



Emergency Medicine

ASSOCIATION OF ADMISSION SERUM CALCIUM LEVELS WITH OUTCOME IN PATIENTS PRESENTING WITH ACUTE CORONARY SYNDROME

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ABSTRACT **Background:** Low serum calcium levels have an adverse effect on outcome in patients with Acute Coronary Syndrome (ACS). This study was undertaken to validate this in Indian urban population **Methods:** This prospective observational study was conducted among 190 diagnosed ACS patients presenting to emergency department of a tertiary care hospital in Delhi, India. Albumin corrected serum calcium levels were recorded at admission and patients were divided into Hypocalcemic ($<8.5\text{mg/dl}$) and normocalcemic ($\geq 8.5\text{mg/dl}$) groups and their data was analysed. **Results:** 44% of the subjects were hypo calcaemic. Incidence of complications such as left ventricular failure (88.1%), arrhythmia (14.3%), cardiogenic shock (14.3%) and ventilatory requirements were more in Hypo calcaemic group. All 5 mortalities were also recorded in hypocalcemic group. **Conclusion:** Low serum calcium levels are significantly associated with short term mortality. It is also an independent predictor of complications such as Left Ventricular Failure, Arrhythmia and Cardiogenic shock.

KEYWORDS : Acute Coronary Syndrome, Hypocalcaemia, Outcome, Complications

INTRODUCTION

Acute coronary syndrome (ACS) is the leading cause of mortality and morbidity worldwide, resulting in high healthcare expenses. The mechanism underlying the poor prognosis of ACS patients have not been well elucidated, and it may be affected by several factors, such as baseline characteristics and treatment before, during and after hospitalisation, thus it is still not possible to accurately identify the patients who are more likely to experience poor outcomes⁽¹⁾.

ACS is a term which includes three conditions which are ST segment Elevation Myocardial Infarction (STEMI), Non ST segment elevation Myocardial Infarction (NSTEMI) and Unstable angina (UA). It is a medical emergency that requires prompt diagnosis and care. The goals of treatment include improving blood flow, treating complications and preventing future problems.⁽²⁾

Calcium plays important roles in the electrical and mechanical activity of the heart. Calcium ions enter the heart muscles in every cardiac cycle and contribute to the electrical signal that coordinates the heart function⁽³⁾. Lack of calcium at the cardiac level may lead to a high risk of complications like arrhythmia, heart failure etc.

Various studies done by researchers have shown that hypocalcaemia is an independent predictor of poor outcome in ACS patients^(4,5,6). However, there are no such reported studies in Indian population. We studied the association between serum calcium levels at admission and in hospital mortality in a cohort of ACS patients in our tertiary care hospital.

MATERIALS AND METHODS

This prospective observational study was conducted among 190 Acute Coronary Syndrome patients presented to the Emergency Department in a tertiary care hospital in New Delhi, India over a period of one year from January 2021 to December 2021. Patients were diagnosed on the basis of typical findings in ECG (ST segment elevation, ST segment depression, T inversion, new onset Left Bundle Branch Block (LBBB), Echocardiography (Ejection fraction and regional wall motion abnormality) and elevated cardiac enzymes (elevated Troponin I and Creatinine Kinase – Isoenzyme B)

Those patients with an already diagnosed chronic kidney disease, chronic liver disease, cerebrovascular accidents, malignancies and pregnant women were excluded from the study as these conditions have an independent impact on outcome of these patients.

Approval was obtained from the Institutional Ethics and Scientific Committee. Study subjects were recruited after taking written informed consent. Data was collected using a pretested semi structured proforma.

The albumin corrected serum calcium of all these patients were measured as part of the routine blood investigations at the time of admission. Patients were categorized into two groups – Corrected calcium levels $< 8.5\text{mg/dl}$ and $\geq 8.5\text{mg/dl}$, and their short term in-hospital outcome was analysed. Incidence of mortality and major complications like arrhythmias, cardiogenic shock, left ventricular failure (LVF) and need of mechanical ventilation, were recorded and compared between two patients groups.

Chi square test was performed to compare the distribution of categorical variables between groups. Multivariate logistic regression (Firth Logistic Regression) was done, and Odds ratios were calculated. P value ≤ 0.05 was considered as significant. SPSS 21 software was used for analysis.

RESULTS

Majority of the patients in this study (67.3%) were within the age group of 46-55 years with a mean age of 52 ± 5.9 years. 77 % were males and 23% females. Hypertension, and Type 2 Diabetes Mellitus were present in 44.7% and 34.2% of the study population respectively, while 17.8% patients had both comorbidities. Only 3 % of the sample group did not have these comorbidities. (Table:1)

44% of our patients were categorised as - hypo calcaemic ($<8.5\text{mg/dl}$), while 56% were found to have normal ($\geq 8.5\text{mg/dl}$) calcium levels at admission to Emergency Department. In our study population, 61 % patients were diagnosed as STEMI, 34% as NSTEMI and 5% had unstable angina.

