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A study evaluating the relationship between chromium level and myocardial infarction

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Abstract
Background: Myocardial infarction (MI) is responsible for any condition that causes a sudden decrease in blood flow to the heart. Certain trace elements play a role in the development of MI. **Objective:** This study aimed to evaluate the association between serum chromium level and cardiac markers in myocardial infarction.
Methodology: the current study, included 25 patients with MI and 25 healthy controls, age ranged 39-80 years for both. Serum concentrations of essential heavy metal (Cr) were determined by flameless atomic absorption spectrophotometry using an atomic absorption spectrophotometer, Cr was measured at wavelength 357.9 nm using a slit width of 0.7 nm and lamp current 10 mA. To determination of cardiac biomarker (tnhs) was measured with immunoassay kits. Serum lipids were measured using standard commercial kits. **Results;** It was observed that the average concentration Cr .292744±.1509356 vs. .677604±.1385790(µg/L), $p < 0.000$) were significantly higher in MI group patients in compared with control objects. The same result was also obtained after adjustment for cardiovascular risk factors including diabetes mellitus (DM-HBA1C and DM-FBS) and TNHS ($p < 0.05$). The mean concentration of total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), S-TG. And S-LDL were strong significantly higher in MI patients ($p < 0.05$). **Conclusion,** the present results appeared that serum levels of essential trace element (Cr) are associated with the presence of MI. These results add to an increasing body of evidence that, the Cr is important for cardiovascular health.
Key words: Chromium, Troponin, Myocardial infarction, Blood samples, Atomic Absorption spectrophotometer

Introduction

Ischemic heart disease is the leading cause of death in the world. Although, development in interventional and medical treatments, survivors of myocardial infarction are at high risk of recurrent cardiovascular accidents. In recent years, coronary micro vascular function has attracted more attention as the main target for risk stratification and as a possible target for pharmacological intervention as a part of multifaceted treatment of ischemic heart disease. Coronary flow reserve is one of the main indices that refer to the status of coronary circulatory function.

Chromium is most likely an essential trace element required for normal carbohydrate, lipid, and protein metabolism (Stoecker et al., 1999; Cefalu and Hu, 2004). Chromium deficiency results in impaired glucose tolerance, hyperglycemia, and glycosuria that cannot be controlled with insulin (Anderson, 1998) .

Although overt chromium deficiency is rare, low chromium intake may be a cause of subclinical insulin resistance and an adverse lipid profile in Western populations (Anderson et al., 1997; Anderson and Kozlovsky, 1985). Use of chromium supplements is increasingly popular in some countries, such as the United States (Vincent, 2003), although their effects on glucose tolerance, body composition, and lipid parameters are still unclear (Vincent, 2004; Cefalu and Hu, 2004) .

The relationship between chromium intake with cardiovascular endpoints is largely not well known. The few early studies available were limited by unreliable analytical methods (Pittler et al., 2003) and/ or the use of serum chromium measurements, which may not adequately reflect long-term chromium intake (National Academy Press, 2001.). To evaluate the hypothesis that long-term exposure to chromium is inversely related to the risk of coronary heart disease, other workers measured the toenail chromium concentrations of participants in the EURAMIC Study (EURopean Multicenter Case-Control Study on Antioxidants, Myocardial Infarction, and Cancer of the Breast) and assessed their association with the risk of a first myocardial infarction (Ahmad, et al., 2010) .

Chromium is an essential nutrient required for normal carbohydrate and lipid metabolism (Pechova and Pavlata, 2007). Signs of chromium deficiency have been observed in humans with elevated blood glucose, insulin, triglycerides and cholesterol, and decreased high density lipoproteins (Jianling et al., 2015) . More severe signs of chromium deficiency reported for patients on total parenteral nutrition, including nerve brain disorders, are responsive to chromium

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supplementation (Jianling et al., 2015) . Conclusive evidence for the essentiality of chromium in human nutrition was documented in 1977 when a patient on total parenteral nutrition developed severe diabetic symptoms that were refractory to exogenous insulin (National Academy Press, 2001) . The patient was given 200 g of supplemental chromium daily. two weeks later, signs and symptoms of diabetes were improved, with highly improved glycemic status and decreased insulin requirements from 45 Units / day to zero .

