Audit of Anesthetic Management of Parturients with Cardiac Diseases Posted for Obstetric Procedures in a Tertiary Care Hospital

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ABSTRACT

The obstetric patient with heart disease challenges the anesthesiologists’ skills. Pregnancy and labor due to hemodynamic burden and the hypercoagulable state compromise an already stressed cardiovascular system. In developed countries, congenital heart disease (CHD) is the most common cause whereas in developing countries, still rheumatic heart disease remains the major concern.

Results: Over a period of 6 months, we encountered 30 patients with cardiac disease posted for different obstetric procedures. Anesthesia management was decided according to severity and pathophysiology of cardiac lesion and urgency of procedure. In this article, we have mentioned our experience with cardiac parturients with CHD, rheumatic heart disease, peripartum cardiomyopathy, and Takayasu arteritis.

Conclusion: Effective management of obstetric patient with cardiac disease includes antepartum counseling, risk stratification, an optimization, monitoring and tailored anesthesia plan for labor, delivery, and obstetric procedure, and intensive care unit care in the immediate postpartum period.

Keywords: Anesthesia, Cardiac monitoring, Cardiac parturients, Labor analgesia.

INTRODUCTION

Incidence of heart disease in parturients is 0.2–3% of pregnancies. It affects fetal and maternal morbidity and mortality.¹ The obstetric patient with heart disease challenges the anesthesiologists’ skills. Pregnancy and labor due to hemodynamic burden and the hypercoagulable state compromise an already stressed cardiovascular system. So, the combined approach involving cardiologist, obstetrician, neonatologist, and anesthesiologist will help for better outcome.

In developed countries, congenital heart disease (CHD) is the most common cause, whereas in developing countries, still rheumatic heart disease remains the major concern.² Patients with CHD are living to reproductive age because of advanced medical and surgical management.³ In addition, the incidence of ischemic heart disease is also increasing.

Over a period of 6 months, we encountered 30 patients with cardiac disease posted for different obstetric procedures. Out of that, 12 were CHD, 16 were rheumatic heart disease, 1 Takayasu aortoarteritis, and 1 peripartum cardiomyopathy (PPCM). Procedures were varied from medical termination of pregnancy (MTP), cervical encirclage, labor analgesia to and lower segment cesarean section (LSCS) (Table 1).

As our hospital is a tertiary institute, most of the patients were referred here for safe confinement, availability of perioperative cardiac consultation, intensive care unit (ICU) backup, and neonatal intensive care. Manier times, as patients are not registered here in antenatal care (ANC), they get admitted in unoptimized state or lesions.

Anesthesia management was decided according to severity and pathophysiology of cardiac lesion and urgency of procedure.⁴ Disease-specific goals of management were kept in mind to preserve the hemodynamic parameters for better outcome. They are listed as follows:

• Treat specific pathophysiological changes that exacerbate the disease
• Continue cardiac medications
• Special investigations: ECG, 2D echo cardiography, ABG, and coagulation profile
• High-risk consent, defibrillator standby
• Infective endocarditis prophylaxis—cyanotic and obstructive lesions
• O₂ supplementation and L.t lateral position
• Aspiration prophylaxis
• Goal-directed fluid therapy
• Invasive cardiac monitoring, such as central venous pressure (CVP), intra-arterial blood pressure (IABP) (whenever required) along with standard American Society of Anaesthesiologists (ASA) monitors
• Appropriate anesthesia technique with multimodal analgesia

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Audit of Anesthetic Management of Parturients with Cardiac Diseases

