(II) CARDIAC (HEART) DISEASE IN PREGNANCY

CARDIOVASCULAR CHANGES DURING PREGNANCY

There are significant hemodynamic and cardiovascular changes during normal pregnancy (see Chapter 6, Fig. 6.6 and Table 6.6 for details). In summary, there is significant increase in cardiac output (30–50%), heart rate, plasma volume (40–45%) and red cell volume (15–20%) with slight reduction in blood pressure. While a normal heart can withstand these extensive hemodynamic changes, with cardiac disease the patient may not be able to withstand these changes and there is risk of cardiac failure and death during the following five times:

1. Between 6–8 weeks of pregnancy
2. Between 30–34 weeks of pregnancy
3. Second stage of labour
4. Immediately after delivery
5. Second week of puerperium (cardiac failure and thromboembolism)

The risk of cardiac failure is increased in the following conditions.

1. Elderly pregnant women
2. Past history of cardiac failure
3. Risk factors during current pregnancy like anaemia, infection, multiple pregnancy and hypertension
4. Lack of antenatal care
5. Left ventricular hypertrophy
6. Cardiac arrythmias
7. Valvular heart disease
8. Pulmonary hypertension
9. Cardiomyopathy

Incidence of heart disease

The incidence of clinically significant cardiac disease in pregnancy varies from 0.1% to 4% with average being 0.8%. Although the incidence of rheumatic heart disease has significantly decreased throughout the world due to effective use of antibiotics for group B streptococci, it still continues to be the major disease during pregnancy in developing countries (90–95%). Due to advancement in cardiac surgery, an increasing number of women with congenital heart disease are reaching reproductive age group and are trying conception making it now an important cardiac lesion in pregnancy.

DIAGNOSIS OF HEART DISEASE DURING PREGNANCY

Many physiological changes during pregnancy mimic a cardiac disease, making diagnosis of heart disease more difficult in pregnancy. It is crucial not to miss the diagnosis of heart disease but equally important is not to make the diagnosis in absence of disease. Table 35.6 gives clinical and diagnostic indicators of heart disease during pregnancy.

Table 35.6: Clinical and Investigational Indicators of Heart Disease During Pregnancy

Symptoms
1. Progressive dyspnea
2. Orthopnoea
3. Chest pain
4. Hemoptysis
5. Syncope
6. Paroxysmal Noctural Dyspnea
7. Noctural cough
Signs
1. Raised jugular venous pressure
2. Cyanosis
3. Clubbing of fingers
4. On auscultation
(a) Pansystolic murmur
(b) Late systolic murmur
(c) Loud systolic murmur of grade 3/6 or more
(d) Diastolic murmur
(e) Persistent arrythmias
(f) Persistent split second heart sound
Diagnostic Tests
1. Chest X-ray (with lead apron shield over abdomen)
(a) Unequivocal cardiomegaly
(b) Enlargement of pulmonary veins
(c) Enhanced pulmonary vascular markings
2. Electrocardiography (ECG).
(a) Cardiac arrythmias
(b) Chamber enlargement or hypertrophy
3. Echocardiography. Non-invasive and accurate method. It detects various cardiac lesions especially structural abnormalities.

CLASSIFICATION OF HEART DISEASE

Heart disease in pregnancy can be classified depending upon etiology (Table 35.7), functional cardiac capacity (New York Heart Association [Table 35.8]) and on risk factors for maternal mortality and morbidity (Table 35.9).

EFFECTS OF CARDIAC DISEASE ON PREGNANCY

Maternal effects

The maternal effects of cardiac disease on pregnancy depend upon the etiology, the type of lesion, functional capacity of heart, presence of risk factors and antenatal care. Various maternal complications can be as follows:

1. Congestive cardiac failure
2. Bacterial endocarditis
3. Pulmonary edema

Table 35.7: Etiological Classification of Heart Disease

Rheumatic Heart Disease (90–95%)
1. Mitral stenosis: most common lesion
2. Mitral incompetence
3. Aortic stenosis
4. Aortic incompetence
Congenital Heart Diseases
1. Non-cyanotic lesions
(a) Atrial septal defect
(b) Ventricular septal defect
(c) Pulmonary stenosis
(d) Coarctation of aorta
2. Cyanotic lesions
(a) Fallot's tetralogy
(b) Eisenmenger's syndrome
Miscellaneous Heart Diseases
1. Miral valve prolapse
2. Cardiac arrythmias and conduction defects
3. Cardiomyopathy
4. Ischemic heart disease
5. Hypertensive heart disease
6. Thyrotoxic heart disease
7. Syphilitic heart disease.

