Association of Angina Pectoris with Some Heavy Metals Hospital Based Study

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Abstract

Background: Trace elements are essential for life and their concentrations in serum vary with human ecology and different pathological conditions. Several studies have pointed out associations between various metals and cardiovascular disease.

Objectives: To evaluate the effect of serum metals such as: nickel, cobalt, cadmium, lead and mercury in patients with angina pectoris and compared to healthy individuals.

Materials and methods: The studied consist of 100 volunteers with age range 40-65 years, 50 healthy individuals compared with 50 patients with angina pectoris in order to investigate the following serum parameters: serum lead, nickel, cobalt, cadmium and mercury levels, and lipids profile test [total cholesterol, high density lipoprotein, low density lipoprotein and triglyceride.

Results: Circulating levels of serum lead, nickel, cadmium ($p<0.001$), cobalt ($p<0.05$) and mercury ($p<0.007$) were significantly higher in patients with angina pectoris than in healthy controls, while high density lipoprotein was decreased ($p<0.05$) and triglyceride, total cholesterol and low density lipoprotein were increased significantly ($p<0.05$) in patients angina pectoris compared with normal control.

Conclusion: In this study high levels of heavy metals (cadmium, lead, nickel, cobalt, and mercury) were detected, which may play role in the genesis of angina pectoris, and this may be due to the main sources of contamination (dependent on the metal) are industry, traffic, tobacco consumption, and agriculture/nutrition. While lipoprofile such as total cholesterol, triglyceride, high density lipoprotein, and low density lipoprotein which may play role in genesis of angina pectoris.

Keywords: Angina Pectoris, heavy metals, trace elements.

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Introduction

In the European Union, 40% of deaths are due to Cardiovascular Disease (CVD). Acute coronary syndromes such as myocardial infarction or sudden cardiac death and stable angina pectoris are the most common coronary manifestations of atherosclerosis [1]. There are different heart diseases, some may be present from early age or from birth such as rare malformations of the structure of heart, and others take a life time to acquire such as the Angina Pectoris. It mainly develops in men but women also affect it [2].

Angina pectoris caused when heart received low amount of oxygenated blood. Angina pectoris patients are at a risk for

having a heart attack; the most common sign of angina pectoris is chest pain behind the breast bone. The discomfort may feel like pressure, squeezing, burning or tightness [3].

Metals it called both trace elements and heavy metals, it can be measured in whole blood, serum, plasma, urine, hair and toenails in the epidemiological setting (variety of body compartments). It has been seen in different studies that using metal determinations such as: Pb, Cd, Ni, Co and Hg levels are rise in patients with coronary artery disease (CAD), during a certain follow-up in cohort studies. Associations' metals with atherosclerosis have been reported by several studies, evaluated by carotid artery intima-media thickness (IMT). In the hypercholesterolemic rabbit and ApoE knock-out mice; more exposure to Cd elevated, while administration of Zn and Cr decreased atherosclerosis giving further support to the theory that metals might be played role in the genesis of atherosclerosis. So, high circulating levels of heavy metals and low levels of trace elements might be more often showed carotid atherosclerotic plaques [4]. Presence of heavy metals even in very low levels in foods, have the capability to cause human health problems. The Information of dietary intake of metals is important to assess risks to consumers. The dietary intake for some toxic metals could account, that found in the blood and urine. On absorption of the metal, it initially accumulates in the liver, kidney, lung, spleen, aorta and skin. Cadmium has unknown biological functions. It interferes with some trace elements function such as Zn, thereby inhibiting enzyme reactions and utilization of nutrient. Also it participated in oxidation reactions, and generating free-radical, caused tissue damage. Lead is a toxic metal affects virtually every organ in the human body. It had the ability to mimic or inhibit calcium affects. Also Pb interacts with proteins such as the primarily active group (carboxyl, amine, sulfyl and phosphate groups). In general the toxic metals primarily affect most organs and metabolism in the body. Also it is associated with hypertension, reproductive development and neurological disorders, some of it may be irreversible [5].

The goal of this study to assay the serum metals levels in patients with angina pectoris compared with healthy individuals, and then find whether there is any relationship between serum heavy metals levels and patients with angina pectoris.

Materials and Methods

In this study 100 samples were collected randomly from patients admitted to Rzgary hospital in Erbil city. The subjects were being included two groups, patient and healthy volunteers, aged between 40-65 years. The patient group consisted of 50 samples (33 males and 17 females) with diagnosed angina pectoris that was randomly selected; also the healthy group consisted of 50 controls (30 males and 20 females).

