Indian Journal of Clinical Anaesthesia 2022;9(3):364–369

Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Clinical Anaesthesia

Journal homepage: www.ijca.in

Original Research Article

A randomised comparative study of desflurane and sevoflurane with esmolol to evaluate hemodynamic parameters and recovery characteristics in middle ear surgery

Smita R Engineer[1], **Arivazhagan J K**[1,*]

[1] *Dept. of Anaethesia, BJ Medical College Hospital, Ahmedabad, Gujarat, India*

ARTICLE INFO

Article history:
Received 08-12-2021
Accepted 05-05-2022
Available online 13-08-2022

Keywords:
Desflurane
Sevoflurane
Hypotention
Surgicalfield
Recovery

ABSTRACT

Background: To produce a blood less field for middle ear surgery performed with operating microscope, controlled hypotention is essential which achieve by means of Inhalational agents and Esmolol.
Aims: The goal of the study was to assess the effects of Desflurane and Sevoflurane vs esmolol in terms of creating controlled hypotension, intraoperative blood loss, surgeon satisfaction with the surgical field, and complications.
Materials and Methods: From December 2019 to July 2021, a prospective, randomised, double-blind trial was undertaken. A total of 100 patients, ranging in age from 18 to 60 years, were recruited and had elective middle ear procedures in the Department of Oto-rhino-laryngology operating theatre. Simple randomization (computer-generated) was used to divide the patients into two groups: Group S and Group D. Inj. Esmolol 0.5 mg/kg was administered as a loading dose, followed by a continuous infusion, and Propofol 2 mg/kg was used to produce anaesthesia. Inj. Vecuronium (0.1mg/kg) was administered to help with laryngoscopy and intubation. Oxygen, Nitrous oxide, Sevoflurane 1-3 percent (Group S) or Desflurane 3-6 percent (Group D) and intermittent InjVecuronium (0.05 mg/kg) were used to maintain anaesthesia. Intraoperative haemodynamics, six-point bleeding score, surgeon satisfaction, and postoperative Aldrete recovery score were all observed. Microsoft Excel was used to input and evaluate the data.
Results: When comparing Group S to Group D, haemodynamic measures were significantly different (p value 0.05). When comparing Group S to Group D, the six-point bleeding score and surgeon satisfaction score were considerably higher in Group S (p value 0.05). Within 5 minutes of surgery, 100% of patients in Group D and 76% of patients in Group S had achieved an aldrete score of 9,10.
Conclusion: In middle ear surgery, sevoflurane produces more controlled hypotension. When compared to the Desflurane group, the sevoflurane group had superior surgical field vision and a higher surgeon satisfaction score. When compared to the Sevoflurane group, the Desflurane group had a superior post-operative Aldrete recovery score.

1. Introduction

The ear in the middle for improved visualisation of surgeries performed under an operating microscope, a bloodless field is required. During middle ear microsurgery, improving anatomical visibility may save surgery time, minimise blood loss, and enhance surgical results. Sevoflurane and desflurane have been shown to have the same potential to lower blood pressure.[1] Because of its limited solubility, sevoflurane is an excellent drug for quick induction and awakening from anaesthesia. When compared to Desflurane, Sevoflurane needed less anaesthetic depth to

* *Corresponding author*.
E-mail address: drariv8993@gmail.com (Arivazhagan J K).

https://doi.org/10.18231/j.ijca.2022.072

maintain optimum intraoperative circumstances and had improved postoperative hemodynamics.[1,2]

When administered alone, a very high dose of inhalational anaesthetics is needed to induce a meaningful decrease in bleeding. Intravenous Esmolol is simple to use, has a rapid beginning of action, and has effects that go away quickly when treatment is stopped.[3] It also cuts down on the need of inhaled anaesthetic. Following infusion termination, arterial blood pressure gradually returned to pre-infusion levels without the development of rebound hypertension.

During middle ear surgery, both Sevoflurane and Desflurane are suitable anaesthetics. During surgery, sevoflurane patients had a lower MAP and have less nausea in the Post Anesthesia Care Unit. In PACU2, desflurane patients needed greater anaesthetic dosages to prevent movement and had a higher rate of nausea.

