Section: Anaesthesiology

Original Research Article

COMPARISON OF THE INCIDENCE OF EMERGENCE AGITATION BETWEEN SEVOFLURANE AND DESFLURANE IN PEDIATRIC PATIENTS

S. Meena[1], S. Manohar[1], D.S. Aarthi[2]

[1]Assistant Professor, Department of Anaesthesiology, Tamilnadu Government Multi Super Speciality Hospital Omandurar Estate, Chennai, Tamilnadu, India
[2]Postgraduate, Department of Anaesthesiology, Stanley Medical College, Tamilnadu, India

Received : 10/08/2023
Received in revised form : 17/09/2023
Accepted : 26/09/2023

Keywords:
General anaesthesia, sevoflurane, desflurane, drug-induced, inhalation anaesthetics, emergence agitation.

Corresponding Author:
Dr. S. Manohar,
Email: drmanohar1987@gmail.com

DOI: 10.47009/jamp.2023.5.5.278

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5 (5); 1403-1407

Abstract

Background: Rather than the speed of emergence, the anaesthetic medication utilised has a greater impact on the emergence of delirium's effects. This study aimed to compare the incidence of emerging agitation between desflurane and sevoflurane in paediatric patients. **Materials and Methods:** A prospective randomised control study was carried out on 60 paediatric patients between the ages of 3 and 12 undergoing elective procedures under general anaesthetic after receiving consent from the institutional ethical committee. We have primarily compared the incidence of postoperative emergence agitation between sevoflurane and desflurane at 10, 20, 30, 45 minutes and 1 hour. The pain intensity at 10, 20, 30, 45 minutes, 1 hour, and 2 hours were compared. The time for tracheal extubation after discontinuing volatile agents in both groups was compared. **Result:** Age distribution data indicated 30% and 40% of participants of age categories 4-6 years and 7-9 years. In this study, there were 43.3% females and 56.7% males. A comparison between age, gender, and ASA-PS I & II within groups indicated no statistically significant association for within-group comparison. Moreover, a comparison of weight, duration of inhalation exposure (mins) and time for extubation after discontinuing volatile (mins) within groups also showed no statistically significant difference. Further, comparing the PAED and VAS scores with Groups also showed no statistically significant difference. **Conclusion:** In paediatric patients, desflurane recovers from anaesthesia more quickly than sevoflurane. Although sevoflurane had a slightly greater prevalence of EA than desflurane in our study, the incidence of emerging agitation is equivalent in both groups.

INTRODUCTION

A general definition of general anaesthesia is a drug-induced, reversible central nervous system depression when all responses to and perceptions of external stimuli are lost. Amnesia, analgesia, and muscular relaxation are the three main components of general anaesthesia.[1]

The most popular medications used to provide general anaesthesia are inhalation anaesthetics. A portion of a volatile anaesthetic added to the inspired oxygen causes amnesia and an unconscious condition. Intravenous adjuvants, opioids, and benzodiazepines work together to create a balanced anaesthetic method that produces analgesia, sedation or hypnosis, and forgetfulness. Because they are simple to administer and have reliable end-tidal concentration and clinical sign monitoring, inhaled anaesthetics are very common.[2,3]

Inhaled anaesthetics have inherent neuromuscular blocking properties that enable rapid awakening from anaesthesia due to simple titrability, making them more suitable for outpatient anaesthesia. We have chosen to concentrate on volatile anaesthetics for outpatient surgery due to the accessibility of less soluble inhalation anaesthetics, such as sevoflurane and desflurane. Given the low blood: gas partition coefficient of sevoflurane and desflurane, faster awakening from anaesthesia is anticipated compared to standard inhalation anaesthetics.[4-6]

In the early phases of emergence, violent delirium, known as "emergence delirium", is most common. It can occur temporarily during the process of emerging from anaesthesia. It is also known as emergence agitation (EA), which can affect adults and children. However, it happens less frequently in adults than in paediatric patients. Under five years old is the peak occurrence age.[3,6-8]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

The emergence-agitated child is irrational and incoherent, and it normally lasts between five and fifteen minutes, is self-limiting, clears up quickly, and is followed by a painless recovery. They don't appear to recognise familiar faces and are inconsolable. Even though it usually resolves on its own, emergency agitation is still thought to be a concerning side effect because it increases the need for constant patient monitoring and restraint despite the risks of falling, self-injury to the child or the surgical site, stress on both carers and families and self-injury to the child or the surgical site.[3-7]

