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Original Article

Assessment of Ventricular Dysfunction by BNP in Correlation with Echocardiography

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Abstract

Objectives: The objective of the study was to assess ventricular dysfunction by BNP in correlation with echocardiography

Methods: We enrolled 91 consecutive patients admitted with decompensated CHF due to CAD, RHD, COPD or non ischemic cardiomyopathy. Blood samples for BNP assay were taken and echocardiographic examination done. Data analysis was done using student's t-test and coefficient of simple correlation using SPSS-10 software.

Results: Out of 91 CCF patients 54 were male and 37 female and their mean age was 53.95±17.585 years. The presentation of patients was as; 51(56%) had CAD, 17(18.7%) RHD, 05(5.5%) COPD and 18(19.8 %) had non ischemic cardiomyopathy. Over all mean BNP level was 2019.88±1353.798 pg/ml, mean BNP level for patients with CAD was 2080.94 ± 1433.733 pg/ml, for patients with RHD it was 1811.24±1137.062 pg/ml, for patients with COPD it was 2355.00±1595.115 pg/ml, and for patients with non-ischemic cardiomyapathy it was 1950.83±1322.386 pg/ml. There was significant correlation between blood BNP levels and left ventricular end systolic diameter (r=0.208, p=0.048), left ventricular fractional shortening (r=-0.327, p=0.002), left ventricular end systolic volume (r=0.225, p=0.032), left ventricular ejection fraction (r=-0.321, p=0.002) and right ventricular end diastolic diameter (r=0.221, p=0.036). There was no significant correlation between BNP levels and left ventricular end diastolic diameter (r=0.086, p=0.420), left atrial size (r=0.023, p=0.831). There was significant difference in the BNP levels in the NYHA III and IV (884±685pg/ml vs. 2666±1207pg/ml, p=0.000).

Conclusions: BNP levels significantly correlate with the left ventricular size and function in systole on echocardiography but not with the left atrial size.

Key Words: Natriuretic peptide, heart failure, echocardiography.

Introduction

The gratifying reduction in the mortality due to acute myocardial infarction and arrhythmias has resulted in an increase in the elderly population with congestive heart failure (CHF) due to coronary artery disease (CAD).[1] The tremendous burden of CHF on the resources[1] necessitates finding the ways to prevent its occurrence, to halt its progression and to minimize the sufferings from it.[2] In the diagnosis of CHF brain natriuretic peptide (BNP) has been shown to supercede the symptoms and physical signs including phonocardiographic S3 and S4.[3,4] Moreover the diagnostic and prognostic role of BNP has been well validated.[5,6] Plasma BNP level is a sensitive indicator of ventricular dysfunction both in symptomatic and asymptomatic patients and its plasma concentration increases with volume and pressure overload in patients with heart failure.[7,8] In addition, the left ventricular (LV) systolic dysfunction, plasma BNP levels have been suggested to be significantly associated with diastolic stage (including newer echocardiographic parameters as tissue Doppler imaging and color M-mode propagation velocity) and right ventricular (RV) functions as well.[9,10,]. Though the relationship between BNP and left and right ventricular functions have been elucidated in patients with systolic heart failure [11], the diagnostic value of BNP in prediction of right and left ventricular systolic/diastolic functions in patients with acute heart failure is not well established and literature data are controversial.[12] The rationale behind the study was to know the correlation between BNP and various echocardiographic parameters of heart failure in patients admitted with

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acute heart failure to cardiology department PGMI,LRH, Peshawar.

Objectives: The objective of the study was to assess ventricular dysfunction by BNP in correlation with echocardiography decompensated CHF in NYHA class III or IV dyspnea.

Material and Methods

This was a cross -sectional study carried out at Cardiology department Post Graduate Medical Institute (PGMI), Lady Reading Hospital (LRH), Peshawar, Pakistan from 15th December 2005 to 7th June 2006. A total of 91 patients (both male and female) presenting with different symptoms were included after informed consent.