The goal of this research was to assess hemodynamic parameters and recovery features in adult patients following middle ear surgery with sevoflurane or desflurane with esmolol inhalation agents.

2. Materials and Methods

After getting the Institutional Ethical Committee approval Ref No : 42/2020 ON 28/02/2020 and Clinical Trail Registry Registration No : REF/2020/08/036136 study was proceeded. This prospective randomised comparative study of desflurane and sevoflurane with esmolol to evaluate hemodynamic parameters and recovery characteristics in middle ear surgery was conducted in 100 patients aged 18-60 years with either gender of ASA I, II physical status undergoing elective middle ear surgeries in the department of Oto-rhino-laryngology Operation Theatre, between December 2019 and July 2021. Patients with an ASA grade of III to V are followed. Mothers who are pregnant or nursing, Hepatic, renal, or cardiopulmonary illness history Significant neurological, psychological, or neuromuscular problems in the past Alcoholism, diabetes, hyperthyroidism, hypothyroidism, and bleeding diathesis were all ruled out. Before the research began, the patients engaged in it gave their informed written permission. A recent history of fever, medication allergy, or past procedures was asked about during the preoperative evaluation. A general examination, systemic exams, and airway evaluation were performed. Hemoglobin (Hb percent), CBC, blood sugar, blood urea, serum creatinine, chest x-ray, and, if required, liver function tests, ECG, and 2D-Echo were all checked on all patients.

In Group S and Group D, patients were randomly assigned to one of two groups using a computer-generated random number sequence. Two IV lines will be set up, and a dextrose saline infusion will begin. Baseline measures of heart rate, mean arterial pressure (MAP), and oxygen saturation by pulse oximetry (SpO2) were taken before to induction of anaesthesia. IV Premedication- Inj. Glycopyrrolate (0.2 mg/kg), Fentanyl (2 ug/kg) given. A loading dosage of inj. Esmolol 0.5 mg/kg was administered through the second intravenous line, followed by a continuous infusion of Esmolol 0.4 to 0.5 mg/kg/hour. For the first three minutes, 100 percent oxygen was delivered via a mask. Propofol 2 mg/kg was used to produce anaesthesia, and IV InjVecuronium 0.05 mg/kg was used to assist endotracheal intubation. With 50 percent oxygen and 50 percent nitrogen oxide, mechanical ventilation was adjusted to give an end-tidal carbon dioxide (CO2) level of 30 to 35mmHg and a SpO2 level of > 95 percent. Controlled ventilation: at TV 8ml/kg, RR 12/min (etco2 34-35 mm Hg) and maintanence with in Group S: Oxygen (50%), Nitrous oxide (50%), Sevoflurane (1-3%) and intermittent InjVecuronium (0.05 mg/kg) and in Group D: Oxygen (50%), Nitrous oxide (50%), Desflurane (3-6%) and intermittent InjVecuronium (0.05 mg/kg)given. Inj. Ondansetron (0.16 mg/kg) and inj. Dexamethsone (0.1mg/kg) was given 30 minutes prior to completion of surgery to prevent postoperative nausea and vomiting. Inj. Neostigmine 0.05 mg/kg and Glycopyrrolate 0.008 mg/kg IV were used to reverse residual neuromuscular blockade after surgery.

The sample size for two separate research groups was generated using computer tools. It revealed that at least 48 patients were needed in each group, assuming it incidence is 77±11 (Gupta N et al)[4] study with a power of 0.95 and a significance level at 95% power (α = 0.05, β = 0.05). We decided to include 50 patients in each group for the possibility of drop out.

Microsoft Excel was used to input and evaluate the data. Categorical data were given as frequency and percentages, whereas continuous variables were presented as means with standard deviation (SD). All of the variables were tested for significance using the "unpaired Student t-test." The non parametric or categorical data were compared using the "Chi-square test." At a P value of 0.05, all of the statistical findings were declared significant (0.05).

