Brain natriuretic peptide and other cardiac markers predicting left ventricular remodeling and function two years after myocardial infarction

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Keywords: *brain natriuretic peptide; cardiac markers; left ventricular remodeling; myocardial infarction.*

Summary. *Background. Left ventricular remodeling is a complex pathologic process of progressive left ventricular dilatation, leading to dysfunction and heart failure in patients after myocardial infarction.*

Objective. To evaluate biochemical markers, reflecting cardiac remodeling process after first myocardial infarction and compare those markers with clinical characteristics of left ventricular remodeling.

Material and methods. Brain natriuretic peptide, troponin I, creatine kinase, creatine kinase MB mass, lactate dehydrogenase levels were measured in 30 patients with acute myocardial infarction on days 1, 2, 3–7 . Brain natriuretic peptide was measured at 3 months, 6 months, and 2 years after myocardial infarction. Echocardiographic parameters of left ventricular remodeling were determined in acute phase (day 1–3), at 3 months, 6 months, and 2 years after MI.

Results. In acute phase, brain natriuretic peptide level progressively increased according to worsening of left ventricular geometry: in normal left ventricle geometry group, brain natriuretic peptide level was 84.1 (58.7–121) pg/mL, in concentric remodeling group – 125 (69.2–165) pg/mL, in concentric hypertrophy group – 128 (74–368) pg/mL, and in eccentric hypertrophy group – 470 (459–494) pg/mL, P=0.02. Patients who had increased left ventricular end diastolic diameter index during 2-year period had higher brain natriuretic peptide level in the acute phase (584 (249–865) pg/mL vs. 120 (67–202) pg/mL, P=0.04) and also higher peak lactate dehydrogenase and troponin I levels.

Conclusions. Brain natriuretic peptide level in acute phase of myocardial infarction is strongly associated with the markers of myocardial injury and related to left ventricular geometry changes and remodeling. Brain natriuretic peptide together with troponin I levels in acute phase of myocardial infarction might be useful in predicting subsequent cardiac function.

Introduction

Left ventricular (LV) remodeling is a complex of pathological processes leading to progressive LV dilatation, dysfunction, and heart failure in patients with myocardial infarction (MI). Remodeling changes begin in the acute period of MI and are progressive and occasionally may continue long after (1). Therefore, early detection of LV remodeling is important in treatment of patients with acute MI. Biochemical markers, which directly reflect or indirectly impact the remodeling process, could be used along with the clinical characteristics for the risk of LV remodeling stratification.

Brain natriuretic peptide (BNP) is a cardiac neurohormone that is synthesized in ventricular myocardium and released in response to increased LV wall stress. Its diverse actions include natriuresis, vasodilatation, inhibition of the rennin–angiotensin–aldosterone system, and inhibition of sympathetic nervous system activity (2). Recently, BNP has been used as a marker of LV dysfunction (3). The level of plasma BNP also increases in an early phase of acute MI and might be used as a predictor of the prognosis after MI (4). In addition, recent data suggest that BNP is not only indicator of impaired left ventricular function; it also might be a predictor of LV remodeling (5).

The aim of this study was to determine and evaluate biochemical markers of myocardial injury that have the highest impact on LV remodeling process and function as long as 2 years after the first MI and to compare those markers with clinical characteristics

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of LV function and remodeling.

Methods

Patient population. We studied 30 patients with acute coronary syndrome admitted to the Department of Cardiology, Kaunas University of Medicine Hospital. Only the patients with the first suspected MI and without previous percutaneous transluminal coronary angioplasty (PTCA), coronary stenting, coronary artery bypass graft operation, or electrocardiostimulation were included in the study. The diagnosis of MI was established according to WHO recommended criteria. All patients underwent clinical and ECG examination.

The investigation conforms to the principles outlined in the Declaration of Helsinki. Kaunas Regional Ethics Committee for biomedical research confirmed the study protocol. Informed consent was obtained from all subjects participating in the present study.

Study design and measurements. Concentrations of troponin I (TnI), BNP and creatine kinase isoenzyme MB mass (CK-MB) and as well as total activity of serum lactate dehydrogenase (LDH) and creatine kinase (CPK) were measured in acute phase on days 1, 2, 3, and 7. Patients were followed up over a period of 2 years. BNP concentration was measured at 3 and 6 months and 2 years after MI.

