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Difficult Labor Epidural: Intrathecal Catheter Management

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Executive Summary

Introduction of the Problem

Labor epidural analgesia or neuraxial blockade is the most common method used to control pain associated with labor and vaginal delivery in the United States (Borne, 2015). In addition to adequate pain relief during labor, epidural analgesia can be modified to provide surgical anesthesia should a cesarean delivery be warranted (Onuoha, 2017). The neuraxial blockade is a safer alternative for both the mother and her baby, especially in non-emergencies (Braga et al., 2019). Despite the clear advantages of labor epidural analgesia, the placement of an epidural catheter is not without risk and can be challenging (Rajagopalan et al., 2019). The epidural needle or catheter may extend beyond the epidural space into the intrathecal space resulting in an accidental dural puncture (ADP) (Heesen et al., 2019; Sivanandan, 2019; Tien et al., 2016). The anesthesia provider may choose to leave the catheter within the intrathecal space to manage labor pain and/or surgical anesthesia. Continuous spinal anesthesia (CSA) is not the traditional technique used for managing labor pain, therefore, labor and delivery staff and providers often have a limited understanding of the benefits and application. The lack of knowledge can limit management options of labor pain after ADP (Prada et al., 2016; Velickovic et al., 2017). Therefore, there was a demand to develop an evidence-based protocol and staff education for the management of ADP with CSA after failed epidural catheter placement at a Level 1 trauma center in the Midwest.

Literature Review

Accidental dural puncture is a potential complication with epidural placement that occurs at an incidence rate of 0.5 to 1.5% (Jagannathan et al., 2016; Izquierdo et al., 2019). Accidental dural puncture is an unintentional penetration of the dura by the epidural needle or catheter (Ayad, 2003; Babazade et al., 2020; Rana et al., 2018). The risk for ADP was related to increasing depth to the epidural space, which increased by about 19% for every 1 cm of tissue the needle must penetrate (Hollister et al., 2012). The loss-of-resistance technique, timing, and patient position did not increase the probability of ADP (Hollister et al., 2012). However, studies identified three independent risk factors for difficult epidural placement, including difficult intervertebral space palpation, spinal deformity, and inability to flex the back (Guglielminotti et al., 2013). Obesity is a major contributing factor to difficult interspinous space palpation because of failure to identify landmarks and deeper epidural space (Eley et al., 2015; Guasch et al., 2017; Hollister et al., 2012; Kula et al., 2017; Uyl et al., 2019).

Studies showed several clear advantages of using CSA in laboring patients, such as the 10% reduced risk of a second ADP, a combination of single-shot spinal and continuous epidural techniques, easy catheter insertion, the establishment of rapid analgesia, reduction of post-dural puncture headache (PDPH), and epidural patch requirement (Cohn et al., 2015; Jagannathan et al., 2016; Heesen et al., 2020; Izquierdo et al., 2019; Moaveni, 2020; Rana et al., 2018; Russell, 2012).

Despite clear advantages, dangers are associated with CSA management, namely medication errors. Accidental administration of an epidural dose into the intrathecal space can lead to high spinal anesthesia resulting in hypotension and respiratory collapse requiring mechanical ventilation (Cohn et al., 2016; Delhaas & Huygen, 2019). The literature

recommended clear labeling of the CSA catheter, tubing, and infusion pump for intrathecal use only, along with placing a CSA in use sign outside the patient room. Other recommendations included the development of a cognitive aid to assist anesthesia providers in decision making with difficult epidural placement, as to whether one should initiate CSA or re-site the epidural catheter following ADP (Moaveni, 2020). Rates of other complications related to intrathecal catheter use were low. Though there could be a potential infection risk linked to the intrathecal catheter's direct access to the CSF, no such cases have been reported (Moaveni, 2020)

The most widely used intrathecal catheters were 19- and 20-gauge epidural catheters inserted through 17- or 18-gauge Touhy needles and advanced 3 to 4 cm into the intrathecal space (Izquierdo et al, 2019; Jagannathan, 2015; Velickovic et al., 2017; Tao et al., 2015). Continuous intrathecal catheters were usually removed soon after delivery, with some left in place for 12, 24, or more hours (Rana et al., 2018; Tao et al., 2015; Velickovic et al., 2017). A longer duration of intrathecal catheter placement was thought to help reduce the incidence of PDPH (Ayad et al., 2003; Veickovic et al., 2017).

