Cardiac disease in pregnancy

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Cardiac disease is an uncommon but potentially serious medical complication of pregnancy. It is an important cause of preventable maternal and perinatal mortality and morbidity. A multidisciplinary approach involving close liaison and collaboration between the obstetrician, cardiologist, anaesthetist, neonatologist, paediatric cardiologist and, if appropriate, the cardiothoracic surgeon, is essential to achieve optimal care in such pregnancies. The principles of management that ensure a good pregnancy outcome include pre-pregnancy counselling, recognition of risk factors, early diagnosis, close obstetric and medical surveillance, anticipation, and prompt identification and treatment of complications, the appropriate use of drugs, surgical intervention, and timely delivery of the baby.

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Introduction

The incidence and changing pattern of heart disease

The incidence of heart disease in pregnancy ranges from 0.3% to 3.5%.[1,2] Hospital statistics from industrialised countries have shown a decrease in the incidence from 0.9% to 0.3% of all births and a 90% reduction in acquired heart disease with persistence of congenital heart disease.[3] This changing pattern is due in part to a sharp decline in the incidence of chronic rheumatic heart disorders, although they remain a significant problem in developing countries.[4] In addition, recent advances in the medical and surgical treatment of patients with congenital heart defects has resulted in an increased survival to reproductive age.

In Hong Kong, the territory-wide incidence of heart disease in pregnancy was 0.7% in 1994 (Table 1) when the first territory-wide audit in obstetrics and gynaecology was published by the Hong Kong College of Obstetricians and Gynaecologists (HKCOG).[5] The incidence and pattern of maternal cardiac disease seen at the Prince of Wales Hospital (PWH) since its opening in 1984, compared with the whole of Hong Kong, are shown in Tables 1 and 2. There has been a decline in the overall incidence of maternal cardiac disease at the PWH, falling from 1.6% in 1984 to 1986 to 1.1% in 1993 to 1994, which is largely due to a sharp reduction in cases of chronic rheumatic heart disease, falling from 56.8% to 26.0% of all the cardiac cases over the same period. Nevertheless, chronic rheumatic heart disease remains a major cause of cardiac disease in pregnancy.

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Maternal mortality from heart disease

Statistics from industrialised countries have demonstrated a decline in maternal mortality from cardiac disease since 1950 from 5.6 to 0.3 per 100 000 births,[3] probably due to improved medical care of the pregnant cardiac patient and a sharp decrease in the incidence of rheumatic heart disease.

In Hong Kong, heart disease is the second most common cause of death in females of all ages and the third most common cause in the age range of 15 to 44 years.[7] These cardiac deaths in the reproductive age group could be potential cases of maternal mortality if they were to become pregnant. Nevertheless, maternal cardiac disease has not been a major cause of maternal mortality in Hong Kong.[6,7] The 1994 HKCOG territory-wide audit revealed two maternal deaths from cardiovascular causes[5] while no maternal mortality from cardiac disease has been reported at the PWH from 1984 to 1994.

The latest report on maternal deaths in the United Kingdom, however, has shown that cardiac disease accounted for the greatest number of maternal deaths (37 of 323) in the 1991 to 1993 triennium as compared with 23 and 18 deaths in the 1985 to 1987 and 1988 to

Table 1. Incidence of maternal cardiac disease in Hong Kong in 1994, and at the Prince of Wales Hospital from 1984 to 1986 and 1993 to 1994

	Hong Kong 1994	Prince of Wales Hospital	
		May 1984 - Dec 1986	Jan 1993 - Dec 1994
Number of cardiac patients	489	220	169
Total number of deliveries	68 063	13 335	15 859
Incidence of cardiac disease in parturients (%)	0.7	1.6	1.1

Table 2. Pattern of maternal cardiac disease in Hong Kong in 1994, and the Prince of Wales Hospital from 1984 to 1986 and 1993 to 1994

