

## VALVULAR HEART DISEASE

### CASE REPORT: CLINICAL CASE

# Management of Woman With Rheumatic Mitral Stenosis During Pregnancy

## Importance of Multimodality Evaluation



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### ABSTRACT

A 29-year-old woman with a history of severe rheumatic mitral stenosis status post mitral valvuloplasty presented with worsening dyspnea on exertion during her second pregnancy. She underwent multimodality evaluation throughout her pregnancy, which helped to guide medical therapy and prevent unnecessary mechanical intervention and premature delivery. (JACC Case Rep. 2024;29:102628) © 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/>).

### HISTORY OF PRESENTATION

A 29-year-old gravida 2, para 1 woman with history of severe rheumatic mitral stenosis (MS) and successful mitral balloon valvuloplasty 2 years prior was hospitalized at 10 weeks of gestation for worsening dyspnea on exertion, decreased exercise tolerance limited to walking 5 minutes on a flat surface, and

2-pillow orthopnea. She stopped taking her beta-blocker 1 month after learning of her pregnancy. On physical examination, her heart rate was 93 beats/min, blood pressure was 110/68 mm Hg, respiratory rate was 18 breaths/min, and oxygen saturation was 100% on room air. Positive findings included mild tachypnea while resting flat, a diastolic murmur at the apex, and mild bilateral pedal edema.

### LEARNING OBJECTIVES

- To understand the increased risk for heart failure in pregnant women with moderate or severe mitral stenosis.
- To describe the role of multimodal evaluation in clarifying the severity of valvular lesions in pregnant patients and guiding management during pregnancy, labor, and the early postpartum period.

### PAST MEDICAL HISTORY

Medical history by the patient was notable for acute rheumatic fever diagnosed in her country of origin at age 11 years. She received prophylactic antibiotics for only 3 years and developed exertional dyspnea at age 19 years with exacerbation of symptoms during her first pregnancy at age 24. She had an uncomplicated cesarean delivery with general anesthesia; records were not available for review. After delivery, she had

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**ABBREVIATIONS  
AND ACRONYMS****MS** = mitral stenosis**MVA** = mitral valve area**PA** = pulmonary artery**PCWP** = pulmonary capillary  
wedge pressure**RHC** = right heart  
catheterization**TTE** = transthoracic  
echocardiography

transient improvement in her dyspnea but redeveloped symptoms and functional decline over the next 3 years. She subsequently relocated to the United States at age 27, at which time evaluation showed severe rheumatic MS and only mild mitral regurgitation (**Figure 1, Video 1**). The transmitral gradient by simultaneous left atrial and left ventricular pressure measures was 19 mm Hg (**Figure 2**). Mitral balloon valvuloplasty was performed with a decreased gradient to 10 mm Hg and significant symptomatic

improvement (**Figure 2, Videos 2 and 3**). Two years after her valvuloplasty, during the 10th week of her second pregnancy, the patient returned to our hospital for recurrent dyspnea.

**DIFFERENTIAL DIAGNOSIS**

The differential diagnosis included hemodynamic changes of pregnancy, severe MS, and pulmonary hypertension.

