

Calcium Determination in Sera of Myocardial Infarction Patients in Basra City, Iraq

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Abstract – Calcium plays a number of important roles in physiology and pathology, but also involved in developing pathological conditions mainly in heart. The elevation in calcium levels may be considered as a biomarker for Myocardial Infarction (MI). This case- control study included 60 number of case of MI and equal number of matched healthy control. The results shows a significantly elevation in calcium levels ($p < 0.001$) in MI patients when compared with healthy control subjects, it's levels were (11.433 ± 3.904) and (10.460 ± 3.347) in MI patients and healthy control respectively. Also there is a significant elevation in serum calcium levels ($p < 0.001$) with age in both cases. According to gender, females tend to be have higher concentrations of calcium in both cases (11.484 ± 1.296) and (10.564 ± 2.938) in MI patients and healthy control compared with males (10.472 ± 3.125) and (10.415 ± 3.852) in MI patients and healthy control respectively. And for smoking effect, the results shows a decreasing in serum calcium levels ($p < 0.001$) in smokers (10.460 ± 3.347) compared with non-smokers (12.338 ± 3.759) .

Keywords – Calcium, Myocardial Infarction (MI).

I. INTRODUCTION

Calcium ion is necessary for the regulation of many homeostatic systems, such as intermediary metabolism and vascular tone hormone secretion [1]. It is considered as the most abundant mineral in the body. The adult's body contains 1kg. 99% is in the skeleton in the form of calcium phosphate salts. The extracellular fluid contains approximately 22.5 mmols of which 9 mmols is in the serum. Calcium found in plasma in 3 types the first type as ionized calcium, the second on as protein (albumin) bound calcium, and the last type as Calcium complexes with organic acids [2].

Calcium is a key messenger in muscle contraction, including the myocardium. It plays a vital role as a co-factor for several enzymes, also its involved in coagulation of blood. Calcium chelators commonly used anticoagulants in blood collection as (citrate, ethylenediaminetetraacetic acid [EDTA])[3].

Calcium ion not only plays a role in regulation of physiological actions, but furthermore is involved in developing pathological conditions mainly in heart [1]. Calcium role in vascular health until this time is less clear-cut, the increasing in calcium level causes peripheral arteriolar and coronary artery 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 [1], [3].

The overload of calcium also causes an increasing in blood pressure, coronary artery calcification and atherosclerosis progression that involves collagen as well as lipid, elastin and calcium accumulation in coronary vasculature [4]-[6].

Serum calcium levels are affected by several important factors including vitamin D and parathyroid hormone (PTH), serum phosphate, and magnesium levels. Abnormalities of calcium derangements and changes in serum calcium levels are common in clinical practice, especially among critically ill patients with prevalence up to 88% [7].

II. MATERIAL AND METHODS

All chemicals used in this study with highly purified material and no farther purification done.

III. SAMPLE COLLECTION AND ANALYSIS

This case control study was conducted in Basrah city, southern Iraq. The study involved 60 diagnosed cases of MI and 60 age and sex matched apparently healthy subjects were selected [From 60 patients with Myocardial Infarction, 35 (58.33%) subject were males and 25 (41.66%) were females. From 60 healthy group, 37 (61.66%) subject were males and 23 (38.33%) were females], variables such as smoking, hypertension, and diabetes mellitus, were recorded. serum calcium was compared between cases and controls. Venous blood samples of (5 ml) drawn from patients of MI and healthy subjects, The blood was allowed to clot at 37 °C for 10-15 minutes, and then centrifuged in (402 X g) for approximately 10-15 minutes then the sera were obtained and stored at 0 °C until analysis.

IV. DETERMINATION OF CALCIUM

Calcium determined by using by Flame Photometry, after the digestion of the sera according to the method of Weather by and Feruson [8].

V. STATISTICAL ANALYSIS

Data were analyzed using SPSS software (Version 19) and the values were expressed as mean and standard deviation. Pearson's correlation analysis was carried out. All comparison were 2-tailed, and p value of <0.05 or <0.01 were considered significant.

