

## ECHOCARDIOGRAPHIC PREDICTORS OF HEART FAILURE PROGRESSION IN PATIENTS WITH VALVULAR HEART DISEASES

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<https://doi.org/10.5281/zenodo.17605682>

### Introduction

Heart failure (HF) remains a major cause of morbidity and mortality worldwide, and its progression in patients with valvular heart diseases (VHD) presents a significant clinical challenge. Valvular lesions, such as aortic stenosis, mitral regurgitation, and aortic regurgitation, impose chronic pressure and volume overload on the myocardium, often leading to structural and functional changes in the heart. Early identification of patients at risk of HF progression is essential to optimize management strategies and improve outcomes. Echocardiography, as a non-invasive and widely available imaging modality, provides detailed assessment of cardiac structure, function, and hemodynamics, making it a crucial tool in the prognostic evaluation of VHD patients.

### Justification of Relevance

Despite advances in surgical and interventional management of VHD, predicting HF progression remains challenging. Conventional clinical parameters are often insufficient to identify patients at risk of rapid deterioration. Echocardiographic parameters, including left ventricular ejection fraction (LVEF), left atrial volume index (LAVI), pulmonary artery systolic pressure (PASP), and global longitudinal strain (GLS), have been increasingly recognized as potential predictors of HF development. Understanding which echocardiographic markers reliably predict HF progression can aid clinicians in decision-making regarding timing of intervention and intensity of medical therapy.

### Goals and Objectives

The primary aim of this study was to identify echocardiographic predictors of HF progression in patients with moderate to severe valvular heart diseases. Specific objectives included:

1. To evaluate conventional echocardiographic parameters (LVEF, LV dimensions, LAVI, PASP) in VHD patients.
2. To assess advanced echocardiographic indices, including strain imaging, as potential predictors of HF progression.



3. To analyze the relationship between echocardiographic findings and clinical outcomes over a 12-month follow-up period.

### **Review of Sources**

A comprehensive literature review was conducted using PubMed, Scopus, and Web of Science databases, focusing on studies published between 2015 and 2024. Key studies highlighted the predictive value of LVEF, GLS, and LAVI in VHD patients. For instance, recent cohort studies demonstrated that reduced GLS, even in patients with preserved LVEF, was associated with earlier HF onset. Similarly, elevated LAVI and PASP were identified as independent predictors of adverse cardiovascular outcomes. These findings guided the selection of echocardiographic parameters for this study.

### **Methods and Techniques**

A prospective observational study was conducted including 120 patients diagnosed with moderate-to-severe valvular heart disease (aortic stenosis, mitral regurgitation, or aortic regurgitation). Patients with prior myocardial infarction, significant coronary artery disease, or other cardiomyopathies were excluded. Comprehensive transthoracic echocardiography was performed using a standardized protocol, measuring:

- Left ventricular ejection fraction (Simpson's biplane method)
- Left atrial volume index (LAVI)
- Left ventricular end-diastolic and end-systolic dimensions (LVEDD, LVESD)
- Pulmonary artery systolic pressure (PASP)
- Global longitudinal strain (GLS) using speckle-tracking echocardiography

Patients were followed for 12 months for the development of symptomatic HF (NYHA class II–IV) or hospitalization due to HF. Statistical analysis included Cox proportional hazards models and receiver operating characteristic (ROC) curves to identify predictors of HF progression.

### **Results**

During the 12-month follow-up, 38 patients (31.7%) developed clinical HF. Univariate analysis showed that reduced LVEF (<50%), elevated LAVI (>34 mL/m<sup>2</sup>), increased PASP (>40 mmHg), and impaired GLS (>-16%) were significantly associated with HF progression ( $p < 0.05$ ). Multivariate Cox regression identified GLS and LAVI as independent predictors of HF progression (hazard ratio [HR] for GLS: 2.5, 95% CI: 1.6–4.1; HR for LAVI: 1.8, 95% CI: 1.1–3.0). ROC curve analysis revealed that GLS had the highest predictive value (AUC = 0.82), followed by LAVI (AUC = 0.75). These findings suggest that both structural



and functional echocardiographic markers provide complementary prognostic information in VHD patients.

### **Conclusions**

Echocardiography is a valuable tool in predicting HF progression in patients with valvular heart disease. Among the parameters studied, impaired global longitudinal strain and increased left atrial volume index were the strongest independent predictors of HF development. Early identification of at-risk patients using these echocardiographic markers can facilitate timely intervention, optimize medical therapy, and potentially improve clinical outcomes. Future studies with larger cohorts and longer follow-up are warranted to validate these findings and integrate them into routine clinical practice.

