

Mitral stenosis before, during and after pregnancy

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Mitral stenosis is the most common cardiac valvular problem in pregnant women with rheumatic heart disease being the most important cause. As a result of hemodynamic changes associated with pregnancy, previously asymptomatic patients develop symptoms or complications during pregnancy. Pregnancy in women with mitral stenosis is associated with a marked increase in maternal morbidity and adverse fetal outcome. Treatment of symptomatic mitral stenosis during pregnancy consists of bedrest, beta-blockers and diuretics. If symptoms persist despite optimal medical treatment, percutaneous mitral valvulotomy should be considered. If possible, surgery should be postponed until after delivery. It is recommended to treat pregnant women with symptomatic mitral stenosis in a tertiary centre with interventional possibilities.

Keywords: Mitral stenosis; Pregnancy; Percutaneous mitral valvulotomy; PMV

Heart disease is a major cause of maternal complications in pregnant women. Up to 20% of the pregnancies in patients with heart disease are complicated by a cardiovascular event such as heart failure, hypertensive disorder or arrhythmia. In the presence of heart disease obstetric and neonatal complications are also encountered more frequently compared to women without heart disease^{1,2}. Although rheumatic heart disease is decreasing worldwide, it is still an important cause of valvular problems with mitral stenosis being the commonest lesion (90%)³. Pathophysiology of mitral valve stenosis in pregnancy. The majority of the pregnant patients with mitral stenosis are diagnosed during pregnancy. Formerly as-

ymptomatic patients become symptomatic due to the hemodynamic changes associated with pregnancy. The development of symptoms is the reason for having their first cardiac evaluation⁴.

In mitral stenosis a gradient exists between the left atrium and left ventricle. The magnitude of this gradient depends on the severity of the stenosis and the blood flow. Pregnancy is associated with a 40 percent increase in blood volume and cardiac output (Fig. 1)^{5,6}. The increase in cardiac output is corresponding directly with an increase in mitral flow. The pressure gradient across the narrowed mitral valve increases greatly. As a result patients develop left atrium enlargement and pulmonary

venous hypertension, subsequently resulting in pulmonary oedema, which eventually can end in pulmonary arterial hypertension and right ventricular overload. This becomes

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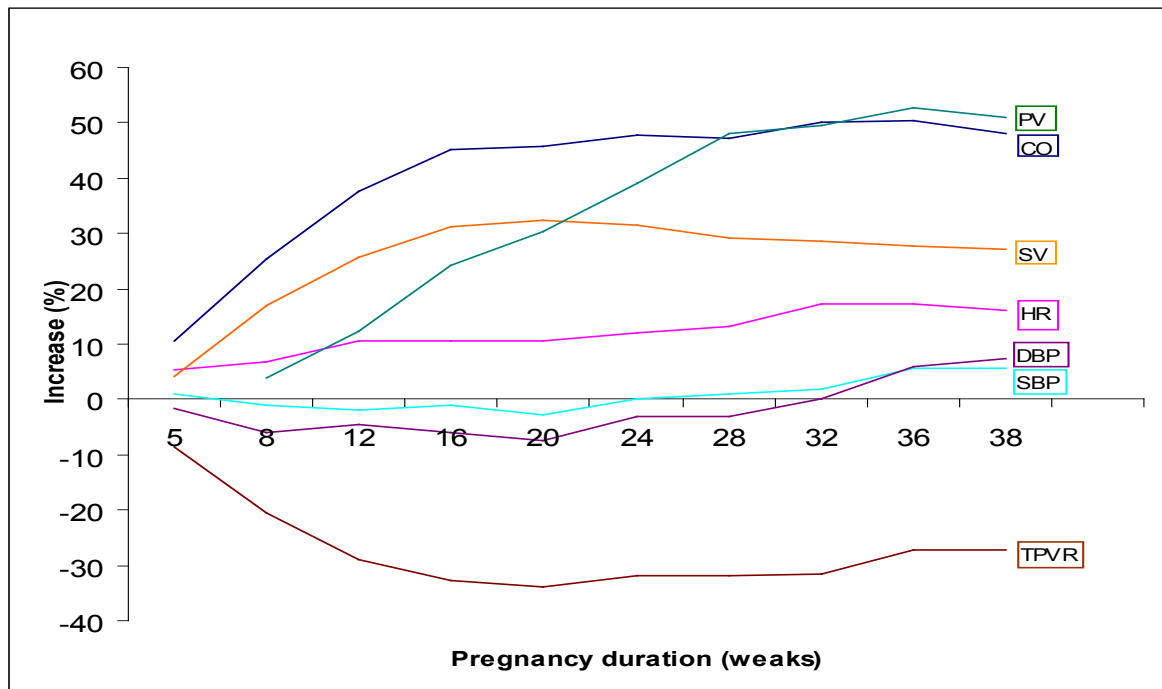