Low calcium was found to be associated with a high incidence of mortality. The most common complication found in the study subjects was LVF (88.1%). The occurrence of complications such as LVF, Arrhythmia, and Cardiogenic shock were significantly more in hypocalcemic group with p values of 0.001 (Table:2). We recorded 5 deaths amongst the patient groups. All these deaths were found in the hypocalcemic group. However, multivariate logistic regression analysis revealed that serum calcium independently makes no significant difference in the occurrence of in hospital mortality (Table:3)

Table 1: Distribution Of Patients

Variables	Categories	Number of patients	Percentage
Age	25-35	2	1.05
	36-45	12	6.3
	46-55	128	67.3
	56-65	44	23.1
	>66	4	2.1
Gender	Male	147	77.37
	Female	43	22.63
Symptoms	Chest pain	108	56.8
	Chest heaviness	77	40.5
	Palpitations	1	0.5
	Shortness of breath	4	2.1
Comorbidities	Hypertension	85	44.7
	T2 - DM	65	34.2
	Both HTN and DM	34	17.8
	None	6	3.1
Types of ACS	STEMI	116	61
	NSTEMI	65	34.2
	Unstable Angina	9	4.7

Table -2: Association Of Serum Calcium With Complications

Serum calcium (mg/dl)	Mortality (n=5)	LVF (n= 98)	Arrhythmia (n =12)	Shock (n=12)	Ventilator requirement (n= 3)
<8.5	5	74	12	12	3
≥8.5	0	24	0	0	0
P value	0.01	0.001	0.001	0.001	0.05

Table 3: Firth Logistic Regression Analysis

Variables	Hypo-calcemia (N=84)	Normo-calcemia (N=106)	Adjusted Odds ratio (95% C I)	P value
Mortality	5 (6%)	0	0.053 (0.002-1.07)	0.056
LVF	74(88 %)	24 (22.6%)	0.03 (0.01-0.08)	0.001
Arrhythmias	12(14.3%)	0	0.02 (0.001-0.45)	0.012
Cardiogenic shock	12 (14.3%)	0	0.03 (0.002-0.48)	0.014
Ventilator requirement	3 (3.5%)	0	0.13 (0.01-2.6)	0.18

DISCUSSION

The study was conducted to evaluate the association between the admission serum calcium levels and in hospital outcome of ACS patients in Indian population. In our study population males outnumbered females with a ratio of 3.5:1. Among the types of ACS patients, 61 % of patients were diagnosed as STEMI, while NSTEMI and Unstable angina were 34.3 % and 4.75% respectively. Similar distribution was recorded by Z Gomez Alvarez et al⁽⁶⁾, in their study.

The patients were categorized as hypo-calcaemic (<8.5mg/dl) and normo-calcaemic (≥8.5mg/dl). We found out that there is significant increase in the occurrence of complications like LVF, Arrhythmia and Cardiogenic shock in the hypo-calcaemic group when compared with normo-calcaemic patients using Firth Logistic Regression Analysis. The need of mechanical ventilation had no significant association with calcium levels. Similar results were reported in studies by Z Gomez Alavarez⁽⁶⁾ and Mei-Xian Jiang et al⁽⁷⁾. This may be because of the fact that calcium is directly involved in the contractile activity of the heart and is impaired in conditions like LVF, arrhythmias and cardiogenic shock.

All 5 deaths in this study were reported in the hypocalcaemic group. Similar findings were reported by A Shiyovich et al⁽⁵⁾ where they found out that In hospital mortality was more in patients with serum calcium less than 9.12 (p value -0.01) compared to higher serum calcium levels. Confounding factors like age, type-2 Diabetes mellitus and hypertension have independent impact on the mortality in an ACS patients⁽⁸⁻¹⁰⁾

Xingbo Gu et al⁽¹⁾ studied if the serum calcium levels are useful for the stratification of midterm mortality in ACS patients and lowest level of mortality was observed in higher or normal levels of serum calcium levels. Multiple restricted cubic spine regression model in their study suggested a reverse j shaped association. The outcome of study by Z Gomez Alvarez et al⁽⁶⁾ is very much similar to the study by Xingbo Gu et al⁽¹⁾ where Multivariate regression analysis showed that the presence of total serum calcium under 8.5mg/dl remained an independent

predictor of mortality(p value-0.012). Some of other studies also reported similar results^(8, 11-13). In our study multivariate logistic regression analysis did not show low calcium levels as independent risk factor for mortality. The contrast in our results could be because these studies have followed up the patients for relatively longer periods of time, while we focussed only on in hospital mortality. Our centre has a round the clock availability of coronary angiography and has a high volume of procedures done annually, which itself decreases the short term mortality, this fact has been corroborated in the study by Jollis JG et al.⁽¹⁴⁾

CONCLUSION

Serum calcium at admission is independently associated with the occurrence of in-hospital complications such as LVF, cardiogenic shock and arrhythmias and is a contributor towards mortality. This easily available serum marker may be used for risk stratification for ACS patients. Further studies are required to determine the effect of early calcium supplementation in Emergency Department in patients presenting with Acute Coronary Syndrome.

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