VI. RESULTS

In this study the calcium tend to be at higher concentration in MI patients, it showed that serum calcium level was significantly higher ($p < 0.001$) in patients (11.433 ± 3.904) when compared with healthy control subjects (10.460 ± 3.347). As for age effect on calcium level, the results show there is a significant elevation in calcium concentration with age in both cases. According to gender, it showed that it's level tend to be significantly higher ($p < 0.001$) in females patients (11.484 ± 1.296) when compared with males from the same case (10.472 ± 3.125), while the control subjects shows no significant differences in calcium level between the both genders, it level was (10.415 ± 3.852) and (10.564 ± 2.938) in males and females respectively. And for smoking effect on calcium level, the obtained results show a significant decrease in calcium concentration in smokers compared with non- smokers' patients (10.460 ± 3.347) and (12.338 ± 3.759) respectively.

Table 1.comparison of levels of Calcium in study cases.

| | Case (n = 60) Mean ± SD | Control (n = 60) Mean ± SD | P-vale |
|---------------|-------------------------|----------------------------|---------|
| Serum Calcium | 11.433 ± 3.904 | 10.460 ± 3.347 | < 0.001 |

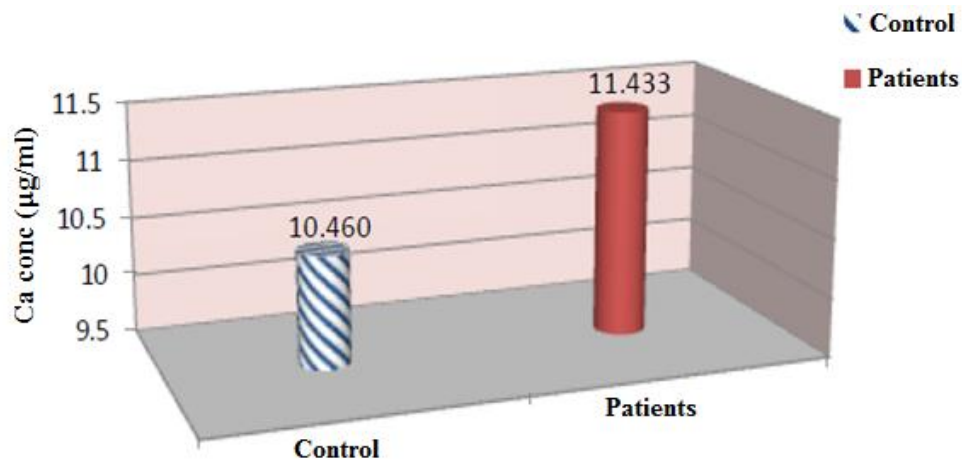


Fig. 1. Comparison of levels of calcium in study cases.

Table 2. Calcium concentration(µg/ml) as a function of Life Span.

| Life Span | Age Range (year) | Control | Patients | P-value |
|-----------|------------------|----------------|----------------|---------|
| 1 | 20-40 | 9.208 ± 2.207 | 9.248 ± 2.171 | > 0.001 |
| 2 | 41-50 | 10.019 ± 1.883 | 9.535 ± 0.519 | < 0.001 |
| 3 | 51-60 | 12.154 ± 1.688 | 10.154 ± 0.909 | < 0.001 |
| 4 | 61-70 | - | 12.209 ± 1.103 | - |
| 5 | 71-85 | - | 16.023 ± 3.131 | - |
| Total | | 10.460 ± 1.926 | 11.433 ± 1.566 | < 0.001 |

