



## A COMPARATIVE STUDY BETWEEN DESFLURANE AND SEVOFLURANE IN PEDIATRIC ANAESTHESIA WITH LARYNGEAL MASK AIRWAY

### Anaesthesiology

**Dr. Lulu Fatema  
Vali**

Professor and Head, Dept. of Anaesthesia, GMC, Chandrapur.

**Dr. Kiran Janwe**

Assistant Professor, Dept. of Anesthesia, GMC, Chandrapur.

**Dr. Abhay Rathod**

Consultant paediatrician.

### ABSTRACT

**Aims and objectives:** Our study compared desflurane with sevoflurane maintenance anesthesia in terms of respiratory events and the emergence characteristics in children with a laryngeal mask airway.

**Methodology:** This randomized controlled trial evaluated 200 children undergoing strabismus surgery allocated to desflurane or sevoflurane groups. After inducing anesthesia with sevoflurane and thiopental sodium 5 mg kg<sup>-1</sup>, the anesthetic agent was changed to desflurane in the desflurane group, whereas sevoflurane was continued in the sevoflurane group.

**Results:** The overall respiratory events did not differ between the groups. However, the incidence of mild desaturation (90% ≤ SpO<sub>2</sub> < 97%) was significantly higher in the desflurane group (7%) than in the sevoflurane group (0%) (P = .007). Emergence was significantly faster in the desflurane group (6.6 ± 3.9 vs 8.0 ± 2.2 min, P = .003).

### KEYWORDS

sevoflurane, laryngeal mask airway

### Introduction:

Desflurane has faster emergence with a comparable incidence of emergence agitation compared with sevoflurane and isoflurane, even in children.[1,2] However, its pungency can provoke airway irritation, causing secretions, breath-holding, cough, and laryngospasm.[3,4] Therefore, desflurane is contraindicated for inhalation induction in children and infants. The use of desflurane is considered safe in terms of airway irritability only with an endotracheal tube and during anesthesia maintenance.[5,6]. Furthermore, the Pediatric Advisory committee of the US Food and Drug Administration recommended that desflurane labeling be "revised to clearly state that the use of maintenance of non-intubated pediatric patients be contraindicated." [7].

Nevertheless, there is increasing evidence that desflurane has a similar incidence of respiratory events as sevoflurane when both are given via an LMA. A retrospective investigation revealed that desflurane did not increase the risk of respiratory events in children with LMA.[8] Also, a meta-analysis by Stevanovic et al[9] concluded that, in adults, there is no difference in adverse upper airway events between anesthesia achieved with desflurane via an LMA, sevoflurane, isoflurane, or propofol anesthesia.

Therefore, this randomized controlled trial compared the respiratory events and emergence characteristics of desflurane versus sevoflurane during ambulatory anesthesia, via an LMA, in children. The primary outcome was the overall incidence of respiratory adverse events, and the secondary outcomes were the emergence time and incidence of emergence agitation according to inhalation agents.

### Materials and methods:

This study used a double-blind, randomized controlled, parallel group design and was conducted at Govt Medical college, Chandrapur. The first participant was enrolled on July 25, 2015. After obtaining written informed consent from the children's parents, the study enrolled 200 pediatric patients from 2 to 6 years of age who underwent general anesthesia for strabismus surgery from July 2015 to July 2017. Anesthesia was induced with 5 mg kg<sup>-1</sup> thiopental sodium, atropine 0.01 mg kg<sup>-1</sup>, and 6 to 8 vol% sevoflurane under 100% O<sub>2</sub> mask ventilation, followed by 0.3 mg kg<sup>-1</sup> rocuronium to facilitate LMA placement. Anesthesia was maintained with 2 to 3 vol% sevoflurane using an oxygen/air mixture in the S group and 7 to 8 vol% desflurane using an oxygen/air mixture in the D group. The minimum alveolar concentration (MAC) during the maintenance period was 0.8 to 1.2 MAC in both groups, as determined by the child's age. Emergence agitation was evaluated at 15 minutes after admission to the PACU using the 4-point agitation scale for emergence delirium, on which emergence delirium is defined by a score of 3 or 4 at any time (1, calm; 2, not calm but could be easily calmed; 3, not easily calmed,

moderately agitated, restless; and 4, excited or disoriented).[10] The scale is simple to use and provides a meaningful and clear end point for the dichotomous outcome of emergence agitation.[11]

### Results:

In total, 200 patients completed the study. The patient characteristics are listed in Table 1. The anesthesia time, defined as the time interval between the initiation of inhalation induction and discontinuation of the inhaled anesthetic agents, was longer in the D group than in the S group with statistical significance (mean difference 1.4 min and 95% confidence interval [CI]: 0.1–3.0 min).

Table 2 provides details of the respiratory adverse events. The incidence of coughing, secretion, breath-holding, and laryngospasm was similar in both groups. No patient developed bronchospasm during emergence. However, the incidence of mild desaturation (90% ≤ SpO<sub>2</sub> < 97%) was significantly higher in the D group.

