International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.11 No.06, pp 57-61, 2018

Mitral Annulus Plane Systolic Excursion (Mapse) From Echocardiography M-Mode as A Parameter for Left Ventricular Diastolic Function

Zulfan Efendi*[1], Zulfikri Mukhtar[1], Zainal Safri[1], Abdullah A. Siregar[1], Nizam Z. Akbar[1], Abdul H. Raynaldo[1]

[1]Department of Cardiology and Vascular Medicine, University of Sumatera Utara, Adam Malik Hospital, Medan, Indonesia

Abstract: Background: Assessment of left ventricular diastolic function is an important part of the routine echocardiographic examination to identify the underlying heart disease and determine the appropriate treatment. Mitral annular displacement toward the apex in systolic plays important role in pump function of the left ventricle. At the start of diastolic, the atrioventricular (AV) plane begins to ascend rapidly toward the atrium away from the apex. Atrial systole also contributes to ventricular filling by further displacing the AV plane in the same direction, and this notice as the last part of the diastolic phase of AV plane displacement and is associated with the P wave of an electrocardiogram.

Methode: A diagnostic test was performed to outpatients and inpatients undergoing elective echocardiography at Department of Cardiology in Haji Adam Malik Hospital Medan from October 2017 to February 2018 in accordance with inclusion and exclusion criteria. Mitral annulus plane systolic excursion (MAPSE)examination was performed using M-mode method on septal, lateral, inferior and lateral mitral annulus and then calculated the mean. The diastolic function is measured by assessing E/e'. The value of the tested points was tested using ROC curve statistic test and obtained sensitivity and specificity values. Further analysis to assessed the strength of the relationship with bivariate analysis.

Result: A total of 81 samples were found in this study, with 41 samples meeting inclusion and exclusion criteria. Mean MAPSE with cutoff value <13,625 had a sensitivity value of 62.5%, specificity 51.2%, positive predictive value of 58.3%, and a negative predictive value of 55.5% ($p < 0.05$). The result of bivariate analysis with Pearson method showed the coefficient value of 0.242 ($p < 0.05$).

Conclusion: MAPSE measurements had a weak positive correlation in determining left ventricular diastolic function so it may help to determine the left ventricular diastolic function along with available parameters.

Keywords: Mitral annular plane systolic excursion, MAPSE, mitral annular displacement, diastolic function, echocardiography, E/e'

Zulfan Efendi *et al* /International Journal of ChemTech Research, 2018,11(06): 57-61.

DOI= http://dx.doi.org/10.20902/IJCTR.2018.110608

Introduction

Echocardiography is a major modality in the evaluation of left ventricular diastolic functions in the last two decades.[1]Nowadays, newer and more refined echocardiographictechnologies, such as strain-rate imaging, tissueDoppler imaging (TDI) and three-dimensional echocardiographyare used for interrogating LV function.[2]Limitations in some areas, particularly in remote areas, are the limitations of medical support equipment such as echocardiography, whereas some regions have echocardiographic devices that are not equipped with Doppler facilities which are the main modalities in determining diastolic function. This study tested the modalities used to assess left ventricular diastolic function with a relatively simple method using M-mode echocardiography.

Echocardiography studies show that the displacement of the atrioventricular (AV) valve plane to the apex at the time of systole indicates an important role in left ventricular pump function. Atrioventricular displacement recording method is quite easy and the magnitude of AV field displacement can be used to assess left the ventricular systolic function in patients with acute myocardial infarction, coronary artery disease, and severe chronic congestive heart failure. At the beginning of diastole, the AV field begins to rise rapidly toward the atrium away from the apex. Atrial systole also contributes to ventricular filling by moving the AV field further in the same direction, and this can be noted at the end of the diastolic phase of AV field displacement and associated with the P wave on the EKG.[3]

Methods

This was a cross-sectional study. The inclusion criteria were 35-70 years old, sinus rhythm, had a left ventricular ejection fraction> 50%, had no significant mitral valve deformities (mitral stenosis and / or mitral regurgitation), lacked significant aortic and aortic root abnormalities (aortic stenosis, aortic regurgitation, or aortic dilatation), had no congenital cardiac abnormalities, pericardial abnormalities such as significant pericardial effusions and pericarditis, and hypertrophic cardiomyopathy disease. Exclusion criterion was a poor acoustic window.

