e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(8); 1563-1572

Original Research Article

Emergence Delirium and Recovery Characteristics Following Desflurane versus Halothane Anaesthesia in Children Undergoing Elective Surgery: A Prospective Randomized Controlled Trial

P. Vishnu Priya[1], N. Krishnan[2]

[1]Senior Resident, Department of Anaesthesiology, Government Karur Medical College, Karur, Tamil Nadu, India

[2]Professor, Department of Anaesthesiology, Institute of Child Health and Hospital for Children, Madras Medical College, Chennai, Tamil Nadu, India

Received: 01-05-2026 / Revised: 15-06-2026 / Accepted: 21-07-2026

Corresponding author: Dr. P. Vishnu Priya

Conflict of interest: Nil

Abstract

Background: Emergence delirium (ED) is a transient neuro-behavioural disturbance commonly encountered during recovery from general anaesthesia in children. It is characterized by restlessness, inconsolable crying, disorientation, and non-purposeful movements, and may interfere with safe postoperative recovery. Although desflurane provides rapid emergence because of its low blood–gas partition coefficient, it has also been associated with a higher incidence of emergence delirium. Evidence comparing the recovery profile of desflurane with halothane using validated paediatric recovery scores remains limited.

Aim: To compare the emergence characteristics of desflurane and halothane in paediatric patients undergoing elective surgery under general anaesthesia.

Objectives: Primary Objective: To compare the incidence and severity of emergence delirium using the Paediatric Anaesthesia Emergence Delirium (PAED) score.

Secondary Objectives: To compare postoperative recovery using the Steward Recovery Score. To compare the time required to achieve discharge criteria using the Modified Aldrete Score. To compare postoperative nausea, vomiting and shivering between the study groups.

Methods: This prospective, randomized, single-blinded controlled trial included 70 children aged 1–7 years with American Society of Anaesthesiologists (ASA) physical status I undergoing elective surgery under general anaesthesia. Following standardized induction with propofol, fentanyl and atracurium, patients were randomly allocated to receive maintenance anaesthesia with desflurane (Group D) or halothane (Group H). Emergence delirium was assessed using the PAED score. Recovery characteristics were evaluated using the Steward Recovery Score and Modified Aldrete Score. Postoperative adverse events were recorded.

Results: Children receiving desflurane demonstrated significantly shorter time to first response, earlier attainment of Steward Recovery Score 6 and more rapid achievement of Modified Aldrete Score ≥8 compared with those receiving halothane ($P < 0.05$). However, PAED scores at extubation and 15 minutes were significantly higher in the desflurane group ($P < 0.001$). By 30 minutes and one hour after surgery, PAED scores were comparable between the groups. The incidence of postoperative nausea, vomiting and shivering did not differ significantly.

Conclusion: Desflurane facilitates faster emergence and earlier postoperative recovery than halothane but is associated with a significantly greater incidence of transient emergence delirium during the immediate recovery period. Appropriate preventive strategies and close postoperative observation are therefore recommended when desflurane is used in paediatric patients.

Keywords: Desflurane; Halothane; Emergence delirium; Paediatric anaesthesia; Recovery profile; PAED score.

DOI: 10.25258/ijcpr.18.8.234

Introduction

Emergence delirium (ED), historically referred to as emergence agitation, is a well-recognised complication during recovery from general anaesthesia in children. First described by Eckenhoff and colleagues in the early 1960s, ED is characterised by a transient dissociative state with confusion, inconsolability, crying, restlessness and non-purposeful movements during the early

recovery period. [1] Despite being self-limiting in most children, ED remains an important perioperative concern because it may lead to accidental removal of intravenous catheters, surgical dressings or monitoring devices, increase nursing workload and delay discharge from the post-anaesthesia care unit (PACU). [2,8]

More than four million paediatric surgical procedures requiring general anaesthesia are performed annually worldwide, and the reported incidence of ED ranges from 10% to 80%, depending on patient age, surgical procedure, anaesthetic technique and the diagnostic criteria employed. [2,8] Younger children, particularly those between two and six years of age, are more susceptible because of developmental immaturity, perioperative anxiety and limited ability to comprehend the unfamiliar postoperative environment. [8,9]

The pathophysiology of ED is multifactorial and incompletely understood. Several perioperative factors have been implicated, including rapid emergence from anaesthesia, postoperative pain, preoperative anxiety, type of surgery, airway irritation, environmental stimulation and the pharmacokinetic properties of volatile anaesthetic agents. [2,7,8] Among these, the speed of emergence appears to be a particularly important determinant. Anaesthetic agents with low blood–gas solubility permit rapid recovery of consciousness, but abrupt awakening before complete restoration of higher cortical integration may predispose susceptible children to emergence delirium. [5,8]

Desflurane possesses the lowest blood–gas partition coefficient among currently available volatile anaesthetic agents (approximately 0.42), resulting in rapid induction and exceptionally fast recovery.

