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Correlation between High-Sensitive Troponin Level, Neutrophil Lymphocyte Ratio and SYNTAX score in Acute Myocardial Infarction Patients Undergoing Coronary Angiography

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ABSTRACT

Background: One of the main causes of death in the developed world is acute myocardial infarction. Non-ST-segment elevation myocardial infarction (NSTEMI) and ST-segment elevation myocardial infarction (STEMI) are two types of acute myocardial infarction (AMI).

Objective: To assess the value of using highly sensitive troponin and the neutrophil-lymphocyte ratio (NLR as marker to predict the complexity of angiographic coronary anatomy in AMI patients assessed by SYNTAX score.

Patients and Methods: In this study, 100 cases with AMI who had coronary angiography with or without stent implantation between November 2021 and May 2022 were included. These patients came to the Emergency Departments of Ain Shams University Hospitals and Misr University for Science and Technology (MUST) Hospitals. A serum sample was acquired for differential CBC counts in order to assess neutrophil-to-lymphocyte ratio (NLR) and zero-point high sensitive troponin to be correlated by SYNTAX score.

Results: The study reported that there was a marked correlation between the NLR and the coronary lesions complexity evaluated by SYNTAX score, but the study couldn't found any correlation between the high sensitive troponin level and coronary lesions complexity.

Conclusion: An increased in NLR on admission is a potential and independent predictor of the complexity of the coronary lesions, but there is no significant correlation between high sensitive troponin level and the complexity of coronary lesion**.**

Keywords: Ischemic heart disease, NLR, Myocardial infarction.

INTRODUCTION

The leading cause of death worldwide is ischemic heart disease (IHD **(1).** In patients with STEMI within 12 hours of the start of symptoms, primary PCI is the preferable reperfusion technique, if it can be completed quickly (i.e., within 120 minutes of the diagnosis of STEMI) by a skilled team **(2).** According to recommendations from the European Society of Cardiology (ESC), invasive approach became prevalent for treating NSTEMI patients (< 2 hour in very high-risk patient, < 24 hour in high risk patient or < 72 hour in intermediate risk patient) **(3)**.

Cardiac troponins (troponin I and T) are markers with high sensitivity and specificity of myocardial injury **(4)**. Guidelines recommended troponin as potential diagnostic marker for acute myocardial infarction **(5).** Atherogenesis and atherosclerosis progression have been found to be significantly influenced by inflammatory indicators **(6)**. In several cardiovascular disorders, NLR considered systemic inflammatory marker and related with cardiac events and mortality **(7, 8, 9).**

Several investigations were conducted to determine the connection between inflammatory indicators, particularly neutrophils, and the complexity of coronary artery disease (CAD) besides the short- and long-term prognosis in cases with AMI. Additionally, current research indicates a relationship between high sensitive troponin (Hs-Tn) levels and coronary artery atherosclerotic burden and extent **(10, 11).**

The SYNTAX score, which is used to measure the severity of CAD, depends on coronary angiograms for visual evaluation of coronary lesions. Additionally, it offers details on the prognosis and the proper revascularization. Therefore, the SYNTAX score is established to judge and help in the decision-making during management of patient with multi- vessel disease **(12).** The current study aimed to evaluate the correlation between high-sensitive troponin level, NLR and the coronary anatomy complexity assessed by SYNTAX score in cases with AMI.

PATIENTS AND METHODS

This prospective interventional study performed in the Cardiology Department, Ain Shams University Hospitals and Misr University for Science and Technology (MUST) Hospital, between November 2021 and May 2022.

The study included 100 patients (above the age of 18) presenting with acute myocardial infarction (STEMI-NSTEMI) and proceeding to coronary angiography according to the ESC guidelines.

Exclusion criteria: Patients with typical angina pain but without acute myocardial infarction according to ESC guidelines, patients with chronic lung diseases, patients with cardiac inflammatory or infectious diseases, patients unfit for coronary angiography and patients with hyper dynamic circulation (sepsis, anemia, liver cirrhosis etc.).