**Table 1: Audit of anesthesia techniques for cardiac parturients during obstetric procedures**

| Disease | Surgery | Anesthesia |
|---------|---------|------------|
| Four ventricular septal defect with PS | Two elective LSCS | Epidural anesthesia |
| ASD operated, ASD with device closure ostium secundum | Emergency LSCS | Low-dose SAB |
| | Cervical encirclage | Epidural analgesia |
| | Emergency LSCS | Low-dose SAB |
| | Labor analgesia | Epidural analgesia |
| | Two TOF unoperated TOF operated | First trimester MTP | TIVA |
| | CHD, pulmonary stenosis | Second trimester MTP | Epidural anesthesia |
| | Seven cases of rheumatic heart disease (RHD), balloon mitral valvotomy (BMV) done, mod. mitral stenosis (MS), mild/mod. pulmonary hypertension (PH) | Labor analgesia | Epidural analgesia |
| | | Elective LSCS | Epidural anesthesia |
| | | Two emergency LSCS | Low-dose SAB |
| | | Cervical encirclage | Low-dose SAB |
| | | Two MTP | TIVA |
| Three RHD, mod MS, MR, TR | Elective LSCS | Epidural anesthesia |
| Two cases of RHD, mild/mod MR, dilated LV | Two emergency LSCS | Low-dose SAB |
| RHD severe MR, AR, TR, mod PH with AS | Elective LSCS | Epidural anesthesia |
| | MTP | TIVA |
| Two RHD, MVR done, TR, AR | MTP | TIVA |
| Takayasu arteritis and Chr HT | Elective LSCS | Epidural anesthesia |
| Peripartum cardiomyopathy 30% EF | Elective LSCS | Combined spinal epidural anesthesia (CSE) |

ASD, atrial septal defect; SAB, subarachnoid block; CHD, congenital heart disease; EF, ejection fraction; TOF, tetralogy of Fallot; TIVA, total intravenous anesthesia; LSCS, lower segment cesarean section

- Minimization of postdelivery hemodynamic changes caused by autotransfusion, relief of vena caval obstruction, oxytocic agents, and hemorrhage
- Perioperative intensive care

**Epidural Analgesia**

For cardiac parturients, vaginal delivery is the safe mode of delivery. Labor analgesia was achieved with the lumbar epidural technique resulting in good hemodynamic stability. The opioids as adjuvants along with low-dose local anesthetic agent improve the quality of labor analgesia without causing sympathetic blockade. Adequate analgesia decreases complications associated with Valsalva’s maneuver during the second stage of labor. This regional analgesia will also help forceps delivery. In cases of time restrain, a low-dose spinal anesthetic can be used.

Continuous or intermittent lumbar epidural analgesia with local anesthetics such as bupivacaine (0.0625–0.125%) and adjuvant opioids such as fentanyl 2 μg/mL was given.

Epidural analgesia with maximum sensory level up to T10 can also be used in the second trimester MTP.

**Epidural Anesthesia**

For elective LSCS cases, epidural anesthesia was preferred for hemodynamic stability. Epidural catheter was put at the L2–L3 level. Test dose was given with 3 cm³ of 2% xylocard and then bolus with 6–8 cm³ of 0.375–0.25% bupivacaine and 50 μg fentanyl. Sensory level up to T10 was achieved within 8–10 minutes. Further top up was tailored according to hemodynamics with 2% xylocard, which was given to achieve maximum sensory level up to T6 and maximum duration required was around 12–14 minutes. During intraoperative period, vitals, such as heart rate, blood pressure, CVP, peripheral capillary oxygen saturation, and U/O, were monitored.

- Low-dose subarachnoid block (SAB). It was low dose of hyperbaric bupivacaine mixed with fentanyl and normal saline. But volume of the spinal drug was maintained for adequate level up to T6 and hemodynamic stability. For LSCS, spinal drug up to 1.4 cm³ of 0.5% hyperbaric bupivacaine was mixed with 10 μg fentanyl and 0.4 cm³ of NS.

  Maximum sensory level up to T6 was achieved within 5 minutes. Motor blockade Bromage scale 2 was attained within 8 minutes. Two-segment regression happened within 45 minutes. Intraoperative vitals were well maintained.