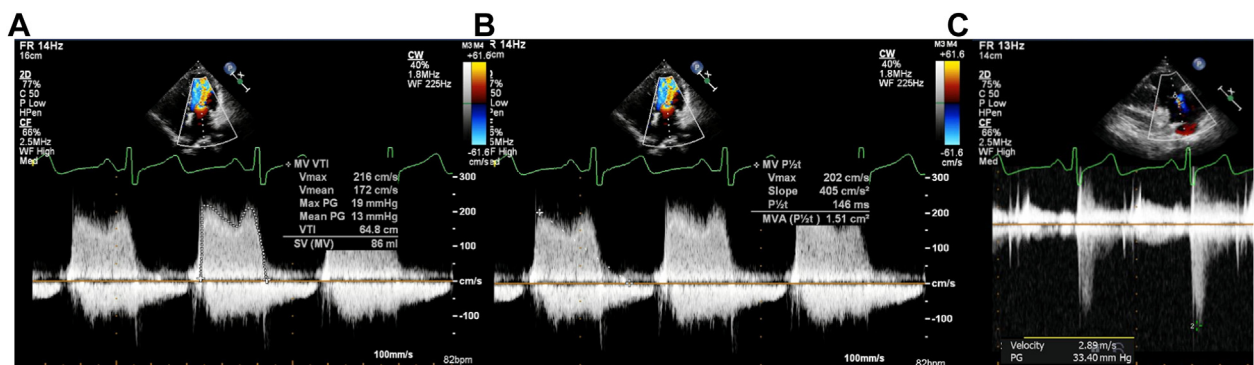
**INVESTIGATIONS**

N-terminal pro-B-type natriuretic peptide level was 123 pg/mL. Electrocardiography showed normal sinus rhythm at 83 beats/min. Chest x-ray revealed no cardiopulmonary pathology. Transthoracic echocardiogram (TTE) showed normal left ventricular systolic function with an ejection fraction of 60% to 65%, normal right ventricular systolic function, moderate MS with a mitral valve area (MVA) of 1.9 cm<sup>2</sup>, mean transmitral gradient of 9 mm Hg at a heart rate of 95 beats/min, and mild mitral regurgitation (**Figure 3**).

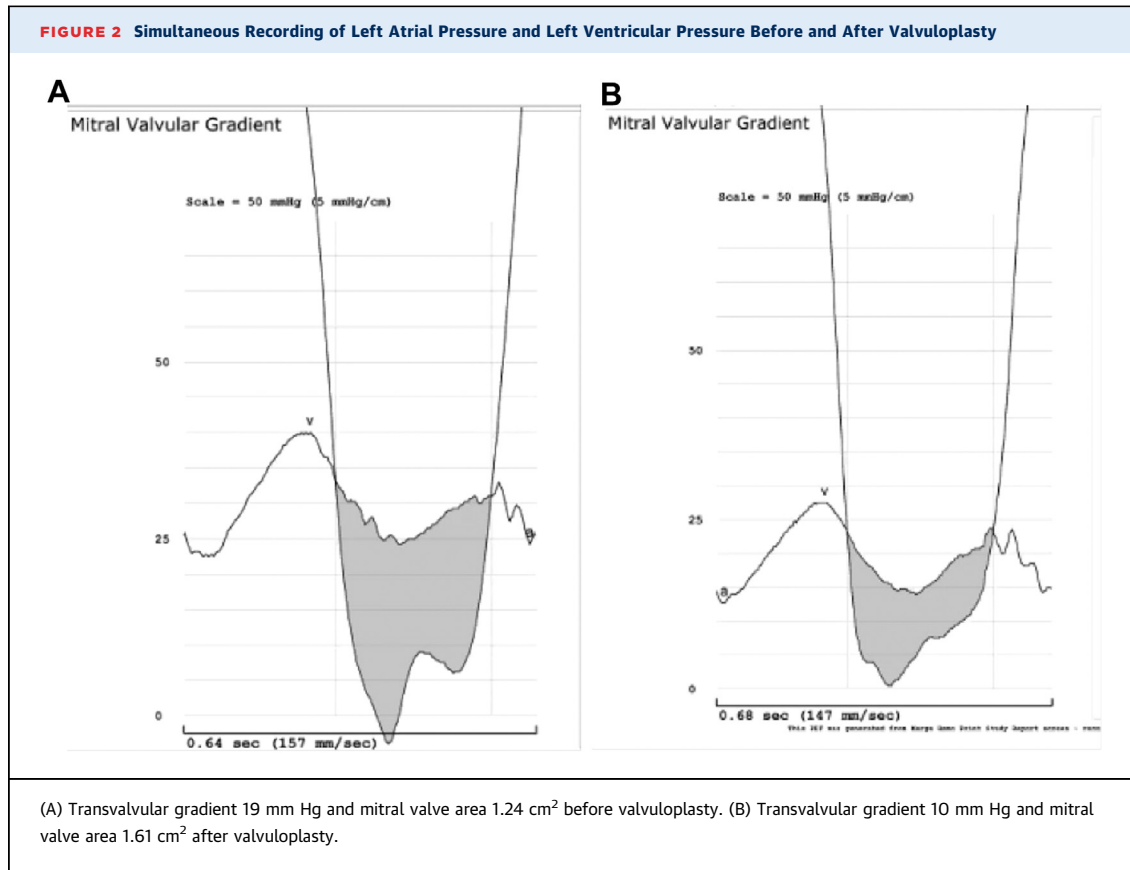
Metoprolol tartrate was reinitiated at a dose of 25 mg every 12 hours with improvement in symptoms; however, she returned to the clinic endorsing worsening dyspnea at mild exertion and decreased exercise tolerance at 18 weeks. A repeat N-terminal pro-B-type natriuretic peptide level increased to 212 pg/mL. Because of the discrepancy between the echocardiographic findings suggestive of only moderate MS and severity of symptoms, a right heart catheterization (RHC) was pursued at 18 weeks and showed only mild elevations of the mean right atrial pressure to 7 mm Hg, mean pulmonary artery (PA) pressure to 27 mm Hg, and pulmonary capillary wedge pressure (PCWP) of 22 mm Hg with normal cardiac output (**Figure 4, Table 1**). Based on these findings, a repeat mitral balloon valvuloplasty was not pursued, and the patient showed a good response to treatment with increasing doses of metoprolol and diuretics.

