

ACUTE MYOCARDIAL INFARCTION;

A cross sectional study to find out the predictive value of creatine kinase-MB (CK-MB), cardiac troponin T (CTnT) and cardiac troponin I (CTnI) as preferred serum marker

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ABSTRACT... A delay in confirming a diagnosis of AMI may increase the risk of complication and a delay in ruling out the diagnosis contributes to overcrowding in the emergency department. A crucial step in confirming or ruling out the diagnosis of AMI is the measurement of myocardial enzymes in the serum. Early administration of thrombolytic therapy results in improved survival after AMI. So this study was planned to find out the serum marker with a better predictive value for the identification of acute myocardial infarction at the time of admission. **Design:** Cross-sectional study. **Setting:** Emergency department of Punjab Institute of Cardiology, Lahore. **Period:** 15th May, 2008 to 15th July, 2008. **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 positive predictive value and negative predictive value 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:** 88.6% cases had CTnI concentration more than the limit value while 11.4% cases had CTnI less than the limit value. The concentration of CTnT was more than the limit value in 70% cases and below the limit value in 30% cases. The concentration of CK-MB was more than the limit value in 35.7% cases and 64.3% cases had CK-MB value less than the limit value. The positive predictive value (PPV) of CtnI is 100% and negative predictive value (NPV) of CTnT is 100% in this study. **Conclusions:** It is concluded that CTnI is the better marker for the identification of acute myocardial infarction and CTnT is the better marker to exclude AMI as compared to CK-MB.

Key words: Acute myocardial infarction (AMI), positive predictive value (PPV) and negative predictive value (NPV)

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INTRODUCTION

Ischaemic heart disease (IHD) is the most common cause of death in the developed world. Its incidence is also increasing rapidly in many developing countries¹. Identification of patients with acute chest pain at high risk for cardiovascular complications is a common and difficult task for clinicians². Distinguishing whether a patient presenting with chest pain has acute myocardial infarction (AMI) or non-AMI problem is at times difficult, despite many insights and innovations over the past two decades^{3,4}. A delay in confirming a diagnosis of AMI may increase the risk of complication and a delay in ruling out the diagnosis contributes to overcrowding in the emergency department⁵.

In 2000, the European society of cardiology and the American College of Cardiology recognized the pivotal role of biomarkers and made elevations in their levels the "cornerstone" of diagnosis of AMI⁶. A crucial step

in confirming or ruling out the diagnosis of AMI is the measurement of myocardial enzymes in the serum⁷. The levels of CK and especially of CK-MB have served as essential components of decision making in emergency rooms for over 25 years⁸. Recently researchers have demonstrated that cardiac specific troponin I (CTnI) and troponin T (CTnT) have similar usefulness for the detection of AMI compared with CK-MB⁹.

Extent of delay in seeking medical care with AMI is receiving increasing attention. Early administration of thrombolytic therapy results in improved survival after AMI¹⁰. Cardiac markers in serum are measured in the early hours after the onset of symptoms not to detect AMI but rather to exclude MI¹¹. So this study was planned to find out the better marker for the identification of acute myocardial infarction at the time of admission.

AIMS AND OBJECTIVES

The aim of this study was to compare the predictive values of Creatine Kinase - MB, Cardiac Troponin T and Cardiac Troponin I as preferred serum marker for 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. All patients underwent an initial clinical assessment by the cardiologist on duty.

Diagnosed cases of AMI¹² 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, and cardiac troponin I, cardiac troponin T and CK-MB were measured by individuals unaware of the clinical status of the patients. The serum was analysed for CTnI by solid-phase, chemiluminescent immunometric assay¹³, with Immulite supplied by DPC (Siemens). The CTnT was analyzed by electrochemiluminescence immunoassay (ECLIA) based upon sandwich principle¹⁴ with Elecsys 2010 analyzer supplied by Roche. The CK-MB was estimated by immune-inhibition method¹⁵, 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 \pm 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. Baseline characteristics of the study population at the time of admission are provided in Table-I.