The few early studies available were limited by unreliable analytical methods and/ or the use of serum chromium measurements, which may not adequately reflect long-term chromium intake (Simonoff, 1984; Anderson, 1998; Stoecker, 1999). To evaluate the hypothesis that long-term exposure to chromium is inversely related to the risk of coronary heart disease, we measured the toenail chromium concentrations of participants in the EURAMIC Study (European Multicenter Case-Control Study on Antioxidants, Myocardial Infarction, and Cancer of the Breast (P van et al., 1999) and assessed their association with the risk of a first myocardial infarction.

Not all studies have demonstrated significant positive effects with chromium supplementation in patients with diabetes. One group reported no significant effect of chromium supplementation (7 – 16 months of 250 g / day) versus placebo on serum glucose levels in 76 patients aged 42 – 83 years of whom had type 2 diabetes) with atherosclerotic disease (Anderson, 2004) . These results are consistent with those of another small-scale trial that indicated no significant effects of chromium supplementation (200 g / day for 2 months) versus placebo on either blood glucose or HbA1c in 30 patients with type 2 diabetes (Nayereh and Hassan, 2013 (

The aim of our present study was to assess the concentrations of Cr in the blood sample of myocardial infarction patients of both genders and correlated with control subjects of matched age group (39–80 years). The differences in levels of these essential trace elements in MI patients as compared to referent subjects was evaluated. The blood samples were prepared by microwave-assisted acid digestion method, and the validity of analytical procedure was checked by corresponding conventional wet acid digestion of certified reference materials.

Material and methods

Apparatus

Vidas Biomrieux, france, Atomic absorption spectrophotometer, Shimadzu, 7000f, Uv visible spectrophotometer, Cecil, france. oil path, F3 hake Germany, Afinion HBA1c, Biolabo of glucose and lipid profile Maizy, france.

Subjects and samples collection

The study included 50 (25 patients and 25 control or healthy) suffering from symptoms of unstable angina or myocardial infarction. Their ages between 39 _ 80 years, for both groups. In the current study, we aimed to the level of chromium (Cr) and in blood samples of myocardial infarction (MI) patients of age ranged (39-80 years) Heart attack (n=25), hospitalized in cardiac ward of Basra hospitals (in the emergency and cardiac care unit at al-sadder teaching hospital, al-fayhaa teaching hospital and al-qurna general hospital)/ Iraq.

Sample of 4ml pink blood were withdrawn using a vacuum tube containing an anticoagulant EDTA K3. As well as 4 ml of a vacuum gel and clot activator tube and separated by centerfuge where isolated serum and the analyses required for the study and keep the samples at -20 c^0.

. Where the Ethics Committee of the Basra Health Department approved the Iraq Study Protocol Committee.

In this study patient diagnosed with acute myocardial infarction (MI) by measuring cardiac marker high sensitive troponin (hs Tn) in addition to clinical feature collected from enrolled patients. Forma and determination some essential elements in MI patients.

Biochemical studies

Determination of serum levels of Cr

The serum levels of Cr was determined at the Chemical Analysis by flameless atomic absorption spectrophotometry using an atomic absorption spectrophotometer (Shimadzu, GFA-7000f, Japan). Cr was measured at wavelength 357.9 nm using a slit width of 0.7 nm and lamp current 10 mA. The levels of Cr was gained by extrapolation of the criterion curve followed by multiplication with the dilution Factor.

Assay of high sensitive troponin I (TNHS)

The serum was divided into aliquots to be used for the determination of cardiac biomarker (TNHS) was measured with immunoassay kits (Vidas Biomrieux France) according to the manufacturer's instructions

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Determination of Lipid profile

(Total cholesterol (TC), triglycerides (TG), low-density lipoprotein-cholesterol (LDL-C) and high-density lipoproteins-cholesterol (HDL-C). Were measured using standard commercial kits By Biolabo, Maizy, france

Determination of Glucose and HBA1C

Determination of glycated hemoglobin (HBA1C) in human whole blood by afinion HBA1C Eurpion.

