Pk Heart J 2025:58(01)
ISSN:0048-2706 E-ISSN:2227-9199

A prospective observational study on assessment of left ventricular systolic function by tissue mitral annular displacement and global longitudinal strain in Nstemi patients

Vishalini D[1]
Priya M[1]
[1]Department of Cardiology, Shri Sathya Sai Medical College and Research Institute, Ammapettai – 603108.

Divya Lakshmi[2]
[2]Department of Cardiology, Chettinad Hospital and Research Institute, Kelambakkam – 603103.

Abstract:

Background:
The term "ACS" describes collection of ischemic disorders, such as unstable angina, non-ST segment elevation myocardial infarction (NSTEMI), and ST segment elevation myocardial infarction (STEMI), that arise from the rupture of coronary plaque. Many NSTEMI patients have occluded coronary artery. However the occlusion is not easily recognized so they do not get urgent revascularization therapy. Prompt detection and treatment of these individuals may reduce infarct size and improve survival. The assessment of LVSF was evaluated by various echocardiographic parameters. The quantitative assessment of LVSF was more determine with accuracy by GLS and TMAD methods.

Methods:
Prospective observational study was done in 100 patients and all their clinical information was recorded. ECG and Troponin test were taken which diagnosed as NSTEMI. Those patients were prospectively reviewed for Left Ventricular Systolic Function using GLS and TMAD. GLs and TMAD is statistically analysed using Pearson correlation in NSTEMI patients.

Results:
A total of 100 NSTEMI patients were taken up for the study. A statistically significant association was found between GLS and TMAD measurements. i.e.,P value <0.05. Both the parameters were moderately correlated. Hence, TMAD might also be used as LVSF assessing echocardiographic marker and it was less time consuming.

Conclusion:
The study shows that Tissue Mitral Annular Displacement might also be used as Left Ventricular systolic function and it was less time consuming.

Keywords:
Acute Coronary Syndrome, Non ST Elevation Myocardial Infarction, Global Longitudinal Strain, Tissue Mitral Annular Displacement.

1. Introduction:

The spectrum of ACS includes unstable angina (UA), STEMI and NSTEMI (1). Clinical outcomes are correlated with the level of cardiac tissue damage caused by acute myocardial infarction, which also impairs systolic function(2-5). In order to decrease infarct size and mortality, patients with STEMI get immediate acute reperfusion therapy (6,7). Despite having blocked coronary arteries and likely sharing many pathophysiologic characteristics with patients who suffer STEMIs, many patients with NSTEMI do not get immediate revascularization therapy because the occlusion is difficult to detect (8-10). individuals with NSTEMIs who have occluded arteries have larger infarcts and decreased LV function; if these individuals are identified and treated promptly, the infarct size may be reduced and survival may be increased(11,12). The sensitivity of electrocardiography to identify acute coronary occlusion is insufficient. As a result, improved instruments for diagnosis are needed (13,14). Increased myocardial injury causes a decrease in systolic LV long-axis distortion (15). Tissue Doppler imaging depicts myocardial motion by measuring tissue velocity at specific regions. The integration of tissue velocity over time produces the absolute distance moved by that particular region (16). Apex remains largely unchanged during the cardiac cycle, and the heart's overall shortening deformation is reflected in the longitudinal MAD(17-19)(TABLE 1.1). GLS measured by 2D STE is a reliable indicator of deformation of myocardium, but it takes a lot of time and requires a clear view of the entire LV curvature (20)(TABLE 1.2). But TMAD was less time-consuming and may also be utilized as an echocardiographic marker to monitor LV systolic function. The objective was to compare the LV systolic function in NSTEMI patients using TMAD and GLS.