Variables Definition:

1. Decompensated CHF: Patient admitted with NYHA class III or IV dyspnea, raised JVP, edema and S_3.
2. NYHA class III dyspnea: Dyspnea on less than ordinary activity i.e. on getting out of bed to the bedside toilet.
3. NYHA class IV dyspnea: Dyspnea at rest i.e. in the bed with head end elevated.
4. Coronary artery disease (CAD): Diagnosed on history or evidence of ischemia on ECG, exercise test, coronary angiography or cardiac imaging.
5. Rheumatic heart disease (RHD): Having deformed regurgitant or stenotic valves on echocardiography[1].
6. Chronic obstructive pulmonary disease (COPD): Right ventricular hypertrophy and dilatation caused by diseases of lung parenchyma and/or pulmonary vasculature unrelated to left side of the heart[2].
7. Cardiomyopathies: Causes of congestive heart failure with systolic or diastolic dysfunction other than CAD, RHD and COPD.

INCLUION CRITERIA:

1. Patients with decompensated CHF in NYHA class III or IV dyspnea for which hospitalization was mandatory for stabilization.

EXCLUSION CRITERIA:

1. Congenital heart disease
2. Acquired ventricular septal defect
3. Pericardial diseases
4. Patients with renal failure having serum creatinin more than 2 mg/dl

Blood BNP levels were determined by using AXSYM (Abbott) BNP assay. Dimensions and fractional shortening of LV were determined using M-Mode. LV Volumes and ejection fraction were determined using modified Simpson's rule.[14]

DATA ANALYSIS: The data were analyzed using SPSS version-10 software. The mean and standard deviation of blood levels of BNP in decompensated CHF were determined for each etiological group. Scatter diagrams and curvilinear regression plots were plotted for plasma BNP levels against LV dimensions, LV fractional shortening, LV ejection fraction, left atrial diameter and RV end diastolic diameter and coefficient of simple correlation were determined. Independent sample t-test and box plot was used to find the difference between the BNP levels in patients with NYHA class III and IV.

Results

Out of 91 CCF patients 54 were male and 37 female and their mean age was 53.95±17.585 years. These heart failure patients had presented with different pathological causes given in Table 2. Sixty four (70.3%) patients were in sinus rhythm while 27(29.7) had atrial fibrillation. Thirty three (36.3%) patients had NYHA class III dyspneaa while 58 (63.7%) had NYHA class IV dyspnea. Over all mean BNP level was 2019.88±1353.798 pg/ml, mean BNP level for patients with CAD was 2080.94 ±1433.733 pg/ml, for patients with RHD it was 1811.24±1137.062 pg/ml, for patients with COPD it was 2355.00±1595.115 pg/ml, and for patients with nonischemic cardiomyapathy it was 1950.83±1322.386 pg/ml. There was no significant difference in the blood BNP levels in those with and without atrial fibrillation (2058±1330 vs. 1928±1428 p=0.678.

There was significant correlation between blood BNP levels and left ventricular end systolic volume (r=0.225,p=0.032, Fig 1) left ventricular end systolic diameter (r=0.208, p=0.048, Fig 2), left ventricular fractional shortening (r=-0.327, p=0.002), left ventricular ejection fraction (r=-0.321, p=0.002), and right ventricular end diastolic diameter (r=0.218, p=0.038) [Table 2] . Significant correlation was also observed between blood BNP levels and right ventricular end diastolic diameter (r=0.218, p=0.038). There was no significant association between BNP levels and left atrial size (r=0.023, p=0.831). Likewise; no significant correlation between BNP levels Left ventricular end diastolic volume (r=0.136, p=0.200), and left atrial size (r=0.023, p=0.831) [Table2]

Discussion

In our study the most significant correlation of the BNP levels, amongst the echocardiographic parameters, was with the LV ejection fraction followed by LV fractional shortening, right ventricular diameter, LV

end systolic volume and left ventricular end systolic dimension (LVESD). Similar finding were found in a study by Gackowski A et al.[15] The correlation of BNP levels with coronary angiographic ejection fraction was more significant (r = -0.690, p <0.001) in a study by Palumbo B et al than the echocardiographic correlation in our study (r=-0.321, p=0.002).[16] Moreover both the blood BNP levels and LV end systolic volume are determinants of mortality and prognosis in patients with CHF.[17,18] In our study the blood BNP levels in patients having NYHA class III was very significantly different from those having NYHA IV dyspnea. Our results tally with the results of Wieczorek SJ et al where the BNP levels increased with the severity of CHF based on NYHA class.[19] BNP can thus be used as an objective measure for dyspnea and an alternative to six minute walk test to assess the severity of heart failure.[20] In a study Lee SC et al found that BNP levels correlated best with the NYHA functional class both at baseline and follow up so much so that they concluded with remarks that plasma BNP is a useful objective biomarker in monitoring human CHF in the outpatient setting.[21] Yasue H et al by comparing the blood BNP levels in the blood samples from aortic root, anterior interventricular and coronary sinus found that the predominant source of BNP release was the left ventricle not the atrium. Our study showing no correlation between the left atrial size and BNP levels and a significant correlation with left ventricular end diastolic volume complement the results of Yasue H et al.[22]

