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EDITORIAL COMMENT

Timing of Mitral Valve Intervention

Reducing the Strain of Decision Making?

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When is the optimal time to refer a patient for heart valve repair or replacement? In patients with severe valvular dysfunction accompanied by symptoms, the decision to proceed with intervention is usually straightforward. In contrast, management of the asymptomatic patient, particularly a patient without conventional markers of adverse remodeling or left ventricular (LV) systolic dysfunction, remains one of the central challenges in valvular heart disease. Any procedural intervention, however safe, carries inherent risk and must be weighed against the competing risk of watchful waiting. This latter risk—the natural history of the disease—is traditionally assessed through symptom surveillance and, in asymptomatic individuals, serial evaluation for myocardial decompensation, typically reflected by LV dilation or a decline in left ventricular ejection fraction (LVEF).

In chronic mitral regurgitation (MR), reliance on these conventional markers may delay intervention beyond the window of optimal myocardial recovery. Accordingly, accurate identification of subclinical myocardial dysfunction has emerged as a critical unmet need, with the potential to refine the timing of intervention and improve long-term outcomes.

RATIONALE FOR STRAIN IMAGING IN VALVULAR HEART DISEASE

Two-dimensional speckle-tracking echocardiography has matured sufficiently to provide reproducible and clinically meaningful measures of myocardial deformation. Strain imaging quantifies myocardial shortening and lengthening along longitudinal, circumferential, and radial axes of the left ventricle, as well as deformation of the left atrium. Among these parameters, LV-global longitudinal strain (GLS) and peak atrial longitudinal strain (PALS) have been the most extensively studied.

Strain imaging consistently detects subtle impairments in myocardial contractility before changes in LVEF become apparent. Contemporary recommendations report LV-GLS as a negative value, with normal values more negative than −18%, borderline values between −16% and −18%, and abnormal values less negative than −16%.[1] Importantly, strain should be interpreted serially rather than as a single-point measurement, given its load dependence and historical intervendor variability. Although vendor harmonization has improved, longitudinal assessment of strain within the same laboratory remains essential for clinical interpretation.

Across valvular heart disease phenotypes, LV-GLS has demonstrated prognostic value, particularly in aortic stenosis and MR, where impaired LV-GLS predicts adverse outcomes and incomplete postoperative LV recovery. PALS reflects left atrial (LA) reservoir function and the chronic diastolic burden imposed by volume or pressure overload. In mitral valve disease, reduced PALS has been associated with atrial fibrosis, atrial fibrillation, elevated filling pressures, symptom development, and worse clinical outcomes, thereby potentially complementing ventricular strain and conventional echocardiographic indices.

STRAIN IMAGING IN MITRAL REGURGITATION

In patients with chronic severe primary MR, LVEF may remain preserved for prolonged periods despite progressive impairment of intrinsic myocardial contractility. This apparent preservation reflects the confounding effects of increased preload and reduced effective afterload. Consequently, early detection of LV dysfunction is critical to support

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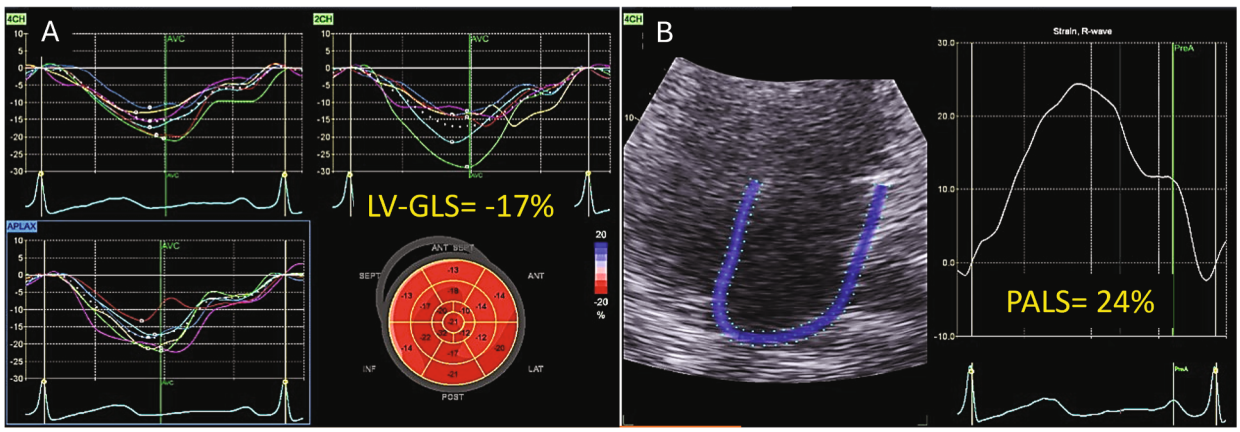
FIGURE 1 PALS and LV-GLS Imaging



	Normal PALS	Impaired PALS
Normal LV-GLS	aHR 1.0	aHR 1.87
Impaired LV-GLS	aHR 1.69	aHR 3.32

In patients undergoing mitral valve surgery for severe degenerative mitral regurgitation, preoperative peak atrial longitudinal strain (PALS) and left ventricular global longitudinal strain (LV-GLS) were independent predictors of long-term survival and demonstrated complementary prognostic value. Impaired LV-GLS (A) and normal PALS (B). Adjusted HR (aHR) from the independent validation cohort (n = 605); impaired PALS (<21.4%); impaired LV-GLS (>−20.5%) defined from the derivation cohort (n = 1,314). aHR data from Oh et al.[5] 2CH = 2-chamber; 4CH = 4-chamber; ANT = anterior; APLAX = anteroposterior long-axis; INF = inferior; LAT = lateral; POST = posterior; SEPT = septal.

timely surgical intervention, which, when performed before irreversible remodeling, can restore normal contractile performance.