Blood samples for the measurement of BNP were obtained by direct venipuncture of antecubital vein in vacutainers containing EDTA, after patient's rest for at least 30 min. Immediately, the whole blood specimens were measured by immunofluorescence BNP assay (Triage BNP, Biosite Diagnostics), which can measure BNP from 5 pg/mL to 1300 pg/mL. The upper limit of normal range, suggested by manufacturer, is 50 pg/ml, although a concentration higher than 100 pg/mL suggests the diagnosis of heart failure (3). Tn I and CK-MB levels were also measured in whole blood specimens by immunofluorescence assay (Triage Cardiac, Biosite Diagnostics). The upper limits of normal ranges suggested by manufacturer were 1.0 ng/mL for Tn I and 4.3 ng/mL for CK-MB.

Echocardiography was performed in all patients in acute phase (1–3 day) as well as 3 and 6 months and 2 years after MI using Hewlett-Packard echocardiograph "Sonos 5500." All estimations were performed according to the criteria of the American Society of Echocardiography. The level of LV remodeling was assessed for all patients. LV geometry was considered as normal when the LV mass index and the relative wall thickness were within the normal rates, the concentric remodeling – when the LV mass index was normal, but the relative wall thickness exceeded 0.45, the concentric hypertrophy – when both the LV mass index and the relative wall thickness were increased, and the eccentric hypertrophy – when the LV mass index and the size of LV chamber were increased, but the relative wall thickness remained normal (6). The LV wall motion score index (WMI) was estimated dividing the LV segmental contraction score sum by the number of the segments. Each segment was assigned a score, based on its contractility as assessed visually: normal – 1; hypokinesis – 2; akinesis – 3; dyskinesis – 4; and aneurysm – 5. LV ejection fraction (EF) was obtained from the apical four chamber and two chamber views and evaluated according to Simpson's method. Systolic dysfunction was defined when LV ejection fraction was less than 40%.

Statistical analysis. Continuous variables were described as mean±SD, and plasma concentrations of BNP were described as the median and interquartile range (IQR). Logarithmic transformation was performed to achieve normal distribution, because BNP concentration data were skewed. Pearson's correlation coefficient between logarithmically transformed BNP and variable parameters was calculated. Group comparisons were made by use of Student's t tests for independent samples and, if data were not distributed normally, using Kruskal-Wallis rank-sum test. The diagnostic utility of BNP was compared with the echocardiographic probability of LV dysfunction using the receiver-operating characteristic (ROC) curves. Multiple regression analysis with a stepwise procedure was used to model BNP as a function of covariables. Logistic regression was used in a univariate and a multivariate approaches for evaluating the ability of cardiac markers to identify LV dysfunction at 2 years after MI. A probability value of <0.05 was taken as the level of statistical significance. Statistical analysis was facilitated by the use of Statistica (Statsoft) software package.

Results

Basic clinical characteristics of the patients are summarized in Table 1. PTCA was successful in 19 patients, and in 11 patients, it was unsuccessful or not performed. All the patients received ACE inhibitors; other drugs were prescribed according to the individual indications. During the 2-year follow-up period, two patients have died (one patient due to sudden cardiac death and one of lung cancer), and three patients were lost because of noncompliance.

BNP concentration was elevated (>50 pg/mL) in 13 patients on day 1, in 23 patients on day 2, and in

Table 1. **Basic characteristics of the studied population**

Feature	Mean (±SD) or mediana (IQR)	n (%)
Age, years	60±8.5	
Male		27 (90)
Time from the onset of symptoms to hospitalization, h	12.8±23.0	
Diagnosis: Q(+) MI Q(–) MI		 27 (90) 3 (10.0)
Anterior myocardial infarction		20 (66)
PTCA: successful unsuccessful not performed		 19 (63) 4 (13.3) 7 (23.3)
Diabetes		2 (6.7)
Hypertension		4 (13.3)
Max TnI concentration (ng/mL)	24.1±18.3	
Max BNP concentration (pg/mL)	270 (128–491)	
LV geometry in the acute phase: normal LV remodeling concentric hypertrophy eccentric hypertrophy		 5 (16.7) 8 (26.7) 11 (36.7) 6 (20)

BNP – brain natriuretic peptide; IQR – interquartile range; LV – left ventricular;
MI – myocardial infarction; – PTCA – percutaneous transluminal coronary angioplasty; TnI – troponin I.

