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Anesthetic Management in Patients Undergoing Cesarean Section with Heart Failure Comorbid due to Rheumatic Heart Disease

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Abstract: ***Introduction: The anesthetic technique commonly used in cesarean section is spinal anesthesia; however the use of spinal anesthesia is relatively contraindicated in patients with severe mitral stenosis due to the risk of hemodynamic instability. Case Report: We reported a case of a 31-year-old woman who presented with shortness of breath during rest and worsened with activity. Cardiovascular examination showed arrhythmia, with systolic murmur on apex area. Electrocardiography examination showed atrial fibrillation with heart rate of 75x/minutes, right axis deviation, with occasional PVC. Echocardiography showed normal LV size (normal wall motion all segment), severely dilated LA, mildly dilated RA, normal RV size, LVEF BP 58.6%, LV diastolic function undetermined, TAPSE 15 mm, eRAP 8mmHg, severe MS, moderate MR, Mild AR, moderate TR. Patients was assessed with ASA physical state III and planned to undergo elective cesarean section under epidural anesthesia. Epidural anesthesia was done using 0, 375% Bupivacaine with volume of 25 ml via epidural catheter. The epidural catheter was placed at 1st-2ndlumbal vertebra level; the length of the catheter in the epidural space was 5 cm with a target tip at 11thoracal vertebra level, dermatome target of 10thoracal vertebra to 1stlumbal vertebra level and viscerotome target of10thoracal vertebra to 2ndlumbal vertebra level. During surgery, hemodynamic fluctuations were controlled without additional medication. The patient was then given epidural bupivacaine 0.0625% and morphine 0, 5 mg volume 10 mL every 10-12 hours and Paracetamol 1 g every 8 hours IV for post-operative analgesia, and was treated in the intensive care unit for close monitoring. Discussion: The choice of anesthetic technique in patients with mitral stenosis should be considered according to the hemodynamic status of the patient at the time of arrival, the type of heart disease, previous drug use and whether the surgery can be elective or must be an emergency. In hemodynamically stable patients, epidural anesthesia or a combination of low-dose epidural-spinal anesthesia is preferable to general anesthesia. Conclusion: Epidural anesthesia is the most preferred anesthetic technique for pregnant patients with rheumatic heart disease undergoing cesarean section.***

Keywords: anesthetic management, epidural anesthesia, cesarean section, mitral stenosis

1. Introduction

Cardiac abnormalities during pregnancy are the main non-obstetric factors that cause morbidity and mortality in pregnant women. In America, it was found that complications of heart problems occur in 4% of pregnancies with the mortality rate of 10-25%. Cardiac valve disorders account for 25% of all cases of cardiac complications, the majority of which consist of mitral valve stenosis and regurgitation. Rheumatic heart disease is a heart valve disorder caused by acute rheumatic fever that precedes it. This disease mainly causes disorders of the mitral valve (75%) and aortic valve (25%). Indonesia is one of the countries with high cases of rheumatic fever and rheumatic heart disease. The prevalence of acute rheumatic fever in Indonesia is estimated to be around 0.3-0.8 in school children aged 5-15 years. Around 60% of 470, 000 patients with acute rheumatic fever per year will progress to rheumatic heart disease.1

Valvular heart disease that is initially asymptomatic might become symptomatic during pregnancy because of physiological changes in cardiovascular system.2 Increased cardiac output during pregnancy will result in worsening of the patient's symptoms. Cesarean section is the main choice of delivery for patients with heart valve disorders. It is a challenge for the anesthesiologist to be able to provide maximum anesthetic management for these patients. The technique commonly used in cesarean section is spinal anesthesia. The use of spinal anesthesia in patients with cardiac disorders is relatively contraindicated in patients with severe mitral stenosis because of the fixed cardiac output state of the patient, causing inability to respond to the hemodynamic changes caused by spinal anesthesia. Recent studies have shown that hemodynamic changes during spinal anesthesia are dose dependent. However, inadequate dosing is associated with inadequate block, thereby affecting maternal and fetal hemodynamic changes due to pain and discomfort. Increasing the dose of opioids can also reduce the need for local anesthetic doses and prevent hemodynamic fluctuations and increase the effect of analgesia both intraoperatively and postoperatively.1 We report a case of pregnant woman with heart failure caused by rheumatic heart disease with severe mitral stenosis and atrial fibrillation who underwent cesarean section.

