



Correlation between highly sensitive troponin I and lipid profile in patient of myocardial infarction (MI) in case-control study.

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Abstract

Background

Myocardial infarction (MI) remains a leading cause of morbidity and mortality worldwide. Dyslipidemia is a major risk factor for coronary artery disease. High-sensitivity cardiac Troponin I (hs-cTnI) is a specific biomarker of myocardial injury.

Aim

To evaluate the correlation between high-sensitivity cardiac Troponin I and lipid profile parameters in patients with myocardial infarction.

Methods

This hospital-based case-control study was conducted at Indira Gandhi Institute of Medical Sciences, Patna, from October 2022 to March 2023. A total of 120 participants were enrolled, including 50 MI cases and 70 healthy controls. Serum lipid profile and hs-cTnI levels were measured using standardized laboratory methods. Statistical analysis was performed using an independent t-test and Pearson correlation analysis.

Results

Mean total cholesterol, triglycerides, LDL, and VLDL levels were significantly higher among cases compared to controls ($p < 0.0001$), while HDL levels were significantly lower ($p < 0.0001$). The mean hs-cTnI level among cases was 534.5 ± 224.1 pg/ml compared to 1.572 ± 1.445 pg/ml in controls ($p < 0.0001$). A strong positive correlation was observed between hs-cTnI and total cholesterol ($R^2 = 0.8612$), triglycerides ($R^2 = 0.9155$), and LDL ($R^2 = 0.4109$), while HDL showed a negative correlation ($R^2 = 0.1706$). Elevated hs-cTnI was observed in 46 out of 50 cases.

Conclusion

High-sensitivity cardiac Troponin I levels are significantly associated with deranged lipid parameters in MI patients. Routine lipid screening may help identify individuals at risk, especially in resource-limited settings.

Keywords: Myocardial infarction, Lipid profile, High-sensitivity cardiac Troponin I (hs-cTnI)

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Introduction

Chest pain is one of the most common reasons for hospital admission worldwide (1). Major risk factors of coronary heart disease are hypertension, diabetes, hyperlipidemia, obesity, etc. Increased levels of low-density lipoprotein (LDL), triglycerides (TG), and total cholesterol (TC), and decreased levels of high-density lipoprotein (HDL) are indicative of increased incidence of cardiac events (2). Raised LDL is highly atherogenic as it could oxidise and initiate atheroma formation (3,4). There is a reduction of blood flow to the heart because of atherosclerotic plaques in the wall of the coronary artery. Cardiac troponin T and I have emerged as cardiac biomarkers of choice for the diagnosis of acute myocardial

infarction over the past 10 years (5). Now there is an emergence of highly sensitive troponin I (hs c Tn I) assay in the diagnostic use (6,7), which allows earlier detection of myocardial injury and improved accuracy over already established (8,9) assay for the diagnosis of acute myocardial infarction. hs-cTn I am now recommended over conventional assays for clinical use. hs-cTn I value above the 99th percentile is indicative of myocardial injury (10). Availability of a new generation of highly sensitive assays enables detection of low concentrations of circulating cardiac troponin (11). Cardiac troponin I is a specific biomarker of myocardial injury and has a role in the management of chest pain (12, 13). High-sensitivity cardiac troponin I assays have been used clinically



in many countries since their clinical introduction for the early diagnosis of myocardial infarction. Highly sensitive cardiac troponin assays are simple, inexpensive, and highly reproducible tools complementing the clinical assessment of chest pain (14). Highly sensitive cardiac troponin I (hs-cTn) assays allow the precise quantification of cardiomyocyte injury around the 99th percentile and increase the accuracy of MI detection (15), as the negative predictive value of highly sensitive troponin I is 99.6% (16)

Therefore, this study aimed to evaluate the correlation between high-sensitivity cardiac Troponin I and lipid profile parameters in patients with myocardial infarction.

Material and methods

Study Design

This was a hospital-based case-control study.

Study Setting

The study was conducted at Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, a tertiary care teaching hospital in Bihar, India, from October 2022 to March 2023.

Participants

A total of 120 participants were enrolled in the study, including 50 patients diagnosed with myocardial infarction (cases) and 70 apparently healthy individuals (controls).

Cases were selected from the Department of Cardiology based on clinical diagnosis of myocardial infarction supported by elevated high-sensitivity cardiac Troponin I (hs-cTnI) levels. Controls were selected from patient attendants without any history of cardiovascular disease to ensure a comparable socioeconomic background.

