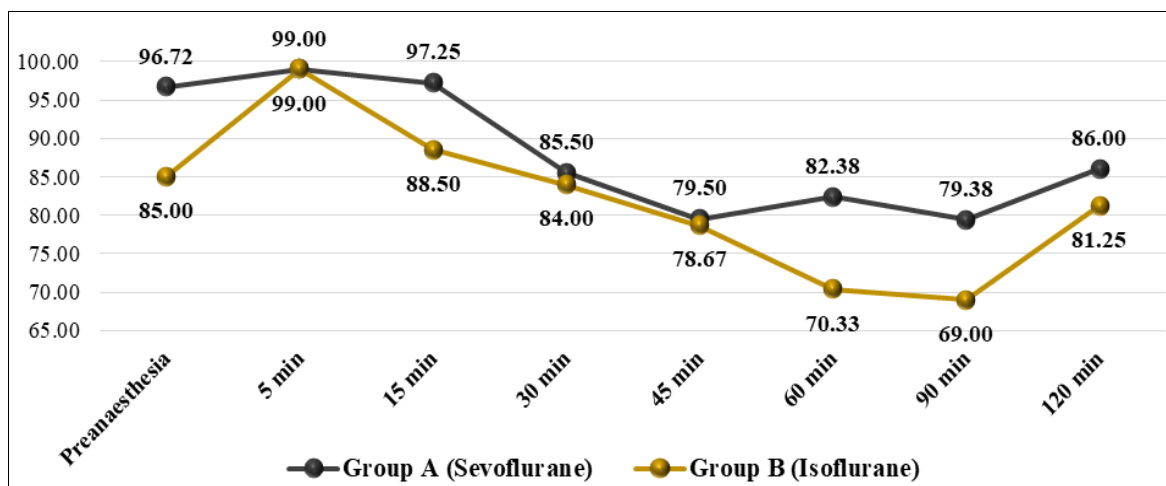


Fig 3: Comparison of changes in intraoperative MAP among group A and Group B (N= 60)

Table 2: Comparison of intraoperative and postoperative attributes of respondents among Group A and Group B (N=60)

Intraoperative and postoperative attributes	Group-A (Sevoflurane) n ₁ =30		Group-B (Isoflurane) n ₂ =30		p value
	Mean	SD	Mean	SD	
Duration of anesthesia	223.67	42.89	253.00	32.26	0.53 ^a
Duration of surgery	182.00	40.21	208.67	41.91	0.58 ^a
Time to achieve airway reflex (in minutes)	3.85	1.19	8.80	1.12	0.05 ^a
Time to eye opening on verbal commands (in minutes)	4.34	1.07	10.92	0.89	0.05 ^a
Time to tracheal extubation (in minutes)	5.16	1.16	12.56	1.05	0.93 ^a
Time to obey commands (in minutes)	7.41	1.13	14.86	0.75	0.01 ^a
Time to achieve orientation (in minutes)	8.53	1.43	17.20	1.08	0.04 ^a
Time to Achieve Modified Aldrete Score of 9 or more (in minutes)	9.48	0.98	19.78	1.04	0.95 ^a
Time of discharge readiness from PACU (in minutes)	29.73	3.81	48.00	5.19	0.05 ^a
Time of first analgesic requirement (in minutes)	49.70	12.34	54.33	9.54	0.07 ^a

^a denotes, p value reached from independent sample t test

In the Isoflurane group (Group B), the duration of surgery and anesthesia was insignificantly higher than the Sevoflurane group (Group A) ($p>0.05$). Time to achieve airway reflex, eye opening, tracheal extubation, obey commands, achieve orientation, achieve Modified Aldrete Score of 9 or more were lower in Group A than Group B and in cases of airway reflex, eye opening on verbal commands, obeying commands, and achieving orientation

the time differences were statistically significant ($p<0.05$). Time of discharge readiness from PACU was significantly lower and time of first analgesic requirement was significantly higher in Group A ($p<0.05$) (Table-2). Incidence of nausea, drowsiness, dizziness, airway hyperactivity was statistically insignificantly higher in Group B ($p>0.05$). Blurred vision, shivering, irregular pulse, choking were evident only in Group A (Table-3).

