RESEARCH PAPER

CORRELATION OF DIAGNOSTIC VARIATIONS LIKE TROPONIN I, 2D ECHO AND CORONARY ANGIOGRAM IN ACUTE CORONARY SYNDROME PATIENTS

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ABSTRACT

Background: Acute Coronary Syndrome (ACS) remains one of the leading causes of morbidity and mortality worldwide despite significant advances in diagnosis and treatment. Early identification of patients at risk of extensive myocardial injury is essential for prompt intervention and improved clinical outcomes. Cardiac Troponin-I (cTnI), two-dimensional echocardiography (2D-ECHO), and coronary angiography are among the most frequently employed diagnostic modalities in ACS. Although each provides unique information regarding myocardial injury, ventricular function, and coronary anatomy, the relationship between these diagnostic tools remains incompletely understood.

Objective: To evaluate the correlation between serum Troponin-I levels, left ventricular ejection fraction assessed by two-dimensional echocardiography, and coronary angiographic severity in patients presenting with Acute Coronary Syndrome.

Methods: A prospective observational study was conducted over six months in the cardiology department of a tertiary care teaching hospital. A total of 121 adult patients diagnosed with STEMI, NSTEMI, or unstable angina were enrolled according to predefined inclusion and exclusion criteria. Clinical characteristics, laboratory investigations, echocardiographic findings, and coronary angiographic reports were collected. Spearman's correlation coefficient was used to evaluate associations between diagnostic variables, with statistical significance considered at $p<0.05$.

Results: The mean age of the study population was 60.50±11.10 years, and males constituted 57% of participants. NSTEMI was the predominant presentation (75.2%). Moderate left ventricular dysfunction was observed in 43.8% of patients, while single-vessel disease was the most frequent angiographic finding (42.1%). Troponin-I demonstrated a statistically significant negative correlation with left ventricular ejection fraction ($r = -0.191$, $p = 0.036$) and a significant positive correlation with angiographic disease severity ($r = 0.301$, $p < 0.001$). CK-MB showed a significant inverse relationship with ejection fraction ($r = -0.377$, $p < 0.001$).

Conclusion: Troponin-I demonstrated significant correlations with both myocardial functional impairment and angiographic disease severity, suggesting its usefulness as a prognostic biomarker in ACS. The combined application of Troponin-I, echocardiography, and coronary angiography provides comprehensive assessment and improves clinical risk stratification in patients with Acute Coronary Syndrome.

Keywords: Acute Coronary Syndrome; Troponin-I; Echocardiography; Coronary Angiography; Left Ventricular Ejection Fraction; Cardiac Biomarkers.

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INTRODUCTION

Acute Coronary Syndrome (ACS) comprises a spectrum of clinical conditions resulting from acute myocardial ischemia caused by partial or complete obstruction of coronary blood flow. It includes ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI), and unstable angina. Despite

improvements in reperfusion therapy and pharmacological management, ACS remains a major contributor to cardiovascular morbidity and mortality worldwide.

The pathophysiological mechanism of ACS involves rupture or erosion of an atherosclerotic plaque followed by platelet activation, thrombus formation, and coronary artery occlusion. Persistent myocardial ischemia results in irreversible myocardial necrosis, ventricular dysfunction, heart failure, arrhythmias, and death if timely intervention is not provided. Hypertension, diabetes mellitus, dyslipidaemia, smoking, obesity, and family history remain major risk factors for disease progression.

Early diagnosis and appropriate risk stratification are essential for selecting optimal therapeutic strategies. Cardiac Troponin-I is currently regarded as the most sensitive and specific biomarker of myocardial injury and has become an integral component of international ACS diagnostic guidelines. Higher Troponin-I concentrations have consistently been associated with larger infarct size and poorer clinical outcomes. However, serum biomarker elevation alone cannot provide information regarding ventricular function or anatomical severity of coronary artery disease.

Two-dimensional echocardiography provides rapid bedside evaluation of left ventricular systolic function, regional wall motion abnormalities, and mechanical complications following myocardial infarction. Left ventricular ejection fraction (LVEF) remains one of the strongest predictors of mortality and long-term prognosis among patients with ACS. Coronary angiography, meanwhile, remains the gold standard for defining coronary anatomy, identifying culprit lesions, and guiding revascularisation strategies.

Although these three diagnostic modalities are routinely performed in clinical practice, evidence regarding their interrelationship remains limited, particularly in the Indian population. Understanding whether biochemical evidence of myocardial injury corresponds with functional impairment and angiographic disease burden may improve early clinical decision-making, optimise resource utilisation, and enhance patient outcomes.

Therefore, the present prospective observational study was undertaken to evaluate the correlation between serum Troponin-I levels, left ventricular ejection fraction measured by two-dimensional echocardiography, and coronary angiographic findings in patients diagnosed with Acute Coronary Syndrome.

Materials and Methods

Study Design

A prospective observational study was conducted over six months in the Department of Cardiology at RVM Hospital, Telangana, India. The study evaluated the relationship between serum Troponin-I, two-dimensional echocardiographic findings, and coronary angiographic severity among patients diagnosed with Acute Coronary Syndrome (ACS).