The cause of EA in children who underwent general anaesthesia with volatile anaesthetics is still unknown. The use of a certain anaesthetic agent or technique has been attempted to be correlated with EA in various research. Compared to halothane and isoflurane, newer volatile agents like sevoflurane and desflurane are believed to have a 20–80% higher prevalence of negative emerging effects. [7] Sevoflurane anaesthesia has a 33% greater incidence of emerging delirium than halothane. Rather than the speed of emergence, the anaesthetic medication utilised has a greater impact on the emergence of delirium's effects.[3-7]

The study aimed to compare the incidence of emerging agitation between desflurane and sevoflurane in paediatric patients.

MATERIALS AND METHODS

This prospective randomised control study was conducted in the Department of Anaesthesiology at Stanley Medical College and Hospital in Chennai for six months. The study was conducted on 60 paediatric kids between the ages of 3 and 12 undergoing elective procedures under general anaesthetic after receiving consent from the institutional ethical committee. After obtaining consent, the study was carried out.

We have primarily compared the incidence of postoperative emergence agitation between sevoflurane and desflurane at 10, 20, 30, 45 minutes and 1 hour. Further, we have compared the pain intensity at 10, 20, 30, 45 minutes, 1 hour and 2 hours. Also, we have compared the time for tracheal extubation after discontinuing volatile agents in both groups.

Inclusion Criteria

Sexes, ages 3-12 years, ASA physical status I, II patients, and elective surgeries under general anaesthesia were included.

Exclusion Criteria

Asthma patients, genetic syndromes, neurological disorders, use of psychiatric medications, patient refusal, autism, and developmental delay were excluded.

Sixty pediatric patients were randomly assigned to receive Sevoflurane 1 MAC (Group S) or Desflurane 1 MAC (Group D) in nitrous oxide (70%) and oxygen (30%) at a constant fresh gas flow of 6 L/min to maintain anaesthesia. Before being extubated, all patients received 10 mg/kg of paracetamol intravenously for analgesia.

Monitored heart rate, continuous ECG, peripheral oxygen saturation, noninvasive blood pressure, and $ETCO_2$ were monitored. Standard anaesthetic monitors, such as a pulse oximeter, noninvasive blood pressure, ETCO2, and an electrocardiogram (ECG), were connected as the patient entered the operating room. Baseline values of HR, BP, and SPO2 were recorded. Peripheral IV was accessed, and all patients received intravenous injections of glycopyrrolate (0.005-0.01 mg/kg), midazolam (0.02 mg/kg), and fentanyl (2 mcg/kg). Injections of propofol (2 mg/kg) and atracurium (0.5 mg/kg) were used to produce anaesthesia and aid tracheal intubation, respectively. Inhalational anaesthetics were stopped, and fresh gas flow was raised to 8 Lpm, 100% oxygen, at the end of surgery. Tracheal extubation occurred when normal breathing was achieved, and the cough or gag reflex returned. Transfer of the patient to the recovery unit. After 10, 20, 30, 45, and an hour, the PAED scale was used to determine the level of delirium. A total PAED score of less than 12 is seen as a sign of emergent delirium at any moment. After extubation, pain scores are determined using the Visual Analogue Scale. Paracetamol 10 mg/kg intravenously was administered if the patient's pain level was higher than 3.

Statistical analysis

The observations during the study are noted in the proforma and entered in MS Excel Sheet. IBM SPSS software version 23.0 was used to assess the collected data. Frequency and percentage analyses were used for categorical variables, while the mean and standard deviation were used for continuous variables. The Mann-Whitney U test and the unpaired sample t-test were used to see whether there was a significant difference between the bivariate samples in independent groups. The Chi-Square test was used similarly to find the significance in categorical data. Fisher's Exact was used if the expected cell frequency is less than 5 in 2×2 tables. A significant level is defined as 0.05 in probability.

RESULTS

Age distribution data indicated that there were 3.3%, 30%, 40%, and 26.7% participants belonging to age categories of up to 3 years, 4-6 years, 7-9 years, and10-12 years, respectively. Further, gender distribution data indicated that 43.3% were females and 56.7% were males. [Table 1].

