Case Report

OPEN HEART SURGERY DURING PREGNANCY

Shakti Bhan Khanna*, Anoop K Ganjoo, Kiranabala Dash*** and Swasti Shalini******

*Senior Consultant Obstetrics & Gynaecology & Gynae. Oncosurgeon, **Senior Consultant, Cardiovascular &Thoracic Surgery, ***Associate Consultant, ****Registrar Obstetric & Gynaecology, Department of Obstetrics and Gynaecology, Indraprastha Apollo Hospitals, Sarita Vihar, New Delhi 110 076, India.

Correspondence to: Prof. (Dr) Shakti Bhan Khanna, 304, SFS Apartment, Hauz Khas, New Delhi 110 016.

The incidence of heart disease in pregnancy has been gradually falling during the last three decades. Cardiopathy still remains a prominent cause of maternal and fetal mortality during pregnancy. Although the cardiac disease is well known in most of the patients before pregnancy, the potential risk factors of deteriorating cardiac function may not be emphasized to them. These women when pregnant, may develop heart failure due to increased cardiopulmonary requirements. In them, if medical treatment proves insufficient, the cardiac surgery during pregnancy may be life saving. The pregnant state is not optimal for cardiac surgery, as the principle interest in the mother and the foetus is different. We report two pregnant women who underwent unavoidable heart surgery with cardiopulmonary bypass and review the literature regarding optimal management of open heart operation in pregnancy aiming to decrease feto-maternal mortality. Careful technical precautions and continuous cardiotocography help to minimize fetal complications during the cardiopulmonary bypass.

Key words: Heart Disease, Pregnancy, Cardiopulmonary Bypass surgery.

INTRODUCTION

The incidence of heart disease in pregnancy has been gradually falling since last three decades. Where as in USA, the incidence is about 1% [1], it is much higher i.e, 27% in developing countries mainly due to the Rheumatic Heart Disease (RHD) [2].According to Bhatla, *et al* RHD accounts for 88% of all cardiac diseases seen during pregnancy [3]. Cardiopathy still remains a prominent cause of maternal and fetal mortality. Although the cardiac disease is well known before pregnancy, the potential risk factors of deteriorating cardiac function may not be emphasized to them. The women when pregnant may develop cardiac failure due to increased cardiorespiratroy requirements. If medical treatment in such women proves insufficient, the cardiac surgery during pregnancy may be life saving. The pregnant state is not optimal for cardiac surgery as the principal interest in the mother and the foetus is different. A number of reviews confirm that surgery on heart or great vessels is associated with major maternal and foetal mortality and morbidity. Open heart surgery during pregnancy is usually well tolerated by mother with mortality rate of 1.5 to 5% as in non pregnant state. Foetal mortality rate still remains high at 16 to 33% as of now [4]. In this report, we present two patients who underwent successful open heart surgery in second trimester of pregnancy.

CASE REPORTS

Case I

A twenty-five year old single parent, Ethiopian, primigravida was admitted at 29 weeks gestation to our hospital with complaints of breathlessness on exertion since 3 months. She gave history of rheumatic heart disease and was on frusemide, atenolol, digoxin and inj. Penidure. She had no antenatal checkups till presentation. Despite medical therapy, her condition had deteriorated. Patient was very ill looking pale, orthopnic with BP of 90/50mm of Hg and NYHA functional class III. On per abdomen examination , uterus was of 26 weeks gestation size with FHR of 136/min. Echocardiography showed Mitral valve of size 0.4cm^2, Mitral Regurgitation gradient of 2/3, Aortic Valve of size 1.5cm^2 with Aortic gradient of 3/4 , systolic pulmonary arterial pressure of 90-95 mm of Hg, central venous pressure of 18-20 and left ventricular ejection fraction of 60%. There was moderate cardiomegaly, left atrium was moderately enlarged, ascending aorta was small, with non coapting trileaflets. She had severe aortic regurgitation and pulmonary artery was tense. Mitral valve had thickened anterior and posterior leaflets. There was severe subvalvualer pathology and severe cordal fusion. Fetal ultrasonographic and Doppler studies showed single live foetus of 29 weeks gestation with severe IUGR and fetal growth at 8th centile. Liquor was normal and placenta

was high up and of grade II. There was absent flow in umbilical vessels.

So, she was diagnosed to have double valve disease of severe mitral stenosis (MS), moderate mitral regurgitation (MR), severe aortic regurgitation (AR), and moderate aortic stenosis (AS), severe PVH and PAH with severe IUGR and NYHA functional class III . On 1.4.08, she underwent double valve replacement with MVR #25 perimount bioprosthetic valve and AVR #19 perimount bioprosthetic valve with hypothermic (32ºC) Cardiopulmonary bypass (CPB) with a CPB time of 2.30 hours with aortic cross clamp time of 2 hours and 30 minutes. Pre operatively Inj Betamethasone was administered anticipating pre-term delivery. FHS was monitored pre, during and post operatively by cardiotocography.