**MANAGEMENT**

As her pregnancy progressed, the patient reported worsening dyspnea and orthopnea, prompting a repeat TTE at 33 weeks, which showed an increase in transmitral valve gradient to 19 mm Hg and MVA to 1.5 cm<sup>2</sup> (**Figure 5**). Given the symptomatic worsening and increased mitral gradient on high-dose medical therapy and to determine the need for early delivery, a RHC was repeated. The study showed no significant change in PA systolic pressure (42 mm Hg) and PCWP (20 mm Hg) compared with the previous study (**Figure 6, Table 1**). A multidisciplinary meeting to discuss delivery planning was held. Participants included maternal-fetal medicine, cardiology, and anesthesiology. Based on the hemodynamic findings,

**FIGURE 1** Severe Mitral Stenosis on Transthoracic Echocardiogram Obtained 2 Years Before Patient's Second Pregnancy

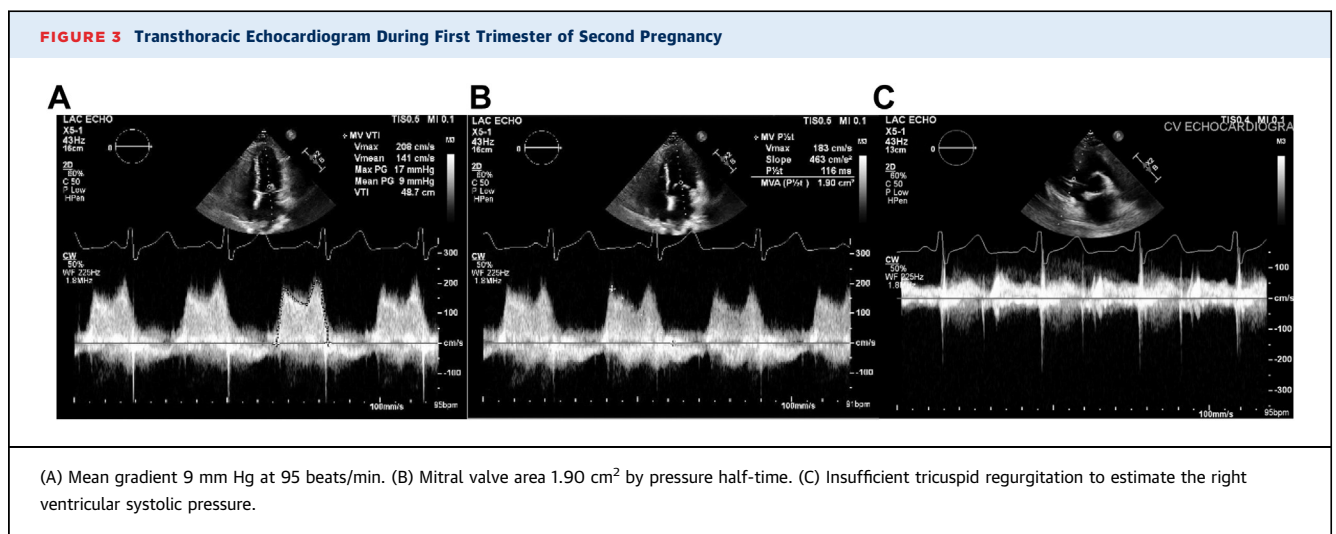
(A) Mean pressure gradient 13 mm Hg at 82 beats/min. (B) Valve area 1.51 cm<sup>2</sup> by pressure half-time. (C) Estimated right ventricular systolic pressure 36 mm Hg assuming a right atrial pressure of 3 mm Hg.