Inclusion Criteria

Patients diagnosed with myocardial infarction based on clinical evaluation and elevated hs-cTnI levels.

Age \geq 18 years.

Individuals who provided written informed consent.

Exclusion Criteria

- Patients with a history of chest trauma.

- Patients with known chronic inflammatory or systemic diseases affecting lipid metabolism.
- Individuals on lipid-lowering therapy.
- Individuals who declined to provide informed consent.
- Individuals who did not meet the eligibility criteria were excluded from the study.

Study Size

Sample size was calculated using Cochran's formula:

$$n = \frac{Z^2 pq}{d^2} = \frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} = 784$$

where $Z = 1.96$ at 95% confidence level, $p =$ estimated prevalence, $q = 1 - p$, and $d =$ margin of error (5%). Based on this calculation, 120 participants were considered adequate for statistical analysis.

Data Collection

Five milliliters of venous blood were collected from each participant under aseptic conditions. hs-cTnI was estimated using Chemiluminescent Microparticle Immunoassay (CMIA) on the Abbott Architect i1000 immunoassay analyzer. Lipid profile parameters (Total Cholesterol, Triglycerides, LDL, HDL, and VLDL) were analyzed using enzymatic colorimetric methods on the Beckman Coulter AU5800 analyzer.

Internal quality control (Bio-Rad) and external quality assurance programs (CMC Vellore) were maintained throughout the study. The same laboratory procedures and instruments were used for both cases and controls to ensure comparability.

Bias

Selection bias was minimized by enrolling consecutive eligible cases during the study period. Measurement bias was reduced by using standardized laboratory protocols and calibrated analyzers.

Statistical Analysis

Statistical analysis was performed using GraphPad Prism version 8. Data were expressed as Mean \pm Standard Deviation (SD). An independent t-test was used to compare biochemical parameters between cases and controls. Pearson correlation analysis was performed to determine the relationship between lipid profile parameters and hs-cTnI levels. A p-value < 0.05 was considered statistically significant.

Ethical Consideration

Ethical approval was obtained from the Institutional Ethics Committee, IGIMS Patna (Approval No: 728/IEC/IGIMS/2022). Written informed consent was obtained from all participants before enrollment.

Results

A total of 135 individuals were screened for eligibility, of which 120 met the inclusion criteria and were enrolled in the study (50 cases and 70 controls). All enrolled participants completed the study and were included in the final analysis.

Table 1: Comparison of lipid profile parameters and hs-cTnI levels between cases and controls

S.N.	Variables	Cases	Control	P value
1.	Total cholesterol(mg/dl)	196±22.2	151.2±29.62	<0.0001
2.	HDL(mg/dl)	39.72 ± 5.36	48.74± 8.514	<0.0001
3.	LDL	114.2± 15.61	93.04± 23.20	<0.0001
4.	Triglycerides	165.3 ±24.08	126.2± 40.23	<0.0001
5.	VLDL(mg/dl)	33.06± 4.73	23.82± 6.95	<0.0001
6.	Hs TROP I(pg/ml)	534.5± 224.1	1.572 ±1.445	<0.0001

Descriptive Characteristics

The study included 50 myocardial infarction patients (cases) and 70 healthy controls. All biochemical parameters were

successfully analyzed for all participants. There were no missing data for any lipid profile or hs-cTnI measurements.

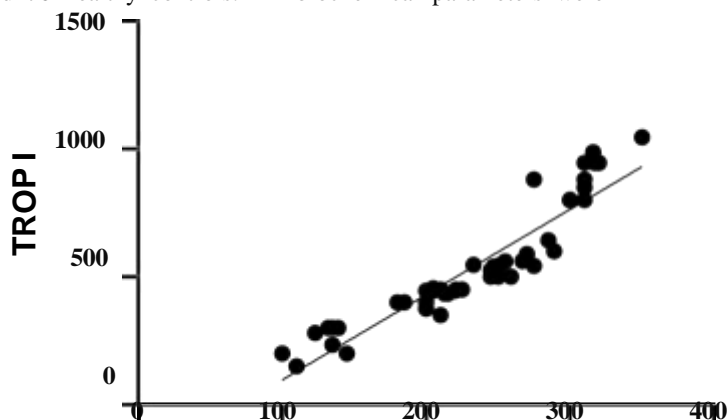


Fig 1: Pearson correlation coefficient analysis between total cholesterol and highly sensitive troponin I (p<0.0001).

