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Research Article

Predictive Value of Left Ventricular Diastolic Parameters on Type and Severity of Acute Coronary Syndrome

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Abstract

Objectives: Coronary artery disease is the most common cardiovascular disease and is associated with high rates of mortality and morbidity. The first impaired echocardiographic parameter in acute ischemia is diastolic function and systolic dysfunction occurs later. In our study, we aimed to evaluate the predictive value of left ventricular diastolic parameters on type and severity of acute coronary syndromes.

Methods: The study was prospectively performed by including 60 patients, who applied to our hospital with complaints of chest pain. 12 –lead ECG was performed for all patients. In order to make diastolic function staging, echocardiography was performed by a cardiologist. After receiving a diagnosis, patients were assessed with statistical analyses regarding their echocardiographic results.

Results: According to echocardiography results of patients included in the study, normal function was observed in 25 patients; impaired relaxation in 21; pseudonormal pattern in 7 and restrictive pattern in 7. According to the diagnosis of the patients, 26 patients were diagnosed with nonspecific chest pain. 27 patients were diagnosed as having NSTEMI and 7 patients were diagnosed as having STEMI. There was no correlation between the echocardiographic results of our patients and the diagnoses they have been received.

Conclusion: Although diastolic parameters have many uses to evaluate diagnosis, prognosis and mortality of acute coronary syndromes, there was no significant difference between the groups in our study. The most likely reason for this is the inadequate number of patients in some groups.

Keywords: Acute coronary syndrome, diastolic function, echocardiography

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Coronary diseases are one of the leading causes of mortality in our country and worldwide. In England, 80.000 deaths have been reported due to cardiovascular diseases in 2009.[1] Coronary artery disease is the most commonly seen disease among cardiovascular disorders associated with high rates of mortality and morbidity.[2] Although registries are insufficient in our country, according to the existing data 32% of deaths are resulted from cardiovascular diseases.[3] On the other hand, 25% of patients experiencing a myocardial infarction (MI) die and the risk of mortality within the first month reaches up to 21% among MI survivors.[4]

Presentation with chest pain is a frequently encountered situation in emergency departments.[5] In our country, conditions of emergency departments, high number of admissions and presence of numerous diseases that can lead to these symptoms make the differential diagnosis difficult.[6]

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Although more than half of patients presenting with chest pain are discharged with the diagnosis of nonspecific chest pain, the first step should be distinguishing several diseases such as acute coronary syndrome, aortic dissection, pulmonary embolism and pneumothorax that may lead to fatal outcome.[7, 8] Medical history and risk factors can be rapidly obtained in anamnesis and are guiding in the management of patients presenting with chest pain.

Electrocardiography (ECG) is a standard method used for the initial evaluation of patients with chest pain. However, a normal ECG does not rule out the diagnosis of acute coronary syndrome.[9, 10]

Echocardiography (Echo) takes an important place in patient evaluation, because it is noninvasive and easy to perform technique.[11] Echo provides important information in showing left ventricular function and prognosis.[12]

Based on this information; patients who presented to our hospital with chest pain were evaluated with ECG, and diastolic functions were divided into four groups according to standard diagnostic tests as normal, impaired relaxation, pseudonormal and restrictive patterns. The objective of this study was to evaluate predicting of the severity and type of acute coronary syndromes by left ventricular diastolic parameters.

Methods

A total of 60 patients who were admitted to our hospital with chest pain, diagnosed with acute coronary syndrome and who accepted to participate were included in the study. Patients with chronic heart failure, chronic renal failure and COPD were excluded from the study.

All patients underwent 12-lead ECG with Nihon Kohden Cardiofax ECG-9132 device at rest. Cardiac Tn I levels were measured in all patients and the same cardiologist unaware the clinical picture evaluated the patients with detailed 2-Dimensional Doppler echocardiographic examination.

Patients' height and weight were measured and body surface area (BSA) was calculated using Dubois formula.[13] Left ventricular mass was calculated using Devereux formula.[14]

$LVM=1.04*\ [([LVEDD+IVSd+PWd]^3-LVEDD^3)]*0.8+0.6$

(LVM: Left ventricular mass, LVEDD: Left ventricular end diastolic diameter, IVSd: interventricular septal thickness, PWd: Diastolic posterior wall thickness).

