Section: Miscellaneous

Original Research Article

A COMPARATIVE STUDY OF RECOVERY CHARACTERISTICS AND HEMODYNAMIC PARAMETERS OF DESFLURANE AND SEVOFLURANE IN FUNCTIONAL ENDOSCOPIC SINUS SURGERY

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Received *: 10/11/2025*
Received in revised form *: 01/01/2026*
Accepted *: 17/01/2026*

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DOI:10.70034/ijmedph.2026.1.90

Source of Support: Nil,
Conflict of Interest: Nonedeclared

Int J Med Pub Health
2026; 16 (1); 509-515

ABSTRACT

Background: Functional Endoscopic Sinus Surgery (FESS) requires an anesthetic technique that ensures hemodynamic stability and rapid postoperative recovery. Desflurane and sevoflurane are commonly used volatile agents with favorable pharmacokinetic profiles; however, comparative data regarding recovery characteristics and intraoperative hemodynamics in FESS remain limited.

Material and Methods: In this prospective comparative study, 100 ASA I-II patients scheduled for elective FESS were allocated into two groups (n=50 each). After standardized induction, anaesthesia was maintained with either end-tidal desflurane 3% (Group D) or sevoflurane 1% (Group S) in 66% nitrous oxide and oxygen. Heart rate (HR) and mean arterial pressure (MAP) were recorded at baseline and 15-minute intervals. Upon cessation of anaesthesia, time intervals to response to painful stimulus, verbal commands, extubation, recall of name, hand grip, limb lift, and achievement of a Post-Anaesthesia Recovery Score (PARS) >10 were recorded. Statistical analysis was performed using unpaired t-test and chi-square test, with $p < 0.05$ considered significant.

Results: Baseline demographic and perioperative variables were comparable between groups ($p > 0.05$). Early recovery was significantly faster in the desflurane group, with higher proportions achieving response to painful stimulus within 9 minutes (88% vs 62%), extubation within 10 minutes (84% vs 46%), and PARS >10 within 12 minutes (82% vs 38%) compared to the sevoflurane group (all $p < 0.001$). Neuromuscular recovery milestones were also achieved earlier with desflurane, including hand grip ≤11 minutes (76% vs 36%) and limb lift ≤12 minutes (72% vs 32%) ($p < 0.001$). Intraoperatively, MAP reduction >30% of baseline occurred less frequently with desflurane (18%) than with sevoflurane (54%) ($p < 0.001$).

Conclusion: Desflurane provides faster early recovery and superior hemodynamic stability compared to sevoflurane in patients undergoing FESS, making it a favorable choice when rapid emergence and controlled hypotension are clinical priorities.

Keywords: Desflurane, Sevoflurane, Functional Endoscopic Sinus Surgery (FESS), Post-Anaesthesia Recovery Score (PARS).

INTRODUCTION

Functional endoscopic sinus surgery (FESS) has become a cornerstone procedure in otorhinolaryngology for the management of recurrent chronic sinusitis, offering high success rates with minimal invasiveness.[1] While initially performed under local anaesthesia with sedation, the refinement of surgical techniques towards more extensive resection has established general anaesthesia with endotracheal intubation as the preferred method. This shift places significant responsibility on the anaesthesiologist to provide optimal surgical conditions, which are critically dependent on maintaining a clear operative field.[2]

Haemorrhage remains the most common and challenging complication of FESS due to the high vascularity of sinonasal tissues. Even minor bleeding can obscure the endoscopic view, prolong surgery, and increase the risk of complications.[3] Therefore, a primary anaesthetic goal is to facilitate controlled hypotension, minimising surgical bleeding without compromising end-organ perfusion. This necessitates a balanced anaesthetic technique that ensures profound intraoperative haemodynamic stability while allowing for rapid and clear-headed emergence to facilitate early neurological assessment and minimise postoperative complications.[4]

The evolution of inhaled anaesthetic agents has been driven by the pursuit of agents offering greater controllability, safety, and faster recovery profiles. Modern volatile anaesthetics, particularly desflurane and sevoflurane, have largely replaced older agents due to their superior pharmacokinetic properties.[5]Their low blood-gas partition coefficients (0.42 for desflurane and 0.69 for sevoflurane) facilitate rapid induction, precise titratability during maintenance, and swift washout at the conclusion of anaesthesia, making them ideal for ambulatory and short-to-medium duration surgeries like FESS.[6]

