Serum Magnesium in Thai Coronary Artery Disease Patients

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Abstract

Hypomagnesemia or magnesium (Mg) deficiency has been hypothesized to play a role in coronary artery disease (CAD). The authors aimed to evaluate serum Mg concentration in 100 CAD patients compared with 100 healthy controls. Mean values of serum Mg level in CAD and the control group were 2.14 ± 0.39, 2.24 ± 0.3 mg/dL respectively (P=0.052). The prevalence of Mg deficiency was 12 per cent in the CAD patients, and 5 per cent in the control group (odds ratio=2.59, 95% confident interval=0.88-7.65, P=0.063). There was no significant difference in the serum Mg level between the 2 groups, although it tended to be lower in CAD patients. The prevalence of Mg deficiency did not differ significantly between the study group, however, it tended to be higher in CAD patients. These findings demonstrated that CAD patients may be associated with Mg deficiency, and contribute to the pathogenesis of CAD or acute thrombosis. Following this evidence, Mg treatment may be necessary in CAD patients with Mg deficiency or acute myocardial infarction (AMI).

Key word : Magnesium, Magnesium Deficiency, Coronary Artery Disease

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Magnesium (Mg) is the second most abundant cation in cells after potassium, it plays an important role in myocardial function including myocardial contractility, electrical activity and the specialized conducting system, and effects the vascular smooth muscle tone. Deficiency in Mg may have an effect on cardiovascular structure, and the development of such common diseases as coronary

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artery disease (CAD) and cardiomyopathy. Several lines of evidence have documented that Mg deficiency may play an important role in modifying risk factors of atherosclerosis such as diabetes, hyperlipidemia and hypertension[1-3]. The Atherosclerosis Risk In Communities (ARIC) study was a prospective study, suggesting that low Mg concentration may contribute to the pathogenesis of CAD or acute thrombosis[4]. The study of Madias et al reported that hypomagnesemia was found approximately in one fourth of AMI patients associated with early presentation to the hospital[5].

This study aimed to evaluate the serum Mg level in CAD patients compared with healthy controls.

MATERIAL AND METHOD

Study population

This was a cross sectional study in 100 CAD patients with triple-vessel coronary angiogram who attended Her Majesty Cardiac Center at Siriraj Hospital between 1998 and 1999; 56 were men and 44 were women, and a total of 100 normal healthy subjects; 49 were men and 51 were women.

Measurements

Blood samples were collected into tubes without anticoagulant and preservative, and centrifuged at 3000 rmp for 15 minutes. The serum was aliquoted and stored at -70°C until analysis.

Serum levels of total cholesterol (Chol) and triglyceride (TG) were measured by enzymatic procedure (Roche Diagnostics, Switzerland). High density lipoprotein cholesterol (HDL-C) was measured by dextran sulfate Mg precipitation followed by enzyme determination of cholesterol. The level of low density lipoprotein cholesterol (LDL-C) was derived from the Friedewald calculation.

The serum Mg concentration was determined by Hitachi 717 xylidyl blue method (Wako Pure chemical, Japan). This method is an *in vitro* colorimetric assay using xylylazo-violet-1 (XB-I) and glycoletherdiamine-N,N,N',N'-tetra acetic acid (GEDTA) so that XB-I specifically reacts with Mg.

Coronary angiography

Coronary angiography was performed on all 100 CAD patients. CAD was defined as a reduction of vessel diameter of at least 50 per cent. All of the CAD patients in this study had triple-vessel disease.

Statistical analysis

Unpaired *t*-test was calculated with SPSS program. Odds ratio was used to determine the statistical significance between the prevalence of Mg deficiency in CAD patients and the controls. Value of $p < 0.05$ were considered statistically significant.

RESULTS

The patients with CAD were significantly older than the control group (mean age 62.1 ± 9.1 *vs* 49 ± 11.4 years) (Table 1). Serum Chol, HDL-C and LDL-C in CAD patients were significantly

Table 1. Demographic, clinical, and laboratory characteristics of patients with CAD and healthy subjects.