2.1. Intraoperative assessment

1. The patients were assessed on the basis of their Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), MBP at the following intervals: Baseline, premedication, induction, intubation,1 min, 3 mins, 5 mins, 15 mins, 30 mins, 45 mins, 60 mins, 75 mins, 90mins.
2. The quantity of blood in the surgical field was measured by the same attending surgeon who was blinded to the treatment groups and conducted all of the procedures at the conclusion of the procedure. The quantity of bleeding in the surgical field was measured using the following six-point scale. Every 15 minutes, it was evaluated by the surgeon. (0 - There is no bleeding; 1 - There is bleeding; 2 - There 1 - Slight bleeding with no need for suctioning;

2 - Slight bleeding with the need for suctioning on occasion; 3 - Slight bleeding with the need for suctioning on occasion; 4 - Slight bleeding with the need for suctioning 3 - Slight bleeding, which needs repeated suctioning The surgical field was endangered by bleeding. 4- Moderate bleeding need regular suctioning. After the suction was withdrawn, bleeding endangered the operative area. 5 - Severe bleeding necessitating frequent suctioning The bleeding looked to be quicker than suction could remove it. 6 - The surgical field is seriously harmed, making surgery impossible.

3. The surgeon's satisfaction score was calculated using a 4-point scale (1-bad, 2- moderate, 3-good, 4-excellent).

2.2. *Postoperative assessment*

1. Sedation assessment -Four point score at every 15 min in first hour, then hourly for 4 hours. Score 1-awake, Score 2-drowsy, cooperative, Score 3-responds to pain, Score 4-unconscious
2. Adverse events - Shivering, Bradycardia (Hr <60 Bpm, Hypotension (Sbp <100mm Hg, Nausea, Vomiting
3. Modified Aldrete recovery score (0-10) at immediate, 1 min, 3 min, 5 min minutes interval till score of 9-10. (Table 1)

Following parameters were noted - Anesthesia duration, surgery time frame, after initiating desflurane sevoflurane, how long did it take you to reach your goal MAP? time it took to go back to a normal MAP level after surgery, Maximum inhalation agent concentration, Bradycardia (HR 60 Bpm), Hypotension (SBP 100mm Hg), Nausea, and Vomiting are some of the complications that might occur. Time to extubate - (Time between stopping of anaesthesia and extubation). Time of emergence – (Time taken after reversal till eye opening and following commands). Time it takes to attain Aldrete's recovery score of 9-10.

3. Results

Patients' demographic profiles, including as age, gender, and ASA grade, were equivalent across the two groups (Table 2). During the anaesthesia, neither group's heart rate differed significantly from one another P value (>0.05). The mean arterial blood pressure in the sevoflurane group was lower than the desflurane group at 15, 30, 45, 60, and 75 minutes. This difference in mean was statistically significant (P0.05) (Table 3), and the bleeding score for skin incision, bone drilling, cholesteatoma clearance, and fascia laying was statistically significant (p value 0.05) in the sevoflurane group compared to the desflurane group (Table 4). In Group S, 92 percent of patients had an excellent or good surgeon satisfaction score, compared to 84 percent in Group D. 16 percent of patients in Group D and 8% of patients in Group S had a moderate score (Figure 1).

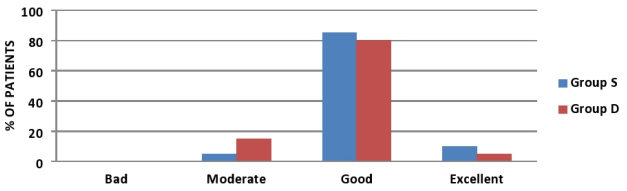

Fig. 1: Surgeons satisfaction score

88 percent of patients in Group D and 4% of patients in Group S achieved an aldrete score of 9,10 in the immediate postoperative period, which is statistically significant (p value 0.05). Only 6% of patients in Group D have achieved an aldrete score of 1-8, whereas 96 percent of patients in Group S have achieved an aldrete score of 1-8, which is statistically significant (p value 0.05). At 5 minutes after surgery, 24% of patients in Group S had achieved an aldrete score of 1-8.

A total of 100% of patients in Group D and 76% of patients in Group S have achieved an aldrete score of 9,10.

