DOI: https://doi.org/10.54393/pjhs.v5i09.2039

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (P): 2790-9352, (E): 2790-9344
Volume 5, Issue 9 (September 2024)

Original Article

OPEN ACCESS

Correlation Between Complexity of Coronary Lesions and Delta High-sensitivity Troponin (hs-cTn) I Levels in Patients of Non-ST Elevation Myocardial Infarction

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ARTICLE INFO

Keywords:
Non-ST Elevation Myocardial Infarction, Syntax Score, Coronary Lesion, Myocardial Injury

How to Cite:
Azam, M. H., Wahab, M. A., Danish, N., Taha, M., Naeem, S. ., & Muhammad, S. K. . (2024). Correlation Between Complexity of Coronary Lesions and Delta High-sensitivity Troponin (hs-cTn) I Levels in Patients of Non-ST Elevation Myocardial Infarction : Complexity of Coronary Lesions and Delta High-sensitivity Troponin I in Non-ST Elevation Myocardial Infarction . Pakistan Journal of Health Sciences (Lahore), 5(09). https://doi.org/10.54393/pjhs.v5i09.2039

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Received Date: 17th August, 2024
Acceptance Date: 28th September, 2024
Published Date: 30th September, 2024

ABSTRACT

Non-ST Elevation Myocardial Infarction is a critical condition where early identification of myocardial injury is essential for risk stratification and treatment. High-sensitivity cardiac troponin I (hs-cTnI) is a well-established biomarker for detecting myocardial damage. **Objective:** To assess the association between Syntax scores and initial significant delta hs-cTnI in patients who had been hospitalized with Non-ST Elevation Myocardial Infarction. **Methods:** Observational cohort study from January 2022 to December 2022 involving a total of one hundred and fifty patients admitted at Hayatabad Medical Complex Peshawar. hs-cTnI on admission and at 1, 2 hours and between (6h-12 h) post-admission daily was measured. Coronary lesion complexity was assessed with Syntax scores according to the results of coronary angiography. Statistical Analysis of data was performed using Pearson correlation to analyze the association between syntax scores delta hs-cTnI levels. **Results:** SYNTAX scores were correlated with Δhs-cTnI levels at all-time points, and the strongest correlation was found 6-12 hours post-admission (r=0.78). The syntax score had a mean value of 24.11 ± 14.74, and hs-cTnI levels increased over time to reflect the extent of myocardial injury. **Conclusions:** It was concluded that in Non-ST Elevation Myocardial Infarction patients, Syntax scores demonstrating more complex coronary lesions are related to higher delta hs-cTnI levels. This value highlights the use of hs-cTnI as a biomarker to evaluate the severity of myocardial injury and direct clinical decision-making in Non-ST Elevation Myocardial Infarction. Delta hs-cTnI measurements in diagnostic and risk stratification algorithms may lead to enhanced early identification of disease with improved outcomes.

INTRODUCTION

Non-ST Elevation Myocardial Infarction (NSTEMI) is a cardiac condition that is characterized by the absence of ST-segment elevation on electrocardiograms, without discharges myocardial necrosis markers such as High-sensitivity cardiac troponin I (hs-cTnI). The complexity of coronary lesions in NSTEMI patients and their association with significant elevations in delta hs-cTn I are coming into increasing prominence as important topics for study. The diagnosis and assessment of risk in acute coronary syndrome (ACS) have been revolutionized by high-sensitivity cardiac troponins such as hs-cTnI and High-sensitivity cardiac Troponin T (hs-cTnT), which have even greater sensitivity and prognostic value than conventional assays [1-3]. Thus, high-sensitivity troponin assays can detect myocardial injury sooner and better delineate the severity as well as prognosis of NSTEMI. High-sensitivity troponins have been shown to detect other conditions beyond MI and are strong predictors of future adverse cardiovascular events. The consequence of this increased sensitivity, however, is a decreased specificity including in patients with comorbidities that may also increase troponin levels independent of acute coronary syndromes