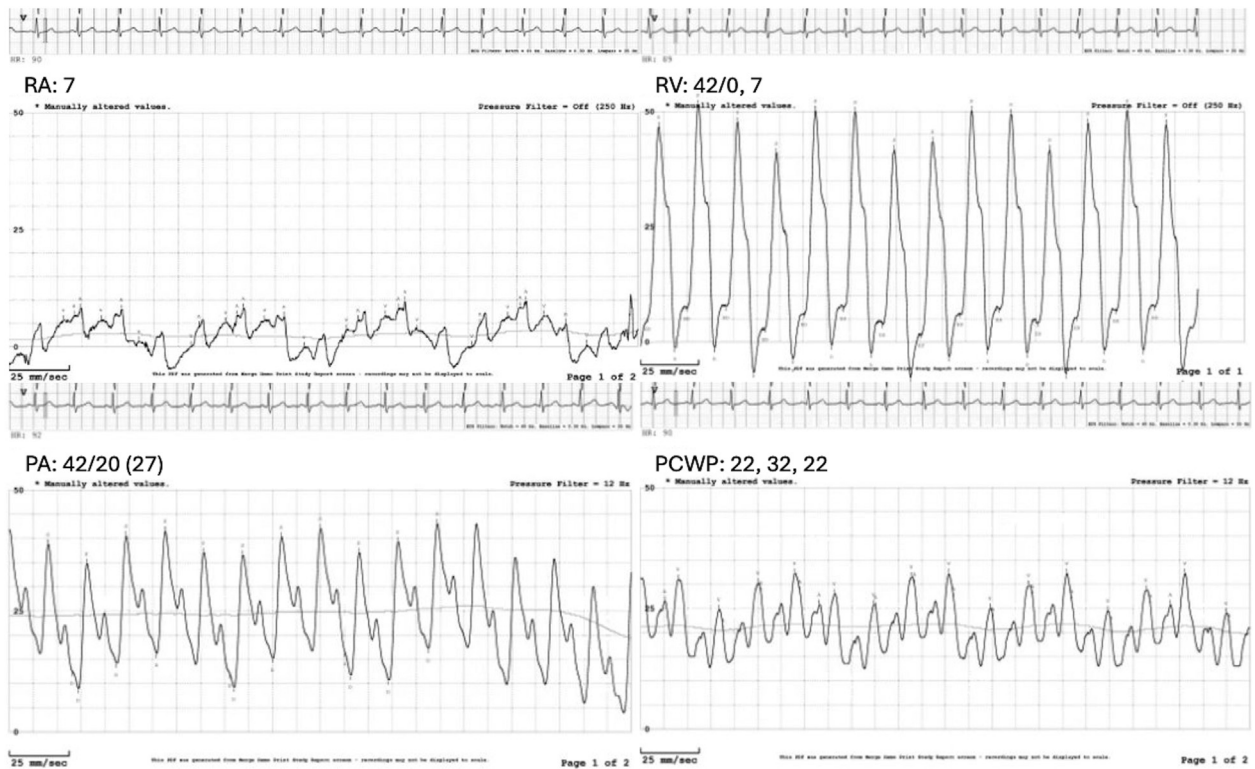


the consensus was to continue the pregnancy and have an elective cesarean delivery at 37 weeks with epidural analgesia and invasive cardiac monitoring for optimization before the delivery.

