PREDICTING OUTCOMES AFTER ACUTE MYOCARDIAL INFARCTION: ECHOCARDIOGRAPHIC ANALYSIS OF LEFT VENTRICULAR VOLUMES AND EJECTION FRACTION

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Abstract:
Acute myocardial infarction (AMI) represents a serious health concern due to its significant impact on subsequent cardiac function and patient prognosis. The left ventricular (LV) volumes and ejection fraction (EF) serve as key clinical markers in guiding patient management. This study aimed to assess post-AMI left ventricular remodeling using echocardiographic parameters and to predict both short- and long-term outcomes in patients. A total of 120 AMI patients were prospectively analyzed over a 6-month follow-up period. Demographic data, sex, and major risk factors (hypertension, diabetes, dyslipidemia) were recorded. Echocardiographic measurements of baseline and 6-month LV end-diastolic volume (EDV), end-systolic volume (ESV), and EF were obtained. The data were analyzed in relation to LV remodeling and the development of chronic heart failure. Results demonstrated that patients with elevated baseline EDV and ESV had significantly reduced EF and were at increased risk of long-term heart failure and mortality. Furthermore, an EF below 40% was identified as an independent predictor of poor prognosis. These findings highlight the importance of echocardiographic assessment in guiding individualized monitoring and optimizing therapeutic strategies in AMI patients. In conclusion, EDV, ESV, and EF measured by echocardiography are effective tools for predicting post-AMI LV remodeling and identifying high-risk patients.

Keywords: acute myocardial infarction, left ventricle, echocardiography, ejection fraction, cardiac remodeling, EDV, ESV, prognosis.

Introduction

Acute myocardial infarction (AMI) is one of the leading causes of cardiovascular morbidity and mortality worldwide. AMI results in necrosis of myocardial tissue, which significantly affects left ventricular (LV) volumes and ejection fraction (EF). Left ventricular remodeling refers to the structural and functional changes that occur in the LV after infarction, which are associated with long-term heart failure and increased mortality risk.

LV volumes, including end-diastolic volume (EDV) and end-systolic volume (ESV), and EF are widely used echocardiographic parameters to assess cardiac remodeling after AMI. Increased EDV and ESV indicate LV dilation and impaired contractility, whereas EF reflects systolic performance. Studies have shown that elevated baseline EDV and ESV and reduced EF are independent predictors of post-AMI remodeling and chronic heart failure development.

Patient prognosis and follow-up after AMI are determined by a combination of clinical, biochemical, and imaging parameters. Echocardiography provides a non-invasive, reproducible method to evaluate LV size and function. EF below 40% is a clinically significant threshold for identifying patients at high risk for adverse outcomes.

The main objective of this study was to evaluate LV remodeling and predict outcomes in AMI patients using EDV, ESV, and EF. Specific objectives included:

1. Measuring baseline EDV, ESV, and EF in AMI patients using echocardiography.
2. Assessing changes in LV volumes and EF over a 6-month follow-up period.
3. Correlating EDV, ESV, and EF with clinical outcomes to identify high-risk patients.

The study aims to provide evidence that echocardiographic monitoring of LV volumes and EF can guide individualized therapy and early identification of patients at risk for poor prognosis, improving quality of life and preventing heart failure progression.

Methods

This prospective observational study included 120 AMI patients treated at the Cardiology Department in Tashkent between 2023 and 2025. Patients were aged 45–75 years, including both men and women. AMI diagnosis was confirmed by clinical

presentation, laboratory tests, and electrocardiography. Inclusion criteria included first-time AMI, no prior history of heart failure, and absence of severe comorbidities.

Transthoracic echocardiography was performed using a GE Vivid E95 system. Baseline measurements were obtained 3–5 days post-infarction, and follow-up measurements were taken at 6 months. EDV and ESV were measured using the Simpson biplane method, and EF was calculated. Demographic and clinical data were collected and analyzed in conjunction with echocardiographic findings.

Statistical analyses were conducted using SPSS 26.0. Parametric data were presented as mean ± standard deviation, while non-parametric data were expressed as median and interquartile range. Baseline and 6-month EDV, ESV, and EF values were compared using paired t-tests. Multivariate regression analysis and Kaplan-Meier survival analysis were used to assess prognostic factors. A p-value < 0.05 was considered statistically significant.

Ethical approval was obtained, and written informed consent was obtained from all patients. All procedures were conducted under safe conditions to ensure patient health.

Discussion and Analysis

Discussion:

The study demonstrated that elevated baseline EDV and ESV were independent predictors of LV remodeling and chronic heart failure following AMI. Patients with EF < 40% at baseline had a significantly higher risk of heart failure and mortality, consistent with previous studies (Pfeffer et al., 1990; Solomon et al., 2005), which showed that LV volume and EF predict post-infarction remodeling.

The mechanism of LV remodeling involves impaired contractility in the infarcted myocardium, valvular insufficiency, and ventricular dilation. Our findings indicated that 35% of patients had elevated EDV and ESV with reduced EF, identifying a high-risk group. Improvement in EF and reductions in EDV and ESV at 6 months correlated with better prognosis, demonstrating that remodeling is a dynamic process amenable to treatment and rehabilitation.

Clinically, monitoring EDV, ESV, and EF allows early identification of high-risk patients and helps tailor therapies such as ACE inhibitors, beta-blockers, and other cardioprotective treatments. Echocardiographic monitoring also supports effective rehabilitation programs.

Comparing risk factors such as age, sex, diabetes, and hypertension, increases in EDV and ESV and reductions in EF were independent predictors of prognosis,

suggesting that combining clinical and echocardiographic data enhances risk stratification and individualized care.

Analysis:

- Baseline EDV: 150 ± 30 mL
- Baseline ESV: 80 ± 20 mL
- Baseline EF: 38 ± 7%

6-month follow-up:

- EDV: 145 ± 28 mL
- ESV: 75 ± 18 mL
- EF: 42 ± 8%

Multivariate regression indicated that EF < 40%, EDV > 160 mL, and ESV > 90 mL were independent predictors of poor prognosis ($p < 0.01$). Kaplan-Meier analysis showed a significantly higher mortality rate in patients with EF < 40%.

Improvements in EF and reductions in EDV and ESV over 6 months reflected favorable remodeling and positive prognostic outcomes, emphasizing the dynamic nature of LV remodeling post-AMI.

Conclusion

This study demonstrates that echocardiographic parameters—EDV, ESV, and EF—play a critical role in predicting post-AMI LV remodeling. Elevated baseline EDV and ESV combined with reduced EF increase the risk of chronic heart failure and mortality. Regular monitoring of these parameters is essential for tailoring individualized management strategies in AMI patients.

Echocardiography provides a non-invasive, practical, and repeatable method to assess cardiac remodeling and stratify patients by risk. EF < 40% and increased LV volumes are independent predictors of poor short- and long-term outcomes.

These findings have important clinical implications for guiding therapy, rehabilitation, and long-term follow-up in AMI patients. Future studies integrating biomarkers and other imaging modalities may further improve prognostic accuracy.

In summary, measurement of EDV, ESV, and EF using echocardiography is an effective tool for predicting post-AMI LV remodeling and early identification of high-risk patients.

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