Journal of Clinical Anesthesia 37 (2017) 92–96

Contents lists available at ScienceDirect

Journal of Clinical Anesthesia

Original Contribution

Perioperative opioid administration in children with and without developmental delay undergoing outpatient dental surgery

Erin R. Conner [a,*], Erica D. Musser [b], Kelsey M. Colpitts [a], Dean L. Laochamroonvorapongse [a], Jeffrey L. Koh [a]

[a] Pediatric Anesthesiology, Oregon Health & Science University, 3181 SW Sam Jackson Park Road, Portland, OR 97239, United States
[b] Psychology, Florida International University, 11200 SW 8th St, Miami, FL 33199, United States

ARTICLE INFO

Article history:
Received 4 July 2015
Received in revised form 2 November 2016
Accepted 7 December 2016

Keywords:
Pediatric anesthesia
Developmental delay
Intraoperative opioids
Postoperative opioids
Postoperative complications

ABSTRACT

Study objective: Prior research has indicated that children with developmental delay (DD) experience qualitative and quantitative differences in health care (Boulet et al., 2009). In the perioperative setting, there is concern that children with DD may be more likely to experience postoperative complications including agitation and nausea/vomiting than typically developing patients (TDP). Differences in the administration and dosage of perioperative opioids may contribute to this, however, empirical investigations are lacking. The purpose of this research was to compare the experience of postoperative nausea/vomiting and agitation, as well as to examine perioperative opioid administration, among children with DD as compared to TDP.
Design: Retrospective original research.
Setting: Operating room, postanesthesia care unit.
Patients: 1145 patients (1–20.9 years, ASA I-III, 23.9% with a history of DD) who had undergone outpatient dental surgery involving extraction/restorations under general anesthesia.
Measurements: Data was obtained and analyzed from the medical records of both DD and TDP across a five-year period. Data included the experience of agitation, nausea/vomiting, as well as perioperative medication administration.
Main results: Postoperative agitation and nausea/vomiting did not differ significantly between the DD and TDP groups. Children with DD were significantly less likely to receive opioids during both the intra and postoperative period ($\chi^2 = 10.02$, $p = 0.001$ and $\chi^2 = 8.08$, $p = 0.003$, respectively). Further, higher dosage of intraoperative opioids was predictive of reduced administration of postoperative opioids among TDP; however, no significant association was observed between the dosage of intraoperative opioids and administration of postoperative opioids in the DD group.
Conclusions: Children with DD experience similar rates of postoperative complications including nausea/vomiting and agitation as TDP. DD children were less likely to receive both intra and postoperative opioids than TDP. Importantly, while the dosage of intraoperative opioids was predictive of administration of postoperative opioids in the TDP group, this was not the case for the DD group. Clinical implications are discussed.
Published by Elsevier Inc.

1. Introduction

Children with developmental delay (DD) do not achieve developmental milestones at the same rate as typically developing patients (TDP). Children with DD may be at increased risk for postoperative complications, including agitation, nausea and vomiting. Additionally, prior research indicates that children with DD may be at an increased risk for postoperative pain [2]. Postoperative pain may be of specific concern in the treatment of children with DD, as these children often have comorbid medical conditions associated with baseline pain, such as neuromuscular scoliosis or extremity contractures [3]. Furthermore, children with DD are more likely to require procedures and surgeries associated with high levels of postoperative pain as compared to TDP [4]. However, despite evidence of preexisting pain and greater rates of painful procedures and surgeries, prior studies have revealed that children with DD, specifically cognitive delay and cerebral palsy, tend to receive a lower total dose of intraoperative opioids than TDP [5]. This reduced dosing of intraoperative opioids may account for increased risk for postoperative pain or other postoperative complications among children with DD.