The patient was admitted to the cardiac intensive care unit as planned at 37 weeks of gestation 24 hours

before delivery for hemodynamic evaluation and monitoring. A RHC before delivery demonstrated increased right- and left-sided filling pressures compared with previous values, likely reflective of progressive plasma volume expansion during the third trimester, with PA systolic pressure at



**FIGURE 4** Right Heart Catheterization Tracings During First Trimester of Second Pregnancy

Mild elevation can be seen in the right- and left-sided filling pressures. PA = pulmonary artery; PCWP = pulmonary capillary wedge pressure; RA = right atrium; RV = right ventricle.

62 mm Hg, mean PA pressure at 44 mm Hg, and PCWP at 32 mm Hg (Figure 7, Table 1). The PA catheter was maintained to guide therapy. The patient received repeated doses of intravenous metoprolol and diuretics before, during, and after the delivery with significant hemodynamic improvement. She underwent an uncomplicated cesarean section delivery 1 day later, giving birth to a viable infant.

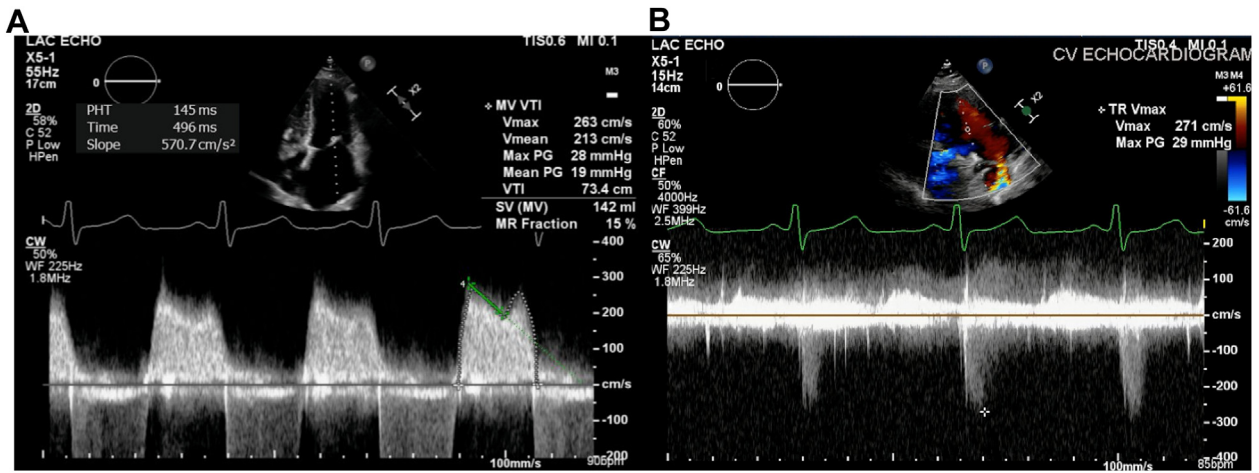
Hemodynamics postdelivery showed normalization of right- and left-sided filling pressures and she was discharged 3 days after the operation (Table 1). In a follow-up appointment 2 weeks after discharge, the patient reported considerable improvement in symptoms and was able to achieve 8.5 metabolic equivalents on a treadmill stress test 6 months later. A follow-up TTE 1 year after her pregnancy

**TABLE 1** Right Heart Catheterization Hemodynamic Data Throughout Pregnancy

Time of Test	Heart Rate (beats/min)	Mean Right Atrial Pressure (mm Hg)	RV Pressure (mm Hg)	Pulmonary Artery Pressure (mm Hg)	Pulmonary Capillary Wedge Pressure (mm Hg)	CO/CI, Thermodilution (L/min, L/min/m <sup>2</sup> )	SVR (dynes/s/cm <sup>5</sup> )	PVR (dynes/s/cm <sup>5</sup> )
18 wk	91	7	42/0, 7	42/20 (27)	22, 32, 22	8.2/4.	1,290	49
33 wk	92	7	40/0, 7	42/25 (31)	22, 30, 20	6.3/3.1	889	140
37 wk	104	8	62/0, 15	62/35 (44)	40, 38, 32	6.4/3.2	1,013	150
Postdelivery	82	6	-	32/18 (23)	Mean 8	5.1/2.5	1,113	235