24 patients on day 7 of MI. There was a strong correlation between BNP concentration on day 1 and BNP concentration on day 2 (r=0.76, P<0.001), on day 7 (r=0.75, P<0.001), after 3 months (r=0.87, P<0.001), after 6 months (r=0.87, P<0.001), and after 2 years (r=0.93, P<0.001).

BNP and LV remodeling characteristics

BNP concentration during acute phase of MI was found being related to LV geometry. BNP concentration on day 7 correlated best with LV geometry to compare with BNP on day 1 and day 2. Plasma BNP concentration on day 7 progressively increased with worsening of LV geometry: patients with normal LV geometry had the lowest BNP concentration – 84.1 (58.7 – 121) pg/mL and in the patients with concentric remodeling BNP concentration was 125 (69.2–165) pg/mL, with concentric hypertrophy –128 (74–368) pg/ml, and with eccentric hypertrophy – 470 (459–494) pg/mL (Fig. 1).

LV geometry at 3 months after MI was related to BNP concentration determined at this time, but not to BNP level in acute phase. In patients with normal LV

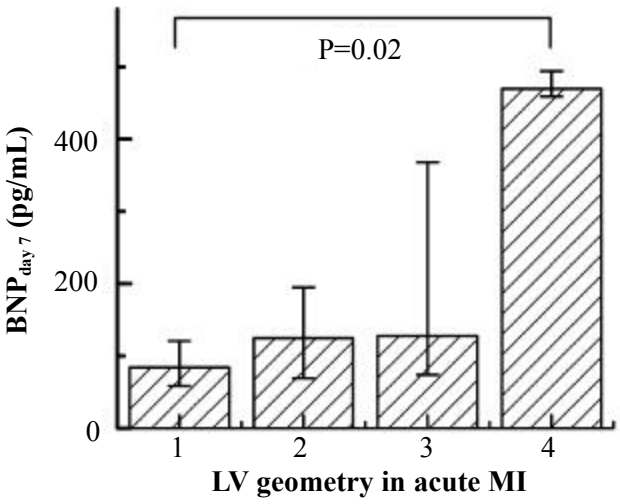

Fig. 1. **Median (interquartile range) BNP concentration levels on day 7 according to LV geometry in acute MI**

1 – normal LV geometry, 2 – concentric remodeling, 3 – concentric hypertrophy, 4 – eccentric hypertrophy. BNP – brain natriuretic peptide; LV – left ventricular; MI – myocardial infarction.

geometry, BNP concentration was 84.6 (34.8–132) pg/mL, with concentric remodeling – 37.9 (17.3–64.7) pg/mL, with concentric hypertrophy – 84.5 (27–117) pg/mL, and with eccentric hypertrophy – 134 (71.7–1130) pg/mL. BNP concentration was significantly higher only in eccentric hypertrophy group to compare with concentric remodeling group (P=0.04). In later period, 6 months and 2 years after MI, LV geometry was not associated with BNP concentration determined in acute phase of MI or 6 months or 2 years after MI.

LV dilatation as one of the LV remodeling markers was assessed by analyzing LV end diastolic diameter (LVEDD) index. BNP on day 1 has correlation with LVEDD in acute phase of MI and after 3 months (Table 2). An increase in LVEDD index >5 mm/m^2 was diagnosed only in four patients after 2 years after MI, but these patients had significantly higher levels of BNP in acute phase of MI on day 2 (584 (249–865) pg/mL *vs.* 120 (67.2–202) pg/mL, P=0.04) and after 2 years (223 (152–729) pg/mL *vs.* 62.9 (29–103) pg/mL, P=0.002). Patients, whose LVEDD index increased in 2 years, also had higher cardiac marker levels in acute phase: peak LDH (1130±595 U/L *vs.* 683±323 U/L, P=0.04) and TnI concentration on day 7 (6.27±7.89 ng/mL *vs.* 1.68±1.94 ng/mL, P=0.03).

Logistic regression model showed that an increase in BNP concentration for 100 pg/mL on day 2 (chi-square 8.2, odds ratio 2.16 (95% CI: 1.0–4.63); P=0.004) and after 2 years (chi-square 11.2, odds ratio 14.9 (95% CI: 1.07–20.6); P=0.001) were independent variables for an increase in LVEDD index 2 years after MI.

