

Subarachnoid block for caesarean section in severe preeclampsia

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Abstract

Pregnancy-induced hypertension constitutes a major cause of morbidity and mortality in developing nations and it complicates about 6–8% of pregnancies. Severe preeclampsia poses a dilemma for the anesthesiologist especially in emergency situations where caesarean deliveries are planned for uninvestigated or partially investigated parturients. This article is aimed to review the literature with regards to the type of anesthesia for such situations. A thorough search of literature was conducted on PubMed, EMBASE, and Google to retrieve the articles. Studies on parturients with severe preeclampsia, undergoing caesarean section, were included in this article. There is growing evidence to support the use of subarachnoid block in such situations when the platelet counts are $>80,000 \text{ mm}^{-3}$. Better hemodynamic stability with the use of low-dose local anesthetic along with additives and better neonatal outcomes has been found with the use of subarachnoid block when compared to general anesthesia.

Key words: Pregnancy-induced hypertension, regional anesthesia or general anesthesia for caesarean deliveries, severe preeclampsia, subarachnoid block for caesarean section, thrombocytopenia and regional anesthesia

Hypertensive disorder during pregnancy can exist in four distinct forms – gestational hypertension, [pregnancy-induced hypertension (PIH)], chronic hypertension, unclassified hypertension, and eclampsia, as classified by the International Society for the Study of Hypertension (ISSHP).^[1] PIH complicates around 6–8% of pregnancies. It is a multiorgan disease and is classified as mild PIH or severe PIH. Severe PIH is defined as the presence of systolic blood pressure (SBP) ≥ 160 mmHg and diastolic blood pressure (DBP) ≥ 110 mmHg, on two occasions 6 h apart, associated with proteinuria > 5 g in 24 h, and with evidence of end organ damage.

Pathophysiology

It is postulated that there is a functional imbalance between the endogenous vasodilators (prostacyclins PG I_2) and

vasoconstrictors (thromboxane A_2) leading to arteriolar vasospasm. There is intense vasoconstriction leading to hypoperfusion of vital organs. The hemodynamic profile is thus altered. Various cardiovascular (CVS) effects like labile blood pressure (BP), decreased colloid oncotic pressure, intravascular volume depletion, increased systemic vascular resistance, hypertension, and hypercoagulable states can coexist. The deleterious effects on central nervous system include cortical blindness, cerebral edema, seizures and cerebrovascular accidents. Renal system involvement can manifest as proteinuria, decrease in renal blood flow with decreased glomerular filtration rate, increased blood urea nitrogen and creatinine. Elevated liver enzymes and decreased plasma serum cholinesterase levels reflect liver involvement. Airway edema, pulmonary edema, and ventilation perfusion mismatch may be associated as a result of respiratory system involvement. Fetal compromise results as a consequence of uteroplacental insufficiency, placental abruption, chronic fetal hypoxia, intrauterine growth retardation (IUGR), and premature labor and delivery.

The definitive cure of PIH is the delivery of fetus and placenta. Termination of pregnancy may be required in the form of induction of labor or caesarean section (CS), which may be a planned or an emergent procedure. Anesthesiologist comes into the picture when caesarean delivery is contemplated. CS may be indicated either in maternal or in fetal interest. The maternal indications may be uncontrolled BP, unfavorable

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cervix, failed induction of labor, or ante partum hemorrhage. The fetal indications may be fetal distress or IUGR.

Search Strategy

A thorough search of literature was done on the Google search engine, EMBASE, and Pubmed. The articles comparing different techniques of anesthesia for CS in parturients with severe preeclampsia till the year 2010 were included in the study. Studies reflecting upon the hemodynamics and neonatal outcomes with different techniques were included. Recent guidelines on the use of regional anesthesia in patients on anticoagulant therapy were also studied. Studies on mild to moderate preeclampsia were excluded from the review process.

