ORIGINAL ARTICLE

Association of Serum Calcium with Acute Myocardial Infarction

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ABSTRACT

Acute myocardial infarction (AMI) is a leading cause of morbidity and mortality worldwide. The incidence of AMI is dependent on certain traditional predisposing risk factors. In addition to the traditional risk factors, raised serum calcium level is also being considered as an associated factor for AMI. The aim of the study is to evaluate the association of serum calcium level with acute myocardial infarction in a tertiary level hospital in Bangladesh. This case control study was conducted in the Department of Biochemistry, Dhaka Medical College, Dhaka from January 2013 to December 2013. In this study, 50 diagnosed cases of AMI and 50 age and sex matched apparently healthy subjects were selected from DMCH purposively according to the selection criteria. Blood pressure, height and weight were measured and BMI was calculated. Biochemical parameters- serum calcium and fasting blood glucose in two groups were estimated in mmol/l. Then serum calcium was compared between two groups to observe the association with AMI. Results were analyzed statistically in SPSS version 17.0. Unpaired student's 't'-test and Spearman correlation analysis was done. All the results were expressed as mean $\pm$SD and p value <0.05 was accepted as level of significance. Present study showed that serum calcium level was significantly higher($p=.001$) in cases ($2.61\pm.15$ mmol/l) when compared with that of controls ($2.13\pm.15$mmol/l). Serum calcium also showed a significant positive correlation with AMI ($rho=0.858$, $p=0.001$).Findings of study concludes that increased serum calcium is associated with AMI.

Key Words: Acute myocardial infarction, Serum calcium, Hypercalcemia

Introduction

Calcium ion is an essential regulator in many homeostatic systems, including vascular tone, hormone secretion, and intermediary metabolism[1]. Calcium is also essential for nerves, muscles, heart and other body system to work properly.

Calcium ion not only plays a role in regulating variety of physiological events, but also involved in developing pathological conditions mainly in heart. Increased level of calcium causes coronary artery and peripheral arteriolar constriction by binding with the heart and smooth muscle through calcium receptor and thus it increases cardiac contractility and causes diminished oxygen supply to myocardium. This eventually increases the risk of cardiovascular disease. According to Nadia[2], increased level of calcium causing abnormality of heart leading to excessively forceful or tight contraction causes increased and irregular heartbeat (tachycardia and arrhythmia).

A calcium overload also causes increased blood pressure, coronary artery calcification[3,4,5] and progression of atherosclerosis that involves lipid as well as collagen, elastin and calcium accumulation in coronary vasculature. Myocyte infiltration, endothelial injury, smooth muscle proliferation and migration are also involved in coronary

atherosclerosis. Several of these processes are also mediated by calcium ion[6]. Moreover, calcium is involved in other events such as coronary spasm, thrombus formation and disruption of atherosclerotic plaque, occlusion of coronary artery following rupture of vulnerable atherosclerotic plaque which can cause myocardial infarction and sudden death[7]. Various studies in different parts of the world suggest that serum calcium is strongly associated with myocardial infarction[8,9]. In a study Lind et al[9], serum calcium has been found to be an independent, prospective risk factor for myocardial infarction in Swedish middle-aged men. In another study by Palmer et al.[10] suggested that not only hypercalcemia is associated with AMI, but also slightly elevated serum calcium levels within the normal range are of importance.

The incidence of myocardial infarction is increasing also in Bangladesh. Rates of cardiovascular diseases have risen greatly in low-income and middle-income countries[11-13] with about 80% of the increased burden now. Effective prevention needs a global strategy based on knowledge of the importance of risk factors for cardiovascular disease in different geographic regions and among various ethnic groups. Risk factors for coronary heart disease vary between populations, e.g., lipids are not associated with this disorder in South Asians[13] and increases in blood pressure might be more important in Chinese people[14]. Known risk factors (generally smoking, hypertension, raised lipids, and diabetes) are being identified and treated. But the incidence rate is still high because these risk factors have been claimed to account for only about half the risk of a myocardial infarction[13]. So, there is a pressing need to identify the associated risk factors of AMI to reduce the incidence and mortality rate.

The relationship between serum calcium and AMI is becoming clear day by day from different studies done around the world, but very few studies have been reported so far in Bangladesh. The present study was designed to observe the association of serum calcium concentration with acute myocardial infarction in Bangladeshi population.

Materials and Methods

This case control study was conducted in the Department of Biochemistry, Dhaka Medical College, Dhaka from January 2013 to December 2013. In this study 50 diagnosed cases of AMI and 50 age and sex matched apparently healthy subjects were selected purposively according to selection criteria. The cases were selected from DMCH. The diagnosis of AMI was based on the electrocardiogram, ischemic cardiac pain lasting at least 30 min, and change in Troponin I. Variables such as smoking, history of hypertension, diabetes mellitus, hyperc holester olemia, height, body weight, current medication prior to the AMI during admission were recorded. Blood pressure, height and weight were measured and BMI was calculated. Biochemical parameters- fasting serum glucose and serum calcium in two groups were estimated. BMI, blood pressure, serum calcium and fasting serum glucose were compared between Cases and Controls. Results were analyzed statistically in SPSS version 17.0. Unpaired student's 't'-test and Spearman correlation were done. All the results were expressed as Mean $\pm$SD and a p value <0.05 was accepted as the level of significance.

Results

Demographic characteristics of the patients are presented in table I. All general characteristics are significantly different between Cases and Controls except for ages and blood glucose. Mean$\pm$SD of age (in years) of the Cases and Controls were 53.30 ± 6.74 and 51.86 ± 7.30 respectively. There was no statistically significant difference of mean age between the two groups ($p=0.308$).