Table 35.8: New York Heart Association (NYHA) Classification of Heart Disease during Pregnancy

Class 1	**Uncompromised state;** where patients with cardiac disease have **no limitation of physical activity.** They do not have cardiac symptoms
Class 2	**Slightly compromised state;** when patients with cardiac disease have **slight limitation of physical activity and are comfortable at rest.** When ordinary physical activity is undertaken, discomfort results in the form of excessive fatigue, palpitation or dyspnea.
Class 3	**Markedly compromised state;** Patients with cardiac disease have **marked limitation of physical activity.** They are comfortable at rest but even minimal activity causes discomfort and symptoms.
Class 4	**Severely compromised state; Symptoms at rest;** Patients with cardiac disease are unable to perform any activity without discomfort.

Table 35.9A: World Health Organisation (WHO) Risk Classification of Cardiovascular Disease and Pregnancy with Management Recommendations

Risk Category	Associated Conditions
I. **WHO 1** – Risk no higher than general population	1. Uncomplicated, small or mild: (i) Pulmonary stenosis (ii) Ventricular septal defect (iii) Patent ductus arteriosus (iv) Mitral valve prolapse with no more than trivial mitral regurgitation 2. Successfully repaired simple lesions: (i) Ostium secundum atrial septal defect (ii) Ventricular septal defect (iii) Patent ductus arteriosus (iv) Total anomalous pulmonary venous drainage (v) Isolated ventricular extrasystoles and atrial ectopic beats
Cardiology consultation once or twice during pregnancy is recommended.	
II. **WHO 2** – Small increase in risk of maternal mortality and morbidity	1. If otherwise uncomplicated: (i) Unoperated atrial septal defect (ii) Repaired Fallot tetralogy (iii) Most arrhythmias
Cardiology consultation is recommended in each trimester	
III. **WHO 2 or 3** – Depends on individual case	1. Mild left ventricular impairment 2. Hypertrophic cardiomyopathy 3. Native or tissue valvular heart disease not considered WHO 4 4. Marfan syndrome without aortic dilation 5. Heart transplantation
Cardiology consultation in each trimester is recommended.	
IV. **WHO 3** – Significantly increased risk of maternal mortality (5–15%) or expert cardiac and obstetrical care required	1. Mechanical valve 2. Systemic right ventricle—congenitally corrected transposition, simple transposition post Mustard or Senning repair 3. Post-Fontan operation 4. Cyanotic heart disease 5. Other complex congenital heart disease
These women are to be managed by obstetricians and cardiologists monthly or bimonthly	
V. **WHO 4** – Very high risk of maternal mortality (25–50%) or severe morbidity; pregnancy contraindicated and termination discussed	1. Pulmonary arterial hypertension (primary or secondary) 2. Eisenmenger's syndrome 3. Severe systemic ventricular dysfunction (NYHA III-IV or LVEF < 30%) 4. Previous peripartum cardiomyopathy with any residual impairment of left ventricular function 5. Severe left heart obstruction 6. Marfan syndrome with aorta dilated ≥ 40 mm
1. Pregnancy is contraindicated and termination indicated 2. If pregnancy occurs, monthly or bimonthly cardiac and obstetrical monitoring to be done after counseling.	

