Original Article

Value of Brain Natriuretic Peptide in Predicting Prognosis of Coronary Artery Disease in Myocardial Infarction

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Abstract

Background: Brain natriuretic peptide (BNP) is an important predictor of outcomes in patients with heart failure but the prognostic value of BNP elevation in patients with myocardial infarction (MI) is not completely defined. This study aims to identify the prognostic value of BNP in patients with MI.

Materials and Methods: We studied patients with MI who were hospitalized in the Coronary Care Unit of Imam Hossein Hospital. Patients' demographic data, past medical and drug history besides echocardiography report and BNP levels were documented during the hospital stay and echocardiography was repeated after 3 months.

Results: This prospective observational cross-section study was done between January 2018 through January 2019. During the study period, 124 patients were recruited. There was significant negative correlation between BNP levels and ejection fraction (P=0.001), systolic blood pressure (P=0.012), diastolic blood pressure (P=0.003) and ratio between early mitral inflow velocity and early diastolic mitral annular velocity (E/e') (P=0.03) and EF in follow up (P=0.001). The correlation between BNP levels with infarction location (P=0.40), arterial involvement in the left main coronary artery (P=0.15), left anterior descending artery (P=0.53), left circumflex artery (P= 0.97), right coronary artery (P=0.50) and hospital stay (P=0.66) were not significant.

Conclusion: BNP is a valuable marker for predicting prognosis in patients with the acute coronary syndrome. Also, it could be considered as a prognostic long-term marker for predicting the EF of patients with AMI.

Keywords: Brain natriuretic peptide, Myocardial infarction, Prognosis

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Introduction

Myocardial infarction (MI) is considered as a subdivision of a spectrum referred to as Ischemic heart disease (IHD) which is the leading cause of death worldwide. World Health Organization (WHO) reported more than 9 million deaths in 2016 worldwide due to IHD[1].

Early diagnosis and successful myocardial reperfusion is the most effective plan for decreasing mortality and morbidity rate in MI patients[2].

Due to the correlation between early therapy and

reduced mortality among patients with MI, It is necessary to use noninvasive imaging techniques, for instance, Echocardiography and precise markers for diagnostic evaluation and estimation of severity and prognosis of the dysfunction as soon as possible[3].

Brain natriuretic peptide (BNP), a cardiac hormone selectively released from ventricles, increased in response to left ventricular (LV) volume expansion, decreased oxygen supply, acute myocardial infarction (MI) and chronic cardiac heart failure (HF)[4–6].

BNP is a 32-amino acid peptide which acts as a strong vasodilator and a natriuretic factor that adjust salt and water homeostasis[4,7].

Previous studies demonstrated that serum levels of BNP present a biphasic model after AMI[8–10], with the leading rises happening almost 24 hours after the onset as a result of ischemia of myocardial cells and the latter rises 3–5 days after the onset due to increased wall stress of the left ventricle[11].

Corroborative evidence had shown the prognosticative importance of BNP during the acute phase of MI. In addition, evidence expressing that alteration in plasma BNP level, measured in acute coronary syndromes, coordinate with the mortality rate and extension of myocardial infarction[12,13].

This study designed for clarification of the predictive value of BNP serum levels for left ventricular function assessed by echocardiography in MI patients.

Methods

The study population was 124 consecutive patients admitted to the Imam Hossein Hospital (Tehran, Iran) from January 2018 through January 2019 with acute MI. The study protocol was approved by the ethics committee of the Shahid Beheshti University of Medical Sciences (IR.SBMU.MSP.REC.1398.150). At first, written informed consents for participation in the study were collected by all patients.

The diagnosis of acute MI was confirmed via the Universal Definition of Myocardial Infarction[14].

The baseline patient characteristics, including the clinical parameters and the biochemical data, were collected at hospitalization and three months after discharge by a cardiology resident.

During hospital stay (after the second day of admission) blood samples for determination of the BNP level and transthoracic echocardiography (TTE) were taken for all the patients.

