Pregnancy Complicated by Cardiac Valvular Disease and Hypertension

Problems of Management

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CASE PRESENTATION

James S. Dunnick, M.D.

M. M. is a 34-year-old white woman who was first seen after ten weeks of her first pregnancy. She was found to be carrying twins. She had a history of rheumatic heart disease resulting in mitral and aortic regurgitation. At age 11, during what was thought to be acute rheumatic fever, she manifested apparent congestive heart failure which ultimately resolved. Monthly antibiotic injections were voluntarily discontinued approximately two years earlier.

At the first evaluation, there were no symptoms attributable to cardiovascular disease, and her physical examination disclosed murmurs compatible with mitral, tricuspid, and aortic regurgitation. Echocardiographic and Doppler study confirmed regurgitation of the mitral, tricuspid, and aortic valves. The mitral regurgitation was moderate in severity; however, lesions of the tricuspid and aortic valves were considered mild.

Progress continued satisfactorily through the pregnancy until 34 weeks of gestation, when the findings of proteinuria and peripheral edema resulted in hospitalization. She was maintained at bed rest, during which her diastolic blood pressure fluctuated between 85 and 95 mm Hg and she remained asymptomatic. Repeat echoangiogram showed no change except for a small pericardial effusion. On the 14th hospital day, however, her developed acute pulmonary edema; her blood pressure rose to 240/140 mm Hg. She was treated with intravenous furosemide and hydralazine and showed clinical improvement. Fetal heart rates began to slow; therefore, an emergency cesarean section was performed, with antibiotics given immediately before this procedure. An abruptio placentae was found without significant blood loss. Although in distress, the twins were successfully delivered with heart rates ranging around 50/min, after which they improved steadily and subsequently recovered.

After delivery, the patient gradually improved with considerable lability of blood pressure. Hypertensive episodes were managed with repeated doses of intravenous hydralazine and furosemide. Hemodynamic monitoring showed moderate pulmonary hypertension ranging around 50/25 mm Hg with pulmonary capillary wedge pressures of 20 to 24 mm Hg. Repeated echocardiograms continued to show normal left ventricular function. Gradual improvement in her hemodynamic status was noted over several days. The blood pressure was subsequently controlled with administration of enalapril combined with furosemide and nifedipine. The proteinuria improved considerably. Also noted was a transient episode of subjective numbness in the left side of the body without objective physical findings. Laboratory evaluation was normal, consisting of an electroencephalogram, magnetic resonance imaging of the brain, and duplex scanning of the carotid vessels. Transient thrombocytosis occurred with the platelet count reaching a high of 630,000. Hemoglobin values remained in the anemic range throughout her pregnancy and postdelivery period, ranging from 8 to 10 g. Over the next several weeks, her blood pressure remained in the normal range with the combination of medications noted above and her hematologic values also returned to normal.

Further cardiologic evaluation was performed six weeks postdelivery with a radionuclide angiographic test revealing a resting left ventricular ejection fraction of 56 percent and a dilated left ventricle with normal wall motion. There was moderate enlargement of the left atrium. Following exercise, the ejection fraction remained fixed without further dilatation of the left ventricle.

QUESTIONS

1. How do you explain the hemodynamic deterioration in this patient?
2. How would you have managed the episode of congestive heart failure?
3. Are there any indications for urgent valve replacement or other type of corrective surgery in this type of situation?
4. After delivery and stabilization, what would you use as indications for valve replacement?
   - for isolated mitral regurgitation?
   - for isolated aortic regurgitation?
   - for a combination of the above?
5. If a valve replacement was required, what type would you recommend and would you approach anticoagulation during subsequent pregnancy?
6. What medications are acceptable for use in pregnancy to control hypertension?

COMMENTS

Celia M. Oakley, M.D.*

This patient had a twin pregnancy which greatly increases the hemodynamic burden such that an increase in cardiac output of even 60 percent may be expected and achieved largely by an increase in stroke volume and slightly by an increase in rate. In this patient with regurgitant valve disease, such an increase in forward stroke volume may not be achieved and so a reflex increase in heart rate would be anticipated. This would cause an increase in left atrial pressure due to a reduction in the low pressure diastolic time and an increase in the number of V-

waves. Acute pulmonary edema would have been no surprise following a rise in blood pressure to 240/140 mm Hg causing increased mitral regurgitation, though clearly the aortic regurgitation was not a problem. As she had been asymptomatic before the pregnancy, I would not have expected her to develop cardiovascular problems even during the twin pregnancy had it not been for the development of the severe hypertension.