Table 1.1: Represents The Range For Tmad

PARAMETER	TMAD's (mm)
NORMAL	>10.5
REDUCED	<10.5

Table 1.2: Correlation Between Gls Strain And Ef

INTERPRETATION	EJECTION FRACTION	GLS STRAIN
NORMAL	>60%	-18% to -25%
MILDLY REDUCED	45% - 55%	-17% to -12.5%
MODERATE	35% - 45%	-12.5% to -8.1%
SEVERE	<35%	<-8%

2. Methods

The present study was a prospective observational study carried out in CSSH's cardiology department. The study assess the LV systolic function in NSTEMI patients using GLS and TMAD. Inclusion criteria includes the patients with age limit of 40 to 70years, both genders, patients with diabetes, hypertension, dyslipidemia were hypothyroidism and with family history of CAD were included. Exclusion criteria includes patients with psychiatric issues, arrhythmias, pregnancy. Patient were informed about the trail and given formal consent. Questionnaire contained significant historical information. The study was conducted in the cardiology department, at Chettinad Hospital and Research Institute in Kelambakkam,. Data is collected in the year of Dec2023 – June2024, CARE. The study consisted, 100 NSTEMI patients. Using Conventional echocardiography ECG gated, 2DSpeckle tracking and TMAD method was done using the Philips affinity 50C machine in Department of Cardiology. Echocardiography images acquired in the apical views of four chamber, three chamber, and two chamber for every individual. A4c, A3c, A2c images of the left ventricle's endocardium were tracked. NSTEMI patients were diagnosed based on clinical presentation, ECG changes like ST-T changes and cardiac biomarkers. Those patients were prospectively reviewed for LV Systolic function using GLS and TMAD.

2.1 Statistical Methods:

Pearson correlation was done to compare the GLS and TMAD obtained from NSTEMI patients. P-value < 0.05 are regarded as statistically significant.

3. Results:

The participants of 100 NSTEMI patients were taken in which 57were male (57%) and 43 were female (43%)(TABLE 3.1). In 100 patients, with average age group of 40-70 years (TABLE 3.2), 28% patients were within average age group of 40 - 50years,46% patients were within the age group of 50 - 60 years, 26% patients were within the age group of 60 to 70years. Among those 100 patients 75 patients had a known comorbidity of DM (28%), 68 patients with SHTN (25%), 31patients with DLP (11%), 23 patients with Hypothyroidism(8%) have developed ACS(TABLE 3.3). The LV systolic function was assessed using GLS and TMAD. TABLE 3.4 Represents mean value of LV AP2, LV AP3 and LV AP4. TABLE 3.5 represents mean value of MV s, MV l, MV m. Table 3.6 represents correlation between GLS and TMAD, which is a Moderately Negative correlation, since they both are inversely proportional. which represents the significance of correlation using P-value which is 3.15885×10^{-24} when P value is <0.05.

