



## Serum Zinc Level in Dilated and Ischemic Cardiomyopathy

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### Abstract

**Background:** Serum trace element alteration has been reported in dilated and ischemic cardiomyopathy. The reports were controversial. We have studied serum Zinc level in cardiomyopathy patients in northern province of Mazandaran and compared them with healthy volunteers.

**Methods:** Serum Zinc level was measured in 30 ischemic and 18 dilated cardiomyopathy patients against 27 healthy volunteers. It was measured using atomic absorption spectrophotometry. Statistical analysis was performed using SPSS for Windows version 14 and independent *t*-test was used for comparing serum Zinc level in ischemic and dilated cardiomyopathy. Pearson correlation and ANOVA tests were used for numeric variables in three different groups.  $P < 0.05$  was considered as statistically significant.

**Results:** The mean serum Zinc level was  $0.97 \pm 0.25$ ,  $1.05 \pm 0.27$ ,  $1.21 \pm 0.42$  mg/L for idiopathic dilated cardiomyopathy, ischemic cardiomyopathy and healthy volunteers respectively. There was no significant difference between three groups. There was also no correlation between echocardiography data and serum Zinc level.

**Conclusion:** This study showed serum Zinc level might not have a role in pathogenesis of ischemic and dilated cardiomyopathy. As intracellular Zinc level play a role in heart subjected to ischemia-reperfusion, measuring intracellular Zinc may give us a better clue about role of Zinc or other trace elements in pathogenesis of cardiomyopathy.

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**Keywords:** Ischemic cardiomyopathy • Dilated cardiomyopathy • Zinc

### Introduction

Congestive heart failure (CHF) is a debilitating condition affecting 1.5-2% of general population and is due to failure of the heart to pump blood into the circulatory system.<sup>1</sup> Prognosis of CHF is poor and classical symptoms are edema, fatigue, tiredness and shortness of breath affecting patient's quality of life and their life expectancy. 30-50% of CHF patients will die during the first year of diagnosis and 70% do not survive up to three years.<sup>2-3</sup>

Cardiomyopathy is a group of diseases affecting heart

muscle. In this group, high blood pressure, congenital heart disease and valvular or pericardial disease do not have any role in their etiology. The most common form is dilated cardiomyopathy, which presents as a mono or biventricular failure. Ischemic cardiomyopathy (ISCMP) is due to coronary artery disease and insufficient myocardial blood supply. In idiopathic dilated cardiomyopathy (IDCMP) we can not establish a causative etiology for cardiomyopathy.<sup>3</sup>

The most principle cause of cardiomyopathy is high

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afterload, and preload and low myocardial contractility, however, imbalance of trace elements may cause myocardial metabolic dysfunction and may play a role in etiology of cardiomyopathy especially in IDCMP.<sup>4</sup>

The role of Zinc in pathogenesis of idiopathic dilated cardiomyopathy is unclear. Some researchers showed lower serum Zinc levels present in patients when compared with the control group<sup>4-8</sup> and others showed no relation between serum Zinc level and IDCMP.<sup>7-9</sup>

In ischemic cardiomyopathy, both high serum Zinc level<sup>10</sup> and low serum Zinc level<sup>8</sup> have been reported.

As there is controversy regarding role of Zinc in pathogenesis of cardiomyopathy, we investigated its serum level in ischemic and dilated cardiomyopathy patients and compared them with a control group.

## Methods

A correlational study was performed on 75 patients in three different groups in Mazandaran Heart Centre in Sari, Iran. Group one included 18 patients with Idiopathic Dilated Cardiomyopathy, group two 30

patients with ischemic cardiomyopathy and group three 27 healthy individuals.

Inclusion criteria for patient group were individuals with clinical symptoms and signs of heart failure i.e. shortness of breath, edema and low exercise tolerance. Clinical history, physical examination, 12 lead ECG, Chest X-ray and Echocardiography were diagnostic tools for CHF.

In idiopathic dilated cardiomyopathy, a normal coronary angiography and echocardiography with no valvular or pericardial disease and no history of myocarditis

were mandatory. Ischemic cardiomyopathy was diagnosed by history of myocardial infarction and an abnormal coronary angiography.

In healthy individuals, clinical history, physical examination and routine laboratory blood tests including: FBS, BUN, Creatinine, LFT, TG, and serum cholesterol and echocardiography were performed to rule out any underlying heart condition.