The above figure compares the PAED Score with Groups by the Mann-Whitney U test, where all the time durations of the PAED Score with Groups show a statistically insignificant difference. [Figure 1]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

The figure table shows a comparison of the VAS Score with Groups by Unpaired t-test was t-value=1.146, p=0.252, which shows a statistically insignificant difference between VAS Score and Groups. [Figure 2]

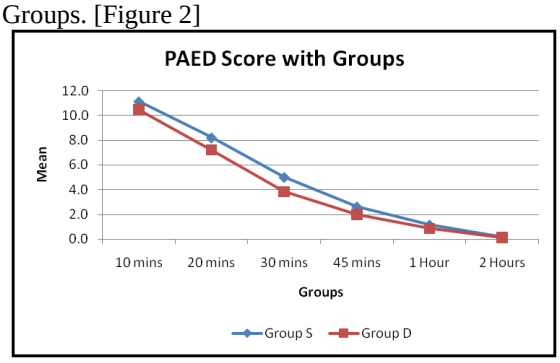

Figure 1: Comparison of PAED score with Groups by Mann-Whitney U test

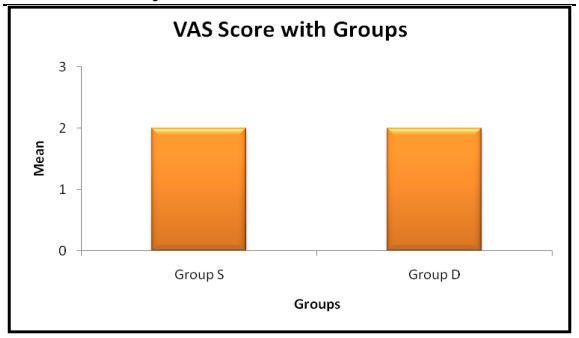

Figure 2: Comparison of VAS Score with Groups by Unpaired T-test

Table 1: Age and gender distribution among participants

Variables	Frequency	Percentage
Up to 3 years	2	3.3
4 - 6 years	18	30.0
7 - 9 years	24	40.0
10 - 12 years	16	26.7
Mean ± S.D for age = 8 ± 3 years		
Female	26	43.3
Male	34	56.7

No statistically significant association between age, gender and ASA-PS I & II for within-group comparison. [Table 2]

Table 2: Comparison between age, gender, and ASA-PS within Groups

		Group S	Group D	p-value
Age	Up to 3 years	2 (6.7%)	2 (3.3%)	0.200
	4 - 6 years	10 (3.3%)	8 (26.7%)	
	7 - 9 years	13 (43.3%)	11 (36.7%)	
	10 - 12 years	5 (16.7%)	11 (36.7%)	
Gender	Female	11 (36.7%)	15 (50%)	0.297
	Male	19 (63.3%)	15 (50%)	
ASA	I	26 (86.7%)	26 (86.7%)	1.000
	II	4 (13.3%)	4 (13.3%)	

Table 3: Comparison of weight, duration of inhalation exposure (mins), and time for extubation after discontinuing volatile (mins) within groups by unpaired t-test

Variables	Groups	Mean	S.D	p-value
Weight	Group S	20.3	7.3	0.153
	Group D	23	7.3	
Duration of Inhalation Exposure (mins)	Group S	62.4	15	0.779
	Group D	63.4	14.3	
Time for extubation after discontinuing volatile (mins)	Group S	11.6	2.6	0.127
	Group D	10.5	2.7	

No statistically significant difference in weight, duration of inhalation exposure (mins) and time for extubation after discontinuing volatile (mins) between groups. [Table 3]

DISCUSSION

Before introducing the PAED scale as the indicator of emergency delirium in children, there was no valid or trustworthy scale able to define the many elements of ED consistently. Despite the PAED score's validation as a credible indicator of ED, there is still disagreement over the appropriate cutoff value.[9,10] In our study, paediatric patients' PAED scores peaked during the first 10 minutes of extubation, comparable with findings from earlier studies regarding the timing of the peak of postoperative agitation 11,33. 12/30 (40%) of the paediatric patients in the desflurane group and 17/30

ISSN (O): 2687-5365; ISSN (P): 2753-6556

(56.7%) of the sevoflurane group had PAED scores of 12 or lower at least once during the postoperative period. Desflurane was observed to have a lower incidence of emerging agitation than sevoflurane. However, these results were not determined to be statistically significant.

