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Anaesthetic Management of Mitral Valve Replacement in Pregnant Woman with Severe Mitral Stenosis and Left Atrial Clot

KEYWORDS: Mitral Stenosis, Mitral valve replacement, Cardio pulmonary bypass, Pregnancy

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ABSTRACT *A 33 year old female with rheumatic mitral stenosis was posted for mitral valve replacement. As patient was severely orthopnoeic with 32 weeks pregnancy and left arterial clot, so closed mitral valvotomy was not indicated. It was her precious pregnancy, so it was a challenge for us to keep the mother and fetus safe, but was successfully managed. Patient was delivered spontaneously on second postoperative day, a male child with normal APGAR 7/10 at 5 minutes.*

Introduction
Mitral stenosis (MS) is almost always due to fusion of mitral valve leaflets at the commissure during the healing process of acute rheumatic fever [1]. Patient is symptomatic when the size of mitral valve (MV) orifice area is less than 1 cm^2 [2]. The most definite assessment of the degree of mitral stenosis is done by measuring the diastolic gradient and gradient more than 10 mm Hg suggests severe stenosis.

Mitral valve disease remains the most common valvular disorder requiring surgery during pregnancy. Woman who has chronic severe MS lesions require close monitoring by cardiologist and obstetrician especially in third trimester during labour, delivery and early post partum period.

Case scenario
A 33 year old female with amenorrhoea of 32 weeks presented with complaints of dyspnoea, orthopnoea and palpitation since two years which increased gradually over a period of three months so that she was unable to sleep. Obstetric history of patient revealed that she had a male child of 15 years and after that no history of conception. Now she complained of increase in signs and symptoms of breathlessness gradually over a period of three months.

Examination & investigations
On examination patient had pulse rate-100pm irregularly irregular, blood pressure 130-90 mm of Hg. Cardiac auscultation revealed loud S1 and diastolic murmur, respiratory rate 28 per minute, patient was orthopnoic, bilateral ronchi present all over the chest.

Per abdomen examination showed uterus size of 32 weeks, uterus not acting, head floating and fetal heart sound 140 per minute.

Patient was on diuretics (furosemide 10 mg), digoxin 0.25 mg and anticoagulents.

Blood investigation including electrolytes were within normal limits. INR was 2.2 Antistreptolysin O titer and C- reactive protein were negative. ECG showing sinus rhythm with P mitrale in all leads. Chest x-ray revealed CT ratio of 0.8, prominent broncho-pulmonary markings, trachea was slightly deviated towards right side. 2 D Echo revealed enlarged left atrium (LA), severe MS, trivial mitral regurgitation (MR), mild tricuspid regurgitation (TR) mitral valve area< 1cm sq., normal systolic left ventricular(LV) function, LA clot, left ventricular ejection fraction (LVEF) 60% pulmonary artery systolic pressure 45 mm of Hg, pulmonary function showed mild ventilatory defect.

Patient was taken for MVR as:
1 Patient was having LA clot, so CMV was not indicated.
2 Simultaneously, cesarean section was not planned as patient and attendant were not ready for it, though they were explained about the possible risk to the fetus during cardio pulmonary bypass (CPB)

Anaesthetic management
On preanaesthetic checkup patient was graded as New York Heart Association (NYHA) III, weight of patient was 50 kg. Patient was shifted to Operation Theater with 18 gauge venous cannula, injection sustain 200 mg i.m. given as prescribed by obstetrician an hour before induction. Left radial artey and right internal jugular cannulation was done. Patient connected with 12 lead ECG, SpO_2, $ETCO_2$ and temperature monitoring. After preoxygenation for 3 minute patient was induced with midazolam 10 mcg/kg body weight, injection rocuronium 0.9mg/kg, injection fentanyl 10 mcg/kg body weight. Patient was intubated with 7.5 mm cuffed endotracheal tube. Patient was positioned supine with pillow under right buttock to shift gravid uterus to left side avoiding pressure over major vessels preventing aorto-caval syndrome. Nasogastric tube was put; nasopharyngeal temperature probe was placed in situ for temperature monitoring. Patient was catheterized with 16 gauge Foley's catheter for urine output monitoring.

Fetal heart monitoring was done by cardiotocography. Fetal heart sound was localized and a probe was secured by a belt to monitor fetal heart and beat to beat variation. Other probe was placed at the fundal height to monitor uterine contraction.

The surgical approach was through sternotomy after opening pericardium. Injection heparin 4mg/kg body weight was given to get ACT> 400 seconds after aortic Superior Vena Cava & Inferior Vena Cava cannulation patient was taken on CPB. Right atrium & LA was opened, lots of clots present in LA were removed and MV replacement and MVR was done with Saint Judes valve.

Intraoperative monitoring of arterial blood gas (ABG), anaesthetic drugs, urine output, ACT, blood sugar, fetal heart and temperature was done regularly.