Eclampsia is cured by delivery so that I would not have waited for her to develop the expected acute pulmonary edema which followed the great rise in her blood pressure, but would have delivered the twins at 35 weeks' maturity when the diastolic blood pressure remained elevated despite bed rest. Delay in delivery despite the blood pressure rise to 240/140 mm Hg further jeopardized the babies who were lucky to survive.

There were no indications for urgent valve replacement as her problem was caused by the severe hypertension.

I assume that she is now again asymptomatic, although I see that she is hypertensive and requires drug treatment, which is a surprise. The indications for valve replacement for isolated mitral or aortic regurgitation are different. In isolated mitral regurgitation, symptoms may remain absent or minimal, as the left ventricle and left atrium increase in size but the left ventricle thins and the operative risks climb once the left ventricular ejection fraction starts to fall. I would use a combination of measurements of left ventricular dimension and of ejection fraction in deciding the timing of surgery unless the mitral regurgitation was nonrheumatic and looked suitable for valve repair, in which case I would advocate surgery much earlier. If valve replacement is going to be needed, increasing left ventricular echo dimensions would suggest that the left ventricle was becoming more spherical and the ejection fraction would probably begin to drop. A left ventricular ejection fraction of only 56 percent suggests the need for frequent review and surgical treatment if the dimension measurements show deterioration.

In isolated aortic regurgitation, the pulse pressure, particularly the diastolic blood pressure, and a normal rhythm at a rate of 70 bpm give a good guide to the severity of regurgitation. There is evidence that even after left ventricular function begins to deteriorate, shown first by a failure of the ejection fraction to rise with exercise, there may still be up to a year's grace during which aortic valve replacement can be carried out in the expectation that left ventricular function will still return to normal. If the patient with aortic regurgitation is allowed to develop symptoms of left ventricular failure, it is probably too late for a low-risk operation to be carried out with anticipation of a first-class result. When mitral and aortic regurgitation occur in combination, the volume load on the left ventricle is very great and the need for valve replacement would be based on left ventricular dimension and ejection fraction and operation carried out even though the regurgitation through the individual valves was only moderate. Afterload reduction is much more effective in mitral than in aortic regurgitation, but should be used only as a temporary measure prior to surgery. I would recommend a mechanical valve with a track record of hemodynamic reliability without change in the valve design or manufacture of at least ten years. This restricts me to the choice of either a Starr-Edwards or a St. Jude prosthesis. Bioprostheses are particularly contraindicated in young women who may wish to become pregnant because of accelerated deterioration in the young and particularly during pregnancy, which will lead to an inevitable need for re-replacement in the near future with the very unwelcome risk for a mother of young children. Anticoagulation should be meticulous and aim at keeping the INR as close to 3.0 as possible. The risk of fetal damage is greatly increased if the INR is allowed to become more prolonged while meticulous control at this recommended level minimizes fetal risk. There may be a case for changing from a coumarin drug to a phenindione, but this is not proven.

Therapy with hydralazine and beta-blockers is safe in pregnancy to control hypertension. A low-salt diet is much preferable to the use of diuretics. The angiotensin-converting enzyme inhibitors are contraindicated because they can cause oligohydramnios and fetal renal failure.

Antibiotic prophylaxis is probably unnecessary during normal vaginal delivery, but I would give it in patients with a history of previous infective endocarditis or a prosthetic heart valve. Cesarean section should be covered by amoxicillin plus gentamicin. This should also be given to high-risk individuals undergoing normal deliveries.

†This would correspond to a prothrombin time (PTT) approximately 1.7 times normal as commonly measured in the USA.