Table 35.9B: Risk Factors for Maternal Cardiovascular Events during pregnancy

1.	Past history of cardiac event like Heart failure, TIA, stroke before pregnancy or arrhythmias
2.	Baseline NYHA class III or IV or cyanosis in current pregnancy
3.	Left heart obstruction (MVA < 2 cm^2, aortic valve area < 1.5 cm^2, peak LV out flow tract gradient > 30 mm Hg by echocardiography
4.	Reduced systemic ventricular systolic function, i.e. ejection fraction < 40%.
	No risk factors - 5% risk of complications 1 risk factor - 27% risk of complications > 1 risk factor - 75% risk of complications

TIA: Transient ischemic attachs; NYHA: NewYork Heart Association; MVA: Mitral valve area; LV: Left ventricular Complications include pulmonary edema, stroke, TIA, arrhythmias requiring treatment, cardiac arrest, cardiac death.

4. Active rheumatic carditis (rheumatic heart disease)
5. Pulmonary embolism
6. Rupture of aneurysm in coarctation of aorta
7. Premature labour
8. Maternal death

Foetal effects

The effects on perinatal outcome also depend upon the etiology, type of lesion and functional capacity. Perinatal mortality is particularly high (up to 45%) in cyanotic lesions. Various foetal effects are as follows:

1. Increased chances of miscarriage
2. Prematurity
3. Foetal growth restriction (FGR)
4. *Increased chances of foetal congenital malformations (3–10%) if parents have congenital cardiac disease. Foetal congenital cardiac disease tends to be same as in mother.*
5. Foetal death

MANAGEMENT OF PREGNANCY

The main aim of management of a cardiac patient is prevention, early diagnosis and prompt and appropriate treatment of cardiac failure during pregnancy. Such patients should always be managed in tertiary care hospitals preferably with facilities of cardiology and cardiothoracic surgery and they should be regularly seen jointly by an obstetrician and a cardiologist.

Prepregnancy counseling

Ideally all women with heart disease should have preconceptional counseling. The women with contraindication of pregnancy (e.g. Eisenmenger's syndrome) should be advised against pregnancy while women with valvular lesion should conceive when they are in NYHA class I or II. Similarly, women with severe mitral stenosis or congenital heart disease needing cardiac surgery should have surgery before they venture for pregnancy for optimum outcome. Unfortunately, most women with heart disease in India usually report during late pregnancy.

Role of Medical Termination of Pregnancy (MTP) in heart disease

As shown in Table 35.9 pregnancy is contraindicated and therapeutic abortion is indicated for women with high risk heart disease.

Absolute contraindications of pregnancy (Indications of MTP)

1. Eisemenger's syndrome
2. Primary pulmonary hypertension
3. Single ventricle
4. Pulmonary veno-occlusive disease
5. Marfan's syndrome with dilated aortic root (> 4 cm on echocardiography)
6. Dilated cardiomyopathy (peripartum cardiomyopathy) with residual left ventricular function impairment.
7. Bicuspid aortic valve with aortic root > 5 cm.

Relative Contraindications of Pregnancy (Relative indications for MTP)

1. Severe obstructive lesion. Left ventricular ejection fraction < 30%.
2. Parous woman with grade III or IV lesion
3. Past history of cardiac failure with heart disease

MTP should be done using suction and evacuation before 12 weeks of pregnancy (preferably before 8 weeks). After this termination may be as dangerous as continuing pregnancy and usually pregnancy is continued in such cases.

Antenatal care

Whenever cardiac disease is diagnosed in pregnancy, the woman should be referred to a tertiary care center where she should be seen regularly by an experienced obstetrician and a cardiologist. She should be counseled regarding high risk factors for timely diagnosis and treatment of cardiac failure. The following antenatal protocol can be pursued.

1. She should be seen every 2 weeks until 30 weeks of pregnancy and then weekly until delivery.
2. At each visit she should be asked about any increase in dyspnea or limitation of activity.
3. She should be given iron and folic acid as per routine for all pregnant women. Women with > 11 g/dL hemoglobin should receive 100 mg elemental iron with at least 0.5–1 mg folic acid per day, while the women with anaemia should receive therapeutic dose of iron (200 mg per day) and folic acid (5 mg/day). Women with heart disease should not be anaemic as it adds to their morbidity.
4. At each visit she should be asked detailed history of any symptoms suggestive of cardiac failure and her functional cardiac status should be assessed. Increasing dyspnea, orthopnoea, fine crepitations on bases of lungs are indicative of cardiac failure and usually require admission.