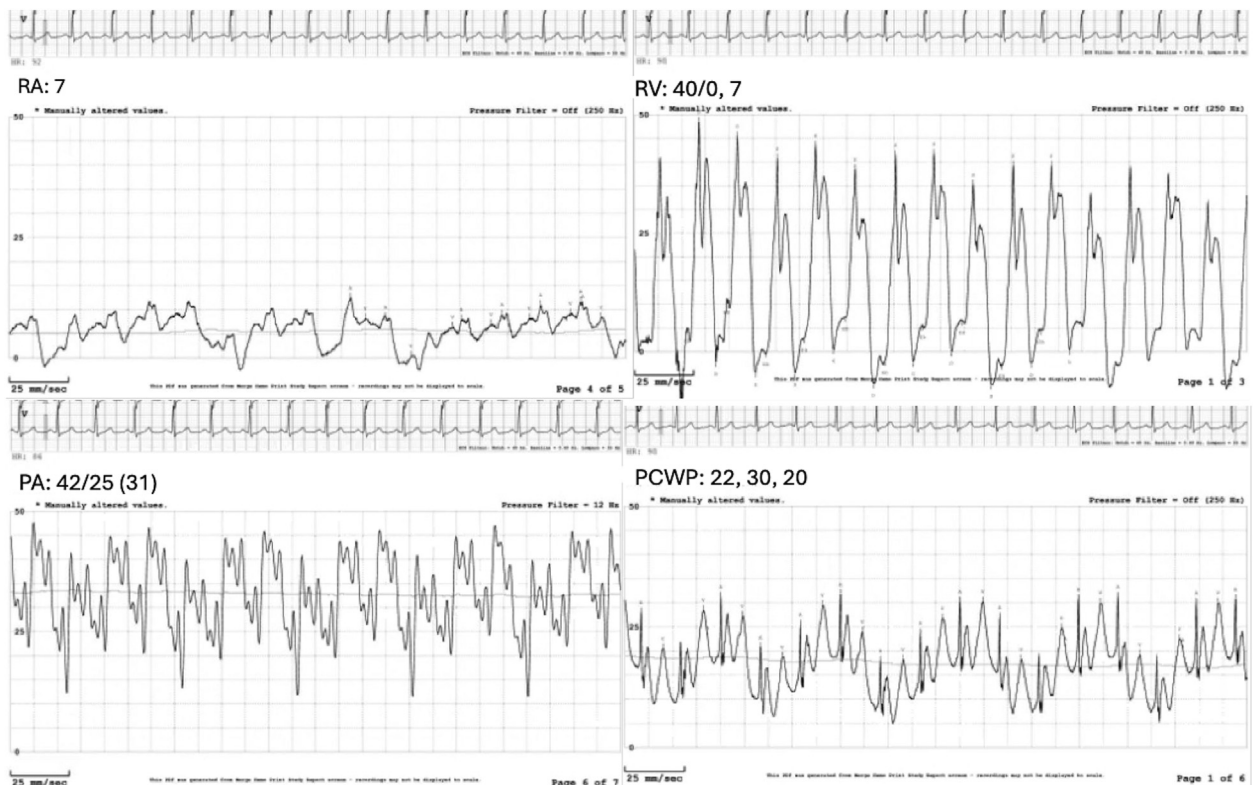
CI = cardiac index; CO = cardiac output; PVR = pulmonary vascular resistance; RV = right ventricular; SVR = systemic vascular resistance.

