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Early Prediction of Ventricular Functional Recovery after Myocardial Infarction by Longitudinal Strain Study

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ABSTRACT

According to certain hypotheses, global myocardial strain (GLS) early after ST-elevation myocardial infarction (STEMI) may be a predictor of improvement in left ventricular ejection fraction (LVEF). To evaluate Based on GLS values, LV recovery following STEMI intervention. The study population consists of 100 patients with acute STEMI and no prior coronary intervention who received primary percutaneous coronary intervention. Transthoracic echocardiography and the speckle tracking method were used to assess LVEF and myocardial strain indices 48 hours and two months following STEMI. A 5% increase in LVEF was judged substantial. Patients whose LVEF had improved by more than 10% two months after their STEMI had substantially higher GLS values (GLS = 25.66% in patients whose LVEF had improved by more than 10% vs. 21.64% in the other group, $p<0.05$). Following STEMI, significant LVEF improvement was predicted by ROC analysis to be associated with GLS values greater than 23.5Patients with inferior, posterior and inferoseptal STEMI had higher GLS compared to patients with anterior, extensive, or anteroseptal STEMI, as did patients with right coronary occlusion vs blockage of the left anterior descending or circumflex arteries. We have found that the early longitudinal LV strain following STEMI is a predictor of recovery. This technique is beneficial for predicting rapid LV recovery following STEMI. A major predictor of LVEF improvement is a GLS value higher than 23.5%.

INTRODUCTION

The degree of myocardial damage in the presence of acute ST elevation myocardial infarction (STEMI) is influenced by numerous factors and the left ventricular ejection fraction (LVEF) is commonly employed to measure it[1]. In individuals with normal LVEF, LVEF cannot measure small myocardial injury or detailed regional changes in contractility, despite its vast range of applications. Global LV strain parameters are just one example of the new metrics that have been developed for precise and early risk estimation following STEMI. The latter calculates, in STEMI patients with post-MI LVEF that is intact, the 30-day risk of major adverse cardiac events (MACE). After a STEMI, a large number of patients with normal LVEF appear to have impaired myocardial strain, supporting the limited utility of LVEF alone in assessing LV function[2]. It's unknown whether myocardial strain values are better at predicting worse long-term outcomes in patients with low LVEF. Global longitudinal strain (GLS), rather than LVEF following STEMI, is a stronger predictor of all-cause death, according to a meta-analysis of the data available in patients with heart failure[3]. In the general population at low risk, it is also a stronger predictor of long-term cardiovascular morbidity and mortality. In patients with low initial LVEF, it appears that there is a strong relationship between the direction and magnitude of change in the LV strain parameters and LVEF in the initial months following STEMI[2]. We looked at echocardiographic LV function markers like GLS and LVEF in a group of patients who had primary percutaneous coronary intervention (PCI) for acute STEMI 48 hrs and 2 months later to see if GLS and its relative factors were prognostic.

Despite tremendous advances in detection and treatment over the last few decades, ST-segment myocardial infarction (STEMI) remains a major public health concern in the developed world and is becoming more so in developing countries. The preferred course of treatment for STEMI patients is timely reperfusion using primary percutaneous coronary intervention (PPCI) within 12 hrs of the beginning of symptoms, which has greatly improved outcomes and prognosis[4]. The extent of myocardial injury is the first of several factors that may contribute to left ventricular (LV) remodelling following STEMI. By preventing changes in LV size, shape and thickness that affect both the infarcted and non-infarcted LV segments, early reperfusion therapy and focused medical care can improve LV function and prognosis[5].

Evidence is mounting that inflammation-related markers may serve as accurate predictors of myocardial damage severity and elevated cardiovascular risk. In a recent human pilot study (CAMI1), C-reactive protein (CRP) concentration or CRP increase throughout the 32 hrs following the beginning of STEMI symptoms and myocardial infarct size (IS) were found to be substantially correlated[6].

Cardiovascular magnetic resonance (CMR) imaging enables a more in-depth evaluation of heart structure, even if echocardiography continues to be the go-to imaging modality in acute STEMI scenarios[7]. Myocardial injury, such as oedema, necrosis/scar, hemorrhage, or microvascular blockage, can be found with CMR, It provides a more precise assessment of ventricular volumes, function and mass. Two CMR-derived metrics, myocardial area-at-risk (AAR) and myocardial salvage index (MSI), have also been proved to be feasible clinical trial endpoints. According to current research, LV strain measured using the feature tracking (FT) technique is an important metric for detecting more subtle functional changes in infarcted and distant myocardial. The global longitudinal strain (LV GLS) in the LV is a stronger predictor of LV remodelling and adverse cardiovascular events[8]. Importantly, LV strain can be easily incorporated into diagnostic and prognostic algorithms alongside other CMR measures.