5. She is asked to avoid excess work, stress and should have home help.
6. She should avoid infection such as influenza by avoiding contact with people having respiratory infections. She should take care of dental hygiene.
7. She should avoid alcohol, smoking and use of illicit drugs.
8. Some salt restriction is advisable.
9. At each antenatal visit her pulse, blood pressure, weight gain, respiratory rate, jugular venous pressure are checked and auscultation of lungs is performed to diagnose and treat impending cardiac failure.
10. Careful vigilance for any signs of pre-eclampsia.
11. Early diagnosis and treatment of any infection like urinary tract infection, dental infection or respiratory tract infection.
12. All women with rheumatic heart disease should receive penicillin prophylaxis to avoid bacterial endocarditis as injection benzathine penicillin (Penidura LA 1.2 mega units) by deep intramuscular injection after sensitivity test every 3 weeks throughout pregnancy.
13. Foetal monitoring by ultrasound, non-stress test or Manning's biophysical scoring.

Indications of Admission to hospital

1. Woman with classes III and IV disease should be admitted whenever diagnosed and should stay in hospital until delivery or until their functional cardiac status improves to lower grade.
2. Women with classes I and II disease should be admitted at least 2 weeks prior to expected date of delivery.
3. Worsening of functional cardiac status
4. Cardiac failure, infective endocarditis or anaemia.
5. Appearance of high risk factors like cough, dyspnea, tachyarrhythmias or basal lung crepitations.
6. Women with prosthetic heart valves (mechanical) for heparin switch over in first trimester and at 36 weeks.
7. Pulmonary hypertension

MANAGEMENT OF LABOUR AND DELIVERY

It is generally agreed that vaginal delivery is the safest mode of delivery for women with heart disease. Cesarean section should be done for strict obstetric indications.

Indications of Induction of Labour

Induction of labour is best avoided and spontaneous onset of labour should be awaited. However, for strict obstetric indications for induction either prostaglandin gel is used or oxytocin should be given in concentrated dosage to avoid fluid overload.

1. Usual obstetric indications
2. Associated pre-eclampsia.
3. Intrahepatic cholestasis of pregnancy (ICP)
4. Non-reassuring biophysical profile

Indications of Cesarean Section

1. Strict obstetric indications (e.g. major degree placenta previa, contracted pelvis, etc.)

Table 35.10: Current Recommendations for Antibiotic Prophylaxis in Heart Disease in Labour

1.	Not recommended for either vaginal delivery or cesarean delivery in the absence of infection, except in patients at highest potential risk for adverse cardiac outcomes
2.	Not recommended for non-dental procedures in the absence of active infection
Antibiotics are recommended in	
1.	Women with prosthetic cardiac valves including bioprosthetic valves
2.	Past history of bacterial endocarditis
3.	Patient with congenital heart disease with – Unrepaired cyanotic heart disease – Completely repaired CHD with prosthetic maternal or device during the first 6 months after the procedure. – Repaired CHD with residual defects at the site or adjacent to the site of prosthetic patch or device.
4.	Cardiac transplant recepient with valve regurgitation due to structurally abnormal valve.
Drugs for antibiotic prophylaxis	
Intravenous Ampicillin (2 gm) or Cefazolin (1 g) or Ceftriaxone (1 g) (30–60 minutes before procedure) If allergic to pencillin/ampicillin: Clindamycin 600 mg (I/V) **Oral** Amoxicillin – 2 g Vancomycin is given if infection by enterococcus is suspected.	

2. Coarctation of aorta where elective cesarean section is indicated to prevent rupture of the aorta or mycotic cerebral aneurysm.
3. Large aortic aneurysm
4. Pheochromocytoma
5. Marfan's syndrome with dilated aortic root
6. Aortic dissection
7. On oral anticoagulants in pre-term labour
8. Warfarin within 2 weeks of labour
9. Severe arortic stenosis (AS)
10. Acute intractable heart failure

