

Review Article

Mitral Stenosis and Pregnancy - Perioperative Considerations

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Abstract

Cardiovascular disease in pregnancy has been estimated to be 0.1-4.1%. The incidence of pregnancies in women with cardiac disease is on the rise due to an increase in the number of women with heart disease reaching childbearing age as a result of the developments in the management of cardiovascular diseases and advances in reproductive medicine, advancing maternal age with associated diabetes mellitus, hypertension, pre eclampsia and multiple fetal pregnancies. Cardiac disease has thus evolved as an important cause of non obstetric maternal mortality. Rheumatic mitral stenosis is one of the most common cardiac illnesses complicating pregnancy. Patients with severe mitral stenosis usually do not withstand the cardiovascular demands of pregnancy. Therefore, a multidisciplinary approach is required to reduce the morbidity and mortality during the antenatal and postnatal period. The role of anesthesiologist and perioperative considerations in such patients leading to prevention of complications with successful outcome of the mother and fetus are discussed.

Key Words: Mitral stenosis, pregnancy, caesarean section

Introduction

Cardiovascular disease in pregnancy has been estimated to be 0.1-4.1%¹. The common cardiac diseases during pregnancy ranges from congenital and acquired cardiac defects to peripartum cardiomyopathy. Valvular heart disease is the commonest cardiac condition in young women planning pregnancy. Cardiac disease is an important non obstetric cause of maternal mortality². Although most women are aware of their diagnosis prior to pregnancy, symptoms manifest for the first time during pregnancy. Though pregnancy is tolerated well in patients with mild valvular disease, pregnancy is not advisable in those with severe mitral stenosis (MS), severe symptomatic aortic stenosis (AS) and valve lesions associated with severe left ventricular (LV) dysfunction or significant pulmonary hypertension³. Pre conception counseling and if indicated, valve intervention should be recommended when planning for pregnancy^{3,4}. Cardiac disease associated with pregnancy represents a unique challenge to the anesthesiologist. All patients with significant cardiac disease have to be jointly managed by the cardiologist, obstetrician and anesthesiologist.

Rheumatic heart disease is still the most common cardiac illness, especially in a developing country like India where it constitutes 80% of the cardiac diseases during pregnancy⁵. In the developed nations, rheumatic heart disease is less common and complex congenital heart diseases have increased recently. This review article focuses on the peri operative considerations in pregnant patients with mitral stenosis.

Pregnancy risk assessment

Risk assessment of pregnancy is very important in a pregnant woman with heart disease⁶. Pre conception counseling previewing the risk of pregnancy for both mother and fetus, long term outcome of pregnancy on the heart, maternal life expectancy, genetic consultation, contraception safety and efficacy, modification of cardiac medications and optimization of cardiac status should be clearly explained. The risk assessment indices that are widely in practice are CARPREG (Cardiac disease in Pregnancy), BACH (Boston Adult Congenital Heart), ZAHARA (Zwangerschap bij vrouwen met een Aangeboren HARTafwijking- II (interpreted as "Pregnancy in women with CHD II risk index"), modified World Health Organization (WHO) classification⁷. The modified WHO risk classification is a reliable system for risk prediction according to many studies⁸. The modified WHO classification divides cardiac lesions as low risk (WHO I), medium risk (WHO II), high risk (WHO III) and lesions in which pregnancy is contraindicated (WHO IV)⁹.

General considerations in pregnant patients with cardiac disease

Pregnancy is accompanied by physiological variations in the cardiovascular system. Four principal cardiovascular variations normally occurring during pregnancy that can have significant anesthetic implications¹⁰:

- 1) There is a 50% rise in intravascular volume that peaks by third trimester. This relative volume overload is not tolerated in patients with low cardiac output due to any cause.
- 2) Systemic vascular resistance decreases progressively during pregnancy, so that normal mean arterial pressure is maintained despite 30 to 40% rise in cardiac output.
- 3) Significant changes in cardiac output happens during labor and immediately following delivery.
- 4) Hypercoagulability associated with pregnancy and the indication for anticoagulant therapy in patients prone to arterial thrombosis and embolization (chronic atrial fibrillation and prosthetic heart valves).