MATERIALS AND METHODS

The study included 100 patients who had acute STEMI and were admitted to NRS Medical College and hospital, Kolkata for primary PCI.

Patients in this trial had a successful primary PCI on the culprit lesion within 48 hrs, with a post-procedure Thrombolysis in Myocardial Infarction (TIMI) score of 3 and an estimated LVEF of less than 50%.

Patients with a history of prior myocardial infarction, coronary artery bypass grafting (CABG), or revascularization were excluded. Patients with significant valvular heart disease or insufficient echocardiographic views were also excluded, as were those who experienced any cardiovascular problems during our 2-month follow-up, including an episode of severe arrhythmia, early hospitalisation, or mortality. All patients signed informed permission forms before to the initial echocardiographic testing.

RESULTS

Out of 100 patients, 74.0% were men, with a mean age of 46.7±11.2 years. 100 individuals had an abnormal lipid profile, 54.0% had diabetes, 68.0% had hypertension and 28.0% had diabetes. 53.0% of patients reported smoking and 41.0% of 100 patients had a known family history of coronary artery disease (CAD) (Table 1).

Thirty eight instances (38.0%) of myocardial infarction involved the anterior territory, 16 patients the anteroseptal territory, 7 cases (7.0%) the inferior territory, 12 cases the posterior territory and 18 patients the inferoseptal territory. Extensive

Table 1: Study group characteristics

characteristics	No.	Percentage
Age		
<60	62	62
>60	38	38
Gender		
Male	74	74
Female	26	26
Diabetes		
Positive	54	54
Negative	46	46
Hypertension		
Positive	68	68
Negative	32	32
Hyperlipidemia		
Positive	28	28
Negative	72	72
Family history		
Positive	41	41
Negative	59	59
Smoking		
Positive	53	53
Negative	47	47
MI type		
Anterior	38	38
Anteroseptal	16	16
Inferior	7	7
Posterior	12	12
Inferoseptal	18	18
Extensive	9	9
Culprit vessel		
RCA	57	57
LAD	24	24
LCX	12	12
OM	7	7
LV diastolic dysfunction after 48 hrs		
Mild	56	56
Moderate	34	34
Severe	10	10
LV diastolic dysfunction after 2 months		
Mild	33	33
Moderate	22	22
Severe	14	14
RV dysfunction after 48 hrs	15	15
RV dysfunction after 2 months	16	16

Table 2: The relationship between GLS after 48 hrs and >5% increase in EF after two months

Significant (>5%) increase in EF after two months	Mean GLS after 48 hrs (%)	p-value
Positive	25.56±11.01	<0.05
Negative	21.74±5.83	

Myocardial Infarction (MI) was present in 9 patients (9.0%). In 57 cases (57.0%), the right coronary artery (RCA) was the responsible vascular, followed by the left anterior descending artery (LAD) in 24 cases (24.0%), the left circumflex artery (LCX) in 12 and the obtuse marginal (OM) in 7 patients.

At 48 hrs after MI, the mean EF and GLS values were 52% and 15.5, respectively, while at 2 months following MI, they were 44 and 22.9. Following the division of the cases into two groups those who experienced an EF measurement improvement of more than 10% and those who experienced less or no improvement the first group of patients included 23 patients, while the latter group included 46 resting patients. The former group was consisting of 10 males and 13 females with a mean age of 62.0±1.9 years old, 8 of the patients had hypertension, ten of them had diabetes mellitus, six of them had hyperlipidemia and four of them were dealing with all the illnesses indicated above at the same time. In this group of patients, 8 patients smoked and 4 of them had a confirmed family history of known CAD. Both the RCA and the LAD were the responsible lesions in 12 cases each. Six individuals experienced inferior MI and two more experienced widespread and anteroseptal MI (Table 2).

Early GLS and early EF values had a Pearson correlation of r = 0.32 and a p = 0.037. The late GLS value and late EF also had a Pearson's r = 0.48, p = 0.001, correlation. Patient groups with eventual EF recovery >5% experienced a mean early EF of roughly 45%, compared to 41% for the remainder (p = 0.069). The average late EF was almost 50% in patients whose final EF recovery was greater than 10% and roughly 52% in the rest (p = 0.012). In patients whose eventual EF recovery was >10%, the mean early GLS value was around 26%, compared to roughly 12% in the remainder of the group (p<0.0001). The average late GLs value was identical to the average early GLs value (p<0.0001). (p = 0.35) EF recovery >10% and GLS recovery >10% were not linked.