Management of First Stage of Labour

1. Patient should rest in bed in a semi-recumbent position.
2. Intravenous fluids should be avoided or restricted to 50–75 mL/hour.
3. Central venous pressure monitoring is useful especially in high risk patients.
4. Intranasal oxygen, if needed, should be given at a rate of 5–6 liters per minute (in grades III and IV diseases)
5. For pain relief, epidural analgesia is best and is encouraged (contraindicated in Eisenmenger's syndrome, severe aortic stenosis and hypertrophic cardiomyopathy where pudendal block or pethidine injection may be given).
6. Careful monitoring of vitals regularly to see any sign of cardiac failure as follows:
   (a) Pulse rate > 100 beats per minute

(b) Edema feet
(c) Dyspnea (respiratory rate > 24 per minute)
(d) Raised JVP
(e) Cyanosis
(f) Basal crepitations

7. **Prophylactic antibiotics.** As per American Heart Association prophylactic antibiotics are not necessary in all heart disease cases but in moderate and high risk cardiac disease patients only. Recommendation given in Table 35.10. Current recommendations for antibiotics prophylaxis in heart disease during labour are given in Table 35.10.

Invasive monitoring. By arterial line or pulmonary artery catheterization (PAC) in high risk cases.

Second Stage of Labour

Prophylactic forceps are not routinely applied for all cases of heart disease. Usually these women have quick spontaneous delivery. If woman does not deliver within 30 minutes of second stage, forceps or ventouse delivery should be applied under epidural analgesia or pudendal block analgesia. Although outlet forceps has been traditionally preferred over ventouse due to no need of maternal effort for forceps, ventouse is preferred these days as it obviates the need of lithotomy position, which may be hazardous for the woman.

Third Stage of Labour

Intramuscular oxytocin 10 units at delivery of placenta is given except in lesions with left to right shunt or severe outflow obstruction (aortic stenosis). Ergometrine is better avoided to prevent sudden overloading of the heart by the sudden increase in intravascular volume from contracted uterus. Prostaglandins also have adverse cardiovascular effects and are best avoided. Misoprostol 1000 µg per rectum is useful to control haemorrhage but can cause hypotension and rarely, hyperpyrexia. However, postpartum haemorrhage should be energetically treated in these women.

PUERPERIUM

Women with heart disease must be meticulously monitored in puerperium as there is a risk of mortality from postpartum haemorrhage, anaemia, infection and thromboembolic events. The concept of 'Golden Hour' especially holds true for heart disease patient. She is observed closely by hourly pulse, BP and respiratory rate. Oxygen is administered. Breastfeeding is allowed except when the patient is in failure. Women on anticoagulant therapy can also breastfeed their babies.

Contraception

Combined oral pills are contraindicated as they can precipitate thromboembolism. Intrauterine device was avoided for fear of infection (relative contraindication) in past but current WHO eligibility criteria recommend its use (category 2). Levonorgestrel intrauterine system can be inserted under all aseptic precautions and infective endocarditis prophylaxis. Implanon can also be given. Progestogen only pill can be given. Inj. DMPA 3 monthly is a good option. Barrier method (condom) is the best method but has high failure rate. Permanent method like minilaparotomy sterilization or husband's vasectomy can be performed.

Treatment of Cardiac failure

Treatment of cardiac failure is like in non-pregnant state in collaboration with cardiologist. The patient should be put in propped up position and given oxygen administration. She should be given intravenous furosemide (40 mg) with sedation (morphine 15 mg intramuscularly). Digitalization by giving 0.5 mg digoxin IV followed by 0.25 mg oral digoxin every day is only indicated for atrial fibrillation, otherwise its value is disputed.

INDIVIDUAL HEART DISEASES IN PREGNANCY–RHEUMATIC HEART DISEASE

Mitral stenosis

Mitral stenosis is the most common lesion in rheumatic heart disease and is important in pregnancy as women may deteriorate secondary to tachycardia, arrhythmias or due to increased cardiac output.

Classification

The classification depends upon valve area on echocardiography **(Echo grading)**.

1. **Normal.** Normal mitral valve area is 4–6 cm^2
2. **Mild stenosis.** < 4 cm^2 to > 1.5 cm^2
3. **Moderate stenosis.** 1.5–1 cm^2
4. **Severe stenosis.** < 1 cm^2

Symptoms like dyspnea (most common), fatigue, palpitations, cough and hemoptysis usually appear when the area decreases to < 2.5 cm^2, while in severe stenosis patient is symptomatic even at rest. Mortality is less than 1% in asymptomatic women but increases significantly (5–15%) in severe stenosis.

