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Case Series on Epidural Volume Extension Technique in High-Risk Obstetric Patients

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ABSTRACT:
Epidural volume extension involves the injection of normal saline into the epidural space shortly after an intrathecal injection, to increase the height of the sensory block. This technique benefits from a significant dose-sparing effect, as it enables the provision of adequate anesthesia and analgesia with minimal hemodynamic disturbances. The present case series highlights the successful application of this technique in Obstetric patients.

Introduction

Epidural volume extension involves the introduction of 0.9% saline solution into the epidural space promptly after administering an intrathecal injection. This technique is intended to swiftly heighten the sensory block level achieved through the deposition of the intrathecal drug. Recent analysis has raised doubts about its effectiveness in enhancing the sensory block level, while also recognizing a lack of adequate data to draw definitive conclusions. It is observed that the efficacy of epidural volume extension may be influenced by various factors. In the realm of regional anesthesia, the amount of local anesthetic administered intrathecally is a recognized factor in determining the sensory level attained following a spinal block. Therefore, the significance of the intrathecal dose itself in determining the success or failure of epidural volume extension could be substantial.

The intrathecal doses used in conjunction with epidural volume extension and their impact have shown variations in previous research. Application of epidural volume extension to intrathecal bupivacaine doses of 8 mg or higher has been well-documented to augment sensory block levels in both obstetric and non-obstetric populations. On the contrary, only two studies have explored doses lower than 8 mg with epidural volume extension for block augmentation, both of which were conducted in obstetric patients and demonstrated unsuccessful block enhancement. Hence, there might be a reliance of epidural volume extension on the intrathecal dose. Intriguingly, case reports continue to emerge showcasing successful utilization of the technique in high-risk patients, despite deliberately administering reduced or sub-optimal intrathecal doses, sometimes as low as 3 mg. The reduction in intrathecal dose was highlighted as a primary benefit of epidural volume extension, with the augmentation of sensory levels induced by normal saline being counted on for adequate block.

CASE DESCRIPTION

Case 1

A 25-year-old primigravida at 36 weeks of gestation presented in obstetric department with complaint of dyspnoea at rest, and clinical examination revealed her to be in cardiac failure. Two D Echo revealed cardiomyopathy, biventricular systolic dysfunction, Grade I diastolic dysfunction with an ejection fraction of 42%. Diagnosis of peripartum cardiomyopathy was made. Tablet furosemide and tablet Methyldopa was started, and she was planned for elective cesarean section.

Case 2

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A 23-year old primigravida who was diagnosed with Takayasu arteritis Type III along with bilateral subclavian and renal artery involvement presented to the obstetric unit for safe confinement. She also suffered from renovascular artery hypertension and dilated cardiomyopathy secondary to Takayasu arteritis. Patient was on tablet nifedipine 10 mg OD, tablet digoxin 0.25 mg OD, tablet levocarnitine 500 mg OD and tablet prednisolone 30 mg OD. She was posted for elective cesarean section

Case 3

A 29-year-old gravid 3 at 38 weeks of gestation presented to obstetric unit and was in congestive heart failure and pulmonary edema. Two D Echo was performed, which revealed cardiomyopathy with an ejection fraction of 42% and pulmonary artery hypertension. She was put on tablet lasix and tablet digoxin. Cardiac consult was sought and she was planned for the elective cesarean section.

Case 4

A 35-year-old woman, experiencing her first pregnancy, was diagnosed with Takayasu's arteritis type III, which involved her bilateral subclavian arteries, the thoracic aorta, and the renal artery. She sought prenatal care at the obstetrics unit to ensure a safe delivery. The patient suffered from renovascular and pulmonary artery hypertension, as well as dilated cardiomyopathy, all of which were attributed to Takayasu's arteritis. She was taking tablet prednisolone 30 mg OD, tablet digoxin 0.25 mg OD, and tablet nifedipine 10 mg OD as part of her treatment. The patient was scheduled for an elective cesarean section.

Case 5

A 29-year-old female patient with a diagnosis of RHD and severe mitral stenosis, severe tricuspid regurgitation, and trivial mitral regurgitation with moderate pulmonary artery hypertension was scheduled for an elective caesarean section due to cephalopelvic disproportion and oligohydramnios. At 7 months pregnant, she began experiencing breathlessness and was subsequently diagnosed with RHD and mitral stenosis, with a mitral valve area of 1 cm2. Her electrocardiogram revealed sinus tachycardia. To treat her right heart failure, the patient was prescribed injectable furosemide 20 mg BD and ivabradine 5 mg OD.