Intraoperative haemodynamic status was maintained by flu-

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ids, ionotropes and blood. Total bypass time was 55 minutes and aortic cross clamp time was 40 minutes. After MVR patient was slowly taken off the CPB. Calculated dosage of injection Protamine was given through peripheral vein to reverse the effect of heparin to get ACT<120 second.

Patient was shifted to intensive care unit (ICU) with all monitoring and kept on ventilator. Patient remained haemodynamically stable and was gradually weaned off the ventilator after 24 hours and patient was successfully extubated next day. Fetal heart and uterine contraction were monitored in ICU regularly.

After 48 hours of operation patient developed labour pains. Obstetrician and pediatrician were called and a spontaneous vaginal delivery was conducted. Patient was watched for bleeding per vagina after placental delivery. Pediatrician was present in ICU for neonatal care, 1.75 kg male child of APGAR 5/10 at 3 minutes and 7/10 at 5 minutes, heart rate 128/ minute, spontaneous breathing at the rate of 56/ minute shifted to neonatal ICU in supervision of pediatrician. Baby stood well and was discharged from ICU on fifth day

Discussion

Cardiac surgery during pregnancy represents a major challenge as it comprise a single operation for two survivors. An incidence of 1-4% of maternal cardiovascular disease during pregnancy has been reported [3, 4]. The pregnant woman with well compensated cardiac disease can be affected due to increased cardio-respiratory requirement during pregnancy.

Medical therapy is not always sufficient to drive a heart with a reduced functional reserve. If and when the clinical condition of a pregnant woman with cardiac disease deteriorates despite maximal therapy, surgical correction is the only alternative to restore cardiovascular function and create conditions for the pregnancy to evolve normally.

Our patient developed severe respiratory distress not responding to medical treatment and echocardiography showed severe MS with LA clot so MVR was decided instead of CMV.

CPB was first used during pregnancy in 1959 [5]. In 1998, Weiss and colleagues reviewed 70 cases and reported 9% maternal mortality and 30 % pre-natal mortality[6]. More recently Arnoni and associates reviewed the outcome of 58 pregnant women undergone CPB and reported maternal mortality of 8% and 18 % of fetuses died [7].

CPB involved several factors that can compromise the delicate biological equilibrium between the fetus and the placenta. Potentially adverse effect of CPB include change in coagulation, alteration in function of cellular and protein components of blood, release of vasoactive substances from leucocytes, compliment activation, particulate and air embolism, non pulsatile flow, hypothermia and hypotension [8]. Most of detrimental agents of CPB do not act directly on the fetus; their influence is exerted on the placenta and the uterus. Only certain conditions such as hyperkalemia may directly affect the fetal myocardium.

Some authors advice to do cesarean section to deliver the infant after heparization and cannulation of the mother before commencing CPB. In our case patient refused to undergo cesarean though she was 32 weeks pregnant so she was allowed to continue pregnancy.

CPB during pregnancy should be conducted with a higher FiO_2 to produce an arterial PO_2 of at least 200 mm Hg. Our perfusionist kept the arterial PO_2 above 250 mm Hg and adjusted FiO_2 accordingly. Fetal bradycardia occurred once which was immediately managed by elevating the arterial PO_2 to 400 mmHg and increasing perfusion flow and pressure [9, 10] which allows better perfusion of placental tissue and favors fetoplacental gas exchange. Perfusate pH and temperature should be adjusted before starting bypass to avoid sudden reduction of placental blood flow and preserve optimal feto-maternal exchanges.

Even mild degree of hypothermia can increase uterine tone and contractions and elevate uterine vascular resistance [10]. Maternal bradycardia, ventricular arrhythmias and fibrillation are also more common during hypothermia therefore, significant hypothermia should be avoided. CPB should be done in normothermia and mild hypothermia to maintain gas exchange at the placental level.

Acid base disturbances are not well tolerated by the fetus as they alter gas exchange efficiency at the placental level. We advised perfusionist to keep patient on normothermic CPB to avoid untoward effect of hypothermia CPB.

The cardioplegia effluent was aspirated from the right atrium and was not allowed to mix with the perfusate. The hyperkalemia, secondary to the cardioplegia infusion can affect fetal myocardium [10,11]).

Fetal heart rate and uterine contraction were monitored by cardiotocography. CPB is a strong stimulus to increase the uterine tone and to develop contractions. Dilution of pregnancy hormones such as progesterone has been suggested to be responsible for the increased uterine activity, and if uterine activity persists despite all adjustments β agonist agent like ritodrine infusion (50-150mg/min) can be used. Pulsatile CPB is preferred but was not possible in our setup.

Conclusion

Cardiac surgery is usually not required during pregnancy and is best planned before conception or delayed until after delivery. Surgical intervention is required in patients refractory to medical management and can sometimes be life saving. Short duration normothermic, high flow if possible pulsatile CPB, with expeditious surgery is ideal. Careful technical precautions and continuous cardiotocography helps to minimize fetal complications during CPB. An experienced team of cardiologists, obstetricians, cardiothoracic surgeons, anaesthesiologist, perfusionist and neonatologist is absolutely necessary to decrease maternal morbidity and fetal mortality.

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