

Original Research Article

A comparative study of Desflurane versus Sevoflurane anesthesia for controlled hypotension in functional endoscopic sinus surgery

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Abstract

Background: Functional endoscopic sinus surgery (FESS) is a highly sophisticated type of surgery, which has revolutionized the surgical management of acute and chronic sinus pathologies when conservative management has failed. During FESS under general anesthesia (GA), bleeding impairs the visibility of the surgical field and increases the operational risk and time. Intraoperative bleeding may be reduced most effectively by induced systemic hypotension. There are several important advantages of using the intentional hypotensive anesthetic technique during functional endoscopic sinus surgeries such as reduction in blood loss hence reduction in blood transfusion rate, improvement in the surgical field, and reduction of the duration of surgery. In hypotensive anesthesia, the patient's baseline mean arterial pressure (MAP) is reduced by 30%, or MAP was kept at 60-70 mm Hg.

Aim and objective: To compare the efficacy of Desflurane and Sevoflurane in achieving controlled hypotension and bloodless surgical field in patients undergoing Functional Endoscopic sinus surgery.

Materials and methods: This single-center prospective, randomized, single-blinded study was conducted at ENT theatre, Department of anesthesia, Tirunelveli Medical College, and Hospital from Jan 2018 to July 2018. This study was done in 80 patients who underwent functional endoscopic sinus surgery of ASA physical status I and II.

Results: The majority of the study population belonged to the ASA 1 category in both groups. It was 70% in desflurane and 65% in the sevoflurane group. There was no significant difference in ASA grade of both groups ($P > 0.05$). The pulse rate was 78/min and 79/min in the desflurane and

sevoflurane groups respectively. The systolic BP was 100 and 108 in the desflurane and sevoflurane group respectively. The diastolic BP was 69 and 64 in the desflurane and sevoflurane group respectively and all these parameters did not differ significantly from each other. The mean pulse rate in both groups did not differ significantly from each other during the anesthesia. All the P-values were more than 0.05.

Conclusion: Hypotensive anesthesia can reduce the extent of intraoperative bleeding and can potentially improve the quality of the surgical field conditions. Various drugs are used to produce controlled hypotension. In our study, we compared the efficacy of two inhalational agent sevoflurane and desflurane for hypotensive anesthesia. We found that both desflurane and sevoflurane can reduce blood loss and could give an acceptable surgical field with a substantial reduction in the vasoactive drug requirement

Key words

Hypotensive anesthesia, Mean arterial pressure, Heart rate, Desflurane, Sevoflurane.

Introduction

Functional Endoscopic Sinus Surgery is a delicate and time-consuming procedure performed routinely under general anesthesia. A minimal amount of bleeding can greatly obstruct the view of the operative endoscope which in turn prolongs the duration of the surgery [1]. Hypotensive anesthesia prevents this by facilitating the operative team to achieve a bloodless field for better visualization of intranasal structures and minimizing intraoperative bleeding [2]. Various agents like Magnesium sulfate, sodium nitroprusside, nitroglycerine, beta-agonists, inhalational anesthetics are used to achieve controlled hypotension [3]. Advantages of inhalational agents are it is easy to administer and easy to control concentration. It does not require an infusion pump and can be quickly washed out from the body by hyperventilation. Induction of hypotension is slow when compared to other drugs. Therefore continuous monitoring of intra-arterial blood pressure is not mandatory. Inhalation agent Causes the least arrhythmia with exogenous adrenaline which is routinely infiltrated into the operating field for creating a bloodless field [4]. Though many pharmacological agents are used in combination to achieve controlled hypotension, the hypotensive effect of the only inhalational agent is not utilized thoroughly [5]. Studies comparing the efficacy, intraoperative variables, and

postoperative morbidities of two inhalational agents for functional endoscopic surgery are very limited. This study was therefore conducted to compare the perioperative effects of Desflurane and Sevoflurane in patients undergoing functional endoscopic sinus surgery and attempts to determine if one agent is superior to the other in achieving controlled hypotension and in recovery parameters [6].

Materials and methods

This was a single-center prospective, randomized, single-blinded study was conducted at ENT theatre, Department of Anesthesia, Tirunelveli Medical College, and Hospital from Jan 2018 to July 2018. This study was done in 80 patients who underwent functional endoscopic sinus surgery of ASA physical status I and II. Ethical committee approval and informed written consent from patients involved in this study were obtained before starting this study.

