RESEARCH ARTICLE

Diagnostic evaluation of myeloperoxidase and Cardiac Troponin I in patients with acute coronary syndrome

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Abstract

Objective: To evaluate the diagnostic accuracy of myeloperoxidase and cardiac troponin-I in patients with acute coronary syndrome.

Method: The validity study was conducted from January to November 2018 at the Emergency and Pathology departments of the Punjab Institute of Cardiology, Lahore, and the Department of Pathology, Postgraduate Medical Institute, Lahore, Pakistan, and comprised adult patients of either gender who presented with complaint of constrictive pericarditis for testing the myeloperoxidase MPO and cardiac troponin-I concentrations. Data was obtained related to age, gender and electrocardiogram, and sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were determined. Data was analysed using SPSS 20.

Results: Of the 62 patients with mean age 56.40+11.39 years, 49(79%) were males, 15(42%) were aged 51-60 years, 24(38.7%) had ST elevation, and 21(33.9%) had normal electrocardiogram. For myeloperoxidase, there were 13(21%) true positive, 39(63%) false negative and 10(16%) true negative cases. For cardiac troponin-I, there were 52(84%) true positive and 10(16%) true negative cases. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy values were 25%, 100%, 100%, 20.4% and 37%, respectively.

Conclusion: Early prognostic assessment is necessary for application of proper treatment and management.

Keywords: Diagnosis, Myeloperoxidase, Cardiac troponin-I, Acute coronary syndrome. (JPMA 73: 294; 2023)

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Introduction

Acute coronary syndrome (ACS) is believed to be an important cause of mortality and morbidity throughout the world.[1] Patients with ACS can be classified according to the risk factors, symptoms and electrocardiogram (ECG) findings, but cardiac biomarkers play an important role both diagnostically and prognostically.[2] According to Pakistan Demographic Survey, released by the Pakistan Bureau of Statistics (PBS), heart attacks and heart failure accounted for 14.74% or 221,100 deaths. Pakistan's crude death rate (CDR) remained 1.5 million people in 2020, while the national population was 224.1 million.[3]

Appropriate ACS diagnosis needs accurate and reliable biomarker assay for the detection of myocardial necrosis. These biomarkers are supposed to give early and exact diagnosis, are cost-effective and have better turnaround time. These biomarkers are measured by immunometric assays for the timely start of treatment. If treatment is delayed, there may be serious consequences leading to tachyarrhythmia and even death.[4]

Myeloperoxidase (MPO) is a heme protein released after inflammation and plays a role in atherosclerosis. Some studies show correlation between MPO levels and cardiac diseases.[5] MPO has pro-inflammatory properties released by activated neutrophils and may be associated with cardiovascular diseases.[6] MPO can transform stable coronary artery lesions to unstable lesions by converting late-stage atherosclerosis into acute cardiovascular adverse events, and, thus, plays a causative role in plaque destabilisation.[7] Raised plasma concentrations of MPO have been found within 2 hours of onset of symptoms in patients with acute myocardial infarction (AMI) or ACS presenting 3-12 hours after the last episode of chest pain.[8]

Neutrophils increase rapidly after AMI and are associated with thrombus formation and with early AMI diagnosis. The cause of AMI is plaque erosion and rupture, and MPO may be a useful marker in an earlier diagnosis.[9] Although the specificity of MPO is lower than that of cardiac troponin-I (cTnI), the sensitivity of MPO is closer to that of cTnI. If there is prolonged duration between the onset of chest pain and blood sampling, the sensitivity is lowered, while specificity of MPO increases in diagnosing ACS, as plasma MPO levels decrease rapidly 6 hours after presentation.[10] The likelihood of progression to MI decreases with normal MPO levels.[11] In cardiac and skeletal muscles, troponin-T (TnT), TnC and TnI are found. TnC has the same structure, while TnT and TnI have different structures in cardiac and skeletal muscles, as measured by immunoassays. Their levels start

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rising after 4-8 hours of acute onset of chest pain which peaks at 10-12 hours. Their levels remain higher in plasma for 7-10 days, showing that troponins may not be the earliest markers of AMI.[12] The current study was planned to evaluate the diagnostic accuracy of MPO and cTnI in patients with acute coronary syndrome.

Patients and Methods

The validity study was conducted from January to November 2018 at the Emergency and Pathology departments of the Punjab Institute of Cardiology (PIC), Lahore, and the Department of Pathology, Postgraduate Medical Institute (PMI), Lahore, Pakistan. The ethical review committee of PIC approved the study and allowed to take samples from the hospital after taking consent from the patient. The samples were taken after taking consent only from those patients who had typical chest pain of duration not more than four hours. All other patients were excluded. First sample was taken at two hours for MPO and second sample at four hours duration for cTnI.

The sample size was calculated on the basis of World Health Organisation (WHO)[13] guidelines using the formula:

$$n = \frac{Z^2_{1-a/2} P(1 - P)}{d^2}$$

where $Z^2_{1-a/2}$ = 95% confidence level = 1.96
P = anticipated sensitivity of MPO = 85%[14]
d = margin of error = 9%.

The sample was raised using non-probability, purposive sampling technique. Those included were adult patients of either gender who presented with complaint of constrictive pericarditis (CP).

Data was obtained related to age, gender, electrocardiogram (ECG) as well as MPO and cTnI concentrations.

