ORIGINAL RESEARCH PAPER

Cardiology

COMPARISON OF VARIOUS DOPPLER ECHOCARDIOGRAPHIC TECHNIQUES IN DIAGNOSING DIASTOLIC DYSFUNCTION IN PATIENTS OF NON ST ELEVATION ACUTE CORONARY SYNDROME (NSTEACS)

KEY WORDS: Non ST Elevation Acute coronary syndrome, unstable angina, non ST elevation MI, Diastolic Dysfunction.

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ABSTRACT

Background: Diastolic dysfunction is an important cause of left heart failure and its role in predicting adverse cardiovascular outcomes is well known. Evaluation for the presence of diastolic dysfunction should be a part of every adult echocardiographic examination in patients presenting with signs or symptoms of heart failure. Coronary artery disease is a well known cause of diastolic dysfunction. In this study we reviewed and compared the common echocardiographic methods to detect diastolic dysfunction in patients with unstable angina and Non ST Elevation MI.

Aims and Objectives: To compare various doppler echocardiographic techniques in the detection of Diastolic dysfunction in patients of Non ST elevation Acute Coronary Syndrome

Materials and Methods: It was a prospective, one year study in the department of cardiology, CMC Ludhiana from 1/04/2016 to 31/03/2017. Patients enrolled in the study were subjected to 12 Lead ECG and complete Echocardiographic examination to assess Diastolic dysfunction.

INTRODUCTION

Diastolic dysfunction results in diastolic heart failure which is a significant cause of morbidity and mortality. Left ventricular diastolic function depends on the relaxation and compliance properties of left ventricular myocardium and abnormalities in diastolic function result in increased LV filling pressures. This can be studied in a non-invasive manner with the help of doppler echocardiographic techniques.[1,2]

Traditional echocardiographic techniques have focussed on transmitral and pulmonary venous recordings to assess diastolic function but these methods are dependent on loading conditions and hence make accurate detection of diastolic dysfunction difficult. An accurate measurement of the mitral inflow velocity is the most important parameter for the assessment of diastolic function by conventional technique. The primary measurements for assessment of mitral inflow include the peak early filling velocity (E wave), peak filling velocity in atrial systole (A wave), the E/A ratio and the deceleration time of the early filling velocity.[2]

Newer echocardiographic methods subsequently developed, such as tissue doppler imaging (TDI), are independent of loading conditions and are thus used in addition to conventional doppler techniques for the detailed and accurate estimation of left ventricular diastolic function by transthoracic echocardiography.

Conventional Doppler methods determine blood flow velocity by measuring high frequency, low amplitude signals from small sized, fast moving red blood cells. TDI employs the same doppler principles to measure higher amplitude, lower velocity signals originating from myocardial tissue motion.[3]

TDI may be performed by pulsed wave and colour doppler methods. Pulsed wave TDI determines peak myocardial velocities. It is very useful for measuring long axis ventricular motion because the ultrasound beam is almost parallel to the longitudinally placed endocardial fibers in apical views.[4] Overall longitudinal left ventricular contraction and relaxation can be very well estimated by mitral annular motion measured by TDI.

In order to estimate longitudinal myocardial velocities, we place the sample volume in the ventricular myocardium immediately adjacent to the mitral annulus. We obtain 3 waveforms representing the cardiac cycle[5]:

1. s': Systolic myocardial velocity seen above the baseline when the annulus descends towards the apex.[6]
2. e': Early diastolic myocardial relaxation velocity visible below the baseline when the annulus descends away from the apex as during early diastole.[7]
3. a': It represents the myocardial velocity associated with atrial contraction.[8,9,10]

Coronary artery disease (CAD) is one of the most important causes of diastolic dysfunction. Both conventional and TDI techniques have been widely employed in the detection of diastolic dysfunction in patients with CAD. E/e' has been proven to be of significant value in early detection of diastolic dysfunction in CAD.[11] In this study we compared different echocardiographic techniques in the detection of diastolic dysfunction in patients with Non ST Elevation Acute Coronary Syndrome (NSTEACS).

AIMS AND OBJECTIVES

To compare various doppler echocardiographic techniques in the detection of Diastolic dysfunction in patients of Non ST elevation Acute Coronary Syndrome.

MATERIAL AND METHODS

The study was a prospective cohort study that was conducted in the department of Cardiology, Christian Medical College and Hospital Ludhiana. This study included all new patients presenting to ICCU with Non ST Elevation ACS from 1/4/2016 to 31/03/2017. Patients were enrolled in the study after satisfying the inclusion and exclusion criteria. Detailed informed consent was taken from the patients enrolled in the study.

Type of study: Prospective Cohort Study

Inclusion criteria

1. All patients of 18 years of age and above, with sign and symptoms of ACS without evidence of ST Elevation were included in the study.

