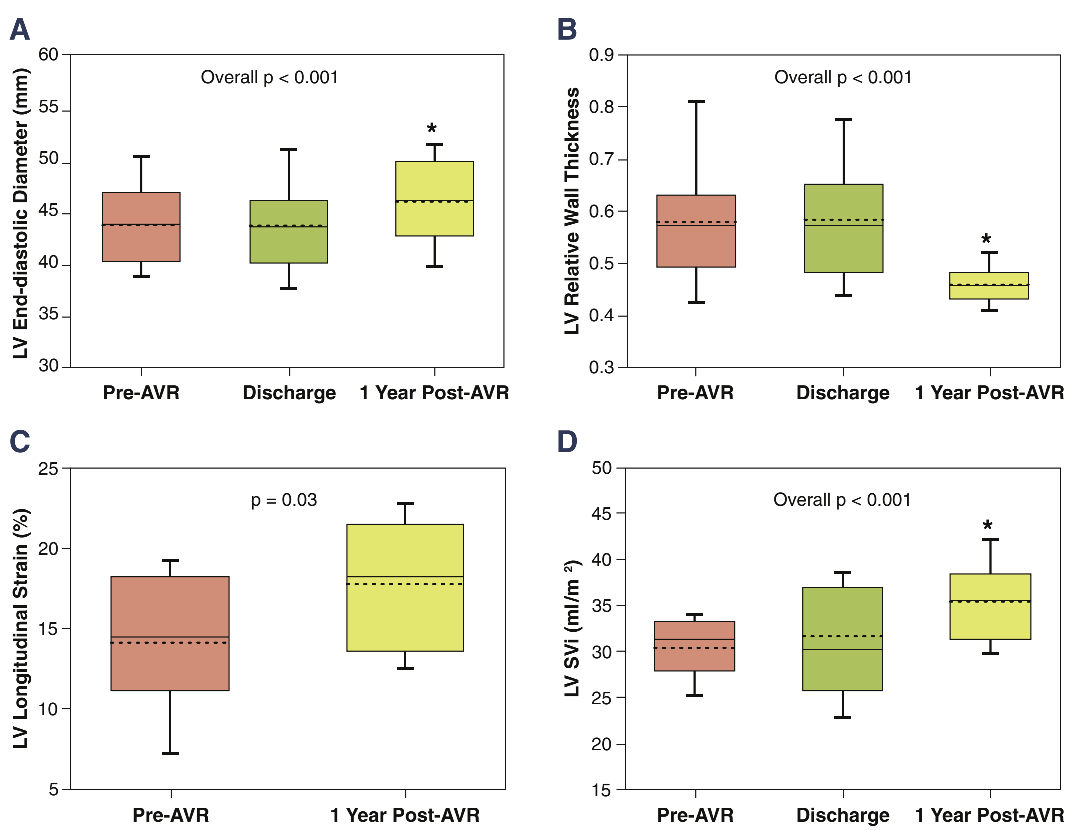
Impact of AVR on LV Remodeling and Function in Paradoxical Low-Flow, Low-Gradient Aortic Stenosis With Preserved LVEF

Paradoxical low-flow, low-gradient aortic stenosis (PLF-LG AS) is a recently described and recognized entity of AS characterized by low-flow status, defined as a stroke volume index (SVi) <35 ml/m^2, a small aortic valve area (AVA: <1.0 cm^2 and indexed AVA: <0.6 cm^2/m^2), a low-gradient (mean gradient: <40 mm Hg), and preserved left ventricular ejection fraction (LVEF) (>50%) (1,2). In these patients, the reduction in SV and thus in transvalvular flow is believed to be predominantly related to pronounced LV concentric remodeling with impaired LV diastolic filling and systolic longitudinal function (2). This study sought to assess the impact of aortic valve replacement (AVR) on LV geometry and function in patients with PLF-LG AS.

We prospectively enrolled and analyzed the preoperative, pre-discharge, and 1-year follow-up echocardiographic data of 32 patients with PLF-LG AS who were recruited at the Quebec Heart and Lung Institute in the context of the TOPAS (Multicenter Prospective Study of Low-Flow Low-Gradient Aortic Stenosis) study and who underwent AVR (23 surgical and 9 transcatheter procedures). The study was approved by the institutional review board committee, and the subjects gave informed consent. Echocardiograms were analyzed in a core laboratory, and LV dimensions, LVEF, SV, AVA, and diastolic function were measured as recommended (3). Global LV longitudinal strain (GLS) was measured at baseline and again at 1 year by speckle tracking and expressed as an absolute value.

