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Original Research Article

SERUM MAGNESIUM AND TROPONIN T IN ACUTE CORONARY SYNDROME: INSIGHTS FROM A TERTIARY CARE TEACHING INSTITUTE

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Abstract

Background: Acute coronary syndrome (ACS) includes a spectrum of clinical conditions such as STEMI, NSTEMI, and unstable angina, all resulting from myocardial ischemia. Cardiac troponin T is a sensitive and specific biomarker of myocardial injury, while magnesium plays a critical role in cardiovascular stability. Emerging evidence suggests a possible inverse relationship between serum magnesium levels and myocardial damage severity. **Materials and Methods:** A comparative cross-sectional study was conducted over one year at Government Medical College, Kozhikode, involving 60 participants—30 ACS patients and 30 age- and sex-matched healthy controls. Serum magnesium was measured using a colorimetric method, and troponin T was assessed via chemiluminescent immunoassay. Statistical analyses included independent t-tests, Chi-square tests, and Pearson correlation. **Result:** The mean serum magnesium level in ACS patients was slightly lower than in controls (2.16 ± 0.37 vs 2.22 ± 0.298 mg/dL), while troponin T levels were significantly higher in cases (1.28 ± 1.96 vs. 0.0092 ± 0.004 ng/mL; $p < 0.001$). A significant negative correlation was found between magnesium and troponin T levels in the case group ($r = -0.644$, $p < 0.01$), indicating greater myocardial injury with lower magnesium levels. **Conclusion:** This study suggests reduced serum magnesium levels may be associated with increased myocardial damage in ACS. Routine magnesium assessment could be a valuable adjunct to troponin T in identifying high-risk patients and guiding management strategies in acute coronary settings.

INTRODUCTION

Acute coronary syndrome (ACS) encompasses a spectrum of clinical conditions, including ST-elevation myocardial infarction (STEMI), non-ST elevation myocardial infarction (NSTEMI), and unstable angina, all resulting from acute myocardial ischemia.[1] Diagnosis is based on a triad of clinical presentation, ECG changes, and elevated cardiac biomarkers, particularly troponin T, which is highly specific for myocardial injury. Troponin T, a subunit of the cardiac troponin complex, is released into the circulation during infarction and correlates with the extent of myocardial necrosis.[2,3]

Magnesium, an essential intracellular cation and cofactor in over 300 enzymatic reactions, plays a key role in cardiovascular physiology by modulating myocardial excitability, vascular tone, and arrhythmia risk.[4,5] Several studies have reported lower magnesium levels in patients with acute myocardial infarction and suggested a negative correlation with troponin levels, indicating its potential role in infarct progression.[1.6] In this context, the present study aimed to estimate and compare serum magnesium and troponin T levels in patients with ACS and healthy individuals and to evaluate the correlation between these two parameters.

MATERIALSANDMETHODS

This comparative cross-sectional study was conducted over one year, from 1 January 2015 to 31 December 2015, at Government Medical College, Kozhikode, to evaluate serum magnesium and serum troponin T levels in patients with acute coronary syndrome (ACS) compared to healthy controls. The Institutional Ethics Committee of Government Medical College, Kozhikode, approved the study.

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Thirty cases were recruited—hospitalized patients aged 30–70 years presenting with their first episode of ACS, including ST-elevation myocardial infarction (STEMI), non-ST elevation myocardial infarction (NSTEMI), and unstable angina, diagnosed based on clinical features and cardiac biomarkers. Controls were 30 healthy individuals within the same age range, with no evidence of ACS and normal ECG findings. Participants with severe skeletal muscle damage, infections, or inflammatory diseases were excluded. Informed written consent was obtained from all participants, and detailed clinical history, blood pressure, and body mass index were recorded.

Venous blood samples were collected under aseptic conditions. Serum magnesium was estimated using a colorimetric method with chlorophosphonazo III on the COBAS c-311 analyzer. Serum troponin T was measured using a high-sensitivity chemiluminescent immunoassay (Elecsys Troponin T hs STAT) on the COBAS e-411 analyzer.