All statistical analyses were performed using SPSS for Windows (Version 21.0; SPSS Inc., Chicago, IL, USA). Quantitative data were tested for normality of distributions by Kolmogorov–Smirnov test, and then compared by Unpaired Student's *t*-test, Mann-Whitney U test for normal and abnormal data, respectively (value of the Kolmogorov-Smirnov Test is greater than 0.05 the data is normal). Qualitative data were analyzed by the Chi-square test, and a P-value of < 0.05 was considered significant.

Results

Patients' demographic data and past medical history including hypertension, hyperlipidemia, and diabetic subjects, and the other characteristics were comparable, are summarized in table 1.

The mean plasma BNP level in patients was 1217.33±1756.99 pg/ml. There was a weak negative correlation between BNP levels of AMI patients with systolic blood pressure (P=0.012, r=-0.24) and diastolic blood pressure (P =0.003, r=-0.28). Data are shown in Figure 1.

The site of infarction was anterior in 60.18% (mean BNP level =1416.22±2087.76 pg/ml), isolated inferior wall infarction in 36.11(929.23±1177.33 pg/ml), inferior right ventricle in 3.7% (1075.50±956.16 pg/ml) of the patients. There was no significant relationship between BNP levels and infarction location (P=0.18, r=0.13).

The average of left ventricular EF in the patients was 48.49 % ±10.31%, and there was a significant reverse association between BNP level and EF (P=0.001, r=-0.39) (Figure 2), besides that there was a slight relationship between BNP level and the ratio between early mitral inflow velocity and early diastolic mitral annular velocity (E/e') (P=0.03, r=0.23). There were no significant association between BNP level and peak early filling (E) (P=0.95, r=0.006), peak velocity flow in late diastole (A) (P=0.84, r=-0.019), early diastolic

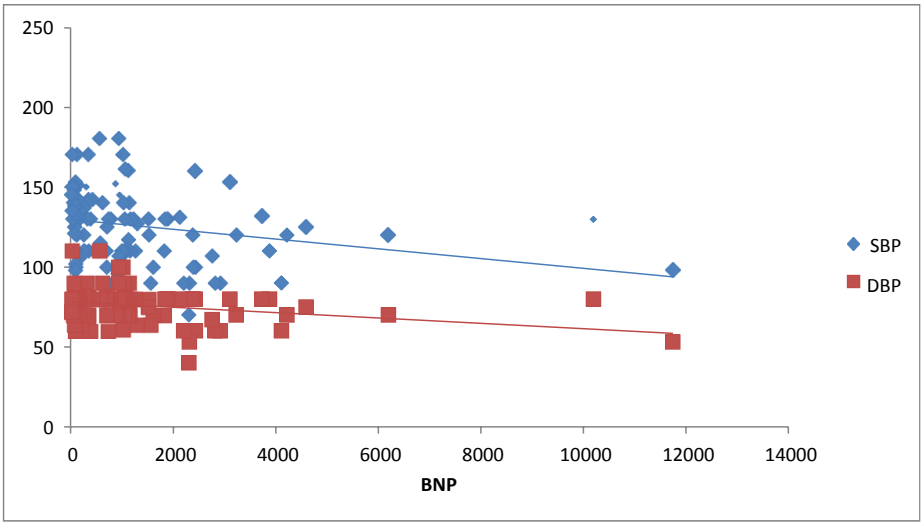

Figure 1. Relationship BNP levels (pg/ml) with systolic and diastolic blood pressure.

mitral annular velocity (e') (P=0.07, r=-0.17) and early to late diastolic transmitral flow velocity ratio (E/A)

Table 1: Main characteristics of patients.