- Total intravenous anesthesia (TIVA). Liberal use of opioid along with etomidate was done for hemodynamic stability. One hundred percent of oxygen was supplemented, and spontaneous ventilation was maintained.

**Discussion**

Effective management of obstetric patient with cardiac disease includes anteapart counseling; risk stratification; an optimization, monitoring, and tailored anesthesia plan for labor, delivery, and obstetric procedure; and ICU care in the immediate postpartum period.

Thorough cardiac evaluation, echocardiography, and electrocardiography will give the idea for residual ventricular dysfunction, valvular function, pulmonary hypertension, and arrhythmias. The fetus is evaluated for congenital anomalies and growth restriction. Incidence of neonatal complications, such as...
premature birth, IUGR, and respiratory distress syndrome, is more in cardiac parturients.8

Conservative therapy includes bed rest in the left lateral position and prudent use of diuretics and cardiac drugs. Treatment of other comorbidities, such as anemia, infection, and hypertension, will help in better outcome. Parturients who had repair of cardiac lesion and have good hemodynamic status generally have successful term pregnancies.3

The physiological changes associated with pregnancy can cause symptoms and signs similar to cardiac disease. Also, many times asymptomatic patients with cardiac ailments get diagnosed and worsened due to this.

Physical findings suggestive of heart disease include signs of heart failure, cyanosis, clubbing, palpable thrill, diastolic murmurs, cardiomegaly, presence of dysrhythmias, and loud P2 sound.

High-risk parturients having critical lesions should undergo corrective procedures during the second trimester of pregnancy, such as balloon valvuloplasty in severe stenotic valvular lesion.

Siu has developed a risk index incorporating following risk factors: NYHA class III and IV, cyanosis, ejection fraction (EF) <40%, and left heart obstruction.9

In a parturient with heart disease without any other morbidities, the chance of a cardiac event (arrhythmia, stroke, pulmonary edema, or transient ischemic attack) is about 5%, increasing to 25–75% depending on the number of associated risk factors.

Preoperative Optimization

For hemodynamic stability, the following factors are important—(1) preload, (2) afterload (systemic vascular resistance [SVR]), (3) myocardial contractility, (4) heart rate, and (5) pulmonary vascular resistance (PVR). These five parameters can be managed by tailored anesthetic techniques and with the use of cardiac drugs, such as digoxin, diuretics, and beta blocker drugs.

Vigilant monitoring and prompt treatment of any significant hemodynamic instability related to the operative procedure or peripartum period, such as blood loss or fluid overload, has to be done.

Monitoring

ASA standard monitoring which includes noninvasive BP (NIBP), ECG, pulse oximetry, respiratory rate, and input–output charting is required in all cardiac parturients during the peripartum period.4

Advanced cardiac monitoring is preferred in cases of parturients with significant ventricular dysfunction (low cardiac output states, such as heart failure, stenotic lesion, and dilated cardiomyopathy).10

Invasive ABR, CVP, and transthoracic echocardiography are indicated to predict and prevent maternal cardiac event. In selected cases, hemodynamic monitoring can be continued in the postoperative period in ICU setup.

Use of noninvasive cardiac output monitoring, such as PICCOTM, LiDCCOTM, or FloTracTM, is advised in the cardiac parturient.

Antibiotic prophylaxis is required during labor and delivery for cardiac parturients except those with repaired patent ductus arteriosus (PDA), isolated ostium secundum atrial septal defects (ASDs), and mitral valve prolapse (MVP) without regurgitation.7

Intravenous (IV) fluid input should be optimized to prevent both a lack of and excess of fluids. Adequate intravascular volume maintains maternal preload, SVR, and hemoglobin–oxygen saturation.