Statistical analysis

The Statistical Package for Social Sciences was used to investigation any significant relationships between the targeted variables. Chi-Square test was used to investigate any significant statistical association between qualitative variables, Student t-test for parametric quantitative variables, Mann Whitney test for non-parametric qualitative ones, Spearman's test to investigate correlations between non-parametric quantitative data, and Pearson test to investigate correlations between parametric quantitative ones. For the purpose of testing relationships, a level of probability value of less than 0.05 was considered significant.

RESULTS

The current study was based on hospitalized myocardial infarction patients. The blood samples were analyzed for the concentrations of Cr in blood samples. However, table (1) shows essential metal- Cr concentrations evaluate in this study in related to DM as risk factor to myocardial infarction as well as the lipid profile and cardiac biomarker (Cardiac- TNHS).

However, the blood samples were analyzed for the concentrations of Cr in biological samples. The data of the current study showed that myocardial infarction was clearly associated pronounced imbalance with primary analysis in compared to healthy subjects.

The concentration of element in the studied samples varies greatly between individuals; hence, a hugely large number of samples from the population must be analyzed if the results are statistically evaluated for meaningful correlation. The concentrations of S. Cr level (.292744±.15093560) in MI patients was significantly decreased (P<0.001) than control subjects (.677604±.1385790). Our results were appeared that there were significant pronounced associations between serums CR-serum and other MI risk factors (HbA1c, fasting blood sugar (FBG), Cardiac- TNHS, total cholesterol (Chol), triglyceride (TG), S. HDL and S. LDL (P<.000, P<.000, P<.0.0001, P<0.000, P<0.030, P<.0.042 and P<0.000) respectively in all subjects (MI patient and normal control) (Table 1).

Table 1; Serum Chromium levels (Tnhs) and Lipid profile of MI patients and healthy control. Values were expressed as (mean ± SD)

Sample	Control (n=25)	Patients (n=25)	P-Value (P<0.05)
DM-HBA1C	5.360±.4975	9.788±1.8946	.000
DM- FBS (mg/dl)	93.36±.8.185	229.56±69.580	.000
Cardiac- TNHS ng/mL	2.912±4.1664	310.552±781.3696	0.0001
ESSENTIAL METAL- Cr (µg/L)	.677604±.1385790	.292744±.1509356	0.001
Total cholesterol (mg/dl)	173.72±19.747	241.28±49.839	.000
S.triglycerides (mg/dL)	178.32±39.587	211.12±47.028	.030
S. HDL cholesterol (mg/dL)	35.24±7.253	30.72± 8.024	0.042
S. LDL cholesterol (mg/dL)	104.00±13.883	156.20± 31.782	.000

DISCUSSION

Although remarkable developments have been made in the remedy of cardiovascular disease, myocardial infarction (MI) remains the leading reason of death worldwide (Keles et al., 2009).

However, trivalent chromium, the reduced form of the element, is required for insulin action (Vincent, 2004). A chromium-containing oligopeptide present in insulin-sensitive cells binds to the insulin receptor, markedly increasing the activity of the insulin-stimulated tyrosine kinase (Sushil et al., 2007).

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Overt chromium deficiency has been demonstrated in patients receiving total parenteral nutrition without chromium supplementation, and it is characterized by hyperglycemia, glycosuria, and weight loss that cannot be controlled with insulin (Paula Amato et al., 2000); therefore, total parenteral nutrition solutions are regularly supplemented with chromium.

Several studies in humans and animals experiments support the beneficial effects of Cr supplementation on glucose metabolism and insulin sensitivity (Yin and Phung, 2015). The relationship between chromium and insulin resistance has been further demonstrated in patients with high insulin resistance, having a corresponding high Cr excretion in urine in comparison to those patients with diabetes who have a lesser degree of insulin resistance (Cefalu et al., 2002).

However, Chromium metabolism is affected by several factors including stress, diet, exercise, and diabetes (Vincent, 2003) and an increased intake of simple sugars leads to an increased loss of chromium (Bagchi et al., 2001). Therefore, people whose lifestyle had not changed with regard to exercise and dietary habits in the past four weeks were enrolled in the study. The ability to mask chromium to a more beneficial form may be the main difference between chromium metabolisms in diabetic patients compared to non-diabetic patients. Diabetics have been shown to have higher chromium uptake but also greater chromium excretion [Fatma Arslan et al., 2018]. Individuals with diabetes tend to lose the ability to convert inorganic chromium to a usable form (Wang et al., 2005). Possibly, similar to the observation that diabetic mice lose the ability to convert inorganic chromium into a usable organic form (organic chromium) that activates insulin.

