Case Reports

Mechanical Mitral Valve Replacement during the 2nd Trimester of Pregnancy

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We report the case of a 44-year-old pregnant woman who was diagnosed with symptomatic severe mitral stenosis that did not respond to optimal medical therapy and balloon valvuloplasty. After a multidisciplinary team discussion on the timing and risks of interventions and postoperative optimization of peripartum anticoagulation, the patient underwent mechanical mitral valve replacement during the 2nd trimester of pregnancy. The outcome was excellent for the mother and the infant. This case emphasizes the importance of a multidisciplinary approach in managing unusual cases. ***(Tex Heart Inst J 2018;45(1):31-4)***

Optimal management of symptomatic mitral stenosis during pregnancy is a challenge, and it requires a multidisciplinary team (MDT). Medical management and percutaneous balloon mitral valvuloplasty (PBMV) are the standard treatments, and surgery is the last recourse. We discuss the challenging decisions made by a 44-year-old pregnant patient and her medical team.

Key words: *Cardiopulmonary bypass; cardiovascular agents/therapeutic use; delivery, obstetric/methods; female; fetal distress/physiopathology; mitral valve stenosis/therapy; pregnancy complications, cardiovascular/diagnosis/drug therapy/surgery; pregnancy outcome; risk factors; treatment outcome*

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Case Report

A 44-year-old woman in her 6th pregnancy presented with pulmonary edema at 19 weeks' gestation. It had been 9 years since her last pregnancy, and she had no history of heart disease. Although she initially reported no symptoms, on closer questioning she described substantial fatigue and reduced exercise tolerance. A transthoracic echocardiogram showed thickened, heavily calcified mitral valve (MV) leaflets and a subvalvular apparatus with severe stenosis (mean gradient, 12 mmHg; calculated MV area by pressure half time, 1.3 cm^2); mild mitral regurgitation; and preserved left ventricular function.

We performed PBMV at 21 weeks' gestation. The valve was initially dilated to 24 mm without causing substantial new mitral regurgitation, as seen on a transesophageal echocardiogram. On the basis of this result and the patient's height, the interventional cardiologist inflated the balloon to 26 mm, intentionally forgoing balloon inflation to 25 mm to minimize the fetus' exposure to radiation. After that, transesophageal echocardiograms revealed substantial mitral regurgitation and disruption to the anterior leaflet.

After PBMV, the patient remained in the hospital, where she continued to receive medical therapy. We planned to defer surgery until after 26 weeks' gestation to improve the chances of fetal survival. However, one week after PBMV, the patient's condition had not improved. Although her pulmonary edema resolved, her exercise tolerance remained low (New York Heart Association [NYHA] functional class III), and she was persistently breathless on minimal exertion. In addition, despite having received optimal diuretic therapy, the patient lost no weight.

At this juncture, there were 2 options: either to delay MV surgery, knowing that the patient could imminently deteriorate and need emergency or salvage surgery; or to expedite the operation, accepting the higher fetal risk it would entail. The consensus among members of the patient's MDT, which included obstetricians, cardiac surgeons, anesthesiologists, cardiologists, hematologists, and neonatologists, was to proceed with MV replacement. The patient, who was involved throughout the discussion, opted for a mechanical valve rather than a biologic prosthesis, given the longevity of the former, and accepted the risk that taking warfarin would pose to her and to her fetus.

The operation was performed during the patient's 23rd week of pregnancy. She was placed at a 15° left lateral tilt throughout the procedure, and her temperature was maintained between 36 and 37 °C. A mean perfusion pressure of 70 mmHg was maintained, and the hematocrit level was kept above 25%. After median sternotomy, she was placed on cardiopulmonary bypass (CPB), and the MV was reached through the atrial transeptal approach. The MV appeared rheumatic. The anterior leaflet was excised, whereas the posterior leaflet was preserved. A 27-mm SORIN mechanical valve (LivaNova PLC) was implanted. After the procedure, the fetal heart rate was within normal range. The patient's postoperative course was uneventful. She was started on warfarin and was discharged from the hospital on postoperative day 13.

The patient's MDT formulated a protocol to manage anticoagulation after surgery. Its goal was to ensure safe delivery and to reduce the risks of bleeding and valve thrombosis. The plan was to admit the patient at 35 weeks of pregnancy, at which time she would be given a therapeutic dose of enoxaparin and would undergo anti-Xa monitoring. Warfarin was to be discontinued once her anti-Xa level reached 1.0 to 1.4 U/mL. Enoxaparin was to be replaced with heparin 24 hours before labor induction. Anticoagulant administration was to be tailored to the different stages of labor and to the postnatal period (Table I).

Labor was successfully induced at 38 weeks plus one day of gestation. The patient had a normal delivery of a healthy baby girl (weight, 2.48 kg). More than a year after surgery, the patient and baby were in good condition.

