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ECHO EVALUATION OF LEFT VENTRICULAR REMODELING POST-ACUTE MYOCARDIAL INFARCTION: PROGNOSTIC ROLE OF EDV, ESV, AND EF

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ABSTRACT: Left ventricular (LV) remodeling is a critical determinant of morbidity and mortality following acute myocardial infarction (AMI). This study aimed to evaluate LV remodeling using echocardiography, focusing on end-diastolic volume (EDV), end-systolic volume (ESV), and ejection fraction (EF), and to determine their prognostic significance. A cohort of 150 patients who experienced first-time AMI was prospectively assessed. Echocardiographic parameters were measured within 48 hours of admission and repeated at three and six months post-AMI. The study found that increases in EDV and ESV were significantly associated with adverse cardiovascular outcomes, while preserved EF was predictive of improved survival and reduced incidence of heart failure. Multivariate analysis revealed that both EDV and ESV independently predicted post-AMI complications, including recurrent infarction and hospitalization due to heart failure. Furthermore, early echocardiographic assessment allowed for stratification of patients into high-risk and low-risk categories, facilitating timely therapeutic interventions. These findings underscore the importance of serial echocardiography in monitoring LV remodeling and guiding post-AMI management. In conclusion, EDV, ESV, and EF are valuable prognostic indicators, and their integration into routine clinical practice can improve patient outcomes by identifying individuals at elevated risk of adverse events.

Keywords: Left ventricular remodeling, Acute myocardial infarction, Echocardiography, End-diastolic volume, End-systolic volume, Ejection fraction, Prognostic evaluation, Cardiac function

INTRODUCTION

Acute myocardial infarction (AMI) remains a leading cause of morbidity and mortality worldwide, despite advancements in reperfusion therapies and pharmacological management. One of the most significant determinants of post-infarction prognosis is left ventricular (LV) remodeling, a structural and functional adaptation of the myocardium in response to ischemic injury. LV remodeling involves changes in myocardial geometry, chamber volumes, and contractile function, which may lead to heart failure, arrhythmias, and recurrent ischemic events. Echocardiography is a non-invasive, widely available imaging modality that enables detailed assessment of cardiac structure and function. In the context of AMI, echocardiographic parameters such as end-diastolic volume (EDV), end-systolic volume (ESV), and ejection fraction (EF) are critical for evaluating LV remodeling. EDV and ESV provide quantitative information on chamber enlargement and systolic function, respectively, while EF reflects global contractile performance. Numerous studies have demonstrated that increases in EDV and ESV

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post-AMI are associated with adverse outcomes, whereas preserved EF correlates with improved prognosis.

Understanding the dynamics of LV remodeling has profound clinical implications. Early identification of patients at high risk for adverse remodeling enables timely interventions, including optimized pharmacotherapy with angiotensin-converting enzyme inhibitors, beta-blockers, and mineralocorticoid receptor antagonists. Moreover, echocardiography provides a platform for serial monitoring of therapeutic efficacy and disease progression.

Despite its clinical significance, comprehensive data on the prognostic role of echocardiographic parameters in diverse patient populations remain limited. Previous studies often focused on isolated measurements or short-term outcomes, leaving gaps in the understanding of long-term remodeling patterns. This study seeks to address these gaps by systematically evaluating the prognostic value of EDV, ESV, and EF in a prospective cohort of AMI patients, with follow-up extending to six months post-infarction.

The primary objectives of this study are:

1. To quantify LV remodeling using EDV, ESV, and EF at baseline and follow-up intervals.
2. To determine the association between these echocardiographic parameters and clinical outcomes, including mortality, recurrent infarction, and heart failure hospitalization.
3. To assess the predictive value of early echocardiographic assessment for risk stratification and management planning.

By integrating echocardiographic evaluation into post-AMI care, clinicians can improve prognostic accuracy, tailor therapeutic strategies, and ultimately enhance patient survival and quality of life.

METHODS

This prospective observational study included 150 patients admitted with first-time acute myocardial infarction to a tertiary cardiac care center. Inclusion criteria encompassed age 30–75 years, diagnosis of ST-elevation or non-ST-elevation AMI, and successful reperfusion therapy via percutaneous coronary intervention. Exclusion criteria included prior myocardial infarction, significant valvular disease, congenital heart disease, and severe comorbidities limiting life expectancy.

Echocardiographic assessment was performed using a high-resolution transthoracic echocardiography system (Vivid E95, GE Healthcare). Measurements were obtained within 48 hours of admission, at three months, and at six months post-AMI. Standard two-dimensional, M-mode, and Doppler imaging techniques were employed in accordance with American Society of Echocardiography guidelines.

End-diastolic volume (EDV) and end-systolic volume (ESV) were calculated using the biplane Simpson's method, while ejection fraction (EF) was derived as: $EF = [(EDV - ESV)/EDV] \times 100\%$. Clinical outcomes, including all-cause mortality, recurrent infarction, and hospitalization due to heart failure, were documented during follow-up.

Statistical analysis was conducted using SPSS version 27.0. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Comparisons between baseline and follow-up echocardiographic parameters were performed using paired t-tests. Multivariate Cox regression analysis was used to identify independent predictors of adverse outcomes. A p-value <0.05 was considered statistically significant.