Among the 32 patients (71 ± 12 years of age; n = 19 males), 59% were in New York Heart Association

FIGURE 1 Changes in LV Geometry and Function Following Aortic Valve Replacement



Changes in left ventricular end-diastolic diameter **(A)**, relative wall thickness **(B)**, LV GLS **(C)**, and SVi **(D)** following AVR. *p < 0.05 for 1 year post-AVR compared with pre-AVR and discharge. **Solid** and **dotted lines** in the boxplots represent the median and mean values, respectively. AVR = aortic valve replacement; GLS = global longitudinal strain; LV = left ventricular; SVi = stroke volume index.

functional class ≥III, 53% had a history of coronary artery disease, 78% had hypertension, and 28% had diabetes. From baseline to 1 year post AVR, there was a significant increase in left ventricular end-diastolic (LVED) diameter and volume with a decrease in septum and posterior wall thickness, resulting in a decrease in LV mass (207 ± 44 g vs. 175 ± 37 g, respectively; $p = 0.002$) and relative wall thickness ratio (0.58 ± 0.11 vs. 0.46 ± 0.06, respectively; $p = 0.0004$) (**Figure 1**). SVi increased significantly from baseline to 1 year (31 ± 3 ml/m^2 vs. 36 ± 7 ml/m^2, respectively; $p = 0.0002$) (**Figure 1**), whereas LVEF remained unchanged (63 ± 6% vs. 63 ± 7%, respectively; $p = 0.99$). Flow was normalized in 56% of the patients at 1 year (SVi >35 ml/m^2) compared with 37% of patients at discharge ($p < 0.0001$). SVi increased in patients with mild diastolic dysfunction (32 ± 3 ml/m^2 vs. 37 ± 4 ml/m^2, respectively; $p = 0.0003$), and those with moderate dysfunction (30 ± 4 ml/m^2 vs. 37 ± 5 ml/m^2, respectively; $p = 0.03$) but not in patients with severe dysfunction (28 ± 6 vs. 27 ± 5, respectively; p = NS). GLS increased significantly from baseline to 1 year (|14.5| ± 3.9% vs. |17.2| ± 4.0%; $p = 0.03$) (**Figure 1**). There was a significant correlation between baseline-to-post-AVR change in GLS and change in SVi ($r = 0.52$; $p = 0.02$). The pre-operative factors independently associated with SVi at 1 year post-AVR were pre-operative SVi ($p < 0.0001$) and presence of severe diastolic dysfunction ($p = 0.008$).

The present study shows that AVR is associated with positive LV remodeling and improvement in LV longitudinal systolic function, which in turn, translates into increase in SVi. It is noteworthy that SVi did not improve following AVR in patients with pre-existing severe diastolic dysfunction. Severe diastolic dysfunction is likely a marker for a more advanced stage of myocardial fibrosis, which is probably not reversible after AVR.

This study has several limitations. First, a significant proportion of eligible patients were excluded, which might have introduced a selection bias. Second, the small sample size might have limited the ability to detect other significant effects of AVR on clinical and echocardiographic variables. The sample size also did not allow us to compare surgical versus transcatheter AVR with respect to changes in LV geometry and function.

In summary, the results of this study suggest that the adverse LV remodeling and impaired LV longitudinal function typically seen in PLF-LG AS are reversible following AVR, which may lead to regression of symptoms and improved outcomes. These results provide further support to the clinical guidelines Class IIa recommendation for AVR in symptomatic patients with PLF-LG severe AS (1).

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Identifying Patients at Risk for LVOT Obstruction in Mitral Valve-in-Valve Implantation

Left ventricular outflow tract obstruction (LVOTO) is a potentially devastating complication of transcatheter mitral valve interventions (1). During mitral valve-in-valve (MViV) procedures, superimposition of a transcatheter valve into the existing surgical bioprosthetic mitral valve creates an impermeable valve-stent cylinder that can project into the existing LVOT. This post-MViV ventricular outflow has been described as the "neo-LVOT" (2), and close proximity of existing subvalvular structures to the intraventricular septum may predispose to