Several theories have been proposed to explain the lower total dosing of intraoperative opioids for children with DD. Health care providers may restrict intraoperative opioid dosing due to concern for increased

* Corresponding author at: Pediatric Anesthesiology, Stanford Hospital and Clinics, 300 Pasteur Drive, Stanford, CA 94025, United States.
E-mail addresses: erin.conner.md@gmail.com (E.R. Conner), emusser@fiu.edu (E.D. Musser), kelsey.colpitts@gmail.com (K.M. Colpitts), laochamr@ohsu.edu (D.L. Laochamroonvorapongse), kohj@ohsu.edu (J.L. Koh).

http://dx.doi.org/10.1016/j.jclinane.2016.12.006
0952-8180/Published by Elsevier Inc.

sensitivity to the respiratory depressant effects of opioids, or other possible adverse effects which may have increased relevance for children with DD [5,6]. In the current literature, there are few empirical studies addressing perioperative opioid dosing in children with DD. Of the few studies that do exist, there tends to be consistency in that children with DD receive lower total dosage of intraoperative opioids compared to TDP. However, results describing whether children with DD receive similar dosages of postoperative opioids to TDP are contradictory [2,6]. Further, while we might anticipate an association between intra and postoperative opioid dosing, this has not been examined among children with DD. To our knowledge, there have been no prior studies addressing rates of postoperative pain and complications including agitation, and nausea/vomiting in children with DD as compared to TDP and whether these postoperative experiences have an association with perioperative opioid dosing.

This study sought to characterize the use of intra- and post-operative opioid administration in children with and without DD undergoing outpatient dental surgery. The study's secondary aim was to characterize signs of increased incidence of immediate postoperative complications, including agitation and nausea/vomiting.

2. Materials and methods

Following approval by the University's Institutional Review Board, 1145 patients (aged 1–20.9 years) treated at the Doernbecher Children's Hospital Pediatric Dental Clinic (between July 2007 and November 2012) were identified via medical record review. All included patients had undergone outpatient dental surgery involving simple extraction/restoration procedures with general anesthesia. Patients were excluded if they received regional anesthesia (in this sample local infiltration with lidocaine was considered regional anesthesia), if the postoperative care included a planned admission to the Intensive Care Unit, or medical records were incomplete. Patients were identified as meeting criteria for DD if a physician recorded the diagnosis in their chart previously. DD was broadly considered to include: autism spectrum disorder ($n = 117$, 10.2%), Down syndrome ($n = 37$, 3.2%), cerebral palsy ($n = 61$, 5.3%), and other intellectual disability/DD-NOS ($n = 98$, 8.6%) with 32 (2.8%) meeting criteria for 2 or more DD. All patients meeting this criterion were treated as the DD group ($n = 274$, 23.9%), while all other patients were treated as typically developing patient (TDP) group ($n = 871$). No inferences were made about the severity of DD, as this information was not available.

Information collected from medical records included demographic information (i.e., age, ethnicity, race, sex, weight), associated medical diagnoses, preoperative data (premedications received), intraoperative data (type of dental work completed, total surgery time, total anesthesia time, and medications and analgesics administered), and postoperative data (administration of opioid analgesics, non-opioid analgesics, length of stay, experience of nausea and vomiting, experience of agitation, and time to discharge). Postanesthesia Care Unit (PACU) providers recorded postoperative data. The Face, Legs, Activity, Cry, Consolability (FLACC) scale is used in our PACU to assess postoperative pain, however, for purpose of this study, postoperative pain was recorded as present if the patient received a postoperative opioid pain medication as proxy. Nausea was recorded if patients vocalized this symptom, and/or if vomiting was recorded for active emesis in the PACU. Agitation was documented by the PACU provider if the patients appeared significantly more agitated, active and/or anxious than would be expected or than was typical given the child's chronological age [7]. No patients were specifically identified to have experienced emergence delirium. It is also noted that no children in this study experienced clinically significant respiratory depression.

