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COMPARATIVE EFFECTIVENESS OF NEURAXIAL ANESTHESIA TECHNIQUES IN OBESE PARTURIENT WOMEN WITH PREGNANCY-INDUCED HYPERTENSION UNDERGOING CESAREAN SECTION

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Abstract: To evaluate the efficacy of various neuraxial anesthesia techniques in parturient women with obesity and pregnancy-induced hypertension (PIH) undergoing cesarean section (CS). A retrospective analysis was conducted on data from 110 parturient women with obesity and PIH who had CS. The participants were categorized into three groups based on the type of neuraxial anesthesia used: spinal anesthesia (SA), epidural anesthesia (EA), and combined spinal-epidural anesthesia (CSE). Clinical variables were assessed and compared across these groups. The average age of the patients was 30 years. Women in the CSE group experienced a longer time from puncture to surgery, smaller intraoperative fluctuations in mean arterial pressure, higher Apgar scores at both 1 and 5 minutes, shorter surgery durations, and lower incidences of nausea, vomiting, and intraoperative hypotension compared to those in the SA and EA groups. Although CSE takes more time to administer in parturient women with obesity and PIH undergoing CS compared to SA or EA, it offers several significant advantages. These include a reduction in surgery time, more stable intraoperative mean arterial pressure, decreased rates of nausea, vomiting, and intraoperative hypotension, and improved Apgar scores at 1 and 5 minutes.

Key words: Neuraxial anesthesia, obesity, pregnancy-induced hypertension, cesarean section, spinal anesthesia, epidural anesthesia, combined spinal-epidural anesthesia, maternal outcomes, neonatal outcomes, Apgar scores.

Introduction: The prevalence of obesity is on the rise globally, especially among women of childbearing age. In many developed countries, approximately 15% to 21% of women in their reproductive years are affected by obesity. This condition significantly increases the risk of complications such as pregnancy-induced hypertension (PIH), which can adversely impact both fetal and maternal health outcomes. One of the major concerns for parturient women with PIH is labor pain, which can lead to dangerous spikes in blood pressure and potentially cause cerebrovascular hemorrhage. These risks complicate the decision-making process for vaginal delivery, often making cesarean section (CS) the preferred option to mitigate the onset of severe complications.

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General anesthesia for elective CS carries a high risk of complications, including difficult intubation, rapid desaturation, increased risk of aspiration, and neonatal depression. Consequently, in the absence of contraindications, neuraxial anesthesia is considered the gold standard for elective CS procedures. Neuraxial anesthesia encompasses spinal anesthesia (SA), epidural anesthesia (EA), and combined spinal-epidural anesthesia (CSE), all of which are commonly utilized in clinical practice for CS.

Despite the widespread use of these three neuraxial anesthesia techniques, there is no clear consensus on which method is superior. Moreover, comparative studies specifically examining the effectiveness of these approaches in parturient women with obesity and PIH are lacking. Therefore, this study aims to fill this gap by comparing the effectiveness of different neuraxial anesthesia approaches in parturient women with obesity and PIH undergoing CS.

Purpose of study: The purpose of this study is to evaluate and compare the effectiveness of different neuraxial anesthesia techniques—spinal anesthesia (SA), epidural anesthesia (EA), and combined spinal-epidural anesthesia (CSE)—in parturient women with obesity and pregnancy-induced hypertension (PIH) undergoing cesarean section (CS). The study aims to determine which anesthesia method offers the best outcomes in terms of surgery duration, intraoperative hemodynamic stability, incidence of adverse events, and neonatal health as measured by Apgar scores.

Material and methods: SA was administered with the patient positioned laterally. The L3–L4 or L2–L3 interspace was selected for needle insertion at the midline. A single 2.5-mL dose of 0.5% ropivacaine was injected using a 25-gauge, 90-mm pencil-point needle after confirming the free flow of cerebrospinal fluid. The target was to achieve a sensory level of analgesia between T6 and T8.

EA was performed with the patient in the lateral position, using a 16-gauge needle at the L1–L2 or L2–L3 intervertebral space. After aspiration, a test dose of 3 mL of 2% lidocaine with 1/200,000 epinephrine was administered. If no epidural bleeding was detected, an additional dose of up to 14 mL of the mixture was given to achieve a T6–T8 block height.

CSE was carried out with the patient in the lateral position. A mixture of 1.5 mL of 1% ropivacaine and 0.5 mL of 10% glucose was injected into the subarachnoid space via the L2–L3 intervertebral space. An epidural catheter was inserted cephalad. Anesthesia was maintained between T6 and T8. If the surgery exceeded 2 hours, an additional 5 mL of 0.5% ropivacaine was administered through the epidural catheter.