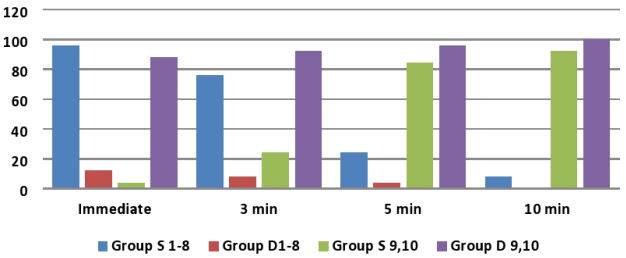

Fig. 2: Surgeons satisfaction score

The Aldrete Recovery Score revealed a statistically significant difference between Group D and Group S in the immediate postoperative period.(Figure 2)

4. Discussion

During middle ear surgery, hypotensive anaesthesia is favoured because a bloodless area allows for better vision beneath the operating microscope. A tiny quantity of bleeding may drastically affect the surgical field and, as a result, the length of the operation, the medications used to reduce bleeding, the healing process, and the need for transfusions. As a result, regulated hypotension plays a significant role in this situation. The implantation of the graft is made easier by the relatively bloodless region. Under an operating microscope, even a little bleed seems to be a huge one, making it difficult for anaesthesiologists to deliver a bloodless field.

We examined the effectiveness of sevoflurane or desflurane in combination with esmolol in producing controlled hypotension, as well as surgical field visibility,

Table 1: Modified aldrete recovery score

Score	2	1	0
Activity	Moves all four limbs voluntarily on command	Moves two limbs	Unable to move limbs
Respiration	Breaths deeply coughs freely	Dyspnoeic, shallow or limited breathing	Apnoea
Circulation	Bp >20mmhg of preanasthetic level	Bp> 20-50mmhg of preanasthetic level	Bp>50mmhg of preanasthetic level
Consciousness	Fully awake	Arousable on calling	Not responding
Oxygen saturation	Spo2>92%on room air	Supplemental o2 required to maintain spo2>90%	Spo2<92% with o2 supplementation

Table 2: Demographic characteristics

Variables	**Group S (N=50)(%)**	**Group D (N=50)(%)**	**P Value**
Age (years) (Mean ± SD)	28±6.68	30±5.48	0.2874
Sex (male : female) (%)	44/56	34/66	0.3052
ASA status (I/II) (%)	42/58	46/54	0.6873

Table 3: Comparison of mean arterial blood pressure

	Group S (n=50)	**Group D (n=50)**	**P value**
Baseline	92.06 ± 4.69	91.67 ± 5.17	0.693
Premedication	95.17 ± 4.16	94.06 ± 5.89	0.279
Induction	74.58 ± 6.06	76.38 ± 4.37	0.092
Intubation	94.52 ± 6.92	97.23 ± 5.54	0.825
1 Min	86.2 ± 4.12	84.88 ± 3.7	0.1357
3 Min	78.10 ± 3.18	78.57 ± 5.04	0.582
5 Min	86.73 ± 3.96	85.35 ± 4.77	0.1632
15 Min	60.86 ± 5.62	60.72 ± 4.89	0.849
30 Min	62.53 ± 2.61	62.00 ± 3.04	<0.0001
45 Min	62.87 ± 2.93	61.35 ± 2.89	0.011
60 Min	63.42 ± 3.13	60.55 ± 3.22	<0.0001
75 Min	65.96 ± 5.64	61.40 ± 3.54	<0.0001
90 Min	60.51 ± 25.33	55.61 ± 21.14	<0.0001

Table 4: Comparison of six point bleeding severity score

	Group S (n=50)	**Group D (n=50)**	**P value**
Skin Incision	1.71 ± 0.57	1.94 ± 0.51	0.0360
Bone Drilling	2.4 ± 0.72	2.04 ± 0.56	0.0317
Clearance Of Cholesteatoma	1.64 ± 0.8	2.0 ± 0.92	0.0394
Laying Of Fascia	1.46 ± 0.70	2.0 ± 0.92	0.001

surgeon satisfaction, postoperative complications, and recovery profile in adult patients having middle ear operations.