Type of cardiac disease	Hong Kong 1994	Prince of Wales Hospital	
		May 1984 - Dec 1986	Jan 1993 - Dec 1994
	No. (%)	No. (%)	No. (%)
Chronic rheumatic heart disease	139 (28.4)	125 (56.8)	44 (26.0)
Congenital heart disease	108 (22.1)	62 (28.2)	27 (16.0)
Mitral valve prolapse	84 (17.2)	na	64 (37.9)
Arrhythmia	62 (12.7)	na	6 (3.5)
Others	96 (19.6)	33† (15.0)	28 (16.6)
Total	489	220	169

na data not available
†Figures include cases of mitral valve prolapse and arrhythmia

1990 trienniums, respectively.[8] It is also the leading cause of indirect maternal death. The number of deaths associated with acquired heart disease has increased markedly, notably deaths from ruptured aortic aneurysm. Substandard care was present in 10 of the 37 cases. Thus, cardiac disease remains an important cause of maternal mortality and is potentially avoidable with optimal care.

Classification and diagnosis of cardiac disease

Cardiac diseases in pregnancy can be divided into three main groups: (1) Pre-existing disease. The disease antedates and is known before pregnancy, e.g. congenital heart disease or rheumatic heart disease; (2) Disease that is first recognised or has its onset during pregnancy, e.g. myocardial infarction; and (3) Pregnancy-specific disease, e.g. peripartum cardiomyopathy.

The diagnosis and assessment of heart disease in pregnancy may be difficult because the physiological changes of normal pregnancy can mimic cardiac symptoms and signs (Box 1) and lead to the over-diagnosis of cardiac diseases. Appreciation of these changes, a high index of clinical suspicion, and timely referral for cardiological assessment and investigations are important for an accurate diagnosis to be made. The diagnosis made should consider all four levels, if appropriate, namely aetiological, anatomical, pathophysiological, and functional. The New York Heart Association (NYHA) functional classification (Box 2) has been widely used and is largely based on limitation of physical activities and associated symptoms.[9] It should be used together with other levels of diagnosis for management planning and prognostication and remains useful for comparing performance of individuals with similar aetiological and anatomical diagnoses. Nevertheless, it has the limitation that it may not be reliable in predicting clinical outcomes such as heart failure or maternal death[9] and a patient's functional class may change as gestation advances.

Maternal mortality from cardiac disease varies with the nature of the lesion and whether or not surgical correction has been performed. Table 3[10,11] represents a synthesis of current estimates for various cardiac diseases on which patient counselling and general management approaches may be based. Exclusion of 'functional' or physiological murmurs can usually be made on clinical grounds without resorting to further investigations.

Box 1. Normal physiological changes of pregnancy that mimic symptoms and signs of cardiac disease

Symptoms
- Tiredness
- Dyspnoea
- Orthopnoea
- Syncope
- Light-headedness

Physical signs
- Peripheral oedema
- Hyperventilation
- Distended neck veins with prominent A and V waves
- Brisk, diffuse, and displaced left ventricular impulse
- Palpable right ventricular impulse
- Increased S_1 intensity
- Persistent splitting of S_2
- Early ejection systolic murmurs at lower left sternal edge or pulmonary area
- Cervical venous hum
- Mammary souffle

Electrocardiogram
- Left axis deviation
- ST segment and T wave changes
- Small Q, inverted P or T wave in lead III
- Increased R wave amplitude in lead V_2
- Atrial or ventricular ectopics

Chest X-ray
- Straightened left upper cardiac border
- Horizontal heart position
- Increased lung markings

Echocardiogram
- Increased left/right ventricular dimensions
- Mild increase in left/right atrial size
- Slightly improved left ventricular systolic function
- Functional tricuspid/pulmonary insufficiency
- Small pericardial effusion

Investigations

A chest X-ray should be ordered if indicated, as the radiation dose to the foetus is minimal when maternal abdominal shielding is used. Failure to do so contributed to substandard care in three of the nine maternal deaths from aortic aneurysm that occurred in the 1991 to 1993 triennium in the United Kingdom.[8]

