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Article

During Tonsillectomy and Adenoidectomy, Children with Obstructive Sleep Apnea Syndrome are Given a Dexmedetomidine Infusion to Help with Pain Management and to Avoid Emerging Agitation

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Abstract: An α2-specific agonist is the medication used to control analgesia; it has been demonstrated to be beneficial in reducing the amount of opioids needed and reducing emergence agitation. The purpose of this study was to evaluate the relative benefits of continuous intraoperative infusion of dexmedetomidine vs a single dose of fentanyl during surgery for avoiding emerging agitation and perioperative painkiller usage in children with OSA undergoing adenotonsillectomy.

Keywords: tonsillectomy, adenoidectomy, obstructive sleep apnea syndrome, dexmedetomidine

1. Introduction

Two hundred and twenty-seven patients aged between 2 and 10 years old, with the diagnosis of obstructive sleep apnea syndrome, were used as subjects in this study. The participants were randomly divided into two groups: the Dex Group, which was given dexmedetomidine by intravenous infusion, and the Fentanyl Group, which was also administered fentanyl through intravenous bolus. Delivery of these drugs occurred after isoflurane anesthesia induction via a mask.

In the Dex Group, patients received a loading dose of 2 mg/kg body weight over a 10-minute period, and then they received a continuous infusion of 0.7 mg/kg/hr. On the other hand, those in the Fentanyl Group were given a bolus dosage of 1 mg/kg of fentanyl.

During surgery, anesthesia was maintained with isoflurane gas in oxygen-nitrous oxide. Both groups received fentanyl titrated to a 30% increase from baseline heart rate or systolic blood pressure levels recorded before incision (0.5 to 1 mg/kg). This lasted for 5 minutes. The treatment group information was not revealed to the observers in the PACU for blinding purposes.

In this study, patients' pain levels were measured using the objective pain score at many intervals during their stay in the PACU: at admission, after five minutes, after fifteen minutes, and then every fifteen minutes for a total of 120 minutes. We employed two measures to assess the emergence agitation: a 5-point Cole scale and the Pediatric Anesthesia Emergence Delirium scale. Patients in both groups received morphine at a dose of 0.05–0.1 mg/kg if they scored a 4 on the pain scale or if they had significant agitation (scoring 4 or 5) that persisted for more than five minutes.

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Our study found that only 9.8% of the Dex Group's patients required intraoperative fentanyl as a rescue, whereas 36% of the Fentanyl Group's patients required it ($P < 0.001$). Additionally, there were notable variations in heart rate and systolic blood pressure between the groups, with the Dex Group exhibiting lower values ($P < 0.05$). Additionally, it was shown that there were significant differences in the lowest alveolar concentration values between the two groups at the $P < 0.015$ level.

In the Dex Group, the median objective pain score was 3, which was statistically significantly less than the score of 5 seen in the Fentanyl Group ($P<0.001$). Furthermore, with respect to rescue morphine administration, 16.3% of patients in the Dex Group required it, while 47.5% of those in the Fentanyl Group did so ($P<0.002$).

In the Dex Group, only 9.8% of patients required intraoperative fentanyl as a rescue, but 36% of patients in the Fentanyl Group required it, according to our research ($P < 0.001$). Significant variations were also noted in heart rate and systolic blood pressure across the groups, with the Dex Group exhibiting lower values ($P < 0.05$). Significant differences were found between the two groups' minimum alveolar concentration levels, using a $P < 0.015$ threshold.

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Tonsillectomy and adenoidectomy (T&A) procedures are commonly performed on children. The primary reason for undergoing this surgery is to address obstructive symptoms and recurrent tonsillitis [1]. The prevalence of sleep-disordered breathing in children is estimated to be between 1% and 3%. After the surgery, it is not uncommon for children to experience severe pain. To improve surgical outcomes and patient satisfaction, hospitals implement proper surgical site marking and time-out processes. These measures ensure surgical accuracy, prevent wrong-site or wrong-procedure surgeries, and promote overall patient safety. Managing pain in this specific population can be challenging. Children with obstructive sleep apnea syndrome (OSAS) who undergo T&A are at a higher risk for respiratory and cardiovascular complications. Additionally, these children have increased sensitivity to pain-relieving effects of opioid drugs, leading to decreased usage of morphine after the procedure [2]. This highlights the significant need for effective pain management.

Individuals undergoing ear, nose, and throat surgical procedures often experience restlessness and confusion. The introduction of additional procedures, particularly those involving dexmedetomidine, poses a challenge. Dexmedetomidine is a medication that activates the α2-adrenergic receptor, inducing sleep and providing anxiety relief and pain reduction. It is especially important for the well-being of children, as it effectively prevents emotional abuse. In surgical settings, substituting dexmedetomidine for fentanyl has demonstrated encouraging outcomes in lowering opioid usage in adult patients recovering from weight reduction surgery. Nevertheless, there is conflicting clinical data about how well dexmedetomidine relieves pain in kids [3]. The purpose of this research is to determine whether using dexmedetomidine in addition to general anesthesia during surgery can either lessen the quantity of opioids needed for post-procedure pain management or act as a safe and effective substitute for opioids. Furthermore, it has been discovered that dexmedetomidine significantly reduces the incidence of obstructive sleep apnea (OSA) [4].

