Review Article

Indian Journal of Maternal-Fetal and Neonatal Medicine
Volume 3 Number 1, January - June 2016
DOI: http://dx.doi.org/10.21088/ijmfnm.2347.999X.3116.6

Cardiovascular Disease and Pregnancy

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Abstract

An increased prevalence of cardiovascular disease (CVD) has been found in women of reproductive age group. Pregnancy is associated with substantial physiologic changes that require adaptation of cardiovascular system. In this article we describe the changes in cardiac physiology encountered during pregnancy, and its effect on pre-existing cardiac disease. Important cardiac , maternal as well fetal assessment is elaborated. We outline the main cardiac pathology that can affect women during pregnancy and labour and provide a summary of the available evidence to guide management. Aspects of obstetric care that require adjustment in the presence of cardiac disease are highlighted.

Pre-conceptional counselling is very important in patients with known cardiac disease. A team approach is needed to manage a pregnancy with cardiac disease to improve the outcome. It includes obstetrician, cardiologist, intensivist, anaesthetist, neonatologist.

Keywords: Cardiovascular Disease (CVD); Pre-Conceptional Counselling; Oral Anticoagulant (OAC); Low Molecular Weight Heparin (LMWH); Unfractionated Heparin (UFH); Fetal Assessment.

Introduction

The maternal mortality rate in women with heart disease is increasing in spite of its prevalance being low in pregnant women.

At present 0.2 – 0.4 % of all pregnancies in western industrialised countries are complicated by cardiovascular diseases (CVD).

Knowledge of the risks associated with CVD during pregnancy and their management are of pivotal importance for advising patients before pregnancy [1].

The full spectrum of structural heart disease including Congenital heart disease (CHD), valvular heart disease & cardiomyopathy and ischemic heart disease (IHD) may be encountered in pregnant women.

In developing countries high prevalance of rheumatic heart disease i.e. valvular heart disease dominate as compared to CHD in developed countries.

The spectrum of CVD in pregnancy is changing and differs in different countries. In western world risk is increasing due to increasing age of 1st pregnancy, increased prevalance of cardiovascular risk factors i.e. diabetes, hypertension and obesity.

In last few years incidence of an acute coronary event during pregnancy has increased due to older child bearing age, and changes in lifestyle with more hypertension , obesity and smoking in women [2].

Pre-Conceptional Counselling

All patients with known cardiac disease should be counselled before conception [3].

Girls with CHD should be referred to joint cardiac and obstetric units for advice about contraception once they attain puberty. As pregnancy comes substantially increased risk for women with CHD, efforts should be made to prevent unwanted pregnancy [4].

The pregnant women should be told about the risks

associated with pregnancy on her and fetal health . The changes which occurs due to pregnancy may increase the severity of heart disease and she may land in cardiac failure.

An important aspect concerning care of young women in consultation about risks of inheritance of cardiac defects [5]. The risk is significantly raised as compared to parents without CVD where risk is 1% . The risk is higher when mother is affected rather than father [6]. The recurrence risk varies between 3%-50% depending on type ofmaternal heart disease [5].

Children of parents with a cardiovascular condition inherited in an autosomal dominant manner (e.g. Marfan syndrome, hypertrophic cardiomyopathy, or long QT syndrome) have an inheritance risk of 50%, regardless of gender of the affected parent [5].

Genetic Testing may be Useful

† in cardiomyopathies and channelopathies, such as long QT

Syndromes [7].

† when other family members are affected

† when the patient has dysmorphic features, developmental delay/mental retardation, or when other non-cardiac congenital abnormalities are present, in syndromes such as in Marfan, 22q11 deletion, Williams–Beuren, Alagille, Noonan, and Holt–Oram syndrome [5].

Genetic screening by chorionic villous biopsy can be offered in the 12th week of pregnancy. All women with congenital heart disease should be offered fetal echocardiography in the 19th to 22nd week of pregnancy [5].

Pre-pregnancy evaluation should focus on identifying and quantifying risks for both mother and offspring including medication use, hereditary. Management of pregnancy and delivery should be planned on individual basis. Treatment options should be discussed with both parents as they may affect mother and child. So optimal care for pregnant women with heart disease requires multidisciplinary involvement and is best in tertiary centre.