Electrocardiography is an important diagnostic tool and 24-hour Holter monitoring may be required to diagnose paroxysmal arrhythmias. Echocardiography is extremely useful in pregnant cardiac patients as it is non-invasive and safe. With M-mode, two-dimensional, and doppler (pulsed, continuous wave, and colour flow) capabilities, congenital structural abnormalities can be detected and cardiac functional status including chamber size, pulmonary artery pressure, ventricular contractility, presence of mural thrombus, valvular function, and myocardial ischaemia can be assessed.[12,13] However, for the assessment of probable 'functional' heart murmurs in pregnancy, Mishra et al[12,14] found that echocardiography is not necessary if there are no cardiac symptoms, no signs of cardiac enlargement or heart failure, and the electrocardiogram is normal. Transoesophageal echocardiography may be useful in selected cases, such as in the assessment of infective endocarditis,[15] aortic dissection, or a technically difficult transthoracic study because of its higher sensitivity and specificity compared with transthoracic echocardiography.[13]

Box 2. New York Heart Association functional classification of cardiac disease

Class I	Asymptomatic with ordinary activity
Class II	Symptomatic with ordinary activity
Class III	Symptomatic with less than ordinary activity
Class IV	Symptomatic at rest

Radionuclide cardiac imaging is valuable in assessing cardiac function, any intracardiac shunts, and coronary artery disease in non-pregnant patients. Although it is a noninvasive procedure and carries a low radiation dose (usually ≤0.8 rad), it is not recommended in pregnancy, especially in the first trimester. This is because there is a small but real radiation risk to the foetus and the same information can usually be obtained with Doppler echocardiography.[13] Magnetic resonance cardiac imaging is useful for evaluating acute myocardial infarction, cardiomyopathy, cardiac neoplasm, pericardial disease, abnormalities of the thoracic aorta, and congenital heart disease. Its safety in pregnancy and effects on the foetus have not been established. It should be avoided in the first trimester and performed only if other imaging modalities provide insufficient information and the evaluation cannot be delayed until after delivery.[13] Left heart catheterisation is seldom necessary in pregnancy as two-dimensional and doppler echocardiography can usually provide the required information.[12,13] It may have a place in individuals who have cardiac decompensation, especially when cardiac surgery is being considered and sufficient information is not obtainable by other approaches. The foetal radiation risk from fluoroscopy may be minimised by maternal abdominal shielding, a brachial approach, or by combining the examination with echocardiography.

Table 3. Maternal mortality risk and cardiac disease

Group	Cardiac disease	Associated mortality risk
I	Atrial septal defect*	<1%
	Ventricular septal defect*	
	Patent ductus arteriosus*	
	Pulmonary/tricuspid valve disease	
	Corrected tetralogy of Fallot	
	Bioprosthetic valve	
	Mitral stenosis, NYHA Class I, II	
II	Coarctation of aorta without valvular involvement	5% - 15%
	Uncorrected tetralogy of Fallot	
	Marfan's syndrome with normal aorta	
	Mechanical prosthetic valve	
	Mitral stenosis with atrial fibrillation or NYHA Class III, IV	
	Aortic stenosis	
	Previous myocardial infarction	
III	Pulmonary hypertension—primary or secondary	25% - 50%
	Coarctation of aorta with valvular involvement	
	Marfan's syndrome with aortic involvement	
	Peripartum cardiomyopathy	

*Uncomplicated

Treatment of the pregnant cardiac patient

Optimal management of the pregnant cardiac patient relies on team care by the cardiologist, obstetrician, cardiothoracic surgeon, anaesthetist, neonatologist, and the paediatric cardiologist. Ideally, the patient should be seen in a combined obstetric and cardiac clinic as this facilitates communication between the specialists and minimises the number of patient hospital visits.

