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Relationship between obesity and NT-proBNP and the effect on prognosis of acute myocardial infarction

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Abstract

Objective: To explore relationship between N-terminal pro-B-type natriuretic peptide (NT-proBNP) and obesity, and effect of them on acute myocardial infarction prognosis in patients

Methods: Sixty cases patients who were diagnosed with acute myocardial infarction, were enrolled from December 2015 to December 2017 in the author's hospital. Thirty of these non-obese patients were divided to control group, and the remaining 30 patients with obesity were assigned to the observation group. NT-proBNP was measured in both groups to observe the prognosis, and explore relationship between obesity, NT-proBNP and prognosis of acute myocardial infarction.

Results: Level of NT-proBNP in the observation group was significantly higher (2234 ± 1457 pg/ml) than that in control ones (1126 ± 826 pg/ml), and adverse cardiac events incidence in observation ones was 13.3% (4/30), which was significantly lower than the incidence of 40% (12/30) in the control group ($P < 0.05$).

Conclusion: NT-proBNP is higher in obese patients, and could be applied to judge prognosis of patients with acute myocardial infarction in obese populations.

Keywords: Obesity, NT-proBNP, Interrelation, Acute myocardial infarction, Prognosis, Effect.

1. Introduction

Acute myocardial infarction (AMI) is the myocardial necrosis caused by acute and persistent ischemia and hypoxia of coronary artery. In clinical practice, the acute myocardial infarction is most common in the America and EU countries, where approximately 1.5 million person experience the myocardial infarction every year. Recently, China has shown a marked upward trend with more than 1.5 million prevalent cases and 400,000 new cases each year. In China, acute myocardial infarction is an acute and severe coronary heart disease with very high morbidity, mortality and disability rate, which has great harm to human health and life. According to a survey report in the United States, the mortality rate of acute myocardial infarction is as high as 5.4% in hospitals (Li L. et al., 2018). In addition, many cases of home mortality cannot be calculated in detail which leads to the higher mortality rate of acute myocardial infarction indicating that this disease is of great harm.

At present, there are many indicators applied to evaluate prognosis of acute myocardial infarction (Granger C.B. et al., 2004; Antman E.M. et al., 2001). Although many risk indexes1 and various independent risk factors have been used in clinical diagnosis, and the experts are still looking for more proper predictors. In recent years, many researches have revealed that N-terminal pro-B-type natriuretic peptide (NT-proBNP) exert promising prognostic value in acute coronary syndromes

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(ACS) (James S.K. et al., 2003). One of the most recent studies has shown that NT-proBNP levels exert higher correlation with mortality and work which was obviously better than troponin T and C-reactive protein (Iwanaga Y. et al.; Goetze J., 2003). NT-proBNP, as a most clinically used heart failure biomarker, are released from the heart under pressure load, and exert similar clinical application value with BNP. The levels of NT-proBNP can be used to reflect myocardial function and the heart failure severity. In comparison, BNP exert a t1/2 of only 0.3 h, while the NT-proBNP, although biologically inactive, has a t1/2 of 1-2 h and is about 16-20 times higher than B-type natriuretic peptide, in the circulation. At the same time, N-terminal pro-B-type natriuretic peptide has little intra-individual variation and almost no diurnal variation; it has good stability in serum and plasma, and can be stable for more than 3 days at room temperature. The blood collection position has no significant effect on the sample results, and its detection results are not interfered by recombinant B-type natriuretic peptide (BNP), or other drugs. Therefore, NT-proBNP is easier to detect and more sensitive, and is a more ideal marker of heart failure in clinical practice.

For acute myocardial infarction, accurate clinical prognosis evaluation should be done in order to take targeted prevention and treatment strategies for high-risk groups. In this study, 60 patients with myocardial infarction who were admitted from December 2015 to December 2017 were selected to explore relationship between obesity and NT-proBNP and its impact on prognosis of acute myocardial infarction.