2. Case Report

We reported a case of a 31-year-old woman, 36 weeks pregnant who presented with complaint shortness of breath since 5 days before admitted. Shortness of breath was felt even when the patient was sitting at rest, and worsened during activity. Shortness of breath was not accompanied by symptoms of cough or fever. The patient also complained of palpitations, but chest pain or swelling in both legs was denied. The patient is currently pregnant with her third child,

with no complaints of shortness of breath during the previous pregnancies. During the examination, the patient said that the complaints of shortness of breath and chest palpitations had improved; the patient was able to sleep with the bed tilted at 45^{o}. There was no history of hypertension, diabetics, asthma, heart disease and other systemic diseases. The patient is a housewife; her activities were currently limited due to shortness of breath.

Figure 1: Patient's clinical pictures

Examination of vital signs showed blood pressure of 102/62mmhg, pulse 87-95x/minute, RR 22x/minute, and oxygen saturation 98% room air. Respiratory examination showed normal breath sound, no rhonchi nor wheezing. Cardiovascular examination showed arrhythmia, with systolic murmur on apex area. Other physical examinations were within normal limits. Complete blood count, hemostasis physiology, renal function test, and electrolyte tests before surgery was within normal limits. Liver function test showed increased AST and ALT levels (AST 106.3 U/L; ALT 141.5 U/L), and albumin level was decreased (Albumin 2.90 g/dL). Blood gas analysis showed respiratory alkalosis with pH 7.47, pCO2 26 mmHg, pO2 129 mmHg, BE-4.8 mmol/L and HCO3-18.9 mmol/L. Electrocardiography examination showed atrial fibrillation with heart rate of 75x/minutes, right axis deviation, with occasional PVC.

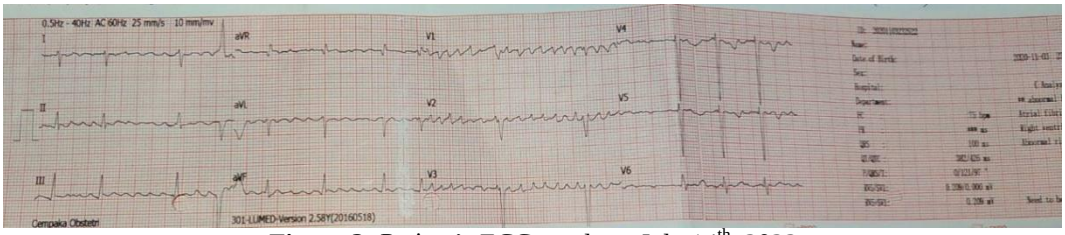

Figure 2: Patient's ECG result on July 14th, 2022

Recent echocardiography (June 20th, 2022) showed normal LV size (normal wall motion all segment), severely dilated LA, mildly dilated RA, normal RV size, LVEF BP 58.6%, LV diastolic undetermined, TAPSE 15 mm, eRAP 8mmHg, severe MS, moderate MR, mild AR, moderate TR.

Patients was assessed with ASA physical state III and planned to undergo elective sectiocaes area under epidural anesthesia. She was positioned in left lateral decubitus position. Aseptic/antiseptic measures was performed in the lumbar area, then covered with sterile drapping cloth, local anesthetic injection with 2% lidocaine was infiltrated, the epidural catheter was placed at 1st-2nd lumbal vertebra level, the length of the catheter in the epidural space was 5 cm with a target tip at 11th thoracal vertebra level, dermatome target of 10th thoracal vertebra to 1st lumbal vertebra level and viscerotome target of 10th thoracal vertebra to 2nd lumbal vertebra level. Epidural anesthesia was done using 0, 375% Bupivacaine with volume of 25 ml via epidural catheter.