Study Population

Adult patients (≥18 years) admitted with ACS, including ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI), and unstable angina (UA), were enrolled consecutively.

Inclusion Criteria

- Adults aged ≥18 years.
- Diagnosis of ACS based on standard clinical guidelines.
- Availability of Troponin-I, echocardiography, and coronary angiography reports.
- Written informed consent.

Exclusion Criteria

- Non-ischaemic causes of Troponin elevation (e.g., myocarditis, sepsis).
- End-stage renal disease on dialysis.
- Pulmonary embolism or aortic dissection.
- Outpatients.

Sample Size

A total of **121 patients** fulfilled the eligibility criteria and were included in the final analysis. The sample size was determined using the RaoSoft sample size calculator with a 95% confidence level and 5% margin of error.

Data Collection

Clinical information was collected from:

- Patient case records
- Laboratory reports (Troponin-I and CK-MB)
- Two-dimensional echocardiography reports
- Coronary angiography reports
- Treating cardiologists' documentation

The following variables were recorded:

- Age and sex
- Cardiovascular risk factors
- Type of ACS
- Troponin-I levels
- Left ventricular ejection fraction (LVEF)
- Coronary angiographic findings
- CK-MB values

Statistical Analysis

Data were analysed using SPSS version 16.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Spearman's rank correlation coefficient was used to evaluate associations between diagnostic parameters. A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study received approval from the Institutional Ethics Committee of Geethanjali College of Pharmacy (Reference No. GCPK/PD25/17 dated 29/08/2025). Written informed consent was

obtained from all participants before enrolment.

Results

Baseline Characteristics

A total of **121 patients** were included in the study. The mean age was **60.50 ± 11.10 years**, with a predominance of males (57%). Hypertension (43%) and diabetes mellitus (37.2%) were the most common cardiovascular risk factors. NSTEMI represented the majority of ACS presentations (75.2%), followed by unstable angina (22.3%) and STEMI (2.5%).

Table 1. Baseline Characteristics of the Study Population (N = 121)

Variable	Value
Mean age (years)	60.50 ± 11.10
Male	69 (57.0%)
Female	52 (43.0%)
Hypertension	52 (43.0%)
Diabetes mellitus	45 (37.2%)
Smoking	8 (6.6%)
Alcohol	13 (10.7%)
Prior MI/PCI/CABG	5 (4.1%)
Family history of CAD	4 (3.3%)
NSTEMI	91 (75.2%)
Unstable Angina	27 (22.3%)
STEMI	3 (2.5%)

Echocardiographic Findings

The mean left ventricular ejection fraction was **46.40 ± 12.08%**. Moderate left ventricular dysfunction was the most common echocardiographic finding (43.8%), followed by normal systolic function (38%). Severe dysfunction was uncommon (3.3%). These findings suggest that many ACS patients present with impaired ventricular function at hospital admission.

Table 2. Echocardiographic Findings

LVEF Category	Patients (%)
Normal	46 (38.0%)
Mild dysfunction	18 (14.9%)
Moderate dysfunction	53 (43.8%)
Severe dysfunction	4 (3.3%)
Mean LVEF	46.40 ± 12.08

Coronary Angiographic Findings

Coronary angiography demonstrated that **single-vessel disease (42.1%)** was the most common angiographic pattern, followed by double-vessel disease (24.0%) and triple-vessel disease (19.8%). Normal coronary arteries were observed in 14% of patients.

Table 3. Coronary Angiographic Findings

Coronary finding	Patients (%)
Normal coronaries	17 (14.0%)
Single-vessel disease	51 (42.1%)
Double-vessel disease	29 (24.0%)
Triple-vessel disease	24 (19.8%)

Correlation Analysis

Troponin-I demonstrated a **significant negative correlation** with left ventricular ejection fraction ($r = -0.191$, $p = 0.036$), indicating that increasing biomarker levels were associated with worsening ventricular systolic function.

A **significant positive correlation** was identified between Troponin-I levels and angiographic severity ($r = 0.301$, $p < 0.001$), suggesting that higher Troponin-I concentrations were associated with increasing coronary vessel involvement.

No statistically significant association was observed between left ventricular ejection fraction and coronary artery disease severity ($r = -0.152$, $p = 0.096$).

CK-MB demonstrated no significant relationship with angiographic severity ($r = 0.169$, $p = 0.063$). However, CK-MB showed a **significant inverse correlation** with left ventricular ejection fraction ($r = -0.377$, $p < 0.001$), indicating that higher CK-MB levels were associated with poorer ventricular function.