These characteristics make desflurane particularly attractive for ambulatory surgery and procedures requiring early neurological assessment. However, rapid emergence has also been associated with a greater incidence of ED in several clinical studies. [3,8] Conversely, halothane, with its higher blood–gas partition coefficient (approximately 2.3), produces slower emergence and prolonged recovery but has historically been associated with a lower incidence of postoperative behavioural disturbances. [3,10]

Although halothane has largely been replaced by newer inhalational agents because of concerns regarding hepatotoxicity and arrhythmogenicity, it represented the standard paediatric volatile anaesthetic for several decades. Comparison between desflurane and halothane therefore provides valuable insight into the relationship between volatile anaesthetic pharmacokinetics, emergence characteristics and postoperative recovery. [3,17] The Paediatric Anaesthesia Emergence Delirium (PAED) scale has become the most widely accepted instrument for assessing ED in children and offers superior diagnostic accuracy compared with earlier observational scales. In conjunction with the Steward Recovery Score and Modified Aldrete Score, it enables comprehensive evaluation of both behavioural recovery and physiological readiness for discharge from the PACU. [8,9] Previous investigations have demonstrated that desflurane facilitates earlier awakening and discharge readiness than halothane, although at the expense of increased emergence agitation. [3,17] However, relatively few prospective randomised studies have simultaneously evaluated emergence delirium, neurological recovery and postoperative complications using validated assessment tools in children undergoing elective surgery.

The present prospective randomised controlled study was therefore undertaken to compare desflurane and halothane with respect to emergence delirium, recovery profile and early postoperative complications in paediatric patients undergoing elective surgery under general anaesthesia. We hypothesised that desflurane would result in significantly faster recovery but a higher incidence of transient emergence delirium compared with halothane.

Materials and Methods

Study Design and Setting: This prospective, randomized, single-blinded, parallel-group interventional study was conducted between October 2019 and December 2019. The study protocol was approved by the Institutional Ethics Committee before commencement of patient enrolment and was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Written informed consent was obtained from the parents or legally authorized guardians of all participating children before inclusion in the study.

Sample Size: The sample size was calculated based on the study by Welborn et al., which compared the emergence and recovery characteristics of desflurane, sevoflurane and halothane in paediatric patients undergoing general anaesthesia.

Assuming an α error of 0.05, study power of 80%, and expected differences in emergence characteristics between the study groups, a minimum sample size of 35 patients in each group was required to detect a statistically significant difference. [17] Accordingly, 70 children were enrolled in the study.

Eligibility criteria

Inclusion Criteria: Children satisfying all of the following criteria were included: Age between 1 and 7 years, American Society of Anesthesiologists (ASA) Physical Status I, Scheduled for elective surgery under general anaesthesia requiring endotracheal intubation, written informed consent obtained from parents or legal guardians

Exclusion Criteria: Children were excluded if they had: Refusal of consent , Emergency surgical procedures , History of seizure disorder, Neurological disease or developmental delay, Altered mental status, Coagulation abnormalities, Severe cardiovascular disease, Significant respiratory illness, Hepatic dysfunction, Renal impairment, Known hypersensitivity to any study medication

Randomization and Allocation Concealment: Patients fulfilling the eligibility criteria were randomly allocated into two equal groups using a computer-generated randomization sequence. Allocation concealment was achieved using sequentially numbered opaque sealed envelopes prepared by an independent investigator who was not involved in perioperative management.

After induction of anaesthesia, the anaesthesiologist administering the volatile agent opened the envelope to determine group allocation. The investigator responsible for postoperative assessment of emergence delirium and recovery scores remained blinded to the intervention throughout the study.

Study groups

Group D (Desflurane group): Patients received maintenance of general anaesthesia with desflurane adjusted to maintain approximately 1.3 Minimum Alveolar Concentration (MAC).

Group H (Halothane group): Patients received maintenance of general anaesthesia with halothane, similarly adjusted to maintain 1.3 MAC. All other aspects of anaesthetic management were standardized between groups.

Anaesthetic Protocol: All children underwent routine pre-anaesthetic evaluation one day before surgery.

Appropriate fasting was ensured according to the American Society of Anesthesiologists fasting guidelines.