2. Materials and Methods

From December 2019 to March 2021 a total of 137 children, aged 2 to 10, were carefully selected from Al-Imamain Al-Kadhimain Medical City and Abi Ghraib General Hospital for this study. Prior to undergoing elective T&A, these children were categorized

based on their ASA status, with consent obtained from their parents. Additionally, children who were at least 7 years old provided their own agreement. All individuals included in the study were diagnosed with OSAS based on their clinical presentation. The severity of OSAS was evaluated by the surgeon using a clinical grading system, with troubled sleep and loud snoring serving as important indicators of the condition's intensity. Parents reported observing breathing interruptions, bedwetting during the night, and loud breathing sounds. Common symptoms such as excessive energy levels and difficulty in proper growth were also noted, which are often seen in hyperactive individuals or those who struggle to thrive. It is worth mentioning that individuals with drug allergies, developmental delays, or heart conditions were excluded from this study [5].

This study focused on individuals with skull and facial abnormalities, a disorder characterized by excessive worry and fear, and ongoing medical conditions that require treatments for chronic pain or physical limitations. Psychological therapies were also utilized. The use of certain medications, such as inhibitors, cardiac medication, acid reducers, bronchodilators, anticonvulsants, and psychotropic drugs, was not included in this study. Two treatment groups were involved: one group received a Dexmedetomidine infusion (referred to as the DEX group), while the other group received IV fentanyl. Prior to the procedure, no medication was given. Monitoring methods included pulse oximetry, electrocardiograms, and noninvasive arterial measurements. Blood pressure (NIBP) and end-tidal CO_2 levels ($etCO_2$) were also measured using an anesthesia monitor. Anesthesia was administered using 8% inspired isoflurane and 60% nitrous oxide (N_2O), which could be converted into oxygen with a facemask. The Dex Group received intravenous (IV) treatment.

The surgical team effectively established intravenous (IV) access by administering Dex at a rate of 2 mg per kilogram over a 10-minute period, followed by a dose of 0.7 mg per kilogram until the final 5 minutes of the procedure. Fluid administration adhered to established protocols, with a well-balanced saline solution being administered. To facilitate tracheal intubation, Rocuronium was administered at a dose of 0.6 mg per kilogram of body weight. During inhalation, the isoflurane concentration was kept as low as feasible relative to the alveolar concentration. As long as the bispectral index (BIS) was below 60, MAC anesthesia with 60% nitrous oxide (N_2O) was considered safe. Each patient had an intravenous dosage of dexamethasone equal to 0.5 mg/kg before to surgery. The highest amount of acetaminophen that should be taken orally is 10 mg, and the maximum amount that should be taken rectal is 1000 mg, which is between 30 and 40 mg per kilogram.

The HR recorded NIBP monitors hemoglobin levels and systolic and diastolic blood pressure during the anesthetic treatment. In addition, every five minutes, the three main components of tension—MAC, BIS, and $EtCO_2$—as well as the blood's oxygen saturation (SpO_2).

Both the time of extubation (TE), which is defined as the amount of time after the tracheal tube was removed and the operation was completed, and the time of awakening (AT), which is defined as the moment the patient spontaneously opens their eyes or reacts to a command following surgery, were recorded. For two hours, every patient in the post-anesthesia care unit (PACU) was watched after by impartial observers who were unaware of the research group. When the patient first arrived in the PACU, as well as after five, fifteen, and then every fifteen minutes for the next two hours of observation, their pain levels were measured using the objective pain score (OPS). Two distinct measures were used to assess the patients' emergence and agitation levels at the same intervals: the 5-point agitation scale created by Cole and the pediatric anesthesia emergence delirium (PAED) scale. The Cole scale was used to determine whether cases included extreme agitation. The patient received morphine at a dosage of 0.05 to 0.1 mg kg-1 if they had agitation or pain with a score of 4 or 5 for more than five minutes. For the first fifteen minutes of the patient's stay in the PACU, the patient's systolic and diastolic non-invasive blood

pressure (NIBP), respiratory rate (RR), and oxygen saturation (SpO_2) were measured every five minutes. For the next two hours, the patient's data was collected at 15-minute intervals. There were also cases of desaturation, in which the SpO_2 level fell below 95%.

For the statistical methods, power analysis indicated that a total of 60 participants per group were required to sufficiently show the effect of Dex on the number of patients receiving rescue fentanyl and morphine in the PACU. With 80% power and a significance threshold of around 0.05, the same sample size was also needed to assess whether therapy with Dex may lower the incidence of serious adverse events following surgery by 50% in comparison to the control group.

A Student's t-test was utilized to assess the mean values in order to compare the quantitative data between the two groups. The following variables were evaluated using bidirectional repeated measures analyses of variance (ANOVA): NIBP, HR, SpO2, MAC, and BIS. The student's t-test was used to compare intragroup values of heart rate and systolic blood pressure during and after surgery. The Mann-Whitney U test was used to compare groups based on non-parametric data, including pain score, PAED score, and EA scores on the Cole scale.

Fischer's exact test was used to compare genders. The research concentrated on the proportion of patients in each group who were diagnosed with mild, moderate, or severe OSAS before to surgery. It also looked at the number of patients who suffered severe adverse events (AEs) and were helped by fentanyl or morphine. At least a 0.05 p-value was considered statistically significant.