Pregnancy termination

The first decision to be made after diagnosing a cardiac condition is whether or not the pregnancy should proceed. The option of a pregnancy termination should be discussed and offered to a patient who belongs to Group III (Table 3), as the risk of maternal mortality in continuing the pregnancy outweighs the associated risks of an induced abortion. If the patient declines this option or there is no indication for pregnancy interruption, the next decision is whether or not cardiac surgery is needed.

Performing cardiac surgery in pregnant patients

In most pregnant patients who have cardiac lesions that are amenable to surgery, the optimal time for performing an elective procedure is after the completion of the pregnancy. Cardiac surgery in pregnancy is therefore not common. While pregnant, patients should be initially managed medically. However, surgical intervention may occasionally be required in a patient whose condition is first diagnosed during pregnancy, in those who have declined cardiac surgery before pregnancy, or if medical treatment fails.[16] Rarely, emergency surgery may be performed for severe disorders such as aortic dissection or iatrogenic life-threatening complications including cardiac tamponade resulting from diagnostic or therapeutic cardiac procedures.[17] Cardiac surgery during pregnancy may be performed safely even if a cardiopulmonary bypass (CPB) is needed.[16] The early published reports of cardiac surgery during pregnancy were on the use of closed mitral commissurotomies and showed favourable maternal (1.8%) and foetal mortality (9%) results that are comparable with those expected for non-pregnant patients.[16] Recently, successful percutaneous balloon mitral or aortic valvuloplasty procedures performed during pregnancy have been reported as safe non-surgical alternatives for well selected patients with valvular stenosis[18,19] and these procedures have superseded closed surgical valvotomy.

Open heart surgery under CPB may still be needed in selected cases. Maternal mortality depends on the operative procedure, nature of the cardiac lesion, functional status of the heart, and the skill of the surgical team. Pregnancy does not itself increase the surgical risk.[20] The foetal mortality rate is about 15% and the main foetal risks of CPB are intra-operative foetal distress and preterm labour. High flow, high pressure normothermic perfusion appears to be safest

for the foetus.[16,20] The bypass should be conducted with the mother in the left lateral tilt position and with intra-operative external foetal heart monitoring. Preparation for a simultaneous caesarean section should be made for a potentially viable foetus if foetal bradycardia persists despite flow rate and pressure manipulation. However, the need for cardiac surgery, even at term, is not by itself an indication for a caesarean section.

Cardiac surgery in pregnancy should preferably be performed in the early second trimester as this reduces the risk of abortion in the first trimester and the likelihood of inducing preterm labour later in the pregnancy.

Medical management

Medical treatment remains the mainstay for managing cardiac disease in pregnancy. General measures such as resting at home and avoiding strenuous exercise should not be neglected, as these are important in conditions that tolerate tachycardia poorly (e.g. severe mitral stenosis) or in those with a low cardiac output (e.g. severe aortic stenosis). Occasionally, patients may need to stop work or undergo early hospitalisation if cardiac decompensation occurs in conditions such as cardiomyopathy with poor ventricular function or Eisenmenger's syndrome. The early identification and prompt correction of aggravating conditions such as anaemia, infection, hypertension, or arrhythmia is also important. Regular and more frequent cardiological follow-up with serial echocardiographic assessment in high-risk cases such as those with cardiomyopathy is recommended. The required drug treatment depends on the nature and severity of the cardiac disorder. Diuretics are useful for the treatment of heart failure and can be given according to the same principles as apply in non-pregnant patients, but care should be taken to avoid overdiuresing. Angiotensin converting enzyme inhibitors have been associated with an increased incidence of foetal death, neonatal renal failure,[21] and renal malformation.[22] They should be avoided in pregnancy unless the maternal benefits outweigh the foetal risks.

