Section: Anaesthesiology

Original Research Article

A PROSPECTIVE RANDOMIZED SINGLE-BLINDED CONTROLLED TRIAL COMPARING THE INCIDENCE OF DESATURATION WITH SEVOFLURANE VERSUS DESFLURANE IN PAEDIATRIC PATIENTS UNDERGOING GENERAL ANAESTHESIA WITH LARYNGEAL MASK AIRWAY ON SPONTANEOUS VENTILATION

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ABSTRACT

Background: Inhalational agents such as sevoflurane and desflurane are widely used in Paediatric Anaesthesia because of their favourable pharmacokinetics and minimal haemodynamic effects. However, comparative data regarding respiratory adverse events, particularly desaturation, remain limited. **Aim:** This study aimed to compare the incidence of intraoperative desaturation between sevoflurane and desflurane in paediatric patients aged 3–8 years undergoing general anaesthesia with spontaneous ventilation via a laryngeal mask airway. **Materials and Methods:** This prospective, randomised, single-blinded study included 200 paediatric patients aged 3–8 years undergoing general anaesthesia with a laryngeal mask airway (LMA). Patients were randomly assigned to receive sevoflurane (Group S) or desflurane (Group D) for maintenance. Standardised protocols for premedication, induction, analgesia, and monitoring were used. The primary outcome was the incidence of desaturation, defined as a drop in SpO_2 below 94%. Secondary outcomes included heart rate (HR), mean arterial pressure (MAP), recovery time, and emergence time. **Results:** Mild desaturation was observed in 11% of patients in the desflurane group compared to 5% in the sevoflurane group (p=0.1). Coughing (10% vs. 6%) and the need for suctioning (9% vs. 8%) were slightly more frequent with desflurane, although the difference was not significant. No cases of laryngospasm were reported in either group. Emergence was significantly faster with desflurane (5.92 ± 1.23 min) than with sevoflurane (8.38 ± 1.67 min), as was recovery time (27.62 ± 3.26 min vs. 32.37 ± 3.85 min), with both differences reaching statistical significance ($p<0.001$). The haemodynamic parameters, including HR and MAP, remained stable and comparable between the groups throughout the procedure. **Conclusion:** Both agents are safe and effective for Paediatric Anaesthesia using LMA. Desflurane offers faster recovery but may be associated with a nonsignificant increase in airway events.

INTRODUCTION

Paediatric anaesthesia poses unique challenges owing to anatomical and physiological differences compared to adults, such as airway size and reduced functional residual capacity. Children have higher metabolic rates, smaller functional residual capacities, and increased oxygen consumption, which predispose them to rapid desaturation during anaesthesia.[1] Among inhalational agents, sevoflurane and desflurane are the most commonly used because of their low blood-gas solubility coefficients, especially in paediatric short procedures. Sevoflurane is widely preferred in paediatric anaesthesia for its pleasant odour, non-irritant nature, minimal cardiovascular effects, and

ability to allow smooth induction even in uncooperative children.[2]

Despite its pungency, desflurane is valued in anaesthesia for its rapid emergence, with a low blood-gas partition coefficient of 0.42, significantly lower than sevoflurane's 0.69, facilitating faster recovery in outpatient procedures.[3,4] However, desflurane's use in spontaneously breathing children is debated due to its propensity to irritate the airway, which may result in coughing, laryngospasm, and desaturation.[5,6]

The Laryngeal Mask Airway (LMA) has become widely used in paediatric airway management for short surgeries, especially when spontaneous ventilation is preferred. Its insertion is less invasive than endotracheal intubation and avoids the use of neuromuscular blockers, which may influence desaturation risk and postoperative outcomes (e.g. emergence agitation and recovery time). However, maintaining effective spontaneous ventilation using LMA with desflurane raises safety concerns. Therefore, the selection of an anaesthetic agent must strike a balance between airway safety and recovery efficiency. Studies have suggested that desflurane may be associated with increased airway reactivity in paediatric patients.[1,4]

As the frequency of ambulatory and daycare surgeries increases, agents that enable rapid turnover and safe discharge are becoming the preferred choice.[7,8] Sevoflurane is commonly used in paediatric anaesthesia for its favourable induction characteristics. However, desflurane's rapid clearance and stable hemodynamic profile have led to renewed interest, particularly in LMA-based techniques, as supported by comparative clinical studies.[9,10,11]

Despite these concerns, desflurane's rapid washout characteristics and potential for fast-tracking recovery are potentially beneficial in daycare surgical setups, especially with the growing trend of minimally invasive paediatric procedures. However, most existing studies have focused on intubated patients, with limited data comparing the two agents in children breathing spontaneously via an LMA.[2,12] Understanding these effects is crucial for optimising anaesthetic protocols and ensuring patient safety; however, comprehensive comparisons under uniform conditions in spontaneously ventilating children using LMAs are scarce.

