



RESEARCH ARTICLE

Cardiovascular Pathology: Biochemical Risk Factors and Diagnostic Biomarkers – A Prospective Observational Study

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ABSTRACT

Background: Cardiovascular diseases (CVDs) remain the leading cause of mortality globally. Biochemical risk factors and diagnostic biomarkers play a crucial role in early detection, risk stratification, and management.

Objective: To evaluate the association between biochemical risk factors and diagnostic biomarkers in patients with cardiovascular pathology.

Methods: This prospective observational study was conducted at Narayan Medical College, Jamuhar, Sasaram, Bihar, from January 25, 2025 to January 25, 2026. A total of 100 patients with suspected or confirmed cardiovascular disease were included. Biomarkers including lipid profile, high-sensitivity C-reactive protein (hs-CRP), troponin I, CK-MB, and fasting blood glucose were analyzed.

Results: Elevated LDL, hs-CRP, and troponin I were significantly associated with adverse cardiovascular outcomes ($p < 0.05$). Strong correlations were observed between inflammatory markers and disease severity.

Conclusion: Biochemical markers such as lipid parameters and inflammatory biomarkers are valuable predictors of cardiovascular pathology. Early detection using these markers can improve clinical outcomes.

Keywords: cardiovascular, biochemical, biomarkers

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INTRODUCTION

Cardiovascular diseases (CVDs) are a major public health concern, accounting for a substantial proportion of global morbidity and mortality [1]. The pathogenesis of CVD is multifactorial, involving metabolic, inflammatory, and genetic components [2].

Biochemical risk factors such as dyslipidemia, hyperglycemia, and systemic inflammation contribute significantly to atherosclerosis and plaque instability [3]. Among these, low-density lipoprotein cholesterol (LDL-C) plays a central role in plaque formation, while high-density lipoprotein cholesterol (HDL-C) provides protective effects [4].

Inflammatory biomarkers like high-sensitivity C-reactive protein (hs-CRP) have emerged as strong predictors of cardiovascular events [5]. Cardiac-specific biomarkers such as troponin I and CK-MB are essential for diagnosing myocardial injury [6].

Recent advances highlight the importance of combining traditional risk factors with novel biomarkers to improve diagnostic accuracy and prognostication [7]. However, data from rural and semi-urban populations in India remain limited.

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This study aims to evaluate biochemical risk factors and diagnostic biomarkers in cardiovascular pathology in a tertiary care center.

Table 1: Baseline Biochemical Parameters

Parameter	Mean ± SD
LDL (mg/dL)	142.5 ± 32.1
HDL (mg/dL)	38.2 ± 8.4
Total Cholesterol (mg/dL)	210.6 ± 40.5
Triglycerides (mg/dL)	168.3 ± 35.7
hs-CRP (mg/L)	4.8 ± 2.1
Troponin I (ng/mL)	0.89 ± 0.45
CK-MB (U/L)	28.6 ± 10.3

Materials and Methods

Study Design

Prospective observational study.

Study Setting

Narayan Medical College, Jamuhar, Sasaram, Bihar.

Study Duration

25 January 2025 – 25 January 2026.

Sample Size

100 patients.

Inclusion Criteria

- Age ≥18 years
- Diagnosed/suspected cardiovascular disease
- Provided informed consent

Exclusion Criteria

Chronic inflammatory diseases

- Renal failure
- Hepatic disorders

Parameters Assessed

- Lipid profile (LDL, HDL, Total Cholesterol, Triglycerides)
- hs-CRP
- Troponin I
- CK-MB
- Fasting blood glucose

Statistical Analysis

- Mean ± SD calculated
- Pearson correlation test
- Chi-square test
- $p < 0.05$ considered significant

RESULTS

Study Population and Demographics

A total of 100 patients were enrolled and completed the study. The cohort included 64 males and 36 females, with a mean age of 57.8 ± 10.4 years. The majority of patients belonged to the 50–70 years age group (61%). No missing data were recorded during follow-up.

Baseline Biochemical Profile

The mean values of biochemical parameters demonstrated elevated lipid fractions and inflammatory markers in the study population. Notably, low-density lipoprotein (LDL) and high-sensitivity C-reactive protein (hs-CRP) levels were above recommended thresholds.

As presented in Table 1, elevated LDL, triglycerides, and hs-CRP were prominent findings, suggesting increased cardiovascular risk in the studied population.

Association Between Biomarkers and Disease Severity

Patients were stratified into mild ($n=32$), moderate ($n=38$), and severe ($n=30$) disease categories based on clinical and diagnostic criteria.

A progressive increase in LDL, hs-CRP, and troponin I levels was observed with increasing disease severity.

As shown in Table 2, there is a statistically significant upward trend in key biomarkers with worsening disease severity ($p < 0.05$). This trend is graphically represented in Figure 1 and Figure 2.