Digoxin is a safe inotropic agent that may be used in heart failure. However, when it is used together with diuretics, careful monitoring for hypokalaemia is essential to minimise toxicity. It should be avoided in hypertrophic obstructive cardiomyopathy (HOCM) as it may aggravate the left outflow tract obstruction. Beta- blockers are useful to reduce tachycardia that is poorly tolerated in mitral stenosis and in symptomatic HOCM. Antihypertensives are important in the maintenance of normotension as hypertension aggravates heart disease and may cause aortic rupture in those with aortic coarctation or Marfan's syndrome.

In the treatment of cardiac arrhythmias in pregnancy, the cardiologist needs to keep in mind the effect of both the disease and the treatment on foetal well-being. Whether drug treatment is required depends on the type of arrhythmia and its haemodynamic effects. Conservative management such as observation, rest, or vagal manoeuvres should be considered where appropriate. Most anti-arrhythmic agents are well tolerated and safe in pregnancy. Phenytoin is contra-indicated due to the risk of foetal hydantoin syndrome developing. Amiodarone should be avoided and reserved for use in life-threatening arrhythmias that are resistant to treatment with other safer drugs. Foetal hypothyroidism, growth retardation, and premature delivery have all been reported in association with this drug.[23] Temporary and permanent endocardial pacing,[24] direct current cardioversion, and implantable cardioverter defibrillators have been safely used during pregnancy.[25]

Heart transplantation is now being performed more commonly, especially to treat cardiomyopathy in young women. Immunosuppressive treatment that includes prednisone, cyclosporin, and azathioprine needs to be continued during the pregnancy to prevent graft rejection. The short-term effects of these drugs on the foetus are minimal but their long-term effects remain uncertain.[3,26]

Anticoagulant prophylaxis during pregnancy is indicated in cardiac patients who have an increased risk of developing thromboembolism. This includes patients with prosthetic heart valves, mitral stenosis with atrial fibrillation, a previous history of thromboembolism, cardiomyopathy, and Eisenmenger's syndrome. For conditions other than prosthetic heart valves, low dose subcutaneous standard heparin should be adequate for prophylaxis against thromboembolism and is safer than oral anticoagulants with less risk of maternal bleeding and no foetal teratogenic risks.[27] Low molecular weight heparin is gaining popularity for obstetric thromboprophylaxis as studies have shown that it is as effective, more convenient and acceptable to patients, and has fewer side effects.[27]

For patients with prosthetic heart valves, continuation of warfarin during pregnancy is recommended, as many reports have shown that subcutaneous heparin does not provide adequate protection against the

development of thromboembolism.[9,27,28] The risk of warfarin embryopathy (about 5%) is probably overestimated and seems to be minimal if the warfarin dose is less than 5 mg daily.[28] Patients should be hospitalised at 37 weeks' gestation as the risk of maternal and foetal bleeding during labour and delivery is increased. Drug therapy should be changed to continuous intravenous standard heparin, which does not cross the placenta. This should preferably be continued for 1 week postpartum as there is a risk of postpartum haemorrhage during this period and warfarin treatment can then be resumed.[28] An alternative anticoagulation approach that can be used in early pregnancy to minimise the foetal teratogenic risk, especially if the warfarin dosage is high, is to substitute the warfarin with continuous intravenous heparin until 12 weeks' gestation.[28]

Obstetric management

The antepartum period

Pregnant cardiac patients should have early antenatal care to enable dating of the pregnancy and a baseline assessment of foetal growth. Serial ultrasonography as well as antepartum foetal well-being tests including cardiotocography and Doppler blood flow studies should be performed for those in whom a risk of intrauterine foetal growth retardation exists—for instance, cyanotic congenital heart disease[29] or severe aortic stenosis, NYHA class IV.