Thirty minutes before transfer to the operating theatre, all patients received oral premedication consisting of:

- Midazolam 0.5 mg/kg
- Atropine 30 µg/kg

Following arrival in the operating room, standard ASA monitoring was instituted, including: Continuous electrocardiography (ECG), Pulse oximetry (SpO_2), Non-invasive blood pressure (NIBP), End-tidal carbon dioxide ($EtCO_2$), Inspired and end-tidal volatile anaesthetic gas concentration monitoring

Baseline heart rate, blood pressure and oxygen saturation were recorded before induction. Peripheral intravenous access was established using an appropriately sized intravenous cannula.

General anaesthesia was induced with:

- Propofol 2 mg/kg intravenously
- Fentanyl 2 µg/kg intravenously
- Atracurium 0.5 mg/kg intravenously

Following adequate neuromuscular blockade, tracheal intubation was performed using an appropriately sized cuffed endotracheal tube.

Mechanical ventilation was adjusted to maintain normocapnia with an end-tidal carbon dioxide concentration between 35 and 40 mmHg. Maintenance anaesthesia was achieved according to group allocation using either desflurane or halothane at approximately 1.3 MAC in oxygen.

Regional analgesic techniques were administered whenever appropriate according to the surgical procedure to ensure adequate perioperative analgesia and minimize postoperative pain as a potential confounding factor influencing emergence delirium. [8]

Additional doses of atracurium were administered according to intraoperative requirements. Haemodynamic variables were maintained within 20% of baseline values throughout surgery. Administration of the inhalational anaesthetic agent was discontinued at the commencement of skin closure. Residual neuromuscular blockade was reversed according to institutional protocol.

Patients were extubated after fulfilment of standard extubation criteria, including: Adequate spontaneous ventilation, Restoration of airway reflexes, Purposeful movements, Haemodynamic stability, and Oxygen saturation ≥95%. Subsequently, all patients were transferred to the post-anaesthesia care unit (PACU).

Outcome Measures

Primary Outcome: The primary outcome was the severity of emergence delirium.

Emergence delirium was evaluated using the Paediatric Anaesthesia Emergence Delirium (PAED) Scale, a validated five-item assessment tool developed specifically for children recovering from general anaesthesia. The PAED score ranges from 0 to 20, with higher scores indicating more

severe delirium. [8] PAED scores were recorded at the following time points: Immediately after extubation, 15 minutes, 30 minutes, One hour after surgery.

Secondary outcomes

Recovery Profile: Neurological recovery was assessed using the Steward Recovery Score, which evaluates: Consciousness, Airway, Motor activity. Scores were documented immediately after extubation and subsequently at regular intervals until patients achieved the maximum recovery score of 6. Time required to achieve Steward Recovery Score 6 was recorded for each patient.

Readiness for PACU discharge: Readiness for discharge from the post-anaesthesia care unit was assessed using the Modified Aldrete Score, which evaluates: Activity, Respiration, Circulation, Consciousness, Oxygen saturation the time required to achieve a Modified Aldrete Score of 8 or greater was recorded for each participant.

Time to first response: Time to first response was defined as the interval between discontinuation of inhalational anaesthesia and the child's first purposeful response to verbal or tactile stimulation.

Postoperative complications: The following postoperative complications occurring during PACU stay were documented: Nausea, Vomiting, Shivering, Airway-related complications, Oxygen desaturation, Requirement for rescue medication

Statistical Analysis: Data were entered into Microsoft Excel and analysed using the Statistical Package for the Social Sciences (SPSS) software (IBM SPSS Statistics, Version XX; IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), whereas categorical variables were expressed as frequency and percentage. Normality of continuous variables was assessed using the Shapiro–Wilk test. Between-group comparisons of normally distributed continuous variables were performed using the independent Student's t-test. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. A two-tailed P value <0.05 was considered statistically significant.

Results

Patient Enrolment: A total of 70 paediatric patients fulfilling the eligibility criteria were enrolled during the study period. Following randomization, 35 patients were allocated to the Desflurane group (Group D) and 35 patients to the Halothane group (Group H). All randomized participants completed the study and were included in the final analysis. No patient was excluded after randomization or lost to follow-up.

Baseline demographic and perioperative characteristics: Both groups were comparable with respect to demographic variables and perioperative characteristics. There were no statistically significant differences in age, sex distribution, body weight, ASA physical status, or duration of surgery between the two groups (P > 0.05).

Time to first response: The interval between discontinuation of inhalational anaesthesia and the first purposeful response was significantly shorter in the Desflurane group than in the Halothane group. The mean time to first response was 5.97 minutes in Group D compared with 12.46 minutes in Group H, representing an average reduction of approximately 6.5 minutes with desflurane anaesthesia.