Table 3.1. Patient Demography

SEX	NO. OF PATIENTS	PERCENTAGE
MALE (1)	57	57%
FEMALE (2)	43	43%

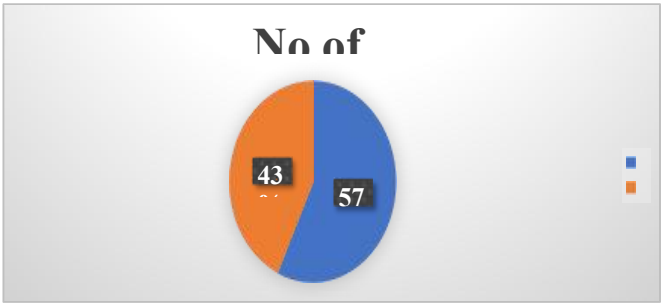

Figure 3.1. Represents Patient Demography

Table 3.2. Age Group

AGE RANGE	PATIENTS
40 – 50	28
50 – 60	46
60 - 70	26

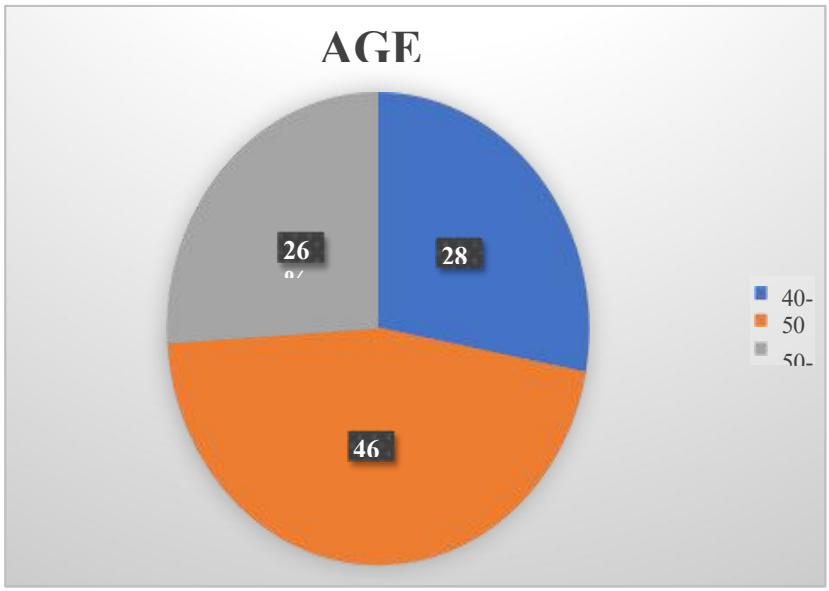

Figure 3.2. Represents Age Group

Table 3.3. Co Morbidities

CO-MORBIDITIES	NO OF PATIENTS
DM	75
HTN	68
DLP	31
HYPOTHYROIDISM	23
FAMILY HISTORY OF IHD	76

