PREGNANCY PLUS

Valvular heart disease

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Valvular disease may be unmasked in pregnancy when physiological changes increase demands on the heart. Women with valvular heart disease require close follow-up during pregnancy, delivery, and postpartum

Valvular heart disease in pregnancy is rare, but it significantly increases maternal and fetal risk. Despite an overall decline in the incidence of rheumatic heart disease in Europe and North America,[1] worldwide rheumatic mitral stenosis is the most common valvular lesion in pregnancy.[w1] With changing patterns of immigration, rheumatic heart disease may well become a serious problem in the United Kingdom. Advances in cardiac medication and surgery mean that more women with congenital valvular disease survive into adulthood and reproductive maturity.

Valvular heart disease may present for the first time in pregnancy as the increasing demands on the heart lead to decompensation and cardiac failure. However, the diagnosis is not always easy as the symptoms of pregnancy (tiredness, shortness of breath, and palpitations) can mask those of deteriorating disease. Moreover, in the United Kingdom, a decline in rheumatic fever means that valvular heart disease is now rare, and doctors—particularly general practitioners and obstetricians, to whom these patients present—are less aware of and less familiar with the condition. The scenario box highlights the complexities of the management of valvular heart disease in pregnancy.

Does pregnancy affect valvular heart disease?

Changes that occur in pregnancy pose a substantial demand on cardiac function in women with valvular disease. By eight weeks' gestation, systemic vascular resistance falls by 30-70% of its preconception value, initiating a 30-50% increase in cardiac output, an increase of 10-20 beats/min in heart rate, and a 30-50% increase in blood volume. Systemic vascular resistance falls by 30-70% of its preconception value. Labour, particularly the second stage, is associated with a further increase in cardiac output. Pain induces a sympathetic response causing an increase in heart rate. Stroke volume is augmented by autotransfusion during contractions. After delivery, the return of uterine blood into the systemic circulation results in a further increase in cardiac output. Stroke volume, heart rate, and cardiac output remain high for 24 hours after delivery, with rapid intravascular volume shifts in the first two weeks postpartum.

Mitral stenosis

In mitral stenosis, the increase in cardiac output is limited by the amount of blood that can flow through the narrowed valve during diastole. The pregnancy induced increase in the maternal heart rate shortens diastole, reducing left ventricular filling.[2] In some cases, this leads to reduced cardiac output, increased left atrial pressure, and overt cardiac failure. About 40% of women with mitral stenosis experience some symptomatic decline in cardiac function in pregnancy.[3] Typically, patients develop shortness of breath with exertion in the second trimester, progressing to orthopnoea and paroxysmal nocturnal dyspnoea as pregnancy advances. Often the deterioration is acute, typically due to an arrhythmia, usually atrial fibrillation secondary to stretch of the left atrium.

Several reports have highlighted the dangers to the mother of pregnancy in the presence of mitral stenosis.[234 w2] Maternal outcomes are favourable in women with mild mitral stenosis, but not in women with moderate or severe mitral stenosis, who have a high rate of morbidity (such as pulmonary oedema, arrhythmias, the need to start or increase cardiac medication, and the need for admission to hospital). Predictors of adverse maternal outcome include the severity of mitral stenosis (valve area < 1.5 cm^2) and

Box 1 | New York Health Association classification

- Class I: Patients with no limitation of activities and no symptoms from ordinary activities
- Class II: Patients with slight, mild limitation of activity who are comfortable at rest or with mild exertion
- Class III: Patients with marked limitation of activity who are comfortable only at rest
- Class IV: Patients who should be at complete rest, confined to bed or chair, and in whom any physical activity brings on discomfort and symptoms occur at rest

This is one of a series of occasional articles about how to manage a pre-existing medical condition during pregnancy.

New York Health Association (NYHA) functional class (box 1).[5] The prepregnancy risk of maternal mortality in the presence of severe mitral stenosis has been quoted at 1-5%[6] and is also associated with NYHA functional class.[7] No data are available on the long term effects of pregnancy on maternal cardiac function in mitral stenosis.

Aortic stenosis

In young women aortic stenosis is usually congenital. The limited ability of the left ventricle to augment cardiac output results in an abnormal rise in left ventricular systolic and filling pressures, leading to a compensatory left ventricular hypertrophy. In pregnancy the increase in stroke volume and fall in systemic vascular resistance lead to an increase in the gradient across the aortic valve.[2] The clinical consequences of the increased aortic gradient depend on the degree of pre-existing left ventricular hypertrophy and left ventricular systolic function. When compensatory changes in the left ventricle are inadequate to meet the demands imposed by the need for increased cardiac output late in pregnancy, symptoms develop.