The literature suggested continuous intrathecal catheter dosing should be diluted in comparison to anesthetic infusions commonly used for labor epidural analgesia. The review advised providers using a CSA to initiate analgesia with a bolus of 0.5 to 1 ml of 0.25% bupivacaine (1.25 to 2.5mg) with 10 to 20 mcg of fentanyl, followed by a continuous basal infusion 0.5-3ml/hr of 0.125% bupivacaine with 2 to 5 mg/ml of fentanyl, or 2.5 to 5mcg/hr of sufentanil (Jagannathan et al., 2016; Moaveni, 2020). The patient-controlled intrathecal analgesia regimen recommendation was 0.125% bupivacaine and 2mcg/ml of fentanyl at 2 ml/hr basal rate, and a bolus of 1 ml of this mixture was given for the breakthrough pain with a lockout interval of 20 to 30 minutes (Jagannathan et al., 2016; Moaveni, 2020). Appropriate

dosing for cesarean delivery to obtain adequate surgical anesthesia avoiding a high spinal and subsequent maternal hypotension, fetal bradycardia, and maternal respiratory failure requiring intubation (Bolden & Gebre, 2016; Moaveni, 2020; Sivanandan & Surendran, 2019). The initial dose of 1 ml (5 mg) 0.5% bupivacaine, with titration to the desired dermatomal level with additional 0.5 ml boluses as appropriate. Alternatively, the T4 level of anesthesia could be obtained with an initial dose of 0.5 ml (3.75 mg) of hyperbaric 0.75% bupivacaine followed by additional titrations of 0.3 ml boluses in approximately 10-minute intervals (Moaveni, 2020).

Project Methods

After completion of the Institutional Review Board approval process, the project was deemed to be a non-experimental quality improvement project. The purpose of the project was to provide education on ADP management with continuous intrathecal catheters in laboring patients. The evidence-based reference tool designed was submitted for review at a Level 3 Perinatal Center in central Illinois, then presented along with an educational PowerPoint to members of the anesthesia team at the host facility. After the educational in-service, participants were surveyed to evaluate the effectiveness of the education.

The survey questions, administered via a weblink, were designed to assess provider's knowledge of continuous intrathecal anesthesia before the presentation, perceived effectiveness of the presentation, intention to use the protocol in practice, the ease of following the protocol, and cognitive aid pamphlets. Providers were also asked to indicate any perceived barriers to the protocol implementation in the open-ended question. The completed online surveys were analyzed and interpreted.

Evaluation

The post-educational questionnaire survey served as a knowledge-based assessment tool. The weblink to a 9-question survey was given to all healthcare providers who were in attendance. The survey included six multiple questions items and one open-ended qualitative question. Two demographic questions evaluated years of anesthesia experience and participant's age.

Two Physician Anesthesiologists, seven CRNAs, and three nurse anesthesia students completed the survey. Based on the demographic data of the twelve respondents considered, the majority had over 6 years of anesthesia experience (58%), and only one participant second-year student, was not aware of the CSA technique (8.3%). Only four providers (33.3%), including two physician anesthesiologists, had any prior experience in administering the CSA with parturients. All participants (100%) indicated the protocol provided sufficient information about how to use it properly, and they were all planning to use it during their practice. An open commentary question examined barriers to the protocol implementation and areas for improvement. All practitioners (12) commented on areas for protocol improvement and implementation barriers. Five individuals (42%) reported staffing education as the most significant barrier to protocol implementation. One individual (8%) reported labor and delivery nurses were not comfortable with CSA due to their limited exposure to the technique. Of the 12 responses for implementation process improvements, three respondents (25%) stated there were no areas necessary for improvement, and one respondent (8%) reported apprehension towards injecting 10 ml of normal saline into intrathecal space prior to catheter removal.

Impact on Practice

The immediate impact of the project was appreciated by the anesthesia providers having a standardized reference tool for continuous catheter administration for labor analgesia and anesthesia following ADP. The evidence supports the use of continuous intrathecal catheters for labor analgesia and surgical anesthesia following ADP. The literature demonstrated faster establishment of analgesia, reduction of PDPH, and epidural patch requirement than re-siting epidural technique. The staff knowledge has increased related to CSA use in obstetrics, which eliminates a previously cited barrier. The updated reference tool with the latest evidence policy regarding treatment options in obstetrics can potentially lead to an improvement in care for difficult epidural placement patients. During the implementation phase, the protocol was customized to the specific facility requirements to include dexmedetomidine as adjunct intrathecal medication, and a simplified bupivacaine dosing regimen. The decision-making algorithm for CSA provides anesthesia staff with a clear alternative in the management of ADP. The visual step-by-step reference tool will be included in all obstetric anesthesia carts within the host facility for a quick reference.

Conclusions

There is growing evidence suggesting continuous intrathecal catheters should be placed preferentially over re-siting of an epidural catheter after an accidental dural puncture in certain types of parturients. Though intrathecal catheters are a reliable and effective technique in managing analgesia and surgical anesthesia during labor; it is not a commonly used technique, and anesthesia providers often have a limited understanding of its benefits and uses. This project helped to increase staff understanding about CSA and provided an easy-to-follow visual tool to initiate and maintain continuous intrathecal analgesia and anesthesia in the clinical setting, quite

possibly improving patient satisfaction and increasing the provider's arsenal of analgesic techniques.

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