Exclusion criteria.

1. Patients who did not give consent for the study.

In all selected patients history and physical examination were noted and each patient was subjected to 12 lead ECG (PHILIPS PAGEWRITERTC 30 CARDIOGRAPH), Echocardiography (PHILIPS HD 11 XE) and tissue Doppler myocardial imaging. To obtain a baseline hemodynamic status, subjects were made to rest in the supine position for 10 minutes before undergoing the imaging examination. Patients underwent imaging in the left lateral decubitus position using the above system equipped with a 3.5 MHz transducer. Two dimensional gray scale, pulsed, continuous, and colour Doppler data were acquired in parasternal and apical views. For tissue Doppler imaging, the sector was adjusted to obtain a frame rate of atleast 115 frames/second. Diastolic dysfunction was studied with the above parameters recorded on Echocardiography.

The following parameters were noted:

1) LV size measurements
   LVIDD
   LVIDS
2) LA size
3) LVEF
4) Pulsed wave doppler at mitral valve annulus (E, A, E/A ratio)
5) Tissue Doppler Imaging at mitral valve annulus

The following parameters were noted

a) Early diastolic myocardial tissue velocity (e') was checked at septal and lateral wall.
b) Late diastolic myocardial tissue velocity (a').
c) Ratio of transmitral blood flow velocity to tissue Doppler velocity in early diastole (E/e').

STATISTICAL ANALYSIS

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Normality of data was tested by Kolmogorov-Smirnov test. If the normality was rejected then non parametric test was used.

Statistical tests were applied as follows-

1. Quantitative variables were compared using ANOVA/Kruskal Wallis test between three groups and ANCOVA was used for comparison between groups after adjusting for confounding factors.
2. Qualitative variables were correlated using Chi-Square test.

A p value of <0.05 was considered statistically significant.

The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

RESULT AND ANALYSIS

Table 1

Subject Distribution of Unstable Angina Vs NSTEMI Vs Control in study population

Study population (Total)	Unstable Angina	Non ST Elevation Myocardial Infarction	Controls
488	266	178	44

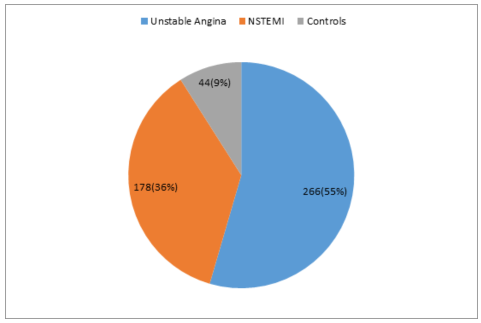
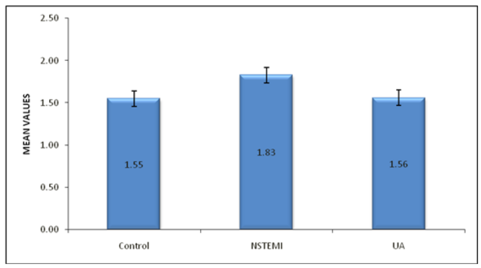


Figure-1 Subject Distribution of Unstable Angina Vs NSTEMI Vs Control in study population

Table 2 E/A ratio on admission amongst Control /UA/ NSTEMI

on ad(E/A)	Control	NSTEMI	UA	Control vs NSTEMI	Control vs UA	NSTEMI vs UA
Sample size	44	178	266	0.586	0.461	0.523
Mean ± ST	0.65 ± 0.18	0.73 ± 0.35	0.66 ± 0.21			

Figure 2 : E/A ratio on admission amongst Control /UA/ NSTEMI



UA=Unstable Angina

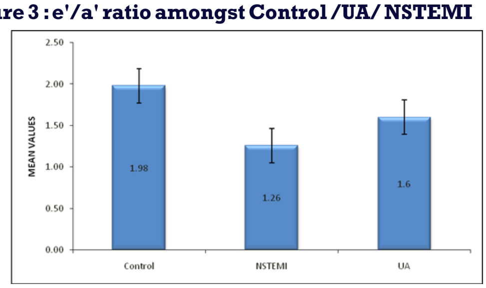
NSTEMI = Non ST Elevation Myocardial Infarction

E/A mean value is higher in NSTEMI group as compared to control and unstable angina but there was no statistical significance as evidence by p value >0.05.