All data analysis was performed using Microsoft Excel and the Statistical Package for the Social Sciences (SPSS, Version 16.0) software for Windows. Continuous variables were expressed as mean ± standard deviation. The Independent‘t’ test and Chi-square test were used to determine statistical significance between cases and controls. Pearson’s correlation coefficient (‘r’ test) was used to assess the relationship between serum magnesium and troponin T levels. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 60 participants were included in this comparative cross-sectional study, comprising 34 males (56.7%) and 26 females (43.3%) aged 30 to 70 years. The study population was divided into two groups: 30 patients diagnosed with acute coronary syndrome (cases) and 30 age- and sex-matched healthy individuals (controls). The mean age of the cases was 59.10 ± 7.59 years, while that of the control group was 62.40 ± 4.28 years. In the case group, males accounted for 60% and females 40%. Most cardiac events were observed in individuals above the age of 40 years, with nearly all female patients (n=12) experiencing their first cardiac event after the age of 45. Hypertension was prevalent in 73.3% of the case group. The mean body mass index (BMI) in the case group was 24.75 ± 2.46 kg/m².

Biochemical analysis revealed that the mean serum magnesium level in the case group was 2.16 ± 0.37 mg/dL, while the mean troponin T level was 1.28 ± 1.96 ng/mL. In comparison, the control group showed a slightly higher mean serum magnesium level of 2.22 ± 0.298 mg/dL and a significantly lower mean troponin T level of 0.0092 ± 0.004 ng/mL. Although the difference in mean magnesium levels between the groups was small, the difference in troponin T levels was markedly higher in the case group. Statistical analysis using the Independent 't' test confirmed that the difference in troponin T levels between cases and controls was highly significant ($p<0.001$).

Correlation analysis using Pearson’s correlation coefficient demonstrated a significant negative correlation between serum magnesium and troponin T levels in the case group ($r = -0.644$, $p < 0.01$), indicating that lower magnesium levels were associated with higher troponin T levels. In contrast, no significant correlation was observed between these variables in the control group ($r = -0.177$, $p = 0.35$). Neither group had a statistically significant correlation between magnesium or troponin T levels and age or BMI.

Table 1: Characteristics of the study population.

Variables	Cases	Controls
Quantitative		
Age in years (Mean±SD)	59.1±7.59	62.4±4.28
BMI(Mean±SD)	24.75±2.46	23.32±1.95
Serum Magnesium (Mean±SD)	2.16±0.37	2.227±0.29
Serum Troponin T (Mean±SD)	1.28±1.96	0.009±0.004
Qualitative		
Sex		
Male N(%)	18(52.9)	16(47.1)
Female N(%)	12(46.1)	14(53.9)
Hypertension		
Yes N(%)	22(53.6)	19(46.4)
No N(%)	8(42.1)	11(57.9)
Diabetes Mellitus		
Yes N(%)	21(65.6)	11(34.4)
No N(%)	9(32.1)	19(67.9)
Addictions		
Yes N(%)	13(61.9)	8(38.1)
No N(%)	17(43.5)	22(56.5)

Table 2: Correlation between Serum Magnesium(Mg),Troponin T(Trop t),Age and BMI

P/C			Trop t	age	BMI
P	Mg	Pearson Correlation Sig. (2-tailed)	**-.644	.229	.178
			.000	.224	.347
	Trop t	Pearson Correlation Sig. (2-tailed)		.112	*-.401

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				.556	.028
	age	Pearson Correlation Sig. (2-tailed)			.118
					.536
C	Mg	Pearson Correlation Sig. (2-tailed)	-.177	.019	-.196
			.350	.921	.298
	Trop t	Pearson Correlation Sig. (2-tailed)		-.135	.087
				.476	.649
	age	Pearson Correlation Sig. (2-tailed)			-.401
					.028

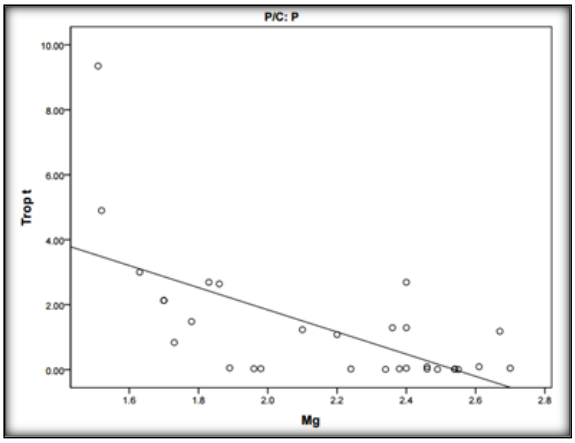

Figure 1: Correlation between magnesium and troponin T in cases

Pearson correlation r-value: -0.644 (p-value: 0.00)

