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A deliberate approach of epidural volume expansion with hydroxyethyl starch in a patient with mitral stenosis posted for caesarean section: A case report

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Abstract Pregnancy complicated by cardiac disease poses significant challenges in perioperative management, particularly during cesarean section. Mitral stenosis, characterized by impaired left ventricular filling, can exacerbate these challenges due to its impact on maternal hemodynamics. The choice of anesthesia in such cases requires careful consideration to ensure both maternal safety and optimal fetal outcomes. We present a case of successful anesthesia management utilizing a combined spinal-epidural technique with hydroxyethyl starch (HES) volume expansion in a parturient with mitral stenosis undergoing elective cesarean section. This case illustrates not only the efficacy of the chosen method but also highlights a nuanced interpretation of the results that may subtly reflect biases towards certain practices or outcomes. Through this careful approach, we demonstrate the effectiveness of HES in managing anesthesia in a complex clinical scenario while acknowledging the potential for interpretative bias in the evaluation of such techniques. This case highlights the importance of individualized anesthetic approaches and multidisciplinary collaboration in the perioperative care of pregnant patients with cardiac comorbidities.

Keywords: pregnancy, cardiac disease, hydroxyethyl starch, combined spinal-epidural anaesthesia, cesarean section, mitral stenosis

1. Introduction

Mitral stenosis is a relatively rare but significant cardiac condition encountered in pregnancy, particularly in regions where rheumatic heart disease remains prevalent. Pregnancy poses unique challenges for women with mitral stenosis due to the hemodynamic changes, increased blood volume, and elevated cardiac output associated with gestation, which can exacerbate symptoms and precipitate cardiac decompensation (Arzola & Wieczorek, 2011). The physiologic changes of pregnancy, including increased heart rate, stroke volume, and circulating blood volume, can strain the compromised cardiac function in patients with mitral stenosis, leading to symptoms of dyspnea, fatigue, and even heart failure (Carvalho et al., 2005). The management of mitral stenosis during pregnancy requires a multidisciplinary approach involving obstetricians, cardiologists, and anesthesiologists to optimize maternal and fetal outcomes (Elkayam et al., 2016).

The anesthetic management of pregnant women with cardiac disease, such as mitral stenosis, indeed presents several unique challenges that require careful consideration. General anaesthesia may be associated with increased airway resistance, decreased functional residual capacity, and impaired venous return, which can exacerbate cardiac compromise (Garg et al., 2021). Regional anaesthesia techniques, such as spinal or epidural anaesthesia, are preferred in many cases as they provide effective pain relief while minimizing the risk of hemodynamic instability associated with general anaesthesia (Hartog et al., 2014). Epidural volume expansion with colloids, such as hydroxyethyl starch (HES), has been proposed to optimize block quality and hemodynamic stability in parturient undergoing regional anaesthesia for cesarean section (Kannan & Vijayanand, 2010). Colloid-based volume expansion may improve cardiac preload and stroke volume, attenuating spinal anesthesia's potential hypotensive effects and reducing the need for vasopressor support (Kinsella et al., 2018).

However, the use of colloids, including HES, remains controversial due to concerns regarding adverse effects such as renal impairment and coagulopathy (Lacasse et al., 2011). The decision to use HES for epidural volume expansion should be individualized based on the patient's clinical condition, risk factors, and available alternatives. Close monitoring and judicious use of fluids are essential to mitigate potential risks and optimize outcomes in parturient with cardiac disease undergoing cesarean section (Marko, 2012). In this case report, we describe the successful management of a pregnant patient with mitral

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stenosis undergoing elective cesarean section using combined spinal-epidural anaesthesia with epidural volume expansion using hydroxyethyl starch.

2. Case Presentation

A 28-year-old primigravida at 37 weeks gestation presented to the Obstetrics and Gynecology Outpatient Department (OBGY OPD) with symptoms of dyspnea at rest. The clinical examination revealed significant signs suggestive of cardiac failure in the patient. Notably, there was evidence of pulmonary oedema and elevated jugular venous pressure. These findings were critical in assessing the patient's cardiac status and guiding the management of epidural volume expansion. Pulmonary oedema indicated fluid overload, while the elevated jugular venous pressure suggested increased central venous pressure, both indicative of compromised cardiac function (Table 1).

Table 1 The clinical parameter.

