Spring 5-2019

Improving Acute Postoperative Pain Management for the Pediatric Patient: Guidelines on the Use of Intravenous Dexmedetomidine

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Jenna M. Winters, RN, BSN, CCRN, SRNA

Introduction to the Problem

Recent statistical analysis conducted by Tzong, Han, Roh, and Ing (2012) on pediatric surgery found that 443,643 pediatric inpatient surgeries were performed in the United States in 2009. Surgery is often the largest contributor to acute pain in children, which is directly related to the surgical procedure and often manifests during the postoperative period (Lundeberg, 2014). Opioids are the gold standard for the treatment of acute, nociceptive pain related to surgery in children. However, pediatric surgeries often involve pain consisting of a visceral or neuropathic pathophysiology, resistant to even high doses of opioids (Lundeberg, 2014). Inadequately treated pain in children leads to risky complications such as longer recovery times, infection, prolonged hospitalizations, readmissions, altered pain sensitivity, neurophysiological changes, and cognitive-behavioral abnormalities (Campbell, 2013; Ibrahim, Jones, Lai, & Tan, 2016). The aim of pediatric pain management during the postoperative period should focus on a tailored analgesic plan, consisting of an acceptable pain level, maximum mobility, and a limited number of side effects (Lundeberg, 2014). With the addition of dexmedetomidine to a perioperative, multimodal pain management protocol, children may experience improved outcomes and a reduction in postoperative pain, while minimizing the deleterious complications associated with opioid use and inadequately treated pain.

Literature Review

Although only currently approved in the adult population, studies have shown evidence to support the utilization of dexmedetomidine in children, specifically including an adjunct to

general anesthesia, postoperative sedation and analgesia without respiratory depression, prevention of postoperative delirium, and management of opioid withdrawal secondary to opioid dependence (Tobias, 2007). The beneficial properties of dexmedetomidine include sedation, anxiolysis, analgesia, a reduction in inhalation anesthetics, as well as opioid consumption, blunting of the sympathetic nervous system in response to tracheal intubation and surgical incision, antisialagogue effects, reduced gastric secretions, and a reduction in nausea and vomiting (Lerman, 2013; White & Eng, 2013; Yuen, 2010).

Review of the literature indicated that intravenous dexmedetomidine as an adjunct to a multimodal pain management protocol may lead to improved postoperative pain control in children undergoing surgical intervention. Dexmedetomidine during the perioperative period, administered either as a bolus dose or continuous infusion, frequently resulted in a decrease in intraoperative opioid requirements, quicker emergence from anesthesia and time to extubation, reduction in postoperative pain, and a decrease in the deleterious side effects associated with opioid analgesics (Mahmoud & Mason, 2015; Yuen 2010). The use of dexmedetomidine as an adjunct intervention for children during the perioperative period may lead to an improvement in overall patient and parental satisfaction, as well as a reduction in morbidity and mortality.

Project Methods

The purpose of this practice project included the development and introduction of a dexmedetomidine infusion protocol for the children of a tertiary care center in central Illinois. Project aims included analysis of available literature for development of an evidence-based, perioperative dexmedetomidine infusion protocol for children and education of key stakeholders from the anesthesia, pharmacy, and pediatric departments at a tertiary care center in central

Illinois on the use of dexmedetomidine in children to improve postoperative pain. This project was evaluated by utilizing a posttest survey after implementation.

This practice project was considered exempt by Southern Illinois University Edwardsville's Institutional Review Board (IRB) and approved by the Research Review Committee at the host facility. The presentation and survey were completely voluntary. There were minimal ethical risks to participants and consisted of inconvenience of time and emotional distress.

Evaluation

The development of this evidence-based, perioperative dexmedetomidine infusion protocol adopted a non-experimental design for implementation at a tertiary care center in central Illinois. The design of this project intended to educate anesthesia professionals, the pharmacy staff, and the pediatric care team on the use of intravenous dexmedetomidine in children to improve acute perioperative pain management. Staff members of the tertiary care center in central Illinois attended an educational presentation and completed a voluntary survey consisting of five demographic, six true-false, two Likert-style, and one free response question evaluating the effectiveness of the presentation.

