

Original Research Article

Wall motion score index and left ventricular ejection fraction as predictors of cardiovascular events after acute myocardial infarction

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ABSTRACT

Background: Left ventricular ejection fraction serves as a vital gauge of left ventricular overall function and plays a crucial role in assessing the severity and prognosis of ischemic heart disease. Another approach for evaluating left ventricular function is through the assessment of regional function using the wall motion score index. In this study, our objective was to assess and compare the predictive value of both WMSI and LVEF in patients with Acute Myocardial Infarction for their ability to predict all-cause mortality and readmission due to heart failure.

Methods: This prospective study was conducted on admitted patients in Government Kilpauk Medical College on 70 patients with Acute myocardial infarction between the first 48 hours of symptoms and before hospital discharge. Follow-up with clinic visits was conducted 3, 6 and 12 months after discharge. The primary endpoint was the composite of all-cause mortality and readmission for heart failure.

Results: 63% of patients had LVEF of less than 40%, and 55% had WMSI>1.5. After a follow-up of 1 year, 3.7% mortality and 11% readmission for heart failure were observed. WMSI>1.5 and LVEF<40% were associated with poor survival, while the WMSI proved to be a better predictor for rehospitalisation. 81% of STEMI group patients had EF<40%, but only 18% of the NSTEMI group had EF < 40%, which is statistically significant. There is no superiority between WMSI and LVEF in the STEMI and NSTEMI groups. Killip classification proved to be an independent predictor of mortality, but no statistical significance was observed in readmission.

Conclusions: Both LVEF and WMSI were predictors of all-cause mortality, while the WMSI was a predictor for readmission for heart failure.

Keywords: LVEF, WMSI, STEMI, NSTEMI, Mortality, Acute myocardial infarction, Heart failure

INTRODUCTION

Echocardiography plays a crucial role in assessing regional and global ventricular function, which is vital for tailoring therapy, identifying mechanical complications, and offering prognostic insights in cases of acute myocardial infarction (AMI).¹ Presently, the guidelines from the European Society of Cardiology recommend that all patients experiencing an ST-segment elevation myocardial infarction (STEMI) undergo transthoracic

echocardiographic assessment to determine left ventricular ejection fraction (LVEF) prior to discharge.² LVEF is widely acknowledged as a prognostic indicator for assessing mortality outcomes following an AMI. The Wall Motion Score Index (WMSI) offers a straightforward alternative to Left Ventricular Ejection Fraction for assessing systolic function following an Acute Myocardial Infarction. It utilizes a scoring system based on the motility of individual segments of the left ventricular wall, where higher scores signify more significant impairment of wall

movement.³ Notably, WMSI differs from LVEF in that it treats normokinesia and hyperkinesia equally, thus avoiding the compensation effect that hypercontractile segments can have on the dysfunctional ones, resulting in a more direct assessment of the myocardial damage's intensity and extent. The objective of our study was to compare the predictive value of LVEF and WMSI in terms of all-cause mortality and readmission due to heart failure in patients who have experienced an Acute Myocardial Infarction.

METHODS

This prospective study was conducted on patients admitted with acute coronary syndrome (ACS) in the Department of Cardiology, Government Kilpauk Medical College for one year, from December 2022 to January 2023. Of the initial 70 patients, 16 patients were lost to follow-up.

Inclusion criteria

Adults patients admitted with Acute myocardial infarction in cardiology intensive care unit, as evident by typical anginal pain, significant ST-T changes and elevated cardiac biomarkers suggestive of myocardial ischemia.

Exclusion criteria

Mechanical complications after AMI, including a free wall rupture, ventricular septal perforation and papillary muscle rupture, cardiogenic shock, and cardiac arrest, were excluded.

All patients received standard pharmacological therapy (Aspirin, Clopidogrel, Angiotensin-converting enzyme inhibitors (ACEI)/Angiotensin receptor blockers (ARB), β -blockers and statin, except when these agents were contraindicated). Primary angioplasty was the preferred reperfusion strategy in patients with STEMI. Thrombolysis was done with streptokinase and Tenecteplase. Lysed patients were managed with a pharmaco-invasive approach. For those diagnosed with NSTEMI, an invasive strategy was implemented, including coronary angiography within the initial 48 hours post-admission, with revascularization guided by coronary anatomy. Subsequent follow-up involved clinic appointments at 3, 6, and 12 months post-discharge. The primary outcome of interest was a composite of all-cause mortality and hospital readmissions due to heart failure.