The cardiovascular changes are ordinarily well tolerated in a healthy young parturient but in patients with cardiac disease these variations place the myocardium under stress. In general, regurgitant lesions are well tolerated in pregnancy because the increased plasma volume and low systemic vascular resistance results in elevated cardiac output whereas stenotic lesions are poorly tolerated with advancing pregnancy due to the incomplete left ventricular filling and consequent inability to increase the cardiac output.

Risk factors for perinatal complications are poor maternal functional class, left heart obstruction, maternal age <20 or >35 years, multiple gestation, smoking during pregnancy and anticoagulant therapy, which are further escalated in women with concomitant obstetric risk factors¹¹.

Mitral Stenosis

Mitral stenosis (MS) is the most common valve lesion in women of childbearing age. Rheumatic MS forms 88% of the heart diseases complicating pregnancy in the tertiary referral centers in India⁵. It accounts for nearly 90% of rheumatic heart disease in pregnancy, with 25% of patients first experiencing symptoms only during pregnancy¹². An anatomically moderate lesion may become functionally severe with the distinct increase in cardiac output that is associated with pregnancy, labor and delivery. Other valve lesions like mitral regurgitation (MR), aortic stenosis (AS) and aortic regurgitation (AR) are also associated with rheumatic fever but less frequently.

Mitral stenosis may present as an isolated lesion or along with right sided or aortic valve disease. Women with mitral stenosis often do not tolerate the cardiovascular demands of pregnancy. Heart rate, cardiac output, red cell mass and plasma volume which are normally increased during pregnancy are not tolerated by patients with MS, according to the severity of the stenosis, leading to increased left atrial pressure and cardiac decompensation.

Pathophysiology

Normal mitral valve orifice has a surface area of 4 to 6 cm². Patients become symptomatic when the area is 2 cm² or less. MS prevents emptying of left atrium (LA)

progression of stenosis, left atrium dilates and left atrial pressure increases leading to a pressure gradient between the left atrium and left ventricle during diastole. The back pressure on the pulmonary vessels leads to pulmonary congestion with symptoms like dyspnea and hemoptysis, and in severe cases pulmonary edema. The symptoms may present for the first time during pregnancy due to hemodynamic changes accompanying pregnancy. Reduction in functional capacity, arrhythmias like atrial fibrillation and pulmonary edema are the most common cardiac complications¹³⁻¹⁵. Complications are related to the severity of MS and baseline New York Heart Association (NYHA) functional class^{13,14}.

Atrial arrhythmias and heart failure often occur in the third trimester when the hemodynamic changes of pregnancy are at its peak. Complications can also occur at the time of labor and delivery or within the first week post partum¹³. Patients with atrial fibrillation (AF) are at risk for cerebrovascular accident and transient ischemic events. The sudden increase in preload immediately after delivery due to auto transfusion from the uterus may flood the central circulation resulting in severe pulmonary edema. Auto transfusion continues for 24 to 72 hours after delivery. Thus the risk of pulmonary edema is extended into the postpartum period¹⁶.

Maternal outcome correlates well with NYHA functional classification and severity of the stenosis - severe (67%), moderate (38%), mild (26%)^{17,18}. Mortality rates for NYHA Class I and II were < 1% whereas for NYHA Class III and IV the mortality rates were 5 to 15%. A system for foreseeing complications during pregnancy was developed by Siu et al based on NYHA classification as follows¹⁹:

- 1) History of heart failure, arrhythmia, transient ischemic attack or stroke
- 2) Baseline NYHA class III or more or cyanosis
- 3) Systemic ventricular dysfunction (Ejection fraction <40%)
- 4) Pulmonary hypertension
- 5) Left heart obstruction – severe aortic stenosis or symptomatic /severe mitral stenosis
- 6) Severe aortic or mitral regurgitation with NYHA Class II or IV symptoms.