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[4-6]. Coronary lesion complexity, quantified by coronary angiography and other methods is related to hs-cTn levels. However, larger more complicated lesions usually are related to higher levels of hs-cTn, which probably represents a greater amount of myocardial damage. Such a relationship, that myocardial infarction without ST-segment elevation (NSTEMI) presentations are expected to be more reliably assessed for prognosis and most appropriate treatment strategies by thorough coronary evaluation [7, 8]. Early and accurate detection of hs-cTn changes, particularly delta hs-cTn I am important for the diagnosis and risk stratification of NSTEMI. Research has shown that the highest percentage of early rises in hs-cTn is tightly linked with a negative prognosis for morbidity and mortality, particularly heart failure (HoF) or major adverse cardiovascular events (MACE). This underscores the importance of early and frequent hs-cTn measurements for risk assessment into diagnosis [8, 9]. To use hs-cTn assays in clinical practice, clinicians should carefully evaluate the type of assay used and correlate it with the patient's context. To more quickly exclude and confirm NSTEMI, the ESC recommends a 0/1-h algorithm that has worked well across backgrounds other than issues with comorbidities or atypical presentations [10-12]. Use of hs-cTn in NSTEMI Recent studies refining practice. This could result, for example in operating characteristics such as sensitivity and specificity being improved by optimizing cutoff values for hs-cTn leading to a reduction of futile interventions or hospitalizations at the same time [13]. In addition, new generation hs-cTn assays are being designed to further improve diagnostic precision and prognostic value [14, 15]. How the complexity of coronary lesions correlates with delta hs-cTn I levels in NSTEMI patients may provide more information for accurate diagnosis, risk stratification and patient prognosis. Toward this end, high-sensitivity troponin assays (particularly hs-cTnI) are invaluable tools to be used wisely but not without recognition of the ongoing research and clinical vigilance that will continue until their potential benefits are finally realized in conjunction with all limitations addressed.

This study aims to assess the association between Syntax scores and initial significant delta hs-cTnI in patients who had been hospitalized with Non-ST Elevation Myocardial Infarction.

METHODS

An observational cohort study was conducted and sampling technique used in this study was convenience sampling. Patients admitted to the Hayatabad Medical Complex, Peshawar, with a confirmed diagnosis of NSTEMI during the study period (January 2022 to December 2022) were consecutively enrolled. The study protocol was approved by the Institutional Review Board of Hayatabad Medical Complex, Peshawar (Reference number: 1025), and informed consent was obtained from all participants before their inclusion in the study, adhering to ethical standards and the Declaration of Helsinki. A total of 150 patients presenting with NSTEMI were included in the study. The inclusion criteria required patients to be 18 years or older, with a diagnosis of NSTEMI confirmed through clinical assessment, electrocardiogram (ECG) changes, and elevated hs-cTnI levels. Additionally, all participants were required to provide informed consent. Exclusion criteria applied to patients with STEMI, those with chronic kidney disease stage IV or higher, and individuals with other conditions that could lead to elevated troponin levels, such as myocarditis or pulmonary embolism. Clinical data collected included demographic information such as age, gender, and medical history, along with risk factors like hypertension, diabetes mellitus, smoking status, and previous history of coronary artery disease. Clinical presentation details, including symptom onset, duration, and type of chest pain, were also recorded. Laboratory measurements involved blood samples collected on admission, as well as at 1 hour, 2 hours, and 6-12 hours post-admission, to assess hs-cTnI levels using the Abbott Architect STAT hs-cTnI assay, with the 99th percentile upper reference limit for a healthy population used for interpretation. All patients underwent coronary angiography within 24 hours of admission, and the complexity of coronary lesions was assessed using the Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery (SYNTAX) score, which evaluates the extent and severity of coronary artery disease based on anatomical criteria. To properly cite references for sample size calculations and justify your methods, you can use relevant sources from literature focused on statistical analysis and sample size determination for correlation studies, specifically in clinical research. Below are a few potential sources you can use, along with a short description of their relevance: The sample size for this study was calculated based on the primary outcome of the correlation between coronary lesion complexity (SYNTAX score) and delta hs-cTnI levels. A power analysis was conducted to ensure an adequate sample size for detecting a significant correlation. Using a power of 80% (1-β=0.80) and an alpha level of 0.05 (two-tailed), we assumed a moderate effect size (r=0.30) based on previous studies . According to standard sample size calculation formulas for correlation studies , the resulting sample size required to detect a significant correlation was 138 patients. To account for potential dropouts and incomplete data, the final sample size was increased to 150 patients. Data Analysis Continuous variables were expressed as mean ± standard deviation (SD) or median (interquartile range), while categorical variables were presented as frequencies and percentages. Pearson or Spearman correlation coefficients were used to examine

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the relationship between SYNTAX scores and delta hs-cTnI levels, depending on data distribution, with statistical significance set at a p-value below 0.05. SPSS version 25.0 (IBM) was utilized for data analysis. To ensure accuracy and reproducibility, all laboratory measurements were performed in duplicate, and data entry and statistical analyses were independently verified by researchers to minimize errors.

