Left atrial Volume Index And Plasma NT-proANP Level In Patients with Acute ST-Elevation Myocardial Infarction

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Abstract: Background: Ischaemic heart disease (IHD) -especially acute myocardial infarction - is one of the leading causes of death in our country. acute ST elevation myocardial infarction (STEMI) is associated with ischemia-induced progressive myocardial damage leading to ventricular dysfunction. The decrease in ventricular compliance causes left atrial dilatation and stretching of the atrial myocardium, which are the main stimuli for the secretion of atrial natriuretic peptide. **Objective:** To evaluate left atrial volume index (LAVI) and plasma NT-proANP level in patients with acute ST-elevation myocardial infarction. **Material and methods:** A study done in Cardiology Department, Matarya Teaching Hospital that included 40 subjects, including 20 patients of acute STEMI and 20 healthy individuals. Plasma a trial natriuretic peptide was measured at admission. Left ventricular function, diameter, LAVI were evaluated using transthoracic echocardiography. left atrial volume were measured in apical four chamber view by using the modified Simpson method in end-systole before mitral valve opening. The LAVI was obtained for all patients by dividing the LA volume by the BSA. Using Doppler echo imaging system (GE Company, Vivid S5) equipped with a 1.7/3.4-MHz imaging transducer in Matarya Teaching hospital, 3-5 cardiac cycles were assessed per view and measurements represent the average of at least 3 measurements. **Results:** The left atrial volume index was increased in patients with acute myocardial infarction compared with that in controls (20.76 ±7.37 vs. 15.46±6.08 p=0.017). Plasma NT-proANP in patients with acute STEMI was elevated compared to controls (742 ± 637.52 vs. 353.7 ±304.38 p=0.019). An independent correlation between the left atrial volume index and the plasma atrial natriuretic peptide level (p=0.011). **Conclusion:** The left atrial volume index and plasma atrial natriuretic peptide level were correlated in patients with acute ST elevation myocardial infarction.
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1. Introduction:

Coronary artery disease (CAD) is the leading cause of both morbidity and mortality worldwide ***(Welch TD, et al. 2012)***. CAD encompasses a wide clinical spectrum ranging from silent ischemia to sudden death. Within this spectrum, acute ST-segment elevation myocardial infarction (STEMI) is the most significant form of the disease with respect to its diagnosis, treatment, and prognosis. Various degrees of left ventricular systolic and diastolic dysfunction occur during STEMI ***(Souza LP, et al. 2011)***. Several parameters are used for the determination of left ventricular (LV) diastolic function, but most of them are affected by a number of technical and physiological factors, including heart rate, age, cardiac rhythm, preload, afterload, and LV geometry ***(Choong CY, et al 1987***). The atria are cardiac structures that are often overlooked during a routine echocardiographic examination ***(Patel DA, et al 2009***). In general, the measurement of left atrial antero-posterior diameter (LAAPD) with M-mode echocardiography is considered sufficient. Although this method is simple, its accuracy in reflecting LA size is controversial due to the asymmetric structure of the LA. Volume calculation represents LA size more consistently than diameter or area measurements. The LA volume indexed to body surface area (LAVI) is the recommended method for LA size quantification ***(Lang RM, et al 2005)***. The left atrial volume index and plasma atrial natriuretic peptide level were correlated in patients with acute myocardial infarction ***(Bacaksiz A et al 2013).*** Increased LA volume is a strong predictor of mortality after STEMI and provides superior prognostic information compared with conventional LV systolic and diastolic function measurements and clinical data ***(Moller JE, et al 2003)***. The natriuretic peptides comprise several structurally related molecules, such as atrial natriuretic peptide (ANP) and brain natriuretic peptide (BNP), which play important roles in cardiovascular homeostasis (***Hoffmann U, et al 2005***). ANP is secreted from atria as a response to increased intra-

atrial pressure and is eliminated from the circulation in minutes either enzymatically or through the clearance receptor ***(Clerico A, et al 2011).*** The biologically inactive N-terminal peptide of pro-atrial natriuretic peptide (NT-proANP) is secreted into plasma in equimolar amounts as ANP, but it has a higher plasma concentration than ANP due to decreased degradation in vivo, which makes it a more appropriate biomarker ***(Bartkowiak R, et al 2010***).

2. Material and methods:

A study done in Cardiology Department, Matarya Teaching Hospital that included 40 subjects, including 20 patients of acute STEMI and 20 healthy individuals. Plasma atrial natriuretic peptide was measured at admission. Left ventricular function, diameter, LAVI were evaluated using transthoracic echocardiography. Left atrial volume were measured in apical four chamber view by using the modified Simpson method in end-systole before mitral valve opening. The LAVI was obtained for all patients by dividing the LA volume by the BSA. Using Doppler echo imaging system (GE Company, Vivid S5) equipped with a 1.7/3.4-MHz imaging transducer in Matarya Teaching hospital, 3-5 cardiac cycles were assessed per view and measurements represent the average of at least 3 measurements.

3. Results

This study included 40 subjects, including 20 patients of acute STEMI and 20 healthy individuals, 62.5 %of them were females & 37.5% were males.

