Summer 5-5-2023

Remifentanil in Labor Analgesia

Courtney Silberberg

Title

Remifentanil in Labor Analgesia

Author

Courtney G. Silberberg

Introduction of Problem

Labor can be the most excruciating and intense physical pain a woman experiences in her life. Labor pain induces a neuroendocrine stress response with associated physiological effects including increased oxygen consumption, hyperventilation, respiratory alkalosis, increased cardiac output, increased systemic vascular resistance, and increased blood pressure with resultant impacts on the parturient and fetus (Shnol et al., 2014). Epidural analgesia is the gold standard for pain relief in labor compared with available alternatives, but may not be an option for women with absolute or relative contraindications to neuraxial anesthesia (Lin et al., 2014). Absolute and relative contraindications may include patient refusal, anatomic limitations, thromboprophylaxis, allergy to local anesthetics, and medical conditions, such as coagulation abnormalities, elevated intracranial pressure, or local infection at the injection site (Gupta & Partani, 2018).

These women rely on other options other than neuraxial anesthesia for labor pain control. Systemic opioids have been used as an alternative with widespread and increasing use; however, their use has been criticized due to limited efficacy (Volmanen et al., 2011). Remifentanil has emerged as a preferred opioid option for labor and delivery. Primary benefits include its rapid onset (peak effect in 1.1 minutes) and rapid metabolism by non-specific plasma esterases (Glass et al., 1999). In addition, the context-sensitive half-life is three to five minutes and independent

of infusion duration, making the drug an excellent option for patient-controlled analgesia (PCA) (Glass et al., 1999).

Literature Review

The literature supports remifentanil PCA as an acceptable alternative for labor pain when neuraxial anesthesia is contraindicated. Remifentanil is a lipophilic, synthetic opioid chemically related to fentanyl, alfentanil, and sufentanil (Glass et al., 1999). The introduction of the methyl ester group is what makes remifentanil structurally unique among the currently available opioids (Glass et al., 1999). Remifentanil is hydrolyzed by non-specific esterases in the blood and tissue and has a context-sensitive half-time of 3-5 minutes, independent of infusion duration (Glass et al., 1999). More important to the obstetric and neonatal population, remifentanil can be rapidly metabolized by the fetus, as demonstrated by analysis of remifentanil concentration in the umbilical cord, uterine artery, and umbilical vein (Kan et al., 1998). These unique pharmacokinetic properties of remifentanil make it an ideal opioid for patient-controlled analgesia in parturients with contraindications to neuraxial anesthesia.

Remifentanil PCA has been compared to other analgesic modalities utilized in labor including IM meperidine, IV fentanyl, nitrous oxide, and epidural analgesia. The evidence suggests that remifentanil PCA is superior to IM meperidine due to a more significant reduction in pain scores, increased maternal satisfaction scores, fewer conversions to epidural analgesia, increased rate of spontaneous vaginal delivery, and similar maternal and neonatal safety profile (Leong et al., 2011; Wilson et al., 2018). When comparing remifentanil PCA to fentanyl PCA, the evidence suggests that it provided similar levels of analgesia (Duoma et al., 2010; Marwah et al., 2012). Remifentanil PCA has an increased prevalence of maternal oxygen desaturation, sedation, and itching, which was quickly reversed with oxygen supplementation and stimulation

(Duoma et al., 2010; Marwah et al., 2012). However, the fentanyl group showed concerning neonatal outcomes compared to remifentanil (Marwah et al., 2012). The evidence suggests that remifentanil PCA provided better analgesia than nitrous oxide (Volmanen et al., 2005; Varposhti et al., 2013). Lastly, when remifentanil was compared with epidural analgesia, higher pain scores were seen in the remifentanil PCA group (Zhang et al., 2021). However, maternal satisfaction scores showed no significant difference between the groups suggesting that remifentanil PCA could be a viable alternative for pain relief (Zhang et al., 2021). There was an increased risk of maternal hyperthermia in the epidural group and an increased risk of maternal desaturation in the remifentanil group, with no significant difference in neonatal outcomes between the groups (Zhang et al., 2021).

Given the concerns of maternal respiratory depression, standardized protocols for administration and monitoring should be implemented at a facility using remifentanil PCA for labor analgesia (Messmer et al., 2016). These include one-to-one nursing care with an ACLS credentialed labor and delivery registered nurse, continuous pulse oximetry, vital signs every 15 minutes, and continuous end-tidal capnography, as well as the immediate availability of anesthesiology personnel (Ven de Velde & Carvalho, 2016; Lin et al., 2014). Respiratory monitoring, including capnography, cannot be viewed as an alternative to the presence of a trained clinician (Marwah et al., 2012). Measures should also be taken to prevent errors, especially if infrequently used at the facility, as healthcare providers' relative lack of familiarity with remifentanil in the obstetric unit can compound safety concerns (Aaronson et al., 2017).

Project Methods

This project aimed to review current medical literature and educate obstetrical anesthesia providers, obstetricians, residents, and pharmacists on remifentanil PCA for laboring parturients

as an alternative to neuraxial analgesia for this subset of parturients. The objectives were to assess participants' knowledge and buy-in following implementation and recommend an evidenced-based remifentanil PCA dosing regimen. An educational PowerPoint presentation was designed to provide practitioners with an in-depth understanding of remifentanil and its current use in labor analgesia.