Patient with stood the surgery well and fetal heart rate remained in normal range till the third post operative day when it was not localized. Ultra sonogram confirmed fetal demise. Labour was induced with misoprostol and patient delivered vaginally, a still born female foetus of 1.0kg weight after 48 hours of induction. Her post operative period was uneventful and she discharged from the hospital in good condition.

Case II

A twenty eight year old primigravida, diagnosed to have RHD at 19 years of age, was admitted at 21 weeks gestation with complaint of breathlessness at rest since 1 week. She was taking digoxin, frusemide and inj Penidure. She underwent echocardiography which revealed thick mitral valve, severe subvalvular thickening, moderately calcified mitral valve,mitral valve area of 0.66 cm^2, mild MR, dilated LA, Left Ventricular Ejection Fraction of 60%, mild TR , pulmonary arterial systolic pressure of 75mmHg and thick aortic valve. Diagnosis of rheumatic heart disease with severe mitral stenosis, mild mitral regurgitation, NSR, moderate PAH with severe PVH and NYHA functional class IV was made. Ultrasonography done on 20.3.09 reported a single live fetus of 21weeks+1day gestation with no anomalies, normal amniotic fluid and expected cervical length of 36mm. Expected weight of foetus was 351gms. On 23.03.09, she underwent open heart surgery for mitral valve replacement with bioprosthetic perimount plus 25 mm valve on normo thermic CPB with a CPB time of 1 hours 49 minutes. Her post operative recovery was uneventful. FHS monitoring was within normal limits. Post operatively she was started on Warfarin from 24.03.09 and dosage of the drug was monitored to have an INR of 3. She was discharged from hospital in good condition with a healthy foetus. This patient was also from Ethiopia and her obstetric follow up is not known.

DISCUSSION

The main issues to be discussed in open heart surgery in pregnancy are related to the mother and foetus as regards their mortality and morbidity. Weiss and colleagues (1998 a) reviewed cases between 1984 and 1996 [5]. In 70 women, 59 of whom had cardiopulmonary bypass, maternal mortality was 6 percent and prenatal mortality was 30 percent. With valvular surgery, maternal mortality was 9 percent. More recently, Arnoni and associates reviewed the outcome of 58 such women from Brazil [6]. The maternal mortality rate was 8 percent, and 18 percent of the fetuses died as a direct result of the surgery. They concluded that mortality might be reduced by performing procedures earlier in gestation, avoiding emergency operations and minimizing bypass time.

Strickland and colleagues reported the Mayo clinic experience in 10 women undergoing cardiopulmonary bypass with pump times ranging from 18 to 154 minutes [7]. The fetal response to bypass was usually bradycardia, and the investigators recommended that high-flow, normo thermic perfusion be used if possible. Khandelwal and associates meticulously recorded fetal and uterine blood flow velocity patterns during a 74 minute bypass procedure at 19 weeks for aortic valve replacement [8]. Despite high peak flow rates and sustained mean arterial pressures, uterine and umbilical artery resistances increased greatly, and fetal hydrocephalus and ascitis developed within 2 days. The causes of maternal mortality or morbidity depend upon the indication for the CBP. *Table* 1 depicts the list of valvular heart lesions associated with high maternal and or fetal risk associated with pregnancy [9]. Effects of CPB are adverse on fetus and it is worth while to understand the 'why' and 'how' of these effects. *Table* 2 shows the risk factors and their effects on the fetus.

Adverse effects of CPB include coagulation changes, alteration in the function of blood components, release of vasoactive substances from leukocytes, complement activation, particulate and gaseous embolism, obstruction of drainage of IVC, uterine artery spasm leading to congenital malformations in fetus [10].

If CPB is performed in first trimester, fetal demise can also occur. Fetal bradycardia can occur during the surgery due to the decreased fetal oxygenation secondary to placental hypoperfusion or acid base changes. Usually FHR normalizes immediately after the operation is over.

