

Full Length Research Paper

Influence of percutaneous coronary intervention (PCI) on plasma B-type natriuretic peptide in patients with acute ST elevated myocardial infarction

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B-type natriuretic peptide (BNP) is secreted from the ventricles in response to volume expansion and pressure overload. It is related to the injuries and function of the heart. This study aimed to investigate whether emergency percutaneous coronary intervention (PCI) could influence the BNP level in patients with ST-segment elevation myocardial infarction (STEMI). 193 patients admitted with STEMI were enrolled in this study. The BNP levels were measured at admission. All patients underwent routine clinical laboratory tests in the first day of hospitalization. 92 patients underwent emergency PCI, and 101 patients underwent drug conservative treatment. The patients that underwent PCI were divided into two subgroups depending on reperfusion time (0 to 3 h, n=42; 3 to 6 h, n=50) for analysis. The study reveals BNP levels were significantly lower in patients undergoing emergency PCI when compared with the conservative treatment (261.0±410.9pg/ml versus 921.5±1126.7pg/ml, p<0.01). BNP levels were significantly lower in super-acute PCI patients than in acute PCI patients. BNP levels were higher in patients whose blood flow was not TIMI 3. BNP is positively related to CKMB. Earlier reperfusion in infarct-related artery results in significantly better BNP level and may be good for myocardial salvage and preservation of heart function.

Key words: B-type natriuretic peptide, ST-segment elevation myocardial infarction, emergency percutaneous coronary intervention.

INTRODUCTION

Several studies had indicated that measurement of circulation of B-type natriuretic peptide (BNP) could predict the prognosis of acute coronary syndromes (ACS) (de Lemos et al., 2001). Perkiömäki et al. (2010) found that increased baseline BNP had a significant association with heart failure hospitalization after AMI. However, there are few reports on the influence of percutaneous coronary intervention (PCI) on plasma BNP of patients with STEMI. This study compared the BNP levels between emergency PCI patients and conservative

treated patients with STEMI, and on another time we investigated the influence of super acute (≤3 h) PCI on STEMI patient's circulating BNP. Our study revealed the earlier PCI, the better.

MATERIALS AND METHODS

Patients

From January to December 2008, consecutive STEMI patients admitted to the emergency room of the Capital Medical University, XuanWu Hospital were enrolled. The inclusion criteria were as follows: older than 18 years old and younger than 80 years old; current chest pain developed within 6 h before admission; patients with acute myocardial infarction (AMI) met at least two of the following standards: (1) persisting chest pain over 30 min; (2) elevation of ST-segment in two or more than two related leads (V_1 - V_3 ≥0.2 mV other leads ≥0.1 mV) or development of left branch bundle blockade; (3) elevation of biomarker of myocardium; and (4)

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Abbreviations: BNP, B-type natriuretic peptide; PCI, percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction

new abnormal regional wall movement in echocardiogram. The exclusion criteria were as follows: the patient had received coronary revascularization within 6 months; severe systemic diseases; renal failure (blood creatinine > 221 $\mu\text{mol/L}$); severe pulmonary heart disease, chronic heart failure, severe valve disease, and the patient refused or unable to attend the study.

Clinical information

The clinical information of all patients, including the time of onset, risk factors of coronary artery disease, characteristics, laboratory results, and cardiac events during hospitalization and in 6 months after discharge were from the database of our hospital.

All patients or legal represent signed the written informed consents. The routine medications were oral aspirin, clopidogrel, beta-blockers, angiotensin converting enzyme inhibitors, pravastatin and subcutaneous injected low molecular heparin. Patients underwent electrocardiogram within 10 min and echocardiogram within 30 min after admission. If the patients agree PCI, they were divided into two groups depending on the time from onset to PCI balloon dilatation (group A, ≤ 3 h; and group B, 3 to 6 h (includes 6 h). The patients who refused the PCI protocol contains the group C. Patients who required coronary artery bypass graft (CABG) were excluded from the study.

Each patient was followed up for 6 months after recruitment and observed for the following events: death from any cause; newly developed or reoccurring of AMI, rehospitalization due to ACS; and newly developed heart failure.

Measurement of circulating BNP level

A point of care test of fluorescence immunoassay for the quantification of BNP was used (Biosite Diagnostics Inc. USA), 1 ml of intravenous blood was collected early after the patient was enrolled and BNP was determined in 20 min as baseline. The second BNP detection was underwent 18 h after onset of symptoms. The level of BNP ≥ 100 pg/ml was positive while BNP ≤ 100 pg/ml indicated negative.