Anesthesia Technique

Either of the two techniques – general anesthesia (GA) or central neuraxial blockade (CNB) – may be employed for anesthesia. GA is often considered unsafe in obstetric practice as such, more so in patients with PIH, because of potentially difficult airway or risk of failed intubation,^[2] hypertensive response to laryngoscopy and intubation, risk of aspiration pneumonitis, drug interactions between magnesium and nondepolarizing muscle relaxants (NDMRs) leading to enhanced sensitivity to NDMRs,^[3] and impaired villous blood supply.^[4]

Regional anesthesia is often considered to be a safer option in such situations as the hazards of difficult airway associated with weight gain and edema can be avoided. The technique of anesthesia has to be chosen judiciously based on individual patient condition.

Concern of Severe Hypotension

Often the concern of severe hypotension following subarachnoid block (SAB) deters the anesthesiologist from choosing this technique in patients with severe preeclampsia. A number of studies have been conducted to find the hemodynamic effects of regional anesthesia in patients with preeclampsia. Aya *et al.* observed that the risk of hypotension was almost six times less in patients with severe preeclampsia than in healthy parturients.^[5] Another study, conducted in 2005, attributed the hypotension following SAB to preeclampsia-associated factors, rather than a small uterine mass.^[6] A review by Dyer *et al.* found that preeclampsia patients had a lower susceptibility to hypotension and probably less impairment of cardiac output than healthy parturients after SAB for CS.^[7] GA, as well as regional anesthesia, has been shown to be acceptable and safe method for conducting caesarean deliveries in preeclampsia, if steps are taken to ensure a careful approach to either technique.^[8] Comparable hemodynamics

were observed with use of SAB, GA, or epidural anesthesia (EA), in patients with severe PIH.^[9,10] EA has been found to be superior to GA as it is associated with a smaller maternal hemodynamic and neuroendocrine stress response.^[11] It reduces the mean arterial pressure (MAP) without altering cardiac index (CI), peripheral vascular resistance (PVR), central venous pressure (CVP), or pulmonary capillary wedge pressure (PCWP).^[12] It also offers the advantage of increasing intervillous blood flow provided that adequate preloading is done and supine hypotension is avoided.^[12] EA has been traditionally regarded as safer in patients with preeclampsia as compared to SAB as it does not produce sudden hypotension. Recent studies have, however, shown that the reduction in BP is comparable with either of the two techniques.^[13-17] Besides maintaining comparable hemodynamics, SAB has the additional advantage of simplicity, faster onset, reliability, and it saves a lot of time.^[17] Recently in a prospective observational study on 15 parturients with severe preeclampsia, even SAB has been shown to produce clinically insignificant changes in cardiac output.^[18] The hemodynamic alterations produced by SAB are comparable with that in GA in severe preeclampsia^[19,20] and hence the uteroplacental blood flow is not altered in parturients receiving SAB.^[20]

Opioids have been used by several workers as an additive to local anesthetic for regional anesthesia, thereby reducing the dose of local anesthetic for CS. Better hemodynamic stability with adequate anesthesia has been found with the use of low-dose hyperbaric bupivacaine (7.5–12 mg and as low as 6 mg, 0.5%) and opioid such as fentanyl or sufentanyl as compared to conventional doses of hyperbaric bupivacaine (12.5–13.5 mg, 0.5%).^[21,22] Parturients with severe preeclampsia have been successfully managed using an ultra-low dose of intrathecal hyperbaric bupivacaine (3.75 mg, 0.5%) with fentanyl (25 µg) or morphine (100 µg) and diluting with normal saline to make the volume up to 3 ml and 3 ml lidocaine 1.5% given via epidural space. Stable hemodynamics have been reported, obviating the need for vasopressors and large volume preload, minimizing the risk of pulmonary edema due to excessive hydration.^[23]

Preloading with crystalloid or colloid in normal parturients undergoing SAB for elective CS has not always been found to be effective.^[24,25] Preloading and coload is still recommended in patients receiving SAB. ASA task force recommends intravenous fluid preloading to decrease the frequency of maternal hypotension in patients undergoing CS under SAB.^[26] Preloading is all the more important in PIH patients as hypovolemia and vasospasm are present. Such patients do not require more volume preloads than normotensive controls to prevent catastrophic hypotension under SAB although individual patient variations may be there.^[5] About 10 ml/kg

fluid should be used to preload the PIH parturients over a period of 10–15 min at the time of SAB.^[27]