3. Results

A total of 137 individuals were included in the study; 122 of those patients' data were examined. For a variety of reasons, including surgical cancellation, non-participation, intraoperative problems, and study withdrawal, fifteen patients were not included in the analysis. The patients that remained were split into two groups based on similar characteristics such as age, gender, systolic non-invasive blood pressure, baseline heart rate, and obstructive sleep apnea (OSA) diagnosis (Table 1). The patients varied in age from 2 to 10 years, with 90% of them being 6 years of age or less. 26 patients (46.2%) in each group were younger than 3 years old. Table 2 intraoperative data showed that, of the 22 patients (36%) in the Fentanyl group, only 6 patients (9.8%) in the Dex group needed fentanyl ($P = 0.001$). Additionally, within the first hour ($P < 0.019$), the Dex group showed a reduced mean systolic non-invasive blood pressure (Figure 1B) and average heart rate ($P = 0.001$) (Figure 1A).

The mean diastolic BP did not significantly differ between the two groups (P=0.29). Nonetheless, the MAC values of isoflurane revealed a significant difference (P=0.015) between the fentanyl group and the Dex group during the first hour of anesthesia. In the Dex group, the MAC ranged from 5.7% to 41.6%, which was lower. Furthermore, there was a significant difference in TA and TE, with the Dex group showing lower values than the fentanyl group (P=0.05). In the Dex group, the surgery took less time overall (P=0.041). The intraoperative doses of both medications were the same, though. The Dex group used less paracetamol than others. Table 3 lists the variables that are assessed in the PACU. Compared to 29 patients (47.5%) in the fentanyl group, 10 patients (16.3%) in the Dex group required morphine (P=0.002). In the Dex group, the median maximum objective pain score was 3, but in the fentanyl group it was 5 (P=0.001). The figure displays the proportion of patients who had an objective pain level of four or above.

Arriving in the PACU and at subsequent measurements after 5 and 15 minutes, the Dex group showed considerably reduced levels of emergence and agitation ($P = 0.001$). As measured by a Cole scale score of 4 to 5, severe emergence and agitation were less common in the Dex group than in the Fentanyl group. Figure 2B shows the frequency of major adverse events. In the next measurements, the Dex group showed lower levels of agitation ($P = 0.028$), continuing the trend of the Dex group having a significantly lower incidence

of serious agitation and emergence (18%) compared to the Fentanyl group (45.9%) (P = 0.004). While 1.6% of patients in the other group exhibited significant agitation or emergence after 30 minutes, none of the patients in the Dex group did. The Dex group had agitation for a considerably shorter period of time (6.59±7.4 minutes) than the Fentanyl group (11.85 to 12.0 minutes) (P = 0.004), according to the Cole scale. The Cole scale's median highest score also showed a significant difference between the Dex and Fentanyl groups, with the former having a median score of 2 and the latter of 4 (P = 0.001).

The percentage of patients with a PAED score of 10 or greater was statistically significantly lower in the Dex group at arrival, as well as at 5 and 15 minutes (P = 0.004 and P = 0.05, respectively). The PAED scale's median highest score did not, however, differ significantly between the Dex group (10) and the fentanyl group (14) (P = 0.051). Within ninety minutes of arriving at the PACU, the Dex group's heart rate showed a statistically significant drop (P = 0.01).

Table 1. Demographic data based on similar characteristics

Demographic Data	Group Fentanyl (n= 61)	Group Dex (n = 61)	P value
Age (years)	3.8 ± 1.5	4.2 ± 2.1	0.16
2–3 years old (%)	26 (42.6)	26 (42.6)	1
Gender (M/F)	35/26	35/26	1
Weight (kg)	18.3 ± 5.7	20.4 ± 8.6	0.12
Baseline HR (beats/ minute)	105 ± 18	104 ± 15	0.77
Baseline systolic NIBP (mm Hg)	101 ± 13.7	104 ± 12.6	0.29
OSAS (% patients)	26	30	
Mild	30	26	
Moderate	50	60	
Severe	20	14	0.55

The data are presented as mean ± SD and n (%). Groups Dex, HR, NIBP, and OSAS stand for dexmedetomidine group, heart rate, noninvasive arterial blood pressure, and obstructive sleep apnea syndrome, respectively.

Table 2. Intraoperative data

Intraoperative Data	Group F (n = 61)	Group D (n = 61)	P value
Rescue by fentanyl, n (%)	22 (36.1)	6 (9.8)	0.001*
Fentanyl rescue dosage (g/kg)	1.04 ± 0.67	0.73 ± 0.25	0.312
Time of rescue (minutes)	10.82 ± 12.5	17.6 ± 6.77	0.256
Acetaminophen dosage (mg/kg)	31.51 ± 4.96	28.30 ± 6.59	0.02*
Dexamethasone dosage (mg/kg)	0.30 ± 0.12	0.30 ± 0.14	0.847
Duration of surgery (minutes)	43.33 ± 17.36	37.54 ± 13.33	0.041*
Duration of anesthesia (minutes)	75.08 ± 24.73	69.80 ± 16.82	0.175
Time to awake (minutes)	8.75 ± 4.06	7.18 ± 4.05	0.03*
Time to extubate (minutes)	10.44 ± 4.15	8.59 ± 4.51	0.02*

* P is greater than 0.05.

The data are presented as a percentage, mean ± SD, and n HR is the heart rate; NIBP is the noninvasive arterial blood pressure; and Group Dex is the dexmedetomidine group.