Left ventricular mass index (LVMI) values were calculated for each patient by dividing left ventricular mass by body surface area.

Detailed examination of left ventricular diastolic function was performed with apical four chamber view using transmitral, pulmonary and pulsed wave Doppler. Transmitral early (E) and late (A) diastolic velocities, E-wave deceleration time (DT), A-wave time and isovolumetric relaxation time (IVRT) were recorded. Diastolic function were divided into four groups as normal, impaired relaxation, pseudonormal and restrictive patterns.

Normal diastolic function was defined as E/A <1 and DT <220 ms. Impaired left ventricular relaxation was defined as E/A <1 and DT >220 ms. Pulmonary vein velocities were used to distinguish normal pattern from pseudonormal pattern in patients with normal transmitral Doppler profile. Pseudonormal pattern was defined as E/A >1, but reversed with valsalva maneuver, a time between A duration and transmitral A duration longer than 30 ms, and pulmonary vein atrial reversal flow velocity >35 cm/sec. Restrictive pattern was defined as E/A >1.5, DT <150 ms and IVRT <60 ms.[15]

Echocardiography

Echocardiography examination was performed by a cardiologist who was unaware of clinical information of the patients in the left lateral supine position with Philips Envisor C model echocardiography device and 3.2 mHz adult probe. M mode images were viewed via the parasternal long axis between the mitral valve and papillary muscles. The probe was placed perpendicular to the interventricular septum and left ventricular posterior wall. The internal diameter of the endocardium was measured. Diameters during diastole were also determined. Contraction measurements were made with typical diastolic E-wave and A-wave using Doppler echocardiography. Ejection times were measured. Isovolumetric contraction and relaxation times were determined.

Laboratory Investigations

Routine blood counts and investigations were performed in all patients according to the relevant procedures. Cardiac markers and biomedical parameters were studied from the venous blood samples at the time of admission to the emergency department for the differential diagnosis.

Statistical Analysis

Data obtained in this study were analyzed using Statistical Package for Social Sciences (SPSS) version 17.0 for Windows software. ANOVA test was used for the analysis of the demographic data, Chi-square for the groups with a small number of subjects and Spearman test for correlations. $p<0.005$ values were considered statistically significant.

Results

A total of 60 patients with a mean age of 59.9±13.44 years were included in the study. Of all patients, 25 (41.7%) were

female and 35 (58.3%) were male. No significant difference was found between the genders in terms of the type of acute coronary syndrome (p=0.064). Again, no significant difference was observed between the genders in terms of diastolic dysfunction patterns (p=0.42).

The mean body surface area was found as 1.83±0.18 m^2 (min-max: 1.43–2.35). The mean IVRT was found as 90±21.4 (min–max: 45-137), the mean left ventricular mass as 192.6±44.8 g (min-max: 87-300) and the mean left ventricular mass index as 105±24.76 (min-max: 53-183) g/m. The mean ejection fraction was found as 57±8.3% (min-max: 30%-70%) and the mean deceleration time as 242±83.4 (42-379).

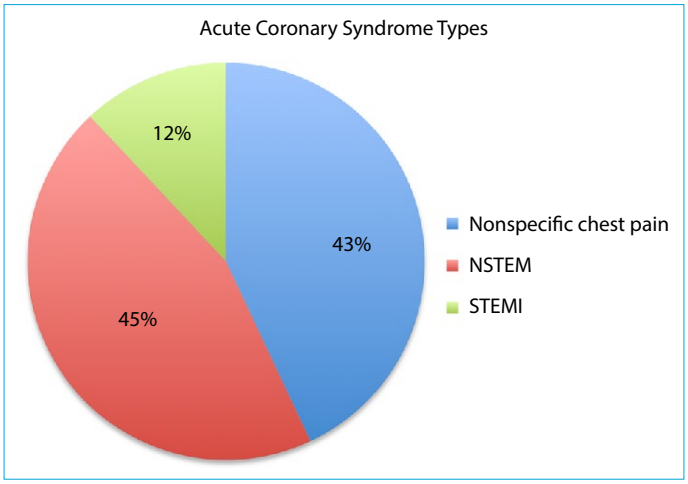

Figure 1. Distribution of the patients according to the type of acute coronary syndromes.