Table I: Demographic characteristics of the subjects

Variables	Case n=50 Mean±SD	Control n=5 0 Mean±SD	p value
Age (years)	53.30 ± 6.74	51.86 ± 7.30	0.308
Male sex n (%)	31 (64%)	31 (64%)	
Female sex n (%)	19(38%)	19(38%)	
SBP (mm of Hg)	137.80±14.92	124.70±11.35	0.001
DBP (mm of Hg)	88.70±10.24	79.60±7.61	0.001
BMI(Kg/m²)	27.34±3.3 7	25.30±3.42	0.001

Unpaired students 't'-test was done to measure the level of significance; Significant = ($p<0.05$).

Table I also showed that Mean±SD of SBP was significantly higher in Cases when compared with that of controls ($p=0.001$) which were 137.80±14.92 mm of Hg and 124.70±11.35 mm of Hg respectively. Mean ±SD of DBP was also significantly higher ($p=.001$) in cases (88.70±10.24 mm of Hg) than that of controls (79.60±7.61 mm of Hg).

Table II: Biochemical parameters of study subjects

Variable	Case (n=50) Mean±SD	Control (n=50) Mean±SD	P value
Serum calcium (mmol/ L)	2.61 ± 0.16	2.13 ± 0.15	0.001
Fasting blood sugar (mmol/L)	5.3±0.821	5.2±0.709	0.297

Unpaired student's 't'-test was done to measure the level of significance. Significant= ($P<0.05$).

Table II shows the biochemical parameters of the study subjects. Mean±SD of serum calcium were 2.61±0.16 mmol/l and 2.13±0.15 mmol/l in Cases and Controls respectively and it was significantly higher in cases ($p=0.001$). Mean±SD of fasting blood glucose (mmol/l) of the Cases and Controls were 5.3±.821 and 5.2±.709 respectively. There was no statistically significant difference of mean blood glucose between two groups ($p=0.297$).

Table III: Correlation between serum calcium and AMI (yes/no).

Study subjects	rho value	p value
AMI (Y/N)	0.858	0.001

rho= Spearman's correlation coefficient; Significant= ($P<0.05$). The correlation of serum calcium and AMI was done by Spearman correlation test. The result shows significant positive correlation (rho=.858, p=.001) between serum calcium and AMI (Table III).

Discussion

In the present study, serum glucose was estimated in Cases and Controls to exclude diabetes. All the subjects in the study were nondiabetic with Mean±SD fasting serum glucose 5.3±8.21 mmol/l and 5.2±.709 mmol/l in Cases and Controls respectively. Serum Troponin I was estimated and ECG monitoring was done to diagnose AMI.

The present study revealed that the Mean±SD serum calcium concentration was 2.61±.16 mmol/l and 2.13 ± 0.15 mmol/l in AMI Cases and healthy Controls respectively. In the current study we found that, serum calcium level was significantly higher (p=.001) in AMI Cases than that of Controls. Similarly, In a previous study Lind et al[9] found that subjects with a history of MI have significantly higher serum calcium than those without infarction. Our finding of a positive association between elevated serum calcium level and AMI is also consistent with other studies[8,15]. Herrmann et al[16] demonstrated that increased serum calcium predisposes calcific deposition in the valve cusps and coronary arteries, which could cause significant aortic valve stenosis and accelerate coronary atherosclerosis; this can mismatch the myocardial oxygen supply and demand.

The mechanisms underlying the associations between circulating calcium, cardiovascular risk factors and cardiovascular diseases appear to be multiple and complex. The calcium-sensing receptors are expressed in the vascular smooth muscle and endothelial cells and mediate some

of the effect of circulating calcium on vascular tone[17]. Thus, serum calcium may be involved in regulating blood pressure by controlling vascular smooth muscle cell contractility and modulating peripheral vascular resistance[18, 19].

The present study show that Mean±SD of SBP and DBP in Cases were 137.8±14.92 mm of Hg and 88.70±10.24 mm of Hg and in controls 124.7±11.35 mm of Hg and 79.60±7.61 mm of Hg respectively. These findings support the study in a Swedish population where it has been shown that the mean value of SBP and DBP are compared between cases and controls[9]. The current study shows that the difference is between two groups (p=0.001) statistically significant in respect of SBP and DBP. In contrast to our findings, the study by Buckley[20] on 325 males and the study by Andersen[21] on 70 men and women from Denmark have reported that the hypertension is associated with lower serum calcium. These inconsistencies might have occurred due to different selection criteria used for study subjects and population, and different methodologies.

In this study, Mean±SD of BMI was 27.34±3.37 Kg/m² in AMI Cases which was significantly higher than that of Controls (p=.001). In this study subjects with AMI has higher BMI and higher serum calcium than that of Controls which is similar to other studies[9, 22]

In our study, Spearman correlation coefficient shows a significant positive correlation between serum calcium and AMI subjects (rho=0.858, p=0.001) suggesting increased serum calcium level significantly increases the chances of AMI. Similarly, a Cohort study by John et al.[23] suggested that plasma calcium is a predictor of CVD and a predictor of MI[8,9] as well as a predictor of cardiovascular mortality[24,25]. However, in Framingham study and Atherosclerosis risk in Communities (ARIC) study calcium was not found to be a predictor of cardiovascular disease in age- and sex-adjusted or multivariable-adjusted models[26,27]. In another study done by Jin Y et al.[28] demonstrated that serum calcium levels are not associated with IHD. The conflicting results from these studies may reflect demographic differences between participants or differences in analysis. Findings of our study suggest that increased serum calcium is positively associated with AMI in both sexes.

It may be concluded that increased serum calcium is associated with AMI. However, the combined evaluation of increased serum calcium and other risk factors might help to assess the risk of future occurrence of acute myocardial infarction as well as to reduce the incidence of AMI.

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