Echocardiography examinations were performed using a Vivid S6 imaging device (GE Medical systems) with a 3.5 MHz variable frequency transducer. Systolic function was performed to measure LVEF by biplane method (modification of Simpson) and diastolic function using mitral inflow method (ratio E / e '), septal e', lateral e ', tricuspid regurgitation rate (TR velocity), and left atrium volume (LA). Mitral annulus plane systolic excursion (MAPSE) was measured on 4-chamber and 2-chamber pieces by placing the M-mode cursor through 4 regions (septal, lateral, anterior, and inferior) of the mitral valve annulus and measuring the distance between the lowest point at the beginning of systolic (the beginning of the QRS complex) to the highest point at the end of systolic (end of wave T). After obtaining all four values of MAPSE from all regions, an average MAPSE score was taken that reflects the global longitudinal function in the left ventricle (Hu K et al., 2013).

Descriptive statistics were used to represent the entry of the study. The free variable was the left ventricular diastolic function in the categorical scale, and the dependent variable was the MAPSE in a numerical scale. The data were assessed for the normality of distribution and transformed as appropriate. Results were expressed as frequencies and percentages for categorical variables. Each characteristic of the data tested its significance between normal and abnormal diastolic function. Cut-off points for numerical data are obtained through the ROC curve, the area under the curve (AUC) was used to assess the accuracy of the diagnostic test. Sensitivity, specificity, negative predictive value, and positive predictive value for each dependent variable were obtained with 2x2 tables. While the MAPSE relationship with left ventricular diastolic function was assessed by Pearson or Spearman correlation test.

Results

Total number of subjects was 81 people, consisting of 40 people with normal left ventricular systolic and diastolic function (hereinafter referred to as controls) and 41 people with normal left ventricular systolic function and abnormal left ventricular diastolic function (hereinafter referred to impaired diastolic function). Male gender consisted of 21 people (51,2%) with impaired diastolic function and control found 23 people (57,5%), while female gender consisted of 20 people (28,8%) with impaired diastolic function and control found 17 people (42,5%). The mean age of subjects with impaired diastolic function was 60.59 years while in control was 48.83 years. Mean left ventricular ejection fraction in control subjects was 57.24% while in subjects with impaired diastolic function was 55.93%. The end diastolic dimension of the left ventricle in control was 44.28 mm, while the subject with impaired diastolic function was 43.41 mm. In addition TAPSE in control was 22.83 mm and in subjects with impaired diastolic function was 21.22 mm.(Table 1)

Tabel 1.Clinical and Echocardiographical characteristic

Variable	Normal diastolic function (Control group) (n=40)	Impaired diastolic function (n=41)	P value
Sex • Female • Man	 17(42.5) 23(57.5)	 20(48.8) 21(51.2)	0.57
Age (year±SD)	48.83±12.08	60.59±6.185	0.000
EF Simpson(%±SD)	57.24±3.79	55.93±2.98	0.702
IVSD (mm±SD)	9.73±2.219	11.27±2.09	0.002
IVSS (mm±SD)	11.38±2.05	12.88±2.147	0.002
LVEDD (mm±SD)	44.28±5.711	43.41±6.054	0.512
LVESD (mm±SD)	28.35±4.86	27.98±4.327	0.715
LVPWD (mm ±SD)	10.23±2.475	10.56±2.259	0.526
LVPWS (mm±SD)	14.53±2.53	14.4±3.171	0.893
FS (%±SD)	36.78±5.2	35.29±4.35	0.168
TAPSE (mm±SD)	22.83±2.86	21.22±3.10	0.018
LA(mm±SD)	32.23±3.92	33.07±4.56	0.373
Ao (mm±SD)	20.20±2.06	20.63±1.98	0.338
E/A	1.24±0.23	0.77±0.24	0.000
DT (msec±SD)	174.4±39.46	282.07±349.12	0.057
MAPSE Septal (mm±SD)	13.2±1.937	12.68±2.11	0.255
MAPSE Lateral (mm±SD)	14.48±1.754	13.78±1.93	0.094
MAPSE Inferior (mm±SD)	14.5±1.71	13.2±2.12	0.003
MAPSE Anterior (mm±SD)	14.2±1.91	13.39±1.93	0.06
MAPSE Average(mm±SD)	14.14±1.53	13.34±1.69	0.03