4. Discussion

Giving dexmedetomidine to children having tonsillectomy and adenoidectomy operations should involve a loading dose of 2 mg/kg and an infusion at a rate of 0.7 mg/kg/hour. This strategy lessens the demand for anesthetics and intraoperative opioids, as well as the need for opioids in the post-anesthesia care unit (PACU). The frequency and duration of serious adverse events were decreased in children receiving dexmedetomidine compared to a control group that received intraoperative IV fentanyl. Owing to the significant surgical stimulation involved in tonsillectomy and adenoidectomy, dexmedetomidine infusion and a large loading dosage must be used from the moment the procedure begins without any preparatory time [6]. Studies have shown that dexmedetomidine has analgesic properties. When mixed with N_2O, it creates an additive interaction that improves pain relief. Our goal was to investigate if a continuous infusion might replace bolus fentanyl while also utilizing the analgesic-sparing action of dexmedetomidine. Surprisingly, 90% of patients in the group treated with dexmedetomidine did not need any analgesics during surgery [7].

Children in the Dex group showed consistently reduced heart rates and systolic blood pressure during the anesthetic phase (Figure 1). On the other hand, neither bradycardia nor hypotension required intervention. Hemodynamic findings have also been reported by other studies under comparable circumstances. Mason et al. (2013) [8] used greater loading doses of Dex (2 to 3 mg/kg), then as the only sedative for children, an infusion of 1.5 to 2 mg/kg/hour. While the patients were awake, they saw a drop in blood

pressure and heart rate, although the results stayed within 20% of the baseline. In a different investigation, Deutsch et al. [9] sedated individuals with one MAC of isoflurane and then gave them a single dosage of Dex (less than 0.5 mg/kg).

It is typical to see an increase in systolic blood pressure in the adult age group, which is followed by a drop in heart rate and stability below baseline. On the other hand, pediatric patients seldom experience these alterations. We have discovered in our everyday practice that giving patients a fentanyl dosage of 1 mg/kg is an excellent way to treat their pain. Notably, fentanyl's analgesic effects can be amplified by lowering the dose, especially in kids with obstructive sleep apnea syndrome (OSAS). For purposes of considering future treatments, this knowledge is crucial. Approximately 66% of patients in our experimental group demonstrated positive outcomes with our novel technique of giving a lower dose of fentanyl, whereas 36% of patients needed extra medical intervention. Both research groups used more rescue fentanyl after surgical stimulation; the elements that caused this rise were systolic blood pressure and heart rate.

The BIS monitor was used to make sure that patients in the Dex Group stayed in a state of appropriate anesthesia and did not show any signs of blood flow or circulation disturbance as a result of the sedative effects of Dex. The objective was to keep the BIS value below 60 while maintaining a constant amount of anesthetic depth in every patient. This meant varying the isoflurane concentration. This strategy is consistent with earlier studies done on adult populations. Notably, to reach the appropriate BIS level, individuals on Dex required a lower MAC of isoflurane. As a matter of fact, the Dex group's MAC decreased significantly, from 5.7% to 41.6%.

Tufanoguallari et al. [5] found that the intraoperative dosage of Dex given affected the mean end-tidal desflurane concentration, which reduced by around 19% to 22%. The dose for the infusion varied between 0.2 and 0.8 grams per kilogram. Promoting early waking and extubation is one benefit of using less anesthetic. The Dex group in the trial had far lower levels of TE (extubation duration) and TA (total anesthesia) despite the large dose utilized. There was no discernible change in TA and TE as compared to a placebo in other studies that used a single, low-dose bolus of Dex during surgery (6,16). Other research, however, did not discover any appreciable difference between TE and a placebo. Additionally, adult patients' postoperative nausea and vomiting can be significantly reduced by the provision of anesthetic. It might be difficult to assess postoperative pain and control emergence agitation (EA), particularly in younger children.

It might be difficult to distinguish between agitation, emergence, and pain because their symptoms are frequently identical. Agitation can also be a result of pain itself. Although researchers have attempted to differentiate between the two using a variety of evaluation instruments, there is usually some overlap in the results, particularly for toddlers who are agitated or thrashing. In our investigation, we found a positive relationship between agitation and pain, with the Fentanyl group scoring higher than the Dex group in terms of emergence, agitation, and pain. Both groups' OPS, Cole scale, and PAED findings showed a similar trend, with scores increasing as soon as they entered the PACU and progressively falling over time (Figure 2, A–C). Remarkably, compared to the Fentanyl group (44%), a far less proportion of patients in the Dex group (18%) needed rescue morphine. However, it is impossible to tell whether morphine was given for pain or agitation because of the difficulties in differentiating between emergence, agitation, and pain, and because morphine was utilized as the rescue medication for both situations in our study.

It is worthwhile to investigate the possible use of lower doses of intraoperative Dex in the management of postoperative pain in pediatric patients, given its efficacy in lowering the requirement for morphine during a 24-hour period following surgery in adult patients. It makes sense to assume that after surgery, the research participants would have pain reduction right away. In contrast to 53% of the placebo group, only 23% of children who received a single dosage of 0.5 mg/kg Dex before to the conclusion of the surgery (T&A) needed opioids for pain management in the PACU, according to a research by Guler

et al. [10]. In a different trial, Erdil et al. [11] examined the pain-relieving effects of a single dosage of 0.5 mg/kg Dex against 2.5 mcg/kg fentanyl in patients having adenoidectomy. They found that Dex was equally effective as fentanyl. It is noteworthy that individuals with OSAS and recurrent hypoxemia are known to be opiate sensitive, despite the extreme pain during T&A that frequently requires opioid therapy [3].