LV dysfunction and cardiac markers

We tested the strength of the link between BNP concentration and LVEF in acute MI and in later period after MI. At all time points, BNP levels correlated strongly with LVEF (Table 3). The logarithmically transformed maximal BNP levels in acute MI were associated significantly not only with LV ejection fraction in acute phase, but also with LVEF at 2 years after MI (Fig. 2). The relation between the common

Table 2. **Correlation between BNP levels and left ventricular end diastolic diameter index**

BNP level at certain time	Correlation coefficients with							
	LVEDD index in acute phase		LVEDD index after 3 months		LVEDD index after 6 months		LVEDD index after 2 years	
	r	P	r	P	r	P	r	P
BNP_{day1}	0.46	0.046*	0.65	0.011*	0.45	0.092	0.42	0.139
BNP_{day2}	0.22	0.252	0.35	0.116	0.36	0.088	0.35	0.108
BNP_{day7}	0.26	0.188	0.36	0.105	0.46	0.028*	0.39	0.077
BNP_{3mo}	0.20	0.321	0.38	0.071	0.52	0.013*	0.42	0.048*
BNP_{6mo}	0.16	0.420	0.43	0.040*	0.42	0.038*	0.37	0.076
BNP_{2y}	0.34	0.093	0.28	0.205	0.43	0.054	0.49	0.014*

*Statistically significant correlation.
BNP – brain natriuretic peptide; LVEDD – left ventricular end diastolic diameter.

Table 3. **Correlation between BNP levels and left ventricular ejection fraction**

BNP level at certain time	Correlation coefficients with							
	LVEF in acute phase		LVEF after 3 months		LVEF after 6 months		LVEF after 2 years	
	r	P	r	P	r	P	r	P
BNP_{day1}	–0.47	0.044*	–0.65	0.012*	–0.31	0.263	–0.67	0.009*
BNP_{day2}	–0.59	0.001*	–0.65	0.001*	–0.37	0.079	–0.50	0.019*
BNP_{day7}	–0.43	0.024*	–0.60	0.003*	–0.67	<0.001*	–0.44	0.044*
BNP_{3mo}	–0.52	0.006*	–0.57	0.004*	–0.62	0.002*	–0.51	0.013*
BNP_{6mo}	–0.46	0.012*	–0.51	0.011*	–0.42	0.032*	–0.54	0.007*
BNP_{2y}	–0.48	0.016*	–0.60	0.002*	–0.60	0.003*	–0.70	<0.001*

*Statistically significant correlation.
BNP – brain natriuretic peptide; LVEF – left ventricular ejection fraction.