Pearson correlation analysis was performed to establish relationship between highly sensitive troponin I lipid

parameters in cases. In total cholesterol versus hsTnI, positive correlation was obtained with coefficient of determination, R² being 0.8612 and 95% confidence interval ranges from 0.8759 to 0.9567(p value<0.0001)

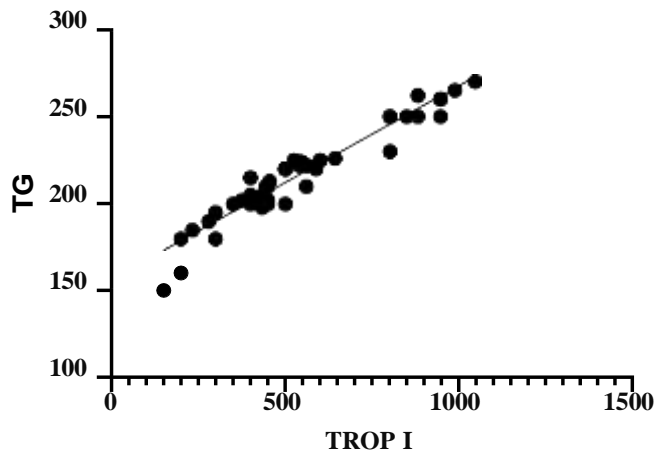


Fig 2: Pearson correlation coefficient analysis between triglycerides and highly sensitive troponin I (p<0.0001).

In triglyceride versus hsTnI, positive correlation was obtained with coefficient of determination, R^2 being 0.9155 and 95% confidence interval ranges from 0.9248 to 0.9754(p value<0.0001)

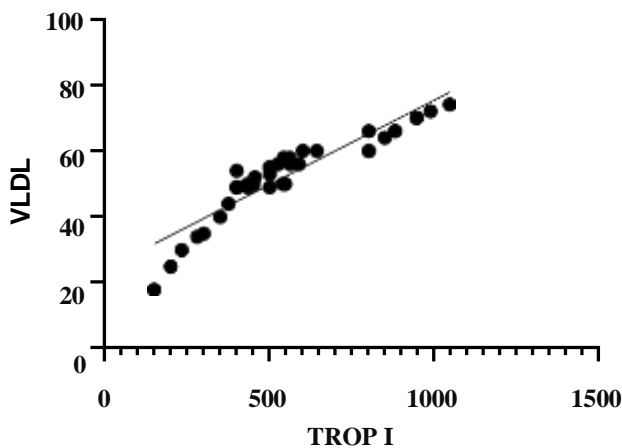


Fig 3: Pearson correlation coefficient analysis between VLDL and highly sensitive troponin I (p<0.0001).

In VLDL versus hsTnI, positive correlation was obtained with coefficient of determination, R being 0.8529 and 95% confidence interval ranges from 0.9248 to 0.9754(p value<0.0001)

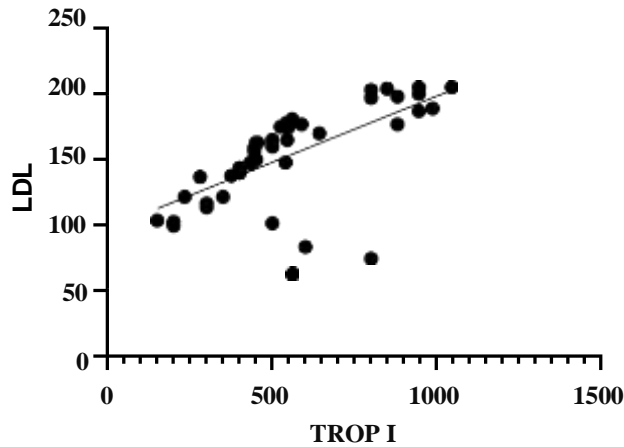


Fig 4 : Pearson correlation coefficient analysis between LDL and highly sensitive troponin I ($p < 0.0001$).