Table 3: Comparison of post-operative complications among Group A and Group B (N=60)

Complications	Group-A (Sevoflurane) n ₁ =30		Group-B (Isoflurane) n ₂ =30		p value
	Frequency	Percentage	Frequency	Percentage	
Nausea	10	33.3%	12	40.0%	0.59 ^b
Vomiting	0	0.0%	0	0.0%	--
Drowsiness	6	20.0%	11	36.7%	0.15 ^b
Dizziness	2	6.7%	5	16.7%	0.36 ^b
Airway hyperactivity	3	10.0%	6	20.0%	0.28 ^b
Blurred vision	1	3.3%	0	0.0%	--
Shivering	1	3.3%	0	0.0%	--
Irregular pulse	2	6.7%	0	0.0%	--
Choking	1	3.3%	0	0.0%	--

^b denotes, p value reached from Chi-square test after adjusting with Fisher's test as required

Discussion

The intraoperative diminution of the systolic and diastolic blood pressure were significantly more pronounced in Isoflurane group compared to the Sevoflurane group ($p<0.05$). The changes in heart rate in the Isoflurane group were more pronounced than that of the Sevoflurane group ($p<0.05$). The fluctuation of MAP was more distinct in the Isoflurane group compared to the Sevoflurane group, and the difference between the groups was statistically significant at different time interval post-induction ($p<0.05$). Frink *et al.* concluded from their study findings that hemodynamic variables were better maintained with Sevoflurane compared to Isoflurane^[9]. In the study of Solan *et al.*, the heart rate change was significantly more marked in the Isoflurane group^[10]. Shan *et al.* denoted that, Sevoflurane offers smoother and steadier changes of hemodynamics when they compared to Isoflurane and Desflurane^[11]. Dupont *et al.* observed that, MAP was significantly lower at Isoflurane group when compared to that of Sevoflurane group^[12]. In the Isoflurane group, the duration of surgery and anesthesia was insignificantly higher than the Sevoflurane group ($p>0.05$) which corresponds to the study findings of Sahu *et al.* and Frink *et al.*^[9, 13]. Evaluation of emergence time showed that, the required time in terms of eye opening, tracheal extubation, was quicker in Sevoflurane group. Similar findings have

been observed in the study of Dupont *et al.* in a sample of patients undergoing pulmonary surgeries and in the study of Sahu *et al.* in day care surgery patients under laryngeal mask airway^[12, 13]. Dupont also found the recovery profile to be faster with Sevoflurane than with Isoflurane. Faster emergence and recovery profile in Sevoflurane receiving sample compared to Isoflurane receiving sample was also observed in a sample of patients undergoing gynaecological laparoscopy^[14]. In this study, the time of discharge readiness from PACU was significantly lower in Sevoflurane group than in Isoflurane group ($p<0.05$) which also similar to the findings of Sahu *et al.* and Gupta *et al.*^[13, 15]. The time of the first analgesic requirement was insignificantly higher in Isoflurane group than in Sevoflurane group ($p>0.05$), which also exhibited by Philip *et al.* and Frink *et al.*^[9, 16]. Among the recorded complications, the incidence of nausea, drowsiness, dizziness, and airway hyperactivity was statistically insignificantly higher in Isoflurane group ($p>0.05$). Nausea and vomiting found to be insignificantly higher in Isoflurane group compared to the Sevoflurane group in the study of Frink *et al.*^[9]. Doi *et al.* observed that, Sevoflurane is the least irritant to airway to cause hyperactivity when compared to Isoflurane, which they found to be the most irritant one^[17]. However, blurred vision, shivering, irregular pulse, and choking were evident only in Sevoflurane group

in this study. O'Hara also found that, the incidence of coughing was significantly higher in the isoflurane group compared to Sevoflurane, and shivering was more noticed in the Sevoflurane received patients [5].

Limitations of the Study

A cross sectional study with small sample size limits the interpretation of the study findings.

Conclusion

Observation from the present study concludes with the findings that, Sevoflurane provides better anesthesia with superior hemodynamic stability and allows for faster emergence and recovery, shorter stay in PACU, with less complication compared to Isoflurane. These characteristics seemingly confer upon Sevoflurane a greater anesthetic potential compared to Isoflurane. Multicenter study with larger sample size can further emphasize the findings to establish the utilization of Sevoflurane as a standard volatile agents for surgical procedures under general anesthesia.

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