Despite their similar low solubility, desflurane and sevoflurane exhibit distinct pharmacodynamic profiles. Desflurane, a fluorinated methyl ethyl ether, has a lower potency (MAC 6.6) and is highly resistant to metabolism (0.02%). However, its pungency can cause airway irritation, making it less suitable for inhalational induction.[7] Sevoflurane, a fluorinated methyl isopropyl ether with a sweeter odour, is more potent (MAC 1.8) and undergoes slightly higher metabolism (3-5%). A particular concern with sevoflurane is its interaction with dry carbon dioxide absorbents to produce Compound A, though its clinical nephrotoxicity in humans remains debated.[7]

The comparative impact of these two agents on haemodynamic parameters during FESS is a key consideration. The surgery often involves infiltration of vasoconstrictors like adrenaline, which can cause transient hypertensive and tachycardic responses. The ideal volatile agent would attenuate this response and promote stable controlled hypotension without profound cardiovascular depression.[9] Furthermore, the quality of recovery is paramount. Faster emergence, earlier response to commands, and quicker attainment of discharge-ready criteria improve operating room turnover and patient satisfaction in a day-care surgical setting.[10]

Several studies have compared desflurane and sevoflurane in various surgical contexts, often demonstrating a more rapid early recovery with desflurane. However, data specific to FESS, where haemodynamic stability is intricately linked to surgical success and the postoperative need for a clear airway is immediate, remains valuable. This study was therefore designed to directly compare the intraoperative haemodynamic parameters (heart rate and mean arterial pressure) and the recovery characteristics of desflurane versus sevoflurane when used for maintenance of anaesthesia in patients undergoing elective FESS, within a standardised balanced anaesthetic technique.

MATERIALS AND METHODS

Study Design and Setting

This prospective, parallel-group, comparative observational study was conducted over a period of six months from June to September 2016. The study was performed in the operating theatres of the Department of Ear, Nose, and Throat Surgery at a tertiary care teaching hospital. The design was chosen to compare two standard anaesthetic maintenance regimens, desflurane-based anaesthesia versus sevoflurane-based anaesthesia, within the routine clinical practice of FESS, without the allocation protocols of a randomised controlled trial. All procedures, assessments, and data collection followed a predefined, standardised protocol to ensure comparability between the two cohorts.

Ethical Considerations and Informed Consent

Prior to the commencement of the study, approval was obtained from the Institutional Ethical Committee. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. All patients scheduled for elective FESS during the study period were screened for eligibility. Each eligible patient received a comprehensive verbal and written explanation of the study's nature, purpose, potential risks, and benefits. Particular emphasis was placed on the fact that both anaesthetic agents were standard of care and that participation would involve the systematic recording of physiological and recovery parameters. Written informed consent was obtained from all participants prior to their inclusion in the study.

Sample Size calculation:

Using OpenEpi 3.0, the sample size of 50 patients per group was estimated based on a prior pilot study

to detect a clinically significant difference of 20% in early recovery times with a power of 80% and an alpha error of 0.05.

Participant Selection (Inclusion and Exclusion Criteria)

A total of 100 adult patients were enrolled and allocated into two comparative groups: the Desflurane group (Group D, n=50) and the Sevoflurane group (Group S, n=50). Allocation was based on a consecutive, non-randomised assignment according to the scheduled operating list and anaesthetic agent availability, aiming to create two groups for comparison.

Inclusion Criteria: Patients of both genders, aged between 18 and 65 years, classified as American Society of Anaesthesiologists Physical Status (ASA PS) I or II, and scheduled for elective functional endoscopic sinus surgery under general anaesthesia were included.

Exclusion Criteria: Patients were excluded from the study if they had a body mass index (BMI) greater than 30 kg/m² (obesity), a history of chronic pulmonary disease (e.g., severe asthma, COPD), a known allergy to any of the study drugs, a recent history of general anaesthesia within the preceding 7 days, an anticipated surgical duration exceeding 2.5 hours, or were on chronic opioid analgesic therapy. These criteria were established to minimise confounding variables that could significantly impact hemodynamic stability or pharmacokinetics of the volatile agents.

