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Efficacy of Propofol and Fentanyl in Reducing Emergence Agitation in Pediatric Patients after Sevoflurane Anesthesia: A Prospective Comparative Study

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Abstract **Original Research Article**

Introduction: Emergence agitation is a common postoperative phenomenon in pediatric patients that can lead to adverse outcomes. Propofol and fentanyl have been used for its management, but their comparative efficacy remains unclear. This study aimed to compare the efficacy of propofol and fentanyl in reducing emergence agitation in pediatric patients after Sevoflurane anesthesia. Methods: This prospective observational study was conducted at the Pediatric Anesthesia Department of Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh over a 6-month period. 160 pediatric patients between the ages of 2-8 who underwent elective surgery and experienced emergence agitation under Sevoflurane anesthesia were selected. Patients with certain medical conditions or allergies were excluded. The participants were randomly divided into two groups: one receiving propofol and one receiving fentanyl. Anesthesia was induced with 8% sevoflurane, and data was collected and analyzed to compare the efficacy of propofol and fentanyl in reducing emergence agitation in pediatric patients. Ethical approval and informed consent were obtained. ***Result:*** Both groups had similar mean age and weight, with the propofol group having a mean age of 3.6 (SD 2.8) years and a mean weight of 15.7 (SD 3.3) kg, while the fentanyl group had a mean age of 3.7 (SD 2.5) years and a mean weight of 15.9 (SD 3.6) kg. Most subjects were male, with 75% in the propofol group and 57.5% in the fentanyl group. The mean duration of anesthesia was similar, with the propofol group at 63.5 (SD 14.8) minutes and the fentanyl group at 61.6 (SD 11.9) minutes. The mean PAED score was lower in the propofol group (4.3, SD 3.2) compared to the fentanyl group (4.9, SD 3.5). Airway obstruction and laryngospasm were less frequent in the propofol group (2.5% and 1.25%, respectively) compared to the fentanyl group (6.25% each), and nausea/vomiting was lower in the propofol group (6.25%) compared to the fentanyl group (26.25%). ***Conclusion:*** The study found that both propofol and fentanyl are effective in reducing emergence agitation (EA) in pediatric patients after sevoflurane anesthesia, with similar efficacy between the two drugs. However, propofol may be a better choice as it resulted in a lower incidence of postoperative nausea and vomiting. The study also found no significant differences in complications and rescue medications between the two groups, but a higher incidence of PONV after fentanyl use. Effective management strategies are necessary to reduce the negative effects of emergence agitation.

Keywords: Emergence Agitation, Children, Sevoflurane, Propofol, Fentanyl.

INTRODUCTION

Emergence agitation (EA) is a common phenomenon that occurs in pediatric patients after anesthesia, particularly after the use of sevoflurane [1,2]. EA is a state of confusion and disorientation that can lead to aggressive behavior, crying, thrashing, and restlessness, and it can lead to delayed recovery, increased healthcare costs, and adverse effects on the patient's psychological and physiological well-being [1,3]. The incidence of EA in children ranges from 10% to 80%, depending on the age of the patient, the type of surgery, and the anesthetic technique used [4–6]. Several drugs have been studied for their efficacy in reducing EA, including propofol and fentanyl. Propofol is a short-acting sedative-hypnotic drug that has been used for anesthesia induction and maintenance in pediatric patients [7]. It has been shown to reduce EA and improve recovery outcomes in children after surgery. Propofol works by enhancing the activity of the inhibitory neurotransmitter gamma-aminobutyric acid (GABA) in the brain, leading to sedation and

anxiolysis. It has a rapid onset and offset of action, making it a suitable drug for use in the postoperative period [8,9]. Fentanyl is an opioid analgesic that is commonly used for pain management in children after surgery [10,11]. It has also been shown to reduce EA in pediatric patients. Fentanyl works by binding to the mu-opioid receptors in the central nervous system, leading to pain relief and sedation. It has a rapid onset and short duration of action, making it an ideal drug for use in the postoperative period [11,12]. Several studies have investigated the use of different opioids in reducing EA in pediatric patients after sevoflurane anesthesia. A study by Jalili*et al.*, (2019) observed the effects of propofol alone and ketamine-propofol mixture in children, where they found that both drugs were effective in reducing EA, with no significant difference between the two groups in terms of EA severity, time to extubation, or time to discharge from the recovery room [13].However, very few studies are available on the comparative observation of propofol and fentanyl in reducing EA. Therefore, there is a need for a large, prospective comparative study to evaluate the effectiveness of propofol and fentanyl in reducing EA in pediatric patients after sevoflurane anesthesia. The current study aims to investigate the efficacy of propofol and fentanyl in reducing EA in pediatric patients after sevoflurane anesthesia.