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

Table-I. Baseline characteristics of study population

Among the 70 patients included in study, the biochemical findings are given in table II and table III.

The positive predictive value (PPV) and negative predictive value (NPV) of these biomarkers was assessed by applying a marker-specific cutoff value and consecutively calculating the corresponding values from a two-by-two factorial design and is presented in table IV.

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%)

Table-II. Biochemical findings of study population

Sex	CK-MB		CTnT		CTnI	
	<25 U/L	Equal or > 25 U/L	< 0.01 ng/ml	Equal or > 0.01 ng/ml	< 0.02 ng/ml	Equal or > 0.02 ng/ml
Male	38	20	19	39	7	51
Female	7	5	2	10	1	11
P-value	0.744		0.325		1.00	

Table-III. Frequency distribution of CK-MB, CTnT and CTnI with respect to Gender
p-value is > 0.05 hence it is not significant.

Status of	PPV	NPV
CK-MB Vs. CTnT	100%	46.67%
CK-MB Vs. CTnI	40.32%	100%
CTnT Vs. CK-MB	51.02%	100%
CTnT Vs. CTnI	79.03%	100%
CTnI Vs. CK-MB	100%	17.78%
CTnI Vs. CTnT	100%	38.09%

Table-IV. Diagnostic Status of CK-MB, CTnT and CTnI

DISCUSSION

Approximately 20 – 23% of patients presenting at emergency cardiology with chest pain have coronary disease¹⁶. The primary function of measuring cardiac markers in blood is to detect the presence of myocardial injury. Among the seventy cases included in this study 88.6% cases had CTnI concentration more than the limit value while 11.4% cases had CTnI less than the limit value. This observation regarding CTnI is in contrast to the observations made by Matelzky et al (2000)¹⁷ and Kontos et al (1999)¹⁸ in

their studies (49% & 39%) due to the use of different analyzers with different upper limit of normal values. The value of CTnI in our study is in accordance with the observations made by Keller (2009)¹⁹ and Chiu et al (1999)⁸ with a positive value of 88% and 80.8% respectively.

The concentration of CTnT was more than the limit value in 70% cases and below the limit value in 30% cases in this study. This observation differs from the values (55%) mentioned by McCann et al (2008)²⁰ due to less duration of chest pain (within 4 hours). Johnson et al (1999)² have mentioned elevated levels of CTnT in 99% of AMI cases who presented to the emergency department within 24 hours of chest pain onset. The observation made by Majeed et al (2002)²¹ that CTnT is an early indicator of AMI and is superior to CK-MB in diagnosis of AMI also complements this study.

The serum was analyzed for CK-MB concentration. The concentration of CK-MB was more than the limit value in 35.7% cases and 64.3% cases had CK-MB

value less than the limit value in this study. The observation regarding CK-MB concentration (81.5%) is different from the observation made by Meier et al (2002)¹²; due to CK-MB analysis with microparticle enzyme immunoassay with consideration of positive value for comparatively lower value (CK-MB 6 µ/L).

PPV of a test is defined as the proportion of people with a positive test result who actually have the disease and NPV of a test is defined as the proportion of people with a negative test result who do not have the disease²². The PPV of CTnl is 100% and NPV of CTnT is 100% in this study. This observation complements the studies of Keller (2009)¹⁹ and Reichlin (2009)⁵ with PPV value of CTnl as 86.7%, and NPV of cardiac troponin assay as 97-99%.

CONCLUSIONS

Cardiac troponins can be reliably used to rule in or rule out the diagnosis of AMI. It is concluded that CTnl is the better marker for the identification of acute myocardial infarction and CTnT is the better marker to exclude AMI as compared to CK-MB.

RECOMMENDATION

The findings of this study need to be confirmed by a large scale multi-centre, age and sex matched, controlled study.

Newer generation analyzers with built-in centrifuge, in which whole blood instead of serum sample can be used, easily used by clinical rather than laboratory personnel with the ability to provide immediate results could maximize the diagnostic efficacy for AMI.

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