RESEARCH PAPER

Anesthesia Management in Pregnancy with Valvular Heart Disease: Increasingly Varied Current Challenges

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ABSTRACT
The physiological adaptations of the cardiovascular system during pregnancy can significantly exacerbate pre-existing valvular heart disease. This pathological state elevates the risk of adverse outcomes for both the mother and fetus, necessitating meticulous peripartum management, with the choice of anesthetic technique being a critical component. This report aims to delineate the anesthetic strategies employed in two cases of cesarean delivery complicated by valvular heart disease. Case one involves a 28-year-old gravida with Rheumatic Heart Disease presenting as multivalvular involvement, specifically severe tricuspid regurgitation, moderate mitral regurgitation, mild aortic regurgitation, and moderate pulmonary regurgitation. The second case details a 24-year-old gravida with severe, high-flow, high-gradient aortic stenosis, a condition consistent with a modified World Health Organization (mWHO) class IV risk categorization. Both patients underwent pregnancy termination via cesarean section using regional epidural anesthesia with titrated administration of 1.5% lidocaine and invasive hemodynamic monitoring using arterial blood pressure monitoring. During the surgical procedure, the hemodynamic conditions of both patients were relatively stable. Patients were treated in the intensive care unit for two days postoperatively before being transferred to the ward and discharged in stable condition. This case report demonstrates that a multidisciplinary approach combined with titrated epidural anesthesia and strict hemodynamic monitoring can be a safe strategy in anesthesia management for pregnancy with valvular heart disease.

Keywords: pregnancy; valvular heart disease; stenosis; regurgitation; regional anesthesia.
How to cite this article: Gunawan W., Fitriati M. Anesthesia Management in Pregnancy with Valvular Heart Disease: Increasingly Varied Current Challenges. Int J Drug Deliv Technol. 2026;16(16s): 267-272. DOI: 10.25258/ijddt.16.16s.28
Source of support: Nil.
Conflict of interest: None

INTRODUCTION

A normal pregnancy necessitates a 30–50% increase in blood volume, cardiac output, and overall metabolic demand, representing a significant physiological stressor on the maternal cardiovascular system. In women with valvular heart disease, this increased burden frequently exacerbates their condition. According to Shapiro, such pathology carries a substantial risk for grave complications, including heart failure, arrhythmias, and compromised uteroplacental blood flow, which present a dual threat to mother and fetus. This risk is reflected in the epidemiological landscape, where cardiovascular disease is implicated in approximately 30% of maternal deaths globally, underscoring the imperative for meticulous and specialized clinical management.[1]

Managing valvular heart disease in pregnant women is difficult due to frequently delayed detection. Many patients are unaware of their condition until symptoms arise from hemodynamic changes during pregnancy.[2] The referral process and the need for multidisciplinary collaboration are also challenges in managing this condition. Anesthesia management at pregnancy termination with comorbid valvular heart disease is also challenging due to its high mortality rate, reaching 15% in developing countries.[3]

In anesthesiology practice, pregnancy with valvular heart disease is a challenging condition because anesthesiologists must maintain maternal hemodynamic stability while ensuring adequate fetal perfusion.[4] Research by Naik explains that the selection of anesthetic techniques in patients with valvular heart disease must take into account the type of valvular lesion, disease severity, and the maternal clinical condition during labor.[5] The increasing survival of women with cardiac conditions to childbearing years, as noted by Naik, has resulted in more intricate and varied case presentations. This escalating complexity mandates a departure from isolated management, requiring instead a cohesive, multidisciplinary approach. The integration of expertise from anesthesiology, cardiology, and

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obstetrics is essential for minimizing peripartum and perioperative complications in this high-risk population.[5]

Despite the availability of numerous published reports on anesthetic approaches for pregnant patients with valvular heart disease, the determination of the most optimal technique continues to present a significant clinical dilemma. This is due to variations in the type of valvular lesion, disease severity, and the patient's hemodynamic condition, which can change dynamically during pregnancy and labor. Additionally, the involvement of multiple heart valves or the presence of severe stenosis can increase the risk of cardiovascular decompensation during surgical procedures. Therefore, this case report aims to describe anesthesia management in two pregnant patients with valvular heart disease undergoing cesarean section and to highlight clinical considerations in selecting anesthetic techniques to maintain maternal hemodynamic stability and fetal safety.

CASE PRESENTATION

The first case was a 28-year-old woman in her third pregnancy, at 33/34 weeks of gestation, referred from Probolinggo Hospital due to complaints of intermittent shortness of breath, especially as the pregnancy progressed. Physical examination revealed blood pressure (BP) of 111/71 mmHg, heart rate of 90–100 beats/minute, and SpO2 of 97% on room air. Echocardiographic examination revealed Rheumatic Heart Disease (RHD) with valvular abnormalities including severe TR, moderate MR (Restrictive PML), mild AR, and moderate PR. The patient was decided to undergo pregnancy termination via cesarean section.

