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Improving Acute Pain Management for Pediatric Patients: Development of a Ketamine Infusion Protocol

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Introduction of the Problem

In 2001, the American Academy of Pediatrics (AAP) recognized acute pain was undertreated in children of all ages. To improve pain control and reduce opioid side effects, the American Society of Anesthesiologists (ASA) and the American Pain Society (APS) recommended multimodal analgesia for acute pediatric pain management (ASA, 2012; Chou et al. 2016). Intravenous ketamine infusions were associated with improved acute pain control in children making ketamine a potentially useful adjunct for acute pain management (Dal, Celebi, Elvan, Celiker, & Aypar, 2007; Elshammaa et al., 2011; Honarmand, Reza Savi, & Jamshidi, 2008). A tertiary care center in central Illinois did not possess a pediatric ketamine infusion protocol. The purpose of this project was to improve acute pain management for pediatric patients by developing a pediatric ketamine infusion protocol for the host facility.

Literature Review

The research has demonstrated ketamine's usefulness for diverse conditions in the pediatric population. The nontraditional use of ketamine in children includes prevention of post-anesthesia emergence delirium, severe or refractory to traditional treatment status asthmaticus, refractory status epilepticus, and breakthrough cancer pain (Abdolkarimi, Zareifar, Eraghi, & Saleh, 2016; Bhatnagar et al., 2008; Chiaretti et al., 201; Costi et al., 2014; Dahmani et al., 2010; Gaspard et al., 2013; Ilvento et al., 2015; Jat, Azad, & Guglani, 2012; Lu, Wu, & Lu, 2012; Sabharwal et al., 2015; Tarocco, Ballardini, & Garani, 2014; Wilkes & Tasker, 2014). Level I evidence has concluded prophylactic administration of ketamine reduces postoperative

emergence agitation in children undergoing general anesthesia with volatile agents (Dahmani et al., 2011; Dahmani, Delivet, & Hilly, 2014; Eghbal, Taregh, Amin, & Sahmeddini, 2013; Fang, Gao, Ge, Zhou, & Zhang, 2016). Level II and III evidence has remained inconclusive of ketamine's benefit for the treatment of status asthmaticus (Jat et al., 2012; Rehder, 2017; Wong, Lee, Turner, & Redher, 2014). Level III and IV evidence has demonstrated improved analgesia with ketamine administration in pediatric oncology patients when used in combination with opioids (Conway, White, Jean, Zempski, & Steven, 2009; Finkel, Pestieau, & Qezado, 2007; Kajiume et al., 2012). Contrary to higher level evidence, Level III and IV studies have indicated successful ketamine use for treatment of refractory status epilepticus (Gaspard et al., 2013; Ilvento et al., 2015, Sabharwal et al., 2015; Tarocco, Ballardini, & Garani, 2014; Wilkes & Tasker, 2014).

Low-dose ketamine infusions are not well-studied in the pediatric population. The existing Level I and II evidence has remained divided on the efficacy of subanesthetic ketamine infusions in postoperative pain control and reduction in opioid consumption among children undergoing surgical procedures (Batra et al., 2007; Cho et al., 2014; Dahmani et al., 2011; Michelet et al., 2016). However, multiple high-level studies have consistently demonstrated intravenous ketamine effectiveness for acute pain control in children when used as an adjunct to other medications including fentanyl, magnesium, dexamethasone, and paracetamol (Asadi et al., 2016; Cha et al., 2012; Elshammaa et al., 2011; Jabbour et al., 2014; Safavi et al., 2012). Thus, incorporating low-dose ketamine infusions into pain management plans and using ketamine as an adjunct to other pharmacological agents may allow providers to improve outcomes of pain control in children.

Project Methods

The purpose of this doctoral project was to improve acute pain management in the pediatric population. The goal of the project was to educate healthcare professionals at a tertiary care center in central Illinois on current evidence concerning the role of ketamine for pediatric patients and encourage them to implement and adopt a low-dose ketamine infusion protocol as a modality in the multimodal approach to acute pain management in children.

The project utilized a non-experimental design. The design included an educational PowerPoint verbal presentation followed by a brief survey. The survey consisted of five demographic questions, seven knowledge-based true/false questions, and a 5-point Likert scale question. The questionnaire addressed the topics of current recommendations from APS, ketamine pharmacology and mechanism of action, and latest literature review findings as well as the participants' likelihood of support for the implementation of the suggested pediatric ketamine infusion protocol.