In LDL versus hsTnI, positive correlation was obtained with coefficient of determination, R^2 being 0.4109 and 95% confidence interval ranges from 0.4414 to 0.7801 (p value < 0.0001)

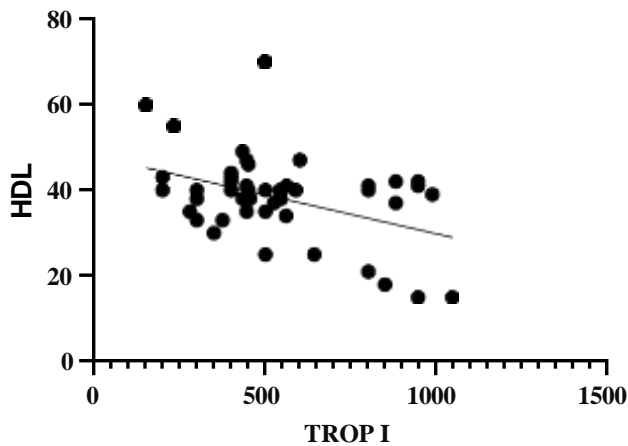


Fig 5 : Pearson correlation coefficient analysis between HDL and highly sensitive troponin I ($p < 0.0001$).



In HDL versus hsTnI, a negative correlation was obtained with a coefficient of determination, R^2 , being 0.1706, and 95% confidence interval ranging from -0.6201 to -0.1521 (p value 0.0029).

Table 1 shows different lipid parameters and the quantitative value of highly sensitive troponin I among cases and controls. Out of 50 cases of myocardial infarction, 46 cases had an increased level of highly sensitive troponin I and an elevated lipid profile. Among the 70 controls, 68 participants had normal high-sensitive troponin I and lipid profile. The differences in various lipid parameters among cases and controls were compared with highly sensitive troponin I in Table 1. Significant differences were observed among two groups of subjects. Among the cases, TC, TG, and LDL were increased with increased highly sensitive troponin I than in the control with normal highly sensitive troponin I. HDL level of the cases with increased hsTnI was significantly lower than that of controls (Table 1). 46 out of 50 cases have increased levels of LDL, TG, and TC, along with increased quantitative value of hsTnI. The mean total cholesterol level (TC) of the cases with increased hsTnI (196 ± 22.2) was slightly below the recommended desirable level (200mg/dl) (17). The level of TC among controls with normal hsTnI (151.2 ± 29.62) was significantly lower than that of cases with increased hsTnI, confirming the importance of maintaining the TC level below the recommended level. Similarly, the mean TG level of cases with increased hsTnI (165.3 ± 24.08) was above the desirable level (< 150 mg/dl), and the level of TG in controls with normal hsTnI was 126.2 ± 40.23 , which was less than the normal level. The mean LDL level of cases with increased hsTnI was 114.2 ± 15.61 , which was more than the recommended desirable level of 100 mg/dl (17), and the mean LDL level among controls with normal hsTnI was 93.04 ± 23.20 .

Discussion:

The present study demonstrated a significant association between high-sensitivity cardiac Troponin I and lipid profile parameters in patients with myocardial infarction. A strong positive correlation was observed between hs-cTnI and total cholesterol ($R^2 = 0.8612$, $p < 0.0001$), triglycerides ($R^2 = 0.9155$, $p < 0.0001$), and LDL cholesterol ($R^2 = 0.4109$, $p < 0.0001$). Conversely, HDL cholesterol showed a statistically

significant negative correlation ($R^2 = 0.1706$, $p = 0.0029$).

Elevated hs-cTnI levels reflect myocardial injury, while deranged lipid parameters contribute to atherosclerotic plaque

formation and coronary artery obstruction. The findings suggest that patients with abnormal lipid profiles are more likely to present with greater myocardial damage, as indicated by elevated hs-cTnI levels.

Similar observations have been reported in previous studies, which demonstrated that patients with positive troponin levels tend to have significantly elevated total cholesterol, triglycerides, and LDL levels along with reduced HDL levels.

In a study, it was found that in 50 cases, the quantitative value of highly sensitive troponin was increased because the negative predictive value of hsTnI is very high, so it can rule out or rule in the cases of myocardial infarction very accurately. In the previous study by Arun Kumar et al in 2012 (17), they found that 740 patients presented to the emergency department with

Symptoms of cardiac ischemia that underwent both troponin and lipid profiles tests were compared with the lipid profiles of 411 normal healthy subjects (controls). The troponin was detected qualitatively when a specimen contains TnI above the 99th percentile ($TnI > 0.5$ ng/mL). The total cholesterol (TC), high-density lipoproteins (HDL), very low-density lipoproteins (VLDL), and Triacyl glycerol (TG) levels were also analyzed, and the low-density lipoprotein level (LDL) was calculated using Friedewald's formula. Results: Patients with chest pain and a positive troponin test (with confirmed cardiac event) were found to have significantly elevated levels of TC, TG, and LDL and significantly reduced HDL levels when compared to the patients who experienced only chest pain (negative troponin) and healthy controls, they found that out of the 740 subjects with the chest pain tested for the presence of troponin in the serum qualitatively, only 101 (13.6%) subjects were detected positive. A larger proportion of the subjects (86.4%) were found to be troponin negative.

