ORIGINAL ARTICLE

CORRELATION OF CARDIAC BIOMARKERS WITH THE LEVELS OF SELENIUM AND ANTIOXIDANT ENZYMES IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION AND A HISTORY OF HYPERTENSION

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ABSTRACT

The aim: To determine the interrelations between the levels of antioxidant enzymes, selenium and the markers of myocardial injury in patients with non-ST segment elevation myocardial infarction and a history of antecedent arterial hypertension.

Materials and methods: A total of 72 patients with non-ST segment elevation myocardial infarctionwere examined (42 with antecedent hypertension - group 1; 30-without hypertension – group2).

Results: Patients of group 1 were characterized by significantly higher troponin I levels ($p = 0.006$), creatine kinase MB levels ($p=0.008$) and lower levels of superoxide dismutase ($p=0.005$), catalase ($p=0.003$) and selenium ($p=0.008$) as compared with group 2. In both groups, the activity of superoxide dismutase had an inverse correlation with troponin I: ($r = -0.46$, $p = 0.005$) and ($r = -0.38$, $p = 0.004$), respectively. A significant inverse relationships were found between selenium levels and both markers of myocardial injury in group 1 ($p \leq 0.009$), whereas in group 2 a weak correlation was found between the levels of selenium and troponin I only ($p=0.006$).

Conclusions: The obtained data suggest that the levels of selenium and antioxidant enzymes in blood of all patients with non-ST elevation myocardial infarction inversely correlate with cardiac biomarkers. Patients with non-ST elevation myocardial infarction and a history of hypertension have significantly lower levels of antioxidant agents, higher levels of markers of myocardial injury, and stronger connections between them, indicating the development of more significant myocardial injury.

KEY WORDS: myocardial infarction, hypertension, cardiac biomarkers, selenium, antioxidant enzymes

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INTRODUCTION

Acute myocardial infarction is one of the leading causes of mortality and a widespread cause of disability worldwide. A major advances in the treatment of acute coronary syndromes and myocardial infarction have occurred over the past several decades. Interventional cardiologic or thrombolytic approaches had become a major breakthrough due to the ability to quickly restore blood flow to the myocardium during heart attack [1]. Thought 'reperfusion' is considered as a major therapeutic aim, the process of ischemia followed by reperfusion is often accompanied by the activation of a damaging cascade. While the pathophysiology of ischemia-reperfusion is complex and not completely understood, there is substantial proof implicating reactive oxygen species as an inceptive cause of the damage [2,3]. Free radicals formed during oxidative stress can oxidize proteins to inactive states, initiate lipid peroxidation and cause DNA strand breaks, all potentially harmful to normal cellular function [4]. Free radicals have been shown to be generated following routine clinical procedures such as thrombolysis and coronary bypass surgery, due to the inevitable episode of ischemia-reperfusion. Moreover, they have been associated with poor recovery of myocardium after ischemia, and recent studies provide an evidence of their role in the development of infarction, apoptosis, necrosis, arrhythmogenesis and endothelial dysfunction following ischemia-reperfusion [5].

Endogenous free radical scavengers such as superoxide dismutase, catalase and selenocysteine dependent enzymes are the key agents of the antioxidant system that act synergistically and protect cardiomyocytes during ischemic and reperfusion injury [6, 7]. Superoxide dismutase, which operates primarily within cells and in extracellular matrices, catalyzes the dismutation of the superoxide anion into hydrogen peroxide. It is the most effective antioxidant enzyme in humans [8]. In turn, catalase and selenocysteine dependent enzymes remove hydrogen peroxide and maintain the cellular redox balance, thus complementing and finishing the cycle of reactive species deactivation [9].

Therefore, a determination of antioxidant status and its influence on the level of myocardial injury in patients with non-ST segment elevation myocardial infarction and antecedent hypertension is a topical issue of treatment of such patients.

Table I. The levels of cardiac biomarkers and antioxidant agents in blood of examined patients.