The second case was a 24-year-old woman in her first pregnancy, at 36/37 weeks of gestation, referred from Gresik Hospital due to worsening shortness of breath over the past 2 days. Shortness of breath had been experienced especially since the third trimester of pregnancy. Physical examination revealed blood pressure of 119/59 mmHg, heart rate of 60–70 beats/minute, and SpO2 of 95% on O2 NRM 10 lpm. Echocardiographic examination revealed mild AR and severe AS with a Pressure Gradient of 91.10 mmHg. The patient was diagnosed with High Flow High Gradient Aortic Stenosis and classified as mWHO class IV. The patient was decided to undergo pregnancy termination via cesarean section.

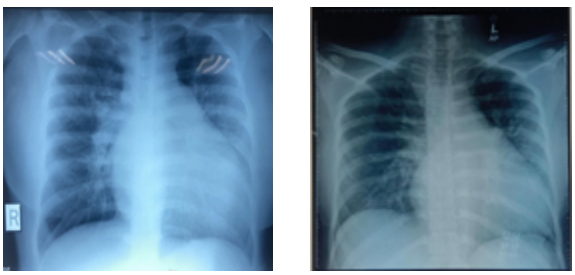

Figure 1. Chest X-ray Findings in Pregnant Patients with Valvular Heart Disease

Both patients were managed by a team consisting of an obstetric specialist, a cardiologist, and an anesthesiologist to optimize patient condition for termination.

Both patients were decided to undergo cesarean section using regional epidural anesthesia after evaluation by a multidisciplinary team consisting of obstetric, cardiology, and anesthesia specialists. In the preoperative phase, standard American Society of Anesthesiologists (ASA) monitors were applied, comprising electrocardiography, non-invasive blood pressure measurement, and pulse oximetry. To enable continuous, real-time hemodynamic surveillance, invasive arterial blood pressure monitoring via an indwelling arterial catheter was also established prior to the initiation of the procedure. Intravenous access was established with large-bore lines to facilitate the administration of fluids and medications during the procedure.

Epidural anesthesia was performed using an aseptic technique at the lumbar intervertebral space using an epidural needle, after which an epidural catheter was placed to allow gradual drug administration. The local anesthetic agent used was lidocaine (Xylocaine) 1.5%, administered in a titrated manner through the epidural catheter until a sensory block level of thoracic six (T6) was achieved. A gradual induction of anesthesia was employed as a strategy to mitigate the risk of a precipitous decline in systemic vascular resistance. Such a decrease could precipitate hypotension and lead to further hemodynamic instability, which is particularly detrimental in patients with pre-existing valvular heart disease.

During the surgical procedure, hemodynamic monitoring was carried out strictly through invasive blood pressure monitoring as well as evaluation of heart rate and oxygen saturation. Fluid management was provided carefully to avoid volume overload that could worsen the cardiac workload. During the procedure, the hemodynamic conditions of both patients were relatively stable without severe hypotensive episodes or significant cardiac arrhythmias.

Postoperatively, both patients were admitted to the intensive care unit for continued cardiovascular surveillance, given the potential for hemodynamic instability during the early post-procedural period. Their clinical course in the ICU remained stable over a two-day period, after which they were successfully downgraded to the general ward (low care). After three days of care in the ward, both patients were discharged in stable clinical condition.

Postoperatively, both were treated in the intensive care unit for 2 days before transferring to the low care ward.

After 3 days of care in the low care ward, the patients were discharged in stable condition.

DISCUSSION

Pregnancy can have an impact on cardiovascular physiological changes.[6] These changes can worsen the condition of pregnant women who already have cardiac pathology. Early detection, a well-functioning referral system, and multidisciplinary collaboration are expected to produce good outcomes. Anesthetic objectives are not uniform but are instead dictated by the underlying valvular pathology, necessitating a tailored approach to hemodynamic regulation.[6,7] The anesthetic strategy for pregnant patients with valvular heart disease must be carefully individualized. While both general and regional anesthesia are feasible, the choice between them is governed by their respective hemodynamic consequences, which can differentially impact the compromised cardiovascular system.[6,7]

Table 1. Comparison of Regional and General Anesthetic Techniques in Anesthesia Management

Anesthetic Technique	Advantages	Consequences
Regional	1. More stable hemodynamics 2. Can be continued for postoperative therapy	1. Titrated drug dosing 2. Adequate fluid administration 3. Preparation of vasopressors in case of significant SVR reduction
General	1. Choice for unstable patient conditions (e.g., hemorrhage, severe dyspnea) 2. Choice if regional fails	1. Must be skilled in airway management 2. Use drugs with minimal cardiovascular effects 3. Ensure adequate anesthetic depth when performing intubation