RESULTS

The patient population had a mean age of approximately 60 years (59.91 ± 11.75 years), with the majority being male (65%). The prevalence of hypertension, diabetes mellitus, smoking, and previous coronary artery disease (CAD) was 57%, 71%, 36%, and 51%, respectively (Table 1).

Table 1: Demographic Characteristics of Patients (n=150)

Parameter	Mean ± SD	Frequency (%)
Age (Years)	59.91 ± 11.75	-
Gender	-	Male: 65%
Hypertension	-	57%
Diabetes	-	71%
Smoking	-	36%
Previous CAD	-	51%

The hs-cTnI levels showed a significant increase over time, from admission to 6-12 hours post-admission. On admission, the mean hs-cTnI level was 27.34 ng/L, which increased to 111.53 ng/L at 6-12 hours post-admission (Table 2).

Table 2: High-sensitivity Troponin I Levels (ng/L) (n=150)

Time Point	Mean ± SD	Minimum	Maximum
Admission	27.34 ± 14.32	0.12	49.97
1 Hour	54.96 ± 27.56	10.02	99.67
2 Hours	87.44 ± 38.78	20.13	148.72
6-12 Hours	111.53 ± 46.29	31.54	198.87

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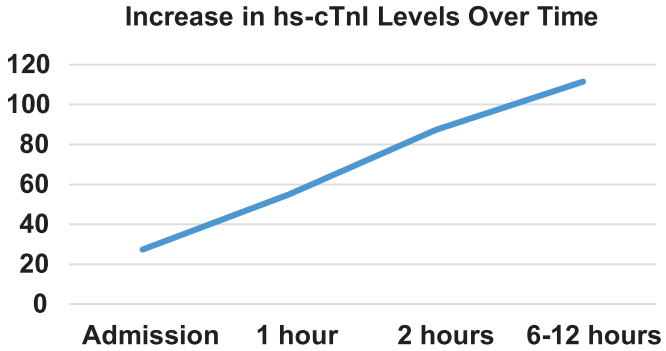

Figure 1: Increase in hs-cTnI Levels Over Time

The complexity of coronary lesions, as assessed by the SYNTAX score, indicated a wide range of lesion complexities among the patients. The mean SYNTAX score was 24.11 ± 14.74 (Table 3).

Table 3: SYNTAX Scores (n=150)

Parameter	Value
Mean ± SD	24.11 ± 14.74
Minimum	0
Maximum	49

The correlation between SYNTAX scores and delta hs-cTnI levels was examined at various time points, and p-values were calculated to determine the statistical significance of the observed correlations. A significant positive correlation was found between the complexity of coronary lesions (SYNTAX score) and delta hs-cTnI levels at all-time points, with the strongest correlation observed at 6-12 hours post-admission (r=0.78, p<0.001) (Table 4).

Table 4: Correlation Between SYNTAX Scores and Delta hs-cTnI Levels (n=150)

Time Point	Correlation Coefficient	p-value
Delta hs-cTnI 1 Hour	0.65	<0.001
Delta hs-cTnI 2 Hours	0.72	<0.001
Delta hs-cTnI 6-12 Hours	0.78	<0.001

The correlation between SYNTAX scores and delta hs-cTnI levels was examined at various time points, and p-values were calculated to determine the statistical significance of the observed correlations (Figure 2).