Nonspecific chest pain was found in 26 (43.3%), NSTEMI in 27 (45%) and STEMI in 7 (11.7%) patients (Fig. 1). Demographic data and echocardiographic measurements of the groups are given in Table 1.

When the patients were grouped according to the isovolumetric relaxation time (IVRT) as the patients with an IVRT<100 ms and those with an IVRT>100, no significant difference was found between the groups in terms of the type of acute coronary syndromes (p=0.8). IVRT did not create a difference in the classification of acute coronary syndromes.

Diastolic function patterns was found as normal in 25 (41.7%), prolonged relaxation in 21 (35%), pseudonormal in 7 (11.7%) and restrictive in 7 (11.7%) patients. No significant difference was found between diastolic dysfunction patterns in terms of body surface area (p=0.15).

No statistically significant difference was found between the patients with nonspecific chest pain, NSTEMı and STEMI in terms of deceleration time (p=0.79) and ejection time (p=0.48).

There was a statistically significant correlation between age and acute coronary syndrome types (p=0.038) (Table 2).

Distribution of the patients according to diastolic dysfunction patterns is shown in Figure 2.

There was a significant difference between the acute coronary syndrome types in terms of diastolic dysfunction patterns, but no significant correlation was found as the number of patients was small (Table 3).

Table 1. Demographic data and echocardiography measurements

	Nonspecific chest pain (n=26)		NSTEMI (n=27)		STEMI (n=7)	
	Mean±SD	**Min-Max**	**Mean±SD**	**Min-Max**	**Mean±SD**	**Min-Max**
Age	54.85±15.838	20-80	63.74±9.91	44-83	63.86±10.479	50-81
Height (cm)	163.15±8.54	148-178	164.96±9,3	148-183	163.14±5.984	154-168
Weight (kg)	78.5±17.436	51-135	74.89±12.342	50-98	82.14±10.839	65-100
Interventricular septum thickness (cm)	1.1538±0.19438	0.8-1.7	1.1778±0.19081	0.9-1.8	1.1286±0.20587	0.8-1.5
LV diastolic posterior wall thickness (cm)	1.0923±0.18094	0.8-1.6	1.1148±0.17911	0.8-1.7	1.1±0.2	0.9-1.5
LV end diastolic diameter (mm)	45.23±3.479	38-53	45.81±4.297	35-54	48.57±5.94	42-60
Left ventricular mass (g)	185.15±44.818	87-273	196.3±45.388	103-300	206.29±44.369	135-270
Body surface area (m^2)	1.8362±0.19582	1.43-2.35	1.82±0.18723	1.46-2.2	1.8743±0.13927	1.63-2.06
Left ventricular mass index (g/m)	101.19±23.38	53-137	108.56±27.072	60-183	109.86±20.852	72-140
Deceleration time (ms)	240.12±82.479	128-370	246.22±88.685	42-379	232.71±76.037	110-322
Isovolumetric relaxation time (ms)	89.31±22.931	52-133	91.93±21.722	45-137	85.86±15.323	65-106
Ejection fraction (%)	61.19±6.413	40-70	54.7±7.7	35-65	51.43±10.799	30-64
Ejection time (ms)	308.19±51.163	207-477	318.63±76.384	240-550	341.71±47.598	300-440

SD: Standard Deviation; Min: Minimum; Max: Maximum.

Table 2. Mean ages of patients according to the type of acute coronary syndrome

	Patient number	Mean	SD	Min	Max
Nonspecific chest pain	26	54.85	15.838	20	80
NSTEMİ	27	63.74	9.910	44	83
STEMI	7	63.86	10.479	50	81
Total	60	59.90	13.439	20	83

SD: Standard Deviation; Min: Minimum; Max: Maximum.