Table 3 shows the emergence characteristics of both groups. The emergence time was significantly shorter in the D group (mean difference 1.4 min and 95% CI: 0.5–2.3 min). There were no group differences in recovery time (mean difference 0.4 min and 95% CI: –2.1 to 1.2 min), the incidence of vomiting, and the incidence of overall respiratory adverse events (relative risk 1.05 and 95% CI: 0.74–1.47).

### Discussion:

In this study, desflurane anesthesia following sevoflurane induction showed slightly faster emergence and a comparable incidence of emergence delirium to that of sevoflurane anesthesia. A meta-analysis of LMA usage in pediatric anesthesia concluded that the incidence of desaturation, laryngospasm, cough, and breath-holding during recovery from anesthesia was lower than with tracheal intubation.[13] Even in pediatric patients with an upper respiratory infection which may increase the airway resistance, the LMA usage considered feasible alternative to the tracheal tube.[14,15]

It should be noted, however, that the degree of airway irritability due to inhalation agents differs between normal and susceptible airways.[16] Known risk factors for perioperative respiratory adverse events include a history of recent URI, age less than 6 years,[1] and airway surgery.[17,18] Perioperative respiratory adverse events during pediatric ambulatory anesthesia are increased in children younger than 3 years regardless of the anesthetic regimen, such as LMA or desflurane anesthetics.[19]

The secondary outcomes of this study were the emergence time and incidence of emergence agitation according to the inhalation agent. Desflurane maintenance anesthesia resulted in faster emergence from anesthesia. However, faster emergence does not guarantee fast

recovery and hospital discharge. Some authors concluded that faster emergence from anesthesia is associated with a higher incidence of postoperative agitation and even a delay in recovery.[20,21] Nevertheless, in this study, desflurane during maintenance anesthesia shortened the emergence time but was similar to sevoflurane with respect to emergence agitation and recovery time.

We found no difference in the incidence of emergence agitation between sevoflurane and desflurane. Consistent with our results, a systematic review of risk factors for emergence agitation showed that there is no difference in emergence agitation according to the inhalation agent.[22] However, the incidence of emergence agitation with both agents was very high in this study. Emergence agitation may affect the postoperative course,[23] and a multimodal approach to reducing the emergence agitation is needed.[11]

We should consider many factors when we choose an inhalation agent for anesthesia, including drug effectiveness, patient safety, costs, and environmental impact.[24] The operating room is a major source of perioperative costs and the anesthesiologist can affect the efficiency of the operating room by choosing anesthetic options that are cost-effective, safe, and facilitate rapid emergence.[25] Clinicians must consider the risks and benefits of desflurane anesthesia with an LMA in children. Careful patient selection and an optimal anesthetic technique are required.

In conclusion, desflurane maintenance anesthesia in children with an LMA might be a possible alternative to sevoflurane during ambulatory anesthesia with respect to the rapid emergence and similar incidence of overall respiratory adverse events.

**Tables:**

For all, Values are expressed as mean(range), mean ± SD, or absolute number of patients. S- sevoflurane group, D- desflurane group. P<0.05 is significant.

**Table 1: The patient characteristics**

	S group (n=100)	D group (n=100)
Female:male	66:34	66:34
Age, y	4.0 (2.0-6.9)	3.8 (2.0-6.9)
Height, cm	104.6 ± 12.2	103.6 ± 14.5
Weight, kg	17.4 ± 4.4	17.3 ± 5.9
Anesthesia time, min	24.7 ± 5.4	26.2 ± 5.8

Values are expressed as mean(range), mean ± SD, or absolute number of patients. S- sevoflurane group, D- desflurane group.

**Table 2 :Showing the detailed incidence of respiratory adverse events during emergence.**

	S group (n=100)	D group (n=100)	P	Relative risk	95% CI
Overall respiratory events, n	39	41	.865	1.05	0.74-1.47
Breath holding, n	10	16	.293	1.60	0.76-3.35
Coughing, n	28	30	.876	1.07	0.69-1.65
Secretion require suctioning, n	12	13	1.000	1.08	0.52-2.25
Laryngospasm, SpO <sub>2</sub> <90%, n	1	4	.365	4.00	0.45-35.16
Bronchospasm, n	0	0	1.000		
Mild desaturation, 90% ≤ SpO <sub>2</sub> < 97%, n	0	7	.007		

**Table 3: Emergence and recovery characteristics.**

	S group (n=100)	D group (n=100)	P
Emergence time, min	8.0 (2.2)	6.6 (3.9)	.003
Recovery time, min	33.1 (5.6)	33.5 (6.1)	.732
Vomiting, n	2	5	.441
Four points agitation score			.449
1	40	36	
2	8	13	
3	43	46	
4	9	5	