Foetal echocardiography is valuable in patients with congenital heart disease as the foetus is at an increased risk of having a congenital heart abnormality, which is usually concordant.[30] It should preferably be performed between 20 and 34 weeks' gestation and can predict foetal cardiac anomalies with a high degree of accuracy when performed by someone experienced.[31,32] If lethal anomalies are detected, a termination of pregnancy can be offered and obstetric intervention for foetal distress in later pregnancy can be avoided. Normal echocardiographic findings can allay maternal anxiety and a planned delivery in a tertiary referral centre with paediatric cardiac support can be arranged for those with non-fatal anomalies.

In high risk cases, cardiologists and anaesthetists should be consulted early regarding the plan for intrapartum analgesia and anaesthesia, invasive haemodynamic monitoring, and postpartum intensive care. A contingency plan that includes cardiopulmonary resuscitation and perimortem caesarean section for maternal cardiac arrest should be in place to enhance efficiency of communication and implementation.[33]

The intrapartum/postpartum period

Drugs should be used with care in labour as some have profound haemodynamic effects. For tocolysis in preterm labour, β-sympathomimetics should be avoided as they can cause cardiac decompensation through tachycardia and may induce arrhythmias or myocardial ischaemia. Magnesium sulphate or calcium antagonists can be used with relative safety while indomethacin needs to be used with caution as it can cause unwanted fluid retention.[3]

Cardiac disease by itself is not an indication for labour induction,[34] which should be reserved for obstetric reasons. Occasionally, labour induction may be performed for administrative reasons so that delivery can take place in the daytime when optimal medical and neonatal support is readily available. Induction of labour may also be suitable for patients with prosthetic heart valves who have transferred from warfarin to heparin as this will minimise the period without warfarin.[35] Prostaglandin E_2 may be used for cervical ripening or labour induction but the minimum dose should be used as there have been reports of cardiac arrest, even in normal patients.[36] Oxytocin, which increases water retention, should be given according to a modified concentrated infusion regimen[34,37] to minimise fluid load.

Cardiac patients should be managed in a left lateral position in labour to avoid supine hypotension, which is especially poorly tolerated in those with Eisenmenger's syndrome, severe aortic stenosis, and HOCM. Pain relief is essential to alleviate anxiety and tachycardia, which may precipitate heart failure. Inhalational analgesia or parenteral narcotics are useful but epidural analgesia appears to be the most effective. The latter, however, should be performed by experienced anaesthetists as these patients tolerate hypotension poorly. Intrathecal morphine and epidural narcotics with or without low dose anaesthetics have been shown to produce effective analgesia with few maternal haemodynamic changes.[38,39]

In high-risk cases (such as Eisenmenger's syndrome), both non-invasive (e.g. cardiac monitoring, pulse oximetry) and invasive (e.g. peripheral arterial catheterisation, Swan-Ganz catheterisation) haemodynamic monitoring in labour should be considered. This should continue for 24 to 48 hours after delivery in the intensive care unit as the mother's condition may deteriorate immediately post partum.

Vaginal delivery is the preferred route for most cardiac patients. Caesarean section is usually re-

served for obstetric indications except in special situations where performing the Valsalva manoeuvre during vaginal delivery may be hazardous. Two examples are when the patient has Marfan's syndrome or coarctation of the aorta, since aortic dissection may occur. Routine prophylactic instrumental delivery is not needed if the maternal effort is good but it may be helpful in certain patients, such as those with HOCM, severe aortic stenosis, and myocardial infarction. Ergometrines containing oxytocics are contraindicated in the active management of the third stage of labour as they can cause systemic and coronary vasoconstriction as well as tetanic uterine contractions. This may result in a markedly increased preload or afterload and myo-cardial ischaemia. Giving prophylactic diuretics during the third stage of labour may be considered for those at high risk of developing pulmonary oedema.[34]

The use of antibiotic prophylaxis to prevent infective endocarditis during labour is debatable. The incidence of bacteraemia during vaginal delivery is low (5%)[12] and recent literature reviews seem to indicate that routine prophylaxis is unnecessary in uncomplicated deliveries.[40] The American Heart Association[41] and the British Endocarditis Prophylaxis Working Party[42] recommend selective prophylaxis for the following high-risk situations:

1. Individuals with prosthetic heart valves.
2. A previous history of infective endocarditis.
3. Those with surgically constructed systemic-pulmonary shunts or conduits.
4. Those undergoing vaginal deliveries in the presence of infection, and who have cardiac lesions that are at an average risk of developing infective endocarditis. Examples of such lesions are rheumatic and acquired valvular heart diseases, and mitral valve prolapse with regurgitation.
5. Immunosuppressed patients with cardiac lesions that are at an average risk of developing infective endocarditis.