Management

Management of the parturient with mitral stenosis requires multidisciplinary approach by the obstetrician, cardiologist, anesthesiologist and neonatologist for optimal maternal and fetal outcome. Cardiac decompensation should be avoided during the antenatal period with regular check-up for volume overload and pulmonary edema. In symptomatic patients, medical management includes bed rest, oxygen therapy, diuretics and beta blockers²⁰. Beta blockers prolong the diastolic filling time and reduce left atrial pressure²¹. Recent trials infer that Digoxin has no role in the treatment of cardiac failure²².

AF demands aggressive treatment with Digoxin and beta blockers to revert it to sinus rhythm and anticoagulants to prevent systemic embolization. Cardioversion is indicated if pharmacologic therapy fails to control the ventricular response. Anticoagulants even in the absence of AF is useful^{23,24}. Women who are refractory to medical therapy, mitral balloon valvuloplasty may be considered. Mitral valve surgery should be considered in patients who are not candidates for balloon valvuloplasty. Major concern regarding cardiopulmonary bypass during pregnancy is fetal mortality; therefore valve surgery is considered only if other therapies have failed because it carries a significantly high fetal mortality risk of 20 to 30%^{13,25,26}. For women who remain stable throughout pregnancy, vaginal delivery with adequate pain relief is the preferable mode of delivery³. Analgesia during the first stage of labor is focused on reducing the pain related increase in catecholamine levels and preventing aortocaval compression. Analgesia for labor and vaginal delivery is best accomplished with lumbar segmental epidural analgesia to prevent fluctuations in hemodynamic parameters. Segmental epidural analgesia allows for careful titration of drug to the desired level of analgesia while minimizing undesirable hemodynamic changes. An opioid like fentanyl added to the dilute local anesthetic mixture enhances the quality of analgesia without causing sympathetic blockade. During second stage of labor, only the uterine contraction force is permissible rather than the maternal expulsive effort that is associated with Valsalva maneuver. Hence the second stage of labor should be shortened by instrumentation²². Epidural analgesia with low concentration of Bupivacaine and Fentanyl reduces systemic vascular resistance and preload²⁷. Caesarean section is indicated for obstetric reasons only.

Anesthetic considerations in operative delivery

Anesthetic options for caesarean delivery must take account of the additional potential hazards of marked fluid shifts secondary to anesthesia technique, operative blood loss and mobilization of blood in the post partum period. In a study by Goldszmidt and others, only 29-31% of the 522 women with heart disease required caesarean section and nearly 70% of them underwent vaginal delivery under epidural analgesia²⁸. A safe anesthetic technique is graded epidural anesthesia whereby the anesthesiologist can titrate the dose of local anesthetic and prevent the occurrence of hemodynamic instability and its consequences. Epidural anesthesia is preferred over spinal anesthesia because of the slower onset of blockade and better controllable hemodynamics²⁹. Prophylactic ephedrine administration as a prophylactic measure for hypotension must be avoided³⁰. If a vasopressor is indicated, the drug of choice is low dose phenylephrine.

The most basic principles of obstetric anesthetic management are³¹

- 1) Provision for maintenance of uteroplacental circulation by avoidance of aortocaval compression
- 2) Sympathetic blockade should be minimized and intra operative volume to be maintained.

- 3) Standard of care monitoring of parturient and fetus
- 4) Provision of aspiration prophylaxis.

Hence the goals of anesthetic management in patients with MS are²²

- 1) Maintenance of acceptable low heart rate as the time required for left ventricular filling is prolonged in MS.
- 2) Immediate treatment of AF and reversion to sinus rhythm
- 3) Avoidance of aortocaval compression
- 4) Maintenance of adequate venous return and systemic vascular resistance
- 5) Prevention of pain, hypoxemia, hypercarbia and acidosis which increases pulmonary vascular resistance.

Patients who are asymptomatic at term generally require increased vigilance but do not require invasive hemodynamic monitoring. Symptomatic patients are at risk in the peripartum period and invasive hemodynamic monitoring is indicated³².