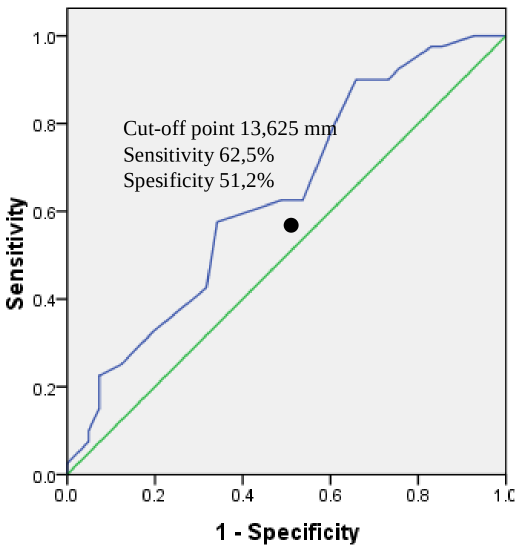

Figure 1. ROC curve mean MAPSE to impaired diastolic function

The mean MAPSE echocardiographic data on diastolic function were searched for cut-off value using ROC curve, then sought sensitivity, specificity, positive predictive value, and negative predictive value.(Figure 1)

Mean MAPSE with a cutoff value of <13.625 mm (p <0.05) for abnormal left ventricular diastolic function has a sensitivity of 62.5%, a specificity of 51.2%, a positive estimate of 55.5%, and a negative predictive value of 58.3%.(Table 2)

Table 2. Sensitivity and specificity of mean MAPSE and impaired diastolic function

Cut off mean MAPSE (mm)	Normal diastolic function	Impaired diastolic function	p-value	AUC	Sens	Spes	ND+	ND–
≥13.625	25(62.5)	20(48.8)	0.037	0.635	62.5%	51.2%	58.3%	55.5%
<13.625	15(37.5)	21(51.2)						

Table 3. Correlation between mean MAPSE and impaired diastolic function

Mean MAPSE (mm)	r Pearson	p-value
13.74±1.65	0.242	0.030

To assess the correlation, this study use Pearson method because the samples were distributed normally. The coefficient of 0.242 was found which showed a weak positive correlation between mean MAPSE with statistically significant diastolic function (p <0.05).(Table 3)

Discussion

This study was a cross-sectional study that examined the MAPSE value in M-mode echocardiography as a parameter in determining left ventricular diastolic function. This research was conducted in Adam Malik hospital Medan since October 2017 until February 2018 and involving 81 sample. The sample were an outpatient and inpatient conducting elective echocardiography examination at echocardiography lab for both routine and diagnostic checks that meet inclusion and exclusion criteria

Impaired ventricular relaxation leads to a reduction in initial ventricular filling, resulting in a larger residual volume in the left atrium in the final phase of the diastolic phase, thus the higher the atrial preload. This results in a stronger left atrial contraction and elevated left atrial activation, which is reflected in the increased contribution of left-handed AV plane displacement. In contrast to longitudinal left ventricle (LV) systolic function, longitudinal LV diastolic function is impaired only in hypertensive patients with normal ejection fraction and fractional shortening which may indicate abnormal LV filling behavior. The diastolic extension of the longitudinal fibers seems to contribute greatly to the diastolic behavior of the left ventricle.[4]

Left ventricular myocardial fibers are predominantly longitudinal or oblique to subendocardium and subepicardium and circular in the intermediate layer. Measurements with M-mode echocardiography from atrioventricular displacement plane have been shown to be a simple method for assessing the systolic and diastolic function of the left ventricular longitudinal fibers. In a variety of clinical settings, this index has been shown to carry important diagnostic and prognostic information with impressive left ventricular dysfunction from the moment. Indeed, some experts have proposed its use as a screening tool that complements the conventional echocardiography index to detect patients with mild myocardial dysfunction.[5]

