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Brief Report

Alteration in serum levels of selenium and glutathione peroxidase in acute myocardial infarction

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Key Words
Acute myocardial infarction; Antioxidant; Glutathione peroxidase; Selenium

Abstract
Atherosclerosis is a vascular disease that occurs primarily in the aorta, coronary arteries and cerebral arteries with thickening of arteries and loss of elasticity. Despite decreased antioxidant activity documented among patients with atherosclerosis, the relationship between atherosclerosis and levels of antioxidants is still unknown. The present study was designed to evaluate serum levels of selenium and glutathione peroxidase (GPx) in patients with acute myocardial infarction with respect to healthy controls. A total of 20 patients (mean age 53.9 ± 11.1 years; 65% were males) in the myocardial infarction with ST-segment elevation group were compared with 29 subjects (mean age 46.9 ± 13.6 years; 55.2% were females) in the control group in terms of serum selenium and GPx levels. Patients with chronic diseases such as diabetes mellitus, hypertension, chronic renal disease, chronic liver disease, malignancy, prior cardiac events were not included. As result, there was a significant reduction in serum selenium levels of patient with myocardial infarction when compared to control subjects. However patient and control groups were similar in terms of serum GPx levels. In conclusion, since serum levels of Se are directly proportional to GPx activity but inversely proportional to the age, addition of Se to the diet in elderly patients seems to have a benefit in increasing antioxidant protection.

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INTRODUCTION

Cardiovascular diseases (CVD) have been considered among major causes of mortality and morbidity [1]. Today, primary treatments aiming protection from ischemic heart diseases intend to control conventional risk factors. Oxidative stress has been demonstrated to have a role in pathogenesis of atherosclerosis in the past studies [2].

Bio-oxidative effects of free radicals on lipids, proteins, and DNA on free radicals were documented to be controlled by antioxidants. Antioxidants inhibit atherogenesis and improve vascular functions by various mechanisms [3]. As an important intracellular antioxidant, glutathione peroxidase (GPx) was reported to be located in the extracellular space at very low concentrations. Peroxide, by reacting free radicals, protects cells from oxidative damage [3].

Selenium (Se), an important integral component of GPx, is a trace element that increases the activity of GPx by taking place in its structure [4]. The present study was designed to evaluate serum levels of Se and GPx in patients with acute myocardial infarction with respect to healthy controls.

MATERIALS AND METHODS

A total of 49 subjects composed of patients diagnosed with acute myocardial infarction (AMI) with ST-segment elevation (n = 20; 7 females, 13 males) and healthy controls (n = 29; 16 females, 13 males) were included in this study conducted at Coronary Intensive Care Unit in Okmeydani Training and Research Hospital. Written informed consent was obtained from each subject following a detailed explanation of the

objective and protocol of the study which was conducted in accordance with the ethical principles stated in the "Decleration of Helsinki" and approval by the institutional ethics committee.

Diagnosis of AMI was confirmed via chest pain and other symptoms; ST-segment elevation in at least two leads in electrocardiography (ECG) and serum troponin and CK-MB elevation. Control subjects were randomly selected from healthy subjects having normal findings in physical examination, ECG, chest radiography and urine-blood tests.

Patients in the age range of 30-70 years and not using vitamin-mineral supplements were the inclusion criteria. Being diabetic, hypertensive, obese, active smoker or vegetarian and to be diagnosed with any non-ischemic heart disease other than AMI and other heart diseases were the main exclusion criteria of the present study. Blood samples for measurement of Se and GPx levels in all subjects was taken into dry tubes and centrifuged and kept at –20ºC until assay. Serum Se levels were measured with atomic absorption spectrophotometry while GPx levels were measured with the method of Paglia and Valentine [5]. Hemogram and biochemical analysis were also performed for subjects in the AMI and control groups. Blood was withdrawn from AMI patients within the first 4 hours of the diagnosis preceding the treatment (thrombolytic, percutaneous transluminal coronary angioplasty-PTCA, *etc*).

Statistical analysis was performed using "SPSS 16.0 for Windows". Data was expressed as "mean ± standard deviation (SD)" and/or percent (%). Descriptive statistics were given for numerical variables and frequency tables for categorical variables. Pearson Correlation test was used to determine the relation between variables. Student t-test was used for the numerical data. $P < 0.05$ was considered statistically significant.