Table 4. Correlation Between Diagnostic Variables

Variables	Spearman's r	p-value
Troponin-I vs LVEF	−0.191	0.036*
Troponin-I vs Number of diseased vessels	0.301	<0.001*
LVEF vs CAD severity	−0.152	0.096
CK-MB vs CAD severity	0.169	0.063
CK-MB vs LVEF	−0.377	<0.001*

***Statistically significant ($p < 0.05$).**

Discussion

The present prospective observational study evaluated the relationship between serum Troponin-I levels, left ventricular systolic function assessed by two-dimensional echocardiography, and coronary angiographic severity among patients with Acute Coronary Syndrome (ACS). The findings demonstrate that biochemical evidence of myocardial injury is significantly associated with both ventricular dysfunction and the anatomical extent of coronary artery disease, supporting the complementary role of these diagnostic modalities in the evaluation of ACS.

The study population consisted predominantly of older male patients, with a mean age of 60.50 ± 11.10 years. Hypertension and diabetes mellitus were the most prevalent cardiovascular risk factors, while NSTEMI represented the most frequent clinical presentation. These findings are consistent with contemporary epidemiological studies reporting an increasing incidence of NSTEMI among ageing populations with multiple cardiovascular comorbidities.

Echocardiographic evaluation demonstrated moderate left ventricular dysfunction in nearly half of the patients, with an overall mean ejection fraction of 46.40%. This observation indicates that a substantial proportion of patients experience impaired myocardial contractility at the time of presentation. Early assessment of left ventricular function is clinically important because reduced ejection fraction is associated with increased risks of heart failure, arrhythmias, and mortality following ACS.

Coronary angiography revealed that single-vessel disease was the most common angiographic finding, followed by double- and triple-vessel disease. Approximately one-seventh of patients had angiographically normal coronary arteries, which may represent microvascular dysfunction, coronary vasospasm, or myocardial infarction with non-obstructive coronary arteries (MINOCA). These findings highlight the heterogeneous nature of ACS and reinforce the importance of comprehensive diagnostic evaluation.

One of the most important findings of this study was the statistically significant negative correlation between Troponin-I levels and left ventricular ejection fraction ($r = -0.191$, $p = 0.036$). Although the strength of the correlation was modest, it indicates that higher Troponin-I concentrations are associated with greater myocardial damage and worsening ventricular systolic function. This observation supports previous studies demonstrating that Troponin-I serves not only as a diagnostic biomarker but also as a useful prognostic indicator in ACS.

The study also demonstrated a significant positive correlation between Troponin-I levels and angiographic disease severity ($r = 0.301$, $p < 0.001$). Patients with higher Troponin-I concentrations tended to have more extensive coronary artery involvement. This finding suggests that Troponin-I may indirectly reflect the burden of coronary atherosclerosis and could assist clinicians in identifying patients who require early invasive management.

No statistically significant association was identified between left ventricular ejection fraction and angiographic severity. Functional impairment of the myocardium may not always parallel the anatomical extent of coronary artery disease because ventricular function is influenced by infarct location, collateral circulation, reperfusion therapy, and pre-existing myocardial disease.

CK-MB demonstrated a strong inverse correlation with ejection fraction but did not correlate significantly with angiographic severity. This finding indicates that CK-MB remains a useful marker of myocardial injury but appears less reliable than Troponin-I for estimating the extent of coronary artery disease.

Overall, the present study supports the combined use of Troponin-I, two-dimensional echocardiography, and coronary angiography for comprehensive evaluation of patients with ACS. Each diagnostic modality provides distinct yet complementary information regarding myocardial injury, ventricular function, and coronary anatomy, thereby improving risk stratification and clinical decision-making.

Clinical Implications

- Troponin-I can serve as an early predictor of coronary artery disease severity.
- Routine echocardiography provides valuable prognostic information through assessment of left ventricular function.
- Combining biochemical, functional, and anatomical investigations improves diagnostic accuracy.
- Early identification of high-risk patients may facilitate timely coronary intervention and improve outcomes.

Strengths

- Prospective observational study design.
- Real-world clinical data from a tertiary care hospital.
- Simultaneous evaluation of three major diagnostic modalities.
- Standardised statistical analysis using Spearman correlation.
- Clinically relevant findings applicable to routine cardiology practice.

Limitations

- Single-centre study.
- Relatively small sample size (121 patients).
- Short follow-up period.
- Long-term clinical outcomes were not evaluated.

- Advanced imaging techniques such as cardiac MRI were not included.

Conclusion

The present study demonstrated that serum Troponin-I levels correlate significantly with both left ventricular systolic dysfunction and coronary angiographic severity in patients presenting with Acute Coronary Syndrome. Elevated Troponin-I concentrations were associated with lower ejection fraction and greater coronary vessel involvement, indicating its value as both a diagnostic and prognostic biomarker. In contrast, left ventricular ejection fraction did not demonstrate a significant relationship with angiographic severity, whereas CK-MB primarily reflected myocardial dysfunction. The findings suggest that **Troponin-I, two-dimensional echocardiography, and coronary angiography should be considered complementary investigations rather than competing diagnostic tools**. Their combined use enhances risk stratification, guides therapeutic decision-making, and may contribute to improved clinical outcomes in patients with Acute Coronary Syndrome.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

Ethical Approval

The study was approved by the Institutional Ethics Committee of Geethanjali College of Pharmacy (Reference No. GCPK/PD25/17). Written informed consent was obtained from all participants before enrolment.

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