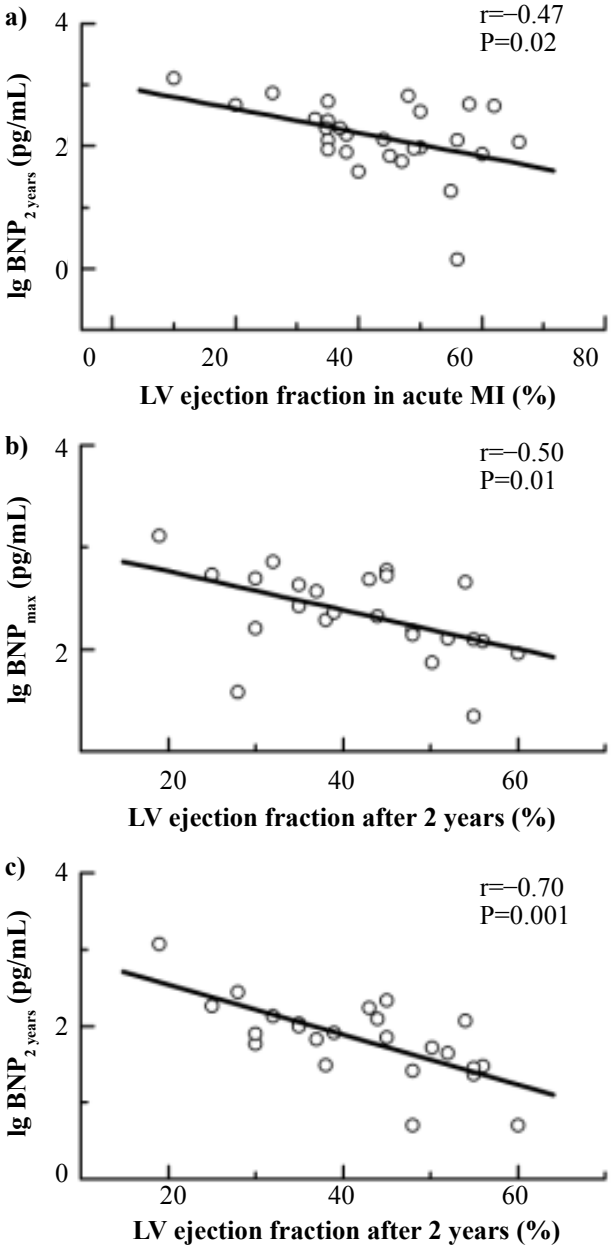

Fig. 2. **The relation between LV ejection fraction and BNP level**

a) correlation between $lgBNP_{max}$ and LVEF in acute phase of MI; b) correlation of $lgBNP_{max}$ level in acute phase and LVEF after 2 years; c) correlation of lgBNP level and LVEF both after 2 years. Because distribution of BNP concentrations was skewed, logarithmic transformation was applied.

BNP – brain natriuretic peptide; LV – left ventricular; LVEF – left ventricular ejection fraction.

logarithm of BNP at 2 years after MI and LVEF at this time was strong (r=–0.70; P=0.001). LVEF after 2 years also correlated with TnI concentration in acute phase on day 7 (r=–0.47; P<0.05).

ROC analysis was performed to find out the critical value of BNP level in acute MI, which could discriminate patients who would develop systolic dysfunction after 2 years after MI. BNP concentration on day 2 was the best predictor of LV dysfunction after 2 years and the critical BNP value was 118 pg/mL, area under curve was 0.70 (95% CI: 0.47–0.88), specificity 58.3%, sensitivity 90%. BNP concentration after 2 years discriminating patients with and without LV systolic dysfunction at same time point was 51.1 pg/mL, sensitivity, specificity and area under the curve were 91%, 62% and 0.75 (95% CI: 0.53–0.90), respectively.

BNP and markers of myocardial injury

We evaluated BNP links with other cardiac markers of myocardial injury. In acute MI, BNP levels correlated with LDH activity, TnI, and CK-MB concentrations on day 2 as well as on day 7. Meanwhile, BNP levels measured later after MI were associated more strongly with cardiac marker TnI levels measured on day 7 than on day 2 (Table 4).

The results of multiple linear regression model showed that BNP concentration on admission, TnI concentration on day 7, and peak concentration of CK-MB had the strongest influence on BNP concentration at 6 months after MI ($F=28.0$, $R^2=0.97$, $P<0.01$). In another model, where echocardiographic parameters were included, the variables with adverse remodeling characteristics had the strongest influence on BNP concentration at 6 months after MI WMI in the acute phase of MI, LVEDD after 6 months, WMI after 6 months, and LV geometry after 6 months ($F=10.5$, $R^2=0.7$, $P<0.001$). When biochemical and echocardiographic parameters were included in the model, BNP concentration on day 1 (or on day 7) and TnI concentration on day 7 revealed the strongest association with BNP concentration after 6 months.

Discussion

The level of plasma BNP depends on the equilibrium between myocardial secretion as compensatory response to injury or wall stress and an amount and activity of expressed guanylyl cyclase- type BNP receptors, BNP clearance receptors, and also peripheral degradation rate of BNP through neutral endopeptidases. According to the data of multiple studies, serial factors such as age, gender, rheumatic valve disease, anemia, renal dysfunction, thyroid dysfunction, fasting and weight loss, some medicine could influence the elevation of plasma BNP levels (7). Though, it is established that BNP levels are associated with severity of heart failure (HF) and prognosis, but little is known about the release of BNP into plasma in early stages of LV remodeling and HF development after myocardial infarction. Considering this aspect, the causative

Table 4. **Correlation between BNP levels and cardiac markers levels in acute myocardial infarction**

BNP level at certain time	Correlation coefficients with							
	$LDH_{day\ 2}$		$TnI_{day\ 2}$		$LDH_{day\ 7}$		$TnI_{day\ 7}$	
	r	p	r	p	r	p	r	p
BNP_{day1}	0.42	0.075	0.49	0.040*	0.18	0.456	0.48	0.041*
BNP_{day2}	0.46	0.015*	0.38	0.055	0.42	0.028*	0.49	0.013*
BNP_{day7}	0.66	<0.001*	0.63	<0.001*	0.56	0.004*	0.57	0.002*
BNP_{3mo}	0.36	0.084	0.45	0.028*	0.48	0.017*	0.67	<0.001*
BNP_{6mo}	0.36	0.067	0.36	0.064	0.23	0.240	0.55	0.003*
BNP_{2y}	0.45	0.031*	0.44	0.038*	0.34	0.116	0.59	0.004*

*Statistically significant correlation.
BNP – brain natriuretic peptide; LDH – lactate dehydrogenase; TnI – troponin I.

mechanisms of the relation between BNP levels and cardiac markers, clinical and echocardiographic parameters as well as the point whether remodeling after MI may be detected by BNP changes are discussed.

