Commentary: A glimpse into the future for transcatheter mitral valve replacement in mitral annular calcification

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Surgical treatment of mitral regurgitation (MR) or stenosis in the presence of severe mitral annular calcification (MAC) is difficult, with increased risk of paravalvular leak, injury to the left circumflex artery, and atrioventricular dissociation. Treatment of severe MAC with transcatheter mitral valve replacement (TMVR) has proved similarly difficult. The TMVR in the MAC Global Registry reported the use of a commercially available balloon-expandable valve in high-risk patients with a calcified mitral annulus and reported technical success in 76.7% of patients but 30-day and 1-year mortalities of 25% and 53.7%, respectively.¹ These procedures were performed using both transapical and transseptal techniques. Major complications occurred, leading to obstruction of the left ventricular outflow tract (LVOT; a near-lethal complication in the Registry), valve embolization, need for a second valve (due to migration or MR), cardiac perforation, or moderate or severe paravalvular regurgitation (PVR).

In this issue of the *Journal*, Serban and colleagues² describe computed tomography (CT)-based computer modeling to simulate the implantation of a TMVR, avoiding LVOT obstruction and PVR. Subsequently, live, real-time fusion of the computer simulation, fluoroscopic, and transesophageal echocardiographic images helped guide transseptal crossing, self-expanding valve alignment, and ideal height of deployment. Both LVOT obstruction and PVR were significantly avoided.

Challenges to CT image fusion are distortion of the cardiac anatomy from stiff wires and devices and motion from cardiac and respiratory cycles. Despite these shortcomings, this case illustrates the feasibility of accurate transseptal TMVR using fusion imaging. In cases in which there is a borderline risk for LVOT obstruction, the simulation would favor a more atrial deployment position. However, in many cases of valve-in-MAC, the risk of LVOT obstruction is prohibitive despite maximal atrial valve

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Central Message

TMVR in MAC is yet to solve challenges with LVOT obstruction and paravalvular regurgitation. CT-based computer modeling and real-time image integration may improve results in this high-risk procedure.

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positioning and the risk of significant PVR. In these cases, alternative strategies should be adopted: (1) the LAMPOON technique,³ which is a transcatheter mimic of chord-sparing anterior leaflet resection; (2) preoperative alcohol septal ablation²; or (3) transatrial surgical anterior leaflet resection and TMVR.⁴ Two of these techniques are being prospectively investigated in clinical trials in the United States (LAMPOON trial NCT03015194; SITRAL trial NCT02830204).

The Tendyne mitral prosthesis (Abbott, Santa Clara, Calif) is a D-shaped, self-expanding prosthesis dedicated for the mitral valve that is placed via transapical access and anchored to an epicardial pad. Results in a feasibility cohort of high-risk patients with MR have been promising.⁵ A feasibility study has begun, recruiting patients with severe MAC and MR to receive the Tendyne valve (NCT03539458).

Imaging guidance should ideally be real-time, 3-dimensional, and clearly define the relevant anatomy and devices. CT overlay can sometimes be a distraction from the dynamic underlying anatomy, which may be better targeted using fluoroscopy or echocardiography. However, as this case elegantly demonstrated, the overall 3-dimensional special view that CT affords, as well as markers from careful preprocedure planning, can aid in device navigation and positioning. The ultimate treatment for patients with severe MR and MAC is a transcatheter

valve, preferably by femoral vein access and transeptal puncture that does not cause LVOT obstruction and has minimal paravalvular leak. That goal for the treatment of this lethal disease is on the horizon and no doubt will include advanced imaging technology and transcatheter techniques.

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