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All cases were analyzed thoroughly as regards:

A. Pre-procedural parameters:

1. **Demographics and risk fact**ors**:** Age**,** hypertension, smoking, sex**,** diabetes mellitus**,** family history of premature CAD and dyslipidemia
2. **Investigations including** serial ECG, CBC with differential count, initial and serial sets of cardiac biomarkers including high sensitive troponin level and serum creatinine level.

B. Procedural parameters:

Emergency coronary angiography and angioplasty were performed where the left and right coronary arteries were visualised. Visual inspection was used to analyse an angiographic result. Following evaluation of the SYNTAX score for each patient, the thrombolysis in myocardial infarction (TIMI) classification and MBG were used to grade the blood flow in the infarct-related artery (IRA) (Myocardial blush grade).

Ethical consent:

The Ethical Institutional Review Board at Ain Shams University approved the study. After explaining our research objectives, written informed consents were obtained from all study participants. This study was conducted in compliance with the code of ethics of the world medical association (Declaration of Helsinki) for human subjects.

Statistical analysis

Data were analyzed using IBM© SPSS© Statistics version 23 (IBM© Corp., Armonk, NY). Categorical variables were presented as counts and percentages and numerical variables as median and interquartile range. The Jonckheere-Terpstra test was used to compare numerical data across groups and the Conover post hoc test was used for post-hoc comparison of groups if needed, at Bonferroni-adjusted $P < 0.017$.

Correlations between continuous variables were tested using the Spearman rank correlation (Spearman's rho). Kendall's rank correlation (Kendall's tau-b) was used to examine correlations between continuous and ordinal variables, and point-biserial correlation was used to examine correlation between continuous and binary variables (p_b).

Receiver-operating characteristic (ROC) curve analysis was used to examine the value of NLR or hs-Troponin for prediction of SYNTAX I grade. $P \leq 0.05$ were considered statistically significant. Post hoc comparisons targeted statistical significance at Bonferroni-adjusted $P < 0.017$.

RESULTS

The study included 100 patients presenting with acute myocardial infarction. The patients' demographic data and risk factors are shown in table (1).

Table (1): The patients' demographic data and risk factors

Patients Variable	Value
Age (years), median (IQR)	60 (52.0 to 66.5)
Male sex, n/N (%)	85/100 (85.0%)
Smoker, n (%)	70/100 (70.0%)
DM, n/N (%)	39/100 (39.0%)
Hypertension, n/N (%)	38/100 (38.0%)
Dyslipidemia, n/N (%)	70/100 (70.0%)
Family history of IHD, n/N (%)	24/100 (24.0%)
IHD, n/N (%)	25/100 (25.0%)
PVD, n/N (%)	3/100 (3.0%)
Duration of symptoms (h), median (IQR)	15 (6.0 to 72.0)
STEMI, n/N (%)	52/100 (52.0%)
NSTEMI, n/N(%)	48/100 (48.0%)

52 % of the patients were presented with STEMI and 48 % presented with NSTEMI. 86% of the studied population underwent percutaneous coronary intervention and 14% underwent CABG. The median SYNTAX 1 score of the studied population was 17.3 with IQR 9.0 to 26.3. The culprit vessel in patients who underwent PCI is shown in table (2). More than 75% showed TIMI III flow as shown in table (2).

Table (2): The culprit vessel in patients who underwent PCI

Variable	Value
Culprit vessel, n/N (%)	
LAD	40/86 (46.5%)
LCX	22/86 (25.6%)
RCA	24/86 (27.9%)
TIMI, n/N (%)	
TIMI <III	21/86 (24.4%)
TIMI III	65/86 (75.6%)

In our study, there was a weak positive correlation between NLR and SYNTAX 1 score, however there was no statistically remarkable relationship between Hs troponin and SYNTAX 1 score as shown in table (3) and figure (1).

Table (3): Correlation between NLR and SYNTAX 1 score and correlation between NLR and SYNTAX 1 score.