Patients were assigned to the SA, EA, and CSE groups based on the neuraxial anesthesia technique used. The demographics recorded for each group included age, BMI, gestational age, and mean arterial pressure (MAP) measured before anesthesia. The following data were also collected: time from puncture to surgery, intraoperative

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MAP changes, sedative use, intraoperative fluid infusion, surgery duration, Apgar scores at 1 and 5 minutes post-birth, adverse events (such as shivering, nausea, vomiting, paresthesia, radicular pain, backache, headache post-CS), and the maximum postoperative numerical rating scale score of the incision. Demographic, intraoperative, and postoperative data were compared across the three groups. Hypotension was defined as a MAP of <75 mmHg or a >25% decrease in systolic pressure from the baseline value.

Continuous variables are presented as mean ± standard deviation. The chi-square test was used for categorical data analysis. Analysis of variance (ANOVA) was employed to compare continuous variables among the three groups. Statistical analyses were performed using SPSS version 17.0 (SPSS, Inc., Chicago, IL, USA), with a significance threshold set at $p < 0.05$.

Results of study: The study included 110 parturient women, with a mean age of 22.3 ± 3.2 years and a mean gestational age of 32.8 ± 0.3 weeks. The participants were divided into three groups: 42 in the SA group, 34 in the EA group, and 32 in the CSE group. There were no significant differences in age, BMI, gestational age, or MAP among the groups.

The rate of sedative use, the volume of intraoperative fluid infusion, the rate of adverse events, the maximum postoperative numerical rating scale score, and the length of hospital stay did not differ significantly among the groups.

- Time from Puncture to Surgery: Women in the CSE group had a longer time from puncture to surgery ($p = 0.010$).

- Intraoperative MAP Change: The CSE group experienced smaller intraoperative changes in MAP ($p = 0.001$).

- Apgar Scores: Higher Apgar scores at 1 and 5 minutes were observed in the CSE group (both $p < 0.05$).

- Surgery Time: The CSE group had a shorter surgery time ($p < 0.001$).

- Adverse Events: The CSE group had lower rates of nausea ($p = 0.029$), vomiting ($p = 0.008$), and intraoperative hypotension ($p = 0.024$) compared to the SA and EA groups.

Since the 1980s, the rate of obesity among women of reproductive age has risen significantly. Although the pathophysiology of PIH is not fully understood, obesity is a known risk factor. PIH can cause significant neonatal mortality and maternal complications. It can lead to placental dysfunction, fetal growth retardation, and poor fetal tolerance to hypoxia. During uterine contractions, the temporary interruption of uteroplacental blood flow exacerbates fetal hypoxia and can result in fetal death. CS can quickly alleviate fetal hypoxia and improve fetal outcomes, reducing the risk of neonatal death compared to vaginal delivery in women with PIH.

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General anesthesia for parturient women with PIH can cause exaggerated hemodynamic responses to endotracheal intubation, leading to increased catecholamine levels and potentially causing cardiovascular complications. These can result in pulmonary edema, cerebral hemorrhage, and increased morbidity and mortality for both the mother and fetus. Neuraxial anesthesia techniques, such as SA, EA, and CSE, are preferred for elective CS due to better Apgar scores and reduced maternal and fetal risks.

Spinal Anesthesia (SA): SA is commonly used for CS due to its rapid onset and minimal anesthetic requirement. However, SA is associated with significant hemodynamic instability, including intraoperative hypotension and substantial decreases in MAP. These complications can compromise maternal and fetal well-being, especially in obstetric patients with PIH, by reducing uteroplacental blood flow and causing fetal hypoxia and acidosis. Hypotension during SA can also increase the incidence of nausea, vomiting, and fetal hypoxia.

Epidural Anesthesia (EA): EA allows for dose adjustments during surgery and provides stable hemodynamics through an indwelling catheter. This flexibility makes it a reliable option for maintaining hemodynamic stability and extending the duration of anesthesia as needed.

Combined Spinal-Epidural Anesthesia (CSE): Although CSE is more time-consuming than SA or EA, it offers rapid onset and superior anesthesia quality. The presence of an epidural catheter allows for top-up doses, optimizing and prolonging the spinal block. In this study, CSE resulted in a more stable MAP, fewer cases of nausea and vomiting, and higher Apgar scores at 1 and 5 minutes. The smaller decrease in MAP during CSE contributed to better uteroplacental blood flow and improved fetal outcomes. Additionally, CSE was associated with shorter surgery times due to the superior quality of anesthesia, facilitating quicker surgical procedures.

Overall, CSE provided the most favorable outcomes in terms of maternal and fetal well-being, making it a preferable choice for neuraxial anesthesia in parturient women with obesity and PIH undergoing CS.

Conclusion: CSE requires more time to administer in parturient women with obesity and PIH undergoing CS compared to SA or EA. However, it offers significant advantages, including a shorter surgery duration, more stable intraoperative MAP, reduced incidence of nausea, vomiting, and intraoperative hypotension, and improved Apgar scores at 1 and 5 minutes post-birth, making it a preferable choice over SA and EA.

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