Counselling after thorough evaluation should be offered to all women with known heart disease.

An exercise test (with VO2 max measurements) and echocardiogram provide essential information on pre-pregnancy cardiac status and reserve [3].

The grading of heart disease as per NYHA should be decided before she enters pregnancy.

Physiological Changes in Pregnancy

Changes start occurring as early as 5- 8 weeks of pregnancy.

Table 1: Normal hemodynamic changes during pregnancy

Hemodynamic Parameter	Change During Normal Pregnancy	Change During Labor and Delivery	Change During Postpartum
Blood volume	↑ 40%-50%	↑	↓ (autodiuresis)
Heart rate	↑ 10-15 beats/min	↑	↓
Cardiac output	↑ 30%-50%	↑ Additional 50%	↓
Blood pressure	↓ 10mmHg	↑	↓
Stroke volume	↑ First and second trimesters; ↓ third trimester	↑ (300-500mL per contraction)	↓
Systemic vascular resistance	↓	↑	↓

Cardiac output increases by 30-50 % secondary to rise in blood volume and heart rate [8]. Heart rate increases by 10-20 beats from 20th week of pregnancy [5]. Cardiac output peaks at the end of 2nd trimester and reaches plateu till delivery [4]. Blood pressure decreases by 10-15 mm hg due to decrease in systemic vascular resistance caused by low resistance circuit by placenta and due to vasodilatation by prostacyclin and nitric oxide [9].

Uterine contractions, positioning (left lateral vs. supine), pain, anxiety, exertion, bleeding, and uterine involution cause significant haemodynamic changes during labour and post-partum. CO increases by 15% in early labour, by 25% during stage 1, and by 50% during expulsive efforts [10]. It reaches an increase of 80% early post-partum due to autotransfusion associated with uterine involution and resorption of leg oedema [5].

Postpartum , the cardiac output is typically reduced for 2 -6 weeks [10].

Pregnancy is a hypercoagulable state due to rise in clotting factors. Studies show that pregnant women have 3 to 4 times chance of developing arterial thromboembolism and 4-5 times chance of having venous thromboembolism as compared to nonpregnant women [11].

Cardiovascular Evaluation during Pregnancy

Detailed personal and family history should be taken. Baseline functional status and previous cardiac status have to be noted in detail as they are strong predictors of peripartum cardiac events[1,3].

Strongest predictors are any prior cardiac event, cyanosis or poor functional class, left sided heart obstruction and ventricular dysfunction[3].

Table 2: Predictors of maternal cardiovascular events & risk score from the CARPEG study[5]

Prior cardiac events(heart failure, transient ischaemic attack, stroke before pregnancy or arrhythmia).
Baseline NYHA functional class > ii or cyanosis
Left heart obstruction (mitral valve area < 2 cm^2, aortic valve area < 1.5 cm^2,
peak LV outflow gradient > 30 mmHg by echocardiography).
Reduced systemic ventricular systolic function (ejection fraction < 40 %)

Prior cardiac events(heart failure, transient ischaemic attack, stroke before pregnancy or arrhythmia).

Baseline NYHA functional class > ii or cyanosis Left heart obstruction (mitral valve area < 2 cm^2, aortic valve area < 1.5 cm^2, peak LV outflow gradient > 30 mmHg by echocardiography).

Reduced systemic ventricular systolic function (ejection fraction < 40%) CARPREG risk score: For each CARPREG predictor that is present a point is assigned. Risk estimation of cardiovascular maternal complications.

0 point 5 %

1 point 27 %

>1 point 75%

ECG has to be done during pregnancy. There is left axis deviation and in the third trimester Q waves in lead III and aVF and inverted T waves in leads III, V1, and V2 are Seen [12].

Echocardiography has become an important tool during pregnancy and is the preferred screening method to assess cardiac function. Transthoracic and transesophageal echo can be done , out of which transesophageal is rarely required [5].

In normal pregnancy there is significant rise in Cardiac output, cardiac index , left ventricular end diastolic volume , left ventricular wall thickness [12].