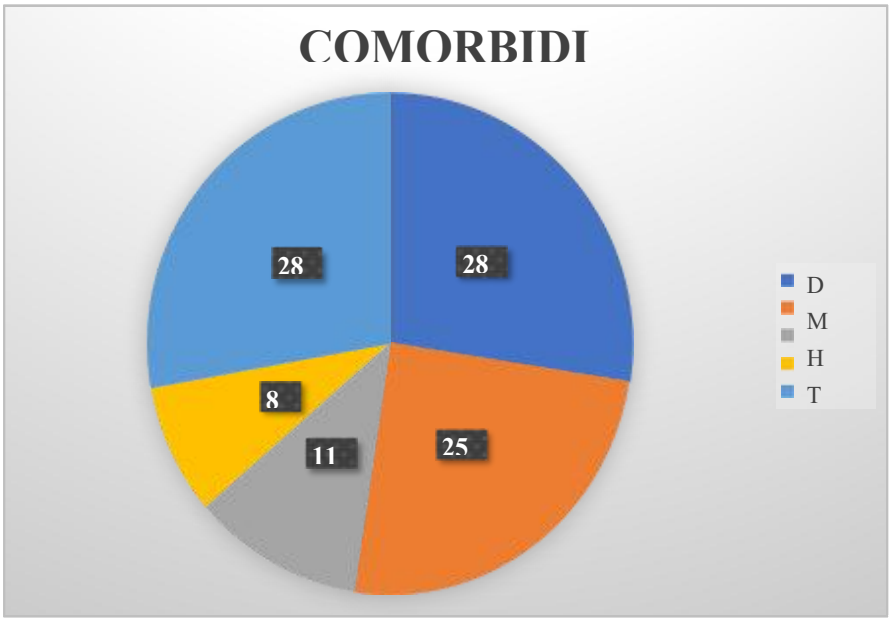

Figure 3.3. Represents The Patient'S Comorbiditie

Table 3.4 Representation Of Mean For Global Longitudinal Strain

PARAMETER	STRAIN (%)
LV AP2 STRAIN	-14.0%
LV AP3 STRAIN	-13.2%
LV AP4 STRAIN	-13.9%

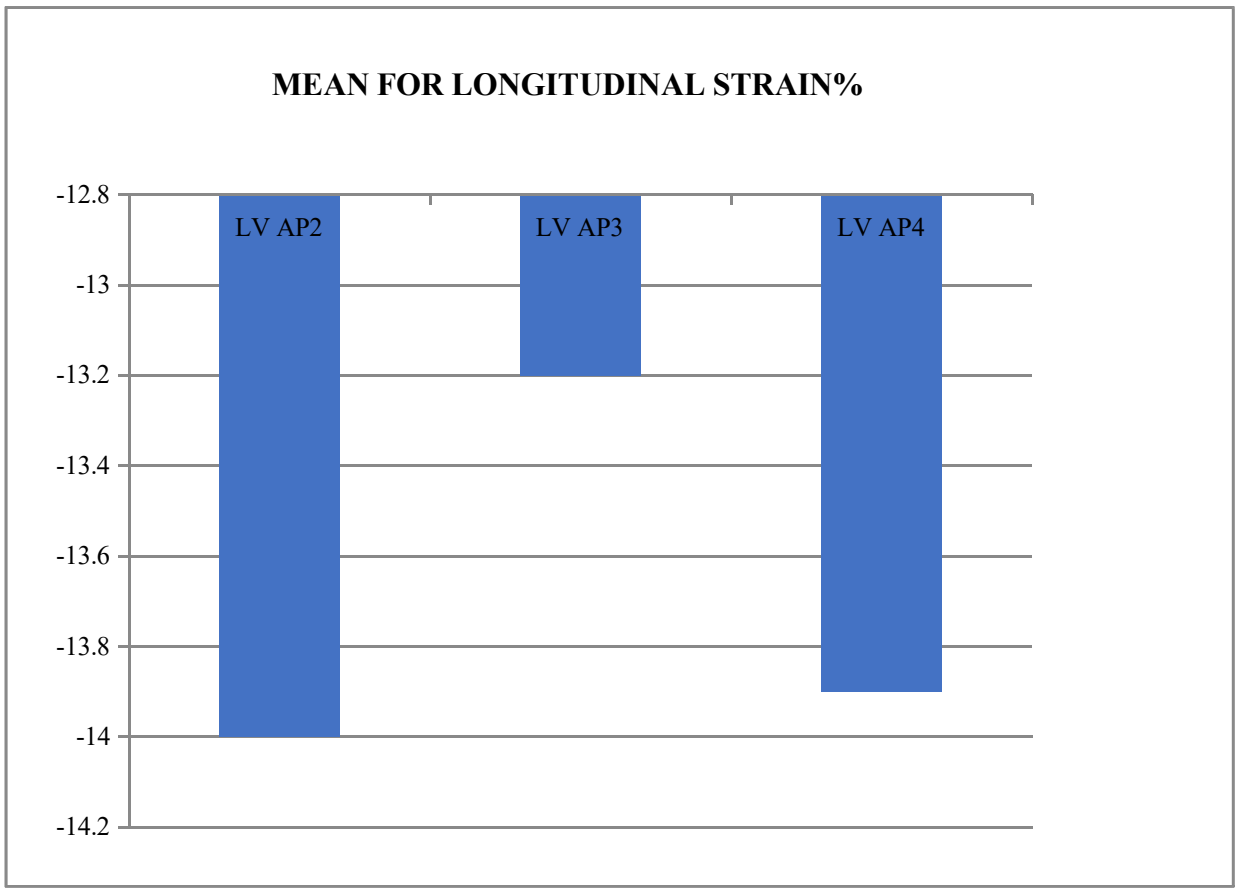

Figure 3.4. Representation Of Mean For Gls

Table 3.5 Representation Of Mean For Tmad

PARAMETER	TMAD (mm)
MV s (SEPTAL)	7.76mm
MV l (LATERAL)	8.01mm
MV m (MID POINT)	7.53mm