Variables	Counts
Male/Female	96/28
Age	57±13
BMI[1]	26.03±3.51
History dyslipidemia (%)	108 (87.1%)
History hypertension (%)	80 (64.51%)
History diabetes mellitus (%)	90 (72.58%)
History myocardial infarction (%)	118 (95.16%)

[1]BMI : Body mass index

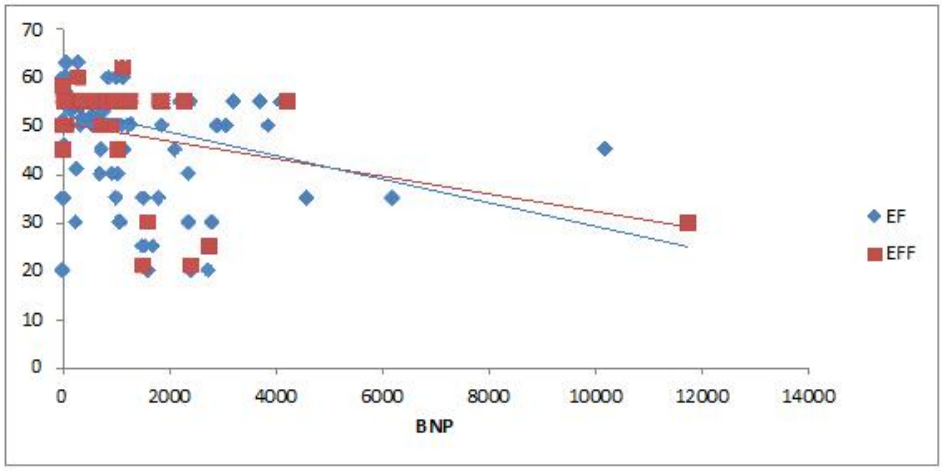

Figure 2. Relationship BNP levels (pg/ml) and EF in hospital (EF) and EF in follow up(EFF) .

(P=0.92, r=0.01) Echocardiography findings are shown in Table 2.

In this study, we investigated the association between BNP level across arterial disturbance in the left main coronary artery (LMCA), left anterior descending artery (LAD), left circumflex artery (LCX), and right coronary artery (RCA). The mean plasma BNP level in patients with LMCA involvement was 2054.50 ±3526.62. There was no significant correlation between BNP level and LMCA disturbance (P= 0.15, r=0.14).

In the current study, 45.96% of patients did not have LAD significant stenosis (mean BNP=941.17±1105.64). From the remaining patients, 33.87% had proximal involvement (mean BNP=1237.57±2047.37), 6.45% had mid LAD stenosis (mean BNP=2235.63±3444.24)

and 13.7% diagnosed with distal LAD stenosis (mean BNP=1470.25±1339.69). There was no significant correlation between BNP level and LAD stenosis (P=0.53, r=0.12).

Also, there was no significant correlation between BNP level with LCX (P=0.97, r=0.01) and RCA stenosis (P=0.50, r=-0.06). Data are shown in table 3.

Table 2: Echocardiography findings at baseline and follow up.

Variables	Base line	Follow up
Echo_EF	48.49±10.31	51.52±8.92
E[1]	75.93±18.85	76.58±15.69
A[2]	78.84±19.95	75.95±19.39
E/E Prime[3]	10.48±2.97	10.93±1.81
E To A[4]	1.01±0.34	1.2±1.15

[1] E: peak early filling
[2] A: peak velocity flow in late diastole
[3] E/E Prime: mitral inflow velocity and early diastolic mitral annular velocity
[4] E To A: early to late diastolic transmitral flow velocity ratio

Table 3: Relationship between BNP levels and Location of coronary artery involvement.

Variables		Number	BNP level (pg/ml)(mean ± SD)
Left Main	Yes	10	1136.04±1488.92
	NO	103	2054.50±3526.62
LAD 1	Normal	57	941.17±1105.64
	Proximal	42	1237.57±2047.37
	Mid	8	2235.63±3444.24
	Distal	17	1470.25±1339.69
LCX 2	Normal	103	1219.59±1791.23
	Proximal	0	0
	Mid	6	1016.83±1394.11
	Distal	4	1459.75±1661.74
RCA 3	Normal	81	1284.98±1941.25
	Proximal	12	881.67±688.90
	Mid	16	1378.75±1478.02
	Distal	4	208.75±153.73

[1] LAD: left anterior descending artery
[2] LCX: left circumflex artery
[3] RCA: right coronary artery
*significant stenosis means 50% or more

The mean hospital stay was 5.89±4.71 days. There was no relation between BNP levels of AMI patients and hospital stay in this study (P= 0.66, r=0.24)

Fifty patients continued their follow up. The mean of EF was 51.59%±8.92%. There was a significant reverse association between BNP level and EF in follow up (P =0.001, r=-0.47). Data are shown in Figure 2.

