

The correlation between serum calcium levels and angiographic severity of coronary artery disease in patients with acute coronary syndrome

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ABSTRACT

Background: Acute coronary syndrome (ACS) is one of the frequent illnesses and causes of mortality worldwide. An easy identifier can assist the physicians to identify a patient with more severe coronary artery disease. This has been investigated using serum calcium, although its correlation with severity observed during angiography remains unclear. This investigation was done to assess the association between serum calcium and the severity of coronary artery disease, determined with the SYNTAX score, among patients with ACS.

Methods: We undertook a cross-section study in Cardiology Department of Ayub Teaching Hospital, Abbottabad. Non-probability consecutive sampling was used to include 105 patients that had ACS. Coronary disease severity was determined by SYNTAX and serum calcium was measured. Data analysis was done on SPSS, and p value of 0.05 was regarded as being statistically significant.

Results: The research entailed 105 patients. Their mean age was 58.94 ± 8.64 years; 70 (66.7%) were men and 35 (33.3%) were women. Mean serum calcium was 8.49 ± 0.44 mg/dL and mean SYNTAX score was 22.22 ± 6.67 . The low, intermediate, and high SYNTAX groups included 55 (52.4%), 42 (40.0%), and 8 (7.6%) patients, respectively. Between a lower SYNTAX score and a lower serum calcium level ($p < 0.001$) a correlation was established between them. The correlation of Pearson indicated that there was a moderate negative relationship between serum calcium and SYNTAX score ($r = -0.658$, $p < 0.001$).

Conclusion: In patients with ACS, continuous lower serum calcium levels led to more severe coronary artery disease on the angiography. The simple and inexpensive serum calcium could be an extra marker that will help derive more data on disease severity.

Keywords: Acute Coronary Syndrome, Coronary Artery Disease, Coronary Angiography, Serum Calcium, SYNTAX Score

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Introduction

Cardiovascular disease is one of the most serious health problems. It is among the initial

causative factors of disease and death and causes the death of millions of individuals every year. An important portion of this issue is coronary artery disease which may cause disablement and even early death (1,2).

Despite the improved prevention and treatment methods over the last 20 years, the patients of acute coronary syndrome (ACS)

still need hospital care. This is in part two because of the ageing population and the increasing occurrence of hypertension, diabetes, high cholesterol, obesity and smoking (3,4).

There are three key conditions that make ACS: unstable angina, non-ST-elevation, and ST-elevation myocardial infarction. These disorders are typically caused by the obstruction of a coronary plaque and sudden drop of the blood flow to the heart. Of interest is the extent of coronary disease observable on angiography, which can impact treatment choices, angiography success in interventions like stenting, and subsequent patient outcome. Clinical value of patients with more severe disease is hence early recognition (2, 5). To study the coronary arteries, the coronary angiography is highly employed. The SYNTAX score is a conventional way of stipulating the intricacy and intensity of coronary artery disease. Laityte SYNTAX scores are worse related to poorer outcome, such as death, repeat of myocardial infarction, and other major cardiac events (6, 7).

The difference in severity of the disease among patients can be partially attributed to known risk factors like hypertension, diabetes and smoking. Scientists have thus sought to find straightforward and cheap biomarkers which can be used to provide useful information. They have investigated blood glucose markers, heavy metals and high-sensitivity C-reactive protein whose results have varied across the populations (8,9,10,11). There are a number of significant roles of calcium in the body. It is required in heart muscle contraction, blood vessels, cell signaling, blood clotting and vascular good health. Oxidative stress, inflammation, vascular damage, calcium deposition in the arterial wall and atherosclerosis have also

been associated with disruption of calcium balance (12,13,14,15).

The findings presented by previous studies are not all the same. Other studies observed that decreased serum calcium level was correlated with greater coronary disease and increased SYNTAX scores (9, 10, 16). The other studies implicated that the relationship might be diluted once common cardiovascular risk factors have been factored in and as such, calcium as a clinical marker cannot yet be used independently (17, 18). South Asian patients are also rather scarce in this region of study, yet coronary disease may occur at an earlier age and potentially be worse in South Asians. There are a number of risks that influence coronary atherosclerosis one of them is diabetes mellitus, hypertension, dyslipidemia, smoking, obesity and other metabolic issues. The development of plaque entails dysfunction of the endothelium, lipid, inflammatory processes, alteration in vascular smooth muscle cells, and plaque calcification. Normal vascular and myocardial functioning depends on calcium, but problematic calcium homeostasis can also be associated with vascular calcification and cardiovascular disease. Angiography provides data on the severity of coronary disease as anatomical in ACS, whereas SYNTAX provides a standardized score of the complexity of the lesions. Pakistan has little data on the relationship between serum calcium and SYNTAX score in ACS patients. This research was thus done to establish whether serum calcium in ACS patients in a tertiary care hospital is related to angiographic severity of the disease, as measured by SYNTAX score.