Table (5): Baseline characteristics of study population.

	Number	%
Sex		
Female	25	62.5
Male	15	37.5
Age		
Range	40-69	
Mean ± SD	49.43±8.35	
Smoking	18	45
Dyslipidemia	22	55

Table (6): shows difference in risk factors among study groups.

Sex	**Groups**					
	Patients		Control		**Tests**	
	N	%	N	%	X^2/t	P-value
Female	10	50	15	75	2.667	0.102
Male	10	50	5	25		
Age						
Range	42.0	69.0	40.0	65.0	0.565	0.576
Mean±SD	54.05	6.98	52.80	7.02		
Smoking	12	60	6	30	3.636	0.057
Dys-lipidemia	14	70	8	40	3.636	0.057

Table (9): shows Comparison between two groups regarding EF.

Groups	**EF**			**T-test**	
	Range	Mean ± SD		t	P-value
Study	46 - 71	57.1 ± 8.14		2.082	0.044
Control	55 - 75	61.6 ± 5.2			

Table (10): shows Comparison between two groups regarding left anteroposterior diameter (LAAPD)

Groups	**LAAPD**			**T-test**	
	Range	Mean ± SD		t	P-value
Study	2.0 - 4.2	3.39 ± 0.59		0.896	0.376
Control	2.4 - 6.6	3.32 ± 0.90			

Table (11): shows Comparison between two groups regarding Left atrial volume index (LAVI).

Groups	**LAVI**			**T-test**	
	Range	Mean ± SD		t	P-value
Study	4.4 - 40.2	20.76 ± 7.37		2.481	0.017
Control	8.5 - 37.3	15.46 ± 6.08			

Table (12): shows Comparison between two groups regarding E/A.

Groups	E/A			T-test	
	Range	Mean ± SD		t	P-value
Study	0.6 - 2.1	1.04 ± 0.50		2.034	0.048
Control	0.7 - 2.5	1.34 ± 0.43			

Table (14): shows Comparison between two groups regarding E/E'.

Groups	E/E'			T-test	
	Range	Mean ± SD		t	P-value
Study	1.1 - 13.0	6.98 ± 1.96		2.354	0.033
Control	3.0 - 8.7	5.59 ± 1.77			

Table (16): shows Comparison between two groups regarding NT-Pro ANP.

Groups	NT-Pro ANP			T-test	
	Range	Mean ± SD		t	P-value
Study	104.0 - 2223.0	742.00 ± 637.52		2.458	0.019
Control	32.0 - 890.0	353.70 ± 304.38			

Table (17): shows Correlation between LAVI and E/A & E/E'

	LAVI	
	r	P-value
E/A	-0.508	0.022
E/E'	0.573	0.008

Table (18): shows Correlation between NT-Pro ANP and all variants.

	NT-Pro ANP	
	r	P-value
Age	0.197	0.405
BSA	0.020	0.935
EF	-0.350	0.130
LAAPD	0.458	0.042
LAVI	0.555	0.011
E/A	-0.477	0.033
E'	-0.207	0.382
E/E'	0.768	<0.001
CKMB	0.566	0.009

4. Discussion

Left atrial enlargement is closely related to the chronicity and intensity of the burden of increased ventricular filling pressure. ***(Lester et al., 1999)***.

Elevated filling pressure cause increased atrial wall tension and myocyte stretch, which induces atrial enlargement, myolysis, apoptosis, and fibrosis. ***(Boixel et al., 2003)***.

The uni-plane measurement of the anteroposterior dimension has decreased accuracy and low reproducibility in the quantification of the left atrial dimension, which are caused by technical limitations such as the ultrasound beam angulations, the irregular geometry of the LA and the fact that the growth of this chamber is not a uniform one due to the physical limitation imposed by the sternum and vertebral column. So, the left atrial volume (LAV) evaluation by resting echocardiography indexed to body surface area is a sensitive index that expresses the severity of the left ventricular diastolic function, as well as providing prognostic information on several cardiac abnormalities. ***(Wade et al., 1987).***

The biologically inactive N-terminal peptide of pro-atrial natriuretic peptide (NT-proANP) is secreted into plasma in equimolar amounts as ANP, but it has a higher plasma concentration than ANP due to decreased degradation in vivo, which makes it a more appropriate biomarker (***Bartkowiak R, et al 2010***).

Plasma ANP is increased in STEMI due to LV load and myocardial damage (***Magga J, et al 2004***).

In patients with STEMI, the plasma ANP level helps predict the prognosis and identify high-risk patients (***Nakamura, et al 1993***).

Svanegaard and colleagues in 1999 demonstrated that the distension of the LA, rather than the dilatation of the LV, is related to the concentration of ANP.

Our study was conducted to demonstrate the relationship between left atrial volume index (LAVI) and level of NT-Pro-ANP in patients with acute STEMI.

This study included 40 individuals; all of them were subjected to resting echocardiography (to evaluate the ejection fraction, the wall motion abnormality, the diastolic function and LAVI) & laboratory investigations. They were divided into 2 groups, group A included the patients with acute STEMI & group B Included apparently healthy subjects.