After clinical diagnosing of AP, blood samples (5 ml) were be taken from each participants and stored in a disposal tube without anticoagulant and were be preserved in an ice-box then were be transferred to laboratory to evaluate the following serum parameters: serum lead (Pb), nickel (Ni), cobalt (Co), cadmium (Cd), and mercury (Hg) levels, were determined by using 1275 A A Varian, atomic absorption spectrophotometer, while lipid profiles (TC, HDL, LDL, and TG] were assayed enzymatically using commercial reagents (kits, BioMerieux, France) [6]. All the chemicals and reagents

used in the study were of analytical grade and pure. Doubly distilled demineralized water was used for all the washings and preparation of solution.

Statistical Analyses

All results were conducted with Statistical Package for Social Sciences (SPSS 13.0) [7].

Results

The result of present study which demonstrated that 33 males were more than 17 females and the mean age was 61.45±12 years while in healthy group the mean age was 59.36±18.7 years.

Table 1 (Figure 1) showed the results of the levels of some serum heavy metals such as: Pb, Ni, Co, Cd and Hg of one hundred participants, 50 healthy volunteers and 50 patients with AP with age range of 40-65 years. The results showed that the levels of serum Co ($P<0.05$), Cd ($P<0.001$), Pb ($P<0.001$), Ni ($P<0.001$), and Hg ($P<0.007$) were increased recorded different significant in patient with AP as compared with control groups as shown in Figure1.

Table (1): Serum heavy metals levels in the control and patients group with angina pectoris.

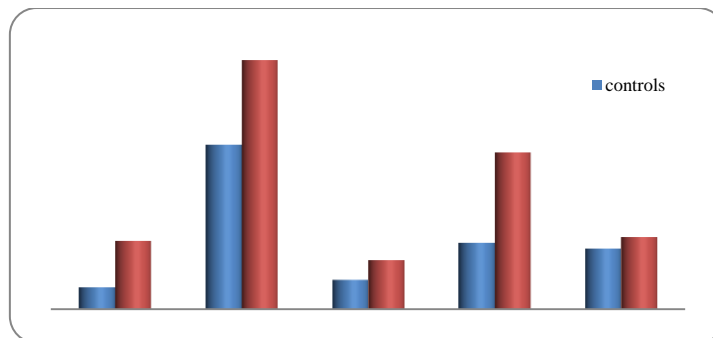| Serum metals	Mean ±SD		P-value
	Controls (n=50)	AP patients (n=50)	
Pb (μg/l)	0.49 ±0.02	1.53 ±0.45	p<0.001
Ni (μg/l)	3.7±0.22	5.6±0.67	p<0.001
Cd (μg/l)	0.66±0.19	1.1±0.46	p<0.001
Co (μg/l)	1.5 ±1.45	3.53±1.03	p<0.05
Hg (μg/l)	1.37±0.97	1.67±1.1	p<0.007

Figure (1): Serum heavy metals levels in the control and patients group with angina pectoris.

The analyses results of the serum levels of TC, HDL, LDL, and TG for 50 patients with AP showed increased in value recorded different significant, but showed decreased in value of HDL these compared with control (Figure 2, table 2).

Table (2): Serum lipid profiles levels in control and patients groups with angina pectoris.

Serum lipids	Mean ±SD		P-value
	Controls (n=50)	AP patients (n=50)	
(TG) Triglyceride (mg/dl)	133.420 ± 8.95	209.6 ± 35.30	p<0.05
(TC)Total cholesterol (mg/dl)	169.11 ±18.22	288.7 ± 7.32	p<0.05
LDL (mg/dl)	105.54± 16.47	214.00 ± 9.81	p<0.05
HDL (mg/dl)	49.64 ± 3.05	31.26 ± 4.19	p<0.05
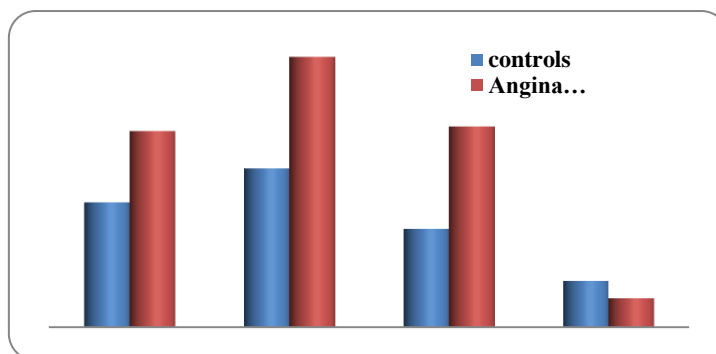
Figure (2): Serum lipid profiles levels in control and patients groups with angina pectoris.

Discussions

The importance of essential trace elements in nutrition began in the late of 19th century and the demonstration that certain elements were essential in different biological function related to various diseases e.g. cardiovascular, cancer, diabetes mellitus, growth retardation and other various diseases [8].