Table 1. Average serum levels of selenium and glutathione peroxidase with respect to age and experimental groups

	n	Serum Se (ng/ml)	Serum GPx (U/l)
Age groups			
<40 years	12	52.3 ± 6.2	227.9 ± 64.6
40-50 years	10	52 ± 9.5	235.1 ± 57.2
50-60 years	15	46.2 ± 9.9	252.8 ± 74.8
>60 years	12	46.3 ± 5.7	237.4 ± 48
Total	49	49.8 ± 6.9	226.1 ± 42.4
Experimental groups			
Control	29	52.1 ± 7.4	233.3 ± 68.5
Acute MI	20	46.5 ± 9*****	241.3 ± 50
Total	49	49.8 ± 8.5	236.6 ± 61.2

Values are presented in mean ± SD; *****$P < 0.05$ compared to Se levels of the control group (Student's t-test)

RESULTS

Subjects in the AMI and control groups were similar in terms of mean age (Table 1). When the overall study population (n = 49) was evaluated with respect to the relation of age to serum levels of Se and GPx; serum Se levels were determined to be reduced at older ages. Besides a very weak negative correlation was determined between serum levels of Se and the age ($P = 0.039$; $r = –0.125$; Fig.1). However, there was no significant correlation between GPx levels and age ($P = 0.796$; $r = 0.038$; Fig.2).

There was a significant reduction in serum selenium levels of patients with myocardial infarction (46.45 ± 9.04 ng/ml) when compared to control (52.07 ± 7.38 ng/ml) subjects ($P = 0.021$) (Fig.3). However, patient and control groups were similar in terms of serum GPx levels (241.25 ± 50 U/l *vs* 233.31 ± 68.50 U/l; $P = 0.660$) (Table 1).

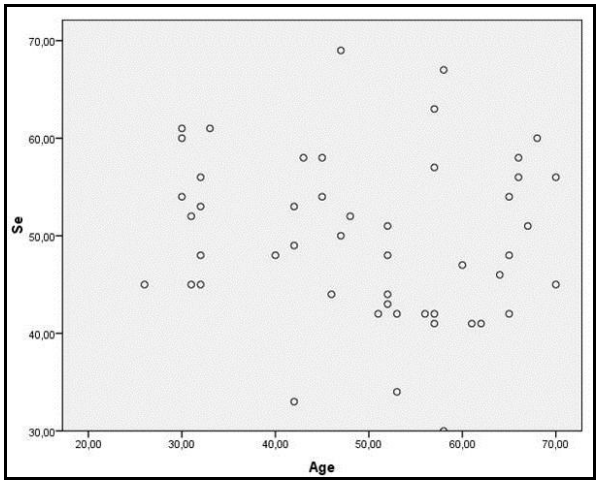

Figure 1. The correlation between serum selenium levels (Se; ng/ml) and age; a weak negative correlation ($P = 0.039$; $r = –0.125$).

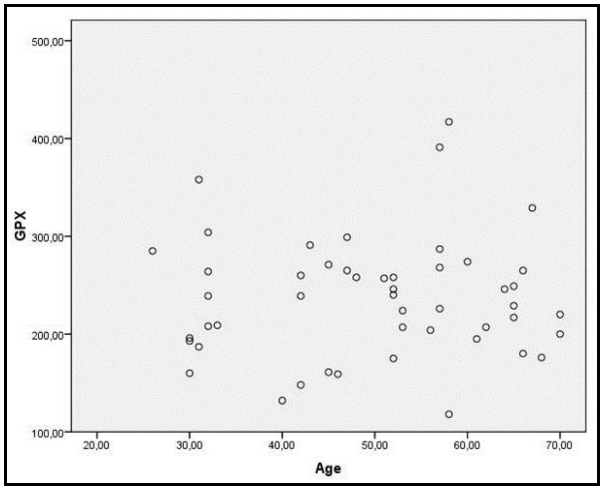

Figure 2. The correlation between serum glutathione levels (GPx; U/l) and age; no correlation ($P = 0.796$; $r = 0.038$).

