

## Serum and Erythrocyte Magnesium Levels in Patients with Myocardial Infarction with or without Heart Failure

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### ABSTRACT:

#### BACKGROUND :

Magnesium (( Mg )) is a mineral that is involved in over 300 reactions in the body. Magnesium is a Potent vasodilation ,and plays an important role in muscle contraction. It has been early documented that Mg deficiency can precipitate ventricular arrhythmias and treatment with Mg has some anti arrhythmic effect. Moreover there is an ample evidence that a significant percentage of patients with IHD suffer from Mg deficiency.

#### OBJECTIVE :

The objective of the present study is to measure Mg levels in serum and RBCs of patients with some forms of IHD.

#### PATIENTS AND METHODS:

The study was conducted in Baghdad hospital and Ibn – Al-Bitar Hospital.The 180 patients with IHD were divided into Two groups. Group I, 80 patients with Ischemic Heart Failure (IHF) (EF<30) aged 65.75±5.97 year (50 males and 30 females), group II, 100 patients with Muocardial Infarction (MI)(EF<50) aged 50.34±6.36 year (58 males and 42 females). Serum Mg and RBCs Mg were measured in all patient groups by Atomic Absorption Spectrophotometer.

#### RESULTS:

The(mean ±SD) value of serum and RBCs Mg in patients with both groups Ischemic Heart Disease (IHD) was significantly lower when compared with that of controls ( $p<0.05$ ).The serum Mg levels ( $0.81\pm SD$  mmol/L) are significantly lower in the IHF group and in MI group ( $0.96\pm 0.18$  mmol/L) when compared with that of controls ( $1.00\pm 0.17$  mmol/L) ( $p< 0.001$ ).

#### CONCLUSION:

The data obtained in present study revealed the decrease of Mg level in serum and RBCs in both patients groups, which affect the contractility of heart muscle and cardiac performance .

**KEY WORDS:** magnesium, ischemic heart disease.

### INTRODUCTION:

Ischemic heart disease ( IHD) is characterized by reduced blood supply to heart muscle usually due to coronary artery disease ( mainly due to atherosclerosis )<sup>(1)</sup>. The risk of IHD increases with age, smoking, hypercholesterolaemia, diabetes mellitus, hypertension<sup>(1)</sup>. Ischemic heart disease presented as stable angina , unstable angina , myocardial infarction , ischemic heart failure and ischemic cardiomyopathy<sup>(2)</sup>. The diagnosis of ischemic heart disease depend on clinical history and investigation including:

Electrocardiogram, Echocardiographical, Chest X ray and routine blood tests<sup>(3)</sup>. Magnesium is the fourth most abundant element in the body and is essential to good health<sup>(4)</sup>. Approximately 50 % of total body  $Mg^{+2}$  is found in bone, and the other half found predominantly inside cells of body tissues and organs, only 1 % of  $Mg^{+2}$  is found in blood, but the body works very hard to keep blood levels of Mg constant<sup>(5)</sup>. Magnesium plays a vital role in normal cardiac function and its deficiency has been increasingly associated with cardiovascular disease<sup>(6)</sup>. The Mg content of red blood cells is a good indicator to the hypomagnesaemia<sup>(7)</sup>. In cardiovascular medicine, Magnesium is of a major importance in the treatment of arrhythmias and coronary artery disease<sup>(8)</sup>. Magnesium has several effects which may be of benefit in unstable angina by

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mainly reducing intracellular calcium overload<sup>(9)</sup>. The aim of the current study was to determination of Mg level in serum and RBCs in patients with Ischemic Heart Disease.

### PATIENTS AND METHODS:

The study was conducted in Baghdad hospital and Ibn – Al-Bitar Hospital. The 180 patients with IHD diagnosed on the base of clinical features, Electrocardiography, Echocardiography, and were divided into Two groups. Group I 80 patients with IHF aged (50-79) year (50 males and 30 females), group II 100 patients with MI aged (38-67) year (58 males and 42 females), with the 130 healthy individuals matched for age & sex as a control group. Serum Mg and RBCs Mg were measured in all patient groups and control by Atomic Absorption Spectrophotometer (Schmiadzu AA5646). Any correlated diseases that can cause hypo or hypermagnesemia are excluded from the study. Blood collection about 5 milliliters was divided into two sample, two milliliters from whole blood added to tube containing 0.2 ( ml ) from heparin. The assay of intracellular magnesium concentration in erythrocytes is performed. Erythrocytes which are washed three times with 0.15 M saline. After cell washing the recentrifugation of the cell suspension of higher forces and longer times than 1200 g for 5 min does not result in further packing of the erythrocytes<sup>(10)</sup>. The cells are then diluted and lyses with ice- cold deionized water to speed up haemolysis. After cell lyses the membrane are removed by centrifugation at

2000 g for 20 min. The haemolysate is diluted 1:50 with 0.3 M HCL containing 0.5 per cent ( w/v ) lanthanum chloride, and the analysis is performed in an atomic absorption spectrophotometer .The other part of the aspirated blood was transferred to plane tube, left to clot in room temperature and then centrifuged for 10 min. The Clear serum was stored into at -20 C ° until used for measuring Mg<sup>+2</sup> level by AAS.