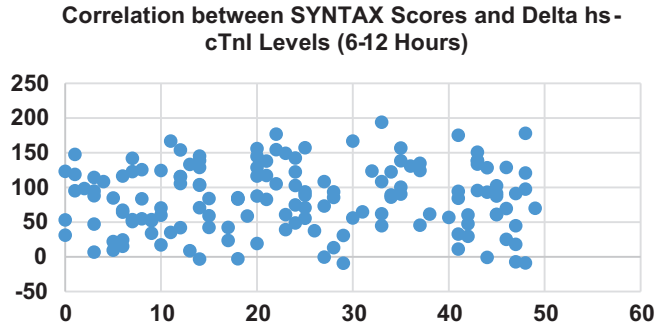

Figure 2: Correlation Between Delta hs-cTnI 6-12hr and SYNTAX Score

The relationship between hs-cTnI levels and patient characteristics, including age, smoking status, and diabetes status, was analyzed using Pearson correlation tests. The correlation between age and hs-cTnI levels at admission (r=0.005) and 6-12 hours (r=-0.034) was negligible, indicating no significant relationship between age and troponin levels. Smoking status demonstrated a weak negative correlation with hs-cTnI levels at admission (r=-0.039) and a weak positive correlation at 6-12 hours (r=0.012), suggesting minimal influence of smoking on troponin levels. Similarly, diabetes status showed a weak positive correlation with hs-cTnI levels at admission (r=0.117) and 6-12 hours (r=0.074), though the association was not strong enough to be considered clinically significant (Table 5).

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Table 5: Correlation Between Patient Characteristics and hs-cTnI Levels (n=150)

Variable	Correlation with hs-cTnI at Admission	Correlation with hs-c TnI at 6-12 Hours
Age	0.005	-0.034
Smoking Status	-0.039	0.012
Diabetes Status	0.117	0.074

DISCUSSION

This study aimed to assess the complexity of coronary lesions and significantly higher levels of hs-cTnI in patients at the time of admission in NSTEMI patients. Conclusion The functional relationship between the delta hs-cTn1 levels at different time points (1 h, 2 h and 6-12 h post-admission) following PCI for significant CAD predicted by SYNTAX scores that assess coronary lesion complexity is optimistically moderate to strong. This was particularly strong between 6 and up to 12 hours. Overall, these results imply that the higher complexity of coronary lesions is accompanied by a more pronounced increase in hs-cTnI levels, demonstrating the advantage of using it to evaluate myocardial injury severity in NSTEMI patients. Our results are consistent with many recent investigations of the analytical and prognostic importance of hs-cTnI in ACS, including NSTEMI. The early diagnosis and risk assessment of ACS have greatly benefited from high-sensitivity cardiac troponin assays. A study by Hussein et al., (2023) confirmed that hs-cTn assays can decrease the time required for a precise diagnosis of myocardial infarction (MI), including NSTEMI, to less than two hours [14]. Another study highlighted the high diagnostic value of hs-cTnI in differentiating STEMI from NSTEMI, supporting our findings on the importance of early and repeated measurements [18]. Hussein *et al.*, (2023) demonstrated that higher levels of troponin I are connected with the degree of coronary artery damage in NSTEMI patients, similar to our findings that show a correlation between SYNTAX scores and delta hs-cTnI levels [14]. Al-assaf et al., (2021) also found that higher hs-cTnI levels are associated with more severe coronary artery disease, emphasizing the role of hs-cTnI in risk stratification and management of NSTEMI patients [13]. The use of delta hs-cTnI levels for early diagnosis and risk assessment is well supported by the literature. Studies have shown that changes in hs-cTnI levels over time can effectively rule out or confirm NSTEMI, guiding timely interventions. In a study conducted to evaluate the real-time application of 0 h/1-hour algorithm with hs-cTnI in the Japanese population, the performance achieving high safety and efficacy for rapid ruling-in/out suspected NSTEMI cases by use of this approach has been validated [18]. The notable correlation of SYNTAX scores with delta hs-cTnI levels intimates the prospective role of hs-cTnI as a useful biomarker for evaluating CAD severity in NSTEMI patients. Identification of hs-cTnI levels associated with complex coronary lesions and thus, complexity prediction at the time of admission may guide relevant decisions on invasive procedures among patients with NSTEMI [19]. In addition, the implementation of delta hs-cTnI eases an on-the-fly examination of ongoing myocardial damage and megascopic efficiency of therapeutic manoeuvres. This is in agreement with new guidelines and evidence on hs-cTn combined with history; clinical findings, and other diagnostics [20].

CONCLUSIONS

It was concluded that the complexity of coronary lesions is importantly associated with the early significant delta hs-cTnI levels in NSTEMI patients, which have been provided by our study as an additional piece for understanding potential mechanisms that explain their high predictive role. These results support hs-cTnI as an essential marker of myocardial damage in NSTEMI and for clinical use. The use of delta hs-cTnI in diagnostic algorithms can support the early identification and risk stratification of patients with NSTEMI, thereby improving patient care.

Authors Contribution

Conceptualization: MHA, MAW
Methodology: MHA, MAW
Formal analysis: ND, MT, SN, SKM
Writing review and editing: MHA, MAW

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

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