In the group of patients whose EF had increased by more than 10% after two months, the mean GLS value was 25.46, in the other group, it was 21.74. The GLS values after 48 hrs were subjected to ROC analysis and the results showed that values higher than 23.5 predicted an increase in LVEF of more than 10% after two months.

Forty eight hours after the onset of symptoms, inferior, posterior and inferoseptal MI were significantly more common, with GLS values greater than 23% being significantly less common (32.2% for anterior MI, 5% for anteroseptal MI and 35% for extensive MI versus 84.1% for inferior MI, 100% for posterior and inferoseptal MI, p = 0.05).

The prevalence of GLS values greater than 23% was significantly higher in cases with RCA occlusion and was significantly lower in situations with LAD branch occlusion (100% for RCA occlusion versus 31.7% for LAD occlusion and 100% for LCX occlusion, p = 0.05).

DISCUSSIONS

Regional and global myocardial function are determined by myocardial strain using echocardiography[9]. GLS has been validated to assess global cardiac function in the setting of STEMI, stable chronic coronary artery disease and the general healthy population, as indicated in the lines that follow.

In the study by Munk, GLS was superior to LVEF and end-systolic volume index (ESVI) but equivalent to WMSI in assessing the infarct size one day after STEMI. Then, 30 days after the STEMI, it was comparable to LVEF and LVSD and inferior to WMSI. A GLS greater than 15% was previously identified by Gjesdal *et al.*[10]

as an effective predictor of infarct size, 9 months following STEMI. Additionally beneficial has been GLS in patients with stable coronary artery disease. Despite the fact that LVEF and wall motion were unchanged, they detected a considerable decline in GLS of ischemic areas. 3 months after conducting PCI, Magdy *et al*.[11]. observed an improvement in baseline GLS in a recent study on a cohort like this one.

GLS is also promising in patients who have undergone revascularization. When patients underwent PCI following inferior STEMI, Song *et al*.[12] investigated the patients' longitudinal, circumferential and radial LV stresses. In comparison to healthy controls, they showed a 60% improvement in global longitudinal and circumferential LV stresses and a reduced LV strain (in all three dimensions) after PCI. LV regional strain was impaired in 87% of patients with inferior MI and improved in 60% of instances after PCI. Despite the fact that the global circumferential strain was only significantly reduced 6 months after Mic, Yang's recent study revealed a significant reduction in GLS in a subset of anterior STEMI patients. As previously stated, Magdy *et al*.[11] recently confirmed comparable findings in a sample of PCI candidates with stable coronary artery disease.

In the general population, GLS has been shown to be a predictor of future cardiovascular events. In order to determine the prevalence and predictive power of LV GLS in the general population, Russo *et al*.[13] organized a community-based investigation. 96% of the 708 study participants had normal LVEF, while 16% of them had abnormal LV GLS. They observed that both the aberrant GLS and abnormal LVEF were strongly linked with unfavourable outcomes after five years of tracking vascular events in the cohort. Once more, persons with abnormal GLS and normal EF were much more likely to experience vascular events. This study validated the utility of GLS assessment in post-ischemic individuals with normal EF. A population of 1296 participants were tracked for 11 years by Biering-Sørensen *et al*.[14] in a more recent prospective study to ascertain the prevalence of heart failure, acute myocardial infarction, or cardiovascular death as well as the predictive indicators. They found that a higher risk of unfavourable cardiovascular events is strongly related with lower GLS levels. Note that when controlled for sex alone, this connection was not found in women.

According to previous studies, there is no agreement on the cut-off GLS value that best predicts mortality and morbidity. Generally, studies indicated a GLS of 12-15%; however, Bendary *et al*.[15] recently discovered that the only significant independent predictor of 30-day MACE with sensitivity and specificity of 77.8% and 83.7% was a baseline GLS value of less than 12.65%. Goedemans *et al*.[16] found that a cut-off value of 14.4% or less was highly associated with all-cause mortality in COPD patients following STEMI.

CONCLUSION

All of our patients who had STEMI had reduced GLS values to less than 18% and reduced LVEF was consistent with the previously noted correlation between reduced LVEF and impaired LV strain. When patients experienced an early post-MI LVEF improvement of more than 5% after two months, we saw significantly higher early GLS values in those individuals. About 13.5% was the GLS cut off number that was a reliable indicator of long-term LV function improvement. According to our research, early GLS is a commonly used and realistic criterion for forecasting future left ventricular recovery, showing little change over the course of time following the acute coronary event. GLS should be considered a complementary approach in all patients with borderline or reduced ejection fraction early after MI, though more comprehensive evidence from larger study populations and taking long-term prognostic outcomes into account is required to support its use in future practise guidelines. This is because early prediction of future LV performance can guide both medicinal therapy and defibrillator indications in the days following STEMI.

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