Radiation should be avoided as far as possible. X ray should be performed on indication [13].

MRI may be useful in complex congenital heart disease & aortic pathology. It is safe after 12 weeks [3].

The blood investigation which are advised are creatinine kinase (C K) MB & Troponin . Out of this troponin I is not elevated in normal pregnancy so this is recommended laboratory test in pregnancy [14]. During pregnancy serial B type natriureteric peptide levels could be useful specifically in excluding suspected adverse cardiac events [15].

Fetal Assessment

1 st trimester USG allows accurate measurement of gestational age . Diagnosis of congenital cardiac malformations can be made as early as 13 weeks in familes with heart disease. This is appropriate timing to screen for congenital heart disease. Review of accuracy of 1st trimester USG for detection of major CHD showed sensitivity and specificity of 85 and 99% [5].

Optimum timing for screening for CHD is 18-22 weeks when visualisation of heart & outflow tract is optimal [16].

When fetal cardiac anomaly is suspected, it is mandatory to obtain [5].

1. Full fetal echocardiogram
2. Detailed scanning of fetal anatomy
3. Family history
4. Maternal medical history
5. Fetal karyotype
6. Referal to maternal-fetal medicine specialist, paediatric cardiologist
7. Delivery at institution

Fetal Doppler and biophysical profile is needed in cases of fetal compromise.

Interventions in Pregnancy

As for as possible, no interventions are to be done in pregnancy. If an intervention is absolutely necessary best time is after 4th month as by this time organogenesis is complete, fetal thyroid is inactive and volume of uterus is small. So there is greater distance between fetus and chest [5].

Cardiac surgery is recommended only when medical therapy & interventional procedure fail & mother's life is threatened. The best period of surgery is between 13th – 28th week [17,18].

Interventional procedures are justified only in emergency situations [3].

Cardiac surgery may lead to fetal mortality in range of 14-33 %. So in view of this ESC (European Society of Cardiology) advice delivery after 28 weeks of

gestation if cardiac surgery is planned [3,5].

Contraindications to Pregnancy are [19].

1. Severe pulmonary hypertension
2. Severe fixed left side obstructive lesion
3. Prior peripartum cardiomyopathy
4. Dilated unstable aorta of 4-5 cm or more
5. Left ventricular ejection fraction of < 40 %

Management of Pregnancy

A team approach is needed including obstetrician , cardiologist , intensivist, anaesthetist, neonatologist.

Patient has to be graded after thorough history & physical examination in NYHA class.

Regular & frequent antenatal visits are needed . In every visit vital parameters are checked along with signs & symptoms of cardiac failure & signs of ischemia are monitored.

All infections including urinary tract infections should be managed aggressively.

Timing & mode of delivery should be discussed in detail in advance with patient & relatives.

Timing & Mode of Delivery

Multidisciplinary approach should again take place at 32- 34 weeks of gestation to establish plan of management for delivery . Features of plan include deciding who should be involved in supervising the labour, whether a caesarean section is appropriate , whether bearing down is advisable in the second stage of labour [4].

Management of Delivery

At around 32-36 weeks of gestation multidisciplinary team should ideally formulate plan fro delivery. The team should include obstetrician, cardiologist & anaesthetist . The plan should include [20].

a. Timing of delivery (spontaneous or induced)
b. Mode of delivery (vaginal or Caesarean section)
c. Whether or not rhythm observation or hemodynamic monitoring is necessary
d. Analgesia / anaesthesia
e. Advice about medication during delivery & lactation.
f. Plan for observation after delivery.

Timing of Delivery

In asymptomatic women with good condition spontaneous onset of labour is awaited [3,5,20].

It is preferable to induce labour in some cases. E.g. in women with mechanical valves, so that anticoagulation can be managed more appropriately . In some case early induced labour is preferred , eg in heart failure or progressive aortic dilation [20].

Timing is individualised according to patient's cardiac status , Bishop score , fetal well being & lung maturity. Due to lack of prospective data & influence of individual patient characteristics standard guidelines do not exist & management should be individualised [5].

Vaginal delivery is preferred due to less blood loss, more rapid recovery, less infection & thromboembolic complications [3,5].