		SYNTAX I Score		
		NSTEMI (N=48)	**STEMI (N=52)**	**All-patients (N=100)**
NLR	**Spearman's rho**	0.380**	0.424**	0.396**
	P-value	**0.008**	**0.002**	**<0.001**
hs-Troponin (ng/l)	**Spearman's rho**	0.223	0.146	0.166
	P-value	0.128	0.302	0.100

**. Correlation is significant at the 0.01 level (2-tailed).

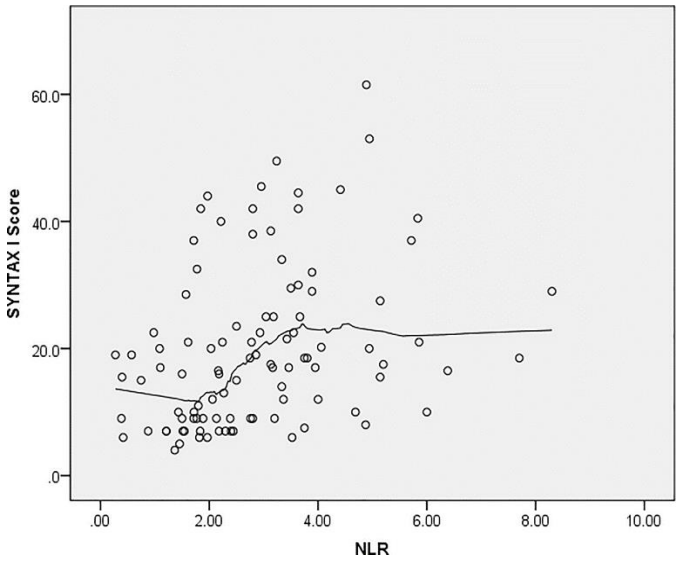

Figure (1): Scatter plot illustrating correlation between NLR and Syntax I score. Fitted line represents the local regression smoothing trend line (LOESS). There was weak positive correlation between both variables (Spearman's rho = 0.396, p < 0.001).

During the study we found predictive value between SYNTAX I score and NLR or Hs-Tn. With cut-off value if NLR > 2.78 the SYNTAX score most probably will be above 22, and Hs-Tn > 2893 ng/I, the SYNTAX score most probably will be above 22, as clarified in table (4) and figure (2).

Table (4): Receiver-operating characteristic (ROC) curve analysis for value of NLR or hs-Troponin for prediction of SYNTAX I score

	Prediction of moderate/high SYNTAX I Score	
Predictor	**NLR**	**Hs-Troponin**
ROC parameter		
Area under the ROC curve (AUC)	0.676	0.548
Standard Error	0.055	0.064
95% Confidence interval	0.575 to 0.766	0.445 to 0.648
z statistic	3.198	0.757
Significance level P (Area=0.5)	0.001	0.449
Youden index J	0.38	0.19
Cut-off criterion	**>2.78**	**>2893 ng/l**
Sensitivity (%)	75.0	53.1
Specificity (%)	63.2	66.2

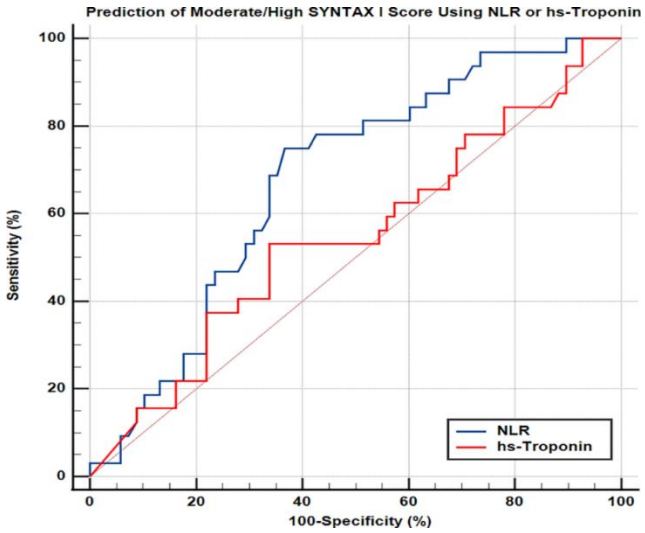

Figure (2): Receiver-operating characteristic (ROC) curves for prediction of moderate/high SYNTAX I Score using NLR or hs-Troponin. Both NLR and hs-Troponion have poor predictive value.