Variable	CAD patients (n=100)	Healthy subjects (n=100)
Age, years	62.1 ± 9.1	49.0 ± 11.4
Sex, male/female	56/44	49/51
BMI, kg/m^2	24.99 ± 4.23	24.56 ± 4.69
History of MI, %	14	2
Current smoking, %	6	23
History of DM, %	43	14
History of HT, %	62	21
History of lipidemia, %	71	35
Serum chol, mg/dL	203.78 ± 48.40	220.0 ± 38.76
Serum TG, mg/dL	166.8 ± 105.73	153.97 ± 94.47
Serum HDL-C, mg/dL	42.38 ± 10.12	49.11 ± 15.05
Serum LDL-C, mg/dL	115.36 ± 34.55	132.0 ± 33.42

BMI = Body Mass Index, MI = myocardial infarction, DM = diabetes mellitus, HT = hypertension, chol = cholesterol, TG = triglyceride, HDL-C = high density lipoprotein cholesterol, LDL-C = low density lipoprotein cholesterol.

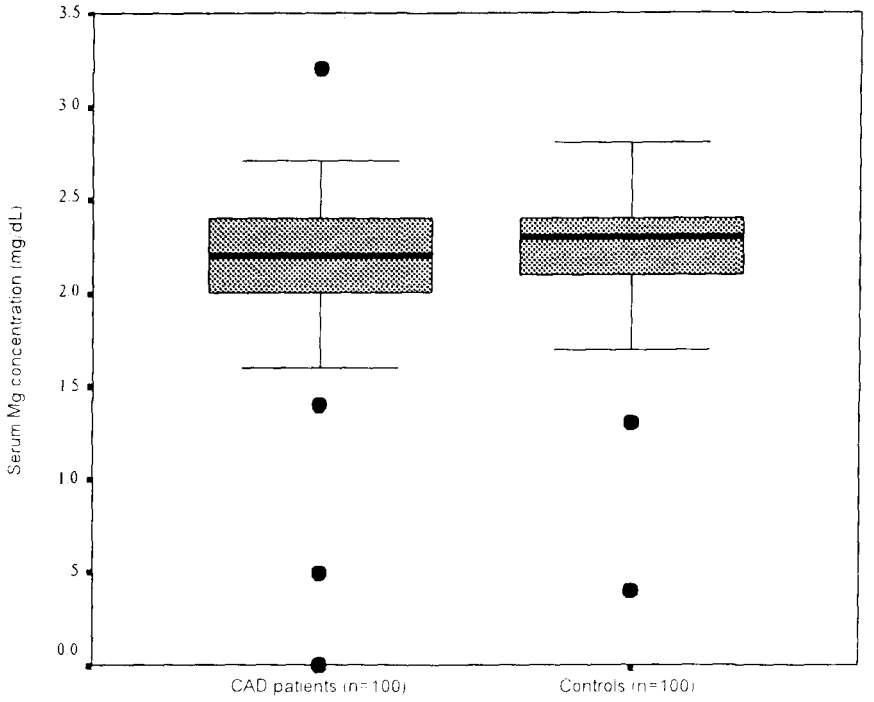

Fig. 1. Serum magnesium in CAD patients and healthy controls.

lower than the control group. (Chol 203.78 ± 48.40 *vs* 220 ± 38.76 mg/dL, HDL-C 42.38 ± 10.12 *vs* 49.11 ± 15.05 mg/dL, and LDL-C 115.36 ± 34.55 *vs* 132 ± 33.42 mg/dL). There were no significant differences in body mass index (BMI) between the CAD patients and controls (24.99 ± 4.23 *vs* 24.56 ± 4.69 kg/m^2).

Serum Mg concentration was the same between the CAD patients and the control group (2.14 ± 0.39 *vs* 2.24 ± 0.3 mg/dL, p=0.052) (Fig. 1). The prevalence of Mg deficiency did not differ significantly between the 2 study groups (12% *vs* 5%, odds ratio=2.59, 95% confidence interval=0.88-7.65, p= 0.063) although it tended to be higher in the CAD patients.

DISCUSSION

Although low concentration of tissue Mg has been associated with greater CAD occurrence[6], the simple tests used for assessing intracellular Mg content were not available. The present study used the test in assessing serum Mg concentration in the CAD patients compared with the control group, demonstrating that the serum Mg in CAD patients tended to be lower than the controls. The prevalence of Mg deficiency of the control group was lower than the CAD patients. The present study was similar to two previous studies (Igawa et al[7] and Goto et al[8]), although they had used intravenous loading test to detect Mg deficiency in variant angina pectoris or coronary vasospastic angina. Another method to measure intracellular Mg in sublingual cell to detect Mg deficiency in AMI patients has been reported by Haigney et al[6]. They reported that the method correlated well with atrial Mg content but not with serum Mg, and intracellular Mg was low in AMI patients. This evidence suggested that patients with CAD had a low level of Mg concentration in both extracellular and intracellular content. Mg deficiency may play an important role in the pathogenesis of atheroscelosis.