**FIGURE 5** Transthoracic Echocardiogram During Third Trimester of Second Pregnancy

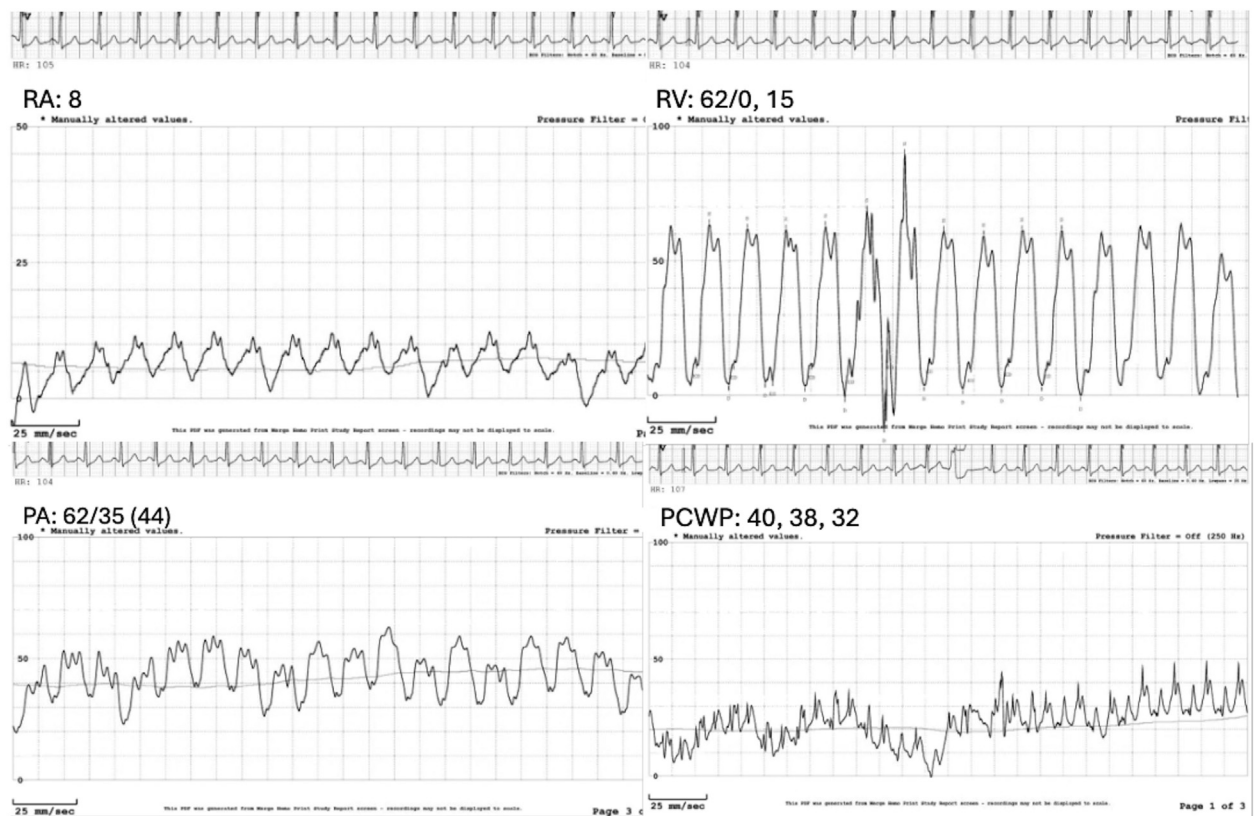


(A) Mean gradient 19 mm Hg at 90 beats/min and mitral valve area 1.5 cm<sup>2</sup> by pressure-half time. (B) Estimated right ventricular systolic pressure 32 mm Hg assuming a right atrial pressure of 3 mm Hg.

**FIGURE 6** Right Heart Catheterization Tracings During Third Trimester of Second Pregnancy



No significant change in filling pressures was found compared with the first trimester. Abbreviations as in Figure 4.

**FIGURE 7** Right Heart Catheterization Tracings Immediately Before Delivery

A mild increase in right- and left-sided filling pressures were found compared with 33 weeks. Abbreviations as in [Figure 4](#).

demonstrated moderate MS with a mean gradient of 11 mm Hg at 76 beats/min and an MVA of 1.8 cm<sup>2</sup> by pressure half-time.