Moderate to severe aortic stenosis (valve area < 1.5 cm^2) substantially affects pregnancy outcome. Studies from the 1970s show a high incidence (17.4%) of maternal mortality.[w3] More recent studies report no maternal or neonatal deaths; however, moderate to severe aortic stenosis is associated with significant maternal morbidity, including heart failure, arrhythmia, and syncope.[4 8 w4] Pregnancy seems to have a long term effect on the clinical course of aortic stenosis, with a 31% rate of cardiac surgery reported within a three year follow-up period.[4]

Aortic and mitral regurgitation

Pregnancy is usually well tolerated in women with chronic left sided valve regurgitation without left ventricular dysfunction. This tolerance is due to the fall in systemic vascular resistance and reduced left ventricular afterload. Symptoms may occur in women with severe lesions, particularly in labour, delivery, and the early postpartum period and include dyspnoea on exertion, orthopnoea, and paroxysmal nocturnal dyspnoea.[2]

Does valvular heart disease affect pregnancy?

The fixed narrowing of left sided stenotic lesions limit the pregnancy induced increase in cardiac output, restricting uteroplacental perfusion and limiting fetal growth. When cardiac decompensation is superimposed on this background—whether this is the result of pulmonary oedema causing hypoxia or an arrhythmia acutely reducing the relatively low cardiac output still further—the prognosis for the fetus may be compromised.

Mitral stenosis

Moderate and severe mitral stenosis have a clear effect on fetal outcomes. A case-control study comparing women who had mitral stenosis with well matched controls found an increased incidence of preterm delivery (28% in moderate stenosis *v* 6% in controls, 44% in severe stenosis *v* 11% in controls) and intrauterine growth restriction (27% in moderate stenosis *v* 0% in controls, 33% severe stenosis *v* 0% in controls). Overall, birth weight in the mitral stenosis group was also significantly reduced (3427 g in controls *v* 2706 g in moderate mitral stenosis (P=0.02) and 3332 g *v* 2558 g (P=0.05) in severe mitral stenosis).[4] Fetal mortality is increased in women with mitral stenosis and is dependent on maternal functional capacity; a fetal mortality of 30% has been reported with NYHA class IV disease in the mother.[5]

Aortic stenosis

Severe aortic stenosis is associated with a higher incidence of preterm delivery (44%), intrauterine growth restriction (22%), and lower birth weight (2650 g *v* 3391 g) compared with well matched controls.[4] In a recent case series, disorders related to hypertension were observed slightly more often than reported in the general population (11.3% *v* 8%).[w5] The authors suggest this may be the result of reduced cardiac output leading to abnormal placental bed vascular remodelling and reduced placental perfusion.

How is pregnancy managed?

Before conception

The management of women with valvular heart disease should ideally take place before conception. In women with congenital lesions this process should begin during adolescence with discussions about family planning, contraception, and pregnancy.

Women with valvular heart disease contemplating pregnancy should be assessed in a multidisciplinary prepregnancy clinic (staffed by an obstetrician, cardiologist, anaesthetist, and midwife). A full cardiac assessment should be performed. The history should focus on the patients' exercise capacity and past cardiac events. Echocardiography should assess cardiac haemodynamics including valve area and pulmonary pressures. In patients with impaired functional capacity an exercise test with maximum oxygen uptake refines risk stratification for pregnancy (box 2). These risks should be discussed with the woman and her family. However, when English is a barrier to

Box 2 | Recommendations for the evaluation and management of women with valvular heart disease who are contemplating pregnancy

- Multidisciplinary review
- History
- Examination
- 12 lead electrocardiography
- Echocardiographic assessment of ventricular and valvular function and pulmonary pressure
- Exercise testing with oxygen consumption
- Discussion with patient and family about anticipated risk of pregnancy to mother and fetus
- Effective contraception that can be used until pregnancy is desired
- Consideration of valve repair or replacement
- Adjustment of drugs to prevent adverse fetal effects

communication, family members should not be used as interpreters for women, either in preconception counselling or for care during pregnancy.[w6]

Valve repair or replacement is recommended before pregnancy in women with severe mitral stenosis (valve area <1.0 cm^2),[2 3 w1] symptomatic aortic stenosis,[w7] and symptomatic mitral regurgitation.[w8] Any medications contraindicated in pregnancy (such as angiotensin converting enzyme inhibitors, angiotensin receptor blockers, amiodarone, and sodium nitroprusside) should be changed to avoid any adverse fetal effects.