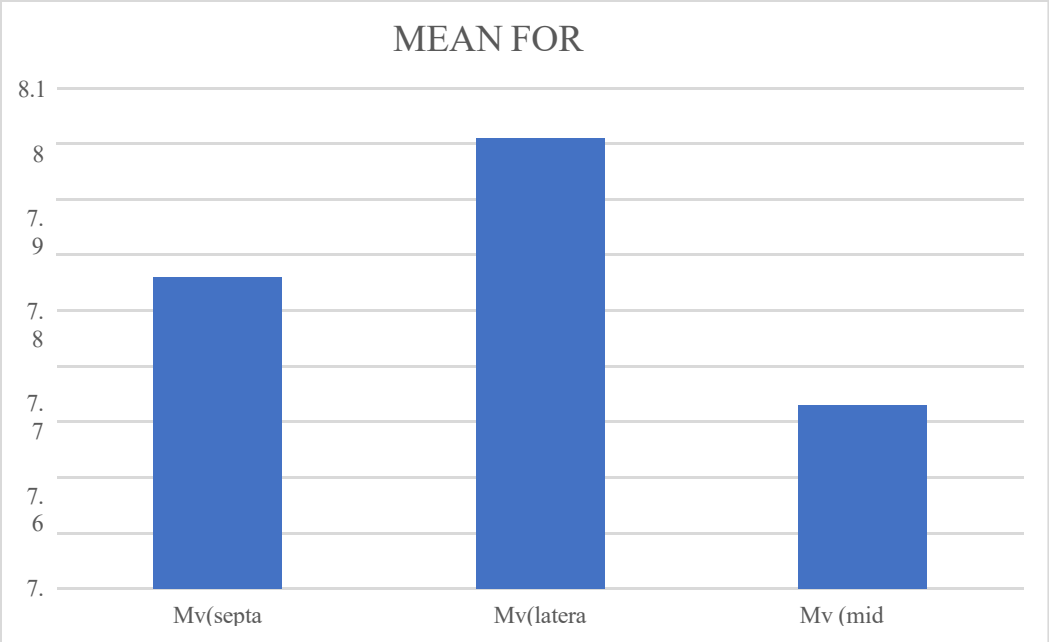

Figure 3.5. Representation Of Mean For Tmad

Table 3.6. Represents The Correaltion Between Gls And Tmad

PARAMETER	r VALUE	CORRELATION
GLS AND TMAD	-0.80780389	MODERATELY NEGATIVE CORRELATION

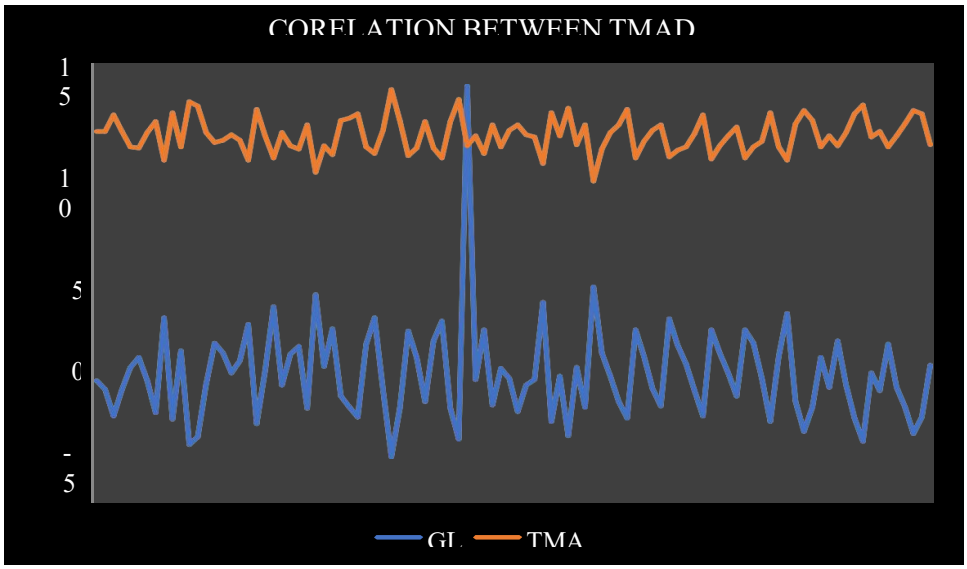

Figure 3.5. Representation Of Correlation Between Tmad And Gls

PEARSON CORRELATION CO EFFICIENT RESULTS:

- The correlation coefficient between TMAD and GLS (r = -0.80780389)
- Population (N=100)
- Degree of Freedom (df=98)

Significanr Based On Population Correlation Coeeficient (P Value):

P value for relation between TMAD and GLS is 3.15885×10^{-24} P value is less than α (0.05 – significance level)

Since P Value is <0.05 the correlation between Tissue Mitral Annular Displacement and GLS is significant.

