

Immediate Improvement of Left Atrial Appendage Contractility after Transcatheter Aortic Valve Replacement in a Patient with Paradoxical Low-Flow Low-Gradient Aortic Stenosis and Preserved Left Ventricular Function

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ABSTRACT

Paradoxical low-flow, low-gradient severe aortic stenosis with preserved left ventricular (LV) ejection fraction is a recently recognized entity characterized by impaired LV filling, altered myocardial function, and worse prognosis. We have shown, for the first time that transcatheter aortic valve replacement is associated with immediate improvement of left atrial mechanical function, as demonstrated by the disappearance of spontaneous echo contrast and increase in left atrial appendage contractility.

Keywords: Left atrial function, paradoxical low-flow, low-gradient severe aortic stenosis, transcatheter aortic valve replacement

Paradoxical low-flow, low-gradient aortic stenosis (PLFLGAS) with preserved left ventricular ejection fraction (LVEF) is characterized by pronounced LV concentric remodeling, small LV cavity, restrictive physiology leading to impaired LV filling, altered myocardial function, and worse prognosis.¹ Low flow (Stroke Volume index (SV_i) to body surface area ≤ 35 ml/m²) is common in critical aortic stenosis (AS) and independently predicts mortality.² Survival is improved with conventional surgical or transcatheter aortic valve replacement (TAVR).² Baseline and follow-up echocardiographic parameters in patients with critical AS following surgical AVR or TAVR have been described in the literature. However, the exact contribution of PLFLGAS with preserved LVEF on left atrial (LA) function, including left atrial appendage (LAA) function, has not been described. LAA dysfunction has been described in various pathophysiologic states and

is a known source of cardiac thrombus formation and stroke. In this imaging vignette, we present a patient with symptomatic PLFLGAS and preserved LVEF who underwent transapical TAVR.

The patient was an 84-year-old woman with history of hypertension, diabetes mellitus, dyslipidemia, and coronary artery disease with patent left circumflex stent, heart failure with preserved EF, multiple old cerebral infarcts, obesity, and severe arthritis requiring the use of a cane. Her society of thoracic surgeons' risk score was 6%. The patient had no history of atrial fibrillation, significant mitral or aortic regurgitation, or mitral stenosis. Baseline transesophageal echocardiogram (TEE) showed a small LV cavity, LV concentric remodeling and normal LVEF. The peak and mean transaortic gradients were 29 and 18 mmHg, respectively (Figure 1a). The aortic valve area (AVA) was 0.63 cm² by the continuity equation with an AVA index of 0.33. The SV_i was 29 mL/m² (Figure 1b). There was mild LA enlargement and moderately elevated LA pressure. The TEE prior to the deployment of transcatheter aortic valve prosthesis showed dense spontaneous echo contrast (SEC) without evidence of formed thrombus in the LA or LAA (Figure 2a, Video 1). The peak filling and emptying LAA flow velocity were below 20 cm/s (Figure 3a), indicative of LAA mechanical dysfunction immediately following