General anesthesia (GA) provides stable hemodynamics if cardiovascular effects that accompany laryngoscopy and intubation as well as with suction and extubation are curtailed. Anesthetic induction agent should not produce wide fluctuations in hemodynamics. Etomidate is an ideal choice. A beta blocker like Esmolol and an opioid like Fentanyl should be administered before or during induction of GA. Methyl ergometrine should be avoided as it may produce hypertension, tachycardia and increased pulmonary vascular resistance³³. Oxytocin should be used cautiously as it can lower the SVR and elevate PVR resulting in a drop in cardiac output³².

Modified rapid sequence induction (RSI) using etomidate, remifentanyl and succinyl choline is an ideal choice in patients with severe MS with pulmonary hypertension. Maintenance of anesthesia may be with oxygen, air, isoflurane, opioids and vecuronium²². Emergence must be carefully controlled to ensure return of protective reflexes and avoidance of tachycardia²⁹. An increase in central circulatory blood volume may occur suddenly in the immediate post partum period and this intravascular load is poorly tolerated in patients with fixed cardiac output³⁴.

Tailoring the anesthetic management according to the patient's cardiovascular status and practitioner's knowledge and experience of the existing treatment options leads to a successful outcome in these patients²⁷. Post operatively, the patient should be managed in a High dependent unit (HDU) or Intensive care unit (ICU) for monitoring of fluid therapy, oxygen saturation and hemodynamics. During the first 24 to 72 hours significant fluid shift occurs, which may lead to congestive cardiac failure (CCF). Effective post operative analgesia may be provided by continuous epidural analgesia or patient controlled analgesia (PCA). Early ambulation to minimize the risk of deep vein thrombosis and paradoxical embolism should be weighed against the risk of cardiovascular stress.

Conclusion

Rheumatic mitral stenosis continues to be the most common cardiac disease complicating pregnancy. A thorough understanding of the physiological changes in pregnancy and the pathological impact of mitral stenosis on pregnancy is mandatory. A multidisciplinary approach and anesthetic planning in order to optimize cardiac function during the peripartum period considerably reduces the mortality and morbidity. The mode of delivery and anesthetic technique could be tailored as per the patient's cardiac condition resulting in successful outcome of the mother and fetus.

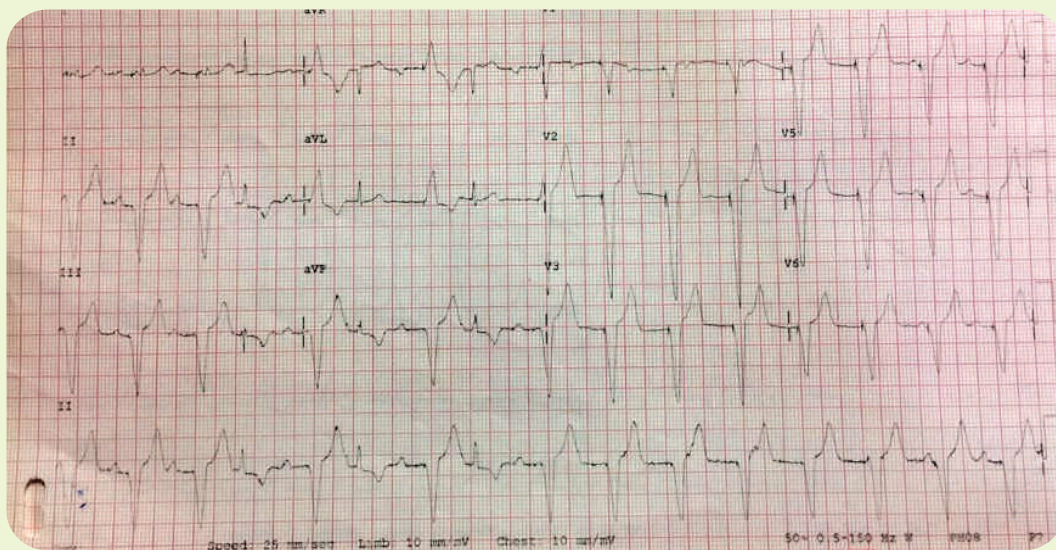
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Diagnose the condition

A 66 year old gentleman with vague chest discomfort and occasional palpitation. His ECG is shown below



Dr. M.Chokkalingam, Consultant Cardiologist, CSSH.

Answer in page : 163