COMMENTS

John G. Gianopoulos, M.D.*

This case represents an interesting clinical dilemma, a patient with preexisting rheumatic valvular disease who develops an acquired complication of the cardiovascular system during pregnancy. The physiologic alterations of pregnancy produce the maximum stress to the cardiovascular system at approximately 32 weeks' gestation. This patient developed pregnancy-induced hypertension at this most critical time in gestation. Further complicating this is the presence of a multifetal pregnancy, which also stresses the hemo-

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dynamic functioning of the cardiovascular system. This patient's hemodynamic decompensation was related to the development of pregnancy-induced hypertension complicating rheumatic heart disease. At the time of this patient's deterioration, with the development of pulmonary edema, management with diuretic preload reduction and vasodilating agents to reduce the afterload were appropriate. One must consider, however, the use of a positive inotropic agent such as digoxin at this time. Information on cardiac function would have been very important, and a pulmonary artery catheterization with its resultant hemodynamic database would have led to a more directed approach to therapy.

Patients with rheumatic valvular disease usually tolerate pregnancy well. Patients with mild-to-moderate regurgitation of the mitral or aortic valve rarely require surgical intervention in pregnancy. Significant left ventricular failure unresponsive to aggressive medical management at gestational ages before fetal viability would lead one to consider valve replacement in pregnancy. These operations, although with some risk, may be safely performed during pregnancy with a moderate incidence of fetal loss (perinatal mortality of 10 to 20 percent). Intensive fetal monitoring during cardiac bypass, and high-flow, high-pressure normothermic perfusion will minimize adverse fetal effects.

The ideal time to replace dysfunctional valves is prior to pregnancy. Patients with mitral insufficiency who demonstrate left ventricular dysfunction with a dilated left ventricular diastolic dimension are candidates for valve replacement. Xenograft valves should be considered in younger female patients with a desire for future childbearing, as they do not require full anticoagulation during pregnancy. However, with the increased hypercoagulability of pregnancy, prophylaxis with antiplatelet agents such as low-dose aspirin (80 mg daily) is advisable. Patients with mechanical valve prostheses require full anticoagulation during pregnancy. As warfarin derivatives are teratogenic in the first trimester and lead to intrauterine intracranial bleeding in the fetus throughout pregnancy, they are considered contraindicated. Anticoagulation with heparin, given in divided doses subcutaneously or continuous subcutaneous infusion via an infusion pump to maintain the PTT at 1.5 times normal, is the therapy of choice.

This patient also presents with the problem of hypertensive therapy in pregnancy. Patients with long-term hypertension requiring therapy should be started on alpha methyldopa. This agent has been shown to have a predictable effect on maternal blood pressure without decreasing placental perfusion. If other agents are required for pressure control, hydralazine is considered the second-line therapy. Beta blockers, such as propranolol and labetalol, may be utilized, but they may reduce placental perfusion leading to decreased fetal growth. Calcium channel blockers may be employed; however, they may lead to profound maternal hypotension with resultant deleterious fetal effect. Angiotensin-converting enzyme therapy has been shown to have adverse fetal effects and should be reserved for resistant cases.

Patients with pregnancy-induced hypertension who require antihypertensive medication for pressure control are at significant risk for maternal deterioration, and depending on gestational age, consideration for delivery must be entertained. The patient in this case was appropriately managed with antihypertensive drugs. One may have considered delivery before fetal compromise ensued (at that time, medical intervention was deemed necessary for pressure control). Patients with rheumatic valvular lesions require antibiotic prophylaxis with agents demonstrating activity against genitourinary pathogens for both vaginal and cesarean routes of delivery. Transient bacteremia has been shown to occur with both routes of delivery.

In summary, this case presents many critical management decisions which serve as an example of the management of patients with preexisting cardiovascular disease during pregnancy.

**EDITORIAL COMMENT**

The varied opinions about the ideal time of termination of a pregnancy, about the type of replacement prosthetic valves recommended for young women desirous of future pregnancies, and about the method of anticoagulation when mechanical valves are used, are all exemplified by our reviewers' comments above. We hope these many controversial areas will receive more study in the future and that this discussion will provide some relief for the beleaguered clinician attempting to manage these difficult problems.

In this particular patient, since the rise in blood pressure was abrupt and without warning, and since she had been relatively stable and near normal prior to the episode of pulmonary edema, attempts were made to postpone delivery for as long as possible. Although it appeared in retrospect to have been desirable to terminate the pregnancy earlier, one would have had difficulty in establishing the optimal time for this. Perhaps Dr. Oakley's suggestion to use the arbitrary time of 35 weeks' gestation might have provided a satisfactory alternative.

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**BIBLIOGRAPHY**