Table 1 shows a comparison between regional anesthesia and general anesthesia techniques in patient management. Regional anesthesia has several advantages, including providing better hemodynamic stability and being continuable as an analgesic method in the postoperative period. However, this technique requires special attention such as titrated drug dosing to prevent sudden hemodynamic changes, adequate fluid administration, and readiness to use vasopressors if a significant decrease in systemic vascular resistance (SVR) occurs. On the other hand, general anesthesia is the choice in unstable patient conditions, for example in cases of hemorrhage or severe dyspnea, and can be used if regional anesthesia fails. The administration of general anesthesia requires good skills in airway management, the use of anesthetic drugs that have minimal effects on the cardiovascular system, and ensuring adequate anesthetic depth during the intubation process to prevent excessive hemodynamic responses.

The judicious selection of an anesthetic technique constitutes a critical determinant of perioperative outcomes in patients with cardiac disease, a principle that is particularly pronounced in the management of pregnant women with valvular heart disease.[5,8] This clinical decision-making is further complicated by the profound physiological adaptations of pregnancy, which exert significant effects on the cardiovascular system and heighten the risk of hemodynamic instability during both anesthetic and surgical interventions. Consequently, a thorough comprehension of the gestational hemodynamic profile is essential for formulating a safe and effective anesthetic plan for patients with cardiac disease.

Pregnancy in the context of valvular heart disease constitutes a high-risk state for maternal morbidity and mortality, as the physiological adaptations of gestation can significantly exacerbate pre-existing cardiovascular pathology. Specifically, cardiac output rises by approximately 30–50%, a function of increased stroke volume and heart rate.[9] Concomitantly, maternal plasma volume expands by roughly 40–50% to accommodate the metabolic demands of both the mother and the developing fetus.[2] Additionally, systemic vascular resistance decreases by approximately 30% as a result of the vasodilatory effects of pregnancy hormones and the formation of uteroplacental circulation.[10] The peak hemodynamic burden, occurring between the second and third trimesters, significantly elevates cardiac workload in individuals with pre-existing structural cardiac abnormalities.[11,12] This temporal correlation accounts for the frequent clinical manifestation of symptoms such as dyspnea, fatigue, and signs of heart failure in pregnant patients with heart disease during the late gestational period.[10]

The first patient presented with Rheumatic Heart Disease (RHD) characterized by multivalvular involvement: severe tricuspid regurgitation, moderate mitral regurgitation, mild aortic regurgitation, and moderate pulmonary regurgitation. It is noteworthy that Rheumatic Heart Disease persists as the

predominant etiology of valvular heart disease among women of reproductive age in numerous developing nations.[13] RHD occurs due to a chronic inflammatory process caused by streptococcal infection that results in structural damage to the heart valves.[14] This damage can cause valvular stenosis or regurgitation, which ultimately disrupts intracardiac blood flow. During pregnancy, increases in maternal blood volume can increase transvalvular flow, thereby worsening the degree of regurgitation in valves with insufficiency.[5] Increased cardiac output can also enlarge cardiac chamber size, worsening the inability of the valve to close completely.[15]

Regurgitant lesions of the heart valves are generally better tolerated during pregnancy compared to stenotic lesions because decreased systemic vascular resistance can reduce afterload.[6] However, in patients with involvement of several valves simultaneously, increased intravascular volume can still cause increased regurgitation and worsen ventricular function.[16] Therefore, patients with multivalvular heart disease have a higher risk of experiencing heart failure symptoms during pregnancy.[16] The dyspnea symptoms experienced by the patient in this case were likely caused by increased cardiac filling pressures and pulmonary congestion due to increased intravascular volume during pregnancy.

The second patient was diagnosed with severe, high-flow, high-gradient aortic stenosis, with a measured pressure gradient of 91.10 mmHg. Aortic stenosis is regarded as one of the most perilous valvular lesions in the gravid patient due to the fixed obstruction it creates at the left ventricular outflow tract. This mechanical impediment restricts the necessary augmentation of cardiac output required to meet the heightened metabolic demands of gestation. The physiologically occurring decrease in systemic vascular resistance during pregnancy can also cause hypotension and decreased coronary perfusion in patients with aortic stenosis. This condition can increase the risk of syncope, myocardial ischemia, or heart failure during pregnancy.[17]

The patient in the second case was classified as modified World Health Organization (mWHO) class IV, which is the highest risk group in pregnancy with heart disease. This classification is used to assess maternal risk based on the type of heart disease the patient has. Patients in mWHO class IV have a very high risk of cardiovascular complications, so pregnancy is often considered contraindicated in this condition. Complications that can occur include heart failure, arrhythmias, thromboembolism, and maternal death.[18]

In both cases presented, cesarean delivery was elected as the mode of pregnancy termination to mitigate the risk of acute hemodynamic decompensation associated with the labor process. Vaginal delivery imposes significant cardiovascular stress; uterine contractions augment cardiac output via autotransfusion of blood from the uteroplacental unit into the systemic circulation. Furthermore, the Valsalva maneuver performed during the second stage elevates intrathoracic pressure, precipitating marked hemodynamic fluctuations. Such abrupt cardiovascular changes pose a substantial threat to patients with underlying severe valvular heart disease.