Discussion

BNP is a valuable marker for predicting prognosis and severity of coronary artery disease in patients with the acute coronary syndrome.

Several novel diagnostic advancements for assessment of AMI were seen in last decade, but mortality and morbidity rate of this status already stays high. In clinical practice, the blood level of BNP is used for the diagnosis and prognosis of heart failure, Recently BNP has been identified as an effective indicator for forecasting acute and chronic left ventricular impairment but its prognostic value in AMI is limited. Hence, this study intended to enhance the prognostic precision rate of this test by including numerous variables in the diagnostic test.

The effect of left ventricular diastolic function on the secretion of B-type natriuretic peptide at rest and directly after exercise test in asymptomatic patients with diabetes or after myocardial infarction with preserved left ventricular systolic function was obvious[15].

In the present study, we understood that the ejection fraction was significantly decreased in patients with higher NT-proBNP. This outcome was analogous to that published by Radwan et al[16]. Besides that, we discovered a highly significant negative relationship between NT- proBNP and ejection fraction. This result was compatible with Namazi et al[17]. and was also supported by Emdin et al who realized that NT-proBNP had admissible precision for recognizing heart failure due to left ventricular dysfunction[18].

Another attractive finding of the current study was patients who developed reduced ejection fraction after 3 months had significantly higher mean values of BNP at 3 days, it was compatible with Manola et al and Clavel et al study[11,19].

Prior studies have shown that BNP is independent of incursive measurements in patients with HF, But the importance BNP in LV function in a patient with AMI is not clear[20].

Kaya et al showed that plasma BNP level in posterior AMI with right ventricular involvement is higher than isolated posterior infarction. Besides that, it was established, as well as pulmonary artery pressure—an indirect indicator of left ventricular diastolic dysfunction and left ventricular volume overload-, BNP levels were also enhanced [20], that result was also confirmed by Fazlinezhad et al study [15]. But in our study, there have not clear predictive value for diastolic LV dysfunction. The result of our study was relevant with Dorobantu et al that showed that BNP measurements on admission and at 24 hours after revascularization have no predictive value for diastolic LV dysfunction, also these measurements have no predictive value for systolic LV dysfunction in inferior AMI patient[21].

We found no relationship between hospitalization periods and BNP level in patients with AMI which is not in concordance with the previous studies. Maybe it be justifiable due to the small number of patients, so data should be expounded cautiously. Eriten et al study in 2019 reported that patients with high BNP values had a longer hospitalization time than the normal group[22].

Our results did not show any correlation between LAD involvement and NT-proBNP level. This outcome was correlated with Namazi et al who showed that LAD involvement difference was significant comparing patients with UA, STEMI, and NSTEMI but there was no remarkable difference in ACS patients without regarding subgroup[17] but Sadanandan et al reported that higher NT-proBNP levels were found in patients with UA and NSTEMI with LAD involvement[23].

Conclusion

Correlated with last studies plasma BNP level could be effective as an important predictor of left ventricular systolic dysfunction, as a reverse relation of BNP levels and LVEF at 3rd day and after 3 months is observed in AMI patients. Another echocardiography finding of this study is relationship between BNP level and ratio between early mitral inflow velocity and mitral annular early diastolic velocity.

Beside that there is significant reverse relation of BNP and blood pressure is seen. Hence, it appears that measurement of plasma BNP level in early phase of

myocardial infarction may be useful as a non-invasive method for recognition of patients, at higher risk of complications.

BNP is a valuable marker for predicting prognosis in patients with the acute coronary syndrome. BNP level correlates with systolic and diastolic blood pressure, and E/e' ratio. Also, it could be considered as a prognostic long-term marker for predicting the later EF of patients with AMI.

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