



Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: <http://www.ijporlonline.com/>

2016 ESPO Congress

Retrospective study of intranasal dexmedetomidine as a prophylactic against emergence delirium in pediatric patients undergoing ear tube surgery

Lisgelia Santana ^{a, b, *}, Katherine Mills ^b^a Department of Anesthesiology, 13535 Nemours Parkway, Nemours Children's Hospital, Orlando, FL 32827, USA^b University of Central Florida College of Medicine, 6850 Lake Nona Blvd, Orlando, FL 32827, USA

ARTICLE INFO

Article history:

Received 7 December 2016

Received in revised form

2 June 2017

Accepted 20 June 2017

Available online 22 June 2017

Keywords:

Emergence
Delirium
Pediatric
Anesthesia
Myringotomy
Ear surgery
Otitis media

ABSTRACT

Objectives: This study evaluated the effect of intranasal dexmedetomidine on emergence delirium (ED) in pediatric patients who underwent ear tube surgeries. Due to the brief nature of the surgery and low levels of pain experienced, an IV is rarely needed, limiting the medications available to anesthesiologists to manage postoperative delirium that may arise during recovery from inhalational anesthesia. Intravenous dexmedetomidine is an alpha-2 agonist anesthetic that is used in pediatric patients for the management of ED in various surgical procedures. However, intranasal medication has not been evaluated specifically in ear tube surgeries for ED prevention.

Methods: We conducted a retrospective chart review of pediatric patients at Nemours Children's Hospital who had undergone ear tube insertion or removal surgery between 2013 and 2015, controlling for confounding variables such as age, surgery duration, and anesthesiologist. We used the post anesthesia emergence delirium (PAED) tool, an instrument created to assess ED in the clinical setting. We analyzed the data for significant differences in PAED score and time in the post anesthesia care unit (PACU) between patients treated with intranasal dexmedetomidine and the control group that did not receive the medication.

Results: We found no significant difference between the PAED scores of those patients treated with intranasal dexmedetomidine prior to ear tube surgeries and those who did not receive the medication, and no difference in the duration of PACU stay.

Conclusion: These results conflict with other research on intranasal dexmedetomidine and its potential to prevent ED in pediatric patients. This information should prompt further prospective investigation into the most efficacious use of dexmedetomidine for ED prevention, both in terms of timing and dosage required.

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1. Introduction

Painful ear infections are common in children, and by age five, nearly every child will experience at least one episode. Most ear infections can be treated with antibiotics if they are bacterial; they will resolve on their own if they are viral. Sometimes, however, these infections and fluid will cause complications such as speech and behavioral problems, hearing loss, and others. In these cases, an

ear tube surgery may need to be considered. More than half a million ear tube surgeries are performed on children every year [1]. The procedure takes less than 20 min to complete, and children usually receive a general inhalational anesthetic such as sevoflurane. However, there are some centers and offices that can perform simple ear surgeries under topical local anesthesia or phenol, and in a minority of cases, inhalational anesthesia needs to be supplemented with intravenous anesthetics [2,3] (see Tables 1 and 2).

A significant portion of these children may experience emergence delirium (ED) upon their recovery from surgery. Emergence delirium is a disturbance in a child's awareness of and attention to his or her environment with disorientation and perceptual alterations including hypersensitivity to stimuli and hyperactive motor

* Corresponding author. Pediatric Pain and Pediatric Anesthesiologist, Department of Anesthesiology, Nemours Children's Hospital, 13535 Nemours Parkway, Orlando, FL 32827, USA.

E-mail address: lisgelia.santana@nemours.org (L. Santana).

Table 1
Patient characteristics.

	Dexmedetomidine (n = 42)	Control (n = 58)	P value
Age (year)	2.10 ± 1.32	2.21	0.81
Weight (kg)	13.57	13.82	0.09
Procedure time (minute)	14:28.57	17:25.86	0.08

Table 2
Primary and secondary outcomes.

	Dexmedetomidine (n = 42)	Control (n = 58)	P value
PAED score	5.26	5.48	0.86
Phase 1 PACU time (minute)	20.64	20.36	0.92
Total PACU time (minute)	48.57	52.34	0.54

behavior in the immediate postanesthesia period [4]. Significant literature on the subject cites incidence rates from 5.3% to 67% [4,5]. The condition lasts five to 15 min and usually resolves without intervention [4]. Patients experiencing ED demonstrate behaviors that can cause injury to themselves or their caregivers, disrupt the surgical site, or remove IVs or other equipment necessary for their postsurgical care, making it a concern for post anesthesia care unit (PACU) staff members and parents [4]. Factors that may contribute to ED include the age of the patient, types of anesthetic involved, presurgical anxiety, and the pain level [4]. The specific mechanism of the condition is unclear, though it is thought to be a multifactorial process [6]. The condition seems to be worse following inhalational anesthetics like those used in ear tube surgeries, specifically sevoflurane and halothane [4]. Children who have ear tube surgeries experience ED after sevoflurane anesthesia significantly more than those treated with halothane and resulted in longer hospital stays [7].