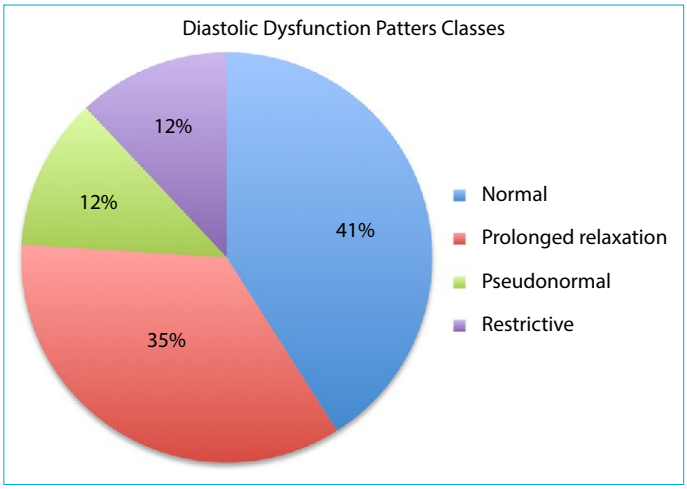

Figure 2. Distribution of the patients according to diastolic dysfunction patterns.

Table 3. Distribution of diastolic dysfunction patterns according to the type of acute coronary syndrome

Echocardiographic diastolic function	Acute Coronary Syndrome			Total
	Nonspecific chest pain	NSTEMI	STEMI	
Normal pattern				
n	17	6	2	25
%	65.4	22.2	28.6	41.7
Prolonged relaxation				
n	6	13	2	21
%	23.1	48.1	28.6	35.0
Pseudonormal				
n	3	2	2	7
%	11.5	7.4	28.6	11.7
Restrictive				
n	0	6	1	7
%	0.0	22.2	14.3	11.7
Total				
n	26	27	7	60
%	100.0	100.0	100.0	100.0

Discussion

Cardiovascular diseases is a commonly seen disease group in our country and worldwide. According to the Turkish Adult Risk Factor Study (TEKHARF) survey, coronary heart disease is seen in 35 per thousand of the adult population in our country.[16] To establish the diagnosis as soon as possible and correctly is of paramount importance in coronary heart diseases. Triage and appropriate directing of patients with acute myocardial infarction in the emergency department, rapid diagnosis and treatment interventions will be helpful in reduction of mortality and morbidity.

Chest pain is the most important symptom of acute coronary syndromes in clinical manifestation. However, these patients may present to the hospital with a variety of signs.[7, 17] In general, this is often seen in diabetic patients, female gender, young people and those aged over 75 years. Classical chest pain may be absent in about one fourth of the cases and the diagnosis is incidentally established in these patients. Moreover, the diagnosis is made upon pathologic Q wave which becomes prominent on ECG and necrosis.[18] In a multicenter study, 7-13% of patients who presented to the emergency department with the complaint of pleuritic and stabbing chest pain were diagnosed with acute myocardial ischemia.[19, 20]

According to the World Health Organization (WHO) stated that at least two of the following criteria are needed to establish the diagnosis of acute myocardial infarction: ischemic chest pain showing retrosternal onset and changes in specific ST segment, T wave and Q wave on serial ECGs, and changes in biochemical cardiac markers in serum.[21]

Acute coronary syndromes are seen in men at an earlier age than women.[22, 23] In our study, no significant difference was found between the genders despite lower mean age found in men. This might be resulted from the relatively small number of patients. However, we found a significant correlation between age and acute coronary syndrome.

According to the definition by WHO, there are marked differences between the studies in terms of the presentation of acute myocardial infarction. Elevated ST segment and pathologic Q wave on ECG are diagnostic for acute myocardial infarction in one third to half of patients. ECG findings may not exist at the time of admission. Therefore, ECG examinations should be consecutively repeated.

In our study, 26 patients were diagnosed with nonspecific chest pain. Of all patients, 27 (45%) were diagnosed with NSTEMI and 7 (11.7%) with STEMI. Among the patients diagnosed with acute coronary syndrome, 79.5% had NSTEMI and 20.5% STEMI. In a study by Gibbons et al.[24] reported NSTEMI and STEMI in 41% and nonspecific chest pain in 32% of their patients % of the patients with acute coronary syndrome were diagnosed with NSTEMI and 15%

with STEMI. In the GRACE study, 34% of the patients were diagnosed with STEMI.[25] Again in a study by Bozkurt et al.,[26] 18% of the patients were reported as NSTEMI, 66% as USAP and 26% as STEMI. Distribution of acute coronary syndrome types were similar in our study.