Among children receiving desflurane, 33 of 35 patients (94.3%) responded within the first 10 minutes after discontinuation of anaesthesia, whereas the majority of patients receiving halothane (13 of 35 patients; 37.1%) responded between 11 and 20 minutes. This difference was highly statistically significant (P < 0.001, unpaired Student's t-test) (Figure 1). These findings demonstrate the markedly faster emergence associated with desflurane compared with halothane.

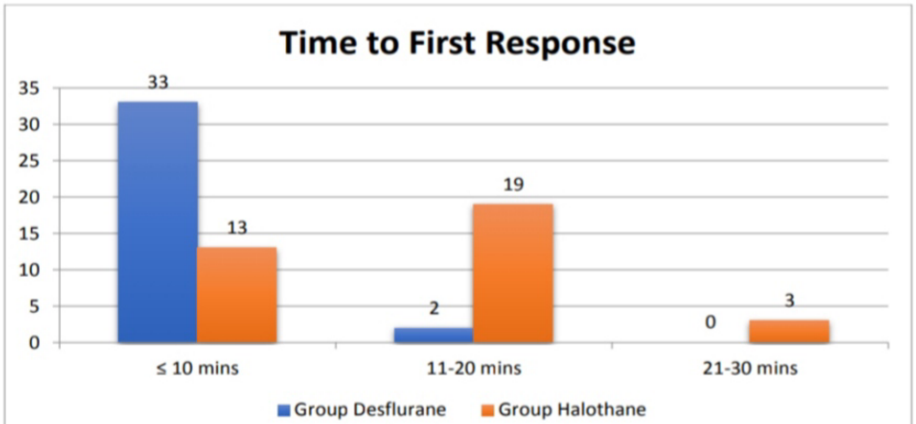

Figure 1: Time to First Response

Emergence delirium (PAED score): Emergence delirium was evaluated using the Paediatric Anaesthesia Emergence Delirium (PAED) score immediately after extubation and during the first postoperative hour.

At extubation: The mean PAED score was significantly higher in children receiving desflurane compared with those receiving halothane (12.57 vs. 8.43, respectively).

This difference was highly statistically significant ($P < 0.001$).

Fifteen minutes after extubation: PAED scores remained significantly higher in the Desflurane group.

The mean PAED score was:

- 9.34 in Group D
- 6.74 in Group H

The difference remained statistically significant ($P < 0.001$).

Thirty minutes after extubation

By 30 minutes after surgery, PAED scores had decreased considerably in both groups.

The mean PAED scores were:

- 5.37 in Group D
- 5.31 in Group H

No statistically significant difference was observed between the groups ($P > 0.05$).

One hour after extubation: At one hour after surgery, emergence delirium had almost completely resolved in both groups.

Mean PAED scores were:

- 2.34 in Group D
- 2.51 in Group H

The difference was not statistically significant ($P > 0.05$).

Overall, desflurane was associated with significantly greater emergence delirium during the immediate postoperative period; however, this behavioural disturbance was transient and resolved within the first 30 minutes following extubation (Figure 2).

PAED Score

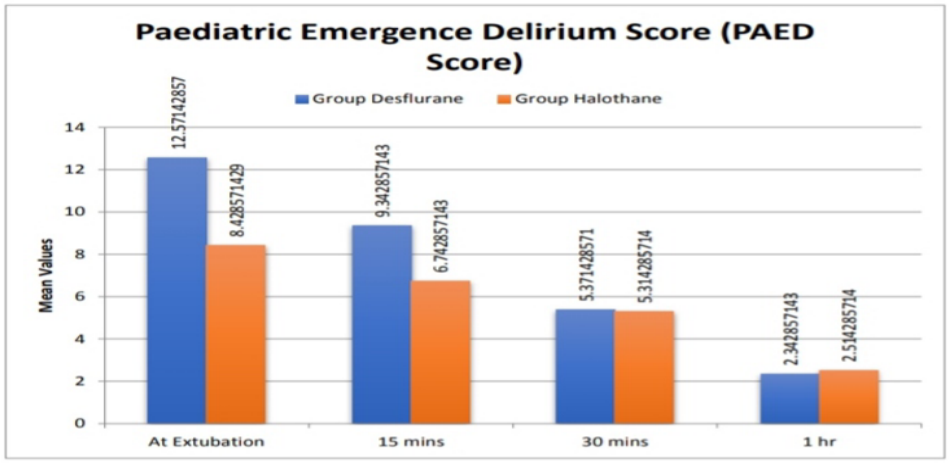

Figure 2: PAED Score

Recovery profile (Steward Recovery Score): Recovery following anaesthesia was assessed using the Steward Recovery Score. Immediately after extubation, the mean Steward Recovery Score was:

- 3.20 in Group D
- 2.97 in Group H

The difference was not statistically significant ($P > 0.05$). However, the time required to achieve complete recovery (Steward Recovery Score = 6) was significantly shorter in the Desflurane group. The mean time to Steward Recovery Score 6 was:

- 25.66 minutes in Group D
- 33.77 minutes in Group H

This difference reached statistical significance ($P = 0.021$) (Figure 3). These observations indicate that desflurane facilitates more rapid neurological recovery despite the increased incidence of transient emergence delirium.

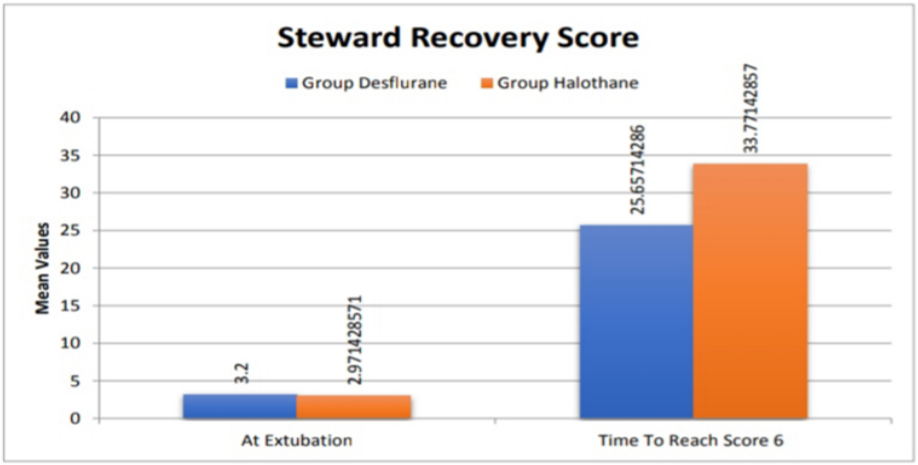

Figure 3: Steward Recovery Score

Recovery and discharge readiness (Modified Aldrete Score): Readiness for discharge from the post-anaesthesia care unit was evaluated using the Modified Aldrete Score. Immediately after extubation, the mean Modified Aldrete Score was significantly higher in the Desflurane group.

Mean scores at extubation were:

- 6.63 in Group D
- 5.86 in Group H

The difference was statistically significant ($P < 0.001$). The mean time required to achieve a Modified Aldrete Score ≥8 was:

- 14.09 minutes in Group D
- 20.29 minutes in Group H

Children receiving desflurane fulfilled PACU discharge criteria significantly earlier than those receiving halothane ($P = 0.026$) (Figure 4).

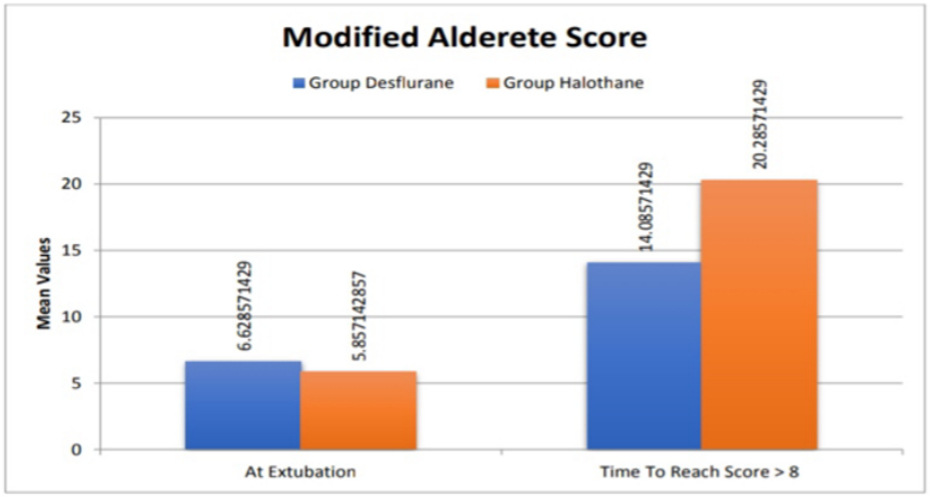

Figure 4: Modified Aldrete Score

Postoperative complications: The incidence of postoperative complications was low in both groups. Among children receiving desflurane:

- No postoperative complication: 27 patients (77.1%)
- Nausea: 2 patients (5.7%)
- Vomiting: 4 patients (11.4%)
- Shivering: 2 patients (5.7%)
- Among children receiving halothane:
- No postoperative complication: 28 patients (80.0%)
- Nausea: 2 patients (5.7%)
- Vomiting: 2 patients (5.7%)
- Shivering: 3 patients (8.6%)

Comparison of postoperative complications between the two groups revealed no statistically significant difference (Fisher's exact test, $P = 0.898$) (Table 1).