## DISCUSSION

The management of pregnancy in patients with MS presents a clinical challenge. The typical hemodynamic changes of pregnancy including increased intravascular volume and a decrease in left ventricular diastolic filling time because of an increased heart rate can result in an increase in transvalvular pressure gradient and left atrial pressure. These hemodynamic changes often result in increased dyspnea, heart failure, and arrhythmias.<sup>1</sup>

Studies have found that degree of stenosis by echocardiogram, NYHA classification, and early hemodynamic changes predict the likelihood of maternal cardiac complications, including the

development of heart failure and arrhythmias during pregnancy and in the early postpartum period.<sup>2,3</sup> Important management decisions during pregnancy, including the administration of drugs with potential effects on the fetus, performance of mechanical interventions, and the decision on timing and mode of delivery, require close monitoring and a multidisciplinary decision.

Symptom assessment can be challenging in pregnant patients with MS. Discerning whether complaints are due to underlying pathology and hemodynamic deterioration or expected normal pregnancy-related changes and symptoms requires a multipronged approach. Echocardiography has been the gold standard tool for the assessment of valvular heart disease; however, changing hemodynamics during pregnancy can lead to an overestimation of PA pressure and affect MVA measurements by the pressure half-time method, as seen in this case.<sup>4</sup> When a

noninvasive estimation of the mitral valve gradient and MVA is inconsistent with one another or with the degree of symptoms, invasive hemodynamic assessment should be performed to determine the appropriate management course.<sup>5-7</sup> The multimodal evaluation was particularly useful in our patient's case because of the significant discordance between the severity of her symptoms, MVA suggesting only moderate stenosis, and degree of the transvalvular pressure compatible with severe stenosis. Obtaining invasive hemodynamic information helped clarify her MS was not severe, which informed multidisciplinary discussions regarding the lack of indication for valvular intervention or premature delivery and allowed stabilization with medical therapy before, during, and after delivery. Beta-blockade to augment diastolic filling time and diuretics to relieve volume overload are indicated for symptom management in MS. Mitral commissurotomy is reserved for women with NYHA functional class II to IV symptoms, severe MS, and/or estimated PA systolic pressure over 50 mm Hg unresponsive to medical therapy.<sup>8</sup> Preconception counseling to discuss maternal risk,

medical therapy, need for intervention, and surveillance plan during pregnancy is essential for reducing adverse cardiac outcomes.

## CONCLUSIONS

This case highlights the challenges in assessing rheumatic MS severity in pregnancy. The multimodal use of noninvasive and invasive techniques can help quantify severity and guide management during pregnancy, labor and delivery, and the early postpartum period.

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## REFERENCES

1. Elkayam U, Bitar F. Valvular heart disease and pregnancy: part I: native valves. *J Am Coll Cardiol*. 2005;46:223-230.
2. Hagen IMv, Thorne SA, Taha N, et al. Pregnancy outcomes in women with rheumatic mitral valve disease. *Circulation*. 2018;137:806-816.
3. Hameed A, Karaalp IS, Tummala PP, et al. The effect of valvular heart disease on maternal and fetal outcome of pregnancy. *J Am Coll Cardiol*. 2001;37:893-899.
4. Nanna M, Stergiopoulos K. Pregnancy complicated by valvular heart disease: an update. *J Am Heart Assoc*. 2014;3:e000712.
5. Penning S, Robinson KD, Major CA, Garite TJ. A comparison of echocardiography and pulmonary artery catheterization for evaluation of pulmonary artery pressures in pregnant patients with suspected pulmonary hypertension. *Am J Obstet Gynecol*. 2001;184:1568-1570.
6. Rokey R, Hsu HW, Moise KJ Jr, Adam K, Wasserstrum N. Inaccurate noninvasive mitral valve area calculation during pregnancy. *Obstet Gynecol*. 1994;84:950-955.
7. Elkayam U, Bansal P, Mehra A. Catheter-based interventions for the management of valvular heart disease during pregnancy. *JACC Adv*. 2022;1:100022.
8. Hagen IMv, Thorne SA, Taha N, et al. ESC guidelines on the management of cardiovascular diseases during pregnancy: the Task Force on the Management of Cardiovascular Diseases during Pregnancy of the European Society of Cardiology (ESC). *Eur Heart J*. 2011;32:3147-3197.

**KEY WORDS** mitral stenosis, peripartum, pregnancy, rheumatic heart disease, valvular heart disease

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