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VALVULAR HEART DISEASE

CASE REPORT: HEART CARE TEAM/MULTIDISCIPLINARY TEAM LIVE: CARDIO-OBSTETRICS 2023

Cardio-Obstetrics Team-Based Management of a Pregnant Patient With Severe Bioprosthetic Aortic Valve Disease

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ABSTRACT

A 38-year-old pregnant patient was managed by the cardio-obstetrics multidisciplinary team for severe degenerative bioprosthetic aortic valve failure. She was medically managed utilizing echocardiogram and brain natriuretic peptide until she demonstrated worsening heart failure. A valve and cardio-obstetrics team evaluation led to valve-in-valve transcatheter aortic valve replacement at 30 weeks' gestation. (J Am Coll Cardiol Case Rep 2024;29:102197) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

CASE PRESENTATION

The patient was a 38-year-old G1P000 woman with bicuspid aortic valve disease who 5 years prior to presentation underwent surgery for mixed aortic valvular disease and ascending aortic dilation of 5.2 cm. She received a #23 St. Jude Medical Trifecta stented bioprosthetic graft with end-to-end anastomosis 8-mm Terumo Gelweave Dacron graft. Four years after her surgery, she had issues with swelling and dyspnea. Transthoracic echocardiography (TTE) demonstrated normal left ventricular ejection fraction (LVEF), with a mean gradient across her bioprosthetic aortic valve replacement (AVR) of 22 mm Hg. A year later, she was diagnosed with first-trimester pregnancy. TTE at that time demonstrated an LVEF of 65% and a mean AVR gradient of 33 mm Hg. She was referred to a cardio-obstetrics program at 16 weeks' gestation. TTE demonstrated an LVEF of 70% and mean AVR gradient of 46 mm Hg, with a dimensionless index of 0.28 consistent with moderate-severe stenosis (**Figures 1 and 2**, Videos 1 and 2). Her brain natriuretic peptide (BNP) was 106 pg/mL. She was doing well with no cardiac

LEARNING OBJECTIVES

- To be able to demonstrate the benefit of multidisciplinary management of pregnant patients with cardiac valvular disease utilizing risk stratification, imaging, and cardiac biomarkers.
- To characterize the risk associated with valvular disease in pregnancy and identify patients for whom intervention may improve perinatal outcomes.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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ABBREVIATIONS AND ACRONYMS

AVR = aortic valve replacement

BNP = brain natriuretic peptide

CT = computed tomography

LVEF = left ventricular ejection fraction

mWHO = modified World Health Organization classification

NT-proBNP = N-terminal pro-B-type natriuretic peptide

TAVR = transcatheter aortic valve replacement

TEE = transesophageal echocardiography

TTE = transthoracic echocardiography

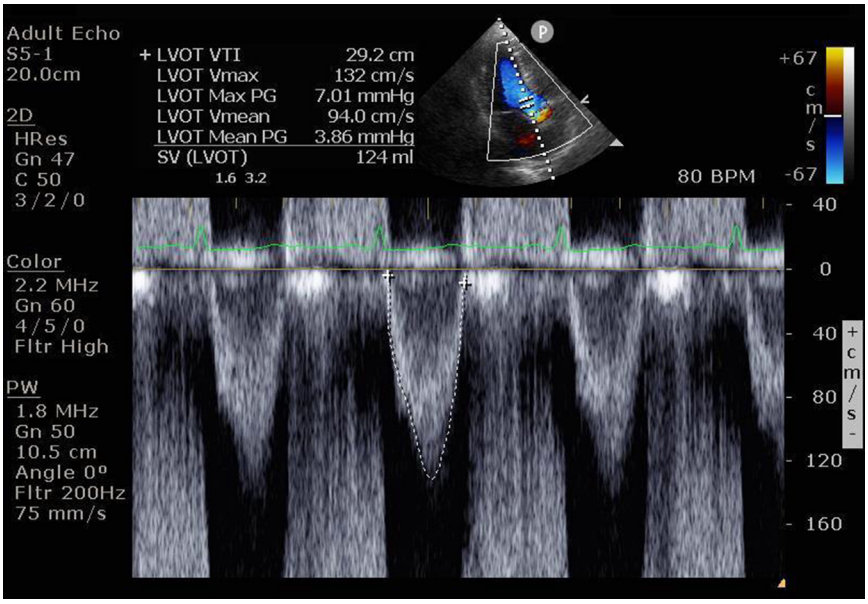
symptoms. Due to her valvular disease and aortopathy, she was classified as modified World Health Organization classification (mWHO) III.