Before the implementation, the project was reviewed and considered exempt by the Institutional Review Board (IRB) from Southern Illinois University Edwardsville and approved by the Research Review Committee at the host facility. The participation in the survey was voluntary. The risks to human subjects were minimal and included the inconvenience of time and emotional distress due to partaking in the survey.

Evaluation

Descriptive statistics and frequency tables were used to define demographics within the sample. The seven knowledge-based questions were analyzed by comparison of the percentages of correct versus incorrect answer choices in the survey. The overall effectiveness of the educational presentation was determined by the evaluation of the percentages of the correct

answer choices. The mean score for the Likert-scale question was calculated to predict the likelihood of the support of the pediatric ketamine protocol utilization.

Seven survey respondents included one male and six females. Three attendees were between the ages 30 and 39, two were ages 40-49, and another two were ages 50-64. Six people were White/Caucasian and one was Asian/Pacific Islander. The group included two anesthesiologists, two certified registered nurse anesthetists, two pediatric intensive care unit registered nurses, and one intensivist. The review of the attendees' responses to seven knowledge-based questions revealed the majority of them gave appropriate answers. The score options on the five-point Likert scale ranged from five (strongly agree) to one (strongly disagree) and included three as a neutral response. The mean score was 4.3, thus indicating the likelihood of staff's support for the implementation of a pediatric low-dose ketamine infusion protocol. The results of the evaluation suggested the educational presentation improved the participants' knowledge concerning acute pediatric pain management and the low-dose pediatric ketamine infusion protocol. The results of the survey confirmed the attendees' support for the implementation of the pediatric ketamine infusion protocol.

The main limitation of this project was the small purposeful sample size. The statistical power of the study might be reduced; the variability and bias might be increased. Thus, the results of the survey cannot be generalizable to a larger population which includes all staff members involved with professional pediatric care at the host institution.

Impact on Practice

Healthcare providers in the United States, including the host facility, are challenged with governmental and societal pressure to reduce the opioid use in and out of hospital settings. Multimodal and opioid-free analgesia is becoming the cornerstone in acute pain management for

adult and pediatric patients. Ketamine is a useful adjunctive alternative for acute pain control in children. The steps are being taken to build the order sets based on suggested low-dose ketamine infusion protocol and make it available to providers for multimodal pain management approach in pediatric care at the host facility. The long-term impact of the project is the sustainability of the implementation of a low-dose ketamine infusion protocol for acute pain control in children. Consequently, the utilization of the pediatric ketamine infusion protocol at the host facility is expected to improve pediatric acute pain management. This project can be replicated and expanded hospital-wide on pediatric care units. In the future, the project should include an online PowerPoint voiceover presentation which can be reviewed at participants' convenience. The collaborative approach and the involvement of the majority of the staff members who provide pediatric care at the host facility are desirable to ensure the continuity of the utilization of the low-dose ketamine infusion protocol. The study can be used at any pediatric hospital or any hospital providing pediatric health care.

Conclusion

A multimodal approach to analgesia is becoming a prominent modality in pain management strategies including pediatric acute pain management. Evidence-based research has demonstrated the versatility of use of ketamine in children. Post-anesthesia emergence delirium, severe or refractory to traditional treatment status asthmaticus, refractory status epilepticus, and breakthrough cancer pain are the conditions in which ketamine use in the pediatric population is well-documented. A low-dose ketamine infusion has a potential to improve acute pain control in children when used in combination with other pharmacological agents. This project helped to educate the healthcare providers at the host facility on current evidence concerning the role of ketamine for pediatric patients and encouraged them to implement and adopt a low-dose

ketamine infusion protocol in a multimodal approach to acute pain management in children. The results of this project revealed the healthcare providers at the host facility support the use of a low-dose ketamine infusion protocol in the pediatric population. The steps are being taken to create the order sets based on proposed protocol for implementation at the pediatric intensive care unit. Therefore, the availability of the pediatric ketamine infusion protocol for acute pain management has the potential to change the healthcare providers approach to pain management and improve patients' outcomes.

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