4. Discussion: The performance of TMAD was comparable with GLS. All results in our study suggest that in patients with NSTEMI, a lower TMAD correlates to a reduced myocardial function(21). Because of longitudinal LV deformation, the annulus moves towards apex during systole;the average annular motion is known as TMAD. The overall shortening deformation of the heart is reflected by TMAD in the longitudinal direction since the apex is stationary throughout the cardiac cycle. This technique is entirely 2D and captures both axial and lateral frames, unlike tissue Doppler-based techniques that rely on angle for motion estimate(22). GLS by 2D speckle-tracking echocardiography is an excellent marker to detect myocardial function. But it needs to be well-visualized, and the analyses need to be done by very skilled trainees. It can be difficult to provide such a service in emergency rooms. However, in order to assess TMAD, the mitral annulus alone must be seen, which is feasible in almost all individuals (23). Variation of MAD can be seen with age or body size, patients with LVH, basal wall motion abnormalities, paradoxical septal motion such as in the case of bundle branch block(24).Although MAD is used to assess EF in more recent studies, it has been demonstrated in earlier research to more accurately represent stroke volume than LVEF(25). Furthermore, the purpose was to test the hypothesis that MAD measurements might be utilized as a quick stand-in for GLS. Every patient's TMAD was measured, and the unique algorithm was used to correlate it with the GLS. In all patients, TMAD and the mean GLS had a linear relationship(26). In conclusion, we discovered that STE derived MAD was technically feasible in most patients and showed a strong correlation with GLS across a wide range of patients with different EFs. It is less time-consuming and may also be utilized as an echocardiographic marker to monitor LV systolic function in a busy clinical environment.

5. Conclusion:

Everyday clinical diagnosis relies heavily on echocardiography. When a patient receives a critical ACS diagnosis, time management is essential. The quantification of LV systolic function was assessed using various echocardiographic parameters. Specifically, GLS methods is widely used. The Tissue mitral annular displacement assess the LV myocardial deformation in longitudinal manner. The mitral annular displacement towards apex is used to evaluate the LVSF. TMAD was significantly correlated with other systolic function parameters like GLS%. Hence, TMAD might also be used as LV systolic function assessing echocardiographic marker and it was less time consuming.

Referance:

1. S.A. Achar, S. Kundu, W.A. Norcross, Diagnosis of acute coronary syndrome. Am Fam Physician, 72 (2005), pp. 119-126.
2. Mollema SA, Delgado V, Bertini M, Antoni ML, Boersma E, Holman ER, et al. Viability assessment with global left ventricular longitudinal strain predicts recovery of left ventricular function after acute myocardial infarction. Circ Cardiovasc Imaging 2010;3:15-2
3. White HD, Norris RM, Brown MA, Brandt PW, Whitlock RM, Wild CJ. Left ventricular end-systolic volume as the major determinant of survival after recovery from myocardial infarction. Circulation 1987;76:44-51.
4. Gaudron P, Eilles C, Kugler I, Ertl G. Progressive left ventricular dysfunction and remodeling after myocardial infarction. Potential mechanisms and early predictors. Circulation 1993;87:755-63.
5. Antoni ML, Scherptong RW, Atary JZ, Boersma E, Holman ER, Van der Wall EE, et al. Prognostic value of right ventricular function in patients after acute myocardial infarction treated with primary percutaneous coronary intervention. Circ Cardiovasc Imaging 2010;3:264-71.
6. Munk K, Andersen NH, Schmidt MR, Nielsen SS, Terkelsen CJ, Sloth E, et al. Remote ischemic conditioning in patients with myocardial infarction treated with primary angioplasty: impact on left ventricular function assessed by comprehensive echocardiography and gated single-photon emission CT. Circ Cardiovasc Imaging 2010;3:656-62.
7. Morrison LJ, Verbeek PR, McDonald AC, Sawadsky BV, Cook DJ. Mortality and prehospital thrombolysis for acute myocardial infarction: a metaanalysis. JAMA 2000;283:2686-92.
8. Koyama Y, Hansen PS, Hanratty CG, Nelson GIC, Rasmussen HH. Prevalence of coronary occlusion and outcome of an immediate invasive strategy in suspected acute myocardial infarction with and without ST-segment elevation. Am J Cardiol 2002;90:579-84.
9. Wang TY, Zhang M, Fu Y, Armstrong PW, Newby LK, Gibson CM, et al. Incidence, distribution, and prognostic impact of occluded culprit arteries among patients with non-ST-elevation acute coronary syndromes undergoing diagnostic angiography. Am Heart J 2009;157:716-23.
10. Montalescot G, Dallongeville J, Van BE, Rouanet S, Baulac C, Degrandsart A, et al. STEMI and NSTEMI: are they so different? 1 year outcomes in acute myocardial infarction as defined by the ESC/ACC definition (the OPERA registry). Eur Heart J 2007;28:1409-17.
11. Grenne B, Eek C, Sjoli B, Dahlslett T, Uchto M, Hol PK, et al. Acute coronary occlusion in non-ST-elevation acute coronary syndrome: outcome and early identification by strain echocardiography. Heart 2010;96: 1550-6.
12. Bello D, Einhorn A, Kaushal R, Kenchaiah S, Raney A, Fieno D, et al. Cardiac magnetic resonance imaging: infarct size is an independent predictor of mortality in patients with coronary artery disease. Magn Reson Imaging 2011;29:50-6.
13. Tragardh E, Claesson M, Wagner GS, Zhou S, Pahlm O. Detection of acute myocardial infarction using the 12-lead ECG plus inverted leads versus the 16-lead
14. ECG (with additional posterior and right-sided chest electrodes). Clin Physiol Funct Imaging 2007;27:368-74.
15. Perron A, Lim T, Pahlm-Webb U, Wagner GS, Pahlm O. Maximal increase in sensitivity with minimal loss of specificity for diagnosis of acute coronary occlusion achieved by sequentially adding leads from the 24-lead electrocardiogram to the orderly sequenced 12-lead electrocardiogram. J Electrocardiol 2007;40:463-9.
16. Chan J, Hanekom L, Wong C, Leano R, Cho GY, Marwick TH. Differentiation of subendocardial and transmural infarction using two-dimensional strain rate imaging to assess short-axis and long-axis myocardial function. J Am Coll Cardiol 2006;48:2026-33.
17. Abraham TP, Dimaano VL, Liang HY. Role of tissue Doppler and strain echocardiography in current clinical practice. Circulation 2007;116: 2597-609.