During the anaesthetic, neither group's heart rate differed substantially from one another in our research. In comparison to Group D, Systolic Blood Pressure, Diastolic Blood Pressure, and Mean Arterial Blood Pressure were lower in Group S throughout 15, 30, 45, 60, 75, and 90 minutes. Group S was more significant (p value 0.05) than Group D.

Neha Gupta et al[4] observed that Desflurane is beneficial in middle ear microsurgery for causing purposeful hypotension. Desflurane with labetalol has been linked to a lower desflurane demand, the lack of reflex tachycardia, quicker induction of hypotension, faster recovery from anaesthesia, and less postoperative drowsiness.

Dal D et al[5] during tympanoplasty, they discovered that desflurane, sevoflurane, or isoflurane gave acceptable controlled hypotension of 60-70 mmHg mean arterial blood pressure and comparable surgical circumstances throughout

the procedure.

A Rossi et al[6] reported that when compared to sevoflurane in maxillofacial surgery, anaesthesia with desflurane may minimise blood loss and provide good surgical visibility with moderate controlled hypotension and a significant reduction in the need for vasoactive drugs.

Iclal Ozdemir Kol[7] observed that In patients having tympanoplasty, both esmolol and dexmedetomidine combination with desflurane offered a successful and well-tolerated approach of producing controlled hypotension and limiting the quantity of blood in the surgical area. When compared to dexmedetomidine, esmolol was linked with considerably quicker extubation and recovery durations, as well as much less postoperative drowsiness.

W. Scott Jellish MD et al[2] observed that For maintenance, DES 6 percent -9 percent or SEVO 2 percent -3 percent were employed. Surgical and emergence times were comparable among groups. Though surgical results were equal, DES anaesthesia was more costly, despite no hemodynamic differences. SEVO may provide further benefits in otologic microsurgery.

Ryu JH et al[8] found that In terms of postoperative pain and other problems, remifentanil and magnesium sulphate were used after middle ear surgery. To induce anaesthesia, 2 mg kg(-1) propofol was given, which was then maintained with sevoflurane. When coupled with sevoflurane, magnesium sulphate and remifentanil gave appropriate controlled hypotension and optimal operative circumstances for middle ear surgery. Patients given magnesium sulphate, on the other hand, had a better postoperative course, with greater analgesia and less shivering, and PONV.G.

Pilli et al[9] observed that Infusion of esmolol for controlled hypotension during middle ear surgery For anaesthesia maintenance, they employed isoflurane, nitrous oxide, oxygen, 0.08 mg/kg vecuronium bromide, and controlled breathing. Because it has no adverse effects, esmolol is an acceptable hypotensive drug for individuals having middle ear surgery under hypotensive anaesthesia. It is simple to administer and produces the required level of hypotension with no side effects.

Beaussier M et al[10] observed that For spinal surgeries requiring modest degrees of controlled arterial hypotension, desflurane and isoflurane are used. They were randomly assigned to receive either desflurane or isoflurane in O2/N2O (1:1) for anaesthetic maintenance. Desflurane demonstrated superior haemodynamic stability than isoflurane in spinal surgery requiring mild arterial hypotension.

In our research, we discovered that Group S had a higher six-point bleeding score for Skin Incision, Bone Drilling, Cholesteatoma Clearance, and Fascia Laying than Group D (p value 0.05). In our research, the surgical field was percent patients in Group S vs 84 percent patients in Group D. A moderate score was found in 16 percent of Group D patients and 8% of Group S patients.

Shams et al[11] observed that the In conjunction with sevoflurane, dexmedetomidine or esmolol provides the best surgical field. Both medications were helpful in reducing the heart rate and establishing a MAP of 55 to 65 mmHg, ensuring favourable surgical conditions and a dry surgical field during FESS.

Chok et al[12] compared surgical field condition between propofol/remifentanil (PR) based anesthesia and desflurane/remifentanil (DR) based anesthesia in endoscopic surgery. They discovered that anaesthesia based on propofol/remifentanil(PR) provided a superior surgical field for endoscopic sinus surgery than anaesthesia based on desflurane/remifentanil. Propofol/remifentanil-based anaesthetic is recommended for endoscopic sinus surgery.