She started to have mild heart failure symptoms in her second trimester but was managed with low-dose oral furosemide and monthly TTE as an outpatient. TTE mid second trimester had an ejection fraction of 73%, mean AVR gradient of 67 mm Hg, moderate-to-severe aortic regurgitation, and pressure half time 148 ms (**Figures 3 and 4**, Video 3). Due to increasing symptoms and near severe aortic regurgitation, valve team evaluation was undertaken. Transcatheter aortic valve replacement (TAVR) computed tomography (CT) to evaluate for valve-in-valve TAVR was completed. The CT scan demonstrated degeneration of the AVR leading to incomplete closure as the cause of her stenosis and regurgitation. The valve and cardio-obstetrics program teams deemed her suitable to proceed with valve-in-valve TAVR if worsening heart failure refractory to medical management (**Figure 5**, Video 4). Monthly evaluation for ongoing severe AVR stenosis and regurgitation was performed. Early in the third trimester, her BNP increased from 200 to 459 pg/mL, and she had worsening lower extremity edema leading to increase in furosemide.

At 30 weeks' gestation, she was admitted for worsening heart failure and shortness of breath, with BNP >1000 pg/mL. She was diuresed with intravenous furosemide but had worsening symptoms. From a fetal standpoint, there was appropriate fetal growth in the 56th percentile for gestational age and normal amniotic fluid volume. She had continued worsening heart failure not responding to intravenous furosemide. She was reclassified as mWHO IV and considered high maternal risk. Due to severe clinical decompensation, she underwent urgent valve-in-valve TAVR for severe bioprosthetic AVR regurgitation.

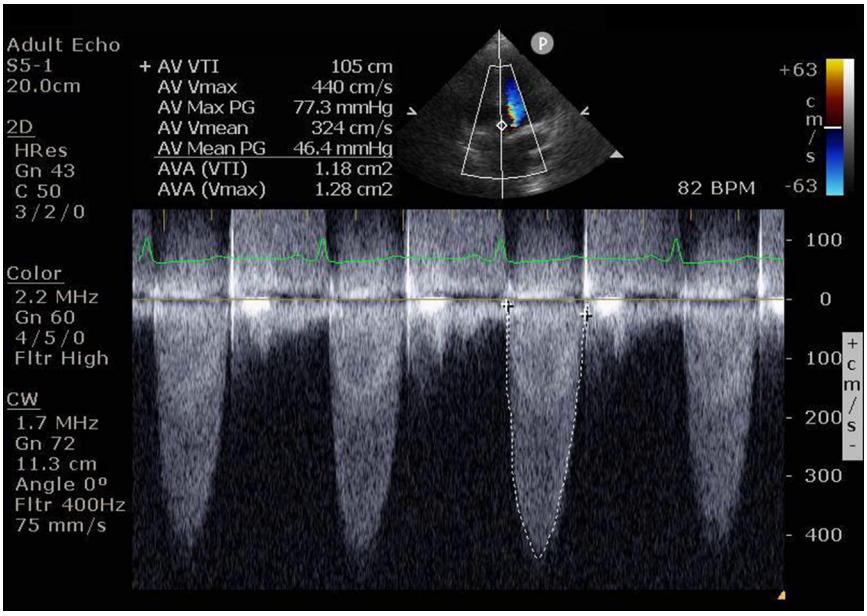
Both the cardio-obstetrics program team and the valve team managed the patient in preparation for TAVR at 30 weeks and 4 days' gestation. The patient was intubated intraoperatively for transesophageal echocardiography (TEE) guidance. A perinatologist was present during her procedure in case urgent

FIGURE 1 Spectral Doppler Bioprosthetic Aortic Valve Replacement LVOT VTI, Early Second Trimester