In a study conducted by [3], it was found that Children with OSAS showed greater sensitivity to morphine during T&A operations and needed less morphine for pain relief thereafter, according to a research by [3]. Consequently, other analgesics such ketorolac, tramadol, and ketamine have been investigated for post-T&A pain management [12], [13], [14]; but, due to worries about side effects or insufficient pain reduction, their use has been restricted. It has been demonstrated that acetaminophen can spare morphine in pediatric day-case surgery [15], and dexamethasone can help lessen pain following tonsillectomy [16]. In our own trial, intraoperative IV dexamethasone and rectal acetaminophen (30–40 mg/kg) were given to all patients before surgery. For this specific patient population at increased risk of respiratory problems, a multimodal strategy to pain treatment is advised, including the use of dexamethasone as used in our research.

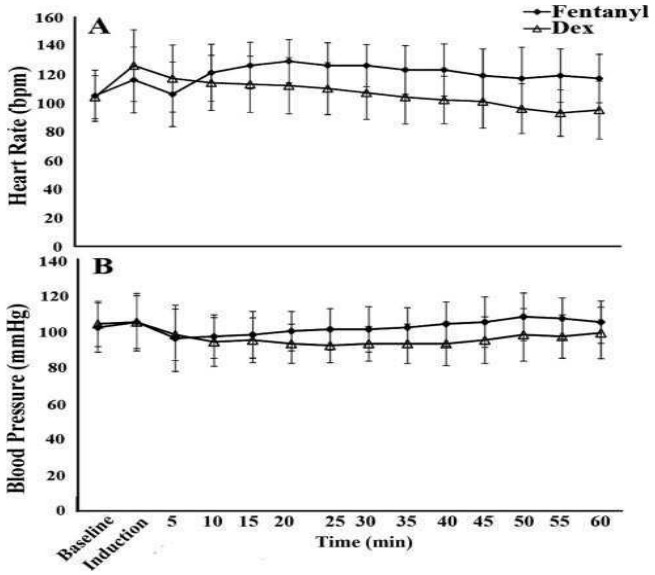

Figure 1. The first sixty minutes of the process, A) heart rate; B) systolic blood pressure. In the dexmedetomidine group, both variables were significantly reduced (P >0.05).

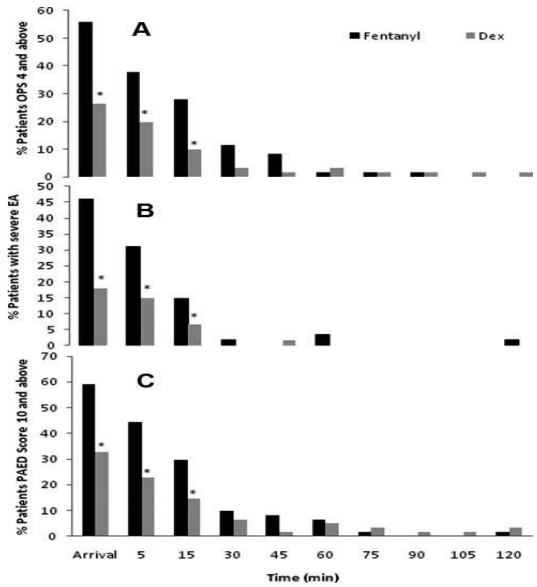

Figure 2. A) Proportion of patients who have an OPS of four or above; B) Proportion of patients with significant emergence agitation (EA); C) The proportion of patients with a PAED (pediatric anesthesia emergency delirium) score of ten or above

Figure 2 (A) is the proportion of patients who have an OPS of four or above. Scores 4 and above that lasted longer than five minutes were addressed. Dexmedetomidine group D showed statistically significant differences upon arrival (P = 0.001), five minutes (P = 0.028), and fifteen minutes (P = 0.011). Figure 2 (B) is the proportion of patients with significant emergence agitation (EA), which is indicated by a 5-point score of 4 or 5. At arrival (P = 0.001), five minutes (P = 0.028), and fifteen minutes (P = 0.028), there was a lower value in group D. Figure 2 (C) is the proportion of patients with a PAED (pediatric anesthesia emergency delirium) score of ten or above. at arrival (P = 0.001), five minutes (P = 0.028), and fifteen minutes (P = 0.011) was statistically lower in group D.

Table 3. The variables that are assessed in the PACU

Post anesthesia Recovery Unit Data	**Fentanyl Group (n = 61)**	**Dex Group (n = 61)**	**P value**
OPS maximum (range)	5 (0–10)	3 (0–10)	0.001*
EA score maximum (range)	4 (1–5)	3 (1–5)	0.001*
Duration of severe EA (minutes)	11.85 ± 12.02	6.59 ± 7.42	0.004*
PAED score maximum (range)	14 (0–20)	10 (0–20)	0.051
Rescue by morphine, n (%)	29 (48)	10 (17)	0.0003*
Morphine dosage (mg/kg)	0.073 ± 0.033	0.074 ± 0.033	0.928
SpO_2 below 95%, n (%)	25 (41)	11 (18)	0.01*

According to the Cole scale, the maximum scores for OPS, PAED, and EA are presented, along with their median values. The remaining data are shown as mean ± SD and n (%). The dexmedetomidine group is referred to as the "Dex Group." Objective Pain Score is represented by OPS, Emergence Agitation by EA, and Pediatric Anesthesia Emergence Delirium by PAED. Noteworthy is the fact that * P > 0.05.

