Troponin I and Creatine Kinase (MB) as Biochemical Markers in Acute Myocardial Infarction

Salman A Ahmed, Dhirgam S Jaafar

ABSTRACT:

BACKGROUND:

Ischemic heart disease is the leading cause of death among adults. Broad based studies that include all ED patients who received an ECG for the evaluation of chest pain syndromes found that 5% of these patients were ultimately diagnosed with acute myocardial infarction (AMI) and an additional 10% had non-AMI acute coronary syndromes (ACS). Thus, 85% of patients have non-ACS causes for their symptoms.

OBJECTIVE:

To study the relation between the level of cardiac troponin I and creatine kinase (MB) in Acute Myocardial infarction.

SUBJECT AND METHOD:

The present study was designed to investigate changes in serum cardiac biomarkers in patients with acute myocardial infarction. The present study consists of 61 patients who were admitted to the hospital with acute myocardial infarction. Serum levels of cardiac troponin I (cTnI) and creatine kinase (MB) were determined on day 1 (within24 hours) and the 3rd day after acute myocardial infarction. Serum cardiac biomarkers were compared between day 1 of acute myocardial infarction and the 3rd day after the acute myocardial infarction with healthy subjects (control group). All measurements were taken through September 2009 to April 2010 in department of medical and molecular biotechnology/ Biotechnology Research Center/ Al-Nahrain university and Ibn Al-Nafees Hospital Department of Clinical Chemistry and Coronary Care Unit. Cardiac troponin I (cTnI) and CK-MB were measured by using microtitre plate ELISA method, absorbance is measured spectrophotometrically at 450 nm. Levels of serum cTnI and CK-MB for smoker patients who suffered from MI and other diseases(diabetes mellitus, and hypertension) (group 4) higher than levels for patients who complained from MI in addition to other diseases(group2), group 2 higher than levels for smoker patients who suffered from MI (group 3) and group 3 higher than levels for patients who complained from only MI (group 1).

RESULTS:

Results showed significant ($p<0.01$) decreases observed for the levels of cTnI in group 4 with group 1 and group 2 with group 1, and significant ($p<0.05$) decreases in group 4 with group 3. Significant ($p<0.05$) decreases were observed for the levels of CK-MB in group 4 with group 1.

CONCLUSION:

Myocardial infarction patients with diabetes mellitus , hypertension and smoking suffer increase levels of cTnI and CK-MB. This proved that cardiac risk factors increase risk for heart injury. However, such results must be considered during the evaluation of the results of cardiac biomarker in patients of MI .

KEY WORDS: acute myocardial infarction, creatine kinase MB, Electrocardiography, troponin I.

INTRODUCTION:

Ischemic heart disease is the leading cause of death among adults. Broad based studies that include all ED patients who received an ECG for the evaluation of chest pain syndromes found that 5% of these patients were ultimately diagnosed with acute myocardial infarction (AMI) and an additional 10% had non-AMI acute coronary syndromes (ACS). Thus, 85% of patients have non-ACS causes for their symptoms. From the ED perspective, it is important to expeditiously distinguish between these two groups of patients [(1)]. Although the standard 12-lead electrocardiogram (ECG) is the single best test to identify patients with AMI upon ED presentation, it still has relatively low sensitivity for detection of AMI [(2)]. The sensitivity of ST-segment elevation for the detection of AMI is 35-50%, leaving more than half of all AMI patients unidentified[(2,3)]. Because of the relatively poor sensitivity of the standard 12-lead ECG to detect patients with ACS, additional strategies are needed. Cardiac biomarkers are the

Department of Chemistry, College of science, Al-Nahrain University. Baghdad-Iraq.

second most commonly used test to identify patients with potential ACS[1].

The utility of individual cardiac biomarkers depends upon their ability to detect and risks stratify patients with potential ACS. In the ED, the ideal cardiac biomarker will allow early detection of patients with ACS, and enable optimal treatment pathways to be initiated and assist with rapid patient disposition and treatment. The optimal use of cardiac biomarkers depends on how exactly the physician is trying to use them. Since up to 85% of patients who present to the ED with potential ACS do not ultimately have a cardiac a etiology for their symptoms, a cardiac biomarker with a high negative predictive value is useful to allow expeditious evaluation and discharge from the ED. Cardiac biomarkers with high positive predictive values are ideal to tailor aggressive care for patients at high risk of cardiovascular complications. To that end, a panel of cardiac biomarkers may ideally provide for both a rapid "rule out" and a rapid identification of patients with high risk ACS [1]

In acute ischemic heart disease, clinical chemistry plays an important role in detection of myocardial injury. The most important tests for this purpose are measurements of the cardiac troponin and creatine kinase (MB), proteins that are found exclusively in heart muscle cells and released into the circulation when cells die. Increased concentrations in the blood are sensitive signs of damage to heart muscle (Fig.1). Conversely, persistently normal concentrations provide powerful evidence for the physician that a patient's symptoms are not related to cardiac injury [4].