The surrogate markers – LV ejection fraction, ventricular volumes, and mass – are often used for evaluation of the LV remodeling. The development and progression of HF is associated with LV remodeling, which manifests as gradual increase in LVED and LVES volumes, LV mass, wall thinning, changes in chamber geometry to a more spherical and less elongated shape (8).

The data from our study show that BNP concentration is increased during acute MI and correlates with LV remodeling, occurring after the first MI. Higher BNP concentrations in the acute phase of myocardial infarction as well as late BNP concentrations at 3 months and at 2 years after MI are linked to the increase of heart chamber size during 2-year period after MI.

BNP release appeared to be directly proportional to ventricular volume expansion and pressure overload. It is known that BNP is over expressed in hypertrophied myocardium. However, Takeuchi *et al.* (2005) have shown that LV overload sustaining hemodynamic status, which could influence the ventricular wall stress in cases of hypertrophic obstructive cardiomyopathy, was not associated with BNP levels (9).

Left ventricular dilatation as one of the characteristics of LV remodeling is important in predicting reduced survival after myocardial infarction. Therefore, early detection of LV remodeling is substantial for the treatment of patients after acute MI. Hence, the assessment of BNP concentration in the acute phase of myocardial infarction would be useful in providing essential information regarding prospective LV remodeling (10, 11). LV remodeling after MI, associated with the changes which occur early (during the first days) and later (after few months), are not fully investigated.

Our findings are consistent with the results of other previously published studies about relation of BNP and LV remodeling (10–12). Nagaya *et al.* have found that BNP concentration on day 7 correlated with the increase in LV diastolic volume index through the first 30 days of acute MI, and that patients in LV remodeling group had higher BNP levels from day 2 to day 90 than patients in non-remodeling group (10). Meanwhile, Yoshitomi *et al.* have shown that BNP concentrations after 1 month are increased in patients, who are likely to develop a progressive LV dilatation in the first 3 months after MI (11). In our study, we have shown that LV remodeling is linked with both early and late BNP levels. However, in the study population, the LV geometry changes were not so prominent, and therefore correlation between BNP concentration and LV remodeling parameters was weaker.

In the present study, we have shown that BNP levels are relative to cardiac function subsequent later after MI. Higher BNP levels in acute phase of myocardial infarction were associated with worse EF after 6 months and 2 years. We have also found a significant relation between BNP concentration in acute phase of myocardial infarction and WMI after 3 months and 6 months as well as 2 years after MI. Crilley *et al.* have reported a strong association between BNP concentration and WMI as a marker of deterioration of left ventricular function after acute myocardial infarction (13). Recently, Mutlu *et al.* have shown that predischarge troponin T (TnT) levels have prognostic importance in acute myocardial infarction (14). Patients with higher TnT levels on day 7 had worse diastolic and systolic LV function after one month. The results from our study show that TnI concentration measured on day 7 is correlated with LV ejection fraction later after MI: at 3 months, 6 months, and 2 years after MI. Meanwhile,

neither TnI concentration on admission nor TnI peak concentration correlated with the LV function after two years.

In the previous work, we have shown that BNP concentrations during acute myocardial infarction are strongly related to the markers of myocardial necrosis, reflecting the extent of injured myocardium, and to the degree of acute heart failure (15). Now we have confirmed these findings and also demonstrated that BNP together with other cardiac markers have additional information on predicting left ventricular remodeling. During acute MI, BNP levels correlated strongly not only with cardiospecific Tn I, but more surprisingly, also with less specific marker of myocardial injury – total activity of LDH. Recently, it has been shown that namely LDH cumulative release strongly predicts left ventricular function after one year after acute myocardial infarction (16).

It is worth to notice that unlike markers of myocardial necrosis, BNP is not considered to be released from necrotizing myocardium. Experimental studies have shown that BNP secretion and BNP mRNA expression are increased mainly in the borderline region between the infarcted and noninfarcted regions (17). The stimulus for this appears to be increased wall stress directly related to the infarction. However, less severe clinical ischemia, insufficient to result in extensive necrosis, is also associated with release of BNP (18). Recent experimental studies show that ischemia itself, rather than changes in wall stress secondary to ischemia, might promote BNP release (19).