Only one patient in the post-anesthesia care unit (PACU) needed an antiemetic during our study's low incidence of nausea or vomiting, most likely as a result of dexamethasone's antiemetic qualities. Agitation emergence (EA) is a multifaceted phenomena with a variety of underlying causes. The definition of EA and the time of its evaluation in the PACU may be to blame for the difference in the reported incidence of agitation amongst studies. We repeated the measurements at regular intervals in order to obtain an

accurate depiction of the real incidence of EA, as a single measurement might not be sufficient. For as long as 30 minutes following their admission in the PACU, the Dex group showed a markedly reduced frequency of severe EA in comparison to the Fentanyl group (Figure 2B). The Fentanyl group had an incidence of 1.6% at the 30-minute mark, but there were no cases of severe EA in the Dex group. Severe EA that lasted more than five minutes was treated right away. Six (18%) of the Dex group's patients had severe EA when they arrived in the PACU, which is consistent with the results [10].

Emergence agitation (EA) is known to occur often in children following tonsillectomy and adenoidectomy (T&A), especially in individuals who are 6 years of age or younger. It's still unclear exactly why this is happening. In our investigation, 2–3-year-old kids made up 46.2% of the patients in both groups. It is noteworthy that hyperactivity and attention deficit disorder are common in individuals with obstructive sleep apnea syndrome (OSAS), which may account for our patients' higher frequency of EA. In order to deal with this problem, some surgeons provide a single dosage of dexmedetomidine (Dex) five minutes before to the conclusion of the procedure, while others choose to give Dex continuously for fifteen minutes after the surgery at a rate of 0.2 mg/kg/h. Both strategies have demonstrated efficacy in mitigating or avoiding pediatric emergence delirium.

Notably, studies on dexmedetomidine have compared it to a placebo, whereas fentanyl, which similarly reduces EA, was given to our control group at a dose of 1 mg/kg. Nonetheless, it has been documented that individuals enduring excruciating operations respond well to a larger dosage of dexmedetomidine. Despite a plethora of research, it is still challenging to ascertain whether the sedative or analgesic effects of alpha-2 agonists are to blame for the decrease in EA. Dexmedetomidine has been proven to be beneficial in children at a variety of dosages, regardless of the mechanism. Dexmedetomidine's half-life in children is 1.8 hours, according to reports, although nothing is known about how long the sedative or analgesic effects last after the infusion is stopped. The Dexmedetomidine group demonstrated a substantial reduction in heart rates for up to ninety minutes in the post-anesthesia care unit (PACU).

After tonsillectomy and adenoidectomy (T&A) operations, the administration of Dex infusion during surgery may result in a decreased reaction to bleeding and may have long-lasting effects on heart rate. One may consider this a disadvantage of Dex injection. Studies have indicated that after T&A surgery, respiratory problems affect about 20% of pediatric patients with obstructive sleep apnea syndrome (OSAS). Severe consequences like bronchospasm and laryngospasm, however, are uncommon; Sanders et al. [17] only describe a small number of instances. It's interesting to note that following extubation, no bronchospasm nor laryngospasm were observed in our research. But it's crucial to remember that one patient experienced intraoperative pulmonary edema and had to be taken out of the research since they required an overnight intubation. It's important to note that patients who used Dex medicine had a more comfortable extubation experience, with less coughing and holding of the breath.

For two hours, every participant in the post-anesthesia care unit (PACU) was closely examined to track their levels of peripheral oxygen saturation (SpO2). It is noteworthy that the number of patients in the PACU with SpO2 values below 95% varied significantly between the two groups. Eleven patients belonged to the Dex group, whereas twenty-five individuals were in the non-Dex group. This difference might be explained by the fact that patients in the Dex group required less opioid medication in the PACU and that severe emerging agitation occurred less frequently and lasted shorter periods of time. Together with additional oxygen and monitoring, patients who got Dex in the PACU were more relaxed, pleasant, and less irritated. It's crucial to recognize several methodological issues

with this investigation, though. In particular, there was no blinding of the anesthesiologist and data recorder in the operating room with respect to the research group.

We are certain that while the study procedure was well monitored, the lack of blinding during the anesthetic administration did not cause any bias. Particular protocols were put in place for a number of areas, including the use of rescue morphine in the PACU, extubation criteria, sevoflurane concentration, and the period at which sevoflurane should be discontinued. The only established grading system for emergence delirium, the PAED scale, was employed to assess emergence behavior. This measure was established by researchers who observed the child's conduct for ten minutes after waking up and making sure they didn't go back to sleep. At first, we thought there could be a problem with the scale since sleeping toddlers were scoring well on the first three things because they couldn't make eye contact, act purposefully, or pay attention to their environment. We changed the scale's score and assigned these elements a zero in order to remedy this. It's evident that kids who were asleep showed no symptoms of restlessness.