Inclusion criteria:

- Patients in the age group of 18-40 years who had given written informed consent belonging to ASA I or II.

Exclusion criteria:

- Patients with hypertension, coronary artery disease, renal/ hepatic/ cerebral insufficiency.
- Patients with coagulopathies or receiving drugs influencing blood coagulation.

Patients were allocated into two groups by simple randomization done with a computer-generated random number sequence in Group D and Group S.

Allocation:

Group D: Desflurane was used as an inhalational agent and to produce controlled hypotension.

Group S: Sevoflurane was used as an inhalational agent and to produce controlled hypotension.

Preoperative assessment was done and written informed consent was obtained from all the patients who fulfilled the inclusion criteria. Patients were randomly assigned to any one of the two groups. Both the groups were received preoperative medication with Inj. Midazolam 2 mg and Inj. Glycopyrrolate i.m. before the

procedure. Induction for both groups achieved by Inj. Fentanyl 2µg/kg and Inj. Propofol 2 mg/kg i.v. Atracurium 0.5 mg/kg was administered intravenously to both groups to aid in intubation. For Maintenance of anesthesia and to achieve controlled hypotension, Group D patients were administered with Desflurane, and Group S patients were administered with Sevoflurane.

Results

Majority of the study participants were distributed equally in both age groups and total. The age did not differ significantly in both groups hence both the groups are comparable in terms of age. There was equal distribution among males and females in both groups. There was no significant difference in the sex distribution of both groups (P>0.05) as per **Table - 1**.

Table - 1: Age distribution profile in both the groups.

Variables	Desflurane group N = 40	Sevoflurane group N = 40	Total N = 80	P-value
Age (in years)				
15-25	23 (57.5%)	17 (42.5%)	40 (50%)	0.180
>25	17 (42.5%)	23 (57.5%)	40 (50%)	
(Mean ± SD)	27.25±6.0	24.45±3.2	25.8±5.0	
Range	18-32	19-38	18-38	

Table - 2: ASA distribution profile in both the groups.

Variables	Desflurane group N = 40	Sevoflurane group N = 40	Total (N = 80)	P-value
ASA				
I	28 (70%)	26 (65%)	54 (67.5%)	0.633
II	12 (30%)	14 (35%)	26 (32.5%)	

Majority of the study population belonged to the ASA 1 category in both groups. It was 70% in desflurane and 65% in the sevoflurane group. There was no significant difference in ASA grade of both groups (P>0.05) as per **Table – 2**.

The baseline vitals pulse rate and blood pressure were similar in both groups and did not differ significantly from each other. The pulse rate was 78/min and 79/min in the desflurane and

sevoflurane groups respectively. The systolic BP was 100 and 108 in the desflurane and sevoflurane group respectively. The diastolic BP was 69 and 64 in the desflurane and sevoflurane group respectively. And all these parameters did not differ significantly from each other (**Table – 3**).

The duration of surgery and mean blood loss was similar in both groups. They did not differ

significantly from each other ($P>0.05$). The duration of surgery was 86 mins and 84 mins in the desflurane and sevoflurane groups respectively (**Table – 4**). The blood loss was 68 ml and 72 ml in the desflurane and sevoflurane group. The blood

Table - 3: Vitals profile in both the groups.

Variables	Desflurane group N = 40	Sevoflurane group N = 40	Total (N = 80)	P-value
Pulse Rate				
Mean±SD	78.8±2.5	79.9±6.9	79.4±5.2	0.350
Range	74-88	74-88	74-88	
Systolic BP				
Mean±SD	100.25±6.1	108.5±13.8	104.4±11.4	0.201
Range	90-110	90-140	90-140	
Diastolic BP				
Mean±SD	69.2±2.6	64.7±6.4	67±5.4	0.101
Range	60-70	60-80	60-80	

Table - 4: Surgery profile in both the groups.

Variables	Desflurane group N = 40	Sevo flurane group N = 40	Total N = 80	P-value
Duration of surgery (minutes)				
Mean±SD	86.6±6.3	84.2±9.1	85.4±7.8	0.180
Range	75-90	60-95	60-95	
Blood loss in ml				
Mean±SD	68.7±15.3	72±13.4	70.8±14.5	
Range	50-100	50-90	50-100	0.192

Table - 5: Comparison of pulse rate during anesthesia in both groups.