Thus, the major finding of our work is that BNP level following MI appears to be associated not only with LVEF impairment but also with the extent of myocardial damage as assessed by cardiac markers, supporting the opinion that elevation of BNP is a general indicator of reduced cardiac performance.

Study limitations

We had possibilities to study only a small number of patients, thus there was insufficient statistical power in some analysis, and our findings should be confirmed in larger studies. Some limitations of this study, in addition to those discussed above, merit consideration. We did not examine changes due to various medications. However, variation of cardiac markers under therapy may dilute its predictive power. In our work, the evaluation of microvascular flow and myocardial perfusion was not performed. Also echocardiographic parameters of LV remodeling and geometry changes are subjected to a greater measurement error in comparison to BNP as a marker of cardiac function.

Conclusions

Brain natriuretic peptide level in acute phase of myocardial infarction is strongly associated with the markers of myocardial injury and related to left ventricular geometry changes and remodeling. Brain natriuretic peptide together with troponin I levels in acute phase of myocardial infarction might be useful in predicting subsequent cardiac function.

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Miokardo pažeidimo žymenų ir B tipo natriuretinio peptido ryšys su kairiojo skilvelio funkcija ir remodeliavimusi iki dvejų metų po miokardo infarkto

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Raktažodžiai: B tipo natriuretinis peptidas, miokardo pažeidimo žymenys, kairiojo skilvelio remodeliavimasis, miokardo infarktas.

Santrauka. Kairiojo skilvelio remodeliavimasis po miokardo infarkto yra kompleksinis patologinis procesas progresuojant kairiojo skilvelio dilatacijai, lemiančiai disfunkciją ir širdies nepakankamumą.

Darbo tikslas. Įvertinti biocheminių žymenų, rodančių širdies remodeliavimosi procesą po pirmojo miokardo infarkto, ryšį su klinikiniais kairiojo skilvelio remodeliavimosi požymiais.

Tirtųjų kontingentas ir tyrimo metodai. 30 ligonių po miokardo infarkto buvo tiriama B tipo natriuretinio peptido, troponino I, kreatinkinazės MB koncentracija, kreatinkinazės ir laktatdehidrogenazės aktyvumas 1, 2, 3–7-ąją parą, o po 3, 6 mėn. ir dvejų metų B tipo natriuretinio peptido koncentracija. Kairiojo skilvelio remodeliavimąsi rodantys echokardiografiniai rodmenys nustatyti ūminės miokardo infarkto fazės metu (1–3

parą), po 3, 6 mėn. ir dvejų metų.

Rezultatai. Ūminės miokardo infarkto fazės metu B tipo natriuretinio peptido koncentracija progresyviai didėjo blogėjant kairiojo skilvelio geometrijai: B tipo natriuretinio peptido koncentracija buvo 84,1 (58,7–121) pg/ml grupėje ligonių, kurių kairiojo skilvelio geometrija normali, 125 (69,2–165) pg/ml – koncentrinio persitvarkymo grupėje, 128 (74–368) pg/ml – koncentrinės hipertrofijos grupėje ir 470 (459–494) pg/ml – ekscentrinės hipertrofijos grupėje, p=0,02. Ligonių, kurių kairiojo skilvelio galinis diastolinis diametras po miokardo infarkto iki dvejų metų laikotarpiu didėjo, ūminės fazės metu buvo didesnė B tipo natriuretinio peptido koncentracija (584 (249–865) pg/ml *vs*. 120 (67–202) pg/ml, p=0,04) ir didesnis troponino I bei laktatdehidrogenazės išsiskyrimas.

Išvada. B tipo natriuretinio peptido koncentracija ūminio miokardo infarkto metu yra susijusi su miokardo pažeidimo žymenų bei kairiojo skilvelio geometrijos kitimu. Remiantis B tipo natriuretinio peptido ir troponino I koncentracijos rodmenimis ūminio miokardo infarkto metu, galima numatyti kairiojo skilvelio funkcijos pokyčius.