Echocardiographic variables

Transthoracic echocardiograms were conducted after the initial symptoms, occurring more than 48 hours into admission. The Philips Affiniti 30 ultrasound system was employed for this study. Left Ventricular Ejection Fraction (LVEF) was determined using the biplane Simpson method, calculated as the percentage ratio of stroke volume (left ventricular end-diastolic volume minus left ventricular end-systolic volume) to left ventricular end-

diastolic volume. The Wall Motion Score Index (WMSI) was computed based on the 16-segment model. Contractility of individual segments received scores as follows: Normal or hypercontractile (1 point), Hypokinesia (2 points), Akinesia (3 points), and Dyskinesia (4 points). WMSI was determined by dividing the total score of all segments by the number of visualized segments. Previous studies have utilized WMSI>1.5 and LVEF<40% as threshold values to define subgroups characterized by significant ventricular dysfunction and increased risk of adverse events.⁴

Statistical analysis

The data were expressed in terms of mean values, standard deviations, frequencies, and percentages. Categorical variables were compared using the Pearson chi-square test. The cut-off value was determined through Receiver Operating Characteristic (ROC) analysis, and cross-tabulations were generated to assess sensitivity and specificity. Statistical significance was established with a two-tailed test, defining significance as p values less than 0.05. The data analysis was conducted using IBM-SPSS version 21.0 (IBM-SPSS Science Inc., Chicago, IL).

RESULTS

Baseline characteristics

The minimum age was 32 years, and the maximum was 79 years. The mean age was 49 years. 35 (64%) were males and 19 (36%) were females. Diabetes mellitus was the most common risk factor (44%), followed by hypertension (37%). Smoking was reported by 22 patients (40%).

Table 1: Baseline characteristics of patients (n=54).

Variables	N (%)
Age	49
Sex (M/F)	35/19 (64/36)
Diabetes	24 (44)
Hypertension	20 (37)
Smoking	22 (40)
Renal dysfunction	13 (24)

Clinical characteristics

22 (40%) patients presented with anterior wall myocardial infarction. 16 (30%) patients had inferior wall myocardial infarction (IWMI). The number of patients with non-ST elevation myocardial infarction (NSTEMI) was 16 (30%). Of the total 38 ST-elevation myocardial infarction, 30 patients were thrombolysed (27 patients with streptokinase and 3 with Tenecteplase). Complete revascularization was done in 45 patients. Thirty-four patients underwent PCI, while 11 patients underwent CABG. Patients with STEMI had significantly lower LVEF compared with the NSTEMI group. This study showed a positive correlation between Killip class and mortality. The higher the Killip class, the higher the mortality ($p=0.03$). Killip classification doesn't

correlate with rehospitalisation due to heart failure ($p=0.13$).

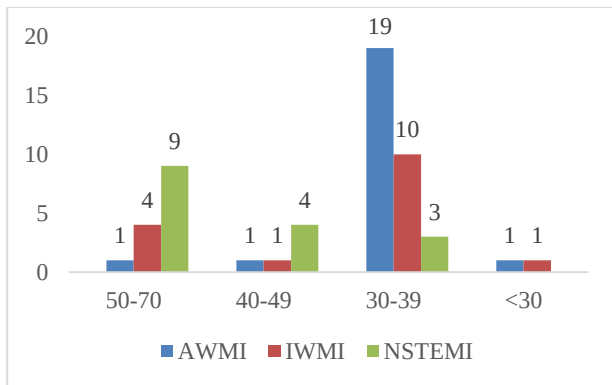


Figure 1: Distribution of AWMI, IWMI and NSTEMI group based on LVEF.