Aim

This study aimed to compare the incidence of intraoperative desaturation with sevoflurane and desflurane in paediatric patients undergoing general anaesthesia with LMA on spontaneous ventilation.

MATERIALS AND METHODS

This prospective, randomised, single-blinded, comparative clinical study was conducted in 200 paediatric patients at the Department of Anaesthesiology, Chengalpattu Medical College and Hospital, Tamil Nadu, India, for one year, from June 2022 to June 2023. The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from the parents and legal guardians of all participants.

Inclusion and Exclusion Criteria

This study included patients aged 3–8 years, classified as ASA physical status I or II, and scheduled for elective surgical procedures lasting approximately 45–60 minutes, without a recent history of respiratory tract infections. Patients with any known airway anomalies, a diagnosis of gastroesophageal reflux disease, underlying neurological deficits, or contraindications for LMA use were excluded.

Methods

Patients (n=200) were randomised into two equal groups, Group D (desflurane) (n=100) and Group S (sevoflurane) (n=100), using a computer-generated random number table to ensure unbiased allocation. All patients received syrup midazolam (0.5 mg/kg) orally 30 min before induction. Standard monitoring included ECG, pulse oximetry, non-invasive blood pressure, and end-tidal CO2. Induction was performed using intravenous propofol (2–3 mg/kg).

LMA was inserted, and anaesthesia was maintained with either desflurane or sevoflurane at 1 MAC in a 50:50 N_2O: O_2 mixture in the respective groups. Caudal epidural analgesia with 0.25% bupivacaine (1 ml/kg) was administered to all patients. The depth of anaesthesia was adjusted as needed, and vital parameters and respiratory events were continuously monitored.

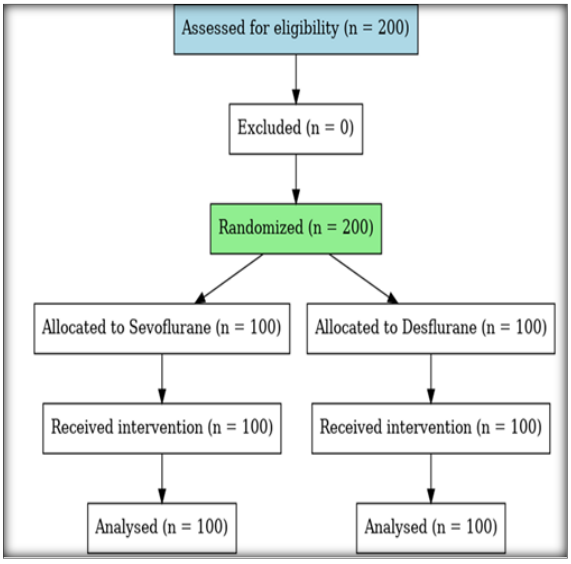

Figure 1: CONSORT flow diagram

The variables collected included the incidence of desaturation, defined as a drop in SpO_2 below 94%, as well as the intraoperative heart rate (HR) and mean arterial pressure (MAP). Emergence and recovery times, measured using a Modified Aldrete score of ≥ 9, were also recorded. Additional observations included the occurrence of coughing and laryngospasm and the requirement for airway

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suctioning during the intraoperative and recovery periods.

Statistical Analysis

Data were analysed using SPSS version 25. Continuous variables are reported as mean ± standard deviation and were compared using independent sample t-tests. Categorical variables were presented as frequencies and percentages and analysed using the chi-square test. Statistical significance was set at $p < 0.05$.