However, the results showed that the levels of (DM-HBA1C and DM- FBS) of patients significantly increased compared with control ($P<0.000$) for both diabetes criteria included in this study in compared with control.

The present study provides data on essential trace element Cr concentrations in serum from the MI patients and control subjects ranging in age from 39 to 80 years living in Different areas of Basra. Although, there is no precise mortality data, there is sufficient evidence to suggest that CVD is increasing dramatically globally (Kazi, et al., 2008).

However, our study was appeared that the patients have lower values of Cr in blood samples, apply with results of other study (Davies et al., 1997). Results from some trial studies have shown that Cr supplementation increases muscle gain and fat loss associated with exercise and improves glucose metabolism and the serum-lipid profile in patients with or without diabetes (Bahijri and Mufti, 2002). Chromium is involved in both carbohydrate and lipid metabolism. Insufficient dietary Cr is associated with increased risk factors linked with non-insulin dependent diabetes and cardiovascular diseases. Most of the patients understudied have cardiac problems, and they are also lined with other studies (Khamaisi et al., 2003; Raj Pathak et al., 2004) which reported that Cr deficiency has also been held responsible for vascular complications associated with diabetes mellitus.

However, lipid profile except HDL were significantly elevated in the patients with diabetes (table1). Lipoprotein abnormalities are usually present in type 2 diabetes, which includes hypertriglyceridemia, increased LDL and reduced plasma HDL- cholesterol and also LDL's are converted to smaller, and more atherogenic, lipoproteins (Ginsberg, 1991;Ginsberg, 2000). These abnormalities are related to the increased metabolism of apolipoprotein B (apoB). Experimental evidence propose that regulation of apoB production, increment lipolysis in adipocytes due to poor insulin activity results in increased fatty acid release from adipose cells. Insulin has also been shown to directly increase the degradation of apoB which ameliorates dyslipidemia (Avramoglu et al., 2003). Therefore, insulin deficiency or hepatic insulin resistance may increase the secretion of apoB, and upregulate VLDL and LDL and increase cardiovascular risk. The significantly low serum chromium in patients with type 2 diabetes agrees with the derailed lipid metabolism. Anyhow, apart from the lipid profile, the metabolism of the biomarkers which are affected by chromium metabolism may be predictors of cardiovascular risk. On other hand, regarding

Level of Cardiac-TNHS and serum blood level of Cr in the current study showed the inverse relationship, where the Cardiac-TNHS higher significantly in patient while Cr level took a different path, i.e., statistically significant decrease (($\mathbf{P<}0.001$) in comparison to control. In a previous study, the decrease in serum levels of Cr^{111} in patients with higher levels of Tn reveal that trace element levels are related to the degree of myocardial damage. Moreover, Cr^{111} levels were significantly inversely correlated with TNHS levels and the prevalence of AMI decreased with increasing Cr^{111} level (Bai1, et al.,2015).

The role of trace elements including chromium in humans has not yet been fully characterized and has remained unclear. Nevertheless, several abnormalities of potential clinical. Relevance have been recognized. In summary, in order to prevent some complications in patients, it may be important to

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monitor the Cr levels. Chromium supplementation may be indicated in some diseases with no controversy concerning the importance of decreased serum and/or tissue levels and documented positive effects of Cr supplementation on the quality of life (e.g. hyperlipidemia).

CONCLUSION

The results of this study are lined with those obtained in other studies, confirming that deficiency and efficiency of some essential trace (chromium) may play a role in the development of myocardial infarction on based the diabetes mellitus as risk factor. I.e. The Cr^{111} concentration was inversely associated with the risk of myocardial infarction attacks. These results add to an increasing body of evidence that, Cr are importance for cardiovascular health.

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Nil.

CONFLICT OF INTEREST

The author exhibited that there is no conflict interest

AUTHORS CONTRIBUTIONS

Kasem H. Khalf (single author) drafted and approved the manuscript.

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