Vasopressor of Choice

The vasopressor of choice in these patients is low-dose phenylephrine. Prophylactic ephedrine administration should be avoided.7

Uterotonic drugs can have deleterious cardiovascular effects. Oxytocin causes decrease in SVR and increase in PVR. It can cause cardiovascular collapse with fast IV bolus, so low-dose infusions are safe. Ergometrine and carboprost should be avoided in impaired ventricular conditions because they cause pulmonary and systemic vasconstriction.5 Per rectal (PR) misoprostol has no cardiac side effects and so it can be used safely. In cases of uterine atony at cesarean section, uterine compression sutures are taken to stop bleeding.

In obstetric cardiac patient, assisted vaginal delivery with labor epidural analgesia is the safe mode of delivery.5 The decompression can be avoided by early epidural analgesia due to decrease in cardiac afterload and pain-related sympathetic drive. Even vasodilation of epidural will compensate the deleterious effect of postpartum autotransfusion.

Different techniques and associated risks and benefits are discussed in Table 2.

The anesthesiologist has an important role in dealing with postoperative pain management. Epidural analgesia is helpful in reducing the stress response and perioperative deep vein thrombosis. Sympathectomy generally improves microvascular flow.

CHD in Pregnancy

Common congenital acyanotic cardiac defects are PDA, ASD, and ventricular septal defect. When anesthetizing patients with CHD, precautions should be taken to avoid accidental IV infusion of air bubbles. So for epidural space identification, saline is used instead of air.4,10 Avoid hypoxemia, hypercarbia, and acidosis to avoid increase in PVR and reversal of shunt flow. Pregnancy is contraindicated in cases with Eisenmengerization.

Patients with corrected cardiac lesion and now asymptomatic can be treated as normal parturient. Infective endocarditis prophylaxis is recommended.11,12

Tetralogy of Fallot and Anesthesia Implications

It is the most common cyanotic CHD. Poor prognostic signs are as follows: Hct >60%, SaO2 <80%, right ventricular hypertension, and syncopal episodes.13

We have to choose an anesthesia technique which will maintain adequate SVR, venous return, and myocardial contractility, so as to avoid increase in the R–L shunt. For general anesthesia, narcotic induction with etomidate is preferred. Neonatal depression can be managed with bag and mask ventilation if required. Titrated induction with epidural is preferred over conventional SAB.14

Rheumatic Heart Disease

During pregnancy, stenotic lesions have more morbidity and mortality compared to regurgitant lesions.15

Stenotic valvular lesions, such as mitral and aortic stenosis, are fixed cardiac output states. The congenitally bicuspid valve is the common cause of aortic stenosis in pregnant patients. Due to this, the physiological changes in pregnancy, such as tachycardia and increased blood volume, cause pulmonary edema.10
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Anesthetic considerations are to maintain a slow heart rate, preload, and afterload. Aortocaval compression and pulmonary vasoconstriction should be avoided. For maintaining adequate coronary perfusion and cardiac output, atrial fibrillation has to be treated with rate control therapy.10

Both general anesthesia and regional techniques can be used depending on the severity of lesion.

Epidural anesthesia is preferred in these patients with mild-to-moderate lesions. Operated patients of valve replacement are on anticoagulant, so central neuraxial blockade increases the risk of epidural/spinal hematoma.

The European Society of Cardiology had put forward the following recommendations regarding peripartum anticoagulation management:

- Replace warfarin with either low-molecular-weight heparin or unfractionated heparin (UFH) from 36 weeks gestation
- Low-molecular-weight heparin should be replaced by IV UFH at least 36 hours before planned delivery. Unfractionated heparin should be continued until 4–6 hours before planned delivery and restarted 4–6 hours after delivery if there are no bleeding complications.16

Regurgitant Lesions—Mitrai and Aortic Regurgitation

Anesthetic considerations focus on reducing labor pain to prevent increases in SVR. Bradycardia can increase regurgitant flow. Atrial fibrillation can lead to hemodynamic instability. So, any heart rate variation should be treated promptly.