In the present study, over 50 per cent of CAD patients had a history of diabetes mellitus (DM), hypertension (HT) and hypercholesterole-

mia, demonstrating that Mg deficiency may play an important role in modifying risk factors of atherosclerosis. This finding is similar to a previous study (9). In animal models, Mg deficiency has been shown to be involved in several steps of the atherosclerotic process, including the metabolism of elastin, collagen, lipid and platelet aggregation. It effects a proinflammatory condition with an excessive production of oxygen-derived free radicals, and chronic Mg deficiency seems to favor free radical production and oxidation of lipid moieties.

Recently, because Mg deficiency is known to cause CAD, intravenous Mg sulfate may play a role in the therapy for AMI patients. Many studies (10-12) reported that cardiovascular effects of Mg include vasodilation of peripheral vessels, thus enhancing perfusion of myocardium by reduction of afterload, reduction of coronary artery tone, and reduction of the likelihood of cardiac arrhythmias by membrane stabilizing effects. Previous studies (13-16) demonstrated that, the use of intravenous Mg in the treatment of patients with AMI were controversial. The current American College of Cardiology/American Heart Association guidelines for the treatment of patients with AMI recommend intravenous Mg only for correction of documented Mg deficiency and for the treatment of torsades de points type ventricular tachycardia.

Finally, although in the present study, the patients with CAD were significantly older than the control group, aging did not effect serum Mg concentration. Yang et al(17) reported that serum Mg did not differ with age (11-75 years).

Study Limitations

Because of the small sample size of triple vessel CAD and the present study had limited power to the direct measurement of intracellular Mg concentration, we cannot exclude the possibility that a larger study group might demonstrate that the serum Mg concentration in CAD patients was lower than the control group, or the prevalence of Mg deficiency in patients with CAD was higher than in healthy subjects.

SUMMARY

The serum Mg concentration of CAD patients tended to be higher than the control group, indicating that Mg deficiency may be associated with CAD, and may play an important role in the pathogenesis of atheroscelosis or acute thrombosis. Mg treatment may be necessary in CAD patients with Mg deficiency or AMI.

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ระดับซีรั่มแมกนีเซียมในคนไทยที่เป็นโรคหัวใจขาดเลือด

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ในปัจจุบันมีการศึกษาพบว่าการขาดแมกนีเซียมอาจมีความสัมพันธ์กับการเกิดเส้นเลือดหัวใจตีบตันได้ การศึกษานี้เป็นการศึกษาเบื้องต้นในประเทศไทยเพื่อวัดระดับแมกเนเซียมในซีรัมของผู้ป่วยโรคหัวใจขาดเลือดจำนวน 100 คน เปรียบเทียบกับกลุ่มประชากรปกติ 100 คน ผลปรากฏว่า ค่าเฉลี่ยของระดับแมกนีเซียมในซีรั่มของผู้ป่วยมีค่า 2.14 ± 0.39 mg/dl ในกลุ่มคนปกติได้ 2.24 ± 0.3 mg/dL (P=0.052), และพบว่าในกลุ่มผู้ป่วยมีภาวะขาดแมกนีเซียม 12% เทียบกับคนปกติ 5% (odd ratio=2.59, 95%CI=0.88-7.65, P=0.063) จากผลดังกล่าวพบว่า แม้ว่าระดับแมกนีเซียมในซีรัมของทั้ง 2 กลุ่มไม่แตกต่างกันทางสถิติ และจำนวนคนที่มีภาวะขาดแมกนีเซียมจะไม่แตกต่างกันก็ตาม แต่จะเห็นว่าระดับซีรั่มแมกนีเซียมในผู้ป่วยมีแนวโน้มน้อยกว่าในคนปกติและจำนวนผู้ป่วยที่อยู่ในภาวะขาดแมกนีเซียมมีมากกว่าในกลุ่มคนปกติ แสดงว่าการขาดแมกนีเซียมน่าจะเป็นปัจจัยร่วมในการเกิดโรคหัวใจขาดเลือดและการตรวจหาระดับแมกนีเซียมในซีรั่มมีความจำเป็นอย่างยิ่งในผู้ป่วยโรคหัวใจขาดเลือดและยังมีส่วนช่วยในการรักษาผู้ป่วยที่มีภาวะดังกล่าวให้ดียิ่งขึ้น

คำสำคัญ : แมกนีเซียม, ภาวะขาดแมกนีเซียม, โรคหัวใจขาดเลือด

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