Exclusion criteria in patient group were renal and or liver disease, alcohol consumption plus vitamin supplement intakes such as multivitamin mineral, multivitamin therapeutic, or Zinc Sulfate within the past week. An exclusion criterion for control group was any disease or any medication for the past week.

Every individual person within the patient and control group had given informed consent for the study and clinical and para-clinical information was documented in study datasheet.

15cc of venous blood was taken from patients and the control group; it was transferred into a plastic test tube and was incubated for an hour in 37 °C incubator. Serum was then

separated from blood cells using a centrifuge and was kept at -20 °C freezer.

For Zinc measurement we made a standard Zinc solution of 0.1%, 0.2%, 0.3% and 0.4% and then defrozeed the serum. One cc of defrozeed serum sample was put into a Balloon Jujeh and 5% Glycerol solution was added into it. The standard solutions and the serum sample solution Zinc level was then measured using Flame Atomic Absorption Spectrometry (Perking Elmer Analyst 100). Using 213.9 nanometer wavelength, the standard solution curves and equation line Serum Zinc level drawings were calculated.

For statistical analysis, we used SPSS 14 software for windows (SPSS Inc. Chicago Ill. USA), to measure mean Zinc level in different samples taken from a single group. We used independent t-test and to compare mean Zinc level in three different groups of samples we used (ANOVA) or analysis of variant test. Pearson correlation was used for quantitative data correlation. A p value of <0.05 was considered statistically significant.

## Results

Patient and control group demographic data are shown in table 1. Forty percent of ischemic cardiomyopathy group and 47% of dilated cardiomyopathy group were female. Mean age was higher in ISCMP compared to IDCMP and control group. Fasting blood sugar was within normal range in patient groups and mean BUN, creatinine, liver function tests, TG, and cholesterol levels were within normal limits in all groups.

Table 1. Demographic data and biochemistry test results inpatients and healthy volunteers\*

Parameters	IDCPM	ISCPM	Control group	P value
Age ( yr)	49.6±8.88	57.17±10.73	42.30±8.99	<0.05
Female (%)	40	47	55	>0.05
FBS (mg/dl)	113.39±54.40	111.57±53.81	85.22±12.20	>0.05
BUN (mg/dl)	17.33±7.21	15.97±6.87	23.73±6.92	>0.05
Creatinine (mg/dl)	0.84±0.21	0.90±0.27	0.77±0.14	>0.05
SGOT (U/L)	38.06±17.66	43.43±22.58	28.11±6.30	>0.05
SGPT (U/L)	31.22±29.12	27.60±14.92	29.15±6.34	>0.05
TG (mg/dl)	131.17±51.01	162.20±87.67	133.81±31.51	>0.05
Chol (mg/dl)	163.44±43.26	163.40±48.24	149.93± 37.06	>0.05

\*Data are presented as mean±SD

IDCM, Idiopathic dilated cardiomyopathy; ISCMP, Ischemic cardiomyopathy; FBS, Fasting blood sugar; BUN, Blood urea nitrogen; SGOT, Serum glutamate oxalacetate transferase; SGPT, Serum glutamate pyroovate transferase; TG, Triglyceride; Chol, Cholesterol

Table 2 shows mean Zinc level and echocardiography data in three groups. There was no statistically significant difference between Zinc level in patient group and healthy individuals



with a p value of 0.42 between control and ISCMP group and a p value of 0.18 between control and IDCMP group. There was a significant difference between LVESD and LVEDD of normal volunteers and patients in ISCMP and IDCMP group with a p value of less than 0.001.

Table 2. Mean serum Zinc level and echocardiography data in patient and control groups

Parameters	IDCMP (n=18)	ISCMP (n=30)	Control Group (n=27)	P value
Zn (mg/L)	0.97±0.25	1.05±0.28	1.12±0.42	>0.05
LVESD (mm)	57.00±8.70	44.77±4.58	27.71±2.82	<001
LVEDD (mm)	68.39±5.084	56.07±5.04	47.54±3.87	<001
EF (%)	23.89±5.83	26.33±5.71	26.33±5.71	<0.05

IDCMP, Idiopathic dilated cardiomyopathy; ISCMP, Ischemic cardiomyopathy; Z, Zinc; EF, Ejection fraction; LVESD, Left ventricular end systolic dimension; LVEDD, Left ventricular end diastolic dimension

Echocardiography data of ISCMP and control group shows a mean difference of 8.52 (6.01-11.03) of

LVESD with a p value of <0.001 and CI=95% and a mean difference of 17.05 (14.91-19.21) for

LVEDD with a p value of 0.001 and CI=95%.