Complications

Hyperdynamic circulatory changes in pregnancy can cause.

1. an increase in left atrial pressure.
2. increased risk of atrial fibrillation.
3. left heart failure with pulmonary edema.

Preconceptional Counselling

Preconceptional counselling is important especially in severe mitral stenosis where women are counseled to get mitral valvotomy (balloon, open or closed) or valve replacement done before conception for optimum maternal and foetal outcomes.

Role of Mitral Valvotomy in Pregnancy

Ideally, it should be done prior to conception in severe mitral stenosis. However, many women in India present for the first time during pregnancy with symptoms of severe mitral stenosis with heart failure or atrial fibrillation. Although it is better to withhold elective heart

surgery during pregnancy, it can be considered in cases of cardiac failure refractory to medical treatment especially in the second trimester (14–18 weeks) of pregnancy. Percutaneous transcatheter balloon dilatation of the mitral value has largely replaced surgical valvotomy during pregnancy in the modern times. Atrial fibrillation can be a complication for which digitalization, β-blockers or heparin anticoagulation should be used.

Management of pregnancy and labour in mitral stenosis is the same as in a case of general heart disease with pregnancy described above. Antibiotic prophylaxis during pregnancy with penicillin and during labour is essential. Early treatment of cardiac failure is required.

During labour, epidural analgesia is ideal with the aim of vaginal delivery and avoiding fluid overload.

Mitral regurgitation

Mitral regurgitation is usually better tolerated than stenosis in pregnancy but, regular monitoring is required in pregnancy as pulmonary edema and fibrillation can occur. Antibiotic prophylaxis during pregnancy and labour is required.

Mitral valve prolapse

Mitral valve prolapse may be seen in 12–17% women in child bearing age and rarely causes any complication in pregnancy. If it gets worse then the woman is treated like regurgitation.

Aortic Stenosis

Aortic stenosis (< 1.5 cm^2) (normal: 2–3 cm^2) is associated with high maternal mortality (8–10% in moderate stenosis, 15–20% in severe stenosis) and perinatal mortality (up to 30%). Standard epidural anesthesia is contraindicated in them and intravenous fluids should be given cautiously and hypotension is avoided. Instrumental delivery can be used and antibiotic prophylaxis is given.

Pulmonary stenosis

Pulmonary stenosis is rare. If it is severe it can cause right heart failure and atrial fibrillation due to arrythmias.

Pregnancy after valve replacement surgery

With the advancement in cardiac care and cardiac surgery, most adolescent girls with severe valvular lesions are undergoing valvular replacement surgeries (severe mitral stenosis, combined mitral stenosis and mitral regurgitation, extensive calcification of valve, failed valvotomy). Two types of valves are used. Bio-prosthetic valves (porcine or human allograft) have the advantage of not using anticoagulation but need revision surgery. Mostly mechanical valves are used these days as they have long life but require long term anticoagulation because of the hazard of thromboembolism. **The risk of thrombosis increases 6-fold in pregnancy and 11-fold in puerperium.** The safest option for the mother is to continue warfarin throughout pregnancy as it is a better anticoagulant than heparin with less incidence of thrombosis. However, warfarin crosses the placenta and can lead on to **foetal warfarin embryopathy** which consists of facial and skeletal dysmorphism (chondrodysplasia punctata), nasal hypoplasia, optic atrophy, microcephaly, cardiac defects and intrauterine growth restriction and also causes placental haemorrhage and a high foetal loss rate. The risk of warfarin embryopathy is dose dependant < 3% if dose is < 5 mg per day, but increases to 8% dose is > 5 mg/day. Hence, some centers recommend giving unfractionated heparin 5000 units twice daily subcutaneously between 6–12 weeks of pregnancy. It is followed by oral warfarin. Normal dosage of warfarin is adjusted keeping prothrombin time (PT) twice and international normalized ratio (INR) 2–3 times of normal followed by oral warfarin to be taken at the same time every day until 36 weeks of pregnancy. Thereafter, it is to be replaced with heparin until 3–4 days of puerperium when warfarin is restarted (it is safe for breastfeeding). Efficacy of subcutaneous low molecular weight heparin to prevent thrombosis in pregnancy is still not fully established but it can be used in place of unfractionated heparin. American Heart Association and American College of Cardiology (2014) and ACOG (2017) have given recommendations for anticoagulation in pregnant patients with mechanical prosthetic valves by recommending either heparin or low molecular weight heparin (LMWH) throughout pregnancy or hepain or LMWH in 1st trimester and after 36 weeks and warfarin in between.