We included the Cole scale and a modified version of the PAED in order to confirm the results of the modified PAED. The Cole scale, as established by Cole et al., has been frequently utilized in research on emerging agitation. It employs a 1 to 5 grading system. It is important to note that this study did not use the Cole scale because it has not been validated. Nonetheless, it is simple to use and makes classifying agitation as light or severe straightforward. The OPS scale has been used in earlier research with children, despite the fact that it has not been verified. However, it might not be the best scale for researching emerging agitation because of the large overlap in scored elements. It's crucial to note that the patients weren't kept under observation after leaving the PACU. However, more research that includes postoperative analgesic use and data from nighttime pulse oximetry would be beneficial.

5. Conclusion

The objectives of a pediatric T&A are to keep the kid pleasantly awake and breathing on their own following surgery, as well as to avoid airway and respiratory issues. Methods that save opioids are especially helpful for kids with OSAS who have a continuous blockage in their airways since these kids exhibit the symptoms of the illness. The intraoperative infusion of Dex, in conjunction with sevoflurane and N_2O, yielded satisfactory results for T&A while maintaining hemodynamic stability. In the fentanyl group, T&A lasted a much less time than TE. A speedier recovery is made possible by the decreased requirement for postoperative opiate use and the less frequent development and faster resolution of severe EA.

A technique for delivering Dex that is effective, safe, and convenient is proposed in this study. Our study utilizes a multimodal opioid-sparing approach with Dex analgesia for children suffering from OSAS and undergoing surgical procedures other than T&A. This approach has been known to reduce the opioid requirement in the perioperative period and decrease the incidence of EA.

REFERENCES

[1] K. A. Brown, “What we don’t know about childhood obstructive sleep apnoea,” *Pediatric Anesthesia*, 2001, doi: 10.1046/j.1460-9592.2001.00719.x.

[2] S. A. McColley, M. M. April, J. L. Carroll, and ..., “Respiratory compromise after adenotonsillectomy in children with obstructive sleep apnea,” … *–Head &Neck* …, 1992, [Online]. Available: https://jamanetwork.com/journals/jamaotolaryngology/article-abstract/620969

[3] K. A. Brown, A. Laferriere, I. Lakheeram, and ..., "Recurrent hypoxemia in children is associated with increased analgesic sensitivity to opiates," *The Journal of the …*, 2006, [Online]. Available: https://pubs.asahq.org/anesthesiology/article-abstract/105/4/665/6803

[4] T. Voepel-Lewis, S. Malviya, and A. R. Tait, "A prospective cohort study of emergence agitation in the pediatric postanesthesia care unit," *Anesthesia &analgesia*, 2003, [Online]. Available: https://journals.lww.com/anesthesia-analgesia/FullText/2003/06000/A_Prospective_Cohort_Study_of_Emergence_Agitation.16.aspx

[5] B. Tufanogullari, P. F. White, M. P. Peixoto, and ..., "Dexmedetomidine infusion during laparoscopic bariatric surgery: the effect on recovery outcome variables," *Anesthesia & …*, 2008, [Online]. Available: https://journals.lww.com/anesthesia-analgesia/fulltext/2008/06000/dexmedetomidine_infusion_during_laparoscopic.21.aspx

[6] J. E. Hall, T. D. Uhrich, J. A. Barney, S. R. Arain, and ..., "Sedative, amnestic, and analgesic properties of small-dose dexmedetomidine infusions," *Anesthesia & …*, 2000, [Online]. Available: https://journals.lww.com/anesthesia-analgesia/fulltext/2000/03000/sedative,_amnestic,_and_analgesic_properties_of.35.aspx

[7] C. Dawson, D. Ma, A. Chow, and M. Maze, "Dexmedetomidine enhances analgesic action of nitrous oxide: mechanisms of action," *The Journal of the American …*, 2004, [Online]. Available: https://pubs.asahq.org/anesthesiology/article-abstract/100/4/894/7849

[8] K. P. Mason, D. Zurakowski, S. E. Zgleszewski, and ..., "High dose dexmedetomidine as the sole sedative for pediatric MRI," *Pediatric …*, 2008, doi: 10.1111/j.1460-9592.2008.02468.x.

[9] E. Deutsch and J. D. Tobias, "Hemodynamic and respiratory changes following dexmedetomidine administration during general anesthesia: sevoflurane vs desflurane," *Pediatric Anesthesia*, 2007, doi: 10.1111/j.1460-9592.2006.02139.x.

[10] G. Guler, A. Akin, Z. Tosun, S. Ors, and ..., "Single-dose dexmedetomidine reduces agitation and provides smooth extubation after pediatric adenotonsillectomy," *Pediatric …*, 2005, doi: 10.1111/j.1460-9592.2004.01541.x.

[11] F. Erdil, S. Demirbilek, Z. Begec, and ..., "The effects of dexmedetomidine and fentanyl on emergence characteristics after adenoidectomy in children," *… and intensive care*, 2009, doi: 10.1177/0310057X0903700405.

[12] K. E. McGoldrick, "Effects of Postoperative, Nonsteroidal Anti-Inflammatory Drugs on Bleeding Risk After Tonsillectomy: Meta-Analysis of Randomized, Controlled Trials," *Survey of Anesthesiology*, 2003, [Online]. Available: https://journals.lww.com/surveyanesthesiology/fulltext/2003/12000/effects_of_postoperative,_nonsteroidal.1.aspx

[13] Ö. L. Erhan, H. Göksu, C. Alpay, and A. Beştaş, "Ketamine in post-tonsillectomy pain," *International journal of pediatric …*, 2007, [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0165587607000183

[14] B. J. Hullett, N. A. Chambers, E. M. Pascoe, and ..., "Tramadol vs morphine during adenotonsillectomy for obstructive sleep apnea in children," *Pediatric …*, 2006, doi: 10.1111/j.1460-9592.2005.01827.x.