RESULTS

There were no significant differences between the Desflurane and Sevoflurane groups in terms of age, height, weight, and sex distribution (p>0.05). [Table 1]

Table 1: Comparison of demographic parameters between the groups

		Mean ± S.D.		P value
		Desflurane	Sevoflurane	
Age (in years)		4.27±1.205	4.52±1.132	0.132
Height (in Cm)		94.78±13.895	96.1±13.643	0.499
Weight (in Kgs)		15.2±4.112	15.3±3.998	0.273
Sex N (%)	Male	72(72%)	69(69%)	0.6
	Female	28(28%)	31(31%)	

Mild desaturation occurred more frequently in the desflurane group (11%) than in the sevoflurane group (5%), but the difference was not statistically significant (p = 0.100). There was no statistically significant difference between the desflurane (9%) and sevoflurane (8%) groups regarding secretions requiring suction (p = 0.5). Coughing (10% vs. 6%) and the need for suctioning (9% vs. 8%) were slightly more common with desflurane, without significant difference. ASA Grade II was slightly higher in the sevoflurane group (14%) than desflurane (13%), and this difference was significant (p = 0.040). [Table 2]

Table 2: Comparison of clinical parameters between the groups

		N (%)		P value
		Desflurane	Sevoflurane	
Mild desaturation	No	89(89%)	95(95%)	0.1
	Yes	11(11%)	5(5%)	
Secretions requiring suction	No	91(91%)	92(92%)	0.5
	Yes	9(9%)	8(8%)	
Coughing	No	90(90%)	94(94%)	0.2
	Yes	10(10%)	6(6%)	
ASA grade	I	87(87%)	86(86%)	0.04
	II	13(13%)	14(14%)	

There was no significant difference in anaesthesia time between the Desflurane and Sevoflurane groups (p=0.917). Patients in the Desflurane group experienced a shorter mean emergence time (5.92 ± 1.228 min) than those in the sevoflurane group (8.38 ± 1.674 min), indicating a significant difference (p<0.0001). Similarly, the Desflurane group had a shorter recovery time (27.62 ± 3.262 min) than the sevoflurane group (32.37 ± 3.8 min), with a significant difference (p<0.0001). [Table 3]

Table 3: Comparison of anaesthesia, emergence, and recovery time between the groups

	Mean ± S.D.		P value
	Desflurane	Sevoflurane	
Anaesthesia time (Minutes)	32.65±8.406	32.53±7.55	0.917
Emergence time (Minutes)	5.92±1.228	8.38±1.674	< 0.0001
Recovery time (Minutes)	27.62±3.262	32.37±3.8	< 0.0001

Intraoperative trends in MAP among paediatric patients in the desflurane and sevoflurane groups showed stability across all recorded time intervals, with no significant differences observed between the two groups (p>0.05). [Figure 1]

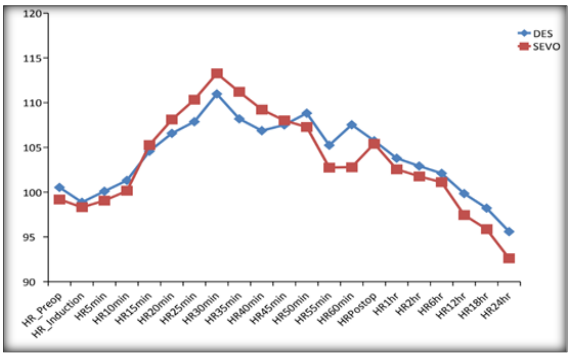

Figure 1: MAP among study participants at a different interval

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Throughout the surgical procedure, the HR values in both groups remained within the normal clinical range. Although slight variations were observed at certain intervals, they were not significant (p>0.05). [Figure 2]

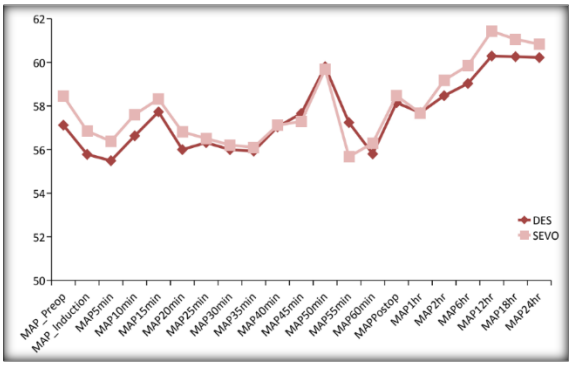

Figure 2: HR among study participants at a different interval

DISCUSSION

Incidence of desaturation

In our study, mild desaturation (SpO_2 <94%) occurred in 11% of patients in the desflurane group compared to 5% of patients in the sevoflurane group, but this difference was not significant (p = 0.1). The higher frequency suggests increased airway reactivity with desflurane, likely due to its pungency and potential to irritate the airway during spontaneous ventilation. This observation is similar to the findings of previous studies. Gupta et al. similarly reported increased airway irritation and transient hypoxia in the desflurane group, with desaturation seen in 8.3% of cases compared to 2.8% in the sevoflurane group.[3]