Patients with hypertension and normal LV ejection fraction and fractional shortening initially thought to have a normal diastolic function or even isolated diastolic dysfunction, have been shown to reduce the systolic function of the left ventricular longitudinal fibers. This may indicate that the change in longitudinal shortening of the left ventricle, determined by the function of the subendocardial fibers, is a very sensitive marker of early systolic dysfunction. Longitudinal fiber diastolic function becomes abnormal only when abnormal diastolic behavior coexists. Assessment of longitudinal fiber diastolic function using M-mode echocardiography can identify left ventricular abnormal relaxation with high accuracy and reproducibility.[4]

The progress of echocardiography has gone hand in hand with the growing knowledge of the function and role of atria in cardiovascular disease.[6,7] Techniques for assessing diastolic function are still developing, looking for a perfect noninvasive way to assess left ventricular diastolic pressure. This study only wants to take part in finding other parameters in determining diastolic function. With the rationale of echocardiography M-mode remains a fundamental part of routine echocardiography examination,[8] this study aimed to tested MAPSE as one of the parameters for determining the left ventricle systolic function in addition to other parameters that already available.

Standard diastolic function examination was performed by following the diastolic function determination algorithm with good systolic function according to ASE guideline 2016 by making E /e' value as the main reference. Meanwhile, the MAPSE examination was performed by placing the M-mode cursor on the mitral annulus in septal, lateral, inferior, and anterior and the mean values are taken. Furthermore, a statistical test was performed to obtain the value of the point of intersection and obtained the value of sensitivity, specificity, positive predictive value, and negative predictive value.

On the basic characteristics of the study subjects found statistically significant at age ($p < 0.001$). The thickness of the septal wall when both systolic and diastolic have significant differences in the study and control subjects ($P = 0.002$). There was no significant difference in the dimensions of the left ventricle, left atrium dimension, or aortic annulus. While the E and A ratios experienced significant differences between control and sample ($p < 0.001$), and mean MAPSE also had statistically significant ($p < 0.05$).

In the statistical test results with ROC curve obtained the number 13.625 on the under the curve area 0.635 as a cutoff point with a sensitivity of 62.5% and specificity 51.2% ($p < 0.05$).

The correlation between mean MAPSE and diastolic function was tested by bivariate analysis using Pearson method and obtained coefficient value 0.242 which has a weak positive correlation between mean MAPSE and diastolic function.

Conflict of interest : None declared

References

1. Nagueh SF, Smiseth OA, Appleton CP, Byrd BF, Dokainish H, et al. EAE/ASE 2016 Recommendations for the evaluation of left vantricular diastolic function by echocardiography: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. *European Journal of Echocardiography* 2016; 29: 277-314.
2. Hu K, Liu D, Herrmann S, Niemann M, Gaudron P, et al. Clinical Implication of Mitral Annular Plane Systolic Excursion for Patients with Cardiovascular Disease. *European Heart Joournal – Cardiovascular Imaging*. 2013;14:205-212. doi: 10.1093/ehjci/jes240.
3. Alam M, Höglund C. Assessment by echocardiogram of left ventricular diastolic function in healthy subjects using the atrioventricular plane displacement. *The American Journal of Cardiology*. 1992; 69: 565-68.
4. Koulouris SN, Kostopoulos KG, Traintafyllou KA, Karabinos I, Bouki TP, et al. Impaired systolic dysfunction of left ventricular longitudinal fibers: a sign of early hypertensive cardiomyopathy. 2005. *Clin. Cardiol*. 28, 282–286.
5. Andrén B, Kind L, Hedenstierna G, Lithell H. Left ventricular diastolic function in a population sample of elderly men. *Jrnl of CV Ultrasound &Allied Tech*. 1998. Vol. 15, No. 5, 443-450.
6. Cameli M, Lisi M, Righini FM, Mondillo S. Novel echocardiographic techniques to assess left atrial size, anatomy and function. *Cardiovasc Ultrasound*. 2012; 10: 4.
7. Zile MR, Brutsaert DL. New concepts in diastolic dysfunction and diastolic heart failure: Part I: diagnosis, prognosis, and measurements of diastolic function. *Circulation*. 2002; 105:1387-93.
8. Anderson B."Basic Principles of M-mode". *Echocardiography : the normal examinationand echocardiographic measurements*.2002. 2nd ed. p77-79. Queensland: MGA graphics.

*****