[15] R. Korpela, P. Korvenoja, and O. A. Meretoja, "Morphine-sparing effect of acetaminophen in pediatric day-case surgery," *The Journal of the American …*, 1999, [Online]. Available: https://pubs.asahq.org/anesthesiology/article-abstract/91/2/442/37353

[16] C. E. Afman, J. A. Welge, and ..., "Steroids for post-tonsillectomy pain reduction: meta-analysis of randomized controlled trials," *… —Head and Neck Surgery*, 2006, doi: 10.1016/j.otohns.2005.11.010.

[17] J. C. Sanders, M. A. King, R. B. Mitchell, and ..., "Perioperative complications of adenotonsillectomy in children with obstructive sleep apnea syndrome," *Anesthesia & …*, 2006, [Online]. Available: https://journals.lww.com/anesthesia-analgesia/fulltext/2006/11000/Perioperative_Complications_of_Adenotonsillectomy.10.aspx

[18] M. Shukry, M. C. Clyde, P. L. Kalarickal, and ..., "Does dexmedetomidine prevent emergence delirium in children after sevoflurane-based general anesthesia?," *Pediatric …*, 2005, doi: 10.1111/j.1460-9592.2005.01660.x.

[19] R. S. Hannallah, L. M. Broadman, A. B. Belman, and ..., "Comparison of caudal and ilioinguinal/iliohypogastric nerve blocks for control of post-orchiopexy pain in pediatric ambulatory surgery," *The Journal of the …*, 1987, [Online]. Available: https://pubs.asahq.org/anesthesiology/article-abstract/66/6/832/29622

[20] N. Sikich and J. Lerman, "Development and psychometric evaluation of the pediatric anesthesia emergence delirium scale," *The Journal of the American Society of …*, 2004, [Online]. Available: https://pubs.asahq.org/anesthesiology/article-abstract/100/5/1138/6415

[21] J. W. Cole, D. J. Murray, J. D. McALLISTER, and ..., "Emergence behaviour in children: defining the incidence of excitement and agitation following anaesthesia," *Pediatric …*, 2002, doi: 10.1046/j.1460-9592.2002.00868.x.

[22] G. C. Petroz, N. Sikich, M. James, H. van Dyk, and ..., "A phase I, two-center study of the pharmacokinetics and pharmacodynamics of dexmedetomidine in children," *The Journal of the …*, 2006, [Online]. Available: https://pubs.asahq.org/anesthesiology/article-abstract/105/6/1098/6896

[23] M. E. Ibacache, H. R. Muñoz, V. Brandes, and ..., "Single-dose dexmedetomidine reduces agitation after sevoflurane anesthesia in children," *Anesthesia & …*, 2004, [Online]. Available: https://journals.lww.com/anesthesia-analgesia/fulltext/2004/01000/Single_Dose_Dexmedetomidine_Reduces_Agitation.15.aspx

[24] G. P. Vlajkovic and R. P. Sindjelic, "Emergence delirium in children: many questions, few answers," *Anesthesia &Analgesia*, 2007, [Online]. Available: https://journals.lww.com/anesthesia-analgesia/fulltext/2007/01000/emergence_delirium_in_children__many_questions,.18.aspx

[25] A. Gurbet, M. Basağan, G. Türker, and ..., "Intraoperative infusion of dexmedetomidine reduces perioperative analgesic requirements," *Canadian Journal …*, 2006, [Online]. Available: https://acikerisim.uludag.edu.tr/handle/11452/21426

[26] I. T. Cohen, J. C. Finkel, R. S. Hannallah, and ..., "The effect of fentanyl on the emergence characteristics after desflurane or sevoflurane anesthesia in children," *Anesthesia & …*, 2002, [Online]. Available: https://journals.lww.com/anesthesia-analgesia/fulltext/2002/05000/the_effect_of_fentanyl_on_the_emergence.23.aspx

[27] D. Tomic, "The burden and risks of emerging complications of diabetes mellitus," *Nat Rev Endocrinol*, vol. 18, no. 9, pp. 525–539, 2022, doi: 10.1038/s41574-022-00690-7.

[28] W. Trzepizur, "Sleep Apnea–Specific Hypoxic Burden, Symptom Subtypes, and Risk of Cardiovascular Events and All-Cause Mortality," *Am J Respir Crit Care Med*, vol. 205, no. 1, pp. 108–117, 2022, doi: 10.1164/rccm.202105-1274OC.

[29] P. Salminen, "Effect of Laparoscopic Sleeve Gastrectomy vs Roux-en-Y Gastric Bypass on Weight Loss, Comorbidities, and Reflux at 10 Years in Adult Patients with Obesity: The SLEEVEPASS Randomized Clinical Trial," *JAMA Surg*, vol. 157, no. 8, pp. 656–666, 2022, doi: 10.1001/jamasurg.2022.2229.

[30] A. Agustí, "Global Initiative for Chronic Obstructive Lung Disease 2023 Report: GOLD Executive Summary," *Am J Respir Crit Care Med*, vol. 207, no. 7, pp. 819–837, 2023, doi: 10.1164/rccm.202301-0106PP.