Demographic parameters were comparable between the two groups, and we observed male predominance in our study, as 56.7% were males. The age of patients ranged between 3-12 years in both groups, with a predominance of 40% being 7-9 years and 30% being in the 4-6 years group. Patients in groups S and D ranged in weight from 9 to 40 kg. With 26 patients in class I and 4 in class II in each group, the ASA PS class was comparable across the two groups. The two groups' inhalational exposure times were also comparable, with group S having a mean of 62.4 and group D having a mean of 63.4. The data mentioned above did not have any statistical significance.

Time to extubation was slightly faster with the desflurane group (10.5 ± 2.7 mins) than the sevoflurane group (11.6 ± 2.6 mins) when used to maintain general anaesthesia. Desflurane is anticipated to emerge more quickly than sevoflurane due to its poorer solubility in blood and lean tissues.[11,12] Welborn et al,[13] and Cohen et al,[14] similarly found similar outcomes in their research. Desflurane's quicker emergence is crucial in busy paediatric ambulatory settings.

The sevoflurane group's PAED score at 10 minutes was marginally higher (11.1 ± 4.1) than the desflurane group's (10.5 ± 3.5), indicating that group S experienced a somewhat greater incidence of emerging agitation than group D. Additionally, group S had higher values for the PAED scores at 20, 30, 45 minutes, 1 hour, and 2 hours compared to group D. However, it was determined that the total results were not statistically significant.

Singh et al,[15] reported a higher incidence of emergence agitation with sevoflurane (40%) than with desflurane (28%). Their trial's extended anaesthetic duration (80–90 min) may cause a greater prevalence of EA. According to Mayer et al,[16] for the induction of anaesthesia in both groups, they also utilised more sevoflurane (8 volume%), which is known to enhance the incidence of EA. Children receiving sevoflurane experienced emergence agitation less frequently (25%) than those getting desflurane (43%), according to Valley et al,[17] The frequency of EA reported by various writers varies, and this may be because multiple scoring systems and characteristics have been developed to identify EA and its complex etiology. [18]

Cravero et al,[7] have demonstrated that EA can also happen in pain-free children. But pain can still be an important causative and confounding factor that would hinder evaluating EA and could bias our results. In our study, pain was measured using the VAS (Visual Analog Scale) score, and there was no statistical significance between the groups. Our study found no significant difference between desflurane and sevoflurane groups regarding high PAED scores. Also, a study by Cohen et al,[14] and Demirbilek et al,[19] could not differentiate the alteration in emergence delirium to maintain general anaesthesia between desflurane and sevoflurane. Research on measures to reduce EA in children is now centred because the PAED scale has been introduced into clinical management, with the ultimate goal of eliminating it. Children who received fentanyl after sevoflurane for general anaesthesia had a reduced incidence and shorter duration of EA, according to a meta-analysis by Dahmani et al.[20]

Additionally, this study discovered that, even though there is no clear requirement for pain control, fentanyl post-intubation can be beneficial in reducing delirium in PACU. Propofol is more effective than fentanyl, according to more recent research, and it is associated with lower PAED scores in children who have undergone general anaesthesia with sevoflurane.[21] In particular, using propofol to end general anaesthesia reduces the likelihood of EA42. There hasn't been a concrete solution to completely eradicate childhood emergence agitation, even though numerous studies have attempted to lower the prevalence of EA in youngsters.

CONCLUSION

In paediatric patients, desflurane recovers from anaesthesia more quickly than sevoflurane. Although sevoflurane had a slightly greater prevalence of EA than desflurane in our study, the incidence of emerging agitation is equivalent in both groups. Both substances are safe to use on kids.