Thus, our data indicates that the quantitative value of hsTnI was increased in every case of MI. And 46 cases have abnormal lipid profiles with increased hsTnI. Highly sensitive cardiac troponin Assays are simple, inexpensive, and highly reproducible tools complementing the clinical assessment of chest pain. Highly sensitive cardiac troponin I (hs-cTn) assays allow the precise quantification of cardiomyocyte injury around the 99th percentile and increase the accuracy of MI detection. In the present study, the relationship between the levels of parameters of lipid profile and the quantitative value of highly sensitive troponin I in patient of Myocardial infarction (MI) was studied, and found that 46 out of 50 cases have increased levels of LDL, TG, and TC along with increased quantitative value of hsTnI. In this study, it was found that the quantitative value of highly sensitive troponin I is positively correlated with total cholesterol, triglycerides,



low-density lipoprotein, and very low-density lipoprotein, and negatively correlated with high-density lipoprotein. In the previous study by S. P. Tejaswi Pullakanam et al in 2021(18), they found that in a retrospective study.

A study of 250 patients presented to the emergency department with symptoms of cardiac ischemia who underwent both troponin-I and lipid profiles tests were compared with the lipid profiles of 100 normal healthy subjects (controls). The troponin-I was detected quantitatively in a specimen. contains troponin I above the 99th percentile (TnI >0.3 ng/ml). The total cholesterol, high-density lipoproteins cholesterol, very low-density lipoproteins, and triacylglycerol levels were also analyzed, and low-density lipoprotein cholesterol level was calculated using Friedewald's formula. Patients with chest pain and a positive troponin-I test (with confirmed cardiac event) were found to have significantly elevated levels of total cholesterol, triacylglycerols, low density lipoprotein cholesterol level and significantly reduced high density lipoproteins cholesterol levels when compared to the patients who experienced only chest pain with (negative troponin-I) and healthy controls. Thus, the result of this study is similar to the study of S. P. Tejaswi Pullakanam et al.

Conclusion

From the present study, it is finally concluded that highly sensitive cardiac troponin I is very important for the diagnosis of Myocardial infarction. It is not only helpful for the diagnosis but also important for the prognosis of the patient. The higher the value of highly sensitive troponin I, worst is the prognosis. Myocardial infarction is best diagnosed by an increased value of highly sensitive troponin I, which is a highly sensitive investigation for MI. Hs TnI has a very high negative predictive value, so it can rule out or rule in the cases of MI. Highly sensitive troponin I is positively correlated with total cholesterol, triglyceride, and low-density lipoprotein and negatively correlated with high-density lipoprotein. Hence deranged lipid profile can be used as an indicator for the risk of MI and help in screening for heart disease, especially in a peripheral small hospital where the hs Tp I estimation facility is not available. Highly sensitive cardiac troponin I is reported in ng/L or pg/L and provides identical information as conventional assays (reported in µg/L), but hsTn I allows precise differentiation between normal and mildly elevated cardiac troponin. (20). Therefore, highly sensitive cardiac troponin I detects a relevant proportion of patients with previously undetectable cardiac troponin concentrations with conventional assays. Highly sensitive cardiac troponin I assays are more cardiac-specific than traditional methods. Serial highly sensitive cardiac troponin I measurements have major

potential to improve the identification of patients with coronary heart disease and to guide the treatment.

Recommendation

Routine lipid profile screening should be encouraged in individuals at high risk of cardiovascular disease. Availability of high-sensitivity cardiac Troponin I testing in peripheral healthcare centers may improve early diagnosis and management of myocardial infarction.

Limitations

The study had a relatively small sample size and was conducted at a single center. Long-term follow-up of patients was not performed. Larger multicenter studies are required to validate these findings.

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Conflict of Interest

The authors declare no conflict of interest.

Source of Funding

This study did not receive any external funding.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions

RR – Concept and data collection
PA – Laboratory analysis
DK – Statistical analysis
RK – Supervision and manuscript review
KP – Data interpretation

List of Abbreviations

MI – Myocardial Infarction
hs-cTnI – High-sensitivity cardiac Troponin I
TC – Total Cholesterol



LDL – Low-Density Lipoprotein
HDL – High-Density Lipoprotein
TG – Triglycerides
VLDL – Very Low-Density Lipoprotein

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