Indicator	Group 1 (NSTEMI + hypertension)	Group 2 (NSTEMI)	p
Troponin I, ng / mL	28.3 ± 3.23	20.9 ± 2.46	0.006
CK-MB, units / L	186.3 ± 24.4	150.5 ± 19.8	0.008
SOD, units/mgHb	2.1 ± 0.02	2.7 ± 0.07	0.005
CAT, mcmol/min ×mgHb	412.3± 35.6	643.4± 32.1	0.003
Selenium, mcg/ml	0.21 ± 0.02	0.26 ± 0.01	0.001

Table II. Correlation between the levels of cardiac biomarkers and antioxidant agents in blood of examined patients.

Indicator	Group 1 (NSTEMI + hypertension)	Group 2 (NSTEMI)
SOD and troponin I	r = -0.46, p = 0.005	r = -0.38, p = 0.004
SOD and CK-MB	r = -0.34, p = 0.004	r = -0.22, p = 0.018
CAT and troponin I	r = -0.28, p = 0.006	r = -0.25, p = 0.003
CAT and CK-MB	r = -0.61, p = 0.003	r = -0.14, p = 0.022
Selenium and troponin I	r= -0.32, p = 0.009	r= -0.12, p = 0.006

THE AIM

The aim of our study was to determine the interrelations between the levels of antioxidant enzymes, selenium and the markers of myocardial injury in patients with non-ST segment elevation myocardial infarction and a history of antecedent arterial hypertension.

MATERIALS AND METHODS

42 patients with NSTEMI and antecedent hypertension were examined in the Cardiological unit of Kharkiv Regional Clinical Hospital, Kharkiv, Ukraine. The mean age of patients was 61.82 ± 7.65 years; there were 11 women and 31 men; the duration of hypertension history was 9.62 ± 3.16 years. All these patients were included in group 1. Also, 30 patients with NSTEMI without previous history of hypertension were examined and formed group 2. Groups were comparable by age and gender.

All patients were examined by general clinical, anthropometric, laboratory and instrumental investigation methods. 12-lead electrocardiogram and transthoracic echocardiography were performed in all of patients by conventional methods. Standard general and biochemical assays of blood plasma were conducted.

The levels of troponin I (TnI) and creatine kinase-MB fraction (CK-MB) were determined in blood of all patients by immunochemical analyzer AQT90 FLEX, "Radiometer". Selenium level was measured by fluorometric method (Fluorat 02-2M, Czech Republic). The activity of superoxide dismutase (SOD) and catalase (CAT) was determined by spectrophotometric method (Specord M-40, Germany). All blood samples were taken when admitting patients to the hospital.

The diagnosis of NSTEMI was established in accordance with the Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation of European Society of Cardiology, 2015 [10] and International Disease Classification of 10th revision.

Medical aid was provided to the examined patients on in-patient basis according to the clinical protocols of the Ministry of Healthcare of Ukraine and local protocols.

All patients signed an informed consent to participate in the study. Ethical approval was obtained from the Bioethics Commission of the Kharkiv National Medical University of Ukraine.

Statistical analysis was performed with SPSS 19 software for Windows. Student's t-test (t) was applied for evaluating credibility between mean quantitative positions of two samples. The Pearson's correlation coefficient (r) between different indicators was analyzed. A value of $p \leq 0.05$ was considered as statistically significant.

RESULTS

During our research we have obtained the following results: patients of group 1, who had NSTEMI and a history of hypertension, demonstrated more intense myocardial injury according to the significantly higher levels of troponin I and creatine kinase-MB, while the activity of antioxidant defenses was notably lower as compared with group 2. The results of study are presented in table I. It should be noted, that the level of troponin I in patients with NSTEMI and antecedent hypertension was 26.1% higher than in patients with NSTEMI only, and the level of CK-MB was 19.3% higher, respectively.

In the same time, all studied indices of antioxidant agents were significantly lower in patients of group 1: SOD - 22.2%, CAT - 35.9%, selenium - 19.2% lower, respectively.