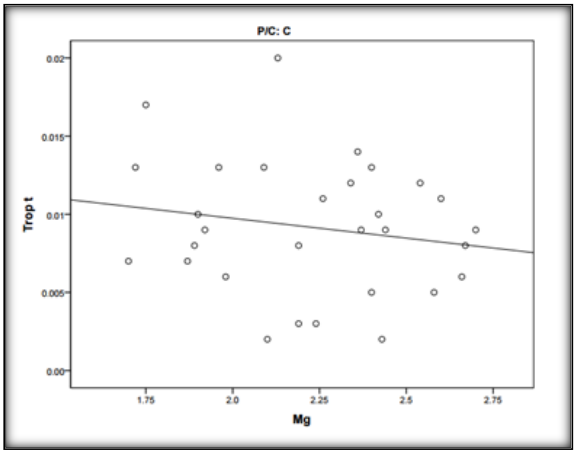

Figure 2: Correlation between magnesium and troponin T in controls

Pearson correlation r-value: -0.177 (p-value: 0.350)

DISCUSSION

In the present study, patients with acute coronary syndrome (ACS) exhibited significantly elevated serum troponin T levels and slightly lower serum magnesium levels than healthy controls. Although the difference in mean magnesium levels between cases (2.16 ± 0.37 mg/dL) and controls (2.22 ± 0.298 mg/dL) was modest, the difference in troponin T levels was pronounced and statistically significant ($p < 0.001$). A significant negative correlation was observed between serum magnesium and troponin T levels among ACS patients ($r = -0.644$, $p < 0.01$), indicating a potential relationship between lower magnesium levels and more significant myocardial injury. This correlation was not evident in the control group.

These findings agree with several previous studies that have demonstrated an inverse association between serum magnesium and the severity of myocardial infarction.[2,4,6-10] In a study by Quader et al., ACS patients had significantly lower mean serum magnesium levels (1.63 ± 0.27 mg/dL) compared to controls (2.35 ± 0.28 mg/dL), with hypomagnesaemia considered a contributing factor to myocardial damage.[2] Similarly, Singh et al. found that patients with lower serum magnesium levels were more prone to post-infarction complications such as arrhythmias and death.[4] Baset et al. also observed that serum magnesium was significantly lower in AMI patients with arrhythmias compared to those without, further supporting its prognostic value.[6] In contrast, a study by Annadatha et al. reported no statistically significant difference in magnesium levels between ACS patients and controls. However, a negative correlation with the Coronary Prognostic Index was noted.[5]

Additional studies further support the cardioprotective role of magnesium. Ajay Kumar and Shaveta Sagar found a weak negative correlation between serum magnesium and troponin T in ACS patients, suggesting lower magnesium may be linked to larger infarct areas.[11] Ramasamy et al. demonstrated that magnesium and related electrolyte ratios could be adjunctive markers for AMI diagnosis.[12] Guipeng An et al. found that low magnesium levels predicted a higher risk of major adverse cardiac events after stenting.[13] Long-term studies by Reffelmann and Wen Zhang et al. linked low serum or dietary magnesium to increased cardiovascular and all-cause mortality.[7,10] Furthermore, magnesium has shown benefits in improving heart rate variability in heart failure (Almoznino-Sarafian et al.),[14] and reducing left ventricular mass (Reffelmann et al.).[10] A meta-analysis by Xinhua Qu confirmed inverse associations between magnesium and total CVD events.[15] These studies emphasize the prognostic and potentially therapeutic significance of monitoring and managing magnesium levels in cardiovascular disease.

Our study supports the hypothesis that even marginal reductions in serum magnesium within the normal reference range may have clinical significance in the context of ACS. The lack of correlation between magnesium or troponin levels

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with age or BMI suggests that the observed relationships are independent of these variables. These findings highlight the potential utility of routine magnesium monitoring in ACS patients as a complementary biomarker alongside troponin T, especially in resource-limited settings.

CONCLUSION

This study identified a significant inverse correlation between serum magnesium and troponin T levels in patients with acute coronary syndrome, indicating that lower magnesium levels may be associated with greater myocardial injury. These findings, consistent with existing evidence, underscore the potential utility of serum magnesium as an adjunctive biomarker in the evaluation and risk stratification of ACS. Incorporating routine magnesium level assessment may enhance early detection of high-risk patients and inform targeted management strategies.

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