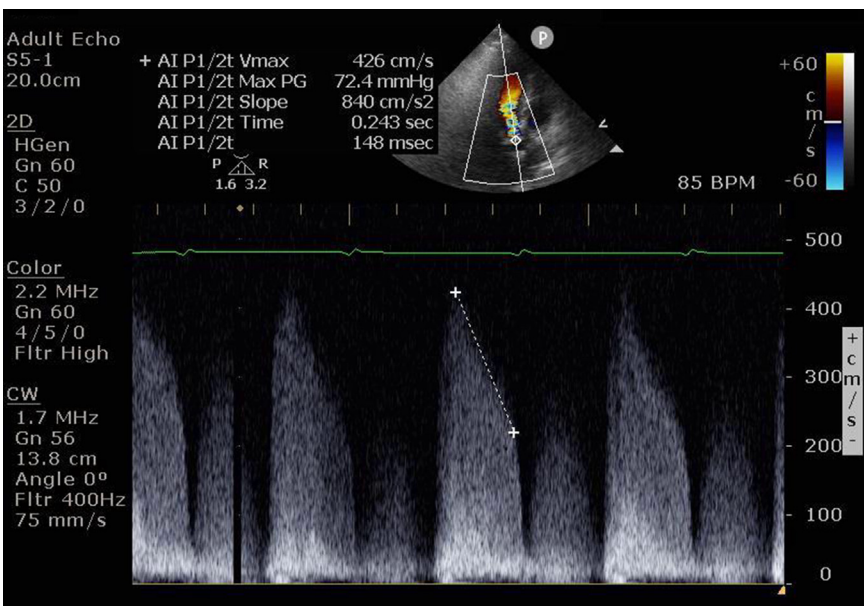
The left ventricular outflow tract (LVOT) velocity time integral (VTI) was 29, spectral Doppler aortic valve early second trimester. VTI was 105, dimensionless index was 0.28, and mean aortic valve replacement gradient was 46.4 mm Hg, indicating moderate stenosis. PG = pressure gradient; PW = pulsed wave Doppler; SV = stroke volume; Vmax = peak velocity; Vmean = mean velocity.

FIGURE 2 **Spectral Doppler Bioprosthetic Aortic Valve Replacement Aortic VTI, Early Second Trimester**



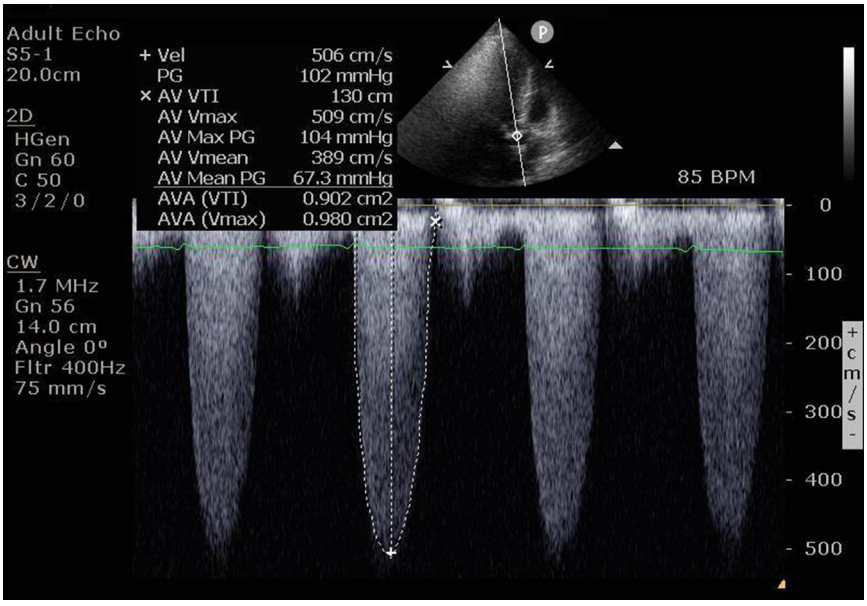
The LVOT VTI was 29, spectral Doppler Aortic valve early second trimester. VTI was 105, dimensionless index was 0.28, and mean aortic valve (AV) replacement gradient was 46.4 mm Hg, indicating moderate stenosis. AVA = aortic valve area; CW = continuous wave Doppler; other abbreviations as in Figure 1.

FIGURE 3 **Spectral Doppler Bioprosthetic AV Replacement Aortic Regurgitation, Late Second Trimester**