2. Materials and methods

2.1. General Materials

Sixty cases of patients with myocardial infarction were picked from December 2015 to December 2017 in our hospital. Thirty of these patients with obesity were divided to observation group and remaining 30 non-obese patients were divided to the control group, and basic information of the two groups were as follows:

Observation group: 17 cases of females, 13 cases of males; the age of patients were ranged from 52 to 82 years (70.52±10.32); BMI: 26~37 (31.54±4.16) kg/m^2.

Control group: 14 cases of females, 16 cases of males; the age of patients were ranged from 52 to 85 years (71.62±12.32); BMI: 20~24 (22.27±1.55) kg/m^2.

Except for BMI, there's no difference between these two groups.

2.2. Methods

About 5 ml of venous blood was collected from two groups of patients, and then was put into anticoagulation test tube for the futher centrifugation in a refrigerated centrifuge. The plasma concentration of NT-proBNP was carefully measured after serum and plasma were separated by ultracentrifugation. And the patients with AMI in both two groups were followed for up to 24 months to monitor the occurrence of adverse cardiac events.

2.3. Clinical observation indicators

(1) Comparing the accurate plasma levels of NT-proBNP between the control and observation groups;

(2) Comparing the adverse cardiac events incidence between the control and observation groups.

2.4. Statistical analysis

The clinical data of the patients participating in the experiment were tested by the statistical software SPSS 17.0. The involved counting data was showed in the form of (n, %) and analyzed by using the test of chi-square. The data of measurement were tested by t value and expressed $\bar{x}$±s. If the statistical calculation result of experimental data of two groups of patients were $P < 0.05$, indicating that there was statistical difference.

3. Results

3.1. The measurement of plasma levels of NT-proBNP

Patients with AMI were randomly grouped according to the BMI value. As a result, plasma levels of NT-proBNP were 1126 ± 826 pg/mL and 2234 ± 1457 pg/mL in normal weight patients and obese patients, respectively, indicating the plasma concentration of NT-proBNP in observation group were obviously higher than those in control group ($P < 0.05$) and the relation between NT-proBNP and body weight was positive. (Table1).

3.2. Adverse Cardiac Event

The total incidence of adverse cardiac events in control group was sinificantly higher than that in observation group (40% vs. 13.3%; $\chi2 = 10.112$, $P = 0.001 < 0.05$). Detailed results were showed in Table 2

Table1: Comparison of NT-proBNP levels between control and observation group

Group	n	BMI (kg/m^2)	Physical status	NT-proBNP (pg/ml)
Observation group	30	31.54±4.16	Obese	2234 ± 1457
Control group	30	22.27±1.55	Normal	1126 ± 826
t		12.876		1.992
P		0.000		0.028

Table 2: ***Comparison of adverse cardiac event between the control and observation group.***

Group	n	Cardiac Death	Nonfatal Myocardial Infarction	Re-percutaneous Coronary Intervention	Coronary Artery Bypass Surgery	Overall Incidence
Observation group	30	0 (0.00)	2 (6.67)	2 (6.67)	0 (0.00)	4 (13.3)
Control group	30	2 (6.67)	4 (13.33)	4 (13.33)	2 (6.67)	12 (40)

3.3. Effect of obesity on the prognostic value of NT-proBNP for AMI

We further conducted a multivariate analysis to investigate the independent prognostic factors for acute myocardial infarction. And the results showed that glucosuria (OR=1.344, P = 0.047), smoking (OR=1.428, P=0.048) and the plasma concentration of NT-proBNP (OR=1.005, P=0.002) were independent prognostic factors for acute myocardial infarction (Not supplied).

4. Discussion

Acute myocardial infarction is considered as acute coronary artery occlusion with interruption of blood flow, resulting in ischemic necrosis of the regional myocardium. Clinical manifestations may include persistent retrosternal pain, shock, arrhythmias, and heart failure, as well as increases in serum cardiac enzymes and electrocardiographic changes.