During surgery, hemodynamic fluctuations were within normal limits, blood pressure was 87-114 / 55/75 mmHg, HR of 68-93x/minute, RR of 20-22x/minute and SpO2 of 99 – 100% with supplemental O^2 3 lpm. The patient is given 300 ml Ringer's Lactate solution, while the bleeding was around 500 mL, and urine production intraoperative was50 mL. The patient was then given epidural bupivacaine 0.0625% and morphine 0, 5 mg volume 10 mL every 10-12 hours and Paracetamol 1 g every 8 hours IV for post-operative analgesia, and was treated in the intensive care unit for close monitoring. Neonates were born, female, with 2200gr weight, and 5-7 apgar score.

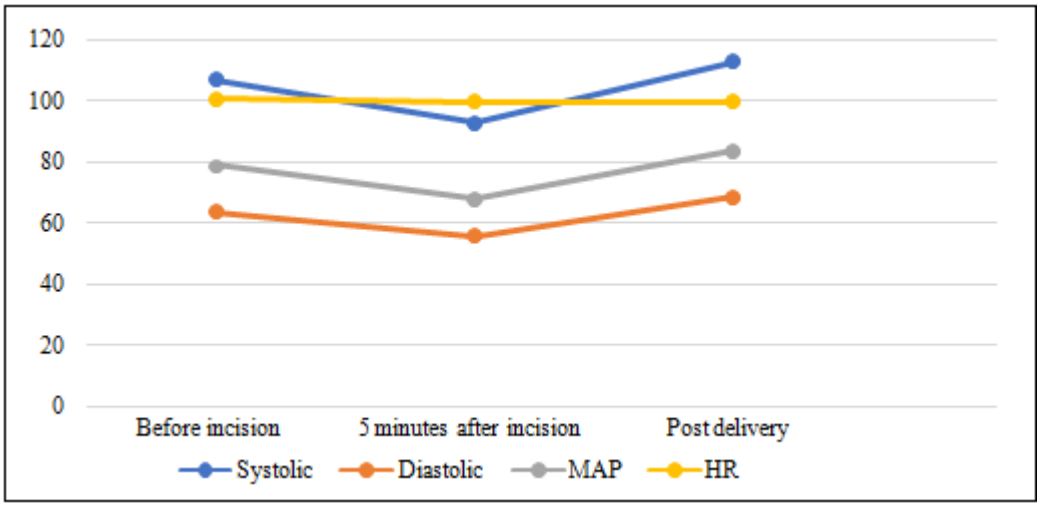

Figure 3: Hemodynamic fluctuations during surgery

Figure 4: The surgical field

3. Discussion

The patient in our case had heart failure due to rheumatic heart disease and mitral stenosis. The patient planned to undergo section cesarean under epidural anesthesia. Regional anesthetic technique chosen in this case considering the severe clinical condition of the patient, in which the patient could only sleep on a pillow with a 45^{o} incline. Peripheral oxygen saturation was still within normal limits, around 97-98% room air. The main principles of anesthesia in patients with mitral stenosis are to prevent tachycardia, maintaining sinus rhythm and treating atrial fibrillation that occur both pharmacologically and with cardioversion, especially in patients with unstable hemodynamic. It is also important to prevent systemic vascular resistance reduction, which may result in increase of blood pressure and high pulse as compensation. All of these conditions may lead to increased work of the heart. In addition, care should be taken to prevent hypovolemia, fluid overload and other factors that can increase pulmonary artery pressure such as hypoxia, hypercapnia and pain. High pulse may shorten the diastolic filling period, impairing left atrial emptying and increasing the pressure differential across the mitral valve. A large pressure difference results in increased pressure of the left atrium. In addition, the presence of atrial fibrillation can also reduce left ventricular filling, thereby affecting cardiac output.[3, 4]

Anesthetic management in these patients depends on the severity of the disease. General anesthesia has traditionally been preferred in patients with severe mitral stenosis. However, tachycardia during laryngoscopy and extubation should be avoided.5 The use of opioids during induction can cause respiratory depression in the neonate whereas extubation may delay the awakening from anesthesia and increase the patient's likelihood of postoperative mechanical ventilation. The increased preload due to autotransfusion after uterine contractions during delivery may cause pulmonary edema, which occurs usually after extubation. Intraoperative positive pressure ventilation is useful to prevent the occurrence of this condition.6Because of these reasons, regional anesthesia then become a popular and safe choice in recent years for pregnant patients with heart disease undergoing cesarean section.