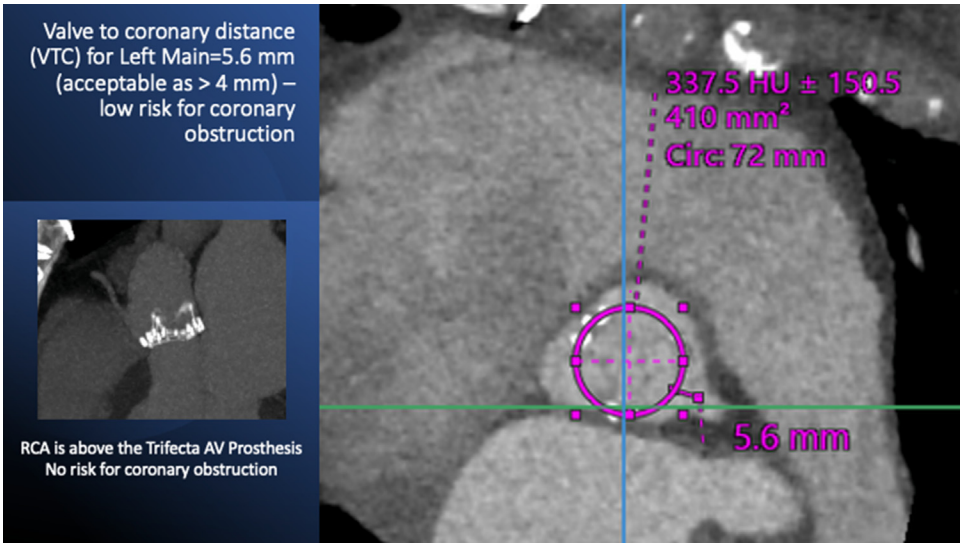
Pressure half time was 148 ms, mean AV replacement gradient was 67 mm Hg, and there was severe stenosis and regurgitation. Abbreviations as in Figures 1 and 2.

FIGURE 4 Spectral Doppler Bioprosthetic AV Replacement Aortic Stenosis, Late Second Trimester



Pressure half time was 148 ms, mean AV replacement gradient was 67 mm Hg, and there was severe stenosis and regurgitation. Vel = velocity; other abbreviations as in Figures 1 and 2.

FIGURE 5 Dose Reduced TAVR CT to Evaluate Size and Coronary Height for Valve in Valve TAVR



Dose-reduced computed tomography transcatheter aortic valve replacement for valve size and coronary distance for valve-in-valve planning within degenerated bioprosthetic aortic valve replacement. Coronary height was acceptable with no risk for coronary obstruction, valve circumference of 72 mm acceptable for a 26 mm Medtronic CoreValve Evolut. RCA = right coronary artery.

delivery was indicated for fetal distress. She had prophylactic emergency vascular access placed prior to anesthesia induction in case she decompensated. Invasive hemodynamics initially were left ventricular systolic pressure 220 mm Hg, end-diastolic pressure 58 mm Hg, and aortic pressure 148/90 mm Hg. After deployment of a 26-mm Medtronic CoreValve Evolut bioprosthesis TAVR, hemodynamics showed left ventricular systolic pressure 100 mm Hg, end-diastolic pressure 20 mm Hg, aortic pressure 90/60 mm Hg, and mean gradient across the aortic valve 8 mm Hg (Videos 5 to 10). No complications occurred. She was extubated same day, further diuresed, and discharged home after 9 days. She was seen back in the cardio-obstetrics program clinic and closely followed post valve-in-valve TAVR. Her mWHO score dropped at time of delivery to II or III. She underwent a term induction of labor at 37 weeks and 4 days' gestation and had a successful vaginal delivery of a healthy female infant. Her postpartum course was uncomplicated.

QUESTION 1: DESCRIBE A MULTIDISCIPLINARY CARDIO-OBSTETRICS PROGRAM?

A cardio-obstetrics program involves multidisciplinary management of pregnant patients. Patients are evaluated in the preconception period to assess risk for pregnancy, decrease cardiometabolic risk factors, as well as evaluating and substituting teratogenic medications. Patients are then managed through pregnancy with follow-up based on cardiac risk scoring schema. Cardio-obstetrics program meetings are held with the multidisciplinary team in order to develop delivery plans prior to 28 weeks' gestation. The team is made up of cardiologists with expertise in cardio-obstetrics, perinatologists, electrophysiologists, obstetrician-gynecologists, pharmacists, social workers, obstetric anesthesiologists, cardiac anesthesiologists, cardiothoracic surgeons, neonatologists, hospitalists, and nurse coordinators. Team-based management of pregnant patients is critical to prevent maternal morbidity and mortality.[1,2] cardio-obstetrics program clinics are associated with decreased adverse cardiac complications in pregnancy.[1]

QUESTION 2: HOW DOES mWHO RISK STRATIFICATION HELP MANAGE PATIENTS IN CARDIO-OBSTETRICS PROGRAM?

