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## **Anesthetic Management of the Parturient with Increased Intracranial Pressure Disorders**

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## **Executive Summary**

### **Introduction of the Problem**

Pregnancy is associated with multiple physiologic changes that can lead to neurologic changes and impact preexisting neurologic disorders (Godoy et al., 2022). When pregnancy occurs in a patient with a preexisting neurologic condition such as Chiari malformation I, pseudotumor cerebri, or mass occupying lesions, the patient is at a high risk of increased ICP (Alves et al., 2021). Unfortunately, increased ICP management techniques are lacking, specifically regarding the safe treatment of the mother and fetus (Anson et al., 2015, Godoy et al., 2022, Sasty et al., 2020, Scott & Kaliaperumal, 2022). A large tertiary care facility in central Illinois reports a lack of a standardized protocol with evidence-based recommendations regarding anesthetic care of the parturient with increased ICP. A comprehensive literature review and guidelines were created detailing best practice recommendations. A survey was conducted to determine staff's willingness to use the reference guide.

### **Literature Review**

In a healthy parturient, various physiologic changes occur throughout the pregnancy that put the patient at risk of increased ICP. Blood volume and cardiac output increase significantly while plasma osmolality and albumin decrease (Anson et al., 2015; Godoy et al., 2022). The risk of increased ICP is compounded when the parturient has an underlying neurologic condition.

Idiopathic intracranial hypertension (IIH), also known as pseudotumor cerebri, is characterized by an increase in intracranial pressure (>20 mmHg) with no known underlying cause (Alves et al., 2021; Anson et al., 2015; Scott & Kaliaperumal, 2022). Delivery can be accomplished vaginally or by c-section. The ideal anesthetic technique is unknown as epidural, spinal, or combined spinal-epidural (CSE) have all been performed successfully (Alves et al., 2021; Hasoon et al., 2020).

Brain tumors are rare during pregnancy yet require unique imaging, neurosurgical, obstetrical, and anesthetic considerations (Rodrigues et al., 2021). Prior to neuraxial anesthesia, MRI imaging must be carefully reviewed to determine the location of the brain mass and its effect on CSF flow. Imaging should ensure the preservation of the continuous flow of CSF and the absence of substantial pressure differences between the intracranial and intraspinal compartments (Leffert & Schwamm, 2013). If the lesion does not obstruct CSF flow, an epidural can be performed for labor analgesia with a reduced local anesthetic dose and slow administration (Leffert & Schwamm, 2013). A spinal anesthetic can be used for c-section or labor if CSF flow is not obstructed. If CSF flow is obstructed, a spinal anesthetic is contraindicated due to the risk of herniation.

Arnold Chiari Malformation I (ACM-I) is defined radiographically as herniated cerebellar tonsils greater than 5mm below the level of the foramen magnum (Sastry et al., 2019). The most recent MRI and patient symptoms should be reviewed and discussed with the patient. If the patient is asymptomatic, vaginal delivery with spinal or epidural analgesia is considered safe. Valsalva maneuvers should be limited. During epidural anesthesia, small bolus doses of local anesthetic are given to minimize increases in ICP (Ghaly et al., 2017). C-sections are reserved for obstetrical indications such as arrest of dilation and progression of labor (Sastry et al., 2019). In patients with ACM-I and no signs of increased ICP, a CSE can provide immediate pain relief, while extradural boluses allow for analgesia during labor (Choi & Tyagaraj, 2013).

When general anesthesia is indicated, such as emergency neurosurgery before delivery or general anesthesia for delivery, the anesthetic plan involves hemodynamic control to maintain cerebral perfusion pressure while maintaining sedation and analgesia to prevent increased ICP. The parturient should be adequately preoxygenated due to the reduced functional residual capacity and risk of hypoxia related to pregnancy. Hypoxia can cause cerebral vessels to dilate and increase ICP (Anson et al., 2015). The patient should not hyperventilate as the PaCO<sub>2</sub> is

already decreased due to the physiology of pregnancy. When hyperventilation lowers PaCO<sub>2</sub> < 25mm Hg, it can cause uterine artery vasoconstriction and a left shift in the maternal oxyhemoglobin dissociation curve (Anson et al., 2015). Opioids can blunt the sympathetic response to laryngoscopy, but the anesthetist must consider the medication and dose as it may lower the fetal respiratory rate and APGAR scores (Anson et al., 2015). Intravenous agents are chosen for induction due to their favorable effects on ICP, cerebral blood flow, and cerebral metabolic rate of oxygen. Anesthesia can be maintained with a 0.5 MAC of volatile anesthetic agent. A lower MAC is used due to anesthesia gases causing uterine relaxation and increasing the risk of bleeding (Waters, 2022). A bispectral index monitor can be used to ensure adequate anesthesia level, with a goal reading of less than 60 (Anson et al., 2015). Total IV anesthesia has been shown to decrease ICP while maintaining CPP. Additionally, propofol acts as an antiemetic and anticonvulsant while avoiding the risk of uterine atony associated with volatile agents (Anson et al., 2015).

### **Project Methods**

The project's overall goal was to evaluate the effectiveness and willingness of obstetric anesthesia staff to use a quick reference guide to determine the safest anesthetic management of the parturient with increased ICP. To reach this goal, the project had two objectives. The first objective was to develop an evidence-based quick reference explaining the labor anesthesia options for the parturient with underlying neurologic disorders and increased ICP. The second objective was to present the findings from the literature review to the anesthesia staff. The project's host facility was St. John's Hospital in Springfield, Illinois. The sample population consisted of obstetric residents, certified registered nurse anesthetists, and anesthesiologists. The project was submitted to IRB at Southern Illinois University, deemed quality improvement, and

exempt from further review. A paper 7-question survey was completed voluntarily by the sample population.

## **Evaluation**

The survey was comprised of two demographic questions and five Likert-style questions. Demographic data was analyzed using descriptive statistics. A five-point Likert scale, ranging from strongly agree to strongly disagree, was utilized to assess improvement in knowledge and staff willingness to use a reference tool to help decide the safest anesthesia labor option in the parturient with increased ICP. The sample size was 8 participants. Sixty-three percent of the participants strongly agreed that the guideline was an appropriate tool for the obstetric unit. Seventy-five percent of the participants strongly agreed that the guideline was easy to read and interpret. Seventy-five percent of the participants strongly agreed that they would likely use the guide to determine the most appropriate and safest anesthesia option for the parturient with increased ICP.

This project had several limitations. The sample size was small, which created less data for interpretation. The sample included two participants who were obstetrical and gynecology resident physicians with no anesthesia experience. A convenience sample was used, so randomization was not possible. These factors limit the ability to generalize the results of this project to the larger population.

## **Impact on Practice**

The survey results show that the proposed guideline is an appropriate tool for the obstetrical unit and that the tool is easy to interpret. Additionally, participants displayed a willingness to use the guide to determine the safest labor anesthesia option for the parturient with increased ICP. The results indicate staff buy-in for the reference guide, meaning that best practices will be implemented in the parturient with increased ICP. The project promotes the

most effective anesthetic care of the mother with increased intracranial pressure while promoting safe care for the fetus.

## **Conclusion**

In conclusion, this doctoral project on the anesthetic management of the parturient with increased intracranial pressure promotes utilization of the safest labor anesthetic option. The survey results suggest that the reference guide will be an excellent tool and will likely be used by the obstetric department at St. John's Hospital. Despite limitations, the project started a discussion and informed staff that a tool was available to help determine the safest anesthetic option. By implementing the reference guide, this project can ensure the best outcomes for the mother and fetus while reducing morbidity and mortality in a unique population.

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