METHODS

This prospective observational study was conducted at the Department of Pediatric Anesthesia, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh. The study duration was 6 months, from July 2022 to December 2022. During this period, a total of 160 patients who had undergone elective surgery under Sevoflurane anesthesia and developed emergence agitation were selected for the study. For inclusion criteria, pediatric patients within the age range of 2-8 years with emergence agitation were included in the study, while patients with a history of psychological disorders or developmental delays, allergies to propofol or fentanyl, or a medical condition that contraindicates the use of these drugs were excluded from the study. The participants were divided in two equal groups of 80 patients each, one receiving propofol, and one receiving fentanyl. Subjects were not pre-medicated. Upon arrival at the operating theatre, subjects were monitored by pulse oximetry, non-invasive arterial pressure, and electrocardiography. Anesthesia was induced by inhalation of 8% sevoflurane in oxygen via a face mask with monitoring of inhaled and exhaled sevoflurane concentrations. Informed consent regarding the study was obtained from the legal guardians of the participants, and ethical approval regarding this study was also obtained from the ethical review committee of the study hospital. All collected data was recorded in a database, and statistical analysis was performed to compare the efficacy of propofol and fentanyl in reducing emergence agitation in pediatric patients after sevoflurane anesthesia .

RESULTS

Table 1: Subject characteristics and duration of anesthesia

Variables	Propofol Group mean (SD)	Fentanyl Group mean (SD)
Age (year)	3.6 (2.8)	3.7 (2.5)
Weight (kg)	15.7 (3.3)	15.9 (3.6)
Male	60 (75%)	46 (57.5%)
Female	20 (25%)	34 (42.5%)
Duration of anesthesia (min)	63.5 (14.8)	61.6 (11.9)
PAED Score	4.3 (3.2)	4.9 (3.5)

The mean age for both groups was similar, with the propofol group having a mean age of 3.6 (SD 2.8) years and the fentanyl group having a mean age of 3.7 (SD 2.5) years. The mean weight for both groups was also similar, with the propofol group having a mean weight of 15.7 (SD 3.3) kg and the fentanyl group having a mean weight of 15.9 (SD 3.6) kg. The majority of subjects in both groups were male, with 75% of subjects in the propofol group and 57.5% of subjects in the fentanyl group being male. The mean duration of anesthesia was similar for both groups, with the propofol group having a mean duration of 63.5 (SD 14.8) minutes and the fentanyl group having a mean duration of 61.6 (SD 11.9) minutes. Lastly, the mean PAED score, which is a measure of the severity of emergence agitation, was slightly lower in the propofol group at 4.3 (SD 3.2) compared to the fentanyl group at 4.9 (SD 3.5).

Table 2: Distributions of scores according to Aono's scale

Aono's Scale	Propofol Group n (%)	Fentanyl Group n (%)
1	49 (61.25%)	49 (61.25%)
2	28 (35%)	22 (27.50%)
3	1 (1.25%)	9 (11.25%)
4	2 (2.50%)	0 (0%)

Aono's scale is a commonly used tool for measuring emergence agitation in pediatric patients. The scale ranges from 1 to 4, with a higher score indicating more severe agitation. In the propofol group, 49 subjects (61.25%) scored a 1, which indicates no agitation or mild agitation that subsides within 5 minutes. 28 subjects (35%) scored a 2, which indicates moderate agitation that subsides with comforting or no treatment. Only one subject (1.25%) scored a 3, which indicates severe agitation that requires pharmacological treatment. Two subjects (2.50%) scored a 4, which indicates extremely severe agitation that requires intensive treatment. In the fentanyl group, 49 subjects (61.25%) also scored a 1, 22 subjects (27.50%) scored a 2, and 9 subjects (11.25%) scored a 3. No subjects in the fentanyl group scored a 4.

Table 3: Distributions of scores according to five-step EAS

Five-Step EAS	Propofol Group n(%)	Fentanyl Group n(%)
1	0 (0%)	0 (0%)
2	0 (0%)	1 (1.25%)
3	53 (66.25%)	57 (71.25%)
4	26 (32.50%)	21 (26.25%)
5	1 (1.25%)	1 (1.25%)

The EAS is a scale that ranges from 1 to 5, with a higher score indicating more severe agitation. In this table, no subjects in either group scored a 1 or 2, which indicates that all subjects had at least mild agitation. In the propofol group, the majority of subjects (53, or 66.25%) scored a 3, which indicates mild to moderate agitation that is not disturbing to caregivers. 26 subjects (32.50%) scored a 4, which indicates moderate to severe agitation that is disturbing to caregivers but does not require pharmacological treatment. Only one subject (1.25%) scored a 5, which indicates severe agitation that requires pharmacological treatment. In the fentanyl group, the majority of subjects (57, or 71.25%) also scored a 3, and 21 subjects (26.25%) scored a 4. Only one subject (1.25%) scored a 2, which indicates mild agitation that is not disturbing to caregivers. One subject (1.25%) also scored a 5, which indicates severe agitation that requires pharmacological treatment.

Table 4: Comparison of time for awakening and PACU stay duration

Variables	Propofol Group mean (SD)	Fentanyl Group mean (SD)
Time for awakening (min)	27.7 (8.5)	30.5 (12.3)
PACU duration (min)	37.1 (8.7)	40.4 (11.5)

The PACU duration refers to the time from the end of anesthesia to the time when the patient was discharged from the PACU. In this table, the mean time for awakening in the propofol group was 27.7 minutes (SD = 8.5), while the mean time for awakening in the fentanyl group was 30.5 minutes (SD = 12.3). The mean PACU duration in the propofol group was 37.1 minutes (SD = 8.7), while the mean PACU duration in the fentanyl group was 40.4 minutes (SD = 11.5).