Methods

The study took place in the Department of Cardiology, Ayub Teaching Hospital, Abbottabad, over a period of six months, i.e., between October 2025 and March 2026 after

the study synopsis was approved and ethical approval was granted by Institutional medical and ethics review committee via letter no RC-EA-2025/197 dated 9-7-2025. The sampling type was non-probability consecutive sampling and 105 eligible patients were enrolled. The patients between the ages 18 and 80 years with the first attack of ACS or with signs of ACS specifically indicating a first attack ACS were taken into account. Patients who had liver disease, chronic kidney disease, cardiomyopathy, valvular disease, heart failure, or bleeding or clotting disorders were not included as these disorders might have influenced serum calcium or hampered the evaluation of the coronary angiogram.

Informed consent was signed by all the patients after being told about the study. The data was measured on a predesigned proforma. The data entailed age, sex, marital status, residence, and smoking status as well as family history of coronary artery disease. Blood samples were taken in the morning after a few hours of fasting. The arsenazo III dye method was used to measure serum calcium. Coronary angiography was done during routine care, whereby coronary artery disease was suspected or diagnosed. The angiograms were looked through by two seasoned cardiologists. Patients were stratified by SYNTAX score low (22 or below) vs. intermediate (23-32) vs. high (>32). The increase in scores represents more complicated coronary disease, such as disease of more vessels, longer lesions, or more complicated lesion locations.

The SPSS version 20 was used to analyze data. Categorical variables were represented in terms of frequencies and percentages. Shapiro Wilk test was applied to test the distribution of age, serum calcium and SYNTAX score. The data were reported as a continuous and either mean with standard deviation or as a median

with interquartile range as was deemed necessary. Correlation (Pearson or Spearman) was applied based on data distribution. Relevant comparisons across groups were achieved by using the Mann-Whitney U test or independent-samples t-test. A p-value <0.05 was considered statistically significant.

Results

The overall analysis consisted of 105 ACS patients. The mean age was 58.94 ± 8.64 years. There were 70 (66.7%) men and 35 (33.3%) women. Most patients were married (94, 89.5%), and 56 (53.3%) lived in urban areas. There were 71 (67.6) patients with hypertension and 57 (54.3) with diabetes with 69 (65.7) having a family history of coronary artery disease and 38 (36.2) having no history. Forty-seven patients (44.8) were current smokers, 13 (12.4) former smokers and 45 (42.9) never. Table 1 shows these results.

Table 1. Baseline demographic and clinical characteristics of the study participants (n = 105)

Variable	Frequency (%) / Mean $\pm$ SD
Age (years)	58.94 $\pm$ 8.64
Male	70 (66.7)
Female	35 (33.3)
Urban residence	56 (53.3)
Rural residence	49 (46.7)
Married	94 (89.5)
Single	11 (10.5)
Hypertension	71 (67.6)
Diabetes mellitus	57 (54.3)
Dyslipidemia	69 (65.7)
Family history of CAD	38 (36.2)
Current smoker	47 (44.8)
Former smoker	13 (12.4)
Never smoked	45 (42.9)
STEMI	45 (42.9)
NSTEMI	32 (30.5)
Unstable angina	28 (26.7)

The most prevalent form of ACS was STEMI, which was present in 45 (42.9) patients with NSTEMI at 32 (30.5) and unstable angina at 28 (26.7) being the other two most frequent conditions. Mean SYNTAX score was $22.22 \pm$

6.67 and mean serum calcium was 8.49 ± 0.44 mg/dL. There was single-vessel disease in 52 (49.5%) patients, double-vessel disease in 40 (38.1%), and triple-vessel disease in 13 (12.4). Based on the SYNTAX score, 55 (52.4) patients had low severity, 42 (40.0) patients had intermediate severity and 8 (7.6) patients had high severity. These findings are shown in Table 2.

Table 2. Angiographic characteristics and serum calcium level (n = 105)

Variable	Value
Serum calcium (mg/dL)	8.49 ± 0.44
SYNTAX score	22.22 ± 6.67
Single-vessel disease	52 (49.5)
Double-vessel disease	40 (38.1)
Triple-vessel disease	13 (12.4)
Low SYNTAX (≤ 22)	55 (52.4)
Intermediate SYNTAX (23–32)	42 (40.0)
High SYNTAX (> 32)	8 (7.6)

Calcium levels in serum gradually declined in the three SYNTAX bands. The average level of calcium was 8.71 ± 0.40 mg/dL in low-SYNTAX group, 8.32 ± 0.33 mg/dL in the intermediate group and 7.92 in the high-SYNTAX group. One-way ANOVA indicated that the difference was statistically significant ($p < 0.001$) as presented as Table 3.