The management of pregnant patients with cardiac disease necessitates a coordinated, multidisciplinary effort involving obstetricians, cardiologists, and anesthesiologists.[19] Termed the "pregnancy heart team," this collaborative model is designed to conduct a comprehensive risk assessment and formulate the safest possible management strategy for both mother and fetus.[20] Evidence indicates that such multidisciplinary collaboration significantly improves maternal and neonatal outcomes in pregnancies complicated by complex heart disease.[21]

In both patients in this case report, the anesthetic technique used was regional epidural anesthesia with titrated dosing using 1.5% lidocaine. Neuraxial anesthesia is often the primary choice in obstetric patients with heart disease because it can reduce the stress response from pain and decrease sympathetic activity. This reduction in sympathetic activity can help maintain blood pressure stability and heart rate during surgical procedures.[16] Additionally, epidural anesthesia administered gradually allows anesthesiologists to control hemodynamic changes better compared to single-dose spinal anesthesia.[22]

The administration of titrated epidural anesthesia serves to attenuate the risk of an abrupt decline in systemic vascular resistance and consequent hypotension. This precaution is particularly critical in patients with aortic stenosis, as a sudden hypotensive event can compromise coronary perfusion pressure, thereby precipitating myocardial ischemia.[23] Therefore, the gradual epidural technique is often considered safer in patients with heart disease compared to single-dose spinal anesthesia.

In both patients, arterial blood pressure monitoring was also installed for invasive hemodynamic monitoring during the surgical procedure. Invasive monitoring enables early detection of changes in blood pressure and tissue perfusion in real time. Strict monitoring is very important in patients with severe heart disease because even small hemodynamic changes can have a significant impact on cardiovascular function.[24]

After surgery, both patients were treated in the intensive care unit for two days before being transferred to the general ward. The postpartum period represents a phase of heightened vulnerability for patients with cardiac disease, characterized by

profound hemodynamic shifts following delivery. The expulsion of the fetus and placenta triggers an autotransfusion of blood from the uteroplacental bed into the systemic circulation, a process that can precipitate an abrupt and significant increase in cardiac output.[25] In patients with severe valvular heart disease, such a surge in cardiac output carries a significant risk of triggering acute decompensated heart failure. As such, rigorous monitoring is unequivocally recommended throughout the first 72 hours following delivery.

These cases collectively illustrate that the management of pregnancy complicated by valvular heart disease hinges upon meticulous risk stratification and effective coordination among specialists. The inherent hemodynamic stress of pregnancy, which culminates in the final trimester, poses a substantial risk of decompensating underlying cardiac lesions. Selecting the appropriate delivery method and an anesthetic strategy that maintains hemodynamic stability are important factors in preventing maternal and fetal complications. The use of titrated epidural anesthesia with invasive hemodynamic monitoring as in both patients in this report has been proven to provide good cardiovascular stability during surgery and produce optimal clinical outcomes.

Practically, this case report confirms that the selection of anesthetic techniques in pregnant patients with valvular heart disease must be carried out individually, taking into account the type of valvular lesion, disease severity, and the patient's hemodynamic condition. A multidisciplinary approach between obstetric, cardiology, and anesthesia specialists is key in determining a safe delivery strategy. Epidural anesthesia with gradual dose administration can be an effective choice for maintaining hemodynamic stability during cesarean section, especially when accompanied by strict hemodynamic monitoring during the intraoperative and postoperative periods.

CONCLUSION

Optimal outcomes in pregnant patients with valvular heart disease are contingent upon effective multidisciplinary collaboration. Anesthetic management must be individualized to the patient's specific pathophysiology, with regional epidural anesthesia often favored in high-risk cardiac populations due to its association with enhanced hemodynamic stability. In the two cases presented, the implementation of titrated epidural anesthesia, coupled with continuous invasive hemodynamic monitoring, successfully preserved cardiovascular stability throughout the operative period. This approach also allows for more gradual control of changes in systemic vascular resistance so that the risk of sudden hypotension can be minimized. With the selection of appropriate anesthetic techniques and strict monitoring during the intraoperative and early postoperative periods, cesarean section in patients with valvular heart disease can be performed safely with good maternal outcomes.

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