Cardiac disease in pregnancy

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Abstract

Cardiac disease is a significant cause of maternal mortality. In the UK in the last maternal mortality report, it was the leading cause of maternal death (2.1 deaths per 100,000 maternities). The overall rate of maternal mortality from cardiac disease has significantly increased over the last three decades, with this increase being mostly attributable to deaths from ischaemic heart disease, myocardial infarction and peripartum cardiomyopathy. Conditions such as pulmonary hypertension, rheumatic heart disease and congenital cardiac lesions also significantly contribute to the mortality figures. With the current increase in age of mothers, increasing rate of maternal obesity and improved survival of children with congenital heart disease, more mothers will require careful cardiovascular assessment and monitoring of their pregnancies. Many women with cardiac conditions will aim to manage their peripartum care in a specialist centre; however, in an emergency they may present to any delivery suite in any hospital. This means it is essential for all obstetric anaesthetists to have a good understanding of different cardiac conditions and how the physiological changes of pregnancy may affect cardiac function.

Keywords Cardiac disease; cardiomyopathy; maternal mortality; pulmonary hypertension

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Physiology

The physiological changes to the cardiovascular system during pregnancy take place to facilitate the increased demand for oxygen and nutrients by the utero-placental unit, and that of the growing fetus. Blood flow to the uterus increases from 50 ml/minute at 10 weeks' gestation to 850 ml/minute at term. This is accomplished by a 50% rise in cardiac output (CO) and blood volume.

There is a drop in systemic and pulmonary vascular resistance due to vasoactive prostaglandins and nitric oxide production, thus preventing a rise in pulmonary artery pressure from the increased circulating volume.[1] The systolic and diastolic pressures fall, reaching their lowest values during the second trimester, before increasing as term approaches, although never reaching pre-pregnancy values.

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During labour CO increases by a further 25−50% with up to 500 ml of blood returned from the intervillous spaces during contractions. Pain and anxiety can supplement this rise in CO by increasing heart rate, blood pressure (BP) and systemic vascular resistance (SVR). The CO further increases after delivery due to a relative hypervolaemic state. This can result in a clinical deterioration in patients with cardiac disease due to the associated rise in ventricular filling pressure and end-diastolic volume. There is a 15% reduction in colloid osmotic pressure during pregnancy, further increasing the risk of pulmonary oedema in these patients.

General approach to cardiac disease in pregnancy

Preconception counselling

Women should have access to comprehensive pre-pregnancy counselling if they are considered to be at risk of significant physiological deterioration during pregnancy from either a congenital or acquired cardiac condition. Risk of maternal and fetal mortality or morbidity should be thoroughly assessed and discussed openly so that women can make an informed choice about becoming pregnant.

Risk assessment

The assessment and risk stratification may take into account the type of cardiac disease and previous cardiac events, current functional capacity, and modifiable risk factors such as obesity, smoking and optimization of pharmacological management.

Evaluation of cardiovascular status should include a careful history to elicit symptoms relating to heart failure, arrhythmias and ischaemic events. Examination should include auscultation for new or changing murmurs, careful blood pressure monitoring with investigation for proteinuria if hypertension is found and monitoring of oxygen saturations in patients with congenital heart disease.

The strongest predictors for peripartum cardiac events include:[2,3]
- prior cardiac event or stroke
- prior arrhythmia
- New York Heart Association (NYHA) functional class greater than 2 or cyanosis
- left-sided heart obstruction − including valve disease or hypertrophic cardiomyopathy (aortic valve area <1.5 cm^2, mitral valve area <2 cm^2 or outflow tract gradient >30 mmHg)
- left ventricular ejection fraction $<40\%$.

Further investigations should be considered as required:[1]
- Twelve lead ECG − common changes of pregnancy relating to a gradual change in position of the heart include a left axis deviation, the presence of a Q wave with

inverted T waves in lead III and inverted T waves in leads V1 and V2. Holter monitoring should be used in patients with suspected arrhythmias.

- Echocardiography — this is the preferred method of assessment of cardiac function in pregnancy as it does not involve exposure to radiation and can be easily repeated to monitor changes in cardiac function throughout pregnancy. Transoesophageal echocardiography may be required in patients with complex congenital cardiac disease.
- Exercise testing — this can be used prior to pregnancy in women with grown up congenital heart disease and in patients with acquired valve disease to aid preconception planning.
- Chest X-ray — although the amount of radiation exposure to the fetus is low, the risks should be communicated and the investigation only used if other methods have failed to clarify the cause of symptoms.
- Cardiac catheterization — may be useful for coronary angiography or electrophysiological studies and ablation. Studies should be restricted to cases in which medical treatment has failed to reverse haemodynamic compromise as the radiation exposure is considerable.

Peripartum care planning

Women should be seen early in joint cardiology and obstetric clinics. Consideration of available facilities and specialists such as cardiologists, specialist obstetricians and anaesthetists, general or cardiac intensive care should inform the decision about where a woman books for her pregnancy and delivery care.

Cardiac function should be optimized, which may include surgical interventions such as valve replacement. Known teratogenic medications should be discontinued.

An individual care plan should be formulated by the multi-disciplinary team to include plans for timing and mode of delivery. The care plan may include advice on anticoagulation during labour, haemodynamic monitoring and the type of analgesia recommended. Lumbar epidural analgesia can reduce pain-related sympathetic surges and harmful tachycardias but should be used with caution in patients with obstructive lesions due to the possibility of systemic hypotension.

Congenital heart disease

In most cases of congenital heart disease the diagnosis, functional status and any therapeutic strategies will be well established pre-pregnancy. Depending on the condition, pregnancy could be well tolerated or be classified as risk class IV in the modified WHO classification of maternal cardiovascular risk (Table 1).

Acquired heart disease

Acute coronary syndromes

Pregnancy increases the risk of acute myocardial infarction by three- to fourfold, with women over 40 years old being at 30 times the risk of women under 20 years old.[4] As the average maternal age continues to increase, the number of pregnant women at risk of an ischaemic event will also increase.

Acute coronary syndromes (ACS) are estimated to occur at 3–6 per 100,000 deliveries and are related to risk factors such as smoking, hypertension, hyperlipidaemia, diabetes and a positive family history. Spontaneous coronary artery dissection is more common in pregnancy, usually occurring in the peripartum period. Maternal mortality after an ACS is estimated at 5–10%, which has improved with the increased availability of primary percutaneous coronary intervention (PCI).

Modified WHO classification of maternal cardiovascular risk[1]

Risk class	Risk of pregnancy	Examples of conditions
I	No detectable increased risk of maternal mortality and no/mild increase in morbidity	Uncomplicated pulmonary stenosis, patent ductus arteriosus Successfully repaired simple lesions (e.g. atrial or ventricular septal defects)
II	Small increase risk of maternal mortality or moderate increase in morbidity	Unoperated atrial or ventricular septal defects Repaired tetralogy of Fallot Most arrhythmias
III	Significantly increased risk of maternal mortality or serious morbidity. Requires expert counselling and intensive specialist input throughout	Mechanical valve Systemic right ventricle Fontan circulation Cyanotic heart disease Aortic dilatation 45–50 mm (40–45 mm in Marfan syndrome)
IV	Extremely high risk of maternal mortality or severe morbidity, pregnancy contraindicated. If becomes pregnant termination should be discussed, if pregnancy continues care as class III	Pulmonary arterial hypertension Left ventricle ejection fraction <30% or NYHA III–IV Previous peripartum cardiomyopathy with residual LV impairment Severe mitral or aortic stenosis Aortic dilatation >50 mm (>45 mm in Marfan syndrome Severe coarctation

Table 1