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DOI: 10.5530/jcdr.2014.2.11

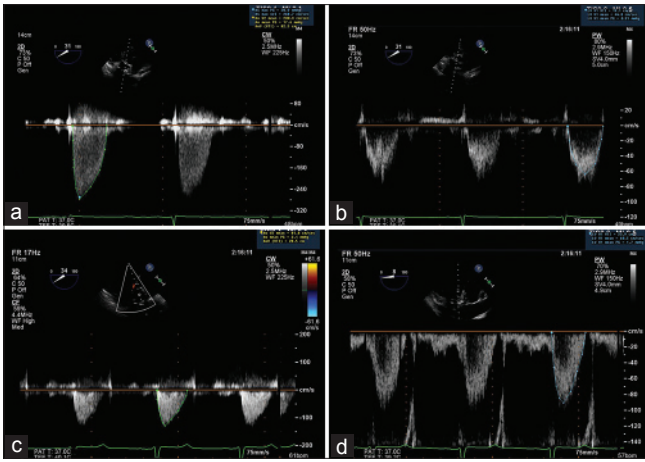


Figure 1. Pre- and post-transcatheter aortic valve replacement (TAVR) transesophageal echocardiogram in a patient with paradoxical low-flow, low-gradient aortic stenosis with preserved left ventricular ejection fraction. (a) Pre-TAVR aortic valve (AV) maximum peak gradient (PG) = 29 mmHg, AV mean PG = 18 mmHg. (b) Pre-TAVR left ventricular outflow tract (LVOT) velocity time integral (VTI), Stroke Volume index (SVi) = 29 mL/m². (c) Post-TAVR AV maximum PG = 3 mmHg. (d) Post-TAVR LVOT VTI, SVi = 36 mL/m².

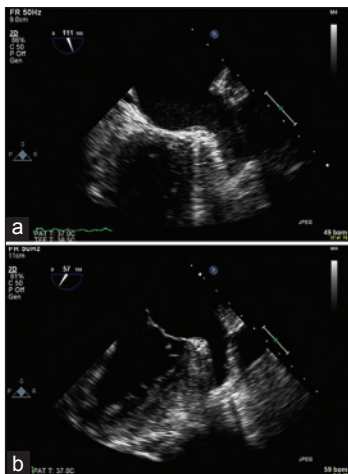


Figure 2. (Video 1 & 2). Pre- and post-transcatheter aortic valve replacement (TAVR) transesophageal echocardiogram (TEE) showing dense spontaneous echogenic contrast (SEC) in the left atrium and left atrial appendage (LAA). (a, Video 1) Pre-TAVR TEE showing LAA with SEC. (b, Video 2) Post-TAVR TEE showing LAA without SEC.

deployment of the prosthetic aortic valve, there was complete resolution of SEC (Figure 2b, Video 2). The LAA filling and emptying velocities increased significantly (Figure 3b), a finding that suggests immediate improvement of LAA contractility. Post-TAVR, the mean transaortic gradient was reduced from 18 to 3 mmHg (Figure 1c) with improvement of SVi to 36 mL/m² (Figure 1d). The patient remained in sinus rhythm throughout the procedure and did not experience a stroke following TAVR.

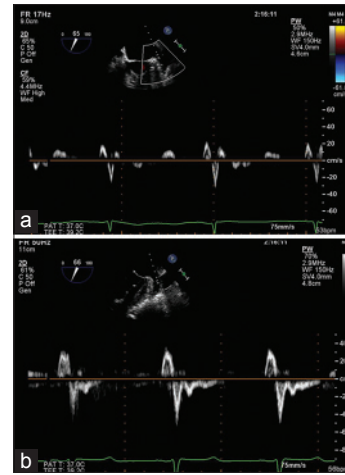


Figure 3. Pre- and post-transcatheter aortic valve replacement (TAVR) transesophageal echocardiogram (TEE) showing left atrial appendage (LAA) flow patterns. (a) Pre-TAVR TEE showing decreased LAA filling and emptying velocities. (b) Post-TAVR TEE showing improvement in LAA filling and emptying velocities.

Critical AS is associated with multiple hemodynamic derangements including reduced systemic arterial compliance that significantly contributes to higher LV afterload and worsening myocardial function, decreased cardiac output as evidenced by lower mean transvalvular flow rates, and lowers transvalvular gradients among patients with low and preserved EF.³ Aortic valve replacement – whether conventional or transcatheter – leads to an immediate decrease in LV afterload, improvement of SVi, and reduction in AV gradients with an increase in effective orifice area. In this case, we have shown that TAVR also is associated with improved LA mechanical function, as demonstrated by the disappearance of SEC and improvement of LAA contractility. We hypothesize that severe LA dysfunction may represent a previously unrecognized aspect of the hemodynamic abnormalities associated with critical AS, and perhaps explain the reason that patients with PLFLGAS experience worse clinical outcome including systemic thromboembolism.

ACKNOWLEDGMENT

The authors would like to thank the TAVR team for their assistance in the pre-screening and successful outcomes of our patients who underwent TAVR.

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Slovut and Taub: Improvement of left atrial appendage contractility after TAVR in LFLGAS

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