Heart rate	Desflurane		Sevoflurane		P-value
	Mean	SD	Mean	SD	
1 min	78.5	2.4	78.5	5.7	0.959
2 min	78.3	2.0	78.6	4.9	0.748
3 min	78.5	2.7	78.7	4.4	0.832
4 min	78.5	3.3	78.6	4.7	0.694
5 min	78.1	3.8	78.6	4.7	0.644
10 min	77.7	3.6	77	4.4	0.138
15 min	77.1	3.1	77.4	4.0	0.116
30 min	76.8	2.8	77.2	4.6	0.106
45 min	77.1	3.2	78.7	4.9	0.085
60 min	77.6	3.6	78.2	5.0	0.571
75 min	77.5	3.6	78.7	5.1	0.226
90 min	77.2	2.8	79.1	4.1	0.061

The mean pulse rate in both groups did not differ significantly from each other during the anesthesia. All the P-value were more than 0.05 (**Table – 5**).

The mean systolic blood pressure during 1, 2, 3, 4, and 45 minutes in the sevoflurane group were not significantly different in both groups (P<0.05). The SBP mean recorded at other time were not significantly different in both groups (Table – 6). This mean difference was statistically significant

Table - 6: Comparison of systolic blood pressure during anesthesia in both groups.

SBP	Desflurane		Sevoflurane		P-value
	Mean	SD	Mean	SD	
1 min	97.1	6.8	87.7	3.5	<0.001
2 min	95.7	7.4	88.3	3.6	<0.001
3 min	92.7	6.5	90.2	2.9	0.031
4 min	91.6	4.7	89.2	2.4	0.005
5 min	88.6	8.7	88.8	2.5	0.890
10 min	89.3	4.3	88.4	2.3	0.239
15 min	89.3	4.3	88.1	3.5	0.167
30 min	88.9	4.9	87.8	3.2	0.266
45 min	89.9	4.1	87.4	3.4	0.004
60 min	90.6	4.8	89.2	2.4	0.113
75 min	90.3	5.3	89.3	2.5	0.325
90 min	89.7	6.6	88.4	3.1	0.368

Table - 7: Comparison of diastolic blood pressure during anesthesia in both groups.

DBP	Desflurane		Sevoflurane		P-value
	Mean	SD	Mean	SD	
1 min	67.1	6.2	56.5	4.4	<0.001
2 min	66.6	5.8	56.2	4.8	<0.001
3 min	66.0	5.6	56	4.8	<0.001
4 min	65.3	6.5	56.9	3.4	<0.001
5 min	62.2	6.2	58.1	2.6	<0.001
10 min	60.7	5.3	56.7	3.7	<0.001
15 min	59.6	4.8	57.5	3.1	0.022
30 min	59.9	4.8	57.5	3.3	0.015
45 min	61.5	7.3	57.2	3.1	0.001
60 min	61.2	7.3	58.1	2.6	0.016
75 min	59.9	5.8	58.6	2.2	0.211
90 min	61.2	5.8	58.6	2.8	0.051

The mean diastolic blood pressure in the sevoflurane group during anesthesia was lesser compared to the desflurane group. This mean difference was statistically significant (P<0.05). Sevoflurane is better in reducing diastolic blood pressure than desflurane group (Table – 7).

The mean diastolic blood pressure in the desflurane group. This mean difference was statistically significant (P<0.05). Sevoflurane is better in reducing mean arterial blood pressure than desflurane group. The respiratory rate stayed constant for all the participants at 12/minute and SPO2 stayed at 100% for all the participants throughout anesthesia (Table – 8).

The mean arterial pressure in the sevoflurane group during anesthesia was lesser compared to

Table - 8: Comparison of Mean arterial pressure during anesthesia in both groups.