Pharmacological management of ED is possible. Alpha-2 adrenergic agonist such as dexmedetomidine can be administered to prevent ED. Dexmedetomidine has a high degree of specificity and a low incidence of hemodynamic side effects [5]. It is used as a treatment for ED and it can decrease the severity of symptoms and duration, specifically after the use of sevoflurane-based general anesthesia [4,5]. Intravenous dexmedetomidine is also used to prophylactically address ED in pediatric patients undergoing other types of surgeries [8]. Low dose intravenous dexmedetomidine reduced ED in patients undergoing strabismus surgery [9].

Children undergoing ear tube surgeries present a specific challenge in the management of ED. The surgery does not require an IV because it is brief and causes low pain, limiting the patient to drugs that do not require intravenous administration. Intranasal medications offer an easy-to-administer, well-tolerated alternative for drug delivery [10]. Intranasal dexmedetomidine is successful when administered to children for other purposes such as preanesthesia anxiolysis and sedation [4,11,12]. In a December 2014 article in Pediatric Anesthesia, Yao reported a significant decrease in ED in children that received intranasal dexmedetomidine before eye surgery [13]. However, there is no data on the use of intranasal dexmedetomidine for the prevention of ED in children undergoing ear tube surgeries.

Dexmedetomidine's unique characteristics make it suitable for the prevention of ED. It is easy to administer, noninvasive, and researchers report no patient irritation or discomfort associated with the intranasal administration [14,15]. Furthermore, its median onset time of sedation in children is a manageable 25 min, with a duration of sedation of 85 min with a 1 µg kg⁻¹ dose [14].

Pediatric anesthesia emergence delirium (PAED) scale was used to evaluate the incidence of ED in pediatric patients who received intranasal dexmedetomidine for ED prophylaxis during sevoflurane general anesthesia using [4]. We hypothesized that the overall PAED scores for children who were medicated with intranasal dexmedetomidine would be lower than those who received none. We predicted that patients medicated with intranasal dexmedetomidine would stay in the PACU longer than those who did not because of the long duration of sedation.

2. Materials and methods

This retrospective cohort study was performed at a 95-bed tertiary pediatric hospital. This study was approved by the institutional review board (IRB study no. 732164–1). The records of patients who had undergone ear tube surgeries between 2013 and 2015 were reviewed. A database query application was used to search electronic records for patients who had undergone ear tube surgeries at the institution and had their anesthetic care under the direction of the same anesthesiologist. Patients who had undergone other procedures at the time of surgery, such as tonsillectomies and adenoidectomy, were excluded from the sample. To ensure validity of the data, we manually checked the records of patients whose procedures lasted longer than 15 min and verified that other procedures were not performed at the time of ear tube surgery. Sixteen records were excluded from the treatment group and ten were excluded from the control group as a result of this manual search. Our institution allows parental presence during induction of anesthesia, and all patients included in the study had one parent with them during induction obviating the need for any premedication with midazolam. The use of anesthetic agents, other than air, N₂O, sevoflurane, and rectal acetaminophen, excluded patients from this study. Another eight patients were excluded from the treatment group because their records were missing the outcome variable PAED score. The staff generally records this value into the patient chart once in the course of recovery from anesthesia. The timing of this assessment can vary depending upon the demands on the staff, the patient census in the PACU, and the status of the patient. The PAED score was developed in 2004 by Sikich et al., for the specific purpose of objectively measuring the delirium status of young patients in the immediate post anesthesia setting [16]. Patients were divided into two groups based on whether they had received intranasal dexmedetomidine during their ear tube surgeries. After inclusion and exclusion criteria were applied, the treatment group included 42 patients who had received the medication, while the control group included 58 patients who had not received intranasal dexmedetomidine during the course of their ear tube surgeries.

The primary outcome of this study was an assessment of whether the use of intranasal dexmedetomidine, the independent variable, significantly impacted patients' incidence of ED, the dependent variable. Secondary outcomes included the impact of intranasal dexmedetomidine, the independent variable, on the duration of patient stay in the PACU, the dependent variable.

In the clinical management of ear tube surgery patients, anesthesiologists administer dexmedetomidine for pain control and prevention of ED. The administration of the drug occurs in the operating room after the patient is given inhalational anesthetics necessary for the procedure. The appropriate dose is applied via a syringe into each nostril and the medicine is absorbed through the nasal mucosa. Pain relievers such as fentanyl are also commonly used for pain control in these surgical circumstances. However, these other agents work via different mechanisms and do not seem to play a role in the prevention of ED. In that regard, dexmedetomidine is unique. At this point, however, ED prophylaxis is an off-

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