2.1. Analysis plan

Data were analyzed in SPSS v. 21. One-way Analysis of Variance (ANOVA) were used to examine group differences in all continuous demographic variables (i.e., age, weight), while Chi-square analyses were used to examine group differences in all categorical demographic variables (i.e., ethnicity, gender, race) and group differences in all categorical medication and complication variables (i.e., all pre-, intra-, and post-operation medications utilized; agitation, nausea/vomiting). In order to address our primary questions of interest (i.e., whether children with DD exhibit a higher incidence of postoperative agitation and/or nausea/vomiting; whether children with DD are more likely to receive intra- and/or postoperative opioids; whether children with DD who received intraoperative opioids were at greater risk for postoperative agitation and/or nausea/vomiting, as well as administration of postoperative pain medication), both main and interaction effects (i.e., DD status, intra-op opioid use, DD status * intra-op opioid use) were examined in a series of 2×2 ANOVA (DD vs TDP group $\times$ Intraoperative Opioid Administration) with postoperative nausea, agitation, and postoperative opioid administration as outcome variables in three separate analyses. In order to examine effects of intraoperative opioid dosage on each of these outcomes, binary logistic regression was used. For each of these primary analyses of interest, the following were treated as covariates: age, ethnicity, race, sex, and weight.

3. Results

3.1. Preliminary analyses

In the full sample (i.e., both DD and TDP), the majority of patients were male (55.4%), non-Hispanic (65.8%), and White (80.2%), ranging in age from 1.05 to 20.90 years (mean = 6.09, SD = 4.25). Table 1 contains group differences between the DD and TDP samples with respect to demographics, administration of pre, intra, and postoperative pain medications, and postoperative complications. Significant DD vs TDP group differences were observed across all demographic variables. Specifically, the DD children had a statistically significantly higher proportion of males than the TDP group (67.1% and 52.9%, respectively, $\chi^2(1) = 16.51$, $p < 0.001$) and a higher proportion of non-Hispanic/White children (68.0% and 44.4%, respectively, $\chi^2(1) = 40.302$, $p < 0.001$). Additionally, the DD children tended to be older (9.81 years, SD = 5.36) than TDPs (4.91 years, SD = 2.98, $F(1,1144) = 367.92$, $p < 0.001$), and the DD children tended to weigh more (35.24 kg, SD = 24.60) than the TDPs (19.95 kg, SD = 11.60, $F(1,1144) = 197.09$, $p < 0.001$).

With respect to preoperative medications, the DD group was less likely to receive medication (83.6%) than the TDP (91.1%, $\chi^2(1) = 12.39$, $p = 0.003$) with a smaller percentage of the DD group receiving acetaminophen (51.1%) and midazolam (78.5%), compared to the TDP group (80.2% and 90.3%, respectively, both $p < 0.001$). However, a larger percentage of the DD group received ketamine (14.6%) than the TDP group (1.5%, $p < 0.001$, see Table 1). With respect to intraoperative medications, the DD group was also less likely to be administered pain medication (87.6%) than the TDP group (93.7%, $p = 0.001$). However, the DD children were more likely to receive any dose of intraoperative fentanyl (51.8%) than TDPs (44.2%, $p = 0.027$), and less likely to receive any dose of intraoperative morphine (37.2%) than TDPs (52.2%, $p < 0.001$). Further, DD children who did receive either fentanyl or morphine received a larger dose of opioid, calculated as morphine equivalents (mg per kg), using the conversion of 25 mcg fentanyl = 1 mg morphine (2.41, SD = 2.46) than TDPs (2.29, SD = 1.43; $p < 0.001$). With respect to the administration of a local anesthetic, groups did not differ ($p = 0.161$). Generally, groups did not differ with respect to administration of anti-nausea medications with roughly 85% of each group receiving an intraoperative anti-nausea medication ($p = 0.861$, see Table 1).

Children with DD tended to have a larger number of restorations/extractions (4.3, SD = 2.92) than TDP (3.1 SD = 2.42; $F(1,1144) = 86.97$, $p < 0.001$); however, there was no difference between the DD (111.24, SD = 60.80) and the TDP groups (109.70, SD = 44.69) with respect to