Table 3. Comparison of serum calcium levels according to SYNTAX score category (n = 105)

SYNTAX category	n	Serum calcium (mg/dL), Mean $\pm$ SD	p-value
Low (< 22)	55	8.71 ± 0.40	
Intermediate (22–32)	42	8.32 ± 0.33	
High (> 32)	8	7.92 ± 0.33	< 0.001

One-way ANOVA.

In correlation analysis, Pearson revealed that the serum calcium and SYNTAX score had moderate negative correlation ($r = -0.658$, $p = 0.001$). Therefore, patients who had lower serum calcium tended to have greater

SYNTAX scores and worse coronary disease. Table 4 shows the correlation.

Table 4. Correlation between serum calcium concentration and SYNTAX score (n = 105)

Variables	Pearson correlation (r)	p-value
Serum calcium vs. SYNTAX score	-0.658	< 0.001

Pearson's correlation analysis.

Discussion

This research paper explored the relationship between patients with ACS, severity of coronary artery disease and serum calcium. We identified that less the SYNTAX score the higher was the serum calcium. A moderate and statistically significant negative correlation was found between the two variables. Simply put, patients who had reduced levels of calcium were more likely to have complicated coronary disease. Our patients had a mean age slightly less than 59 years old and approximately two out of three were men. This trend resembles with other ACS patient studies undergoing angiographic evaluation with the large population of the study being composed of middle aged and older men (7,8,9). Other shared cardiovascular risk factors were high cholesterol, diabetes, and smoking, which concerned our patients. There are no secrets in patients who are known to have coronary disease and have been mentioned in the past ACS studies (1, 2, 7, 10).

The key result of this research was that there was a negative correlation between serum calcium and SYNTAX score ($r = -0.658$, $p < 0.001$). There was also a decrease in serum calcium between the low-SYNTAX group and intermediate and high-SYNTAX groups. This is in accordance with prior studies that have demonstrated a reduced level of calcium in the patients with more complex coronary disease and an increased SYNTAX score (4-6). Other researchers have also associated

cardiovascular outcomes associated with low calcium in ACS being poor (4, 5). This association could have a number of biological explanations. Calcium plays a role in heart muscle contraction, blood vessel functioning, cell signaling, platelet functioning and in maintaining the vessel lining. Oxidative stresses, inflammations, vascular damages, and the formation of plaques have also been associated with changes in calcium balance. The processes can lead to the development of coronary artery disease.

Other basic biomarkers have been analyzing in ACS as well. An increase in high-sensitivity CRP has been linked to increased coronary extent and angiographic severity, indicating a role of inflammation (8). More severe angiographic disease has been linked to poor glycemic control (10). Some of the characteristics of a coronary disease have been associated with heavy metal exposure, but a definite relation with angiographic severity is not demonstrated yet (9). These results indicate that laboratory routine testing can complement the evaluation of cardiovascular risk by other relevant data.

The results can be of practical value since serum calcium testing is cheap, universal and generally provides results promptly. The admission measurement of calcium would give some extra information on the patient with more severe coronary disease within ACS. It must however be combined with clinical assessment and angiographic findings and not replacement of these.

Strength of study

There are some strengths in this study. It involved various ACS presentations, employed SYNTAX score to determine the angiographic severity and employed a frequently used laboratory test.

Limitations of study

There are significant limitations as well. The research was cross sectional and was carried out at one center hence it demonstrates an association but does not provide a cause and effect relationship. The prospective follow-up of patients was not implemented. We also opted not to measure ionized calcium, vitamin D or parathyroid hormone and measured total serum calcium only. More substantial prospective studies required to validate these results and determine their significance in the long run should be done with more than one center.

Conclusion

Higher SYNTAX scores in patients with ACS were linked to lower serum calcium levels. Reduced levels of calcium were also linked with a worse angiography-coronary artery disease. Estimation of serum calcium could offer a cheap and easy source of additional information when evaluating ACS patients. It is not to be used instead of clinical evaluation or coronary angiography.

Recommendations: A multicenter study that is larger and has a longer follow-up period is necessary to know whether serum calcium could be used to predict cardiovascular outcomes in long term.