Box 4 | Recommended antibiotic prophylaxis during delivery for women with valvular heart disease

No allergy to penicillin

Ampicillin 2 g intramuscularly or intravenously, plus gentamicin 1.5 mg/kg intravenously 30 minutes before delivery. Ampicillin 1 g intravenously or amoxicillin 1 g orally six hours after delivery

Allergy to penicillin

Vancomycin 1 g intravenously over two hours, plus gentamicin 1.5 mg/kg intravenously 30 minutes before delivery

During pregnancy

As valvular heart disease may present for the first time during pregnancy, clinicians should be watchful. The normal flow murmur of pregnancy is typically soft (grade 1 or 2), located at the pulmonary region, associated with a normal first and second heart sound, and is not accompanied by a diastolic murmur (box 3). Always bear in mind the possibility of valvular heart disease, particularly in women from developing countries.[w9] Investigation with echocardiography is indicated in women with a history of resting or worsening dyspnoea, any signs of heart failure, a grade 3 or greater systolic murmur, or any diastolic murmur.

During pregnancy, women with valvular heart disease require regular review by the multidisciplinary team. The frequency of antenatal visits is determined by the type and severity of the valve lesion and the clinical course. In general, antenatal visits should be every month in women with mild disease and every two weeks in women with moderate and severe disease until 28 weeks then weekly thereafter until delivery. This allows the detection of any deterioration in maternal cardiac state and prompt intervention if needed. Women who miss appointments should be immediately contacted and followed up.[w6]

Cardiac function may worsen simply because of the increased workload of pregnancy or as a result of an arrhythmia, anaemia, or infection. Interventions such as bed rest and avoidance of the supine position may be useful. Medical treatment aims to reduce the heart rate and improve loading conditions. Cardiac drugs that are often used and are relatively safe in pregnancy include β blockers, hydralazine, diuretics, and digoxin. Atrial arrhythmia requires prompt treatment, including cardioversion.[w7] Alternatively β blockers and digoxin can be used for rate control. Thromboprophylaxis with unfractionated heparin is indicated during bed rest and in the presence of atrial arrhythmia, particularly if the left atrium is dilated.

Box 3 | Cardiac findings in pregnancy for which further investigation is necessary

- Symptoms
- Angina
- Resting dyspnoea
- Paroxysmal nocturnal dyspnoea
- Sustained arrhythmia
- Signs
- Heart failure
- Grade 3 or greater systolic murmur
- Diastolic murmur

Patients who remain symptomatic despite adequate drug treatment may require repair or replacement of the diseased valve, particularly if prematurity means the fetus cannot be safely delivered. Balloon mitral valvuloplasty is the treatment of choice in mitral stenosis.[w10] The reported results in several studies have been excellent, with few maternal or fetal complications.[w11 w12] Reported rates of maternal complications are small but include cardiac tamponade, excessive blood loss, transient atrial fibrillation, worsening of mitral regurgitation, systemic embolisation, uterine contractions, and labour.[w11] Favourable long term results for both mother and baby have recently been reported.[w13] In symptomatic aortic stenosis, aortic balloon valvuloplasty is useful as a palliative procedure, allowing deferral of valve replacement until after birth.[w14]

At the beginning of pregnancy women should be counselled about potentially worrying symptoms and advised to attend the labour ward if such symptoms develop. They should be given information about the available options during their care and be involved in all decision making.

During delivery

Labour and delivery are an additional burden on the maternal cardiovascular system. Timing and mode of delivery should be carefully planned by the multidisciplinary team. Vaginal delivery with epidural anaesthesia is the preferred delivery mode unless surgical delivery is obstetrically indicated.[3 4 9 w7 w14] Invasive monitoring may be required in symptomatic women and those with severe disease,[w15] and the length of the second stage should be shortened by elective assisted delivery to avoid excessive maternal effort.[10] Antibiotic prophylaxis should be considered for all valvular lesions irrespective of delivery mode (box 4).[9 10] During the third stage, a bolus dose of oxytocin can result in hypotension and should therefore be given slowly or as an infusion. During caesarean section a prophylactic compression suture may also be placed to reduce the risk of postpartum haemorrhage.