Standardised Anaesthetic Protocol

A uniform, balanced anaesthetic technique was employed for all patients to isolate the comparative effects of the two volatile maintenance agents.

Pre-anaesthetic Preparation: After securing intravenous access with an 18G cannula, all patients were preloaded with Ringer's lactate solution at approximately 150 ml/hr. Standard monitors were attached, including continuous electrocardiogram (ECG), non-invasive blood pressure (NIBP), pulse oximetry (SpO_2), capnography ($EtCO_2$), and anaesthetic gas analysers for oxygen, nitrous oxide, and the respective volatile agent.

Premedication and Induction: All patients received a standardised intravenous premedication comprising glycopyrrolate (4 mcg/kg), midazolam (0.05 mg/kg), and fentanyl (2 mcg/kg) approximately 15 minutes before induction. Following pre-oxygenation with 100% oxygen for 3 minutes, anaesthesia was induced with thiopentone sodium (5 mg/kg). Neuromuscular blockade to facilitate endotracheal intubation was achieved with vecuronium (0.1 mg/kg). The trachea was intubated with an appropriate-sized cuffed endotracheal tube after confirming adequate muscle relaxation, and correct placement was verified by capnography.

Maintenance of Anaesthesia: Following induction, patients were assigned to one of two maintenance regimens based on the pre-determined group allocation.

- **Group D (Desflurane):** Anaesthesia was maintained with an end-tidal desflurane concentration of 3% in a carrier gas of 66% nitrous oxide (N_2O) and 33% oxygen (O_2).
- **Group S (Sevoflurane):** Anaesthesia was maintained with an end-tidal sevoflurane concentration of 1% in a carrier gas of 66% nitrous oxide (N_2O) and 33% oxygen (O_2).

Mechanical ventilation was controlled to maintain a tidal volume of 10 ml/kg and a respiratory rate of 12-14 breaths per minute, aiming for an $EtCO_2$ between 30-35 mmHg. Neuromuscular blockade was maintained with incremental doses of vecuronium (0.02 mg/kg) as required. All patients received intravenous dexamethasone (0.1 mg/kg) and ondansetron (0.1 mg/kg) for antiemetic prophylaxis. The surgeon infiltrated the surgical field with approximately 4 ml of 2% lignocaine containing 1:80,000 adrenaline to aid haemostasis. The fresh gas flow (FGF) was initially set at 6 L/min (O_2 2L, N_2O 4L) and was reduced to a low flow of 3 L/min (O_2 1L, N_2O 2L) once the target end-tidal volatile concentration was stable.

Intraoperative Hemodynamic Management: Heart rate (HR) and mean arterial pressure (MAP) were recorded at baseline (pre-induction) and subsequently at 15-minute intervals from induction until the end of surgery. A protocolised approach was used to manage deviations: hypotension (MAP < 60 mmHg) was treated with a 100 ml fluid bolus and incremental doses of intravenous ephedrine (6 mg); hypertension (MAP > 120 mmHg) was treated with a fentanyl bolus (1 mcg/kg); bradycardia (HR < 50 bpm) with atropine (0.6 mg); and tachycardia (HR > 100 bpm) with esmolol (0.5 mg/kg).

Study Measurements and Data Collection

Primary Outcome Measures:

1. **Hemodynamic Parameters:** Serial recordings of HR and MAP at defined intervals (0, 15, 30, 45, 60, 75, 90, 105 minutes post-induction).
2. **Recovery Characteristics:** The following time intervals were recorded in minutes from the discontinuation of the volatile anaesthetic (time zero):
   - Time to response to painful stimulus (firm trapezius pinch).
   - Time to response to verbal commands (e.g., "open your eyes").
   - Time to first spontaneous motion.
   - Time to extubation (performed when the patient was breathing regularly, responsive, and had adequate muscle power).
   - Time to recall of own name.
   - Time to achieve a firm hand grip on command.
   - Time to purposeful limb lift on command.