In our study, there was a non significant relation between the two groups in LAAPD with p-value=0.376,

In agreement with this study, ***Bacaksiz & colleagues in 2013*** studied 110 patients with acute myocardial infarction and 50 controls and compared the two groups for left atrium antero-posterior diameter (LAAPD) and found no significant relationship between the 2 groups in LAAPD.

In our study, there was a significant relation between the two groups in EF with p-value = 0.044.

In agreement with this study, ***Bacaksiz & colleagues in 2013*** studied 110 patients with acute myocardial infarction and 50 controls and compared the two groups for EF and found significant relationship between the 2 groups in EF with p-value 0.01).

In our study, there was a significant relation between the two groups in **E/E'** with p-value =0.033.

This result was found in agreement with other study (***Dogan et al 2013***), they enrolled 58 patients with STEMI who were treated with primary PCI and 23 healthy subjects as a control group, as regard E/E', it was significant with patients with STEMI (P = 0.001).

In our study, there was a significant relation between the two groups in CKMB with p-value <0.001.

In agreement with this study, ***Gibler & colleagues in 1992*** found that Serial CK-MB determination in the emergency department can help identify AMI patients with initial nondiagnostic ECGs. Use of serial CK-MB analysis may facilitate optimal in-hospital disposition and help guide therapeutic interventions in patients with suspected AMI with (sensitivity, 79.7%) & (specificity, 93.7%), despite a non-diagnostic ECG.

In our study, there was a significant relation between the two groups in Troponin with p-value <0.001.

In agreement with this study, ***Ahmad & Sharma in 2012*** said that: The most widely established and useful biomarker for myocardial injury is cTn.

In our study, there was a significant relation between the two groups in NT-ProANP with level of (742 ± 637.52 pg) in the study group compared to (353.70 ± 304.38 pg) in control group with p-value = 0.019.

In agreement with this study, ***Bacaksiz & colleagues in 2013*** studied 110 patients with acute myocardial infarction and 50 controls and compared the two groups for NT-ProANP and found significant relationship between the 2 groups in NT-ProANP with p-value <0.001.

In our study, there was a significant relation between the two groups in LAVI with p-value = 0.017.

In agreement with this study, a prospective cohort of 171 patients diagnosed with ACS whose LAVI was calculated within 48 hours after hospital admission. According to LAVI, they found that Increased LAVI is an important predictor of MCE in a one-year follow-up and increased LAVI increased the probability of MCE (HR = 3.08, 95% CI = 1.28-7.40, p = 0.012) ***(Secundo et al., 2014)***.

This agrees with the results of ***Bangalore & colleagues in 2007*** study, where they worked on 2705 patients undergoing stress echocardiography. They found that the left atrium size indexed to body surface area was able to predict both the normal and abnormal stress echocardiographic groups. In the presence of a dilated LA with an abnormal stress echocardiography, they had a worse prognosis compared with patients with normal LA size. A dilated LA added incremental value over traditional risk factors for the prediction of cardiovascular events ($p < 0.05$).

In our study, there was a significant relation between enlarged LAVI and the presence of diastolic dysfunction in the studied groups as regard E/A & E/E' with p= 0.022 & 0.008 respectively.

These results agree with results found by ***Pritchett & colleagues in 2005*** who worked on a cross-sectional sample of Olmsted County, Minnesota, residents ≥ 45 years of age (n = 2042) underwent comprehensive Doppler echocardiography and medical record review. Pulsed-wave Doppler examination of mitral flow as well as Doppler tissue imaging of the mitral annulus was performed in each subject to assess diastolic function. The results of Pritchett study showed that the more increasing in LAVI, the more diastolic dysfunction grading ($p < 0.001$).

In our study, there was a significant relation between enlarged LAVI and level of ANP with p value = 0.011 and between ANP and diastolic dysfunction represented by E/A & E/E' with p value 0.033 & <0.001 respectively.

These results were in agreement with results of ***Hae-Ok Jung & colleagues in 2006*** who worked on 100 patients referred for echocardiography, Doppler recording of the mitral inflow and tissue Doppler imaging of the mitral annulus were obtained LAVI was measured by modified Simpson's method in apical 4-chamber view at end-systole. Plasma levels of BNP and ANP were measured with p value p<0.001.

In this study, there was a significant relation between level of ANP and LAAPD & CK-MB level with p value = 0.042, 0.009 respectively.

Increased left atrial volume index (LAVI) is consistent with chronic elevation of filling pressure and may be an indicator of increased general cardiovascular risk. ***(Tsang et al., 2002).***

LAVI has been shown to be highly predictive of

cardiovascular risk including hypertension, atrial fibrillation, heart failure, stroke, death associated with dilated cardiomyopathy, death after acute myocardial infarction. ***(Tsang et al., 2002), (Moller et al., 2003) & (Beinart et al., 2004)***.

5. Conclusion:

The left atrial volume index and plasma atrial natriuretic peptide level were correlated in patients with acute myocardial infarction.

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