Figure 1: Changes in cardiac output (CO), stroke volume (SV), plasma volume (PV), total peripheral vascular resistance (TPVR), heart rate (HR) and blood pressure (SBP=systolic blood pressure, DBP=diastolic blood pressure) during pregnancy

especially manifest in the third trimester because at that time the hemodynamic burden of pregnancy is at its greatest. Plasma volume and heart rate are at their maximum in the third trimester. The physiological tachycardia results in impaired diastolic filling of the left ventricle. The periods most at risk for complications are labor, delivery and the early puerperium since acute heart failure may be precipitated by an increased venous return to the heart as a result of decompression of the inferior caval vein and physiological return of extravascular fluid into the systemic circulation (autotransfusion).

Preconceptional considerations. Patients with mitral stenosis should ideally be evaluated before pregnancy. The preconceptional evaluation comprises aside from the severity of mitral stenosis, assessment of the New York Heart Association functional classification. Siu

et al. identified predictors of adverse maternal and fetal outcomes in pregnant women with congenital and acquired heart disease⁷. A former cardiac event, abnormal functional capacity (NYHA>II) at baseline, impaired left ventricular systolic function (ejection fraction <40%) and left-sided heart obstruction (mitral valve area <2 cm², aortic valve area <1.5 cm²) were predictors of adverse cardiac events. The presence of more than one predictor came down to a cardiac complication rate of nearly 70%. In a large study of 74 women with mitral stenosis and 80 pregnancies the risk for maternal complications rose from 26% in mild mitral stenosis (mitral valve area (MVA)>1.5 cm²) to 38% in moderate mitral stenosis (MVA 1.1 cm²>1.5 cm²) and up to 67% in severe mitral stenosis (MVA<1.0 cm²).² Despite this high maternal morbidity, mortality is rare.

Table 1: ACC/AHA practice guidelines classification of valvular lesions in pregnancy (AR=aortic regurgitation; AS=aortic stenosis; MR=mitral regurgitation; MS=mitral stenosis; MVA=mitral valve area; MVP=mitral valve prolaps; NYHA=New York Heart Association)

Conditions associated with low maternal and fetal risk	Conditions associated with high maternal and fetal risk
Mild MS (MVA>1.5 cm ²) without pulmonary hypertension	MS with NYHA class II-IV symptoms
MR with NYHA class I or II and normal left ventricular systolic function	MR with NYHA class III-IV symptoms
MVP with no MR or mild to moderate MR with normal left ventricular systolic function	Mitral or aortic valve disease with severe pulmonary hypertension (pulmonary pressure>75% of systemic pressure)
Asymptomatic AS with low mean gradient (<25 mmHg) and with normal left ventricular systolic function	Mitral or aortic valve disease with severe left ventricular dysfunction (ejection fraction<40%)
AR with NYHA class I or II and normal left ventricular systolic function	Severe AS with or without symptoms
Mild to moderate pulmonary valve stenosis	AR with NYHA class III-IV symptoms

Adverse fetal and/or neonatal outcome (e.g. premature birth, small for gestational age and respiratory distress) however, is common (30%) and increases along with the severity of the stenosis. Fetal and neonatal mortality may be up to 4%.^{1,2} Current guidelines for valvular heart lesions in pregnancy are in line with these findings (Table 1)⁸. The risks associated with pregnancy should be discussed with patients. Patients with mitral stenosis who are symptomatic before conception should be considered for percutaneous interventional treatment before conception.