**References:**

- Lerman J, Hammer GB, Verghese S, et al. Airway responses to desflurane during maintenance of anesthesia and recovery in children with laryngeal mask airways. Paediatr Anaesth 2010;20:495-505.
- Sale SM, Read JA, Stoddart PA, et al. Prospective comparison of sevoflurane and desflurane in formerly premature infants undergoing inguinal herniotomy. Brit J Anaesth 2006;96:774-8.
- Taylor RH, Lerman J. Induction, maintenance and recovery characteristics of desflurane in infants and children. Canad J Anaesth 1992;39:6-13.
- Zwass MS, Fisher DM, Welborn LG, et al. Induction and maintenance characteristics of

- anesthesia with desflurane and nitrous oxide in infants and children. Anesthesiology 1992;76:373-8.
- Valley RD, Freid EB, Bailey AG, et al. Tracheal extubation of deeply anesthetized pediatric patients: a comparison of desflurane and sevoflurane. Anesth Analg 2003;96:1320-4.
- Nordmann GR, Read JA, Sale SM, et al. Emergence and recovery in children after desflurane and isoflurane anaesthesia: effect of anaesthetic duration. Brit J Anaesth 2006;96:779-85.
- Cope JU, Rosenthal GL, Weinel P, et al. FDA safety reviews on drugs, biologics, and vaccines: 2007-2013. Pediatrics 2015;136:1125-31.
- No HJ, Koo BW, Oh AY, et al. Retrospective cohort investigation of perioperative upper respiratory events in children undergoing general anesthesia via a supraglottic airway: a comparison of sevoflurane and desflurane. Medicine (Baltimore) 2016;95:e4273.
- Stevanovic A, Rossaint R, Fritz HG, et al. Airway reactions and emergence times in general laryngeal mask airway anaesthesia: a meta-analysis. Eur J Anaesthesiol 2015;32:106-16.
- Aono J, Ueda W, Mamiya K, et al. Greater incidence of delirium during recovery from sevoflurane anesthesia in preschool boys. Anesthesiology 1997;87:1298-300.
- Costi D, Ellwood J, Wallace A, et al. Transition to propofol after sevoflurane anesthesia to prevent emergence agitation: a randomized controlled trial. Paediatr Anaesth 2015;25:517-23.
- Saros GB, Doolke A, Anderson RE, et al. Desflurane vs. sevoflurane as the main inhaled anesthetic for spontaneous breathing via a laryngeal mask for varicose vein day surgery: a prospective randomized study. Acta Anaesthesiol Scand 2006;50:549-52.
- Luce V, Harkouk H, Brasher C, et al. Supraglottic airway devices vs tracheal intubation in children: a quantitative meta-analysis of respiratory complications. Paediatr Anaesth 2014;24:1088-98.
- Eikermann M, Cote CJ. Laryngeal mask airway and children's risk of perioperative respiratory complications: randomized controlled studies are required to discriminate cause and effect. Anesthesiology 2008;108:1154.author reply 1155.
- Tait AR, Pandit UA, Voepel-Lewis T, et al. Use of the laryngeal mask airway in children with upper respiratory tract infections: a comparison with endotracheal intubation. Anesth Analg 1998;86:706-11.
- von Ungern-Sternberg BS, Saudan S, Petak F, et al. Desflurane but not sevoflurane impairs airway and respiratory tissue mechanics in children with susceptible airways. Anesthesiology 2008;108:216-24.
- Mamie C, Habre W, Delhumeau C, et al. Incidence and risk factors of perioperative respiratory adverse events in children undergoing elective surgery. Paediatr Anaesth 2004;14:218-24.
- von Ungern-Sternberg BS, Boda K, Chambers NA, et al. Risk assessment for respiratory complications in paediatric anaesthesia: a prospective cohort study. Lancet (London, England) 2010;376:773-83.
- Subramanyam R, Yeramaneni S, Hossain MM, et al. Perioperative respiratory adverse events in pediatric ambulatory anesthesia: development and validation of a risk prediction tool. Anesth Analg 2016;122:1578-85.
- Welborn LG, Hannallah RS, Norden JM, et al. Comparison of emergence and recovery characteristics of sevoflurane, desflurane, and halothane in pediatric ambulatory patients. Anesth Analg 1996;83:917-20.
- Lim BG, Lee IO, Ahn H, et al. Comparison of the incidence of emergence agitation and emergence times between desflurane and sevoflurane anesthesia in children: a systematic review and meta-analysis. Medicine (Baltimore) 2016;95:e4927.
- Costi D, Cyna AM, Ahmed S, et al. Effects of sevoflurane versus other general anaesthesia on emergence agitation in children. Cochrane Database Syst Rev 2014;9:CD007084.
- Vlajkovic GP, Sindjelic RP. Emergence delirium in children: many questions, few answers. Anesth Analg 2007;104:84-91.
- Tabing AK, Ehrenfeld JM, Wanderer JP. Limiting the accessibility of cost-prohibitive drugs reduces overall anesthetic drug costs: a retrospective before and after analysis. Canad J Anaesth 2015;62:1045-54.
- Joshi GP. Efficiency in ambulatory surgery center. Curr Opin Anaesthesiol 2008;21:695-8.