If patient goes into labour on warfarin, then cesarean delivery is preferred to prevent intracranial foetal bleeding. If she is in advanced labour, give intramuscular vitamin K to mother (also to baby after birth). 4 factor prothrombin complex concentrate (4P- PCC, rich in factors 2, 7, 9 and 10) (preferred) or fresh frozen plasma (if 4P-PCC is not available) is given intravenously to the mother to prevent postpartum haemorrhage (PPH).

If patient goes into labour on low molecular weight heparin (LMWH), give protamine intravenously to the mother and continue vaginal delivery.

If patient goes into labour on unfractionated heparin (ufH), stop ufH, allow vaginal delivery. Usually protamine is not required unless there is bleeding.

Risk of PPH (postpartum haemorrhage is least with ufH, intermediate with LMWH and is highest with warfarin.

Monitoring

For warfarin; INR (International normalised ratio) is kept between 2-3 times of normal.

For ufH; APTT is kept about 2 times of normal.

For LMWH; Usually monitoring is not required. Factor Xa levels can be done and are kept between 0.8-1.2.

Stop all anticoagulants on day of delivery. Restart after childbirth; 24 hours after cesarean delivery. ufH or LMWH can be started. Add warfarin orally between 5-7 days and then ufH or LMWH can be stopped.

CONGENITAL HEART DISEASES IN PREGNANCY

Congenital heart diseases in pregnancy are shown in Table 35.11.

Table 35.11: Congenital Heart Disease in Pregnancy

Lesion	Transmission to fetus (risk of congenital HD) in fetus	Pregnancy management	Antenatal management	Intrapartum management	Postpartum management
Mitral valve prolapse		Echocardiography to check for mitral regurgitation	Arrhythmia surveillance - Infective endocarditis prophylaxis	Same as in heart disease	Same as in heart disease
Ventricular septal defects (VSD) and atrial septal defects (ASD)	6–10%	Screen for pulmonary hypertension; Consider repair of uncorrected lesion	Serial echocardiography Foetal echocardiography	Avoid hypertension	Careful fluid balance
Pulmonary hypertension including Eisenmenger's syndrome complex		1. Counsel against pregnancy 2. Echocardiography	1. Terminate 2. Obstetric cardiology anesthesiology liaison 3. Thromboembolism prophylaxis 4. Hospital admission and SpO_2 (oxygen saturation) monitoring 5. Foetal surveillance	1. Invasive monitoring 2. Fluid balance 3. Epidural analgesia 4. Strict fluid balance 5. IV or inhalated prostacyclin	1. Oxygen 2. Thromboprophylaxis 3. Fluid balance 4. Prostacyclin or nitrous oxide (NO)
Coarctation of aorta	4–7%	Screen for aneurysms and aortic stenosis	Terminate if severe	Avoid hypertension, cesarean delivery	
Tetralogy of Fallot (TOF)	5%	Surgical correction	1. Terminate, if severe 2. SpO_2 maintenance 3. O_2 supplementation	Epidural, vaginal delivery	
Transposition of great arteries (TGA)	Probably not transmitted	Evaluate cardiac status (especially right ventricle) arrhythmia screen	Echocardiography	1. ECG 2. Cut short second stage of labour 3. Electronic foetal monitoring	Fluid balance
Patent ductus arteriosus (PDA)	4%	Screen for pulmonary hypertension	Screen for pulmonary hypertension	Screen for pulmonary hypertension	
Marfan's syndrome	50%	1. Genetic counselling 2. Counsel against pregnancy 3. Echo for aortic root dilatation	1. Serial echo for aortic root 2. β-blocker 3. Avoid hypertension 4. Surgery in extreme cases	Cut short second stage of labour, cesarean section if aortic root dilatation	Vigilance for aortic dissection up to 8 weeks of puerperium

MISCELLANEOUS CARDIAC DISORDERS IN PREGNANCY

Cardiomyopathy

Cardiomyopathy can predate pregnancy in cases of hypertrophic, dilated and restrictive cardiomyopathy. Peripartum cardiomyopathy has following features.