### Statistic:

Statistical analysis were performed by SPSS version 18.0 t-test for data analysis and the results were expressed as mean ± SD. between group mean. The significance level was set as p<0.05. A p-value less than 0.05 were considered statistically significant (S), p-value greater than 0.05 considered non significant(NS).

### RESULTS:

The (180) patients with IHD divided into two groups . First group, (80) patients with IHF (50 males & 30 females) and second group (100) patient with MI (58 males & 42 females) compared with (130) healthy individuals (81male–49female) as a control group. The mean age was (65.75±5.97, 50.34±6.36) years for the IHF and MI respectively, and (46.82±6.39) years for the control group. The mean value of age of patients with MI indicating no statistical significant difference with control group (p<0.4). While ,the mean value of age patients with IHF was significantly higher when compared with the age of healthy controls (p<0.0001), as shown in(table 1)

**Table 1: Distribution of the studied sample according to demographic characteristics:**

	IHF		MI		Control	
Age (Mean±SD)	65.75±5.97		50.34±6.36		46.82±6.39	
p-value with cont.	0.0001		0.4			
Sex Male n.(%)	50	62.5	58	58.0	81	62.3
Female n.(%)	30	37.5	42	42.0	49	37.7

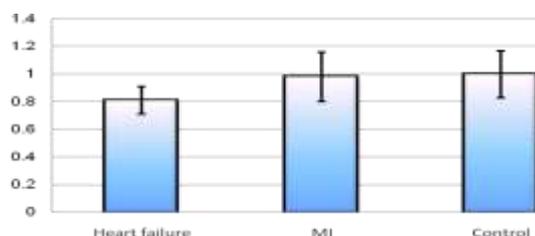
The results of current study showed that the mean serum Mg levels of patients with IHF (0.81±0.10mmol/L) and with MI(0.93±0.18mmol/L) and in the healthy control was (1.00±0.17 mmol/L). The values of

IHF patients was significantly lower than those in normal controls (p<0.0001). The mean value of serum Mg in the patients with MI was significantly lowered than that of controls (p<0.031). shown in (table 2)(figure 1).

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**Table 2: Serum Mg levels in patient groups of IHD and controls.**

Serum Mg (mmol/l)	IHF	MI	Control
Mean±SD	0.81±0.10	0.93±0.18	1.00±0.17
P value compared to control	0.0001*	0.031*	-
P value compared to MI	0.0001*	-	-

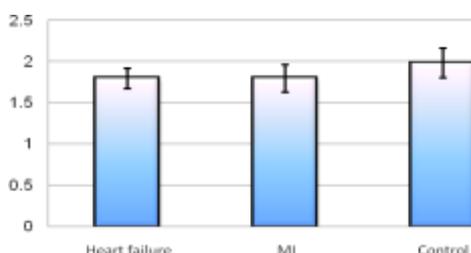


**Figure 1: Levels of serum Mg in control and patients groups of (MI, IHF).**

Also the results of current study showed that the mean RBCs Mg levels of patients with IHF (1.80±0.12mmol/L) and MI(1.80±0.17mmol/L) was significantly lower when compared with the healthy controls (1.99±0.18 mmol/L) (p<0.0001). as shown in (table 3)(figure 2)

**Table 3: RBCs Mg levels in both control and patient groups of IHD.**

RBCs Mg (mmol/l)	IHF	MI	Control
Mean±SD	1.80±0.12	1.80±0.17	1.99±0.18
P value compared to control	0.0001*	0.0001*	-
P value compared to MI	-	-	-



**Figure 2: Levels of RBCs Mg in control and patients groups of (MI,IHF).**

### DISCUSSION:

In the study the mean value of serum &RBC mg were significantly lower than those in the control and and this deficiency is more in the group of patient with ischemic heart failure due to urinary excretion and and this fit with Johnr et. al study<sup>(11)</sup>. Another reason for this low serum &RBC Mg is due to digitalis use and this fit with study done by Whang et.al<sup>(12)</sup>. The more lowering of serum & RBC Mg in patient with IHF have been seen in many over international studies while have been set as prognostic

indicator for survival include 71% of people in one study was 71% in those with normal serum Mg as in Lim & Jacob study<sup>(13)</sup>. Another study took the aspect of using serum Mg as a risk factor for sudden death and mortality but the result was inconclusive Durlach JB<sup>(14)</sup>. Many other researchers went further in studying the effect of Mg on the incidence of errhythmia as in cerruzynskil et.al study<sup>(15)</sup>. Other studies done by Holtmaler et.al<sup>(16)</sup>, Huqhos and Touks<sup>(17)</sup>