Chaaban MR et al[13] when compared to inhalational anaesthesia, total intravenous anaesthesia (TIVA) using propofol has been linked to shorter operational times, less perioperative hazards, and less intraoperative blood loss (IA). Reduced bleeding from the mucosal surfaces during endoscopic sinus surgery (ESS) might enhance anatomical visibility and lower the likelihood of significant consequences. There was no difference in blood loss or surgical circumstances between the TIVA and IA groups in this research.

Manorema et al[14] sevoflurane and desflurane caused reduced blood loss and improved surgical field visibility, and the sevoflurane group had lower mean arterial blood pressure under anaesthesia than the desflurane group.

Yuan X et al[15] both groups had scores of 2 meaning no clinical differences between them. PR (Propofol/Remifentanil) anaesthesia resulted in lower surgical field visibility scores than DR (Desflurane/Remifentanil) anaesthesia resulted in lower surgical field visibility scores than DR (Desflurane/Remifentanil) anaesthesia resulted in lower surgical field visibility scores than DR (Desflurane/Remifentanil) an the operating circumstances were satisfactory thanks to DR. Despite the fact that the DR group consumed more remifentanil.

Although we found that 96 percent of patients in Group S and 6 percent of patients in Group D reached an aldrete score of 1-8, which is statistically significant (p value 0.05), and 88 percent of patients in Group D and 4 percent of patients in Group S reached an aldrete score of 9,10, which is statistically significant (p value 0.05).

At 5 minutes after surgery, 100% of patients in Group D had recovered entirely, but only 76% of patients in Group S had recovered completely.

In Group D and Group S, the Aldrete Recovery Score revealed that there was a statistically significant difference at immediate.

McKay et al[16] the effects of desflurane and sevoflurane on the restoration of airway reflexes during the early postoperative phase were studied, and the desflurane group had a faster recovery. The decreased resolution of desflurane in blood and tissues is thought to be the cause of this.

Priyanka Gupta et al[17] reported that both sevoflurane and desfluran ehave similar pharmacokinetics so both produced rapid emergence. Desflurane lowers blood pressure: When compared to sevoflurane, the blood partition coefficients of desflurane were much lower, resulting in significantly shorter extubation and emergence times in the desflurane group.

Cohen et al[18] observed that In children having adenoidectomy, desflurane offered earlier emergence and recovery than sevoflurane. They also noticed that in the desflurane group, the time to eye opening on verbal orders and the time to tracheal extubation were both faster.

There were no post-operative problems in either group, such as bradycardia (HR 60 bpm), hypotension (SBP 100mm Hg), nausea, or vomiting.