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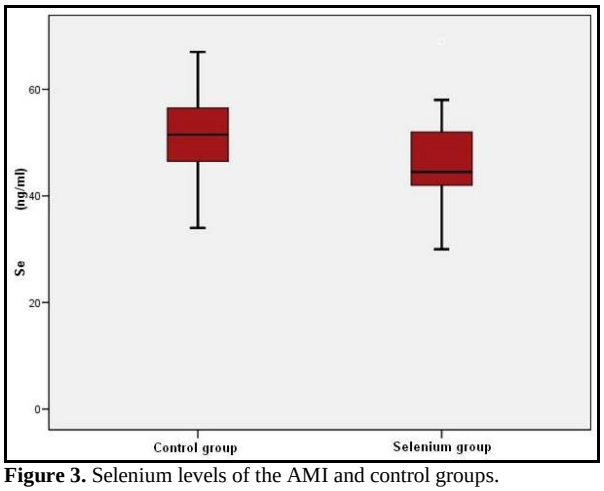

Figure 3. Selenium levels of the AMI and control groups.

DISCUSSION

Amongst the various hypotheses suggested about the pathogenesis of atherosclerosis, oxidative stress hypothesis is one of the most valid ones [6, 7]. Physiological role of antioxidants is to prevent free radical associated tissue damage resulting from chemical reactions. In this regard, owing to common use of antioxidants in prevention and treatment of CVDs, there is a growing interest towards antioxidant foods [8].

Scavenging enzymes are essential in the antioxidant defense against intracellular free radicals [9]. GPx is also one of the most important enzymes to protect intracellular lipids from peroxidation. Selenium is located in the structure of GPx enzyme which plays an antioxidant role in the prevention of certain metabolic diseases such as atherosclerosis. In contrast to toxic and carcinogenic potential shown in the past studies, Se has been considered as an important and useful element for biological systems in recent studies [10].

Accordingly, based on limited and inconsistent data on the role of GPx activity and Se level in the CVD etiology despite driving more than 20 years of research, findings of the present study seem to benefit in clarification of the role of antioxidant mechanisms in the etiology of the CVD.

Significant decrease in serum or plasma Se concentrations was documented in past studies in AMI, chronic ischemic heart disease, congestive heart failure, cardiomyopathy and hypertension. Selenium deficiency is known to increase the likelihood of CVDs including AMI related to ischemia/reperfusion injury. Also, Se deficiency was shown to lead to an increase in the requirement for coronary bypass surgery, heart transplant and coronary angioplasty while Se supplements were stated to be cardioprotective against the ischemia-reperfusion injury [5, 6, 11, 12]. In a study conducted with 46 patients, administration of Se supplements (400 µg/day, 7 days) was shown to reduce the need for cardiovascular surgery [13] while AMI patients were determined to have significantly lower levels of serum Se when compared to control subjects [14]. Furthermore, decrease in the antioxidant activity of GPx has also been considered to have a role in the CVD etiology [15].

Based on the mutual interaction between Se and GPx, the studies in the literature concerning GPx together with its cofactor Se has been increasing in number. Decrease in erythrocyte GPx levels was shown to be related to increased cardiovascular risk depending on the degree of atherosclerosis [16]. Indeed indicating the relation of GPx activity to severity of coronary artery disease, GPx activity was reported to be significantly reduced in patients with 2 to 3 damaged vessels compared to patients with single damaged vessel and healthy controls while there was no significant relationship between GPx activity and AMI in the original study [17].

Our findings concerning lower Se levels in older subjects are in line with previously shown reduction in Se levels by increasing age in the literature [18]. In this context, addition of Se supplements to the diet in the older ages may have a beneficial effect in reducing the risk of CVD increased by aging.

In contrast to chronic events, past studies concerning alteration in serum levels for GPx during acute MI revealed inconsistent results [19]. Accordingly, in our population, despite significant reduction determined in Se levels, there was a non-significant increase in GPx levels during acute AMI which seems to be in line with previously reported low levels of Se but high levels of GPx during AMI interpreted as a defense against increased oxidative stress in the literature [20].

In conclusion, since reduction in Se levels are proportional to GPx activity as well as the likelihood of coronary artery disease, addition of Se to the diet in elderly patients with prominent cardiovascular risk seems to have a benefit in increasing antioxidant protection.

