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Pediatric Postoperative Agitation Mitigation by Dexmedetomidine: A Cross-Sectional Study

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ABSTRACT

As a highly selective α-2 receptor agonist, dexmedetomidine induces sedation, analgesia and anxiolytic through central sympatholytic mechanisms. This study aimed to investigate the impact of dexmedetomidine in managing postoperative emergence agitation (EA) in pediatric patients undergoing sevoflurane anesthesia. The study included 100 male and female patients aged 2-7 years, classified as ASA class I (American Society of Anesthesiologists) and those who were scheduled for elective adenoidectomy, tonsillectomy, or both. Patients were instructed to refrain from consuming solid foods or milk six hours prior to surgery. If necessary, filtered liquids were permitted until two hours before the procedure. No premeditation was administered and upon arrival in the operating room, agitation levels were assessed and scored using a four-point scale. Standard monitoring, including electrocardiography, pulse oximetry and non-invasive blood pressure measurement, was performed. The data revealed that majority of patients were calm, while about 30% exhibited agitation, with a chi-square test indicating statistical significance. Additionally, the incidences of bradycardia, hypotension and vomiting were noted, with chi-square values, which was also statistically significant. Dexmedetomidine effectively reduced the occurrence of postoperative emergence agitation in children under sevoflurane anesthesia. Dexmedetomidine may help reduce postoperative pain, extend emergence and extubation times. Based on the findings, dexmedetomidine appears to be a promising agent for preventing EA in pediatric patients under sevoflurane anesthesia. However, additional studies are needed to further explore its potential in preventing postoperative nausea and vomiting.

INTRODUCTION

Sevoflurane is among the most frequently utilized inhalational anesthetics in pediatric anesthesia, primarily due to its non-irritating nature and ability to facilitate a smooth and rapid induction process. Its low blood-gas partition coefficient allows for both swift induction and prompt recovery once administration is ceased. Additionally, sevoflurane exhibits broncho dilatory properties and causes minimal airway irritation compared to other volatile anesthetic agents currently in use[1]. Owing to its low pungency, rapid onset, favorable recovery profile, minimal cardio depressive effects and limited toxicity, sevoflurane is a preferred agent in pediatric anesthesia[2]. However, its use is linked to a significant incidence of emergence agitation (EA), ranging from 10-80% in children[3]. The underlying causes of EA are multi factorial and include rapid emergence from anesthesia, pain, preoperative anxiety, the nature of the surgical procedure, patient temperament and the specific anesthetic agent used. Additionally, EA may result in adverse consequences such as self-inflicted injuries, heightened anxiety and increased medical costs due to the need for additional management[4]. Pharmacological agents like dexmedetomidine, an α-2 adrenoceptor agonist, have demonstrated potential in mitigating EA following sevoflurane anesthesia. Dexmedetomidine exhibits a high degree of selectivity for α-2 adrenoceptors, possessing an eightfold greater affinity than clonidine[5]. It exerts sedative, analgesic and anxiolytic effects while producing minimal adverse reactions. Multiple clinical studies have confirmed that intravenous administration of dexmedetomidine significantly lowers the incidence of EA in pediatric patients undergoing sevoflurane anesthesia[6]. As a highly selective α-2 receptor agonist with an affinity approximately 1600 times greater for α-2 than α-1 receptors, dexmedetomidine induces sedation, analgesia and anxiolytic through central sympatholytic mechanisms. These properties make it particularly useful in both intensive care and perioperative settings[7,8]. This study aimed to investigate the impact of dexmedetomidine in managing postoperative emergence agitation (EA) in pediatric patients undergoing sevoflurane anesthesia.

MATERIALS AND METHODS

The present study was conducted over one year at an Indian medical college. The procedure and the trial were thoroughly explained to the parents by the anesthesiologist and after understanding the details, the parents provided written consent. A total of 100 children, aged between 2 and 7 years, with ASA class I, who were scheduled for elective adenoidectomy, tonsillectomy, or both, were selected using a convenient sampling method. The study included male and female patients aged 2-7 years, classified as ASA class I (American Society of Anesthesiologists) and those who were scheduled for elective adenoidectomy, tonsillectomy, or both. Children with intellectual or developmental disabilities (IDD), neurological disorders, upper airway abnormalities, or comorbid cardiovascular diseases were excluded. Additionally, children with a history of asthma, other lung diseases, or lung infections in the past four weeks were not included. Special conditions during the surgery, such as severe hypotension, malignant arrhythmias, significantly prolonged surgery times for other reasons, refusal by parents to participate in the study, or use of chronic pain medications by the child, were also grounds for exclusion. Patients were instructed to refrain from consuming solid foods or milk six hours prior to surgery. If necessary, filtered liquids were permitted until two hours before the procedure. No premedication was administered and upon arrival in the operating room, agitation levels were assessed and scored using a four-point scale. Standard monitoring, including electrocardiography, pulse oximetry and non-invasive blood pressure measurement, was performed. Data were entered into Microsoft Excel 2013 and statistical analysis was carried out using SPSS for Windows (version 23). Categorical variables were expressed as percentages, while continuous variables were represented as mean±standard deviation (SD). The chi-square test or Fisher's exact test was used to compare proportions. For continuous variables, the Student's t-test was applied for parametric data and the Wilcoxon rank-sum test was used for non-parametric distributions. A p-value of <0.05 was considered to indicate statistical significance.