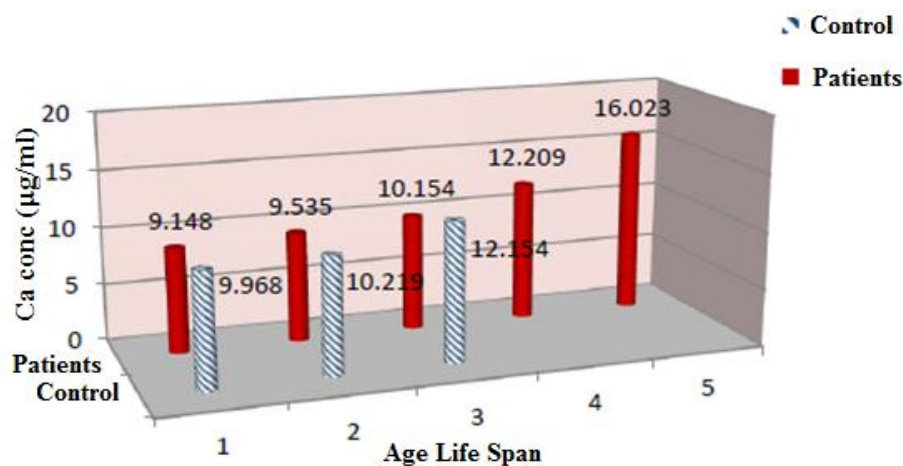


Fig. 2. Calcium concentration (µg/ml) as a function of Life Span.

Table 3. Calcium concentration (µg/ml) as a function of gender.

| Gender | Male Mean ± SD | Female Mean ± SD | P-value |
|----------|----------------|------------------|---------|
| Control | 10.415 ± 3.852 | 10.564 ± 2.938 | > 0.001 |
| Patients | 10.472 ± 3.125 | 11.484 ± 1.296 | < 0.001 |

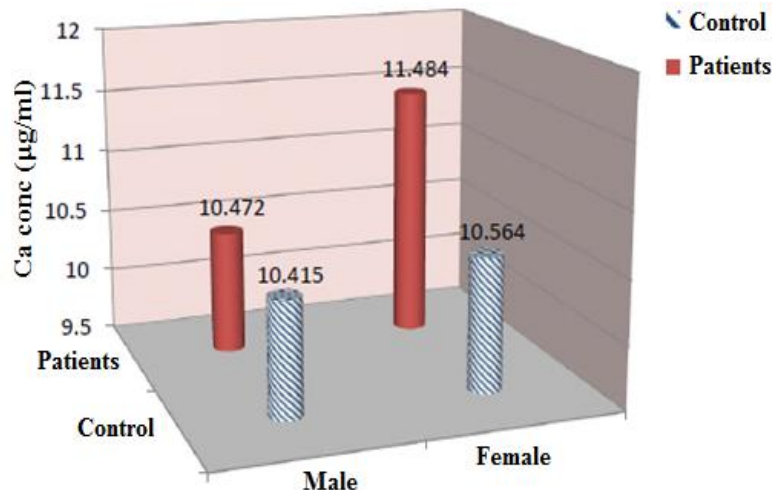


Fig. 3. Calcium concentration (µg/ml) as a function of gender.

Table 4. Calcium concentration (µg/ml) as a function of Smoking Status.

| Manner | Smokers | Non-Smokers | P-value |
|----------|----------------|----------------|---------|
| Patients | 10.460 ± 3.347 | 12.338 ± 3.759 | <0.001 |

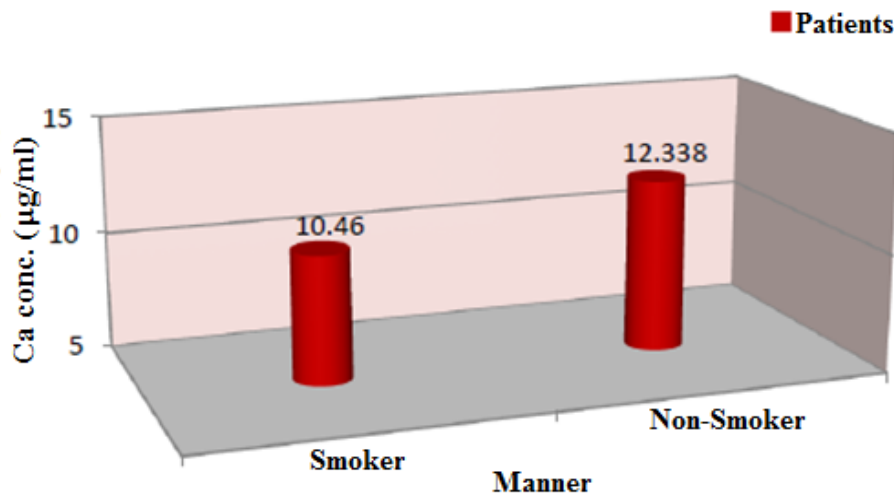


Fig. 4. Calcium concentration (µg/ml) as a function of Smoking Status.

