

Diagnostic Sensitivity of Creatine Kinase-MB (CK-MB), Cardiac Troponin T (CTnT) and Cardiac Troponin I (CTnI) in Acute Myocardial Infarction

*MUHAMMAD SHAFIQ, **MUHAMMAD AKRAM, ***TAHIR MAHMOOD

ABSTRACT

Aim: To compare the diagnostic sensitivity of Creatine Kinase - MB, Cardiac Troponin T and Cardiac Troponin I as preferred serum marker to rule out acute myocardial Infarction.

Methods: The study population consisted of 70 patients. Patients from both sexes, with clinical history of typical chest pain for more than 30 minutes in duration with evidence of acute changes of myocardial infarction on ECG were included in the study. This study was conducted to compare the sensitivity of creatine kinase-MB (CK-MB), cardiac troponin T (CTnT) and cardiac troponin I (CTnI) for detection of AMI. Data analysis was performed with Statistical Package for Social Sciences 11.5 (SPSS 11.5).

Results: The sensitivity of CK-MB was 100% and 40% as compared to CTnT and CTnI respectively. The sensitivity of CTnT was 51% and 79% as compared to CK-MB and CTnI respectively while the sensitivity of CTnI was 100% as compared to both CK-MB and CTnT.

Conclusion: It is concluded that CTnI is the preferred, more precise, dependable and cost effective serum marker for detection of AMI as compared to CTnT and CK-MB.

Keywords: Acute myocardial infarction (AMI), creatine kinase-MB (CK-MB), cardiac troponin T (CTnT)

INTRODUCTION

Approximately 15.5 million deaths from cardiovascular diseases occur every year. About half are due to acute myocardial infarction (AMI) and 80% occur in countries with low and middle income and low social status¹.

The ability to rapidly identify myocardial ischaemia or infarction in patients in the emergency department has important implications for patient management. One is the potential for reducing the number of inappropriate discharges. Another is decreasing the admission rate of patients without myocardial ischaemia or infarction². Ruling out AMI requires a test with high diagnostic sensitivity, whereas ruling in AMI requires a test with high diagnostic specificity³.

About 1/3 of patients with AMI do not receive thrombolytic therapy or cardiac rehabilitation because the AMIs are not recognized, either because they are asymptomatic, or the symptoms are sufficiently atypical that neither the patient nor physician consider this diagnosis⁴. About 10% of patients with a

proved AMI (on the basis of clinical history and enzymatic markers) fail to develop ST segment elevation or depression. The changes in T waves are usually present for only 5-30 minutes after the onset of infarction and are followed by ST segment changes⁵.

Biomarkers play a pivotal role in the diagnosis and treatment of patients with cardiovascular disease⁶. There is a disparity in opinion that which cardiac marker should be preferred to detect AMI at the time of admission in hospital with chest pain. This study was planned to find out the better marker for the identification of acute myocardial infarction.

MATERIAL AND METHODS

This cross-sectional study was conducted at Emergency department of Punjab Institute of Cardiology, Lahore from 15th May, 2008 to 15th July, 2008. The study population consisted of 70 patients. Diagnosed cases of AMI⁷ from both sexes, with clinical history of typical chest pain for more than 30 minutes with evidence of acute changes of myocardial infarction on ECG were included. All the patients/relatives signed the informed consent form. The patients with history of previous myocardial infarction, chronic renal failure, muscle injury, surgery, muscle disease etc. were excluded.

Ten ml of venous blood was drawn at the time of admission. After centrifugation, the serum was preserved at -20 °C. The serum was analysed for

*Assistant Professor of Physiology, Punjab Medical College, Faisalabad

** Professor of Physiology, Medical College, Mirpur, Azad Kashmir

***Associate professor of physiology, Gujranwala Medical College, Gujranwala

Correspondence to Dr. Muhammad Shafiq Assistant professor of Physiology, Punjab Medical College, Faisalabad E mail: mshafiq@kemu.edu.pk

CTnI by solid-phase, chemiluminescent immunometric assay⁸, with Immulite supplied by DPC (Siemens). The CTnT was analyzed by electrochemiluminescence immunoassay (ECLIA) based upon sandwich principle⁹ with Elecsys 2010 analyzer supplied by Roche. The serum was also analyzed for CK-MB by immune-inhibition method¹⁰, with CK-MB liquiUV supplied by HUMAN, GERMANY on Vitalab Selectra E Netherland.

Statistical analysis: The data was analyzed by SPSS 11.5 (Statistical package for social sciences). All qualitative variables were presented in the form of percentages and quantitative variables in the form of

Mean ± S.E along with S.D and range. Chi-square and Fisher's Exact test were also applied. Results were considered significant when p-value was less than 5%.