The most concerning complication that arise with neuraxial anesthesiais hemodynamic disturbances. Epidural anesthesia is generally preferred over spinal anesthesia. The use of vasoconstrictors such as phenylephrine and judicious administration of intravenous fluids to prevent hypotension and tachycardia would help to maintain stability for both the mother and baby. However, there is controversy regarding the use of neuraxial anesthesia in patients with severe mitral stenosis because this condition causes fixed cardiac output and thus the patient may not be able to tolerate the decrease in systemic vascular resistance.7 In addition, patients with this condition are also more likely to be taking diuretics and beta-blockers which suppress cardiovascular compensatory mechanisms. Despite the disadvantages of epidural anesthesia, this technique is preferred for patients with severe heart disease undergoing cesarean section because the increased venous capacity would compensate for the increased blood volume during autotransfusion.8

In this case, epidural anesthesia was performed by giving 0.375% plain bupivacaine in 25 ml volume. In this case,

epidural anesthesia was chosen because the incidence of hypotension is considered lower in epidural anesthesia compared to spinal anesthesia. Because uterine blood flow is not auto regulated, the uteroplacental perfusion will be directly affected by maternal blood pressure. The decrease in maternal blood pressure may be tolerated by the mother but not by the fetus. Alternative anesthetic strategy that can be used to maintain hemodynamic stability is spinal anesthesia using low-dose bupivacaine in combination with an opioid adjuvant.2 In this case; there were no episodes of hypotension and desaturation.

Several studies have shown the effectiveness of opioids in spinal anesthesia, especially in cesarean section. Previous studies have shown that lipophilic opioids such as fentanyl hastens the onset and prolongs the duration of action of bupivacaine block, as well as prolongation of postoperative analgesia duration. The combination of these two techniques has an onset rate of 5 minutes viaintrathecal, 10 minutes via epidural and shorter duration of action due to redistribution. No active metabolites were found and fentanyl is 800 times more lipid soluble than morphine. Because of its high lipid solubility, fentanyl rapidly binds to opioid receptors on the dorsal side of the spinal cord. This rapid onset is very useful as analgesia in either normal delivery oremergency cesarean section. Low doses of bupivacaine is also routinely used in cesarean sections which mainly aim to prevent hypotension. The incidence of hypotension in patients given the combination of 5 mg of bupivacaine and 25 mcg of fentanyl is estimated to be 31%, while the rate of hypotension in patients given single 10 mg of bupivacaine is estimated to be around 94%.2

Other studies also support the use of bupivacaine and ropivacaine for epidural anesthesia. However, Mishra et al showed that the combination of lignocaine and adrenaline before the use of bupivacaine and fentanyl in patients with Eisenmenger syndrome provides a more rapid onset and adequate duration of blockade.8 Adrenaline may help to maintain blood pressure and has the same effect as ephedrine.5

The choice of anesthetic technique should be considered according to the hemodynamic status of the patient at the time of arrival, the type of heart disease, previous drug use and whether the surgery can be elective or must be an emergency. Regional anesthesia is contraindicated in patients with severe stenosis, hemodynamic instability and severe hypoxia. Patients with NYHA class III and IV are not recommended for spinal anesthesia due to the possibility of hemodynamic disturbances. In hemodynamically stable patients, epidural anesthesia or a combination of low-dose epidural-spinal anesthesia is preferable to general anesthesia according to some studies. General anesthesia often results in decreased cardiac contractility and increased pulmonary vascular resistance through positive pressure ventilation. Laryngoscopy, intubation and aspiration may cause hemodynamic fluctuations in patients undergoing general anesthesia. Preoperative management must involve multiple disciplines including obstetricians, cardiologists, pediatrics and anesthesiologists to manage the complications that may occur.2

4. Conclusion

Cesarean section is the safest choice for pregnant patients with heart valve disorders. Anesthetic management in patients with heart disease, especially severe mitral stenosis, is very challenging. The main hemodynamics goals of pregnant patients with rheumatic heart disease undergoing surgeries are to maintain sinus rhythm, prevent tachycardia, prevent increased cardiac output and hypovolemia or fluid overload due to intravenous fluid administration. Epidural anesthesia is the most preferred anesthetic technique for pregnant patients with rheumatic heart disease undergoing cesarean section.

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