Data was analysed using SPSS 20. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy (DA) were determined.

Results

Of the 62 patients with mean age 56.40+11.39 years, 49(79%) were males (Table 1), 15(42%) were aged 51-60 years (Figure), 24(38.7%) had ST elevation, and 21(33.9%) had normal ECG (Table 2).

Table-1: Gender distribution.

Sex	n (%)
Male	49 (79)
Female	13 (21)
Total	62 (100)

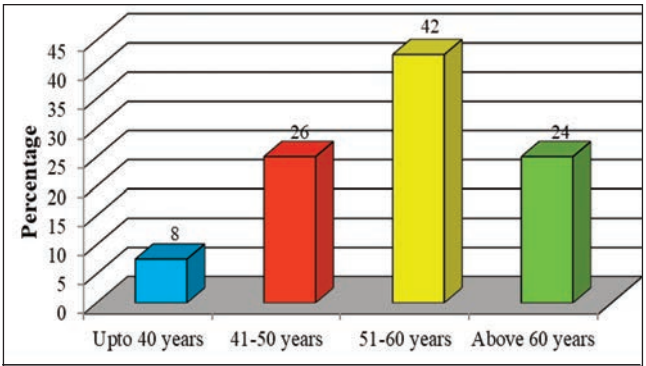

Figure: Age distribution.

Table-2: Electrocardiogram (ECG) distribution.

ECG	n (%)
Ischaemia	17 (27.4)
ST Elevation	24 (38.7)
Normal	21 (33.9)
Total	62 (100)

Table-3: Myeloperoxidase (MPO) distribution.

MPO	n (%)
Positive	13 (21)
Negative	49 (79)
Total	62 (100)
Mean±SD	3.21±1.21

Positive: > 5 u/ml, Negative: < 5 u/ml

Table-4: Cardiac troponin-I (cTnI) distribution.

CTnI	n (%)
Positive	52 (83.8)
Negative	10 (16.2)
Total	62 (100)
Mean±SD	5.12±2.09

Positive: >0.3 ng/ml; SD: Standard deviation.

Table-5: Diagnostic evaluation of myeloperoxidase (MPO) and cardiac troponin-I (cTnI) in patients with acute coronary syndrome (ACS).

MPO	CTnI		Total
	Positive	Negative	
Positive	13(TP)	0 (FP)	13
Negative	39 (FN)	10(TN)	49
Total	52	10	62

TP: True positive, TN: True negative, FP: False positive, FN: False negative.

For MPO, there were 13(21%) true positive (TP), 39(63%)

Table-6: Frequency Evaluation of MPO in Patients with ACS.

Sensitivity	25%
Specificity	100.0%
PPV	100.0%
NPV	20.4%
Validity	37%

PPV: Positive predictive value, NPV: Negative predictive value;
ACS: Acute Coronary Syndrome.

false negative (FN) and 10(16%) true negative (TN) cases Mean MPO level was 3.21±1.21u/ml. For cTnI, there were 52(84%) TP and 10(16%) TN cases (Table 3-5).

The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy values were 25%, 100%, 100%, 20.4% and 37%, respectively (Table 6).

Discussion

Plaque rupture being the most common cause of cardiovascular disease leading to the decreased blood flow to hear and acute myocardial infarction (AMI) with or without ST segment elevation and ischaemic heart disease (IHD). It is also believed that cardiovascular diseases are associated with increasing age. In the current study, 68% patients were aged 41-60 years old and 26% were aged >60 years. The mean age of the patients was 56.40 years. The results are closely comparable with an earlier study.[15] ACS prevalence was found predominantly in males (79%), which is in line with literature.[16]

According to ECG, majority (38.7%) had ST elevation in the current study. Patients with Ischaemia on ECG were 27.4%. There were 33.9% subjects assessed normal according to ECG. One study indicated that most of the patients (19.4%) had T wave inversion, followed by ST elevation (18.6%) and ST depression (13.0%).[17]

In the current study, MPO testing showed 13(21%) patients were positive (MPO >5u/ml), while 49(79%) were negative (MPO<5 u/ml). The mean MPO level was 3.21±1.21u/ml. The results are different from those of a study which reported mean MPO level of ACS patients to be 5.12±2.09u/ml.[18] This may show the difference of reference ranges in a society. If the reference ranges are established in our population, the existing values may change and the results may be different.

With respect to cTnI, 52(83.8%) patients in the current study were positive (cTnI>0.3ng/ml) and 10(16.2%) were negative (cTnI<0.3ng/ml). Mean cTnI was 5.42±1.16ng/ml. The findings are similar to those of an earlier study.[19] Increased level of myocardial damage markers, mainly cTnI, is a prerequisite for AMI diagnosis.[20]

In the current study, sensitivity, specificity, PPV, NPV and DA values were 25%, 100%, 100%, 20.4% and 37%, respectively. Another study showed that sensitivity, specificity, PPV and NPV was 95.7%, 97.3%, 98.2% and 93.7%, respectively.[21]

Limitations: This study needed to be conducted on large scale and the reference values should be obtained at local level as these may be different from the provided values. We could perform better if this study was supported by the government or nongovernment organizations.

Conclusion

Early prognostic assessment is necessary for application of proper treatment and management.

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Conflict of Interest: None.

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