LV-GLS has consistently been shown to be more sensitive than LVEF for detecting early LV dysfunction in MR. Under the augmented loading conditions characteristic of MR, LV-GLS values are often more negative than −20%. Progressive attenuation of LV-GLS is associated with worsening prognosis and may identify patients who could benefit from earlier intervention, even in the absence of symptoms. Moreover, LV-GLS provides incremental prognostic value when combined with circulating biomarkers such as B-type natriuretic peptide.

Previous reports have explored the utility of LV-GLS in patients with MR. In a cohort of 593 patients with severe primary MR who were undergoing valve surgery, worse preoperative LV-GLS (less negative than approximately −20.6%) was independently associated with higher all-cause mortality and cardiovascular events, a finding underscoring its potential utility in surgical timing.[2] Similarly, in another observational cohort of approximately 500 patients, impaired LV-GLS predicted postoperative cardiac events, including heart failure hospitalization, reoperation, and death, more effectively than conventional echocardiographic metrics.[3]

The utility of PALS has also been studied in similar groups of patients with MR. In short, it has been demonstrated to be a reproducible speckle-tracking measure of LA reservoir function that correlates with MR severity and independently predicts clinical outcomes across primary, asymptomatic, and functional MR populations, often providing prognostic information beyond LA size and traditional parameters.[4] However, whether combined atrial and ventricular strain assessment offers superior risk stratification compared with either parameter alone has remained uncertain.

INSIGHTS FROM THE CURRENT STUDY

In this issue of *JACC: Cardiovascular Imaging*, Oh et al[5] address this question by evaluating the prognostic significance of LV-GLS and PALS in a large cohort of patients with severe degenerative MR who

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underwent mitral valve surgery. Using a retrospective derivation cohort (n = 1,314) and an independent external validation cohort (n = 605), Oh et al[5] assessed whether integrated atrial-ventricular strain measurements improve long-term mortality prediction, particularly in asymptomatic patients.

Spline-derived thresholds were identified for impaired strain (PALS <21.4%; LV-GLS >−20.5%). Patients were stratified into 4 groups on the basis of preserved or impaired PALS and LV-GLS, and all-cause mortality was assessed over a median follow-up of 8.4 years. Strain measurements were performed in a core laboratory using vendor-independent software, with excellent reproducibility.

Both PALS and LV-GLS emerged as strong, independent predictors of mortality. Patients with impairment in both parameters experienced the highest risk of death, a finding that was consistently reproduced in the external validation cohort (**Figure 1**). Notably, traditional markers such as LV end-systolic dimension and LVEF did not retain prognostic significance in multivariable analysis.

Among asymptomatic patients—including many who did not meet conventional guideline thresholds for intervention—reduced PALS and LV-GLS remained independently associated with mortality. These findings suggest that myocardial and atrial strain identify a vulnerable subset of patients who may appear clinically compensated yet harbor advanced subclinical disease.

IMPLICATIONS FOR VALVE GUIDELINES

Current American College of Cardiology/American Heart Association valve guidelines do not include strain imaging as a Class I indication for diagnosis or management but acknowledge its emerging role as an adjunct marker of subclinical myocardial dysfunction.[6] In asymptomatic severe primary MR, LV-GLS and biomarkers may be considered to guide early intervention (Class IIb). More recent expert consensus statements from imaging societies have further endorsed strain imaging for risk stratification and detection of early dysfunction while emphasizing that strain complements rather than replaces established criteria.[1]

The present study strengthens the evidentiary basis for this position and raises the possibility that integrated atrial-ventricular strain assessment could meaningfully refine current guideline algorithms. Specifically, PALS and LV-GLS may help identify asymptomatic patients who are unlikely to remain stable with continued observation and who may benefit from earlier referral to experienced mitral valve centers. Although these data do not yet justify strain-based surgical thresholds, they support incorporation of strain parameters into a more nuanced, risk-based framework for clinical decision making.

STUDY LIMITATIONS AND FUTURE DIRECTIONS

The retrospective design and restriction to patients with primary degenerative MR limit generalizability, and strain measurements were not used to guide clinical decision making. Extrapolation to secondary MR or atrial functional MR is therefore not appropriate. In addition, the high reproducibility achieved in a core laboratory may be difficult to replicate in routine practice, particularly for PALS, which often requires manual adjustment and operator expertise. These considerations reinforce current recommendations to interpret strain as a longitudinal trend rather than an isolated measurement.

Looking ahead, prospective studies are needed to determine whether strain-guided intervention strategies improve outcomes compared with conventional approaches. Integration of atrial and ventricular strain with biomarkers, advanced imaging, and clinical risk models may ultimately support a paradigm shift from symptom-based to myocardial health-based timing of valve intervention. In this context, the work by Oh et al[5] represents an important step forward, reinforcing the concept that in MR, the absence of symptoms does not necessarily equate to preserved myocardial health.

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