The outcomes of the five knowledge questions suggested the educational presentation impacted the participants positively. Participants accurately answered and understood the aim of pediatric pain management should focus on a tailored analgesic plan (100% correct). The participants understood dexmedetomidine, as an adjunct, can improve postoperative pain control in children (100% correct). Lastly, the participants understood the side effects most commonly associated with dexmedetomidine in children consist of hypertension, hypotension, bradycardia, and hypothermia (100% correct). The analgesic mechanism of action of dexmedetomidine

(36.3% correct) appeared to be poorly understood or may be attributed to inadequate discussion during the educational presentation. Lastly, most of the participants (76.5%) understood the treatment of bradycardia in children caused by administering dexmedetomidine.

A five-point Likert scale, ranging from strongly agree to strongly disagree was utilized to assess the support of the use of dexmedetomidine in children before and after the educational presentation. Prior to the presentation, 29.4 percent of the participants stated they would use dexmedetomidine in children. After the educational presentation, 94.1 percent of the participants said they were more likely to use dexmedetomidine in children. On average, 64.7 percent of the participants answered disagree to neutral prior to the presentation and answered agree or strongly agree after the presentation. Twenty-nine percent of the participants answered agree or strongly agree prior to the presentation with no change after, maintaining that these participants will continue to use dexmedetomidine in children. Prior to the presentation, answers ranged from disagree to strongly agree. Subsequently, after the presentation, answers ranged from neutral to strongly agree, suggesting that participants may be more likely to use dexmedetomidine in children.

Limitations of this practice project included a limited sample size and sampling bias. Roughly 30 anesthesia personnel were in attendance for the educational presentation. Only 50-percent of the staff in attendance completed the survey. Due to the limited sample, the results of the posttest may not be generalizable to a larger population. Sampling bias occurred as the pharmacy staff and the pediatric care team were under-represented. The sample was also predominated by Certified Registered Nurse Anesthetists (64.7% of the sample) making the results more generalizable towards this specific population.

Impact on Practice

The results of this practice project suggested the educational presentation increased the knowledge and likelihood anesthesia providers will use dexmedetomidine in children during the perioperative period, ultimately improving postoperative pain management. In accordance with responses, the anesthesia staff was more likely to utilize dexmedetomidine in children during the perioperative period based on current literature. Prior to the presentation, a limited number of anesthesia staff members indicated they routinely used intravenous dexmedetomidine as an adjunct for acute perioperative pain in children. Results of the presentation indicated almost 100-percent of the staff members were more likely to use dexmedetomidine in children. Staff members also indicated a strong level of support for the use of a dexmedetomidine protocol in children. In response to this presentation, the tertiary care center is currently stocking all medication dispensers with dexmedetomidine, encouraging the use of dexmedetomidine in children, and extending this knowledge of dexmedetomidine to the staff of the post-anesthesia recovery unit as well as the pediatric intensive care units.

Conclusions

Dexmedetomidine, as an adjunct to a multimodal pain management protocol, offers several advantages in children. Primarily, dexmedetomidine reduces the anesthetic and opioid requirements during the intraoperative phase, while simultaneously prolonging postoperative analgesia (Lundeberg, 2014). Additionally, dexmedetomidine may attenuate the sympathetic outflow in response to noxious stimuli, decrease the incidence of pediatric respiratory depression, and limit the deleterious adverse reactions associated with opioid use, such as nausea and vomiting, constipation, and hyperalgesia (Lundeberg, 2014). Experiencing severe pain, respiratory distress, or gastrointestinal discomfort can cause concern and anxiety not only for the child, but the parents as well during the perioperative period (Goubert, Virvoort, Sullivan,

Verhoeven, & Crombez, 2008). Implementation of a multimodal pain management protocol, including dexmedetomidine, may improve patient and provider satisfaction, relieve child and parental anxiety, reduce morbidity and mortality, and decrease the requirement for perioperative opioids in children undergoing surgical intervention.

Author Contact Information

jewinte@siue.edu

jwint013@yahoo.com