The study of the interrelations between the levels of biomarkers of myocardial injury and indicators of the antioxidant system in blood of examined patients allowed

us to establish the presence of correlations of varying degrees between the content of troponin I, CK-MB and the levels of SOD, CAT and selenium. The predominance of correlations' number and strength was observed in patients with NSTEMI and antecedent hypertension. The results of study are presented in table II. In both groups, the activity of superoxide dismutase had a negative correlation with troponin I: ($r = -0.46$, $p = 0.005$) and ($r = -0.38$, $p = 0.004$), respectively. The same pattern of correlation was observed between catalase and troponin I, however, the strength of connections was slightly weaker in both groups. So, the lower was the level of endogenous antioxidant enzymes, the higher was the level of myocardial injury during NSTEMI with or without hypertension.

The study of correlations between catalase and creatine kinase-MB levels demonstrated a strong negative correlation ($r = -0.61$, $p = 0.003$) between the studied indices in group 1, while a weak negative relationship ($r = -0.14$, $p = 0.022$) was revealed in group 2. The correlation between superoxide dismutase and creatine kinase-MB levels has shown moderate inverse interdependence in group 1 and weak negative relationship in group 2.

Significant negative relationships were found between selenium levels and the indices of cardiac biomarkers in group 1: both with troponin I ($r=-0.32$, $p=0.009$) and creatine kinase-MB ($r=-0.18$, $p=0.005$), whereas in group 2 a weak correlation was found between the levels of Se and troponin I only ($r=-0.12$, $p=0.006$).

DISCUSSION

As seen from our research, patients with NSTEMI and antecedent hypertension demonstrated more evident myocardial injury according to the significantly higher levels of cardiac biomarkers, while the activity of antioxidant defenses was notably lower as compared with NSTEMI patients with no hypertension history. It is well known, that cardiac troponins are more sensitive and specific markers of cardiomyocyte injury than MB isoenzyme of creatine kinase [10]. However, in this case both biomarkers have shown reliable differences between studied groups.

As seen in table I, patients with NSTEMI and antecedent hypertension experience more significant depletion of antioxidant defense resources. In pathological underlying situations, particularly atherosclerosis or hypertension, the release of reactive oxygen species exceeds endogenous antioxidant capacity, leading to cell injury. Therefore, development of acute myocardial infarction against the background of hypertension accelerates free radical injury, inhibits defensive abilities of antioxidant system and slows down the recovery of its components [11, 12].

The study of the correlations between the levels of biomarkers of myocardial injury and the activity of antioxidant defenses demonstrates the fact that the activity of antioxidant enzymes directly influences the degree of myocardial injury during NSTEMI. Stronger negative connections between the antioxidant enzymes and the markers of myocardial injury in patients with antecedent hypertension suggest that there is a certain "exhaustion" of the enzymatic component of antioxidant system going on in patients, who experience almost a 10-years history of antecedent hypertension.

Selenium is a trace element, which possesses some degree of its own antioxidant activity or can act as a component of selenoproteins [13]. The provision of membranes with selenium, along with other factors that determine the resistance of cells to oxidative stress, is of fundamental importance for cardiomyocytes [14]. Low level of selenium in blood of patients with NSTEMI, especially in those with antecedent hypertension, and its inverse relationship to troponin I reflects significant disorders of lipoperoxide homeostasis, reduction of protective capabilities of the antioxidant system, which in turn causes disruption of the structural and functional organization of cardiomyocyte membranes and indicates the important role of initiation of oxidative stress as a pathogenetic mechanism in the development of acute myocardial infarction and hypertension.

CONCLUSIONS

The obtained data demonstrate that selenium levels and the activity of antioxidant enzymes in blood of patients with NSTEMI inversely correlate with cardiac biomarkers. Patients with NSTEMI and a history of hypertension have significantly lower levels of antioxidant agents, higher levels of troponin I and creatine kinase-MB, and stronger connections between them, indicating the development of more significant myocardial injury. Further research should be performed in this realm to find effective methods of correction of antioxidant status in patients with acute myocardial infarction in order to prevent worsening of myocardial injury.

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Conflict of interest:
The Authors declare no conflict of interest.

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