18. Tsang W, Ahmad H, Patel AR, Sugeng L, Salgo IS, Weinert L, et al. Rapid estimation of left ventricular function using echocardiographic speckletracking of mitral annular displacement. J Am Soc Echocardiogr 2010; 23:511-5.
19. Roberson DA, Cui W. Tissue Doppler imaging measurement of left ventricular systolic function in children: mitral annular displacement index is superior to peak velocity. J Am Soc Echocardiogr 2009;22: 376-82.
20. Feigenbaum H. Recording mitral annular motion: a discovery made while investigating the poor specificity of the mitral valve diastolic (E to F) slope. J Am Soc Echocardiogr 2012;25:975-7.
21. Geyer H, Caracciolo G, Abe H, Wilansky S, Carerj S, Gentile F, et al. Assessment of myocardial mechanics using speckle tracking echocardiography: fundamentals and clinical applications. J Am Soc Echocardiogr 2010; 23:351-69.
22. DeCara JM, Toledo E, Salgo IS, Lammertin G, Weinert L, Lang RM. Evaluation of left ventricular systolic function using automated angleindependent motion tracking of mitral annular displacement. J Am Soc Echocardiogr 2005;18:1266-9.
23. Pai RG, Bodenheimer MM, Pai SM, Koss JH, Adamick RD. Usefulness of systolic excursion of the mitral annulus as an index of left ventricular systolic function. Am J Cardiol 1991;67:222-4.
24. Gjesdal O, Vartdal T, Hopp E, Lunde K, Brunvand H, Smith HJ, et al. Left ventricle longitudinal deformation assessment by mitral annulus displacement or global longitudinal strain in chronic ischemic heart disease: are they interchangeable? J Am Soc Echocardiogr 2009;22:823-30.
25. Wandt B, Bojö L, Wranne B. Influence of body size and age on mitral ring motion. Clin Physiol. 1997 Nov;17(6):635-46. doi: 10.1046/j.1365-2281.1997.00065.x. PMID: 9413650.
26. Feigenbaum H, Zaky A, Nasser WK. Use of ultrasound to measure left ventricular
27. stroke volume. Circulation 1967;35:1092-9.
28. Tsang, W., Ahmad, H., Patel, A. R., Sugeng, L., Salgo, I. S., Weinert, L., … Lang, R.
29. M. (2010). Rapid Estimation of Left Ventricular Function Using Echocardiographic Speckle-Tracking of Mitral Annular Displacement. Journal of the American Society of Echocardiography, 23(5), 511–515. doi:10.1016/j.echo.2010.03.003.