Immediately after delivery the venous return to the heart is greatly increased, which may precipitate pulmonary oedema. Consequently, haemodynamic monitoring should continue for 12 to 24 hours after delivery. Women should be discharged only when clinically stable.

Scenario

A 32 year old woman from Iran was referred to the joint cardiac obstetric team at 28 weeks of pregnancy. She had a history of severe rheumatic mitral stenosis. This was her fourth pregnancy—her previous three children had been delivered at term by caesarean section. During this pregnancy she had had two episodes of pulmonary oedema, which were treated with bed rest, diuretics, and a β blocker. As her symptoms persisted despite medical treatment, a mitral valvuloplasty was carried out at 32 weeks of pregnancy. The procedure was uncomplicated, increasing the mean mitral valve area from 0.8 cm^2 to 2.6 cm^2. Four hours after the procedure, preterm labour was diagnosed, and a live male infant weighing 2345 g was delivered by emergency caesarean section. The operation was done under general anaesthesia with invasive cardiac monitoring. The estimated blood loss was 650 ml; to prevent further blood loss a prophylactic compression suture was sited. The patient had requested sterilisation, which was performed during the caesarean section. The postoperative period was uncomplicated, and the patient was discharged nine days after delivery.

Follow-up

Women should be reviewed six weeks postpartum by the multidisciplinary team. This appointment should include a full cardiac assessment and post-natal check. Appropriate advice on contraception should be given[w16] and follow-up with a cardiologist arranged.

Conclusion

Valvular heart disease may manifest itself for the first time during pregnancy, particularly in women from developing countries. Overall, risk during pregnancy is dependent on the valve lesion, its severity, and maternal prepregnancy functional capacity. Women with valvular heart disease require close follow-up during pregnancy, delivery, and postpartum so that any deterioration in cardiac state can be detected early and managed in a timely way.

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CORRECTIONS AND CLARIFICATIONS

Dressings for venous leg ulcers: systematic review and meta-analysis

Several errors in this paper by Palfreyman and colleagues persisted through the editorial process to publication (*BMJ* 2007;335:244-8, 4 Aug). In fig 2 of the full version (fig 1 of the abridged version), the results for Moffatt 1992 should be 13/30 healed in hydrocolloid arm and 7/30 in the low adherent arm (not the other way round), giving a pooled relative risk of 1.09 (0.89 to 1.34). In addition, the discussion of trial quality in both versions should have said that five [not three] trials stated the method of randomisation,[w3 w4 w10 w11 w13] and the full version should have said that two studies [not one study] reported a priori sample size calculations.[w9 w10] The discussion of external validity in both versions (and table 1 in the full version) should have stated that three trials [not just one trial] used life table analysis.[w9 w17 w39] In both versions, the duration of the included trials should read four to 40 [not 48] weeks. Finally, the authors omitted to acknowledge the support and advice of the Cochrane Wounds Group in the course of the review and to thank Rona Lochiel for helping to develop the protocol.

Long term results of compression therapy alone versus compression plus surgery in chronic venous ulceration (ESCHAR): randomised controlled trial

In this paper by Manjit S Gohel and colleagues, two values were transposed in the results section under the heading "Ulcer recurrence" (*BMJ* 2007;335:83-7, 14 Jul). The second sentence should begin: "For patients with isolated superficial reflux, recurrence rates at four years were 27% in the compression plus surgery group and 51% in the compression group."

In brief: *BMJ* authors win award

In this news story (*BMJ* 2007;335:364, 25 Aug) of how Karsten Jorgensen and Peter Gotzsche won first prize in a new annual award for clear and elegant writing, we wrongly named the awarding organisation as the Society of Medical Authors. Its correct title is the Society of Medical Writers (www.somw.org.uk).

Agency warns about dosing error for amphotericin after patients with cancer die

In this news article by Nigel Hawkes (*BMJ* 2007;335:467, 8 Sep) we inadvertently confused the lipid and non-lipid formulations of amphotericin. Fungizone is the non-lipid presentation, whereas AmBisome is one of the lipid formulations. We wrongly defined them as the other way round.

Change Page: Using a combination inhaler (budesonide plus formoterol) as rescue therapy improves asthma control

An editorial oversight led this Practice article by Peter J Barnes (*BMJ* 2007;335:513, 8 Sep) to claim that the author had no competing interests. In fact, in his original manuscript he had declared: "PB receives research funding from AstraZeneca, GlaxoSmithKline, Novartis, Pfizer, and Boehringer Ingelheim, all of whom are involved in the development of asthma therapies."