1. Development of cardiac failure in the last month of pregnancy or within 5 months of delivery.
2. Absence of an identifiable cause for the heart failure.
3. Absence of recognizable heart disease prior to the last month of pregnancy.
4. Left ventricular systolic dysfunction on echocardiography (like decreased ejection fraction). Treatment is bed rest, digoxin and diuretics (for heart failure), hydralazine (to reduce afterload), β-blockers and prophylactic heparin (for high incidence of associated thromboembolism). Vaginal delivery is preferred and epidural anesthesia is advisable.
5. Peripartum cardiomyopathy is usually seen in older and obese multiparous women with hypertension. The women usually present with dyspnea, tachycardia or pulmonary edema. The complications are thromboembolism (50% cases), arrhythmias (often fatal) and heart failure. There is a very high mortality (up to 25%) and risk of recurrence in subsequent pregnancy.

Ischemic heart disease

Ischemic heart disease is rare in pregnancy. However trends to delay child bearing to thirties and [illegible] advancing maternal age, obesity and smoking and hypertension all put women at high risk for ischemic heart disease. Treatment of acute myocardial infarction is the same as in non-pregnant state with even coronary angioplasty being performed. Labour management is as any other cardiac case but elective delivery within weeks of infarction should be avoided. β-blockers may be used for tachycardia and epidural analgesia can be given. Vaginal delivery is preferred. The second stage should be shortened with forceps to avoid maternal strain.

HEART DISEASE WITH PRETERM LABOUR

Patients with heart disease during pregnancy may [illegible] into preterm labour. Tocolytic drugs like ritodrine or betamethasone given for foetal pulmonary maturity can make them prone to pulmonary edema which can be serious. Hence, caution must be exercised and limited fluids should be given. Oxytocin antagonist atosiban available is best in such a case as a tocolytic agent and superior to β agonists.

Key Points

1. Heart disease is an important cause of maternal morbidity and mortality.
2. Certain physiological cardiovascular changes in pregnancy can mimic cardiac disease.
3. Heart disease with primary or secondary pulmonary hypertension, severe mitral stenosis, severe peripartum cardiomyopathy and Marfan's syndrome with aortic root dilatation are contraindications for pregnancy.
4. Pregnancy counselling is important and the woman should be advised to try pregnancy only when her cardiac disease under control.
5. Cardiac disease during pregnancy is classified by New York Heart Association (NYHA) as class 1 being with no limitation of physical activity, class 2 with slight limitation of physical activity, class 3 with marked limitation of physical activity while class 4 being severely compromised patients who may be symptomatic even at rest.
6. Women with heart disease should be carefully managed jointly by obstetrician and cardiologist by regular and more frequent ANC visits, iron and folate therapy, antibiotic prophylaxis and careful vigilance and early treatment of any cardiac failure.
7. As a general principle women with cardiac disease should go into spontaneous labour. Induction and augmentation are avoided unless absolutely indicated. Aim is to deliver them vaginally. During labour they should be kept in propped up position, minimum fluid should be given to avoid overloading the circulation, antibiotic prophylaxis and to avoid prolongation of the second stage of labour. Active management of the third stage is avoided but PPH is to be energetically treated with oxytocin. Epidural analgesia can be given.
8. Cesarean delivery is avoided but is to be done for coarctation of aorta, Marfan's syndrome with aortic arch dilatation and for strict obstetric indications.

Suggested Reading

1. American College of Obstetricians and Gynecologists: Use of Prophylactic Antibiotics in Labour and Delivery. Practice Bulletin No. 120, June 2011, Reaffirmed 2016.