Anaesthetic plan

All patients underwent comprehensive assessment, and all were administered aspiration prophylaxis. Before being transported to the operating room (OR), each patient was given 1 mg of midazolam intravenously. Upon entering the OR, non-invasive blood pressure, SpO2, and electrocardiogram leads were attached to monitor vital parameters. A wide-bore peripheral intravenous line was secured, and patients were preloaded with 500 mL of crystalloids. Employing aseptic precautions, a 18 G epidural catheter was inserted using a 16 G Tuhoy needle via the L2-L3 interspace, following the loss of resistance technique to air, and fixed at the 4 cm mark. This was followed by subarachnoid block with 1 mL of 0.75% hyperbaric ropivacaine and 25 µg of fentanyl injected intrathecally via the L3-L4 interspace using a 25 G Whitacre needle. In all obstetric cases, a wedge was placed under the right hip joint, and 8 mL of normal saline was injected through the epidural catheter 5 minutes after the subarachnoid block. The right internal jugular vein was cannulated after administering an appropriate dose of midazolam and local anesthetic infiltration. Intraoperative fluid management was guided by central venous pressure and direct arterial pressure monitoring in all patients. The dermatomal level of anesthesia was assessed at 3, 5, and 10 minutes after epidural saline administration by the pin prick method. All patients remained hemodynamically stable throughout surgery due to the traditionally lesser density of sympathetic blockade achieved by this technique compared to classical subarachnoid blockade. Following surgery, patients were transferred to the intensive care unit for overnight observation, and postoperative analgesia was maintained through epidural infusion of ropivacaine 0.2% at a rate of 4-6 mL/h.

Discussion

Epidural volume extension (EVE) is a regional anesthesia technique that combines the benefits of spinal and epidural anesthesia while avoiding the drawbacks of general anesthesia. It is particularly beneficial for high-risk patients, as it uses a small amount of drug, reducing the potential for hemodynamic compromise. The EVE technique eliminates the need for potent cardiodepressant drugs, providing the anesthetist with a valuable tool for regional anesthesia. We chose this technique for our patient because it offers the advantages of both regional and general anesthesia while minimizing the risk of adverse effects. The EVE technique provided the rapidity, density, and reliability

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of spinal anesthesia, enabling us to titrate the level of anesthesia, vary the intensity of the block, extend the duration of anesthesia, and deliver postoperative analgesia.

If spinal anesthesia was unsuccessful, and it also enabled us to bypass the negative consequences of airway manipulation and anesthetic agents, which could have had an unfavorable impact on the patient's cardiovascular system. By using subarachnoid block to achieve mild vasodilation, we were able to offer benefits to patients with isolated left ventricular dysfunction. Furthermore, our technique prevented the negative inotropic effect of anesthetic agents and the adverse impact on venous return caused by positive pressure ventilation. In conclusion, our approach was superior to general anesthesia in terms of sidestepping these potential complications.

Cardiac patients who undergo LSCS can receive either regional or general anesthesia. We chose to use the EVE technique as it has been reported to provide several benefits. The technique has a significant dose-sparing effect, provides adequate anesthesia and analgesia with minimal disruptions to blood flow, and allows for faster recovery of muscle function. Additionally, the EVE technique is reliable and offers the advantage of epidural anesthesia, which can extend the duration of anesthesia if needed. It can also be used for postoperative pain relief. The EVE technique is preferable to general anesthesia because it avoids the need for airway manipulation and the accompanying stress response, which can negatively impact a patient's cardiovascular health.

The most frequently cited theory for EVE is thecal compression caused by the volume effect on subsequent epidural injections of saline. A study conducted by Blumgart et al. demonstrated higher levels of analgesia with the EVE technique compared to spinal anesthesia alone. This was due to the volume effect in the epidural space, which compresses the subarachnoid space and enhances the intrathecal spread of the drug. Mardirosoff and colleagues observed that EVE performed 20 minutes after intrathecal injection failed to produce any significant increase in the sensory level. However, EVE performed 5 minutes after intrathecal injection yielded a significantly higher sensory block. This is the reason why we decided to administer 8 ml of normal saline 5 minutes after intrathecal injection.

Lew and his team discovered that the use of the EVE technique in CSE resulted in quicker motor recovery, which in turn reduced the amount of time spent in the post-anaesthetic care unit. Additionally, Takiguchi et al. conducted a myelographic study on healthy volunteers, demonstrating the calf compression following EVE.

Conclusion

EVE's method is a unique approach that enabled us to attain the desired level of surgical anesthesia using a smaller dose of local anesthetic agent, which prevented the adverse hemodynamic effects typically associated with conventional doses. By carefully administering fluids under close monitoring and tailoring regional anesthesia to the patient's needs, we were able to meet our anesthetic goals. The EVE technique can be safely used on high-risk cardiac patients undergoing LSCS to achieve the desired surgical anesthesia without causing adverse hemodynamic disturbances.

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