Both our patients had normal FHR post CPB. Rossouw GJ, *et al* postulated that normothermic CPB with high perfusion flow avoids the occurrence of fetal bradycardia

Table1. Valvular heart lesions associated with high maternal and/or fetal risk during pregnancy (Bonow, *et al* ACC/AHA Practice Guidelines *e167*)

1. Severe AS with or without symptoms
2. AR with NYHA functional class III-IV symptoms
3. MS with NYHA functional class II-IV symptoms
4. MR with NYHA functional class III-IV symptoms
5. Aortic and/or mitral valve disease resulting in severe pulmonary hypertension (pulmonary pressure greater than 75% of systemic pressures)
6. Aortic and/or mitral valve disease with severe LV dysfunction (EF less than 0.40)
7. Mechanical prosthetic valve requiring anticoagulation
8. Marfan syndrome with or with out AR

Table 2. Risk factors and their effects on the fetus during cardio-pulmonary bypass

Risk Factors	Effect of Factors
Non Pubatile flow pump	IUGR
Uterine arteriovenous Shunts	Small for gestation baby
Hypothermia-30°	Reduced oxygen supply through placenta
Hypotension-55mm Hg	Increased risk of fetal arrhythmia and cardiac arrest, increased congenital malformation
Long duration of bypass	Permanent fetal Bradycardia
Sudden warming after CPB	Extensive Uterine contractions resulting in placental failure and secondary foetal hypoxia
Heparinisation	Placental haemorrhagia, foetal abortion or premature labor.

[11]. Embryo fetal mortality was 24.0% when hypothermia was used, compared with 0.0% while operating in normo thermic condition. Maternal mortality did not change [12]. Case I was operated at mild hypothermic perfusion while Case II was operated in normo thermic perfusion. Studies recommend application of normo thermic or mild hypothermic perfusion unless aortic clamp time is unexpectedly long. This is because rewarming period can augment uterine contractions leading to preterm labour [13,14].

Gurley MF, *et al* reported a case series of 17 patients who underwent cardiac surgery during pregnancy from 1976-2005. In their study, median gestational age (GA) at surgery was 21 weeks (range 7–35 weeks) and median pre operative NYHA class was III. Median bypass time was 49.5 minutes (range 16-185), median cross-clamp time 31 minutes (range 9-128), median flow rate 2.4 l/min/m^2 (range 2.2-2.6) and median perfusion temperature 37°C (range 20-37). Eight patients (47%) required emergent or urgent surgery, four underwent cesarean section (CS) immediately prior to sternotomy delivering viable infants (median GA 32 wks). There were 3 fetal deaths; one (GA 7wk) was associated with TAA repair using partial bypass (surgery duration 340 minutes) in a methamphetamine user, the second occurred in a poorly controlled Type 1 DM undergoing AVR and CABG (GA 15 wk), and the third occurred after MV replacement (1986) using deep hypothermic circulatory arrest (DHCA) at 28ºC (GA 26 wk). Six of the remaining 10 fetuses were delivered alive vaginally (median GA 39 wks), 2 were delivered alive by caesarean section (median GA 36 wks), and 2 were lost to follow-up. They concluded that cardiothoracic surgery can be performed with relative safety during pregnancy and fetal demise is associated with urgent, high-risk surgery, maternal comorbidities and early gestational age [15].

There have been reports of fetal death despite appropriate conditions during CPB. Rossouw GJ, *et al* reported a case of mitral valve replacement at 23 weeks GA using mild hypothermic CPB when fetal heart could not be detected after CPB and the fetus was stillborn [11].

Case I was NYHA class III while Case II was NYHA class IV. Cardiopulmonary bypass time of Case I was 190

min while that of Case II was 109 min. Comparing both the cases, while Case I was a lower NYHA class than Case II, she had double valve disease (mitral and aortic), had undergone double valve replacement with a longer bypass and aortic cross clamp time at a lower perfusion temperature. Bioprosthetic valves were used in both cases as desired by the patients. Both of them were explained about the need for repeat valve replacement in case of bioprosthetic valves. Still, they preffered to have it. Oakley suggested that selection of bioprosthetic valves to avoid the need for anticoagulation is not a suitable alternative to metallic valves because of their accelerated degeneration during pregnancy and the consequent need for repeated mitral valve surgery [16]. Although Case II was NYHA class IV and was operated at an earlier gestational age, the fetus survived the surgery whereas case I had a stillbirth.

Recommendations are to use appropriate anesthetic and supportive agents, maintain acid base balance, use high flow rates, more than 72.52 lit//min, high perfusion pressure i.e, mean arterial pressure of 70mm Hg., normo thermia or mild hypothermia during CPB, minimizing duration of CPB and aortic cross clamp time during open heart surgeries in pregnant women [17]. External monitoring of FHR and uterus has been reported to reduce fetal mortality rate to 9.5% as potential problems can be detected early and managed accordingly during CPB [18,19]. Agarwal, *et al* recommend a 30-60 degrees pelvic tilt during surgery, correction of anemia pre-operatively, higher arterial flow, mean arterial pressure >70mmHg, higher FiO_2, acid base management, avoiding the mixing of cardioplegic agent with the perfusate and cardiotocographic monitoring during CPB [20] .

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 help to minimize fetal complications during CPB. An experienced team of cardiologists, obstetricians, cardiothoracic surgeon, anesthetist, perfusionist and neonatologist is absolutely necessary to decrease maternal morbidity and foetal mortality.

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