Ephedrine has been used safely for maintaining BP because it does not adversely affect the uterine blood flow.^[28,29] Berends *et al.* have concluded that the use of prophylactic ephedrine is a safe and effective method for prevention and treatment of hypotension after CSE technique.^[29] In a recent study, the degree of hypotension and requirement of vasopressors was found to be similar in two groups of patients administered either SAB or EA.^[14] In a prospective study, Sharwood-Smith *et al.* concluded that patients with severe preeclampsia administered SAB required less ephedrine as compared to those administered EA.^[30]

A prospective randomized multicenter study comparing the hemodynamic effects of SAB and EA for CS in preeclampsia showed that although the incidence of hypotension was more frequent in SAB than in the EA group (51% vs. 23%), the duration of significant hypotension (SBP \leq 100 mmHg) was short (\leq 1 min) in both the groups. Hypotension was easily treated in both groups by administration of ephedrine, although its use was more in the SAB group. This study concluded that SAB was safe for CS in patients with severe preeclampsia.^[15]

Phenylephrine also restores the MAP without increasing the maternal cardiac output.^[18] Chiu performed a 5-year retrospective analysis for CS for mild to moderate and severe preeclampsia and found that decreases in BP were similar after SAB and EA. The use of intravenous fluids and ephedrine was also comparable in the two groups. The results support the safety of SAB in women with preeclampsia.^[16] Phenylephrine and ephedrine have been compared in a number of studies, which have concluded that neonates of women receiving phenylephrine have higher umbilical artery pH values.^[31] A study by Macarthur *et al.* found that though the uterine artery resistance may be increased with phenylephrine, the oxygen consumption by the fetus is not and, therefore, the net oxygen balance is more favorable with phenylephrine than with ephedrine.^[32] ASA task force recommends that both intravenous ephedrine and phenylephrine are acceptable drugs for treating hypotension during neuraxial anesthesia.^[26]

Concern Regarding Neonatal Outcomes

Neonatal outcomes after various anesthesia techniques have been studied by various workers. Neonatal APGAR scores and umbilical arterial blood markers are predictors of neonatal outcomes. It has been shown that these variables are not influenced by the type of anesthesia. No statistically significant difference was found in the 1st and 5th minute APGAR

scores and umbilical artery blood gas markers (pH, PCO₂, HCO₃⁻ BE) between two group of patients administered SAB or GA.^[20] Other studies tend to differ and place SAB on a superior platform to GA. APGAR scores have been found to be marginally better in the SAB group in a study conducted by Van Bogaert *et al.*^[10] Other studies in support of SAB have also shown that transient neonatal depression seen after GA can be avoided by using SAB.^[11] Neonatal outcome of patients with PIH for CS under SAB and EA has been found to be comparable.^[16,30] Even addition of fentanyl to low-dose bupivacaine has not been found to affect the neonatal outcomes.^[22]

Complications

The types of complications associated with SAB are less serious and easily manageable as compared to the more serious nature in GA which may even lead to mortality, the reported mortality being as high as 4.3%.^[33] Postoperative complications like nausea, vomiting, and hypertension were found to be higher in patients receiving GA. Besides these, SAB does not expose the mothers to the hazards of GA.^[20] In a retrospective observational study of 54 cases of SAB, no complications were reported in mothers with preeclampsia and their fetuses, thus establishing the safety of the technique.^[34] A retrospective analysis on the duration of hospital stay was conducted on 1619 women who received GA ($n = 582$) or neuraxial anesthesia [$n = 614$ for combined spinal and epidural anesthesia (CSEA) and $n = 423$ for EA]. It was found that neuraxial anesthesia for CS is associated with a shorter duration of hospital stay as compared to GA.^[35]