Secondary Outcome Measures:

1. **Post-anaesthesia Recovery Score (PARS):** The Aldrete and Kroulik score was assessed at 1-minute intervals from discontinuation of anaesthetic until a score >10

was achieved. The PARS evaluates consciousness, ventilation, circulation, activity, and colour on a 0-2 scale for each parameter.

2. **General Data:** Patient demographics (age, gender, weight), ASA PS, total duration of surgery, total duration of anaesthesia, time to discontinuation of N_2O, and time to administration of neuromuscular reversal (neostigmine 0.05 mg/kg with glycopyrrolate 8 mcg/kg) were recorded.

Emergence and Postoperative Protocol

At the conclusion of surgery, the volatile anaesthetic and N_2O were simultaneously discontinued. The FGF was increased to 100% oxygen at 6 L/min. Oropharyngeal suctioning was performed, and the throat pack was removed upon the return of spontaneous respiration. Neuromuscular blockade was reversed at the discretion of the attending anaesthetist, typically when at least two twitches were present on train-of-four monitoring. All recovery times were recorded by an independent observer who was aware of the group allocation, as the distinct odour of the agents made blinding impractical. Patients were monitored for any adverse events, such as postoperative nausea and vomiting (PONV), airway complications, or hemodynamic instability, for 30 minutes in the operating theatre.

Statistical Analysis

Data were analysed using IBM SPSS Statistics software (Version 23.0). Descriptive statistics were presented as mean ± standard deviation (SD) for continuous variables and as frequency (percentage) for categorical variables. The normality of data distribution was assessed using the Shapiro-Wilk test. To compare continuous variables (e.g., recovery times, hemodynamic parameters) between the Desflurane and Sevoflurane groups, the independent samples t-test was used for normally distributed data. The Chi-square test (or Fisher's exact test where appropriate) was used to compare categorical variables such as gender and ASA PS distribution between the groups. A two-tailed p-value of less than 0.05 was considered statistically significant for all analyses.

RESULTS

Table 1 summarizes the baseline demographic and perioperative characteristics of patients in the desflurane and sevoflurane groups. The mean age of participants was comparable between the desflurane group (29.4 ± 8.7 years) and the sevoflurane group (28.1 ± 7.5 years; p = 0.424). Males constituted the majority in both groups, accounting for 40 patients (80.0%) in the desflurane group and 36 patients (72.0%) in the sevoflurane group, with no statistically significant difference in gender distribution (p = 0.349). Most patients in both groups belonged to ASA physical status I [43 (86.0%) in the desflurane group and 42 (84.0%) in the sevoflurane group], while ASA II patients comprised 7 (14.0%) and 8 (16.0%) participants, respectively (p = 0.779). The mean duration of surgery was similar between groups (1.42 ± 0.09 hours with desflurane vs 1.40 ± 0.05 hours with sevoflurane; p = 0.275), as was the duration of anaesthesia (1.47 ± 0.05 hours vs 1.46 ± 0.04 hours; p = 0.303).

Table 1: Baseline Demographic and Clinical Characteristics among the groups (n=100)

Variable	Desflurane (n=50)	Sevoflurane (n=50)	p value
Age (years), mean ± SD	29.4 ± 8.7	28.1 ± 7.5	0.424
Male sex	40 (80.0%)	36 (72.0%)	0.349
Female sex	10 (20.0%)	14 (28.0%)	
ASA I	43 (86.0%)	42 (84.0%)	0.779
ASA II	7 (14.0%)	8 (16.0%)	
Duration of surgery (hours), mean ± SD	1.42 ± 0.09	1.40 ± 0.05	0.275
Duration of anaesthesia (hours), mean ± SD	1.47 ± 0.05	1.46 ± 0.04	0.303

Table 2 compares early emergence and cognitive recovery parameters between the desflurane and sevoflurane groups. A significantly higher proportion of patients in the desflurane group demonstrated rapid recovery across all assessed endpoints. Response to painful stimulus within 9 minutes was observed in 44 patients (88.0%) receiving desflurane compared with 31 patients (62.0%) in the sevoflurane group (p < 0.001). Similarly, early response to verbal commands within 10 minutes occurred in 41 patients (82.0%) in the desflurane group versus 26 patients (52.0%) in the sevoflurane group (p < 0.001). Spontaneous movement within 10 minutes was achieved by 40 patients (80.0%) receiving desflurane compared to 24 patients (48.0%) receiving sevoflurane (p < 0.001). Extubation within 10 minutes was significantly more frequent with desflurane [42 patients (84.0%)] than with sevoflurane [23 patients (46.0%); p < 0.001]. Likewise, recall of name within 11 minutes was observed in 39 patients (78.0%) in the desflurane group compared to only 19 patients (38.0%) in the sevoflurane group (p < 0.001)