REFERENCES

1. Hennekens CH. Increasing burden of cardiovascular disease. Current knowledge and future directions for research on rise factors. Circulation 1998; 97:1095-102.
2. Sies H. Oxidative stress: introdoctory remarks. In: Sies H (ed) Oxidative Stress, Academic Press, San Diego, New York, London, pp 1-8, 1985.
3. Sies H. Strategies of antioxidant defense. Eur J Biochem 1993; 215:213-9.
4. Schwenke DC. Antioxidants and atherogenesis. J Nutr Biochem 1998; 9:424-45.

5. Paglia DE, Valetine WN. Studies on the quantitative and qualitative characterization of erytrocyte glutathione peroxidase. J Lab Clin Med 1967; 70:158-69.

6. Westhuyzen J. The oxidation hypothesis of atherosclerosis: an update. Ann Clin Lab Sci 1997; 27:1-10.

7. Uysal M. Atherosclerosis, cardiovascular diseases and free radicals. Aktuel Tip Dergisi 2000; 5:15-21.

8. Hertog MG, Kromhout D, Aravanis C, Blackburn H, Buzina R, Fidanza F, Giampaoli S, Jansen A, Menotti A, Nedeljkovic S, Pekkarinen M, Simic BS, Toshima H, Feskens EJM, Hollman PCH, Katan MB. Flavonoid intake and long-term risk of coronary heart disease and cancer in the seven countries study. Arch Intern Med 1995; 155:381-6.

9. Roux S, Loffler BM, Gray GA, Sprecher U, Clozel M, Clozel JP. The role of endothelin in experimental cerebral vasospasm. Neurosurgery 1995; 37:78-85.

10. Gebre-Medhin M, Ewald U, Platin L. Elevated serum selenium in diabetic children. Acta Pediatr Scand 1984; 73:109-14.

11. Toufektsian MC, Boucher F, Pucheu S, Tanguy S, Ribuot C, Sanou D, Tresallet N, de Leiris J. Effect of selenium deficiency on the response of cardiac tissue to ischemia and reperfusion. Toxicology 2000; 148:125-32.

12. Allan C, Lacourciere G, Stadtman T. Responsiveness of selenoproteins to dietary selenium. Ann Rev Nutr 1999; 19:1-16.

13. Liu D, Liu S, Huang Y, Liu Y, Zhang Z, Han L. Effect of selenium on human myocardial glutathione peroxidase gene expression. Chin Med J 2000; 113:771-5.

14. Oster O, Dexler M, Schenk J, Menertz T, Kasper W, Schuster CJ, Prellwitz W. The serum slelenium concentration of patients with acute myocatdial infarction. Ann Clin Res 1986; 18:36-42

15. Blankenberg S, Rupprecht HJ, Bickel C, Torzewski M, Hafner G, Tiret L, Smieja M, Cambien F, Meyer J, Lackner KJ; AtheroGene Investigators. Glutathione peroxidase 1 activity and cardiovascular events in patients with coronary artery disease. N Engl J Med 2003; 349:1605-13.

16. Espinola-Klein C, Rupprecht HJ, Bickel C, Schnabel R, Genth-Zotz S, Torzewski M, Lackner K, Munzel T, Blankenberg S; AtheroGene Investigators. Glutathione peroxidase-1 activity, atherosclerotic burden, and cardiovascular prognosis. Am J Cardiol 2007; 99:808-12.

17. Koca HB. In coronary artery patients, lipid and protein oxidation with selenium containing antioxidant levels. Master Thesis; Afyon Kocatepe University, Afyonkarahisar, Turkey, 2007.

18. Savarino L, Granchi D, Ciapetti G, Cenni E, Ravaglia G, Forti P, Maioli F, Mattioli R. Serum concentrations of zinc and selenium in elderly people: results in healthy nonagenarians/centenarians. Exp Gerontol 2001; 36:327-39.

19. Cheng ML, Chen CM, Ho HY, Li JM, Chiu DT. Effect of acute myocardial infarction on erythrocytic glutathione peroxidase 1 activity and plasma vitamin levels. Am J Cardiol. 2009; 103:471-5.

20. Bor MV, Cevik C, Uslu I, Guneral F, Duzgun E. Selenium levels and glutathione peroxidase activities in patients with acute myocardial infarction. Acta Cardiol. 1999; 54:271-6.

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