Prophylaxis is not needed for cardiac lesions causing minimal risk such as isolated mitral valve prolapse and surgically corrected cardiac diseases with no residual lesion, and when the labour occurs more than 6 months after surgery.

However, de Swiet continues to advise routine prophylaxis for structural heart diseases except mitral valve prolapse as data from the United Kingdom for the 1985 to 1987 triennium did show that maternal cardiac death is associated with endocarditis.[9]

Contraception and family planning

With contraceptive counselling, the risks associated with an unwanted pregnancy and induced abortion should be weighed against those of the contraceptive method itself.

Low-dose contraceptives can be safely used by cardiac patients provided they do not have a high risk of developing thromboembolism.[3] This contraceptive method should be avoided in patients with mitral stenosis and a history of thromboembolism or atrial fibrillation, prosthetic heart valves, cardiomyopathy, or Eisenmenger's syndrome.

Although less effective than oral contraceptives, oral and injectable progestogens or barrier methods (male and female condoms, diaphragm) are safe alternatives.[43] Intrauterine devices are relatively contraindicated in patients with a significant risk of infective endocarditis and are less suitable for those who are taking anticoagulant treatment due to the associated heavier menstrual loss. For those who have completed their families and are surgical candidates, female sterilisation should be considered. Male sterilisation is a good alternative in those women who have significant operative risks.

Pre-conceptional counselling

This is an important aspect of management for the cardiac patient planning a pregnancy. Ideally, the obstetrician and cardiologist should work together to help the patient make an informed decision. One essential function of pre-conceptional counselling is to prevent an unwanted pregnancy and avoid the risks associated with pregnancy continuation or termination. Patients who belong to Group III (Table 5) or who have cardiomyopathy with poor ventricular function as well as those with a past history of peripartum cardiomyopathy and persistent cardiomegaly should be advised against becoming pregnant.[44,45]

Fitness for pregnancy as well as maternal and perinatal mortality and morbidity associated with the cardiac disease in question need to be discussed. This will help to alleviate the patient's uncertainty or anxiety about her ability to carry a pregnancy. Before embarking on a pregnancy, the patient should be optimally prepared to maximise the chances of a safe delivery. This includes elective surgical correction of any underlying cardiac lesions, changing from a drug contraindicated in pregnancy to a safer alternative, and meticulous stabilisation of

her heart disease before pregnancy is attempted.

Patients with congenital heart disease, Marfan's syndrome, or HOCM should be given genetic counselling. The risk of congenital heart defects developing in the foetus depends on the nature and cause of the cardiac lesion and varies from 3% to 18%.[30,43,46] Marfan's syndrome and HOCM are inherited in an autosomal dominant manner.

Conclusion

Pregnancy causes significant haemodynamic changes and imposes an additional burden on the cardiac patient, especially around the time of labour and in the immediate puerperium. To achieve a successful pregnancy outcome, a clear understanding of these haemodynamic adaptations as well as meticulous maternal and foetal surveillance for risk factors and complications throughout the antepartum, intrapartum, and postpartum periods are essential. Appropriate contraceptive and family planning advice as well as pre-conceptional counselling are also important. The concerted efforts of a team consisting of the obstetrician, cardiologist, anaesthetist, cardiothoracic surgeon, neonatologist, and paediatric cardiologist are mandatory to ensure optimal results.

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