Table 2: Comparison of Early Emergence and Cognitive Recovery Parameters among the groups (n=100)

Recovery Parameter	Desflurane (n=50)	Sevoflurane (n=50)	p value
Response to painful stimulus ≤9 min	44 (88.0%)	31 (62.0%)	<0.001
Response to verbal command ≤10 min	41 (82.0%)	26 (52.0%)	<0.001

Spontaneous movement ≤10 min	40 (80.0%)	24 (48.0%)	<0.001
Extubation ≤10 min	42 (84.0%)	23 (46.0%)	<0.001
Recall of name ≤11 min	39 (78.0%)	19 (38.0%)	<0.001

Table 3 presents the comparison of neuromuscular and motor recovery outcomes between the desflurane and sevoflurane groups. Rapid reversal of neuromuscular blockade within 7 minutes was achieved in 43 patients (86.0%) in the desflurane group compared to 21 patients (42.0%) in the sevoflurane group, a difference that was statistically significant ($p < 0.001$). Similarly, early recovery of motor function, assessed by hand grip within 11 minutes, was observed in 38 patients (76.0%) receiving desflurane versus 18 patients (36.0%) receiving sevoflurane ($p < 0.001$). Limb lift within 12 minutes was also achieved by a significantly higher proportion of patients in the desflurane group [36 patients (72.0%)] compared with the sevoflurane group [16 patients (32.0%); $p < 0.001$].

Table 3: Motor and Neuromuscular Recovery Outcomes among the groups (n=100)

Parameter	Desflurane (n=50)	Sevoflurane (n=50)	p value
Neuromuscular reversal ≤7 min	43 (86.0%)	21 (42.0%)	<0.001
Hand grip ≤11 min	38 (76.0%)	18 (36.0%)	<0.001
Limb lift ≤12 min	36 (72.0%)	16 (32.0%)	<0.001

Table 4 summarizes the post-anaesthesia recovery outcomes assessed using the Aldrete and Kroulik PARS. A significantly higher proportion of patients in the desflurane group achieved a PARS greater than 10 within 12 minutes of anaesthetic discontinuation [41 patients (82.0%)] compared with the sevoflurane group [19 patients (38.0%)], and this difference was statistically significant ($p < 0.001$). Conversely, delayed recovery beyond 12 minutes was more common in the sevoflurane group, occurring in 31 patients (62.0%), whereas only 9 patients (18.0%) in the desflurane group required more than 12 minutes to reach a PARS >10.

Table 4: Post-Anaesthesia Recovery Score (PARS) among the groups (n=100)

Outcome	Desflurane (n=50)	Sevoflurane (n=50)	p value
PARS >10 within 12 min	41 (82.0%)	19 (38.0%)	<0.001
PARS >10 after 12 min	9 (18.0%)	31 (62.0%)	

Table 5 compares intraoperative hemodynamic stability between the desflurane and sevoflurane groups. A fall in mean arterial pressure (MAP) greater than 20% from baseline was observed in 18 patients (36.0%) in the desflurane group compared with 34 patients (68.0%) in the sevoflurane group, a difference that was statistically significant ($p < 0.001$). More pronounced hypotension, defined as a MAP reduction exceeding 30% of baseline, occurred in only 9 patients (18.0%) receiving desflurane but was noted in 27 patients (54.0%) in the sevoflurane group ($p < 0.001$). Bradycardia episodes were also less frequent with desflurane, occurring in 4 patients (8.0%) compared to 11 patients (22.0%) in the sevoflurane group ($p = 0.048$). Similarly, the requirement for vasopressor support was significantly lower in the desflurane group [6 patients (12.0%)] than in the sevoflurane group [15 patients (30.0%); $p = 0.031$].