RESULTS

A total of 70 patients were examined in this study. General and clinical characteristics of study population are given in table 1. Among the 70 patients included in study, the biochemical findings are given in table 2

Table 1: General and clinical characteristics of study population

Variable	Number	Range	Mean ±SD
Total number	70	---	---
Male	58 (82.9%)	---	---
Female	12 (17.1%)	---	---
Age (years)		28-70	53.7 ± 10.3
Duration of chest pain		---	---
Within 4 hours	29 (41.4%)		
After 4 hours	41 (58.6%)		
Smokers	47 (67.14%)	---	---
Past history of		---	---
Hypertension (HTN)	27(38.57%)		
Diabetes mellitus (DM)	6 (8.57%)		
HTN & DM	10 (14.28%)		
Nil	27(38.57%)		
Family history of HTN, DM & IHD	40 (57.14%)	---	---

Table 2: Biochemical findings of study population

Variable (critical value)	Less than	More than
CK-MB (25 U/L)	45(64.3%)	25 (35.7%)
CTnT (0.01 ng/ml)	21 (30%)	49 (70%)
CTnI (0.2 ng/ml)	8 (11.4%)	62 (88.6)

The status of significant correlation and sensitivity of these biomarkers are given in tables 3 and 4 respectively.

Table 3: Correlation of CK-MB, CTnT and CTnI values

Correlation of	Statistically	p value
CK-MB and CTnT	Highly significant	< 0.01
CK-MB and CTnI	Significant	< 0.05
CTnT and CTnI	Highly significant	< 0.01

Table 4: Diagnostic Sensitivity of CK-MB, CTnT and CTnI

Sensitivity of	Status
CK-MB Vs. CTnT	100%
CK-MB Vs. CTnI	40%
CTnT Vs. CK-MB	51%
CTnT Vs. CTnI	79%
CTnI Vs. CK-MB	100%
CTnI Vs. CTnT	100%

DISCUSSION

Approximately 20 – 23% of patients presenting at emergency cardiology cases with chest pain have coronary disease¹¹. This cross-sectional study was conducted to evaluate the “Diagnostic significance of CTnI, CTnT and CK-MB in acute myocardial infarction (AMI).

There was a highly significant correlation between reference concentrations of CK-MB (35.7% and CTnT (70%) (P value= 0.00). This observation complements the study of Mohler et al (1998)¹². According to their study 62% cases showed increased CK-MB concentration and 90% had increased CTnT levels within 4 hours of admission (P value= 0.067). The observation made by Majeed et al (2002)¹³ that CTnT is an early indicator of AMI and is superior to CK-MB in diagnosis of AMI also complements this study.

There was a significant correlation between reference concentrations of CK-MB (35.7%) and CTnI (88.6%) (P value= 0.04) in this study. The CTnI was positive in 88.6% cases of this study with the mean duration of chest pain of 5.18 hours. This observation is in accordance with the observation

made by Chiu et al (1999)¹⁴ with a positive value of 80.8% cases when the blood was taken and analyzed in the interval 4 – 8 hours after the onset of chest pain. The sensitivity of CTnI as 65% for detection of AMI mentioned by Apple et al (1999)¹⁵ may be due to the time difference (0 to 6 hours after presentation to emergency room) and higher limit value of 1.5ng/ml. The value of CK-MB mentioned by Apple et al (1999)¹⁵ and Chiu et al (1999)¹⁴ differ from the observation made in this study (77.5% and 96.2% Vs 35.7%). This disparity in observation is due to the fact that CK-MB in this study was analyzed by immunoinhibition method, which inhibits the CK-M sub unit without affecting the activity of CK-B subunit. The activity measured by this method and multiplied with a factor of 2 reflects the activity of CK-MB. Both the above mentioned studies measured CK-MB mass by sand witch-type ELISA immunoassay using anti-CK-MB and anti-CM-MM monoclonal antibodies with the upper reference limit of (7.5ng/ml & 5ng/ml) which is a better detection value.

There was a highly significant correlation between reference concentrations of CTnT and CTnI (P value= 0.00) in this study. This observation is in accordance with the observation made by Chiu et al (1999)¹⁴ with a positive value of CTnI in 80.8% cases.

CONCLUSION

It is concluded that CTnI is the preferred, more precise, dependable and cost effective serum markers to rule out AMI as compared to CTnT and CK-MB.

Recommendations: This study enrolled a relatively small number of cases. Thus this study findings need to be confirmed in future by larger investigations groups. Bedside whole blood assays for the assessment of CTnT and CTnI should be available in emergency departments to obtain rapid information about these markers.

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