Adequate pain relief with epidural analgesia will help to attenuate hemodynamic changes with accompanying labour. It also allows controlled fetal descent to pelvic floor by suppressing bearing down reflexes [3].

Epidural catheters are contraindicated in women with anticoagulants [3].

Here intravenous analgesia is considered. Adequate measures to prevent sudden decrease in PVR associated with epidural anaesthesia should be considered should be considered in women with left ventricular outflow tract obstruction. Once patient goes into labour lateral decubitus position is given to accentuate hemodynamic impact of uterine contractions [21,22]. Assisted vaginal delivery is recommended (by vaccum or forceps).

Labour Induction

Oxytocin & artificial rupture of the membranes are indicated when the Bishop score is favourable. Long induction–delivery time is avoided if cervix is unfavourable. While there is no absolute contraindication to misoprostol or dinoprostone, there is theoretical risk of coronary vasospasm & low risk of arrhythmia. Dinoprostone has more profound effect on blood pressure than Prostaglandin E1 & so contraindicated in active CVD [3].

Caesarean Section

It annihilates the hemodynamic changes associated with labour. It permits more invasive and non-invasive hemodynamic monitoring & management.

Caesarean section is considered for patients on oral anticoagulants in preterm labour, patients with Marfan syndrome & aortic diameter > 45 mm,

patientswith acute or chronic aortic dissection , acute intractable heart failure [3].

Caesarean section increases risk of infection, venous thrombo-embolism, Postpartum haemorrhage. Epidural anaesthesia or general anaesthesia is preferred [20].

Delivery in patients who are on anticoagulation

In 1st trimester OAC should be switched to LMWH or UFH. Then from 2nd trimester to 26 weeks onwards OAC can be continued. From 36 weeks OAC should again be switched to LMWH or UFH.

Women treated with LMWH should be switched to IV UFH at least 36 hours before induction of labour or caesarean section. UFH should be discontinued 4-6 hrs before planned delivery, and restarted 4-6 hrs after delivery if there are no bleeding complications. In event of urgent delivery in patients on OAC, caesarean section preferred to reduce risk of intracranial haemorrhage in the fully anticoagulated fetus [5]. If emergency delivery is necessary FFP should be given prior to caesarean section to achieve target INR of < = 2 [23] . Oral vit. K (0.5 -1 mg) also can be given, but it takes 4-6 hrs to influence the INR. If mother was on OAC at the time of delivery, anticoagulated newborn can be given FFP& should receive Vit K. If patient is on UFH or LMWH during emergency delivery protamine should be considered. Protamine will only partially reverse the anticoagulant effect of LMWH [5].

Postpartum Care

A slow i.v. infusion of oxytocin (0.2 U/min), which avoids systemic hypotension, is administered after placental delivery to prevent maternal haemorrhage. Prostaglandin F2α analogues are useful to treat post-partum haemorrhage, unless an increase in pulmonary

artery pressure (PAP) is undesirable. Methylergonovine is contraindicated because of the risk (0.10%) of vasoconstriction and hypertension [24,25]. Meticulous leg care, elastic support stockings, and early ambulation are important to reduce the risk of thrombo-embolism [5].

Prophylactic diuretics and ACE inhibitors may be indicated in high-risk patients with severe systemic ventricular dysfunction [3].

A routine echocardiographic examination post-delivery in high-risk women is advisable, paying careful attention to the aortic root in women with Marfan syndrome or aortic valve disease. The risk of thrombo-embolic complications is further increased post-partum and anticoagulation should be adjusted accordingly [26].

In patients with low risk for heart failure, short observation period of several hours to 48 hours postpartum might be sufficient [3].

While lactation is permissible in most women with heart disease, it might be contraindicated due to medication use, severely decreased effort tolerance, or risk of mastitis and bacteremia in some women [3].

Prophylaxis for Infective Endocarditis

Infective endocarditis during pregnancy is rare with estimated risk of 1 per 100,000 pregnancies & incidence of 0.5 % in patients with known valvular or congenital heart disease [27].

As per European guidelines endocarditis prophylaxis is not recommended before vaginal or caesarean delivery. It is only recommended for patients with higher risk of acquiring endocarditis, eg dental procedures [5].

