

## IMAGING VIGNETTE

INTERMEDIATE

## CLINICAL VIGNETTE

# 4D Flow Cardiovascular Magnetic Resonance Versus 3D Transesophageal Echocardiography in a Mitral Paravalvular Leak



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## ABSTRACT

Three-dimensional transesophageal echocardiography and 4-dimensional flow magnetic resonance imaging as complementary techniques in the preoperative planning of a mitral paravalvular leak allow the evaluation of its location, shape, and size and qualitative-quantitative analysis of mitral regurgitant orifice. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2019;1:438-9) © 2019 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/>).

**A** 42-year-old man with a bicuspid aortic valve underwent aortic valve replacement with a bioprosthesis for infective endocarditis. Surgical reintervention was required after significant paravalvular leak and new severe mitral insufficiency. Aortic and mitral valve replacement was combined with reconstruction of the mitroaortic fibrosa using David's technique.

Two months after surgery, coinciding with the clinical signs of right heart failure and hemolysis data in blood tests, transthoracic echocardiography showed an increase in the mean transprosthetic gradient resulting from severe mitral periprosthetic leak at the level of mitral-aortic junction. Owing to the results from transthoracic echocardiography, a study was completed with 3-dimensional (3D) transesophageal echocardiography (TEE) and 4-dimensional (4D) flow magnetic resonance imaging (MRI) (**Figure 1, Videos 1, 2, and 3**). Consequently, the patient was accepted for a second surgical reintervention consisting of mitral paravalvular leak closure by implanting a heterologous pericardium patch. Thus, the images of 3D-TEE and 4D flow-MRI allowed for preoperative planning with this complex pathology.

Four-dimensional flow through cardiovascular magnetic resonance consists of the codification of flow by phase contrast sequences in the 3D space and a fourth dimension represented by timing throughout the cardiac cycle. Such a technique allows the performance of a retrospective analysis of flows in any location after the acquisition of a single cardiac volume (1,2).

In this case, 3D-TEE and 4D flow-MRI were complementary techniques for a correct anatomic localization of paravalvular leak and its shape and size, as well as the performance of the relevant qualitative and quantitative analysis of the mitral regurgitant orifice. Although TEE is still the current standard of care for evaluation of mitral valve pathology, we consider that MRI is a suitable noninvasive alternative, especially when TEE is either relatively contraindicated or not tolerated, or carries some risk. Four-dimensional flow MRI was useful

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for the visual assessment of regurgitant jet severity together with a quantitative analysis by an anatomic measure of the jet at the vena contracta (**Figure 1E**) (3). In the authors' opinion, MRI was much easier and faster, allowing for functional analysis of mitral paravalvular leak, in combination with an anatomical study (location, size, shape, and trajectory) without being affected by metallic artifacts (3). In conclusion, 4D flow MRI can be useful for paravalvular leak analysis in clinical practice, especially in those cases in which TEE is not possible or inconclusive.

**ABBREVIATIONS  
AND ACRONYMS**

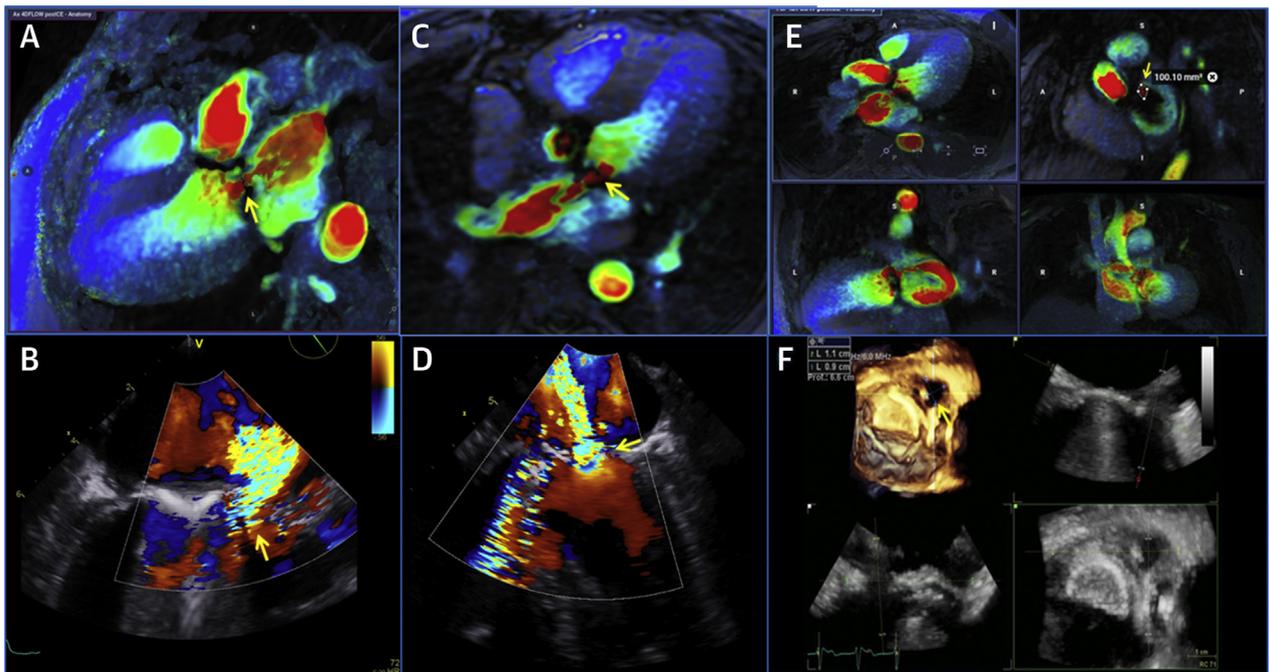
**3D** = 3-dimensional

**4D** = 4-dimensional

**MRI** = magnetic resonance  
imaging

**TEE** = transesophageal  
echocardiography

**FIGURE 1** 4D Flow-MRI and 3D-TEE



(A) Four-dimensional (4D) flow magnetic resonance imaging (MRI) versus (B) 3-dimensional (3D) transesophageal echocardiography (TEE): 3-chamber view showing mitral paravalvular leak at the level of mitroaortic junction (**yellow arrows**). (C) 4D flow-MRI versus (D) 3D-TEE: 4-chamber view showing mitral paravalvular leak (**yellow arrows**). Multiplanar reconstructions of the mitral regurgitant orifice (**yellow arrows**) using (E) 4D flow-MRI and (F) 3D-TEE showing a gap at the level of mitroaortic junction, spheroid morphology, size 1 cm<sup>2</sup>. See *Videos 1, 2, and 3*.

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**KEY WORDS** 3-dimensional imaging, cardiac magnetic resonance, MR sequences

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