MATERIALS AND METHODS:

SUBJECTS:

A total of 61 subjects with 23 controls, were included in the study. Subjects of MI were classified into four groups. Group 1 contained patients who complained from only MI. Group 2 consisted of patients who complained from MI in addition to other diseases. Group 3 comprised smoker patients who suffered from MI. Group 4 consisted smoker patients who suffered from MI and other diseases.

Serum Collection :

Blood samples of patients were taken within 24 hours (1 day) of the onset of symptoms of MI and the 3rd day after acut MI to measure level of Cardiac Troponin I (cTnI) protein and Creatine kinase enzyme. Blood was drawn into sterile, disposable plastic syringes. After allowing 30 minute for blood clotting in test tubes, the serum was separated from blood cells by centrifugation at 2000 rpm for 10 minute at room temperature. serum was stored in -20°C until assayed.

Laboratory Analysis: Cardiac Troponin I (cTnI) and Creatine kinase (CK-MB) were measured by using ELISA techniques.

Myocardial Infarction.

Statistical Analysis: Data were analyzed statistically, by application of students t-test & one way ANOVA. Statistical analysis was performed with the SPSS 16 statistical Package Package for social sciences and also Excel 2007 with significant difference was set at $P<0.05$.

RESULTS:

To understand the effect of related diseases (risk factors for heart diseases) like diabetes mellitus and hypertension, and smoking on biochemical markers tests in patients of MI, the patients of MI were classified into four groups. Group 1 consisted of 14 patients, group 2 contained 23 patients, group 3 comprised 8 patients, and group 4 involved 16 patients. The results of levels cTnI and CK-MB for all groups are shown as in table 1-4.

The data demonstrated significant elevations of cTnI activity in group 4 patients of MI compared to those of group 1 patients ($p<0.001$) ,and group 3 patients ($p= 0.041$), group 2 patients showed significant elevations compared to those of group 1 patients ($p=0.001$) . CK-MB activity was found to be significantly raised in group 4 patients of MI with respect to the group 1patients ($p= 0.014$), as in table 5.

Table 1: Comparison of serum biochemical markers between day 1 (within 24 hours) and the 3rd day in patients who complained from only MI.

Groups	1&2	1&3	1&4	2&3	2&4	3&4
cTnI (ng/ml)	0.001	N.S	0.001	N.S	N.S	0.041
CK-MB (ng/ml)	N.S	N.S	0.014	N.S	N.S	N.S

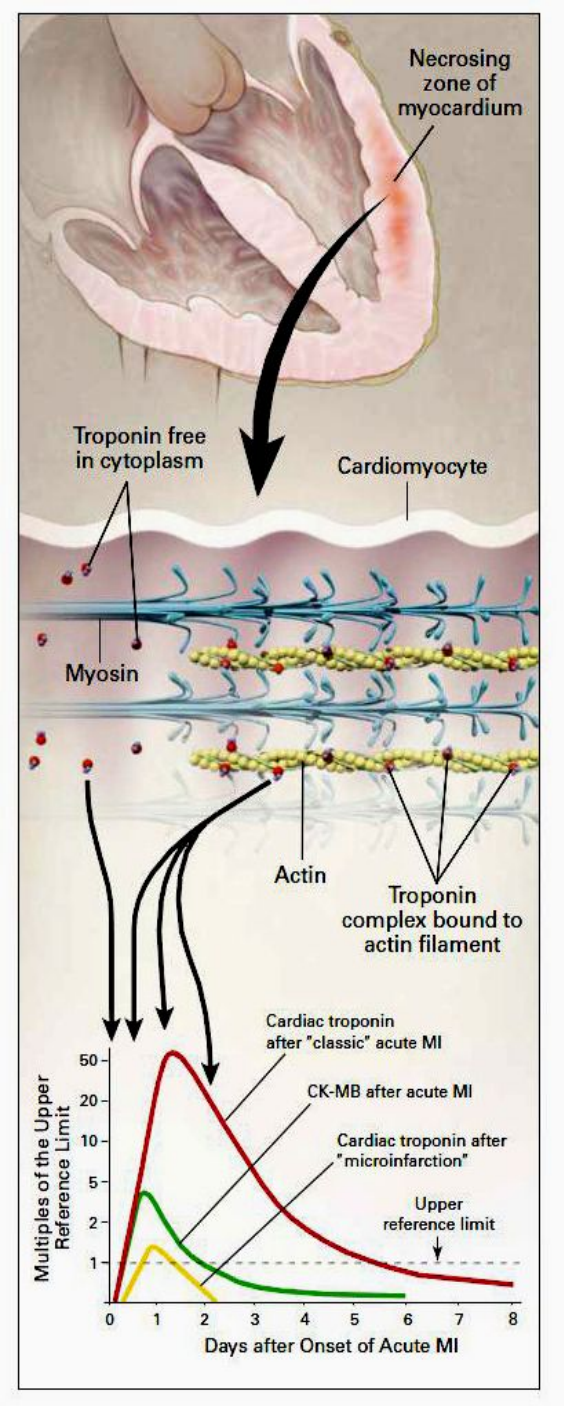

Fig.1: Release of cardiac troponins in acute infarction

Table 2: Comparison of serum biochemical markers between day 1 (within 24 hours) and the 3rd day in patients who complained from MI in addition to diabetes mellitus and hypertension