Thus, although desflurane was associated with a higher incidence of emergence delirium, it did not increase the incidence of common postoperative adverse events such as nausea, vomiting or shivering.

Table 1: Post-operative Incidence of Nausea, Vomiting and Shivering Status

Post-operative Incidence of Nausea, Vomiting and Shivering Status	Group Desflurane	%	Group Halothane	%
Nil	27	77.14	28	80.00
Nausea	2	5.71	2	5.71
Vomiting	4	11.43	2	5.71
Shivering	2	5.71	3	8.57
Total	35	100.00	35	100.00
P value, Fishers Exact Test		0.898		

Summary of the principal findings: The major findings of the present study are: Desflurane produced significantly faster emergence from anaesthesia than halothane ($P < 0.001$). Children receiving desflurane achieved complete neurological recovery significantly earlier ($P = 0.021$). Readiness for discharge from the PACU occurred significantly sooner following desflurane anaesthesia ($P = 0.026$). Emergence delirium was significantly more frequent and severe immediately after extubation and at 15 minutes in the Desflurane group ($P < 0.001$). Emergence delirium resolved spontaneously by 30 minutes, with no significant difference between groups thereafter. The incidence of postoperative nausea, vomiting and shivering was comparable between the two anaesthetic techniques.

Discussion

The present prospective randomized controlled trial compared the emergence profile and postoperative recovery characteristics of desflurane and halothane in children undergoing elective surgery under general anaesthesia. The principal findings demonstrated that desflurane provided significantly faster emergence, earlier neurological recovery and more rapid fulfilment of post-anaesthesia care unit (PACU) discharge criteria than halothane. However, these advantages were accompanied by a significantly higher incidence of emergence delirium during the immediate postoperative period. Importantly, the increased emergence delirium observed with desflurane was transient, resolving within 30 minutes after surgery without increasing postoperative adverse events. These findings support the concept that the pharmacokinetic advantages of desflurane are associated with a predictable increase in early postoperative behavioural disturbances. [3,6]

Rapid recovery has become an important quality indicator in paediatric anaesthesia because it facilitates early neurological assessment, improves operating room efficiency and shortens PACU stay. Desflurane possesses the lowest blood–gas partition coefficient among currently available volatile anaesthetic agents (approximately 0.42), resulting in rapid alveolar washout, minimal tissue accumulation and faster restoration of consciousness following discontinuation of anaesthesia. [4,24] In contrast, halothane has a substantially higher blood–gas partition coefficient, resulting in slower elimination and delayed emergence. The significantly shorter time to first response, earlier attainment of Steward Recovery Score 6 and faster achievement of Modified Aldrete discharge criteria observed in the present study are therefore consistent with the known pharmacological characteristics of these agents. [4,5] Our findings agree closely with the landmark study by Welborn et al., who demonstrated significantly shorter emergence, extubation and recovery times with desflurane than with halothane in paediatric ambulatory surgery. [3] Similarly, Davis et al. reported faster recovery following desflurane anaesthesia without compromising intraoperative haemodynamic stability. [2] More recently, Kotwani and Malde also demonstrated superior recovery characteristics with desflurane compared with sevoflurane in children undergoing ambulatory surgery, further confirming the recovery advantages associated with low-solubility volatile anaesthetic agents.

Despite its favourable recovery profile, desflurane produced significantly higher PAED scores immediately after extubation and 15 minutes after surgery. Emergence delirium remains one of the most challenging behavioural complications following paediatric anaesthesia and is characterised by confusion, inconsolable crying, restlessness, disorientation and non-purposeful movements during the early recovery period. [1,6,7] The reported incidence varies widely from 10% to 80% because of differences in patient age, surgical procedures, anaesthetic techniques and assessment methods. [6]

The exact mechanism responsible for emergence delirium remains incompletely understood. Current evidence suggests that multiple factors contribute, including rapid awakening, immature cortical development, postoperative pain, preoperative anxiety, environmental stimulation and the intrinsic pharmacological properties of volatile anaesthetic agents. [6,6] Rapid restoration of consciousness before complete recovery of higher cortical integration has been proposed as one of the principal mechanisms explaining the higher incidence of emergence delirium associated with

rapidly eliminated agents such as desflurane and sevoflurane. [6,21]