Table 3: e'/a' ratio amongst Control /UA/ NSTEMI

on ad(e'/a')	Control	NSTEMI	UA	Control vs NSTEMI	Control vs UA	NSTEMI vs UA
Sample size	44	178	266	0.662	0.965	0.749
Mean ± ST	2.98 ± 0.53	2.26 ± 0.31	2.6 ± 0.39			

Figure 3 : e'/a' ratio amongst Control /UA/ NSTEMI



UA=Unstable Angina

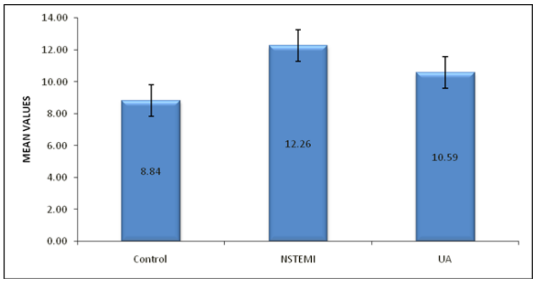
NSTEMI = Non ST Elevation Myocardial Infarction

Lower e'/a' mean values are in Non ST Elevation Myocardial Infarction, and higher values are in control group. However the result is not statistically significant.

Table 4 E/e' ratio amongst Control /UA/ NSTEMI

on ad(E/e')	Control	NSTEMI	UA	P value	Control vs NSTEMI	Control vs UA	NSTEMI vs UA
Sample size	44	178	266	<0.001	<0.001	<0.02	<0.04
Mean ± ST	8.84 ± 2.28	12.26 ± 3.57	10.59 ± 3.73				

Figure 4 : E/e' ratio amongst Control /UA/ NSTEMI



UA=Unstable Angina
NSTEMI = Non ST Elevation Myocardial Infarction

E/e' mean value is significantly different in Non ST Elevation Myocardial Infarction, control and unstable angina(12.26 ± 3.57vs8.84 ± 2.28 vs10.59 ± 3.73). Higher E/e' mean values are in Non ST Elevation Myocardial Infarction, and lower values are in control group.

DISCUSSION

In our study, total of 488 subjects were taken out of which 178 had NSTEMI, 266 had UA and 44 subjects were taken as controls **(table 1 and figure 1)**. Diastolic dysfunction was measured using conventional Doppler echocardiography and Tissue Doppler imaging. The variables which were studied included E/A, E/e' and e'/a'. Mean value of E/A amongst control, NSTEMI and UA at time of admission were 0.65 ± 0.18, 0.73 ± 0.35 and 0.66 ± 0.21 respectively **(table 2 and figure 2)**. There was no statistically significant difference amongst the study group. Similar results were observed by another study **(Sharp et al)**[12]

As seen in table 3 and figure 3, e'/a' value amongst control, NSTEMI and UA groups were 2.98 ± 0.53, 2.26 ± 0.31 and 2.6 ± 0.39 respectively. Lower e'/a' mean values were observed in NSTEMI group as compared to control and UA. The results were statistically found to be non-significant. In our study, we also calculated E/e' ratio amongst the study groups. As seen in **table 4 and figure 4,** E/e' ratio amongst control, NSTEMI and UA groups was 8.84 ± 2.28, 12.26 ± 3.57 and 10.59 ± 3.73. Higher E/e' values were observed in NSTEMI group when compared to UA and control. There was high statistical significance in the results observed, signifying high prevalence of diastolic dysfunction amongst NSTEMI group.

The results observed in our study in identifying diastolic dysfunction using E/e' ratio in tissue Doppler echocardiography revealed statistically significant results. Similar results were observed in another study **(Sharp et al)**[12]

in which diastolic dysfunction was compared to other indices. One possible explanation is that when coronary artery disease causes regional hibernation of myocardium, the e' velocity drops. This velocity has been shown to rise again after percutaneous coronary intervention **(Diller GP et al)**[13]

In our study, we also tried to evaluate the role of e'/a' in detection of diastolic dysfunction in our patient population. This parameter has not been extensively studied previously in studies evaluating the diagnosis of diastolic dysfunction. Since the values of e'/a' showed no statistically significant difference between NSTEMI, UA and control groups, it can be assumed that it was not a reliable marker for diagnosing diastolic dysfunction in patients of ACS in our study.

CONCLUSION

We studied most frequently used parameters to detect diastolic LV dysfunction on echocardiography in ACS patients i.e. transmitral E/A, mitral valve annular e'/a' and E/e'.

We found that transmitral E/A and mitral valve annular e'/a' were not significantly abnormal in ACS patients as compared to controls.

As expected, only E/e' was significantly increased in ACS patients relative to control when cut off values of either mild (12-15) or severe (>15) abnormality were used for comparison of two groups. There was no statistically significant difference in two groups when cut off values of <12 were used.

This proves our pre-study hypothesis that diastolic dysfunction occurs early in ACS patients and as a group it differentiates ACS patients from controls. Thus it is especially true when E/e' is taken as a parameter of diastolic LV dysfunction.

Hence, it can be concluded that E/e' seems to be the best marker for detecting diastolic dysfunction in ACS patients. Further research and large scale studies in varied groups of patients is needed to better characterize the role of other parameters in detecting diastolic dysfunction.

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