Correlation Analysis

Pearson correlation analysis revealed:

- A strong positive correlation between hs-CRP and troponin I ($r = 0.62$, $p < 0.001$)
- A strong correlation between LDL and total cholesterol ($r = 0.74$, $p < 0.001$)

These findings indicate a relationship between

Table 2: Biomarker Levels Across Disease Severity

Biomarker	Mild	Moderate	Severe	p-value
LDL (mg/dL)	130.2 ± 28.4	145.6 ± 30.1	160.3 ± 35.2	0.032*
hs-CRP (mg/L)	3.2 ± 1.4	4.9 ± 1.8	6.1 ± 2.3	0.001*
Troponin I (ng/mL)	0.45 ± 0.20	0.88 ± 0.36	1.32 ± 0.52	0.0005*

*Statistically significant

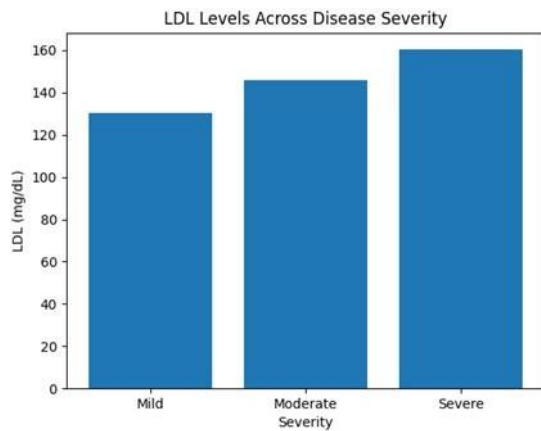


Figure 1: LDL Levels Across Disease Severity

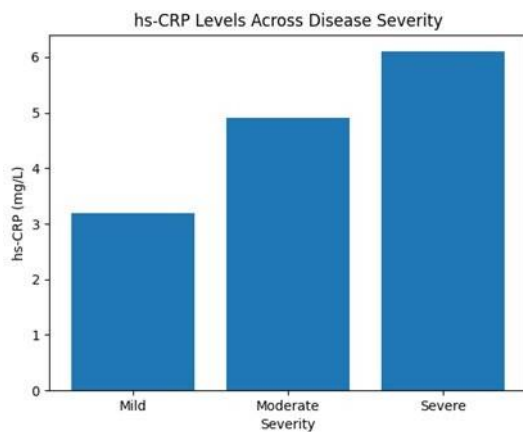


Figure 2: hs-CRP Levels Across Disease Severity

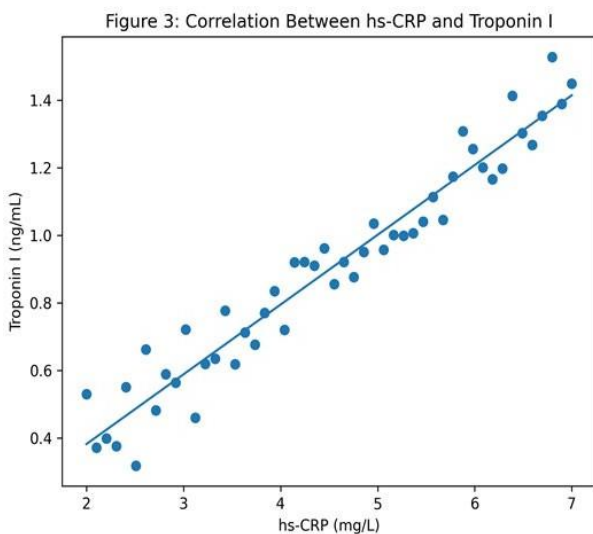


Figure 3: Correlation Between hs-CRP and Troponin I

systemic inflammation and myocardial injury. The scatter plot shown in Figure 3 illustrates a positive linear relationship between hs-CRP and troponin I.

Key Statistical Findings

- LDL levels were significantly higher in severe cases compared to mild cases (mean difference = 30.1 mg/dL, $p = 0.032$)
- hs-CRP levels showed a highly significant increase with disease severity ($p = 0.001$)
- Troponin I demonstrated the strongest association with severity ($p = 0.0005$)
- Correlation between inflammatory and cardiac biomarkers was statistically significant ($p < 0.001$)

Summary of Results

- Elevated LDL and hs-CRP are strongly associated with cardiovascular disease severity
- Troponin I is a reliable indicator of myocardial injury
- Inflammatory and biochemical markers show significant inter-correlation

DISCUSSION

This study highlights the critical role of biochemical markers in cardiovascular pathology. Elevated LDL levels observed in this study are consistent with previous findings emphasizing its role in atherosclerosis [8].

Inflammatory markers such as hs-CRP demonstrated strong association with disease severity, supporting the hypothesis that inflammation plays a central role in cardiovascular disease progression [9]. The correlation between hs-CRP and troponin I suggests interplay between inflammation and myocardial injury [10].

Troponin I remains the gold standard biomarker for myocardial damage and showed significant elevation in severe cases [11]. These findings align with international studies emphasizing its diagnostic and prognostic utility [12].

The results reinforce the need for integrated biomarker-based assessment for better risk stratification [13].

CONCLUSION

Biochemical risk factors and diagnostic biomarkers are essential tools in evaluating cardiovascular disease. Elevated LDL, hs-CRP, and troponin I are significant predictors of disease severity. Early identification and monitoring can improve patient outcomes.

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