Table 5: Intraoperative Hemodynamic Stability among the groups (n=100)

Parameter	Desflurane (n=50)	Sevoflurane (n=50)	p value
MAP fall >20% of baseline	18 (36.0%)	34 (68.0%)	<0.001
MAP fall >30% of baseline	9 (18.0%)	27 (54.0%)	<0.001
Bradycardia episodes	4 (8.0%)	11 (22.0%)	0.048
Vasopressor requirement	6 (12.0%)	15 (30.0%)	0.031

Figure 1 shows that the mean heart rate at pre-induction period, 15mins, 30 mins, 45 mins, 60 mins and 75 mins intervals were comparable in both groups. At 90 mins of induction, there was significant change in the heart rate in both groups with Sevoflurane group having fall in heart rate more than 30% of the baseline and Desflurane group having a fall in heart rate of less than 30% of baseline. The p value being significant (.002).

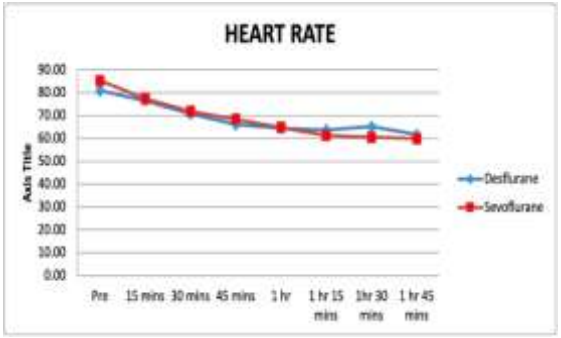

Figure 1: Intra operative heart rate among the Study Groups

Figure 2 shows that mean arterial pressure was comparable between the desflurane and sevoflurane groups at pre-induction and 15 minutes after induction ($p > 0.05$). From 30 minutes onward, a fall in MAP >20% of baseline was observed in both groups, but was significantly more frequent with sevoflurane [34 patients (68.0%)] compared to desflurane [18 patients (36.0%); $p < 0.001$]. At 60 minutes and beyond, MAP reduction >30% of baseline occurred predominantly in the sevoflurane group [27 patients (54.0%)] versus the desflurane group [9 patients (18.0%); $p < 0.001$]. Overall, sevoflurane was associated with a significantly greater and sustained intraoperative MAP reduction from 30 minutes until the end of surgery.

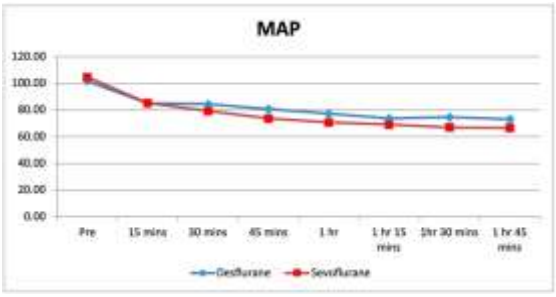

Figure 2: Mean arterial pressure among the Study Groups

DISCUSSION

The present comparative study was undertaken to examine differences in hemodynamic behavior and recovery quality between desflurane and sevoflurane in patients undergoing FESS. Although both volatile agents provided satisfactory anaesthetic depth and operating conditions, desflurane demonstrated a clear advantage in terms of faster early recovery and more stable intraoperative hemodynamics, particularly with respect to MAP, when compared with sevoflurane.

A major finding of this study was the consistently shorter emergence and recovery times observed in patients receiving desflurane. Parameters such as response to painful stimulus, response to verbal commands, extubation, recall of name, and achievement of a Post- PARS greater than 10 occurred significantly earlier in the desflurane group. This observation is physiologically plausible and aligns well with previously published work comparing modern volatile anaesthetics.[11-13] The lower blood–gas partition coefficient of desflurane (0.42) relative to sevoflurane (0.69) allows for faster elimination from the lungs and a more rapid decline in cerebral partial pressure once administration is discontinued, resulting in quicker restoration of consciousness and motor function.[11,14] Similar advantages of desflurane in early recovery have been documented across a range of surgical procedures, with reports indicating 20–40% reductions in early emergence times compared to sevoflurane.[12,15] In the context of FESS, where rapid return of airway reflexes, cognitive clarity, and neuromuscular coordination is particularly desirable this pharmacokinetic benefit assumes even greater clinical relevance.