DISCUSSION

In this study we aimed to assess the value of using highly sensitive troponin and NLR as marker to predict the complexity of angiographic coronary anatomy in AMI patients assessed by SYNTAX score.

The study was conducted on 100 patients presenting with AMI to Ain Shams University Hospital and MUST Hospital through the period from September 2021 to June 2022. All patients underwent coronary angiography.

In this investigation, there was a marginally positive correlation between NLR and the coronary lesions complexity assessed by the SYNTAX score, for NSTEMI patients and STEMI patients. This agrees with **Altun *et al.*** [13] who reported that higher NLR was correlated with higher SYNTAX score. In Alton's study, 154 patients with NSTE ACS and 133 patients with STEMI were both included. In the STEMI and NSTE-ACS groups, NLR and SYNTAX Score were substantially linked.

According to the following hypothesis, tissue damage is caused by a range of proteolytic enzymes released by active neutrophils, including myeloperoxidase [14]. Thus, a composite sign of inflammation that combines increased neutrophils and low lymphocyte counts may offer complementary information. Low lymphocyte count in ACS patients is a prevalent observation that is linked to high cortisol levels that cause apoptosis [15]. Low lymphocyte and CD4 cell count along with a CD4/CD8 ratio inversion have been observed in individuals with myocardial infarction [16]. Two WBC subsets with opposing effects on vascular inflammation are integrated by the NLR. As a result, this ratio may be more accurate than either measure by itself.

It is worthy to mention that in our study we found value of NLR for prediction of SYNTAX score with sensitivity 75% and specificity 63.2% with cut off criterion > 2.78, so if NLR > 2.78 the SYNTAX score

probably will be above 22. In **Altun *et al.* [13]** study the cut off value of NLR for prediction of high SYNTAX score was > 4.48, with sensitivity 58.6% and specificity 78.9%.

In our study there was no prominent relationship between NLR and coronary no-reflow, which is in opposite with **Kurtul *et al.* [17]** study that was conducted on 644 patients presented with STEMI. This study showed that a higher NLR on admission was notably correlated with prolonged coronary no-flow after wire insertion in cases with STEMI receiving primary percutaneous coronary intervention. High NLR has been linked to adverse outcomes in cases with CAD, according to several studies [18, 19, 20] as mentioned also in **Gazi *et al.* [21]** study, which were conducted on 525 patients presented with acute coronary syndrome. According to the study, the in-hospital cardiovascular mortality rate was considerably greater in the high-NLR group compared to the low-NLR group. Because of this, the NLR was thought to be a reliable indicator of cardiovascular mortality in-hospital in AMI cases. So further studies should be conducted on AMI cases with high NLR regarding the short-term and long-term major adverse cardiovascular event.

No significant relationship between Hs-Tn level and the coronary lesions complexity assessed by SYNTAX score was found in our investigation. This finding may be in line with the fact that all patients who participated in the study received a score of zero. This is in agreement with a Brazilian study by **Faria *et al.* [22].** No remarkable relationship between lesion severity or coronary circulation and elevated troponin I levels, these results was discovered by the author in this investigation. However **Cardoso *et al.* [23]** study, which was conducted on 174 patients with ACS, showed a positive linear relationship of the coronary lesions complexity with hs-Tn levels.

After statistical analysis, our results showed that there was a poor predictive value of Hs-Tn for prediction of high SYNTAX score with sensitivity of 53.1% and specificity of 66.2% with cut of criterion >2893 ng/L.

LIMITATIONS

- Our study was non-randomized. The procedures were performed by different operators.
- The blood sample that obtained from the study population was zero point set and not the peak high sensitive troponin value.
- Relatively small study population.
- Absence of follow-up after hospital discharge.

CONCLUSION AND RECOMMENDATION

An increase in NLR on admission is a predictor of the coronary lesions complexity. High sensitive troponin level has a poor correlation with the coronary lesions complexity. Further studies with a large number of population to assess the effect of NLR on MACE in short term during hospital stay and on long term after discharge. Also, to assess the relationship between the peak of Hs-Tn level and the complexity of coronary lesions. Further studies should be conducted separately on patient with STEMI and NSTEMI and to assess if there is any correlation between NLR, troponin and no-reflow.

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