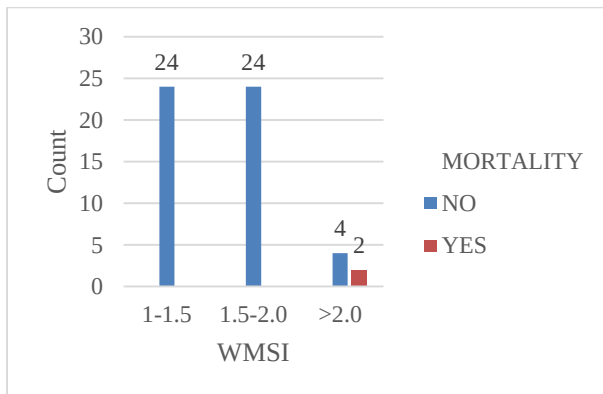


Figure 2: Mortality distribution among the WMSI group.

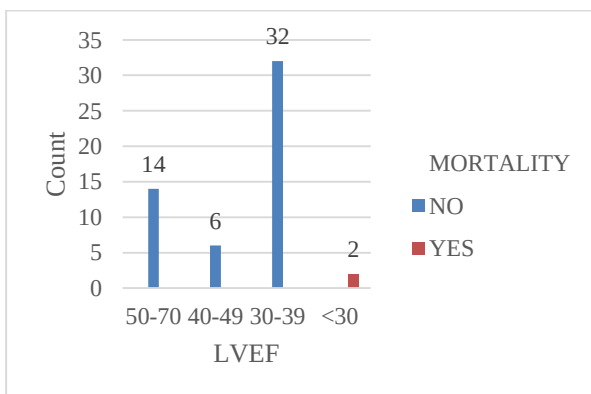


Figure 3: Mortality distribution among the LVEF group.

Echocardiographic data

Among 54 patients, 63% had LVEF<40% and 25% had normal LV systolic function. WMSI with significant LV dysfunction was found in 28 (55%) patients. During a median follow-up of 12 months, mortality and readmission were observed in 2 (3.7%) and 6 (11%) patients,

respectively. No mortality was observed in the NSTEMI group. Patients who died had higher WMSI (>1.5) ($p<0.0001$) and lower LVEF ($<40\%$) ($p<0.0001$), which signifies both variables are good predictors of mortality. In patients who were readmitted for heart failure, WMSI proved to be statistically significant ($p=0.002$) and a better predictor than LVEF ($p=0.2$).

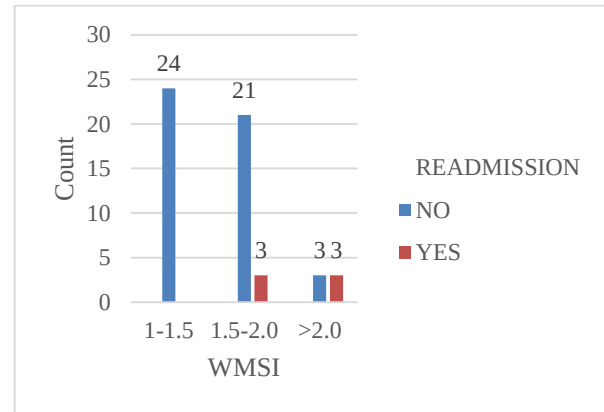


Figure 4: Readmission among the WMSI group.

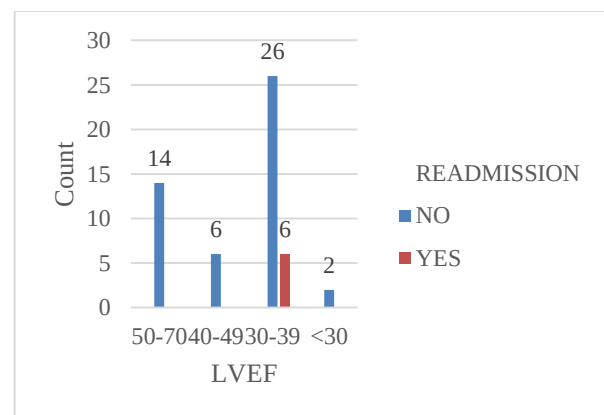


Figure 5: Readmission among the LVEF group.