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References

1. Virani SS, Alonso A, Aparicio HJ, Benjamin EJ, Bittencourt MS, Callaway CW, et al. Heart Disease and Stroke Statistics-2021 Update: A Report from the

- American Heart Association. *Circulation*. 2021;143(8):e254-e743. doi:10.1161/CIR.0000000000000950
2. Collet JP, Thiele H, Barbato E, Barthélémy O, Bauersachs J, Bhatt DL, et al. 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. *EurHeartJ*. 2021;42(14):1289-367. doi:10.1093/eurheartj/ehaa575
3. Zhao D, Liu J, Wang M, Zhang X, Zhou M. Epidemiology of cardiovascular disease in China: current features and implications. *Nat Rev Cardiol*. 2019;16(4):203-12. doi:10.1038/s41569-018-0119-4
4. Benjamin EJ, Muntner P, Alonso A, Bittencourt MS, Callaway CW, Carson AP, et al. Heart Disease and Stroke Statistics-2019 Update: A Report from the American Heart Association. *Circulation*. 2019;139(10): e56e528. doi:10.1161/CIR.0000000000000659
5. Papazoglou AS, Farmakis IT, Zafeiropoulos S, Moysidis DV, Karagiannidis E, Stalikas N, et al. Angiographic severity in acute coronary syndrome patients with and without standard modifiable risk factors. *Front CardiovascMed*. 2022;9:934946. doi:10.3389/fcvm.2022.934946
6. Sianos G, Morel MA, Kappetein AP, Morice MC, Colombo A, Dawkins K, et al. The SYNTAX Score: an angiographic tool grading the complexity of coronary artery disease. *EuroIntervention*. 2005;1(2):219-27. doi:10.4244/EIJV1I2A35
7. Sharma A. Association of Hs-CRP levels in patients with acute coronary syndromes and its correlation with angiographic severity of coronary artery stenosis. *Indian J Cardiovasc Dis Women*. 2023;8(1):37-42. doi:10.1055/s-0043-1768589
8. Prakash VR, Shariff MO, Prakash VS. Correlation of glycemic status with angiographic severity of coronary artery disease in acute coronary syndrome. *J Assoc Physicians India*. 2025;73(8):61. doi:10.5005/japi-11001-0428
9. Jha A, Tiwari BC, Upadhyay AC, Vijay SK, Jamwal N, Singh AK, et al. Serum Heavy Metal Burden and Its Association with Angiographic Severity and Six-Month Outcomes in Coronary Artery Disease: A Prospective Observational Study From North India. *Cureus*. 2025;17(10): e95177. doi:10.7759/cureus.95177
10. Azam MH, Danish N, Wahab MA, ur Rehman A, Naeem S, Muhammad SK. The Relationship between Serum Calcium Levels and Angiographic Severity of Coronary Artery Disease in Patients with Chronic Coronary Syndrome. *Pak Heart J*. 2024;57(3):194-200. doi:10.47144/phj.v57i3.2678
11. Wang H, Li J, Tian J. Correlation between serum calcium and cardiovascular outcome among patients suffering from acute coronary syndrome. *Iran Red Crescent Med J*. 2021;23(2): e676. doi:10.32592/ircmj.2021.23.2.676.
12. Wang R, Tian J. Correlation between serum calcium and cardiovascular outcome in patients with acute coronary syndrome. *J Capital Med Univ*. 2023;44(1):154. doi: 10.3969/j.issn.1002-1922.2023.01.021.
13. Noshin TF, Ali MR, Banik S. Increased oxidative stress and altered serum macro-minerals and trace elements levels are associated with coronary artery disease. *J Trace Elem Med Biol*. 2021; 64:126707. doi: 10.1016/j.jtemb.2020.126707
14. Park B, Lee YJ. Borderline high serum calcium levels are associated with arterial stiffness and 10-year cardiovascular

- disease risk determined by Framingham risk score. *J Clin Hypertens (Greenwich)* 2019;21(5):668-73. doi:10.1111/jch.13540
15. Tibaut M, Caprnda M, Kubatka P, Sinkovič A, Valentova V, Filipova S, et al. Markers of atherosclerosis: part 1-serological markers. *Heart Lung Circ* 2019;28(5):667-77. doi: 10.1016/j.hlc.2018.01.009
 16. Zhang C, Bangming C, Huang X, Jian G, Ming X, Xiangjun Y, et al. Association between serum calcium and first incident acute myocardial infarction: a cross-sectional study. *IranJPublic Health* 2020;49(7):1278. doi:10.18502/ijph.v49i7.3580
 17. Ismail A, Abdeltawab A, Roshdy A. Echocardiography calcium score as predictive tools of severity of coronary artery disease. *QJM* 2021;114(Supplement1) doi:10.1093/qjmed/hcab090.011
 18. Pathakota SR, Durgaprasad R, Velam V, Ay L, Kasala L. Correlation of coronary artery calcium score and carotid artery intima-media thickness with severity of coronary artery disease. *J Cardiovasc ThoracRes*.2020;12(2):78. doi:10.34172/jcvtr.2020.14

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