Pharmacological treatment. The primary treatment of mitral stenosis consists of measurements to reduce heart rate in order to allow improved ventricular filling. For this purpose patients should be advised to take bedrest. Beta-blockers are indicated to optimize diastolic filling and in general, are relatively safe during pregnancy. The use of beta-blockers is

associated with a mildly lower birth weight and can cause post-partum fetal bradycardia. Diuretics are given to relieve pulmonary and systemic congestion. Furosemide has been proven safe during pregnancy, however it should be used with caution to prevent hypovolemia and subsequent reduction in uteroplacental flow. In case atrial fibrillation occurs, therapeutic-dose anticoagulation should be given and an attempt should be made to restore sinus rhythm.

Treatment with low molecular weight heparins is safe during pregnancy. Coumarin derivatives have teratogenic effects in 6% of the cases when given during the period of 6th to 9th week of pregnancy and are associated with a higher miscarriage rate(9). Whether anticoagulation should be given in the absence of atrial fibrillation to reduce thromboembolic events is a point of discussion¹⁰.

Table 2: Grading of the mitral valve from echocardiographic characteristics (Mitral leaflet mobility, valvular and subvalvular thickening and calcification are graded from 0 to 4. This gives a maximum echo score of 16

Grade	Mobility	Subvalvular thickening	Thickening	Calcification
1	Highly mobile valve with only leaflet tips	Minimal thickening just below the mitral leaflets	Leaflets near normal in thickness (4-5 mm)	A single area of increased echo brightness
2	Leaflet mid and base portions have normal mobility	Thickening of chordal structures extending up to one third of total chordal length	Mid-leaflets normal, considerable thickening of margins (5-8 mm)	Scattered areas of brightness confined to leaflet margins

Mitral valve interventions. In patients with persistent symptoms despite optimal medical therapy, invasive treatment should be considered. When anatomically suitable valves are present percutaneous mitral valvulotomy (PMV) has been shown to be a safe and effective treatment during pregnancy. Successful PMV (defined as an increase of the mitral valve area to $>1.5 \text{ cm}^2$ or an increase of $>25\%$) was achieved in 90-95% of the procedures^{11,12}. In the study of Esteves et al. the short-term outcome of PMV was good for the mothers, despite an increase in mitral regurgitation (MR) after PMV¹². At 48 months follow-up 90% of these patients were free of surgical mitral valve repair. Although the need for surgical intervention after PMV during pregnancy is not uncommon, it is comparable with PMV in non-pregnant patients. Fawzy *et al.* found a 5-year restenosis-free survival of 89% after successful PMV in the general population. Surgical reintervention was performed in 4% and a repeat PMV in 6%¹³. Zimmet *et al.* found a higher rate of surgery after PMV in the general population in a retrospective analysis on 243 patients undergoing PMV. Surgery-free survival after PMV was 80% at 5 years follow-up¹⁴. The higher rate of surgery after PMV in the study of Zimmet might be explained by a

higher age of the patients. The need for surgery after previous PMV depends on the valvular anatomy. Independent predictors of surgery after PMV were found to be the severity of mitral regurgitation and a higher echo score (Table 2)^{14,15}. Cardiac surgery during pregnancy is associated with high fetal and neonatal mortality of 20 to 40%.^{11,16} Performing PMV instead of surgery during pregnancy leads to a significant reduction in fetal and neonatal death¹¹. The use of radiation is the principal argument against PMV during pregnancy. Doses in excess of 50 to 100 milliSievert increase the incidence of fetal malformation. However, only a small amount of the radiation delivered on the thorax reaches the fetus. Shielding the gravid uterus is of limited value, since this will not prevent internal radiation scatter. The additional risk of fluoroscopy guided cardiac procedures on the development of childhood cancer, hereditary defects and birth defects is small^{17,18}. No adverse effects are observed in children of women with PMV during pregnancy. The study of Gamra followed 63 babies of 61 women with PMV during pregnancy for 5 and a half years after ballooning. They found no difference in height, weight and head circumference compared with the normal population.