Thus our null hypothesis was partially rejected i.e. some of the echocardiographic parameters correlated well with plasma BNP levels. The rather bye product of our study which came out very strongly was the very significant difference in BNP levels based on the NYHA functional class. This fact, if validated by larger randomized studies will go a long way towards the objective assessment of functional status in CHF.

Study limitations:

1. Small sample size
2. Uneven etiologic groups
3. Difference based on NYHA class was not included in our objectives.

Conclusion

Blood BNP levels significantly correlate with the left ventricular size and function in systole on echocardiography but not with the left atrial size.

Table 1: Distribution according to etiology n=91

Patient's presentation	n (%)
CAD	51(56%)
RHD	17(18.7%)
COPD	05(5.5%)
Cardiomypathy	18(19.8 %)
Total	91(100%)

Table 2: Correlations of Echocardiographic parameters with blood BNP levels n=91

Parameters	r	P value
LVEDD& BNP	0.086	0.420
LVESD& BNP	0.208	**0.048**
LVFS& BNP	-.327	**0.002**
LVEDV& BNP	0.136	0.200
LVESV& BNP	0.225	**0.032**
LVEF& BNP	-.321	**0.002**
LA DIAMETER& BNP	0.023	0.831
RVEDD& BNP	0.221	**0.036**

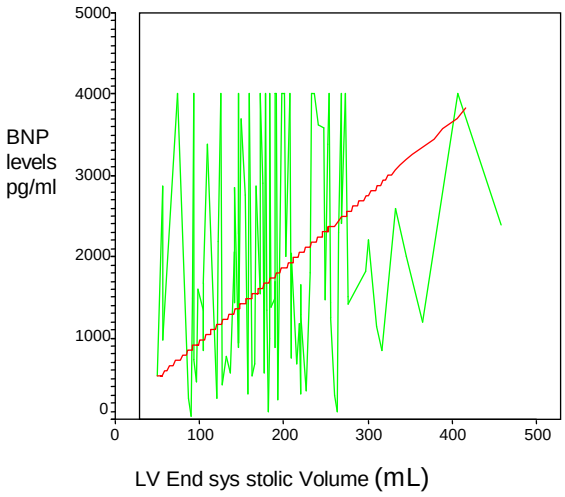

Fig 1: Correlation between BNP and LVESV

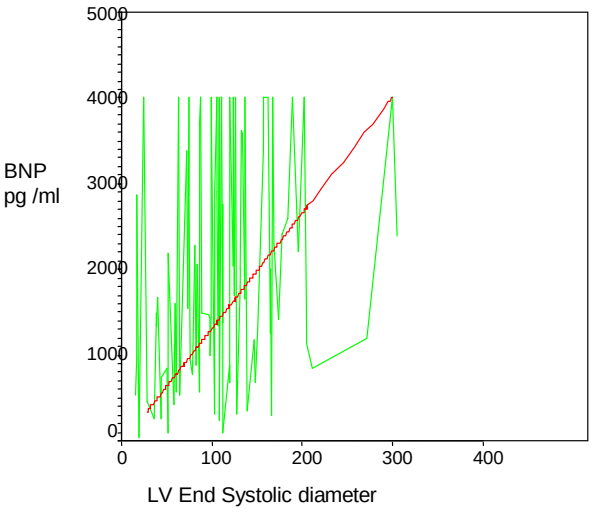

Fig 1: Correlation between BNP and LVES diameter n=91

Brain Natriuretic Peptide (pg/ml)			
Diagnosis	Mean	N	Std. Deviation
CAD	2080.94	51	1433.733
RHD	1811.24	17	1137.062
COPD	2355.00	5	1595.115
CARDIOMYOPATIES	1950.83	18	1322.386
Total	2019.88	91	1353.798

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