Thrombocytopenia, Coagulopathy, and Subarachnoid Block

A nagging concern while deciding the type of anesthesia is the presence of thrombocytopenia. Platelet function can also be abnormal in such parturients, besides the decrease in platelet count. Platelet count decreases by 20% during normal pregnancy.^[36] This, by and large, is not a contraindication for spinal or epidural placement. Approximately 0.5–1% patients present with platelet count of $< 1,00,000 \text{ mm}^{-3}$.^[37] The overall risk of developing an epidural or spinal hematoma after central neuraxial blockade is 1:1,50,000 to 1:2,20,000.^[38] Patients with preeclampsia may have rapidly changing platelet counts and it is important that serial platelet counts be taken instead of relying on a single value.

Thrombocytopenia is seen in preeclampsia patients and this may contraindicate regional anesthesia or analgesia. Platelet count $< 1,00,000 \text{ mm}^{-3}$ is also not a contraindication for EA

as indicated by the results of three retrospective studies.^[37,39,40] Robson *et al.* recommend that EA should not be used if the platelet count is below $80 \times 10^9 \text{L}^{-1}$.^[41] Beilin *et al.* conducted a survey and found that most anesthetists would perform an epidural when the platelet count is between 80,000 to 1,00,000 mm^{-3} . However, few were willing to place an epidural catheter in counts below 80,000 mm^{-3} .^[42] Bleeding time is not a reliable indicator of clotting abnormality as it does not necessarily reflect the risk of bleeding at other sites^[43,44] and it is not prolonged until platelet count falls below 1,00,000 mm^{-3} .^[45,46] Thromboelastography (TEG) is a better measure of platelet function as it measures all the phases of coagulation and fibrinolysis.^[36] Orlikowsky *et al.* conducted a study comparing platelet count, TEG parameters, and bleeding time in healthy parturients and those with preeclampsia. There was a strong correlation between platelet count and TEG in thrombocytopenic patients.^[47] Aspirin is also known to alter the platelet function significantly. Preeclampsia patients may also be on concurrent aspirin prophylaxis, which has been demonstrated to significantly improve the maternal and perinatal outcome in such patients.^[48]

A history of easy bruising or evidence of petechiae or ecchymoses should alert the anesthesiologist, and regional anesthesia should be avoided. A platelet count should be obtained. Single values may be inconclusive, but a rapidly decreasing platelet count should be a red signal. A review by Vandermuelen *et al.* revealed 61 cases of spinal hematoma out of which 68% occurred in patients with coagulopathy and 75% of all the cases had received EA instead of SAB. Out of the cases conducted under EA, 88% had an epidural catheter inserted and almost 50% of these cases developed epidural hematoma after catheter removal.^[38]

If the epidural catheter is placed, a midline approach should be used and assessment of sensory and motor function should be done every 2 h. Immediate evaluation should be done if abnormal blockade or prolonged blockade is suspected. If a patient has an epidural catheter *in situ* and develops a coagulopathy, the catheter should be removed only after the correction of coagulation status.^[38] Immediate evaluation is necessary because if the patient has an epidural hematoma, emergency laminectomy and decompression must be performed within 6–12 h to preserve the neurologic function.^[49]

SAB offers an advantage over EA for it can be performed with a smaller gauge needle in contrast to a larger gauge needle required for EA. Koyama *et al.* have reported a case of spinal subarachnoid hematoma following SAB in a patient with HELLP syndrome. The case was followed up and managed conservatively and the patient had an almost complete recovery within 3 months. They concluded that it

is important for the clinicians to recognize the symptoms and signs of spinal subarachnoid hematoma to avoid delay in the treatment that might result in severe neurological deficit.^[50]

Single shot SAB May be a good choice for CS when compared to GA or EA even for patients with severe preeclampsia without features of impending eclampsia. Careful selection of patients is, however, important. SAB is safe both for the mother and the baby; it provides better neonatal outcome and has fewer complications. Early breast feeding can be initiated. The shorter duration of hospital stay is an added advantage for the mother and the newborn.

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