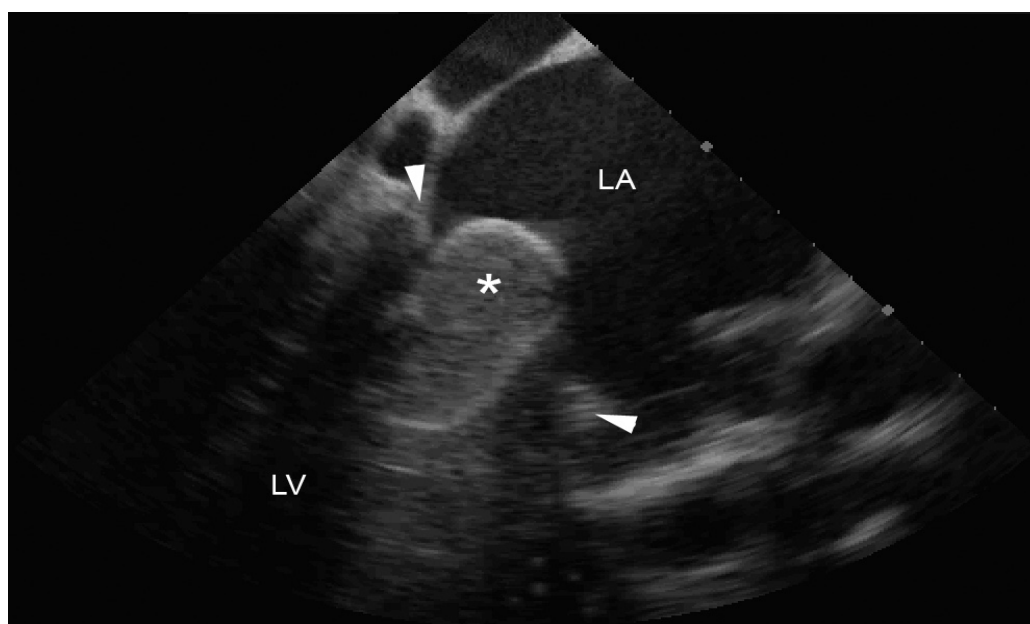


Figure 2: Intracardiac echocardiographic imaging of a percutaneous mitral valvulotomy (The asterix indicates the balloon and the arrowheads the mitral annulus. LA=left atrium; LV=left ventricle)

In addition, a standardized mental assessment of the children did not show any significant difference in relation to the normal population^{19,20}.

Performing the PMV under guidance of transesophageal or transthoracic echo investigations can reduce radiation exposure during the procedure. However, both techniques have their limitations. Transesophageal echo, although permitting an optimal view, is uncomfortable for the patient and general narcosis of the patient is required if prolonged intraprocedural imaging is required. General narcosis is not easy to manage in pregnant patients with symptomatic mitral valve stenosis since strict fluid and heart rate management is required. Hypervolemia may cause pulmonary oedema, while hypovolemia, with associated tachycardia, may cause reduced preload and subsequently lower cardiac output. On the other hand, transthoracic echo is patient friendly, but

often does not allow optimal viewing of the position of the balloon catheter. Good positioning and manoeuvring of the balloon is mandatory for a good result. A useful new tool in guiding PMV is performing the procedure with use of intracardiac echo, if necessary in combination with minimal radiation. Intracardiac echocardiography is easy to perform and will offer optimal visualisation of the valve and position of the balloon catheter without sedating the patient (Fig. 2)¹⁸. At this point the costs of the intracardiac echocatheter may be a limitation on its use. Development of re-usable catheters would be a major step forward.

Delivery. Delivery might precipitate tachycardia as a result of anxiety and physical effort. The regulation of heart rate is indicated in order to prevent acute heart failure. Convincing data proclaiming either vaginal delivery or caesarean section have not been reported. However, most experience has been with

vaginal delivery. Caeserean section is associated with more blood loss and is mainly performed for obstetric reasons. Endocarditis prophylaxis is not indicated in uncomplicated vaginal delivery⁸. However for pragmatic reasons, routine prophylactic antibiotics may be considered since in case of complications antibiotics are often forgotten or given too late. **The puerperium.** In the puerperium, patients are still at risk for cardiac complications. Delivery causes a volume overload due to auto-transfusion. Patients are recommended to be examined for signs of heart failure and clinical observation for at least 3 days after delivery.

Pregnancy can be tolerated in patients with mild mitral stenosis, however the risk of maternal and fetal complications increases with the severity of the lesion. Percutaneous mitral valvulotomy during pregnancy is a successful treatment modality. It is recommended to treat pregnant women with symptomatic mitral stenosis in a tertiary centre with interventional possibilities.

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