Discussion

Mitral stenosis, the most typical valvulopathy found during pregnancy, is caused primarily by rheumatic disease.[1] Women with substantial mitral stenosis should be counseled against pregnancy, and if they do plan to become pregnant, they should undergo intervention before that time.[2]

In pregnant patients with mitral stenosis, the aim of medical therapy is to optimize the heart rate and reduce left atrial pressure. Therapy includes the selective use of β_1-adrenergic blockers, which reduce interference with β_2-mediated uterine relaxation. Diuretics may also be used, in conjunction with salt restriction; however, aggressive diuresis should be avoided.[1]

The intervention of choice in these patients is PBMV, which has low rates of maternal and fetal morbidity and mortality and which produces favorable long-term results in relieving symptoms in pregnant women.[3-5] Esteves and colleagues[3] reported performing PBMV in 71 pregnant women with rheumatic mitral stenosis (NYHA functional class III to IV), 98% of whom

TABLE I. Multidisciplinary Team Protocol for Optimizing Anticoagulation after Mechanical Mitral Valve Replacement in a Pregnant Woman

Delivery Stage	Protocol
First stage of labor	Have patient wear antiembolic stockings.
	Avoid epidural insertion unless necessary during labor. In the event of epidural insertion, stop enoxaparin (24 hr) and heparin (4 hr) before catheter insertion. Protamine sulfate should be readily available in case emergency reversal of heparin is needed.
Second stage of labor and delivery	Avoid delivery by vacuum extraction or by high forceps.
	Avoid administering a pudendal block because of bleeding risk. Spinal anesthesia, administered in the operating room, is preferred if instrumental delivery is required.
	At delivery, conduct immediate pediatric review and administer vitamin K to the baby. Take cord blood samples for coagulation screening.
Early labor or cesarean section	Early labor: Discuss anticoagulation with hematology team. Avoid epidural insertion if enoxaparin was given within 24 hr.
	Cesarean section: Consider the use of drains and additional oxytocin because of the higher risk of secondary postpartum hemorrhage, hematomas, and intra-abdominal bleeding.
	Stop heparin 4 hr before surgery.
Postnatal period	Observe the patient in the intensive care unit for the first 48 hr.
	Restart heparin at 4 hr if there is no substantial bleeding.
	Restart warfarin at a therapeutic dose until the international normalized ratio is ≥2.

had improved functional status (NYHA class I or II) at follow-up. No maternal or fetal death was reported at short-term follow-up, and the one death at 48-month follow-up was unrelated to PBMV. Of the neonates, 88% were of normal weight and the rest were premature.

The first CPB operation in a pregnant woman was performed in 1959; the patient underwent a pulmonary valvotomy with closure of an atrial septal defect. The mother survived, but the fetus was spontaneously aborted 3 months later.[6] Parry and Westaby[7] reviewed 133 cases of CPB operations during pregnancy and reported a maternal mortality rate of 3%; in contrast, the fetal mortality rate was exceedingly high at 19%. The authors recommended avoiding open-heart surgery during the first trimester; if surgery was needed at any time during pregancy, they recommended maintaining normothermic, high-pressure, high-flow CPB while simultaneously monitoring the condition of the fetus.

In 1964, Kerr and associates[8] reported the results of their radiologic studies of the inferior vena cava (IVC) during late pregnancy. They concluded that the IVC is occluded when a patient is in the supine position during a cesarean section, and venous return is maintained via the azygos and vertebral veins. This occlusion of the IVC is at least partially relieved in the lateral position.[8] We kept our patient at a 15° left lateral tilt with a wedge-shaped cushion, which enabled adequate venous return to the heart-lung machine.

More recently, investigators have reported lower maternal mortality rates among pregnant patients undergoing CPB; however, fetal risk remains high.[9] In their study of 21 women undergoing CPB during pregnancy, John and colleagues[10] reported one in-hospital maternal death after an emergency aortic valve thrombectomy, as well as 3 fetal deaths.

Mechanisms contributing to fetal death after CPB are yet to be fully elucidated. Various explanations, including bypass-induced inflammatory response and inappropriate fetal response to bypass, have been proposed.[11-13] Current knowledge of the mechanisms is derived from Lam and associates' study of CPB in fetal sheep.[14] The authors found a strong correlation between elevated vasopressin levels and increased vascular resistance in the placenta, which in turn had a marked effect on fetal hemodynamic status, leading to clinical deterioration. They concluded that vasopressin might play an important role in the pathogenesis of placental dysfunction. In our patient, we chose not to perform fetal monitoring during surgery because the chance of fetal survival was deemed low, and an emergency cesarean section during CPB would have added to the maternal risk. Nevertheless, the obstetric team was available to intervene if a problem, such as placental hemorrhage, occurred.

Warfarin is associated with embryopathy and premature birth, particularly in the first trimester. This risk is the lowest during the 3rd trimester and when the dose of warfarin is maintained at ≤5 mg/d. Evidence also suggests that the use of warfarin and other oral anticoagulants during pregnancy is associated with a lower risk of thromboembolism than is the use of other anticoagulation regimens.[15] In our patient, who was informed about the side effects of warfarin, including embryopathy, a dose of 3 to 4.5 mg of warfarin was enough to maintain an international normalized ratio of 2.5 to 3. Our decision to use warfarin was in accordance with the European Society of Cardiology guidelines for the management of cardiovascular diseases during pregnancy. These guidelines recommend the use of oral anticoagulants in patients undergoing mechanical valve replacement during the 2nd and 3rd trimesters, as well as continuing oral anticoagulants until the 36th week of pregnancy (class I, level C evidence).[2]

Our experience emphasizes the importance of a multidisciplinary approach in treating pregnant women who need heart operations. Our MDT was instrumental in determining the optimal timing of surgery and in balancing the risks and benefits of peripartum anticoagulation. It also formulated a peripartum anticoagulation protocol, which was followed in the current case and which we plan to use in similar cases. Finally, the MDT facilitated communication between different teams and healthcare professionals in our institution.

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