MAP	Desflurane		Sevoflurane		P-value
	Mean	SD	Mean	SD	
1 min	77.1	5.8	66.9	3.9	<0.001
2 min	76.4	5.8	66.7	4.5	<0.001
3 min	74.9	5.2	67.3	3.4	<0.001
4 min	74.2	5.3	67.8	2.6	<0.001
5 min	71.5	4.8	68.6	1.9	0.001
10 min	70.1	4.3	67.4	3.0	0.02
15 min	69.5	3.7	67.7	2.8	0.023
30 min	69.8	4.3	67.4	2.9	0.006
45 min	70.5	4.9	67.1	2.9	<0.001
60 min	70.4	5.6	68.4	2.4	0.037
75 min	69.8	5.2	69.0	1.6	0.373
90 min	70.9	5.2	68.5	2.2	0.045

Discussion

FESS being a delicate technique needs a clean and blood-free field. In nasal surgeries, local anesthesia used traditionally causes discomfort and pain as the patient remains conscious, in addition to the risk of having an incomplete block. Hence, general anesthesia is often preferred over topical anesthesia in FESS as it produces an immobile surgical field, effective airway protection, adequate analgesia, patient comfort, and the provision for controlled hypotension if required [8]. The use of hypotensive anesthesia further reduces bleeding and thus clearing the field during surgery. To attain clear visibility in the surgical field, various methods are used [9]. The surgical field visibility depends upon the type of anesthesia, blood pressure, and heart rate. It is known that Desflurane produces a moderate rise in heart rate, central venous pressure, and pulmonary artery pressure which is not apparent at lower doses of desflurane [10]. Sevoflurane did not alter the patient's heart rate and cardiac output and it was maintained well as causes desflurane. Although there is a slight difference in cardiovascular effects between these two inhalation agents [11], White PF, et al. found that desflurane, sevoflurane, or isoflurane provided adequate controlled hypotension of 60-70 mmHg mean arterial blood pressure and similar surgical conditions during tympanoplasty throughout intraoperative period Similarly, in our

study also there were no significant differences between Desflurane and Sevoflurane group [12]. Dexter F, et al. reported that the target means arterial blood pressure of 55-65mmHg was achieved with desflurane with or without labetalol and also they provided a satisfactory surgical field for surgeons. In the desflurane group, hypotension was achieved with an increase in heart rate and also faster recovery from anesthesia [13]. In our study also we reported that compare to Sevoflurane, the Desflurane group had slight tachycardia and also faster recovery from anesthesia [14]. Sukhjinder Singh reported that both sevoflurane and desflurane have similar pharmacokinetics so both produced rapid emergence. Desflurane has lower blood: Gas and fat: Blood partition coefficients compared to sevoflurane so that the extubation time and emergence time were significantly shorter in the desflurane group [15]. Michel B et al. observed that desflurane provided early emergence and recovery compared to sevoflurane in children undergoing adenoidectomy. And also they observed that the time to eye-opening verbal commands and time to tracheal extubation were shorter in the desflurane group.[16] In adult patients undergoing ambulatory surgeries, recovery endpoints such as time to eye-opening on verbal commands and regaining orientation were found to be significantly faster with desflurane. They also demonstrated that

Desflurane reduces the average extubation time by 25% as compared to sevoflurane [17]. In our study also we found that the time to extubation, time to obeying oral commands, and postoperative recovery time was significantly shorter in the Desflurane group compared to Sevoflurane [18]. Tantry TP reported that anesthesia with desflurane could reduce blood loss and could give acceptable surgical visibility with mild controlled hypotension and with a substantial reduction in the vasoactive drug requirement compared to sevoflurane in maxillofacial surgery [19]. In our study, we found that both sevoflurane and desflurane produced less blood loss and better surgical field visibility. And also we found that mean arterial blood pressure during anesthesia was lesser in the sevoflurane group compared to the desflurane group [20].

Conclusion

Patients who undergo functional endoscopic sinus surgeries are at risk of considerable intraoperative bleeding, and the outcome of the surgical procedure depends on the quality of the surgical field conditions. Hypotensive anesthesia can reduce the extent of intraoperative bleeding and can potentially improve the quality of the surgical field conditions. Various drugs are used to produce controlled hypotension. In our study, we compared the efficacy of two inhalational agent sevoflurane and desflurane for hypotensive anesthesia. We found that both desflurane and sevoflurane can reduce blood loss and could give an acceptable surgical field with a substantial reduction in the vasoactive drug requirement. Desflurane provides earlier emergence and recovery from anesthesia compared to sevoflurane. Both maintained hemodynamic stability. The mean blood pressure was lesser in the sevoflurane group during anesthesia compared to the Desflurane group. Appropriate patient selection, careful monitoring, and adequate intraoperative volume replacement are mandatory in hypotensive anesthesia for its safe implementation in patients.

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