REFERENCES

1. Sikich N, Lerman J. Development and psychometric evaluation of the pediatric anesthesia emergence delirium scale. Anesthesiology 2004;100:1138–45.
2. Kim YS, Chae YK, Choi YS, Min JH, Ahn SW, Yoon JW, et al. A comparative study of emergence agitation between sevoflurane and propofol anesthesia in adults after closed reduction of nasal bone fracture. Korean J Anesthesiol 2012;63:48–53.
3. Abdelhalim AA, Alarfaj AM. The effect of ketamine versus fentanyl on the incidence of emergence agitation after sevoflurane anesthesia in pediatric patients undergoing tonsillectomy with or without adenoidectomy. Saudi J Anaesth 2013;7:392–8.
4. Aono J, Ueda W, Mamiya K, Takimoto E, Manabe M. Greater incidence of delirium during recovery from sevoflurane anesthesia in preschool boys. Anesthesiology 1997;87:1298–300.
5. Oh AY, Seo KS, Kim SD, Kim CS, Kim HS. Delayed emergence process does not result in a lower incidence of emergence agitation after sevoflurane anesthesia in children. Acta Anaesthesiol Scand 2005;49:297–9.
6. Khattab AM, El-Seify ZA. Sevoflurane-emergence agitation: Effect of supplementary low-dose oral ketamine premedication in preschool children undergoing dental surgery. Saudi J Anaesth 2009;3:61–6.
7. Cravero JP, Beach M, Dodge CP, Whalen K. Emergence characteristics of sevoflurane compared to halothane in

ISSN (O): 2687-5365; ISSN (P): 2753-6556

pediatric patients undergoing bilateral pressure equalisation tube insertion. J Clin Anesth 2000;12:397–401.
8. Kawaraguchi Y, Miyamoto Y, Fukumitsu K, Taniguchi A, Hirao O, Kitamura S, et al. The effect of ketamine on reducing postoperative agitation after sevoflurane anesthesia in pediatric strabismus surgery. Masui 2002;51:1343–8.
9. Bajwa SA, Costi D, Cyna AM. A comparison of emergence delirium scales following general anesthesia in children. Paediatr Anaesth. 2010;20:704–11.
10. Locatelli BG, Ingelmo PM, Emre S, Meroni V, Minardi C, Frawley G, et al. Emergence delirium in children: a comparison of sevoflurane and desflurane anesthesia using the Paediatric anesthesia emergence Delirium scale. Paediatr Anaesth. 2013;23:301–8.
11. Yasuda N, Lockhart SH, Eger EI, Weiskopf RB, Johnson BH, Freire BA, et al. Kinetics of desflurane, isoflurane, and halothane in humans. Anesthesiology 1991;74:489–98.
12. Steward A, Allott PR, Cowles AL, Mapleson WW. Solubility coefficients for inhaled anaesthetics for water, oil and biological media. Br J Anaesth 1973;45:282-93.
13. 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;83:917–20.
14. 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;94:1178–81.
15. Singh R, Kharbanda M, Sood N, Mahajan V, Chatterji C. Comparative evaluation of the incidence of emergence agitation and postoperative recovery profile in paediatric patients after isoflurane, sevoflurane and desflurane anaesthesia. Indian J Anaesth 2012;56:156-61.
16. Mayer J, Boldt J, Röhm KD, Scheuermann K, Suttner SW. Desflurane anesthesia after sevoflurane inhaled induction reduces the severity of emergence agitation in children undergoing minor ear-nose-throat surgery compared with sevoflurane induction and maintenance. Anesth Analg 2006;102:400-4.
17. Valley RD, Freid EB, Bailey AG, Kopp VJ, Georges LS, Fletcher J, et al. Tracheal extubation of deeply anesthetised pediatric patients: A comparison of desflurane and sevoflurane. Anesth Analg 2003;96: 1320-4.
18. Silva LM, Braz LG, Módolo NS. Emergence agitation in pediatric anesthesia: Current features. J Pediatr (Rio J) 2008;84:107-13.
19. Demirbilek S, Togal T, Cicek M, Aslan U, Sizanli E, Ersoy MO. Effects of fentanyl on the incidence of emergence agitation in children receiving desflurane or sevoflurane anaesthesia. Eur J Anaesthesiol. 2004;21:538–42.
20. Dahmani S, Stany I, Brasher C, Lejeune C, Bruneau B, Wood C, et al. Pharmacological prevention of sevoflurane and desflurane related emergence agitation in children: a meta-analysis of published studies. Br J Anaesth 2010;104:216-23.
21. Kim MS, Moon BE, Kim H, Lee JR. Comparison of propofol and fentanyl administered at the end of anaesthesia for prevention of emergence agitation after sevoflurane anaesthesia in children. Br J Anaesth. 2013;110:274–80.

ISSN (O): 2687-5365; ISSN (P): 2753-6556