Parameter	Subject	No.	Within 24 h of MI	The 3rd day of MI
cTnI (ng/ml)	Patient Control	14 5	45.40 ± 5.98 0.22 ± 0.1	31.64 ± 1.38
CK-MB (ng/ml)	Patient Control	14 5	31.94 ± 15.37 2.6 ± 1.46	2.81 ± 0.48

Table 3: Comparison of serum biochemical markers between day 1 (within 24 hours) and the 3rd day in smoker patients who suffered from MI.

Parameter	Subject	No.	Within 24 h of MI	The 3rd day of MI
cTnI (ng/ml)	Patient Control	23 6	58.06 ± 11 0.41 ± 0.01	41.09 ± 4.51
CK-MB (ng/ml)	Patient Control	23 6	41.74 ± 15.31 3.2 ± 0.1	3.5 ± 0.6

Table 4: Comparison of serum biochemical markers between day 1 (within 24 hours) and the 3rd day in Smoker patients who suffered from MI, diabetes mellitus and hypertension.

Parameter	Subject	No.	Within 24 h of MI	The 3rd day of MI
cTnI (ng/ml)	Patient Control	8 5	51.14 ± 10.36 0.33 ± 0.09	35.7 ± 2.67
CK-MB (ng/ml)	Patient Control	8 5	38.72 ± 11.78 2.9 ± 0.9	3.05 ± 0.65

Table 5: Results of analysis of variance (ANOVA) for biochemical markers levels in patients of myocardial infarction with respect to other diseases and smoking.

Parameter	Subject	No.	Within 24 h of MI	The 3rd day of MI
cTnI (ng/ml)	Patient Control	16 7	60.25 ± 11.27 0.43 ± 0.08	47.92 ± 3.77
CK-MB (ng/ml)	Patient Control	16 7	49.21 ± 10.97 3.9 ± 0.49	4.09 ± 0.34

1: Patients of MI.
2: Patients of MI and other diseases.
3: Smoker patients of MI.
4: Smoker patients of MI and other diseases.

DISCUSSION:

Atherosclerosis and acute MI in the cause of death in many diabetic patients as Beckman (2002) [5] and lopaschuk (2002) [6] study that there is evidence exist for the linear association between worsening glycemic control and increased risk for CHD. In the current study, patients of MI were classified after taking in to consideration the related disease which are diabetes mellitus and hypertension in addition to smoking. We found that levels of serum cTnI and CK-MB for group 4 higher than levels for group 2, group 2 higher than levels for group 3 and group 3 higher than levels for group 1. This finding is consistent with existing literature that suggests both systolic and systolic-diastolic hypertension

confer abnormalities of endothelial function and platelet activation [7]. Endothelial micro particles also correlated with the presence of diabetes mellitus and smoking, factors also known to produce endothelial activation injury. The correlation of endothelial micro particles with blood pressure persisted in the presence of multiple coexisting risk factors for endothelial injury activation. The analysis of the data in table 5 pointed out that patients of related diseases (groups 2 and 4) exhibited significant variation in some parameters of biochemical cardiac markers tests when compared with other patients. This observation indicated that changes of biochemical markers levels in patients of MI are aggravated by smoking, diabetes mellitus and hypertension diseases.

High blood pressure is a powerful risk factor; every 1 mmHg reduction in the mean population systolic blood pressure could prevent approximately 10 000 CHD deaths each year in the United States[8] .

There may be differences in the action of insulin on the vasculature, insulin normally causes vasodilatation and enhanced muscle blood flow ,an effect that appears to be mediated in part by nitric oxide (Steinberg *et al*.1996) [9] .

This study show non significant mean difference for biochemical markers between group 3 and group 1 and this disagreement with M S Mahonen (2004) [10] showed that the risk of non-fatal MI was five times higher in smokers than non-smokers in the age group 30–49 years. In the British male doctors cohort study reported by Doll and Peto,[11] the risk of CHD death in heavy smokers was 15 times higher than in non-smokers in the age group 45 years.

CONCLUSION:

This study proved that higher levels risk of cardiac biomarker increase risk for heart diseases. Coronary risk factors criteria according to our study can be arranged from higher frequency to lower frequency as follow: diabetes mellitus and hypertension in addition to smoking, diabetes mellitus and hypertension, and smoking. These biomarkers reflect myocardial damage but do not indicate its mechanism. Thus, an elevated value in the absence of clinical evidence of ischemia should prompt a search for other causes of cardiac damage, such as myocarditis.

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