## Discussion

In the present study, serum zinc levels were measured in 30 patients with ischemic cardiomyopathy, 18 patients with idiopathic dilated cardiomyopathy and 27 healthy volunteers as control group. There was no statistically significant difference between

serum Zinc level in control and cardiomyopathy group (P>0.05).

Trace elements are known to have a key role in myocardial metabolism.<sup>1</sup> Research about the role of Zinc in cardiomyopathy is listed in table 3.

Zinc is part of several enzymes like superoxide dismutase and glutathione peroxidase.<sup>11</sup> In superoxide dismutase, deficiencies in superoxide anions will react with hydrogen peroxide and produce hydroxide radicals, which react with cell membrane lipids and induce cell damage. Zinc and even copper have a protective role against free radicals and thus have a preventive role in cardiovascular diseases.<sup>11</sup> In heart failure, activation of atrial natriuretic peptide will induce high urine Zinc excretion, which reduces serum and RBC Zinc levels. Zinc deficiency will affect myocardial performance.

Kosan and colleagues reported that IDCMP serum Zinc level was less than that observed in the control group with a P value of (P=0.000). Topuzoglu and colleagues<sup>4</sup> and Ripa and colleagues<sup>12</sup> reported the same results.

Chou and colleagues<sup>7</sup> on the other hand did not show any difference between serum Zinc level in IDSMP and control group. In our study, serum Zinc level in IDSMP patients was less than control group (0.97±0.25 in patient group comparing with 1.12±0.41 in control group) which was not statistically significant with a p value 0.17.

Low serum Zinc level was reported<sup>8,9,13</sup> in the ischemic cardiomyopathy group as well, but with a (1.05±0.27 in patient group comparing with 1.12±0.41 in control group) p value of 0.41; our study did not show any statistically significant results.

In 1995, Powell and colleagues<sup>14</sup> reported Zinc supplementation of St Thomas's cardioplegia solution would enhance its protective effectiveness in in-vitro hypothermic cardiac arrest.

Then in 2007, Karagulova and colleagues<sup>15</sup> reported a protective role for intracellular Zinc in ischemia reperfusion heart.

In our study, we measured serum Zinc level. Measuring intracellular Zinc may give us a better clue regarding its role in pathogenesis and the potential therapeutic use of Zinc supplementation in cardiomyopathy.

Table 3. Role of Zinc in pathogenesis of cardiomyopathy

	Reference	No Type of cardiomyopathy	Number of patients	Serum Zinc Level
Kosar & colleagues (2006)	8	ISCMP, IDCMP	ISCMP(28) IDCMP(26) Control(30)	Lower serum Zinc level in patient group
Topuzoglu & colleagues (2003)	4	IDCMP	IDCMP(20) Control(30)	Lower serum Zinc level in patient group
Chou & colleagues (1998)	7	IDCMP	IDCMP(32) Control(31)	No difference in patient and control group
Atlihan & colleagues (1990)	10	ISCMP	ISCMP(15)	No difference in patient and control group
Ripa & colleagues(1998)	11	HCMP, IDCMP	IDCMP(15) HCMP(11)	Lower serum and RBC Zinc level in patient group
Bialkowska & colleagues ( 1987)	12	Arteriosclerosis, MI	Patients(29) Control(23)	Higher serum Zinc level in patient group

ISCMP, Ischemic cardiomyopathy; IDCMP, Idiopathic dilated cardiomyopathy; HCMP, Hypertrophic cardiomyopathy; RBC, Red blood cell; MI, Myocardial infarction



## Conclusion

This study showed serum Zinc level might not have a role in pathogenesis of Ischemic and dilated cardiomyopathy. As Intracellular Zinc levels play a role in heart subjected to ischemia- reperfusion, measuring intracellular Zinc may give us a better clue about the role of Zinc or other trace elements in pathogenesis of cardiomyopathy.

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