Table 5: Incidence of complications and use of rescue medications during the postoperative period

Variables	Propofol Group n (%)	Fentanyl Group n (%)
Airway Obstruction	2 (2.50%)	5 (6.25%)
Laryngospasm	1 (1.25%)	1 (1.25%)
Nausea or Vomiting	5 (6.25%)	21 (26.25%)
Delayed Vomiting	0 (0%)	0 (0%)
Ondansetron use	5 (6.25%)	21 (26.25%)

The results show that airway obstruction and laryngospasm occurred in 2.5% and 1.25% of patients in the Propofol group, respectively, compared to 6.25% in each complication in the Fentanyl group. The incidence of nausea or vomiting was also lower in the Propofol group (6.25%) than in the Fentanyl group (26.25%). None of the patients in either group experienced delayed vomiting. Ondansetron was used in 6.25% of patients in the Propofol group and 26.25% of patients in the Fentanyl group to manage postoperative nausea and vomiting.

DISCUSSION

The present study aimed to investigate the efficacy of propofol and fentanyl in reducing emergence agitation (EA) in pediatric patients after sevoflurane anesthesia. A total of 160 children, aged

between 1 to 6 years, were enrolled in the study and were equally divided into two groups: propofol group (n=80) and fentanyl group (n=80). The mean age of the participants in the propofol group was 3.6 years (SD=2.8), and in the fentanyl group, it was 3.7 years (SD=2.5). The mean weight of the children in the propofol group was 15.7 kg (SD=3.3), and in the fentanyl group, it was 15.9 kg (SD=3.6). In both groups, the majority of the participants were male, with 75% in the propofol group and 57.5% in the fentanyl group. Overall, the subject characteristics and duration of anesthesia were similar between the propofol and fentanyl groups, which suggest that any differences in the efficacy of the two drugs in reducing emergence agitation cannot be attributed to differences in these variables. The higher incidence of male participants in this study was understandable, as various causes lead to a higher injury rate among young boys compared to girls. This trend is observable in various global studies [14,15]. The findings of the study suggest that both propofol and fentanyl are effective in reducing EA in pediatric patients, with a higher proportion of patients in the propofol group having Aono's score of 1 and 2 compared to the fentanyl group. Overall, the majority of subjects in both groups scored a 1 or 2 on Aono's scale, which suggests that most of the emergence agitation observed in this study was mild to moderate and subsided with minimal or no treatment. The distribution of scores was similar between the propofol and fentanyl groups, which suggest that both drugs may be equally effective in reducing the severity of emergence agitation in pediatric patients after sevoflurane anesthesia. Additionally, the five-step EAS score was lower in the propofol group, indicating a lower incidence of EA. These findings are consistent with previous studies that have reported the efficacy of propofol and fentanyl in reducing EA in pediatric patients. Overall, the distribution of scores was similar between the propofol and fentanyl groups, which suggest that both drugs may be equally effective in reducing the severity of emergence agitation in pediatric patients after sevoflurane anesthesia. However, it should be noted that a relatively high proportion of subjects in both groups had at least mild agitation, which highlights the importance of effective management strategies to reduce the negative effects of emergence agitation on patients and caregivers. These findings are consistent with previous studies that have reported the efficacy of propofol and fentanyl in reducing EA in pediatric patients [16,17]. The time for awakening was shorter in the propofol group (27.7 min, SD=8.5) compared to the fentanyl group (30.5 min, SD=12.3), but the difference was not statistically significant. Similarly, the PACU duration was also shorter in the propofol group (37.1 min, SD=8.7) compared to the fentanyl group (40.4 min, SD=11.5), but the difference was not statistically significant. Regarding complications and rescue medications, the incidence of airway obstruction and laryngospasm was similar between the two groups, indicating that both propofol and fentanyl are safe for use in pediatric patients. However, the incidence of nausea or vomiting and the use of ondansetron were higher in the fentanyl group compared to the propofol group. This finding is consistent with previous studies that have reported a higher incidence of postoperative nausea and vomiting (PONV) with the use of fentanyl [18–20]. Overall, the findings of the present study suggest that propofol and fentanyl are both effective in reducing emergence agitation in pediatric patients after sevoflurane anesthesia. While the incidence of emergence agitation was slightly lower in the propofol group compared to the fentanyl group, the differences were not statistically significant. Keeping in mind the higher incidence of postoperative nausea and vomiting after use of fentanyl, propofol seems to be the better choice for controlling EA among pediatric patients.

Limitations of the Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

The study found that both propofol and fentanyl are effective in reducing emergence agitation (EA) in pediatric patients after sevofluraneanesthesia, with similar efficacy between the two drugs. However, propofol may be a better choice as it resulted in a lower incidence of postoperative nausea and vomiting. The study also found no significant differences in complications and rescue medications between the two groups, but a higher incidence of PONV after fentanyl use. Effective management strategies are necessary to reduce the negative effects of emergence agitation.

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