Although heavy metal exposure by ubiquitous pollutants has frequently been associated with atherosclerosis. Pb, Hg, and Cd also play a tangential role in cardiovascular research and have been over shadowed by heavy weights. In the present study, the results showed a significant rise in serum Pb, Ni, Hg, Co and Cd in patients with angina pectoris when compared to control groups. This may occur due to the main sources of contamination (dependent on the metal) are industry, traffic, tobacco consumption, agriculture and nutrition [1] (above all, fish [9] and alcohol consumption). Heavy metals are long

lasting substances which persist for decades [1]. Large concentrations of heavy metals were found in bee products from hives located in areas of high industrial or agricultural activity [10]. But it seems that low amount of Cd, Hg, or Pb, in quite low amounts, play a major role in the genesis of coronary artery disease (CAD), particularly when compared to the influence of the other diseases [11]. Meat from different sources were purchased and investigated for toxic metals (Cr, Cd, Hg, Pb and As in meat from seven different animals; sheep, goat, pig, cow, deer, rat, and grass-cuter), and their concentrations are compared to international standards [12].

A study shows that Cd, Hg, or Pb, in very low concentrations, play a major role in the genesis of CAD, particularly when compared with other factor such as: blood pressure, blood sugar, and lipid profile in Austria. Nickel is also an essential trace element whose role in the body is not fully

known, body tissues contained it. However, nickel can combine with carbon monoxide (CO) to form a complex, nickel tetracarbonyl [Ni (CO)$_4$], which is extremely poisonous, it is more poisonous than CO, which is one of its precursor. Nickel levels were related to the number of carotid arteries with plaques in an inverted U-shaped manner after adjustment for multiple CV risk factors [1]. Elevated dietary intake of the metal is associated with increased thyroid problems, cancer and heart disease [5].

Cadmium is a toxic element [13]. It is one of the most toxic metals and constitutes a threat for fish because of its widespread occurrence in the aquatic environment. Even at very low environmental concentrations, fish can accumulate Cd ions that eventually cause deleterious effects [14]. In the current study the mean Cd levels in the AP group was significantly higher (P<0.001) than the normal group. This result is in agreement with the results obtained by Lind *et al* [4]. A further source of pollution for Cd is nicotine consumption and in the second hand is smoking [15]. The toxic mechanisms of Cd are not clear, and it is unable directly to generate free radicals, [16] and it is known to act intracellularly, mainly via free radical-induced tissue damages, particularly to the heart and other organs [4]. Elevated blood Cd and/or Pb may increase blood pressure and contribute to the development of cardiovascular disease [17]. Cadmium has generally been reported higher in conditions associated with heart diseases [18]. Cadmium can replace Fe and Cu in various cytoplasmic and membrane proteins (e.g. ferritin, apoferritin), thus increasing the amount of unbound free or poorly chelated Cu and Fe ions participating in oxidative stress via Fenton reactions [19].

Lead is one of the toxic elements that have known to biological functions [20]. The myocardial infarction patients have high level of lead than the normal ones [2]. The level of Pb was insignificantly (P<0.001) high in the patients with AP as compared with control. This finding agrees with that reported on the hypertensive patients with or without associated problem of Ischemic Heart Disease [21].

The present study revealed that the mean serum Hg levels in the AP group were significantly higher (p< 0.007) than in the healthy group. Further reports have been done to investigate the influence of fish consumption and Hg levels. The correlation between Hg amounts in blood and fish consumption has been described in large studies (eg, in the Canadian population and US children and women). However, although Hg intake by fish consumption seems unequivocal the cardioprotective effects of a fish-rich diet seem to predominate [1, 22].

This study demonstrates that hypernickelemia develops in patients with AP, and this was agreed with the report studied by Lind *et al* and Afridi *et al* [23]. It appears that hyperrnckelemia may be related to the pathogenesis of CHD [4]. The cobalt containing hydroxycobalamin (vitamin B12) is an essential nutrient to humans. While the amount of levels of the Co metal was significant (p< 0.05) rise in AP patients than control groups in the present study as shown in Figure 1 (Table 1), and this may be due to the most realistic in vivo production of hydroxyl radical according to the Fenton reaction occurs when Mn+ is iron, copper, chromium, or cobalt [24].

In the current study the high levels of cholesterol, LDL, TG, and VLDL are found in the cases of AP, whereas serum levels of HDL lower when compared to the control groups (Figure 2, Table 2).

However, since metal exposure has also been linked to several of the well-known CV risk factors, including lipid oxidation, which is a crucial step in atherosclerosis development [25]. It is unclear by which route metals could induce myocardial infarction [4].

In conclusion, It is concluded from the foregoing results that the balance of different metals of serum such as (Cd, Pb, Ni, Co and Hg) were significantly increased in patients with AP, this may be indicative of pathological disorder of angina pectoris. This increased of heavy metals may be due to the main sources of contamination or pollution of environment (dependent on the metal) such as industry, traffic, tobacco consumption, agriculture and nutrition. Also alteration of lipid profile in patients with AP such as TG, TC, and LDL, were significantly increased, while HDL was significantly decreased, which may play role in the genesis of AP.

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