Echocardiogram examination

An IE33 type echocardiograph (GE Company, USA) and Enconcert ultrasound imaging transformation and integration workstation 2.0 were used. Half an hour after each patient was enrolled, the technician collected the echocardiograph information at bedside. The second echocardiogram was collected at 24 h. Two echocardiographers, not involved in this study, read the results and made diagnosis. Left ventricular ejection fraction (LVEF) was measured by area on the apical four-chamber and two chamber views. The mean of the two values was taken as the LVEF of the patient.

Coronary angiogram

An angiography (AXIOM Artis Dfc, SIEMENS, GERMANY) was used. Each patient undertook a coronary angiogram within 60 min after enrollment. PCI was performed to the defective vessel unless contraindicated.

Statistical analysis

Data was presented by mean \pm standard deviation (SD), and analysed by SPSS 11.5. Independent samples t test was used to

compare different groups. Variate analysis used Person's χ^2 test.

RESULTS

Clinical characteristics of patients

A total of 193 patients were enrolled in the present study. On admission, BNP was 22% positive. The median BNP level was 36 pg/ml, ranged from 5 to 188 pg/ml. All patients were divided into PCI and conservative groups. The PCI group was divided into super-acute and acute groups.

Age, gender, history of cardiac dysfunction, history of acute myocardial infarction, diabetes, BNP on admission, BNP on 18 h after ictus and LVEF is shown in Table 1.

There was no significant different between the two groups in hypertension, diabetes, smoking, alcoholic, systolic blood and heart rate on admission. There was no significant differentiation in BNP at admission, while BNP 18 h after onset was significantly higher in conservative treatment group; and obviously more patients died in this group. LVEF did not reach significant difference, but mitral valve E/A level was lower in conservative group.

In the PCI group, 6 patients did not reach TIMI 3 level blood, their BNP were 668 ng/ml (18 h), which was significantly higher than the other 86 patients whose mean BNP was 232 pg/ml. The TIMI was separately 1, 2 and 3 level in the three dead patients in the PCI group. The BNP levels are mean 1680 pg/ml (18 h) in the patient who died. Among all the patients, mean BNP was 2113 ± 673 pg/ml in dead patients which was significantly higher than those who survived (461 ± 382 pg/ml, $P < 0.05$). There was significantly positive correlation between BNP and CKMB ($r = 0.602$, $P < 0.05$).

PCI time and BNP

Among 92 PCI patients, 42 patients enrolled into super-acute group and 50 patients into acute group according to time performed PCI. The BNP and CKMB levels were compared in Table 2. The BNP and CKMB levels were significantly higher in the acute group than the super-acute group ($P < 0.05$).

Baseline and BNP

BNP as the dependent variable, gender, age, diabetes, hypertension, smoking, LVEF, anterior myocardial infarction, whether emergent PCI as independent variables, we did logistic regression analysis. We found age, diabetes, hypertension, anterior myocardial infarction and PCI are related with the level of BNP (Table 3).

DISCUSSION

Dilić et al. (2011) found that there were two different

Table 1. Baseline characteristics and some outcome.

Baseline characteristics	PCI group (n=92)	Conservative group (n=101)	P
Age (years)	63.6±12.3	62.4±11.2	>0.05
Male (%)	55.4	58.4	>0.05
Onset time (h)	4.5±2.5	3.6±2.3	>0.05
Hypertension (%)	45.7	51.4	>0.05
Diabetes (%)	33.7	31.7	>0.05
Smoking (%)	61.9	57.2	>0.05
Alcoholic (%)	22.2	12.9	>0.05
Heart rate (bpm)	84±23	77±19	>0.05
SBP (mmHg)	124±23/78±12	118±21/66±17	>0.05
Anterior myocardial infarction (%)	29 (31.5%)	30 (29.7%)	>0.05
LVEF (%) at admission	57.3±21.8	59.4±20.2	>0.05
E/A at admission	1.21±0.44	1.17±0.33	>0.05
LVEF(%) at 24 h	55.4±23.6	52.8±21.3	>0.05
E/A at 24 h	1.16±0.35	0.79±0.37	<0.05
CKMB (ng/ml) at admission	56±32	64±28	>0.05
CKMB (ng/ml) peak	157±87	254±105	<0.05
TNI (pg/ml) at admission	1.7±0.5	1.9±0.7	>0.05
TNI peak (pg/ml)	22.5±3.4	29.9±4.6	<0.05
BNP (pg/ml) at admission	45±23	39±28	>0.05
BNP (pg/ml) at 18 h	261±410	921±1126	<0.01
Death (%)	3 (3.3%)	14 (13.9%)	<0.01

BNP: B-type natriuretic peptide; TNI: troponin I; LVEF: left ventricular ejection fraction; E/A: early(E) and atrial (A) transmitral maximal flow velocities, the ratio.