Our observations are consistent with the comprehensive review by Mason, who identified rapidly eliminated inhalational anaesthetic agents as important independent predictors of emergence delirium in children. [6] Similarly, Moore and Anghelescu emphasised that preschool children are particularly susceptible because of developmental immaturity and limited ability to interpret unfamiliar postoperative surroundings. [7] Kain et al. further demonstrated that preoperative anxiety independently increases the risk of emergence delirium and postoperative maladaptive behavioural changes, highlighting the multifactorial nature of this complication. [10]

An important finding of the present study is that the difference in PAED scores disappeared by 30 minutes after extubation, with no significant difference between the groups at one hour. This observation suggests that emergence delirium following desflurane is generally transient and self-limiting. Similar findings have been reported by Welborn et al., Singh et al., and Cravero et al., all of whom observed spontaneous resolution of emergence agitation within the early postoperative period without persistent neurological sequelae. [3,15,25]

Although desflurane was associated with increased emergence delirium, postoperative nausea, vomiting and shivering were comparable between the two groups. This finding suggests that desflurane primarily affects behavioural recovery rather than increasing overall postoperative morbidity. Similar observations have been reported by Wallenborn et al. and Welborn et al., who found no significant differences in common postoperative complications despite differences in recovery characteristics. [3,14]

The present study possesses several strengths. The randomized controlled design minimised selection bias, while perioperative management was standardised in both groups. Emergence delirium was assessed using the validated Paediatric Anaesthesia Emergence Delirium (PAED) Scale, which has demonstrated excellent reliability and construct validity for evaluating postoperative behavioural disturbances in children. [8]

Recovery was simultaneously assessed using the Steward Recovery Score and Modified Aldrete Score, allowing objective evaluation of neurological recovery and discharge readiness rather than relying solely on extubation time. [15,16]

The findings should nevertheless be interpreted within the context of evolving paediatric anaesthetic practice. At the time the study was conducted (2019), halothane continued to be available in selected institutions and therefore represented an appropriate comparator for evaluating recovery characteristics. However, halothane has now been largely replaced by newer volatile agents because of concerns regarding hepatotoxicity, arrhythmogenicity and slower recovery.

Consequently, the direct clinical applicability of comparisons involving halothane is limited in current practice. Nevertheless, the study remains scientifically valuable because it clearly demonstrates the relationship between volatile anaesthetic solubility, emergence kinetics and postoperative behavioural recovery—fundamental pharmacological principles that remain relevant for contemporary inhalational agents. [4,6,24]

Recent evidence has demonstrated that emergence delirium can be substantially reduced through both pharmacological and non-pharmacological interventions. Prophylactic administration of dexmedetomidine, low-dose propofol at the conclusion of surgery, adequate multimodal analgesia, parental presence during recovery and reduction of preoperative anxiety have all been shown to decrease the incidence and severity of emergence delirium while preserving rapid recovery. [20,21]

Future studies should compare desflurane with currently preferred agents such as sevoflurane in larger multicentre trials while evaluating long-term behavioural outcomes, parental satisfaction and cost-effectiveness.

The present study has certain limitations. First, it was conducted at a single tertiary care centre with a relatively small sample size, which may limit generalisability. Second, postoperative pain was not quantified using a validated paediatric pain score and therefore could not be completely distinguished from emergence delirium. Third, the study was single blinded, introducing the possibility of observer bias despite the use of validated assessment tools.

Most importantly, halothane is no longer routinely used in contemporary paediatric anaesthetic practice because of concerns regarding hepatotoxicity and the widespread availability of safer volatile agents such as sevoflurane and desflurane.

Consequently, the direct clinical applicability of the present comparison is limited. Nevertheless, the study remains scientifically relevant because it illustrates the influence of volatile anaesthetic pharmacokinetics on emergence characteristics and postoperative recovery, concepts that continue to guide current paediatric anaesthetic practice. [6,24]

Clinical Implications

Desflurane should be considered when rapid recovery and early PACU discharge are desirable, particularly in ambulatory paediatric surgery. However, clinicians should anticipate a greater likelihood of transient emergence delirium and implement preventive measures including adequate analgesia, reduction of perioperative anxiety, parental reassurance and, where appropriate, prophylactic administration of dexmedetomidine or low-dose propofol. [20]

Conclusion

Desflurane anaesthesia resulted in significantly faster emergence, earlier neurological recovery and more rapid achievement of PACU discharge criteria than halothane in children undergoing elective surgery under general anaesthesia.