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showed the serum Mg level was lower in their patient with Myocardial Infarction than the control, however Brown et.al<sup>(18)</sup> and Hyatt et.al<sup>(19)</sup> they did not find such difference. The mechanism of Mg on coronary blood vessels is by inducing dilation, so preventing platelets aggregations and preventing coronary spasm<sup>(20)</sup>.

### CONCLUSION:

Data obtained revealed a decrease in serum and RBCs Mg in all patients groups, which affect the contracting of heart muscle and cardiac performance.

### REFERENCES:

1. World Health Organization Department of Health Statistics and Informatics in the Information, Evidence and Research Cluster. The global burden of disease update Geneva : WHO; ISBN.2008:9241563710 .
2. Liew R, Sulfi S, Ranjadayan K, Cooper J, Timmis AD Declining Case fatality rates for acute myocardial infarction in south Asian and white patients in the past 15 years , Heart 2006; 92;8: 1030-34.
3. Mitchell , Richard Sheppard ; Kumar; Vinay ; Abbas Abul K; Fausto , Nelson Robbins Basic Pathology ( 8 th ed ) . Philadelphia : Saunders .pp.3us .; ISBN 2007;1- 4160-2973 -7.
4. Rude RK. Mg deficiency Acute . of heterogeneous disease in humans .J Bone Miner Res 1998 ;345-465.
5. Saris NE, Meraa laE . Karppanen H, Khawaja JA Lemestam A.Mg ion update on physiological , Clinical and analytical aspects , Clinica chimica Acta 2007;543-65.
6. Pittman JAL. Magnesium sulphate for pre-eclampsia and a sudden bradycardia. BrJ Anaesth 2000;85:327-80.
7. Woods K possible pharmacological action of Mg in acute MI 1992:33-76.
8. White RE, Hartzell HC.Effect of intracellular free Magnesium on Calcium current in isolated cardiac myocytes . science 1988 ;239:778-80.
9. Ferrari R, Albertini A, Curello M. Myocardial recovery during post – ischemic reperfusion ; effects of nifedipine , Calcium and magnesium , JMO cell cardiol 1986;18:487-98.
10. Rousselet ,F.&Durlach, J.: Methodes analytiques et exploration pratique du metabolisme du magnesium en Clinique humaine . symposium on magnesium deficit in human pathology,. 1971;l: 65-90.
11. Johnr et.al .Magnesium disorder and cardiovascular disease clin. Cardiol .2008;5:556-68.
12. Whang R, Oei T, Watanabe A. Frequency of hypomagnesemia in hospital patients receiving digitalis. Arch Intern Med 1985;145:655-65.
13. Lim. Gottlieb SS, Baruch L, Kukin M, Fisher ML, Jacop M. Prognostic importance of the serum magnesium in patients with congestive heart failure. J Am Coll Cardiol 1999;16:827-31.
14. Durlach J. Mg in clinical practice . London – paris :John Libbey , 1988:453-523.
15. Cermuzynski L. ; Jurgiel R.; Kulotowski P., and Gebalska J. (Treatment of arrhythmias in acute Myocardial infarction prevented by intravenous Magnesium Sulfate ); Am. Heart J. 1989; 118:1332-34.
16. HOLTMELER,H.J.Magnesium Stoffwechselfaustausch und Herzinfarkt. In: Herzinfarkt und Schock edited by L.Heilmeyer and H.j Holtmeier Stuttgart :George Thieme Verlag 2007:110-54.
17. HUGHES ,A.AND R .S TONKS .Platelets magnesium and myocardial infarction .Lancet 2006;1:1044-1100.
18. BROWN , D. F .,R. B. MCGANDY,E. GILLIE AND J. F. DOYLE. Magnesium – lipid relation in health and in patients with myocardial infarction. Lancet.1958;2:993-1020.
19. HYATT ,K. H. L. LEVY , M . NICHAMAN AND M. OSCHWITZ Relationship of serum cholesterol and triglyceride levels and to myocardial infarction. Appl. Spectroscopy.1966;20:142-67.
20. Elwood PC. And Pickering J- ( Magnesium and cardiovascular Disease : A Review of Epidemiological Evidence ) J.Clin .Basic cardiol . 2007; s: 61-66.