Stevanovic et al., in a meta-analysis of 10 randomised controlled trials, found that desflurane was associated with a higher incidence of airway complications (OR 2.63; 95% CI 1.50–4.61; p = 0.0008), including coughing and laryngospasm, and emphasised the need for careful titration to minimise these effects.4 In contrast, Kim et al. reported a significantly higher rate of desaturation (7% vs. 0%, p = 0.007) and airway complications with desflurane in spontaneously breathing paediatric patients.[1]

Emergence and recovery time

In our study, a key advantage of desflurane was its significantly faster emergence (5.92 ± 1.23 min vs. 8.38 ± 1.67 min) and recovery (27.62 ± 3.26 min vs. 32.37 ± 3.85 min), both with p < 0.001. These results are in line with previous studies by Kotwani and Malde, who observed shorter awakening and recovery times with desflurane in paediatric ambulatory procedures.[5] Gupta et al. reported enhanced early recovery with desflurane in paediatric neurosurgical patients.[3] Similarly, Kim et al. demonstrated more rapid awakening in children receiving desflurane than in those receiving sevoflurane.[1]

Agrawal et al. observed shorter emergence and recovery times with desflurane.[6] Hwang et al. also found faster awakening with desflurane, although their study involved intubated patients, which differs from the LMA-based approach.[2] A 2016 meta-analysis by Lim et al., including 13 randomised controlled trials, showed that desflurane significantly resulted in faster emergence times, although with more frequent airway irritation.[13] Voepel-Lewis et al. also observed a high incidence of emergence agitation in paediatric patients during recovery, highlighting the importance of early behavioural monitoring.[14] These findings further support the need for cautious use of desflurane in spontaneously breathing children.

Respiratory events and airway tolerance

In our study, coughing (10% vs. 6%) and suction requirements (9% vs. 8%) were slightly more frequent in the desflurane group, although these differences were not significant. This was consistent with the findings of Stevanovic et al., that desflurane was associated with a significantly higher risk of airway complications than sevoflurane, with an odds ratio of 2.63 (95% CI: 1.50–4.61; p = 0.0008), particularly for coughing and laryngospasm.4 Kim et al. further supported these findings in their randomised controlled trial, where they observed coughing in 15% and desaturation in 7% of children receiving desflurane, compared with 3% and 0%, respectively, in the sevoflurane group (p < 0.05).[1]

In a prospective randomised study by Kotwani et al. involving 60 children aged 6 months to 6 years undergoing short surgical procedures, desflurane demonstrated significantly faster emergence and recovery times than sevoflurane. The time to awakening and removal of the supraglottic airway was shorter with desflurane (5.3 ± 1.4 min and 5.8 ± 1.3 min) than with sevoflurane (9.1 ± 2.4 min and 10.0 ± 1.6 min), with p-values < 0.0001. Recovery times were also faster with desflurane (18 ± 8.4 min) than with sevoflurane (45.3 ± 9.7 min) (p < 0.001). No respiratory adverse events were reported in either group during the maintenance phase.[5]

Hemodynamic Stability

HR and MAP remained stable and comparable throughout the procedures, supporting the haemodynamic safety of both desflurane and sevoflurane when used with regional analgesia. These findings are in agreement with those of Kim et al. and Gupta et al., who reported stable haemodynamic parameters with both anaesthetic agents in the paediatric population.[1,3] While desflurane offers faster emergence and recovery, which is valuable in short procedures and daycare settings, its slightly higher incidence of desaturation and coughing warrants careful intraoperative monitoring. With appropriate technique and premedication, it can be a safe and efficient alternative to sevoflurane in Paediatric Anaesthesia using LMA and spontaneous ventilation.[15]

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CONCLUSION

Our study concluded that both desflurane and sevoflurane are safe and provide haemodynamic stability. However, desflurane was associated with a nonsignificant increase in mild desaturation (11% vs. 5%) and airway events, such as coughing and the need for suction. Despite this, it offers significantly quicker emergence and recovery times than sevoflurane. These findings suggest that although desflurane may slightly increase airway reactivity, its rapid recovery profile offers a distinct advantage in short paediatric procedures, making it a viable alternative to sevoflurane when appropriate monitoring conditions are in place.

Limitations: This was a single-centre study with a limited age range of 3–8 years, which may have affected the generalizability of the results. This was a single-blinded study, and long-term postoperative outcomes were not assessed.

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Conflict of interest: None

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