Table 2. Super-acute PCI vs. acute PCI.

Baseline characteristics	Super-acute group(n=42)	Acute group (n=50)	P
BNP (pg/ml) at admission	12±6	22±10	>0.05
CKMB (ng/ml) at admission	18±12	30±16	<0.05
BNP (pg/ml) at 18 h	183±197	326±589	<0.05
CKMB (ng/ml) peak	102±67	204±105	<0.05

Super-acute: PCI≤3 h, acute: PCI in 3 to 6 h.

Table 3. Logistic regression analysis.

Characteristics	OR	95% CI	P
Male	0.956	0.651-1.561	0.201
Age	1.160	1.013-1.306	0.031
Diabetes	1.092	1.005-1.219	0.033
Hypertension	1.135	0.975-1.964	0.026
Smoking	0.897	0.765-1.105	0.058
LVEF at admission	0.598	0.152-2.341	0.460
Anterior myocardial infarction (%)	1.182	1.083-1.406	0.031
PCI	1.215	1.043-1.205	0.029

patterns of BNP release in AMI; monophasic pattern-concentration in the first measurement was higher than in

the second one, and biphasic pattern-concentration in the first measurement was lower than in the second one.

Group with biphasic pattern of BNP release had significantly higher BNP concentration compared to monophasic pattern group. In biphasic pattern group, there were significant presence of lower LVEF, Killip class II and III, LV remodelling and MACE. They suspected that second peak secretion was not only due to systolic dysfunction and subsequent remodeling of LV but also due to impact of ischaemia. In this study, we proved if the patients with STEMI could be treated by PCI successfully, their BNP could be significantly lower than those treated conservatively. The sooner the ischemic site got reperfusion, the better for the stable of circulating BNP level after 18 h post the onset.

The mechanism underlying the increase in BNP during acute coronary syndrome is not fully understood until now. Although, rise in plasma BNP levels may be caused by direct release from necrotic areas of infarcted myocardium, experimental studies have shown that there is increased BNP mRNA expression in the viable myocytes in the peri-infarct areas and the stimulus for this seems to be increased wall stress directly related to the MI (Sumida et al., 1995; Norio et al., 1995). BNP gene expression during ischemia has been demonstrated in other studies (Sabatine et al., 2004). Other investigators have shown that hypoxia was a stimulus for BNP secretion from human cardiac myocytes in adult patients who had cyanotic congenital heart disease (Hopkins et al., 2004). The present study shows that if the ischemia could be stopped, the BNP level could be significantly lower than the continuous ischemic ones. This is in agreement with previous studies,

Jiang et al. (2004) proved that in patients whose early circulating BNP level was greater than 80 pg/ml, the incidence of mortality and heart failure could be reduced in patients with acute coronary syndromes provided by early PCI (Jiang et al., 2004). Their early PCI means in 6 h after onset of symptoms. Here, we proved if the PCI could be performed in super-acute time (in 3 h), the BNP could be more stable. Ceriani and Giovanella (2007) studied the perfusion defect in MI patients using 99mTc-sestamibi G-SPET and showed a positive correlation between BNP and the perfusion defect after MI. Other studies revealed that BNP 24 h after onset is an independent predictor of major adverse cardiac events during 12 months follow-up after elective successful PCI (Yildirim et al., 2008). We found that BNP at 18 h are significantly higher in patients who did not survive at last, which indicated that if BNP is increased highly, the prognosis of the patient could be much more dangerous than BNP stable patients. Increased evidences showed that BNP measurement improves cardiovascular disease prevention and could provide strong and incremental prognostic information to traditional risk factors (Campbell, 2008; Omland et al., 2007). From BNP levels comparison between super-acute PCI and acute PCI treated patients, we suggest that reperfusion rescue of infarction should be performed as early as it could

be which may influence the prognosis of patients.

Conclusion

Earlier reperfusion in infarct-related artery results in significantly better BNP level and may be good for myocardial salvage and preservation of heart function.

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