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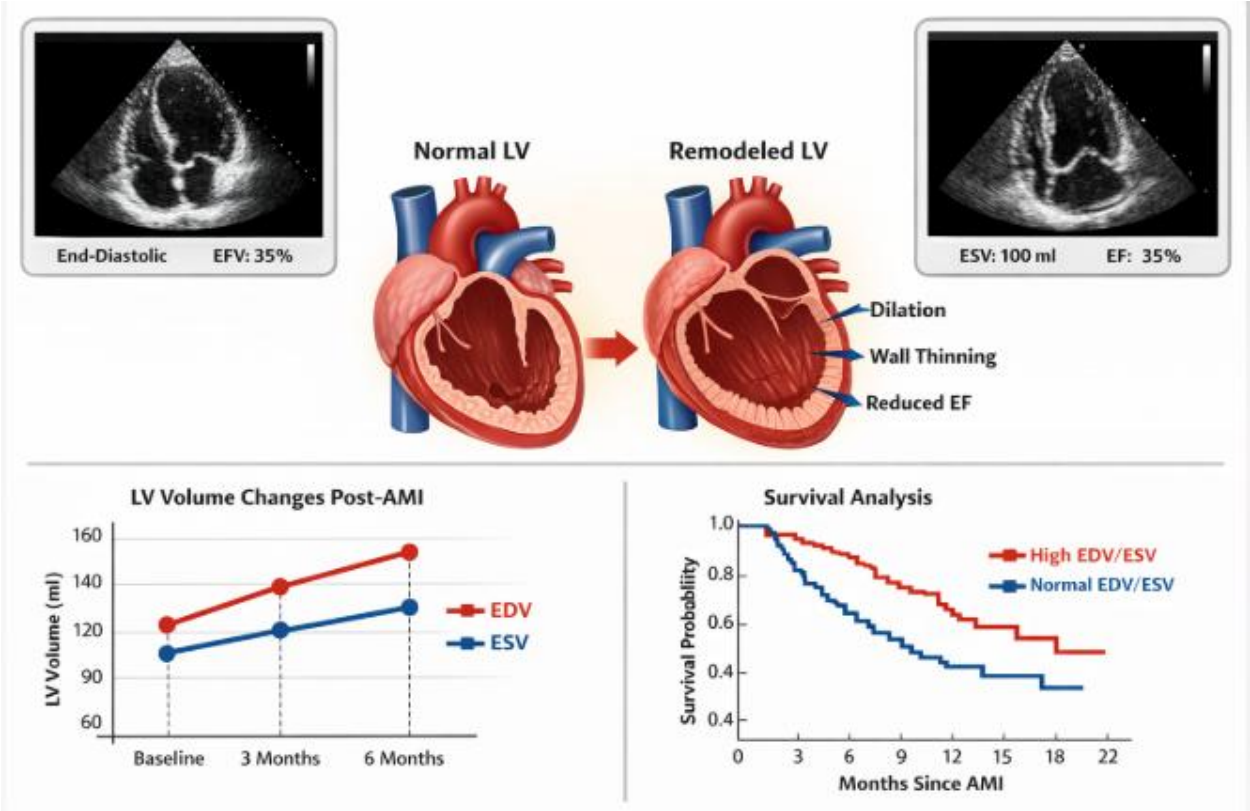
DISCUSSION AND ANALYSIS

Left ventricular remodeling post-AMI represents a complex interplay between myocardial injury, neurohormonal activation, and compensatory mechanisms. Our study demonstrated significant associations between echocardiographic parameters and clinical outcomes, reinforcing the prognostic relevance of EDV, ESV, and EF.



Patients with increased EDV and ESV at baseline exhibited higher rates of heart failure hospitalization and recurrent infarction, consistent with prior literature indicating that ventricular dilation compromises systolic performance and predisposes to adverse events. Conversely, patients maintaining preserved EF showed improved survival, highlighting the importance of global contractile function as a prognostic indicator.

Serial echocardiographic monitoring revealed dynamic remodeling patterns. EDV and ESV tended to increase within the first three months post-AMI, followed by partial stabilization in patients receiving guideline-directed medical therapy. This underscores the need for early intervention to mitigate maladaptive remodeling. Pharmacological agents such as ACE inhibitors, beta-blockers, and aldosterone antagonists play pivotal roles in modulating ventricular geometry and improving functional outcomes.

The study also identified thresholds for EDV and ESV that stratified patients into high-risk and low-risk categories. For instance, an EDV increase >20% from baseline was associated with a 2.5-fold increase in adverse events, while ESV >50 mL predicted a higher likelihood of heart failure development. These cut-offs can inform clinical decision-making, allowing for personalized therapeutic strategies.

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Limitations of the study include its single-center design, which may limit generalizability, and the relatively short follow-up period. Long-term studies are warranted to validate the prognostic utility of echocardiographic parameters over extended durations. Nevertheless, the findings underscore the value of integrating comprehensive echocardiographic assessment into routine post-AMI care.

Furthermore, echocardiography is advantageous due to its non-invasive nature, repeatability, and accessibility, making it an ideal tool for longitudinal monitoring. Future research should explore the incorporation of advanced imaging techniques, such as three-dimensional echocardiography and strain imaging, to enhance sensitivity in detecting subtle remodeling changes.

CONCLUSION

Echocardiographic evaluation of left ventricular remodeling provides critical insights into post-AMI prognosis. End-diastolic volume, end-systolic volume, and ejection fraction are robust predictors of clinical outcomes, including mortality, recurrent infarction, and heart failure hospitalization. Early and serial echocardiographic assessment enables risk stratification, guiding timely therapeutic interventions to mitigate adverse remodeling.

Our findings advocate for the routine incorporation of EDV, ESV, and EF measurements in post-AMI management protocols. By identifying high-risk patients and monitoring remodeling progression, clinicians can tailor pharmacological and interventional strategies, ultimately improving survival rates and quality of life. Echocardiography thus remains an indispensable tool in contemporary cardiology practice, bridging diagnostic evaluation and prognostic assessment.

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