Methods of Contraception

Apart from barrier methods (condom), the levonorgestrel releasing intrauterine device is the safest and most effective contraceptive that can be used in women with cyanotic congenital heart disease and pulmonary vascular disease [28].

A copper intrauterine device is acceptable in non cyanotic or mildly cyanotic women [5].

Monthly injectables that contain medroxy-progesterone acetate are inappropriate for patients with heart failure because of the tendency for fluid retention [29].

Tubal ligation is usually accomplished safely, even in relatively high risk women. It is however not without risk in patients with pulmonary hypertension, cyanosis & Fontan circulation due to associated anaesthesia & abdominal inflation. The risk may be lower with minimally invasive hysteroscopic thechniques like Essure device. Advantage of hysteroscopic sterilisation include the ability to perform the procedure in outpatient setting and without an incision. A disadvantage is the 3 month waiting period until tubal occlusion is confirmed [30].

Vasectomy is an efficacious option as compared to tubectomy. But the longterm prognosis of the female partner must be considered as the male partner may outlive her [5].

Medical Termination of Pregnancy

It should be done in preferred cases only. 1st

trimester is safest time for termination. Methods should be decided on individualised basis. Medical method may be an alternative to suction & evacuation[5].

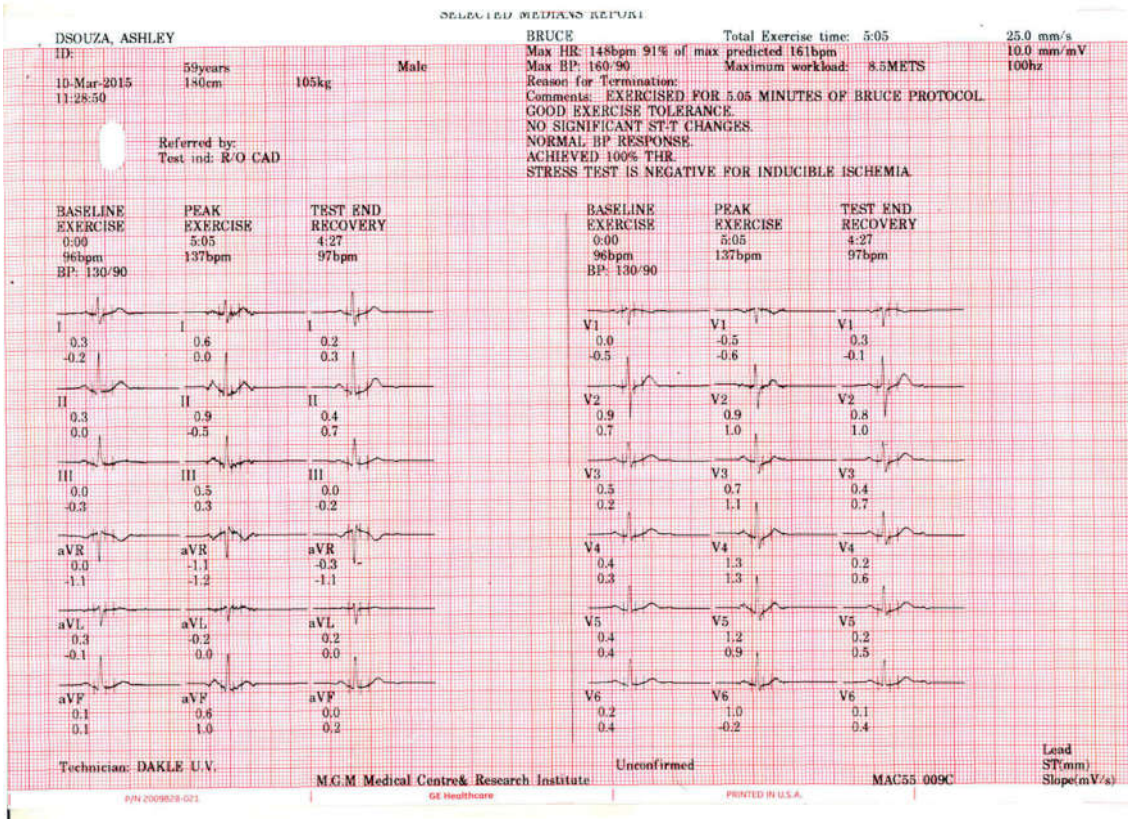

Fig. 1:

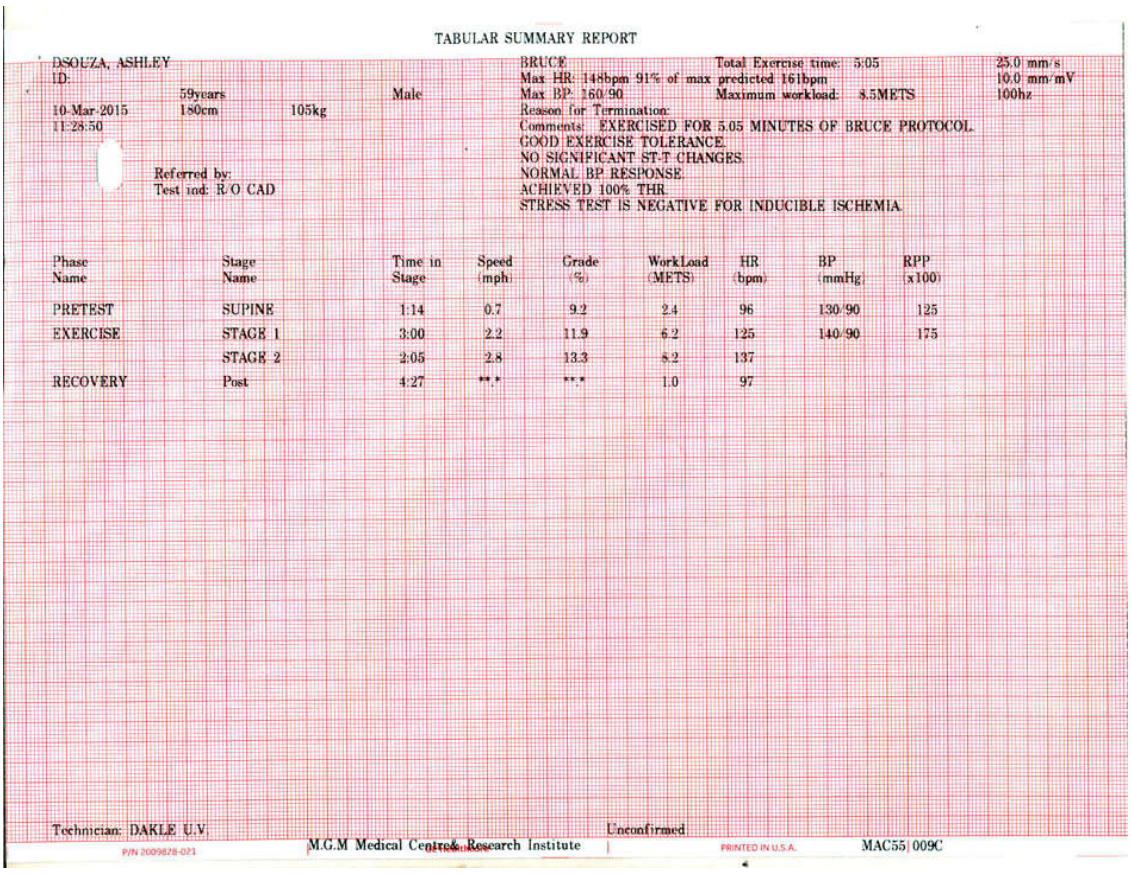

Fig. 2:

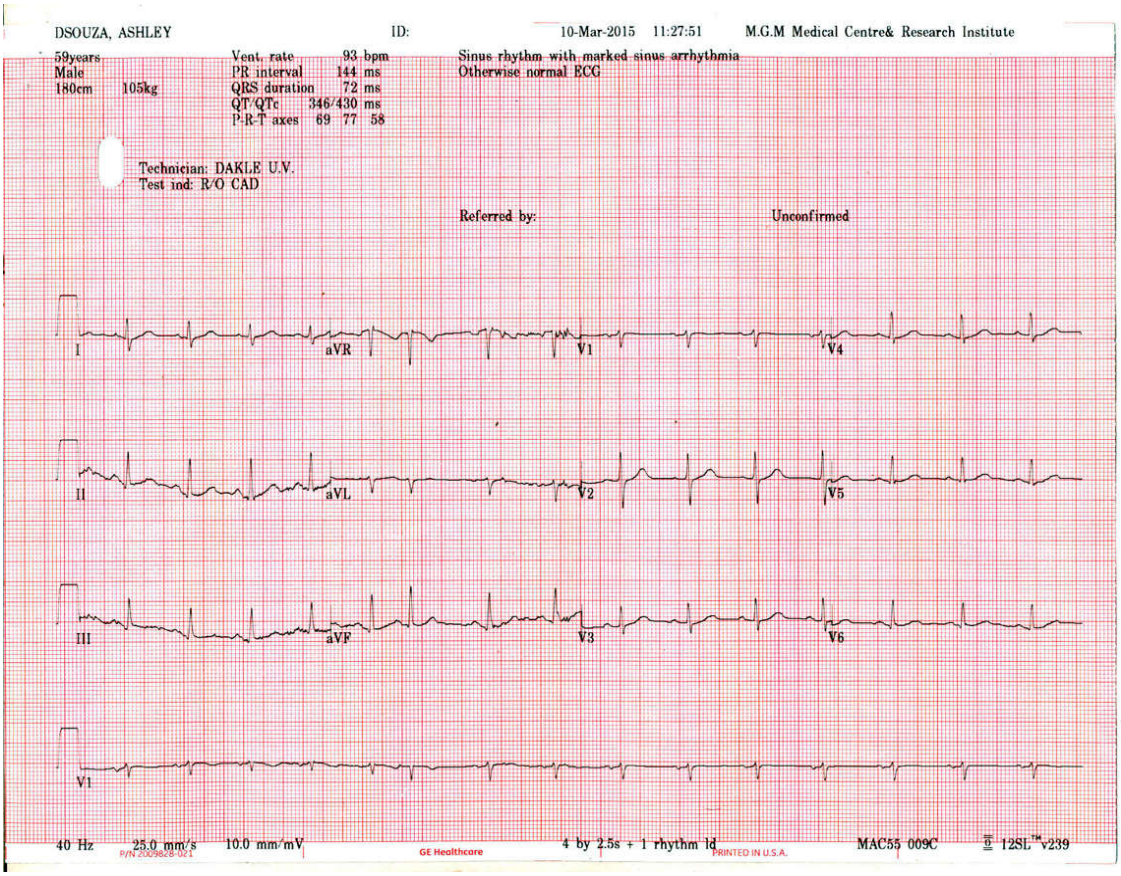

Fig. 3:

Summary

Although its prevalence is relatively low in pregnant women, cardiac disease is important cause of maternal mortality as well morbidity. Problems may arise due hemodynamic burden and hypercoagulable state of pregnancy.

Preconceptional counselling is very important for those patients. Girls with CHD should be referred to joint cardiac and obstetric unit for contraception advice once they attain puberty.

Rise in cardiac output starts as early as 5th week in pregnancy, peaks at the end of 2nd trimester and reaches plateu till delivery. It rises again in labour by 25 to 75% .

Prior cardiac event, cyanosis or poor functional class, left sided heart obstruction and ventricular dysfunction are strong predictors of peripartum cardiac events.

Echocardiography is the preferred method to asses cardiac function during pregnancy.

Optimum timing for screening of fetus for CHD by USG is 18 -22 weeks.

A multidisciplinary team consist of obstetrician, cardiologist, intensivist, anaesthetist, neonatologist is needed for management of pregnancy complicated by cardiac disease. Multidisciplinary approach should establish plan of management of delivery at 32-34 weeks regarding time & mode of delivery.

Vaginal delivery is preferred over caesarean section due to less blood loss, rapid recovery, less infection & thromboembolic complications.

Asymptomatic women with good condition spontaneous onset of labour is awaited. Oxcytocin and ARM are indicated when Bishop score is favourable if induction is needed.

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