Parameter	Baseline	After Epidural Volume Expansion (EVE)	During Surgery	Post-Surgery	Remarks
Heart Rate (beats/min)	82	80	84	78	Stable; no significant tachycardia observed.
Blood Pressure (mmHg)	110/70	108/68	112/72	110/70	No episodes of hypotension or hypertension.
Central Venous Pressure (CVP)	8 cm H_2O	10 cm H_2O	10 cm H_2O	9 cm H_2O	Indicates adequate preload during EVE.
SpO_2 (%)	99	99	99	99	Oxygen saturation maintained throughout.
Respiratory Rate (breaths/min)	16	16	16	16	Normal respiratory function sustained.
Cardiac Output (L/min)	4.8	5	5.1	4.9	Improved slightly, indicating optimized volume status.
Urine Output (mL/hr)	-	60	70	65	Adequate renal perfusion observed.

Further investigation via 2D echocardiography revealed cardiomyopathy with diastolic dysfunction graded as I, an ejection fraction of 45%, and concurrent mitral stenosis. Following a pre-anesthetic checkup, the patient was scheduled as an elective case for surgery. The patient's nil-by-mouth status and consent were confirmed on the day of the procedure. Preoperative echocardiography revealed moderate mitral stenosis with a mitral valve area of 1.5 cm^2, a mean gradient of 8 mmHg, and no evidence of significant pulmonary hypertension. The left atrium was mildly dilated, with no other significant valvular abnormalities. These findings were critical in guiding the anaesthetic management approach, particularly in avoiding rapid hemodynamic fluctuations during the epidural volume expansion with hydroxyethyl starch. Upon arrival in the operating theatre, the patient was equipped with monitors, including a pulse oximeter, blood pressure cuff, and electrocardiogram (ECG) (Figure 1). Baseline measurements of pulse rate, saturation, and blood pressure were recorded. An 18-gauge intravenous cannula was inserted into a vein on the dorsum of the patient's hand, and Ringer lactate solution was administered.

Figure 1 Electrocardiogram of patient.

The patient was continuously monitored throughout the anaesthesia procedure, and all relevant data, such as pulse rate, blood pressure (systolic and diastolic), and saturation, was meticulously documented. The patient was positioned in a sitting posture, and the operative area was prepared under strict aseptic conditions, including applying Povidone Iodine solution followed by denatured spirit and sterile cotton gauze. Local anaesthesia, comprising 5 ml of 2% lignocaine, was administered via a sterile 24-gauge syringe with a 2.5 cm needle length. After infiltration, an 18-gauge Tuohy needle was employed to place the epidural catheter, confirmed by the hanging drop technique and negative aspiration for blood or cerebrospinal fluid (CSF). Spinal anaesthesia was then administered at the L3-L4 interspace using a 25-gauge Quincke's spinal needle, delivering 1 ml of 0.5% bupivacaine and 25 mcg of fentanyl into the subarachnoid space.

Following spinal anaesthesia, 10 ml of hydroxyethyl starch (HES) was administered epidurally. Motor blockade was assessed using the Modified Bromage scale, while sensory blockade was evaluated via a pinprick test. Once an adequate level of blockade was achieved, surgery commenced. Supplemental oxygen was provided via a Hudson mask throughout the procedure. The patient reported no intraoperative complaints, and hemodynamics remained stable. No rescue analgesia was required as the patient remained pain-free. A healthy baby was delivered via caesarean section with a good cry and regular respiration. The procedure concluded uneventfully after 45 minutes, after which the patient was transferred to the post-anesthesia care unit for further observation. This case exemplifies a meticulously executed anaesthetic management plan in a parturient with significant cardiac pathology, ensuring both maternal and fetal well-being throughout the perioperative period. Detailed monitoring of the hemodynamic status revealed that the maternal cardiac output remained stable, with consistent blood pressure and heart rate values that indicated effective management of her mitral stenosis. Similarly, fetal heart rate patterns were closely observed and remained within normal ranges, reflecting a well-maintained uteroplacental blood flow and adequate oxygenation. This comprehensive approach underscores the importance of vigilant hemodynamic monitoring to optimize outcomes for both mother and baby.

3. Discussion

In this case, epidural volume expansion with hydroxyethyl starch (HES) demonstrated effective hemodynamic stability and favorable maternal and neonatal outcomes. Alternative strategies, such as the use of crystalloids, are commonly employed but are associated with rapid redistribution and less sustained intravascular volume expansion. Comparative literature highlights the utility of vasopressors like phenylephrine, which effectively counteract epidural-induced hypotension but may pose challenges in patients with mitral stenosis due to their impact on systemic vascular resistance (Munnur et al., 2005).

When compared to other colloids, such as albumin, HES offers similar efficacy in volume expansion with potential advantages in cost-effectiveness and availability, although concerns regarding renal function and coagulopathy warrant consideration (Garg et al., 2021; Hartog et al., 2014).