These advantages were accompanied by a significantly higher incidence of transient emergence delirium during the immediate postoperative period.

However, emergence delirium resolved spontaneously within the first 30 minutes after surgery and was not associated with an increased incidence of postoperative complications. Although halothane has largely been replaced in modern paediatric anaesthetic practice, the present study demonstrates the important relationship between volatile anaesthetic pharmacokinetics and postoperative recovery characteristics. Appropriate perioperative strategies to minimise emergence delirium should accompany the use of rapidly eliminated inhalational anaesthetic agents to optimise postoperative recovery in children. [3,6]

References

1. Eckenhoff JE. Relationship of anesthesia to postoperative personality changes in children. Am J Dis Child. 1961;102:592–595.
2. Davis PJ, Cohen IT, McGowan FX Jr, et al. Recovery characteristics of desflurane versus halothane for maintenance of anesthesia in pediatric ambulatory patients. Anesthesiology. 1994;80(2):298–302.
3. Welborn LG, Hannallah RS, Norden JM, Ruttimann UE, Callan CM. Comparison of emergence and recovery characteristics of sevoflurane, desflurane, and halothane in pediatric ambulatory patients. Anesth Analg. 1996;83(5):917–920.
4. Fisher DM, Zwass MS. Minimum alveolar concentration of desflurane in 60% nitrous oxide in infants and children. Anesthesiology. 1992;76(3):354–356.
5. Murray DJ, Mehta MP, Forbes RB, Dull DL. Additive contribution of nitrous oxide to halothane minimum alveolar concentration in infants and children. Anesth Analg. 1990;71:120–124.
6. Mason KP. Paediatric emergence delirium: A comprehensive review and interpretation of the literature. Br J Anaesth. 2017;118(3):335–343.
7. Moore AD, Anghelescu DL. Emergence delirium in pediatric anesthesia. Paediatr Drugs. 2017;19(1):11–20.
8. Sikich N, Lerman J. Development and psychometric evaluation of the Pediatric Anesthesia Emergence Delirium Scale. Anesthesiology. 2004;100(5):1138–1145.
9. Voepel-Lewis T, Malviya S, Tait AR. A prospective cohort study of emergence agitation in the pediatric postanesthesia care unit. Anesth Analg. 2003;96:1625–1630.
10. Kain ZN, Caldwell-Andrews AA, Maranets I, et al. Predicting emergence delirium in children. Anesth Analg. 2004;99:1648–1654.
11. Vlajkovic GP, Sindjelic RP. Emergence delirium in children: Many questions, few answers. Anesth Analg. 2007;104:84–91.
12. White PF, Tang J, Wender RH, et al. Desflurane versus sevoflurane for maintenance of outpatient anesthesia: Effects on early versus late recovery. Anesth Analg. 2009;109:387–393.
13. Hasani A, Gecaj-Gashi A, Llullaku S, et al. Emergence agitation in children after propofol versus halothane anesthesia. Med Arh. 2009;63:84–86.
14. Wallenborn J, Rudolph C, Gelbrich G, et al. The effect of clonidine on postoperative agitation in children. Anesth Analg. 2007;105:794–799.
15. Aldrete JA, Kroulik D. A postanesthetic recovery score. Anesth Analg. 1970;49:924–934.
16. Steward DJ. A simplified scoring system for the postoperative recovery room. Can Anaesth Soc J. 1975;22:111–113.
17. Kuratani N, Oi Y. Greater incidence of emergence agitation in children after sevoflurane anesthesia compared with halothane: A meta-analysis. Anesthesiology. 2008;109:225–232.
18. Reduque LL, Varughese AM. Pediatric emergence delirium. Continuing Education in Anaesthesia Critical Care & Pain. 2013;13(2):39–41.
19. Harsoor SS. Changing concepts in anaesthesia for day-care surgery. Indian Journal of Anaesthesia. 2010;54:485–488.
20. Abbas MS, El-Hakeim EH, Kamel EZ, et al. Dexmedetomidine versus propofol for prevention of emergence agitation in children: A systematic review and meta-analysis. Paediatr Anaesth. 2020;30:133–145.
21. 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.
22. Kim HJ, Kim DK, Yang HS, et al. Prevention of emergence agitation using dexmedetomidine in paediatric anaesthesia: Systematic review and meta-analysis. J Clin Med. 2023;12:xxxx.
23. Sun L. Early childhood general anaesthesia and neurodevelopment. Anesthesiology. 2010; 113:1143–1145.
24. Lerman J. Inhalational anaesthesia in paediatric practice. Br J Anaesth. 2021;126: 111–123.