Several risk stratification models exist, including the CARPREG II (Canadian Cardiac Disease in Pregnancy) expanded risk score and the mWHO classification. Data demonstrate that risk stratification can predict not only pregnancy-associated adverse outcomes, but also long-term cardiac outcomes in the highest risk categories. The risk stratification schema also predicts fetal outcomes. Utilizing mWHO criteria predicts which patients can be managed and delivered at local hospitals vs those who require close monitoring and intervention during pregnancy at expert centers. For pregnant patients at the highest risk, cardio-obstetrics program will monitor serially, recommend changes to delivery location and mode of delivery, and provide other considerations for the delivering obstetric team.[3-5]

QUESTION 3: HOW DOES VALVULAR HEART DISEASE IMPACT RISK DURING PREGNANCY?

Valvular heart disease in pregnancy is linked to adverse outcomes. In pregnant patients with both mechanical heart valves and bioprosthetic heart valves, there is an increase in major adverse cardiac events, hypertensive disorders of pregnancy, and ante/postpartum hemorrhage, as well as an increase in duration of hospitalization and cost. Fetal outcomes, including stillbirth, are also increased. There is no significant difference in maternal outcomes between mechanical and bioprosthetic heart valves.[6] Invasive interventions may be needed in severe hemodynamic deterioration of valvular disease. Catheter-based interventions are an alternative to surgery during pregnancy. Patients who need catheter-based intervention should be evaluated and managed in a multidisciplinary fashion. Procedures should be carried out at experienced centers. To date, valve-in-valve TAVR for bioprosthetic degeneration in pregnancy has been completed in a few cases and limited outcome information is available, but there appears to be short-term safety and efficacy of this intervention.[7]

QUESTION 4: DOES BNP AID IN THE MANAGEMENT OF PREGNANT PATIENTS?

Hemodynamic changes in pregnancy may lead to maladaptation in pregnant patients with cardiac disease or with an underlying susceptibility to cardiac decompensation. N-terminal pro-B-type natriuretic peptide (NT-proBNP) and BNP are released in cardiomyocyte stretch, myocardial dysfunction, and increased circulating volume. NT-proBNP and BNP are the gold standard in biomarker evaluation for heart failure. In healthy pregnancy with no cardiac dysfunction, NT-proBNP and BNP are stable through all trimesters and postpartum. Both retain their negative predictive value to exclude heart failure in pregnancy. NT-proBNP and BNP can be followed

through pregnancy in patients with cardiac lesions at increased risk for heart failure, pre-existing cardiomyopathy, and maternal congenital heart disease. As they should remain stable through trimesters, a significant increase may signal worsening heart failure.

NT-proBNP and BNP increase in patients with preeclampsia. Higher concentrations are seen in early onset and severe preeclampsia. In evaluation of peripartum cardiomyopathy, NT-proBNP and BNP help with diagnosis, and higher levels are associated with worse prognosis. During pregnancy, measurements of NT-proBNP and BNP with signs and symptoms of heart failure may help guide management.[8]

QUESTION 5: WHAT ARE FACTORS TO CONSIDER WHEN IMAGING THE PREGNANT PATIENT?

TTE is the mainstay for evaluating cardiac conditions in the pregnant patient. The American College of Obstetrics and Gynecology recommends that TTE be performed in all pregnant women with any cardiac diagnosis. Serial evaluation is recommended for valvular and congenital disorders. TTE is considered safe for both the pregnant patient and fetus. TEE in the pregnant patient may have increased risk of emesis and aspiration due to decreased gastric motility, increased relaxation of the lower esophageal sphincter, and increased intra-abdominal pressure. After 18 weeks, pregnant patients are considered "full stomach." Risk and benefits of a TEE must be weighed. Endotracheal intubation is often recommended for TEE after 18 weeks due to the increased risk for aspiration. Fetal considerations for the administration of anesthesia for TEE include fetal hypoxia, possible fetal sedation or distress, and miscarriage/preterm birth; however, routine anesthetics are not teratogenic. Anesthesia/TEE should be pursued if the study alters outcome. Maternal and fetal monitoring should be considered in all procedures after fetal viability or gestational age >22 to 24 weeks, with plans in place for delivery if fetal distress is encountered. CT scanning leads to fetal exposure of ionizing radiation. Doses typically used in clinical practice are well below the threshold for fetal anomalies, intellectual disability, or childhood leukemia.[9] Fetal exposure to radiation should be minimized and appropriate shielding should be used. Shared decision for both CT scanning and TEE should be undertaken. In the setting of management of valve in valve, there is limited utility for 2-dimensional/3-dimensional TEE for valve sizing compared with CT. Undersizing TAVR in pregnancy may lead to worse outcomes; thus, CT scanning may be needed.[10,11]

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APPENDIX For supplemental videos, please see the online version of this paper.