VII. DISCUSSION

The current study revealed that the Mean ± SD serum calcium concentration was (10.460 ± .3437) µg/ml and (11.433 ± 3.904) µg/ml in healthy Controls and MI patients respectively. We found, in this study, calcium levels was significantly higher (p<0.001) in MI patients compared with healthy Controls, this results agree with studies of Jorde R. *et al.*, [9], Reid I. [10], Chowdhury S. *et al.* [1], Kumari P. *et al.* [2], and Reid I. *et al.*[3].

Herrmann *et al* [11] revealed that the elevation in serum calcium predisposes the deposition of calcific in the cusps of valves and coronary arteries, which can cause a stenosis in aortic valve and helps in acceleration in coronary atherosclerosis; this will lead to a mismatching in the supply and demand of the oxygen myocardial.

The receptors of calcium-sensing are expressed in the smooth muscle of vascular and endothelial cells and mediate the effect of calcium circulating on vascular tone [12]. Thus, serum calcium might involve in the blood

pressure regulation by controlling the contractility of vascular smooth muscle cell and modulating the resistance of peripheral vascular [1].

The possible purpose of the increasing in calcium in MI patients might due to the strong relation of blood pressure with total calcium. Increased serum calcium is the risk factor in MI. The increasing in serum calcium is the risk factor in MI. Thus, the increasing in total serum calcium seems to be an indicator of cardio vascular disease. The cardiac muscles requires the calcium in order to contract and squeeze the blood out of the heart into the arteries. After the contraction, the calcium streams out of the channels to allow the muscle relaxation. The abnormality in heart muscle which can caused by the Increased calcium it can lead to a tightly contraction of myocardium then causing arrhythmias. The elevation in calcium can causing a high blood pressure. Calcium is dangerous in causing a timely and strong contractions in the cardiac muscle to circulate the blood at all the body. Several studies observed there is a positive association between vascular calcifications and the levels of serum calcium [2], [13].

There is an increasing in the thickness of carotid artery plaque and a calcification in abdominal aortic in individuals whom have a higher levels of calcium, that led to a suggest that the calcium affects the walls of vessel directly. The another possible mechanism is the calcium binding with pyrophosphate, which plays an active role as an inhibitor of tissue calcification. In the excess serum calcium, there is a reduce in pyrophosphate, and then there may be more in the calcification of tissue [14]-[16].

A third mechanism explain that the increases in serum calcium maybe have an early effect on the morbidity of cardiovascular via its effects on the stiffness of arteries [17].

According to age, the results shows a significant elevation in serum Calcium levels during age in the both cases (control and MI patients). The results of many studies, including a study of Lind L. *et al.*, [18] and Jorde R. *et al.*, [9] have shown that there is an increase in serum calcium levels in females with age, and unlike of that in males.

As for gender, our results shows an increasing in calcium levels in females compared with males in both cases, this increase was slight in control group (10.564 ± 2.938) and (10.415 ± 3.852) in females and males respectively, while in patients group there is a significant increase in calcium levels in females (11.484 ± 1.296) compared with males (10.472 ± 3.125). This elevation in serum calcium levels in females was related clearly to the menopause, its levels significantly higher in females which whom reached the menopause, revealed that there was an increasing in albumin levels nearby the menopause that will explain the serum calcium elevation [9], [19].

And for smoking effect on calcium level, the obtained results show a significant decrease in calcium concentration in smokers compared with non-smokers' patients (10.460 ± 3.347) and (12.338 ± 3.759) respectively, the results of current study agree with study of Hussein, S.O. [20] and Dai, D. *et al.*, [21] both of these studies found a decrease in calcium concentration in smokers compared with non-smokers, and it shows a disagreement with study of Ucar, R.M. *et al.*, [22], while a study of Meral, I. *et al.*, [23] shows there is no differences in calcium concentration in smokers and non-smokers.

This decreasing in calcium levels can be attributed to the lower calcium absorption by intestine, which causing by smoking and then lead to lowering in serum calcium levels in smokers [24].

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