In addition to recovery characteristics, intraoperative hemodynamic trends revealed meaningful differences between the two agents. While heart rate remained broadly comparable throughout most of the procedure, sevoflurane was associated with a significantly greater and more sustained reduction in MAP beginning approximately 30 minutes after induction. Both agents are known to cause dose-dependent reductions in systemic vascular resistance; however, sevoflurane exerts a stronger direct vasodilatory effect and has been shown to blunt baroreceptor-mediated compensatory responses more prominently than desflurane.[16,17] In contrast, desflurane may provoke mild sympathetic stimulation at lower concentrations, which can partially offset hypotensive effects.[18]

Controlled hypotension is often intentionally sought during FESS to reduce surgical field bleeding and improve visibility. Nevertheless, the degree and predictability of hypotension are critical. In the present study, MAP reductions in the sevoflurane group frequently exceeded 30% of baseline values, approaching thresholds that necessitated pharmacological intervention. Desflurane, on the other hand, produced a more moderate and controllable decrease in MAP, maintaining values within safer limits for most patients. While some studies have reported minimal differences in hemodynamic stability between these agents,[19] others have similarly observed improved hemodynamic controllability with desflurane, particularly during prolonged procedures or when titrated carefully.[20] Our findings support the latter view and suggest that desflurane may offer a wider margin of safety in terms of blood pressure control during FESS.

The clinical significance of faster recovery extends beyond numerical differences in emergence times. Earlier restoration of psychomotor function enables more reliable neurological assessment, safer patient transfer, and potentially shorter post-anaesthesia care unit (PACU) stays. These factors translate into improved operating room efficiency, reduced PACU workload, and enhanced patient throughput, considerations of increasing importance in high-volume surgical centers. However, these benefits must be balanced against known disadvantages of desflurane, particularly its propensity to cause airway irritation and coughing during emergence.[21-23] Although airway reactivity was not systematically evaluated in this study, it remains a relevant concern in nasal surgeries where coughing may precipitate postoperative bleeding.[24]

Several limitations of this study should be acknowledged. First, although comparative, the study design was not blinded, which introduces the possibility of observer bias in the assessment of

recovery endpoints. Effective blinding is inherently challenging with desflurane due to its characteristic pungency. Second, induction of anaesthesia was performed using thiopentone, which is less commonly used in contemporary practice; recovery profiles may differ if propofol-based induction were employed. Third, depth of anaesthesia was guided by end-tidal agent concentration and clinical signs rather than processed EEG monitoring such as bispectral index (BIS), which could have allowed more precise titration and potentially influenced both recovery and hemodynamic outcomes. Fourth, the study was conducted at a single center with a relatively homogeneous patient population, limiting generalizability. Finally, the use of fixed end-tidal concentrations (1% sevoflurane and 3% desflurane) does not account for interindividual variability in anaesthetic requirements.

The results of this study have practical implications for anaesthetic choice in FESS and other short-to-intermediate duration procedures. Desflurane appears particularly advantageous when rapid early recovery and tighter hemodynamic control are prioritized, making it well suited for ambulatory surgery and situations requiring prompt postoperative neurological evaluation. Sevoflurane remains a valuable alternative due to its smooth inhalational profile, lower airway irritability, and cost considerations, especially in patients with reactive airways. Ultimately, agent selection should be individualized based on patient comorbidities, institutional resources, economic factors, and surgical priorities.

CONCLUSION

In summary, this comparative study demonstrates that within a standardized balanced anaesthetic technique for Functional Endoscopic Sinus Surgery, desflurane provides significantly faster early recovery than sevoflurane, including quicker extubation and earlier return of cognitive and motor functions. Desflurane was also associated with greater intraoperative hemodynamic stability, reflected by less pronounced reductions in mean arterial pressure. While these advantages must be weighed against its higher cost and potential for airway irritation, the findings underscore the importance of pharmacokinetic properties in determining recovery profiles and support the selective use of desflurane when rapid, clear-headed emergence and stable hemodynamics are clinical priorities.

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