RESULTS AND DISCUSSIONS

The basic demographic profile of the study participants is presented in (Table 1), where a total of 100 participants were included, with 64 males (64%) and 36 females (36%). The mean BMI for males was 14.57± 1.41, while for females, it was 13.97±2.81. Statistical analysis revealed no significant gender difference in BMI (p=0.158).

Table 1: Basic Profile of Study Participants

	Male		Female
n	64		36
%	64.00		36.00
BMI (Mean±SD)	14.57±1.41		13.97±2.81
P Value		0.158	

Regarding the clinical profile of the participants, as shown in (Table 2), the mean duration of anesthesia was 23.68±3.90 minutes and the mean duration of surgery was 33.47±1.45 minutes. Both variables demonstrated no significant differences (p=0.47 and p=0.64, respectively). However, the emergence from anesthesia had a significant difference with a mean duration of 8.69±4.68 minutes (p=0.01), suggesting a faster recovery in participants receiving dexmedetomidine.

Table 2: Clinical Profile of Study Participants

Variable	Mean±SD	P-Value
Duration of anesthesia (min)	23.68±3.90	0.47
Duration of surgery (min)	33.47±1.45	0.64
Emergence from anesthesia (min)	8.69±4.68	0.01

The preoperative agitation levels are summarized in (Table 3). A majority of the participants (70%) were calm preoperatively. Among the remaining patients, 29% were not calm but could be easily calmed, while 1% exhibited moderate agitation. None of the participants were classified as combative, excited, or disoriented.

Table 3: Preoperative Agitation Among Study Population

Level of Preoperative Agitation	n	%	P-Value
Calm	70	70.00	<0.05
Not calm, but could be easily calmed	29	29.00	
Moderately agitated or restless	1	1.00	
Combative, excited and disoriented	0	0.00	

(Table 4) presents the side effects associated with dexmedetomidine administration. Bradycardia was observed in 6% of the participants, with a statistically significant difference ($p<0.05$). Other side effects, such as hypotension and vomiting, were less common, affecting 3% and 1% of the participants, respectively. The lower incidence of these side effects suggests that dexmedetomidine is generally well-tolerated in pediatric patients.

Table 4: Side Effects Profile

Side effect	n	%	P-Value
Bradycardia	6	6.00	<0.05
Hypotension	3	3.00	
Vomiting	1	1.00	

The incidence and severity of emergence agitation (EA) were lower in patients administered dexmedetomidine. The difference in EA occurrence during the first 30 minutes between these groups was statistically significant, with the dexmedetomidine group demonstrating a reduced incidence. In contrast, group SD exhibited a rising trend in EA incidence within the initial 30 minutes. This finding in group SD differed from the results reported by Ali MA and Abdellatif[8], which may be attributed to variations in the study population, as their research focused on children undergoing adenotonsillectomy-a procedure known to have a high risk of EA. Group SD recorded the peak EA incidence at 25 and 30 minutes, whereas group SP showed the highest EA occurrence within the first 15 minutes, reaching its maximum at five minutes postoperatively. The findings in group SP from the present study were consistent with the observations of Ali MA and Abdellatif[8], who reported elevated EA incidence and severity within the first 15 minutes in the control, propofol and dexmedetomidine groups in the PACU. The control group displayed the highest EA occurrence compared to the other two groups, while the dexmedetomidine group had the lowest, corroborating the present study's findings. The extubation time between the two groups demonstrated a statistically significant difference, with group SD exhibiting shorter extubation times ($p<0.01$). However, the incidence of side effects and the duration of ICU stay were comparable between the groups. These results were in agreement with the findings of Ali MA and Abdellatif AA, who reported no statistically significant difference in these parameters ($p\geq0.05$)[8] and other studies[9-12]. Wu *et al.* observed a shorter extubation time (11.35±3.17 minutes) in patients receiving intravenous propofol at 2 mg/kg compared to those administered a saline placebo (21.41±4.62 minutes) ($p<0.01$). This reduction in extubation time was positively correlated with lower Pediatric Anesthesia Emergence Delirium (PAED) scores in the propofol group[13]. Dexmedetomidine, a highly selective α-2 adrenergic receptor agonist, exerts anxiolytic, sedative and analgesic effects with minimal respiratory and circulatory suppression at standard dosages. Additionally, dexmedetomidine enhances cognitive function in children recovering from general anesthesia and provides dose-dependent suppression of EA and emergence delirium (ED) following surgical procedures. The optimal dexmedetomidine dose for EA prevention was determined to be 0.30 µg/kg (95% CI: 0.21-1.00 µg/kg)[14].

CONCLUSION

Dexmedetomidine has been shown to reduce the occurrence of postoperative emergence agitation (EA) in children receiving sevoflurane anesthesia. Additionally, our findings suggest that dexmedetomidine may help reduce postoperative pain, extend emergence time and delay extubation. Based on these results, we suggest that dexmedetomidine is a promising therapeutic option for preventing EA in pediatric patients undergoing sevoflurane anesthesia. However, further research is needed to assess its potential in preventing postoperative nausea and vomiting.

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