DISCUSSION

Most of the study participants were male (64.8%), and the average age was 49. These baseline characteristics align with prior research indicating a higher risk of coronary heart disease (CHD) in older men.⁵ Interestingly, the study observed that individuals with acute myocardial infarction under 50 years of age had significantly lower cardiovascular (CV) and all-cause mortality compared to those aged 65 years or older, even after adjusting for confounding factors, possibly explaining the relatively low mortality rate in this study. Traditional risk factors were prevalent among the subjects, with diabetes (44.4%) and hypertension (37%) being the most prominent. Previous studies have highlighted the elevated risk of acute coronary thrombosis in diabetic patients and the independent risk factor hypertension poses for AMI.^{6,7} Additionally, smoking, a known contributor to atherosclerosis, was a significant risk factor among the

subjects, with 22 patients (40.7%) being active smokers. Studies have shown that active smokers tend to develop CHD at an earlier age than non-smokers.⁸ The study also found a strong negative linear correlation between Wall Motion Score Index, assessed beyond the acute phase of AMI, and Left Ventricular Ejection Fraction, consistent with previous research by Jurado-Román et al.⁹ Furthermore, the study identified both LVEF and WMSI as vital predictors of mortality, with WMSI proving to be a superior predictor of heart failure-related readmission. This superiority might stem from WMSI's heightened sensitivity in detecting myocardial damage, even in patients with preserved LVEF.

Notably, the study suggests that WMSI can detect early systolic dysfunction, especially in patients with preserved LVEF, where diastolic dysfunction is the primary driver of heart failure development before systolic failure in myocardial ischemia occurs. This distinguishing feature of WMSI may be particularly valuable in conjunction with LVEF, particularly in cases of minor myocardial damage. Previous studies by Jurado-Román et al and Moller et al have highlighted the potent prognostic value of both LVEF and WMSI following AMI, with WMSI demonstrating greater predictive power, particularly in cases of NSTEMI with less myocardial damage.^{9,10} The current study, however, did not observe significant adverse events among NSTEMI patients, though it underscores the substantial role of myocardial ischemia and ventricular dysfunction in the mortality of these patients. Notably, the Killip classification emerged as a crucial independent predictor of mortality in this study, along with the occurrence of relevant complications such as cardiac arrest during hospitalization and acute renal failure. However, the Killip classification's predictive power for rehospitalization did not reach statistical significance in this study.

While the findings underscore the superiority of WMSI over other systolic function measures, including LVEF, in predicting outcomes post-myocardial infarction, it is crucial to acknowledge the lack of consistency in wall motion scoring models and cut-off values across existing literature. Establishing standardized cut-off values for WMSI could enhance its utility in risk stratification, potentially identifying high-risk patients beyond traditional LVEF measurements or existing STEMI risk scores. Furthermore, WMSI's clinical utility is underscored by its ability to be assessed even with poor acoustic windows, requiring no additional software or expertise for analysis. Additionally, WMSI correlates effectively with EF measured by radionuclide ventriculography (RNV).¹¹ Given its cost-effectiveness and predictive power, clinicians should consider integrating WMSI into risk stratification and treatment decision-making. The study aligns with the ASE guidelines, recommending the use of the ASE 16-segment model over the 17-segment model for routine WMSI scoring, as it better accommodates cases where visualization of the apex segment may be challenging.

Limitations

Limitation was since this is a prospective study with few events, making it difficult to draw a definitive conclusion.

CONCLUSION

The wall motion score Index stands out as a straightforward, reproducible, and clinically applicable echocardiographic technique, demonstrating a robust linear correlation with Left Ventricular Ejection Fraction. It's noteworthy that a significant number of patients exhibit an abnormal WMSI despite having a relatively preserved LVEF. Conversely, when WMSI is within the normal range, no patient shows a reduced LVEF. Both LVEF and WMSI emerge as valuable sources of prognostic information following an Acute Myocardial Infarction. While both LVEF and WMSI prove effective in predicting all-cause mortality, the WMSI excels as a superior predictor for heart failure-related readmissions compared to LVEF.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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