Echocardiography is a commonly used imaging modality in daily practice for the evaluation of left ventricular sizes and functions. Echocardiography is an easy to access, reliable, easy to use, noninvasive and relatively inexpensive method.

There may be some limitations in the evaluation of cardiac function with echocardiography. These limitations include poor echogenicity, left ventricular geometry, heart rate, and affecting by preload and afterload. In addition, as a disadvantage Echo depends on the clinician.[27]

Hole et al.[28] followed-up patients with acute myocardial infarction for 2 years and found a significant difference between patients who developed heart function after 2 years and those without heart failure in terms of the initial diastolic function parameters.

Left ventricular diastolic functions are one of the first impaired functions in acute coronary syndrome. Therefore these functions can be used in the prognosis of acute coronary syndrome. Ommen et al.[29] studied left ventricular diastolic functions and reported no correlation between deceleration time and Ef and LVPD. Oh et al.[30] underlined the importance of using deceleration time in acute coronary syndromes. Deceleration time has demonstrated significant differences especially in the conditions that resulted in advanced heart failure. Teixera et al.[31] found that left ventricular end-diastolic pressure different was significantly lower in patients with acute coronary syndromes. Again Giannuzzi et al.[32] found significant differences between the parameters related to deceleration time. However, in our study no significant difference was found between acute coronary syndrome groups in terms off deceleration time.

In a study regarding the value of echocardiography in early periods of acute coronary syndrome, Poulsen et al.[33] emphasized significant value of ejection time. In our study, although ejection time was increased in patients with STEMI, the difference was not statistically significant. This might be resulted from the small number of our patients diagnosed with STEMI.

In the present study, no significant difference was found between diastolic dysfunction patterns in terms of body surface area. Interestingly, there was also no significant difference between acute coronary syndrome types in terms of body surface area. Because obesity is among the risk factors for coronary artery disease and many studies have shown that left ventricular diastolic dysfunctions are impaired in obese people.[34] In obesity, primarily eccentric hypertrophy and diastolic dysfunction are seen due to chronic volume load, and volume load leads to impairment of both systolic and diastolic functions as the process continues.[35]

In our study, classification according to isovolumetric relaxation time was not significant in predicting the type of acute coronary syndromes.

With their studies, Tei et al.[36] brought to the literature Tei index as a parameter providing information about the prognosis of heart failure with diastolic functions values. The authors reported a correlation between systolic and diastolic parameters. Again M Richardson et al.[37] showed that bedside diastolic function evaluation can provide prognostic information about acute coronary syndromes.

In our study, although there was a difference between acute coronary syndrome types in terms of diastolic functions, we could not find a statistical correlation. We attributed this to our small number of patients diagnosed with STEMI.

The most important limitation of this study was the small number of patients. In addition, patients who were not evaluated by the same cardiologist were excluded from the study.

Conclusion

Triage and appropriate directing of patients with acute myocardial infarction in the emergency department, rapid diagnosis. Although diastolic parameters are commonly used in the diagnosis, prognosis and mortality of acute coronary syndromes, we could not find any difference between the groups in our study. The most probable reason for this is insufficient number of patients in some groups. We believe that further studies with a larger series of patients are needed to enlighten the correlations between left ventricular diastolic dysfunction parameters and acute coronary syndrome types.

Disclosures

Ethics Committee Approval: The Ethics Committee of Abant İzzet Baysal University provided the ethics committee approval for this study (05.05.2014-2014/29-93).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – M.E.D., N.A.K., K.Ç.; Design – M.E.D., N.A.K.; Supervision – N.A.K., K.Ç.; Materials – M.E.D., B.O.T., T.Ç.; Data collection &/or processing – M.E.D., K.Ç., T.Ç.; Analysis and/or interpretation – M.E.D., K.Ç.; Literature search – M.E.D., T.Ç., B.O.T.; Writing – M.E.D., N.A.K., B.O.T.; Critical review – M.E.D., N.A.K.

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