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References

1. Cohn JN, Ferrari R, Sharpe N. Cardiac remodeling – concepts and clinical implications: a consensus paper from an international forum on cardiac remodeling. J Am Coll Cardiol 2000;35:569-82.
2. Stein BC, Levin RI. Natriuretic peptides: physiology, therapeutic potential, and risk stratification in ischemic heart disease. Am Heart J 1998;135:914-23.
3. Peacock WF IV. The B-type natriuretic peptide assay: a rapid test for heart failure. Cleve Clin J Med 2002;69:243-51.
4. Morrow DA, de Lemos JA, Sabatine MS, Murphy SA, Demopoulos LA, DiBattiste PM, et al. Evaluation of B-type natriuretic peptide for risk assessment in unstable angina/non-ST-elevation myocardial infarction: B-type natriuretic peptide and prognosis in TACTICS-TIMI 18. J Am Coll Cardiol 2003; 41:1264-72.
5. White M, Rouleau JL, Hall C, Arnold M, Harel F, Sirois P, et al. Changes in vasoconstrictive hormones, natriuretic peptides, and left ventricular remodeling soon after anterior myocardial infarction. Am Heart J 2001;142:1056-64.
6. Oh JK, Seward JB, Tajik AJ. The echo manual. 2nd ed. Philadelphia: Lippincott Williams & Wilkins; 1999.
7. White HD, Norris RM, Brown MA, Brandt PW, Whitlock RM, Wild CJ. Left ventricular end-systolic volume as the major determinant of survival after recovery from myocardial infarction. Circulation 1987;76:44-51.
8. Pieske B. Reverse remodelling in heart failure – fact or fiction? Eur Heart J 2004;6:D66-78.
9. Takeuchi I, Inomata T, Nishii M, Koitabashi T, Nakano H, Shinagawa H, et al. Clinical characteristics of heart disease patients with a good prognosis in spite of markedly increased plasma levels of type-B natriuretic peptide (BNP). Anomalous behavior of plasma BNP in hypertrophic cardiomyopathy. Circ J 2005;69:277-82.
10. Nagaya N, Nishikimi T, Goto Y, Miyao Y, Kobayashi Y, Morii I, et al. Plasma brain natriuretic peptide is a biochemical marker for the prediction of progressive ventricular remodeling after acute myocardial infarction. Am Heart J 1998;135:21-8.
11. Yoshitomi Y, Nishikimi T, Kojima S, Kuramochi M, Takishita S, Kangawa K, et al. Plasma natriuretic peptides as indicators of left ventricular remodelling after myocardial infarction. Int J Cardiol 1998;64:153-60.
12. Nagaya N, Goto Y, Nishikimi T, Uematsu M, Miyao Y, Kobayashi Y, et al. Sustained elevation of plasma brain natriuretic peptide levels associated with progressive ventricular remodeling after acute myocardial infarction. Clin Sci (Lond) 1999;96:129-36.
13. Crilley JG, Farrer M. Left ventricular remodeling and brain natriuretic peptide after first myocardial infarction. Heart 2001;86:638-42.
14. Mutlu B, Yilmaz A, Sonmez K, Eroglu E, Turkmen M, Basaran Y. Prognostic importance of predischarged troponin T levels in acute anterior myocardial infarction. Jpn Heart J 2004;45:43-5.
15. Grybauskiene R, Vaara I, Janenaite J, Babarskiene R, Grybauskas P, Luksiene D. Miokardo pažeidimo biocheminių žymenų ir B tipo natriuretinio peptido išsiskyrimo ryšys esant ūminiam koronariniam sindromui. (Relationship between the release of brain natriuretic peptide and cardiac markers in patients with acute coronary syndromes.) Lith J Cardiol 2001;8:142-9.
16. Elsman P, Zijlstra F, Miedema K, Hoorntje JC, Dikkeschei LD, Slingerland RJ. The predictive value of cumulative lactate dehydrogenase release within the first 72 h of acute myocardial infarction in patients treated with primary angioplasty. Ann Clin Biochem 2004;41:142-8.
17. Hama N, Itoh H, Shirakami G, Nakagawa O, Suga S, Ogawa Y, et al. Rapid ventricular induction of brain natriuretic peptide gene expression in experimental acute myocardial infarction. Circulation 1995;92:1558-64.
18. Talwar S, Squire IB, Downie PF, Davies JE, Ng LL. Plasma N terminal pro-brain natriuretic peptide and cardiotrophin 1 are raised in unstable angina. Heart 2000;84:421-4.
19. D'Souza SP, Yellon DM, Martin C, Schulz R, Heusch G, Onody A, et al. B-type natriuretic peptide limits infarct size in rat isolated hearts via KATP channel opening. Am J Physiol Heart Circ Physiol 2003;284:H1592-600.

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