Pregnancy induced a hypercoaguable state and stasis as regurgitation cause increased the chances of systemic embolism. Regional or general anesthesia can be planned. Due to decrease in SVR, epidural anesthesia causes forward flow of blood and reduces regurgitant flow.17

Mitrail valve prolapse is much more common among pregnant women. Women with MVP usually tolerate pregnancy well. Most patients are asymptomatic and can be managed as regurgitant lesion.

Peripartum Cardiomyopathy

Peripartum cardiomyopathy is a severe myocardial dysfunction, similar to dilated cardiomyopathy. Parturient presents with heart failure in the third trimester of pregnancy or within 5 months postpartum having no preexisting heart disease (EF less than 45% on echo).18

Anesthetic management will be same as those for severe cardiomyopathy. Primary goals are to avoid myocardial depression, optimum fluid management (use of diuretics and vasodilators), maintenance of normal heart rate, and sinus rhythm. Both regional and general anesthesia can be used, but slow titrated induction is preferred.

Using low-dose spinal anesthesia and opioid combination along with epidural can also be instituted depending on the urgency of cesarean section and clinical expertise.

For patients with severe left ventricular dilation, anticoagulation is needed.

If general anesthesia is planned, then opioid induction with etomidate is preferred. The intermittent positive-pressure ventilation causes decrease in venous return and increase in PVR. Inhalational agents cause negative inotropic effects.

Postoperative ICU care with hemodynamic monitoring upto 72 hours is advisable for better outcome.

Takayasu Arteritis

Takayasu arteritis is a form of granulomatous panendarteritis resulting in occlusion and thrombosis of the aorta and pulmonary arteries, arterial aneurysms, and carotid occlusion.19

Hypertension and cerebral dysfunction are main complications affecting the anesthetic management of these patients. Perioperative steroid replacement is advisable to prevent Addisonian hypotensive

Table 2: Anesthesia techniques, their risks and benefits

| Anesthesia technique | Advantages | Disadvantages |
|----------------------|------------|---------------|
| Epidural anesthesia | Gradual onset of sympathectomy | Slow onset |
|                      | Slow fall in SVR and BP and no increase in PVR | Less dense block, rarely missed segment |
|                      | Avoidance of airway manipulation and stress response | No postoperative analgesia PDPH C/I—fixed low cardiac output (severe stenotic lesions), Eisenmengerization |
|                      | Prolonged analgesia and postoperative analgesia | Better hemodynamic stability compared to conventional |
|                      | Better APGAR score | SAB minimal anesthetic drug requirement |
|                      | Less chances of thromboembolism | Sympathetic stimulation of intubation extubation |
| Low-dose SAB         | Quicker to perform, faster onset, reliable block | Myocardial depression, increase in PVR and decrease in SVR |
|                      | Better hemodynamic stability compared to conventional SAB | Failed intubation |
| General anesthesia   | Better oxygenation in cyanotic heart disease | Aspiration |
|                      | Stable hemodynamics | PONV |
|                      | Preferred in patients with cardiac failure, on anticoagulation, right to left shunt, fixed cardiac output, and coarctation of aorta | No postoperative analgesia |
|                      | | Fetal drug depression |
|                      | | Risk of DVT in cyanotic hypercoaguable state |

SVR, systemic vascular resistance; BP, blood pressure; PVR, pulmonary vascular resistance; SAB, subarachnoid block; PONV, postoperative nausea and vomiting; PDPH C/I, post-dural puncture headache, contraindicated; DVT, deep vein thrombosis
Crisis. In cases of regional anesthesia, clinical neurologic monitoring in an awake patient in intraoperative period is easy. The rate of thrombosis will also be decreased. General anesthesia avoids sympatholysis. But, it can cause hypertensive episode leading to cerebral/cardiac events, so cerebral function monitoring is needed.

**Conclusion**
The skill and knowledge of the anesthesiologist about cardiac disease in parturient on frequent intraoperative scenarios and quick management of hemodynamic disturbances are more important than the type of anesthesia technique or agent used. The anesthetist working as a perioperative physician is need of the hour.

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