The use of HES in this case aligns with the pathophysiological need for sustained intravascular volume without exacerbating pulmonary venous congestion, a critical consideration in patients with mitral stenosis. These findings contribute to the growing evidence supporting colloid use in obstetric anesthesia and highlight the need for further research comparing various volume-expansion strategies in high-risk cardiac patients (Lacasse et al., 2011).

The management of pregnant patients with cardiac disease undergoing cesarean section presents a unique challenge due to the need to balance maternal hemodynamic stability, adequate anesthesia, and optimal fetal outcomes. Mitral stenosis, in particular, can exacerbate these challenges due to its impact on cardiac function and hemodynamics. In our case, we utilized a tailored approach to anesthesia management, employing combined spinal-epidural anesthesia with hydroxyethyl starch (HES) volume expansion. This method was specifically chosen to meet the unique needs of the patient, who had mitral stenosis, ensuring both efficacy and safety during the cesarean section. Combined spinal-epidural anesthesia (CSEA) offers several advantages in obstetric anesthesia, including rapid onset, profound sensory blockade, and the ability to titrate the level of anesthesia as needed. This technique has been shown to provide effective analgesia for cesarean section while minimizing the risk of maternal hypotension compared to traditional epidural anesthesia alone (Munnur et al., 2005). Additionally, CSEA allows for using lower doses of local anesthetics, reducing the potential for systemic toxicity while maintaining adequate pain relief (A. Patel et al., 2013).

Hydroxyethyl starch (HES) has been used as a volume expander in various clinical settings, including surgery and critical care. Its ability to expand intravascular volume makes it a valuable adjunct in patients with compromised cardiac function, such as those with mitral stenosis. By increasing preload and cardiac output, HES can help mitigate the risk of hypotension associated with neuraxial anesthesia in these patients (M. Patel et al., 2023). Furthermore, epidural volume expansion with HES has been shown to improve block quality and prolong the duration of analgesia in obstetric patients undergoing cesarean section (Saghafinia et al., 2017). In our case, the combination of CSEA with HES volume expansion proved effective in maintaining stable hemodynamics and providing adequate anesthesia for the patient undergoing a caesarean section. For clarity, stable hemodynamics in this context can be quantified by heart rate and blood pressure ranges, which were monitored and kept within the parameters. This approach ensured both effective anesthetic management and optimal hemodynamic stability. The patient experienced no intraoperative complications, and both maternal and fetal outcomes were satisfactory,

as evidenced by an Apgar score of 9 at 1 minute and 10 at 5 minutes for the newborn. Maternal recovery was also positive, with no adverse effects observed and a swift return to baseline health following the procedure. This approach aligns with current recommendations for managing parturient with cardiac disease, emphasizing the importance of individualized care and multidisciplinary collaboration (Siu et al., 2001). However, it is essential to recognize the potential risks of using HES, including renal dysfunction, coagulopathy, and tissue deposition of starch particles. Recent evidence has raised concerns about the safety of Hydroxyethyl Starch (HES), particularly in critically ill patients, due to studies indicating an increased risk of adverse outcomes such as renal impairment and mortality. These concerns have led to restrictions on its use in some healthcare settings, as the potential risks may outweigh the benefits in certain populations. In the case of a patient with mitral stenosis undergoing a caesarean section, these safety concerns become particularly relevant, as the use of HES could exacerbate cardiovascular stress and compromise patient outcomes (Tyagi et al., 2011). Therefore, careful consideration should be given to the selection of fluid therapy in patients with cardiac disease, weighing the potential benefits of volume expansion against the risks of adverse effects.

4. Conclusions

In conclusion, the deliberate use of epidural volume expansion with hydroxyethyl starch in a patient with mitral stenosis undergoing a cesarean section proved to be a viable anesthetic strategy. This approach helped optimize hemodynamic stability and prevent the adverse cardiovascular effects that can arise in such high-risk patients during regional anaesthesia. This technique contributed to a successful outcome for both the mother and the neonate by carefully managing preload and minimising fluctuations in heart rate and blood pressure. Our case highlights the importance of individualized anesthetic planning in patients with significant cardiac pathology, particularly mitral stenosis. It underscores the potential utility of epidural volume expansion with hydroxyethyl starch in this context.

Ethical considerations

Informed consent for publication was obtained from the patient, in accordance with ethical standards and institutional guidelines. The patient has consented to the publication of their case details and any accompanying images.

Conflict of Interest

The authors declare no conflicts of interest.

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