Prior to the educational presentation, a 10-question multiple-choice pre-test assessment and two Likert scale survey items were administered to the participants in attendance at a Level 3 Perinatal Center in Central Illinois. Concluding the educational presentation, a 10-question multiple-choice post-test assessment, two Likert scale survey items, and an additional two open-ended questions, were administered to the same staff in attendance. Participants included in the study included certified registered nurse anesthetists, student registered nurse anesthetists, physician anesthesiologists, physician obstetricians, and pharmacists employed by the hospital. The sample size was 9 participants. All participants had access to the assessment and survey with a QR code on their personal devices.

This project was submitted to Southern Illinois University’s IRB committee for approval and was granted exemption. The project is a quality improvement project and does not include human subject experimentation.

Evaluation

This project was non-experimental in design. The project was aimed to assess stakeholders' knowledge gained and survey buy-in for utilizing remifentanil PCA at their facility. Nine participants filled out the pre-presentation survey while only seven completed the post-presentation survey. The attrition rate was 22% due to provider availability.

The outcomes of the ten knowledge questions suggested that the educational presentation impacted the participants positively. Before the education presentation, the overall score for the 10-question multiple-choice assessment was 54 percent. After the presentation, the overall score was 86 percent. This was an overall increase of 59.3 percent from pre-test to post-test scores. Participants accurately answered seven questions in the post-test assessment (100 percent correct). Questions that showed the greatest increase in scores assessed providers' knowledge of remifentanil pharmacokinetics.

A five-point Likert scale, ranging from strongly agree to strongly disagree, was utilized to assess the support for the use of remifentanil PCA in labor analgesia before and after the educational presentation. Prior to the presentation, 77.8 percent of participants either strongly agreed or agreed that remifentanil PCA is a feasible alternative for parturients when neuraxial anesthesia is contraindicated. After the educational presentation, 100 percent of participants either strongly agreed or agreed with this statement. This was a 14.63 percent increase in mean scores following the educational intervention. In addition, another statement assessed the willingness to use remifentanil PCA in parturients with contraindications to neuraxial anesthesia if a remifentanil PCA protocol was available. Prior to the presentation, 77.8 percent of participants either strongly agreed or agreed with the statement. After the presentation, 100 percent of participants either strongly agreed or agreed with this statement. This was a 17.5 percent increase in mean scores from the pre-test to the post-test. Overall, prior to the presentation, the answers ranged from neutral to strongly agree. Subsequently, after the presentation, answers ranged from agree to strongly agree, suggesting that participants may be more likely to use remifentanil PCA in the parturient population when neuraxial anesthesia is contraindicated.

Open-ended questions were available following the educational presentation. Two participants responded that in their current practice, they utilize IV fentanyl or nitrous oxide and Nubian as an alternative to neuraxial anesthesia. Three participants responded with comments about the potential barriers to the implementation of a remifentanil protocol. Common themes seen included the cost of remifentanil and providers unwilling to adapt to a change in practice. Navigating these barriers is essential to promote buy-in at this facility. This facility encounters women who meet the criteria for remifentanil PCA less than six times per year. The pharmacy department has been reluctant in the past to provide remifentanil due to its high cost compared to fentanyl, hydromorphone, and morphine. Due to the infrequency of remifentanil's potential use, providers might forgo the cost barrier to provide parturients with adequate pain relief. Additionally, increasing providers' knowledge base on remifentanil PCA in labor analgesia and the creation of an evidence-based remifentanil PCA protocol might decrease the percentage of providers who are unwilling to change their practice.

There are several limitations to this quality improvement project. The greatest limitation of this project was the research utilized in this literature review demonstrated clinical heterogeneity. Different study protocols with respect to implementation methods, dosing, timing, rate of administration, lockout intervals, and comparative drugs made it difficult to conduct a comparison. Participants included in most of these studies were also homogeneous in nature with most being healthy ASA I or II patients who met strict inclusion criteria. Other limitations to this quality improvement project include sampling bias and limited sample size. Due to time constraints and staff member availability, a convenience sample was used for this project. Only seven staff members properly completed the pre- and post-presentation survey. Thus, the results from this project are not generalizable due to the small sample size.

Impact on Practice

The purpose of this doctoral project was to educate obstetrical anesthesia providers, obstetricians, residents, and pharmacists at a Level 3 Perinatal Center in Central Illinois on remifentanil patient-controlled analgesia (PCA) for laboring parturients as an alternative to neuraxial analgesia. Specific objectives included an extensive literature review to determine the efficacy of remifentanil PCA in parturients and to suggest an evidence-based remifentanil PCA dosing regimen. According to survey results, participant knowledge regarding remifentanil PCA in labor analgesia increased, suggesting that knowledge was gained from the educational presentation. Additionally, according to the 5-point Likert scale, participants favored the implementation of a remifentanil PCA protocol in the obstetrics unit. The information provided in the literature review will be presented to pharmacy staff and obstetricians by the head OB CRNA and a standardized remifentanil PCA protocol for labor analgesia will be created at an unknown time.

Conclusion

Remifentanil's unique pharmacokinetic properties make it an ideal opioid for labor analgesia in women with contraindications to neuraxial anesthesia. Remifentanil PCA appears to provide the most effective non-neuraxial labor analgesia, with high levels of maternal satisfaction and favorable delivery and neonatal outcomes. However, safety measures, including a high-quality standardized protocol, should be implemented at a facility using remifentanil PCA for labor analgesia due to concerns for maternal adverse events.

Author Contact Information

Courtney Silberberg BSN, RN, SRNA

cosilbe@siue.edu