5. Conclusion

Clinical differences between desflurane and sevoflurane for middle ear otologic operations were discovered in our research. During surgery, the Sevoflurane group had a lower MAP than the Desflurane group. Sevoflurane had much higher surgical field visibility and surgeon satisfaction than Desflurane. When comparing Desflurane to Sevoflurane, the Aldrete recovery score was superior in Desflurane. In middle ear surgery, Sevoflurane with intravenous esmolol infusion is a superior option than Desflurane with esmolol infusion.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Khan IK, Hayes I, Buggy DJ. Pharmacology of anaesthetic agents. *Contin Educ Anaesth Criti Care Pain*. 2014;14(3):106–11.
2. Jellish WS, Owen K, Edelstein S, Fluder E, Leonetti JP. Standard anesthetic technique for middle ear surgical procedures: a comparison of desflurane and sevoflurane. *Otolaryngol Head Neck Surg*. 2005;133(2):269–74.
3. Erbesler ZA, Bakan N, Karaören GY, Erkmen MA. A Comparison of the Effects of Esmolol and Dexmedetomidine on the Clinical Course and Cost for Controlled Hypotensive Anaesthesia. *Turk J Anaesthesiol Reanim*. 2013;41(5):156–61.
4. Gupta N, Talwar V, Prakash S, Deuri A, Gogia AR. Evaluation of the efficacy of desflurane with or without labetalol for hypotensive anesthesia in middle ear microsurgery. *J Anaesthesiol Clin Pharmacol*. 2017;33(3):375–80.
5. Dal D, Celiker V, Ozer E, Başgül E, Salman MA, Aypar U. Induced hypotension for tympanoplasty: a comparison of desflurane, isoflurane and sevoflurane. *Eur J Anaesthesiol*. 2004;21(11):902–6.
6. Rossi A, Falzetti G, Donati A, Orsetti G, Pelaia P. Desflurane versus sevoflurane to reduce blood loss in maxillofacial surgery. *J Oral Maxillofac Surg*. 2010;68(5):1007–12.
7. Kol IO, Kaygusuz K, Yildirim A, Dogan M, Gursoy S, Yucel E, et al. Controlled hypotension with desflurane combined with esmolol or dexmedetomidine during tympanoplasty in adults: A double-blind, randomized, controlled trial. *Curr Ther Res Clin Exp*. 2009;70(3):197–208.
8. Ryu JH, Sohn IS, Do SH. Controlled hypotension for middle ear surgery: a comparison between remifentanil and magnesium sulphate. *Br J Anaesth*. 2009;103(4):490–5.
9. Pilli G, Güzeldemir ME, Bayhan N. Esmolol for hypotensive anesthesia in middle ear surgery. *Acta Anaesthesiol Belg*. 1996;47(2):85–91.
10. Beaussier M, Paugam C, Deriaz H, Mestari M, Chandon M, Sautet A, et al. Haemodynamic stability during moderate hypotensive anaesthesia for spinal surgery. A comparison between desflurane and isoflurane. *Acta Anaesthesiol Scand*. 2000;44(9):1154–9.
11. Shams T, Bahnasawe NE, Abu-Samra M, El-Masry R. Induced hypotension for functional endoscopic sinus surgery: A comparative study of dexmedetomidine versus esmolol. *Saudi J Anaesth*. 2013;7(2):175–80.
12. Cho K, Lee JY, Park SK, Cheong SH, Lee KM, Lim SH, et al. Comparison of surgical conditions during propofol or desflurane anesthesia for endoscopic sinus surgery. *Korean J Anesthesiol*. 2012;63(4):302–7.
13. Chaaban MR, Baroody FM, Gottlieb O, Naclerio RM. Blood loss during endoscopic sinus surgery with propofol or sevoflurane: a randomized clinical trial. *JAMA Otolaryngol Head Neck Surg*. 2013;139(5):510–4.
14. Manorema V, Maharajan M. A comparative study of Desflurane versus Sevoflurane anesthesia for controlled hypotension in functional endoscopic sinus surgery. *Int Arch Integr Med*. 2021;8(2):19–26.
15. Yuan X, Liu T, Hu C, Shen X. Comparison of surgical field visibility during propofol or desflurane anesthesia for middle ear microsurgery. *BMC Anesthesiol*. 2019;19(1):85. doi:10.1186/s12871-019-0759-x.
16. Mckay RE, Large MJ, Balea MC, Mckay WR. Airway reflexes return more rapidly after desflurane anesthesia than after sevoflurane anesthesia. *Anesth Analg*. 2005;100(3):697–700.
17. Gupta P, Rath GP, Prabhakar H, Bithal PK. Comparison between sevoflurane and desflurane on emergence and recovery characteristics of children undergoing surgery for spinal dysraphism. *Indian J Anaesth*. 2015;59(8):482–7.
18. Cohen IT, Finkel JC, Hannallah RS, Hummer KA, Patel KM. The effect of fentanyl on the emergence characteristics after desflurane or sevoflurane anesthesia in children. *Anesth Analg*. 2002;94(5):1178–81.

Author biography

Smita R Engineer, Professor

Arivazhagan J K, PG Student

Cite this article: Engineer SR, Arivazhagan J K. A randomised comparative study of desflurane and sevoflurane with esmolol to evaluate hemodynamic parameters and recovery characteristics in middle ear surgery. *Indian J Clin Anaesth* 2022;9(3):364-369.