When coronary atherosclerosis results in luminal narrowing and insufficient blood supply to the myocardium, and collateral circulation is not established, myocardial infarction can occur due to aggravated myocardial ischemia for the following reasons: (1) Complete occlusion of the coronary artery: bleeding in the atherosclerotic plaque of the diseased vessel or under the intima, thrombosis in the lumen or persistent spasm of the artery, resulting in complete occlusion of the lumen. (2) The sudden drop in cardiac output: shock, dehydration, bleeding, severe arrhythmia or surgical operation, coronary perfusion is seriously insufficient. (3) The demand for oxygen in the myocardium surges: severe physical work, emotional or blood pressure surges, the left ventricular load dramatically increased, catecholamine secretion increased, myocardial oxygen demand increased. Acute myocardial infarction can also occur in the absence of coronary atherosclerosis coronary spasm, but also occasionally due to coronary embolism, inflammation, congenital malformations. Severe arrhythmia, shock or heart failure after myocardial infarction can further reduce coronary perfusion and enlarge the extent of myocardial necrosis.

The N-terminal prodiuretic peptide which generates the 32-amino acid brain diuretic peptide, NT-proBNP, with more activity in a cleavage reaction (Madamanchi C. et al., 2014) In general, NT-proBNP exists in ventricular cardiomyocytes. If ventricular volume increases, wall tension increases, and cardiac stress increases, the myocardium will secrete more BNP in response to traction stimulation. Therefore, diagnosis of heart failure can be made clinically by detectin the level of BNP and specific extent of damage to cardiomyocytes could also be predicted (Zheng L.H. et al., 2014). Similarly, NT-proBNP could be applied as a single prognostic indicator for acute myocardial infarction and for early assessment of the patients' condition. However, there are many factors affecting the plasma NT-proBNP levels. For instance: the patients with normal renal function will rapidly metabolize NT-proBNP within 120 minutes because of that NTproBNP is mainly cleared by renal metabolism, and more consideration should be given to patients with renal dysfunction; Sex and age could also influence NT-proBNP measurements, such as elderly female usually showed higher results compared elderly male and young patients, and this factor also needs to be taken into account (Darche F.F. et al., 2019). Previous research suggested that obesity also has an impact on the levels NT-proBNP. Data indicated that levels of NT-proBNP are relatively high in obese patients, while they are relatively low in normal patients. Hence it should be noted negative correlation between obesity and NT-proBNP (Almuwaqqat Z. et al., 2019).

The relationship between obesity, NT-proBNP and prognosis of acute myocardial infarction could be analyzed combining with the 24-month follow-up results comprehensively (Whitman I.R. et al., 2019). Assuming that the NT-proBNP cannot be applied as the prognostic factor in obese patients under the influence of obesity, previous research data displayed lower NT-proBNP levels in no-obese patients than that in obese patients. However, Kristensen believed that the NT-proBNP is an independent marker for the prognostic evaluation of acute myocardial infarction (Kristensen S.L. et al., 2017). It means that obese patients have a worse prognosis after the onset of acute myocardial infarction, Kristensen also exhibited the higher cardiac adverse events incidence in control group than in observation group (40%>13.3%). Altogether, negative correlation presents between obesity and NT-proBNP, and both obesity and NT-proBNP related to prognosis of patients with acute myocardial infarction closely. Obesity and increased NT-proBNP may rise the adverse cardiac events incidence.

Currently study still has some limitations. First, our study is not a completely randomized controlled trial, and therefore, there is the presence of selection bias. Second, we grouped according to body mass index, which is not very meaningful compared with similar studies since the World Health Organization and China's body mass index are not identical. Third, we could not continue to monitor the body mass index and NT-proBNP levels in the follow up time. There are also studies suggesting that early NT-proBNP plasma concentrations (measured 2 to 6 days after the onset of acute myocardial infarction) have better predictive value than the plasma concentrations of NTproBNP measured at the time of patient arrived at the hospital.

In conclusion, plasma concentration of NT-proBNP are higher in obese patients with AMI than that in nonobese obese patients, while the NT-proBNP remains an independent prognostic marker in obese patients with acute myocardial infarction, and elevated NT-proBNP implies a worse prognosis in obese patients. The incidence of adverse cardiac events can be increased by obesity. These two indicators should be legitimately used to evaluate the prognosis of patients in clinical practice.

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