SERUM MARKERS FOR EARLY DIAGNOSIS OF NON-'Q' WAVE AND 'Q' WAVE MYOCARDIAL INFARCTION

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ABSTRACT

The present study conducted on twenty-five uncomplicated cases of acute myocardial infarction diagnosed by clinical and electrocardiographic findings indicated significantly increased level of cardiac Troponin-T and increased activities of the enzymes total creatine kinase, creatine kinase-MB, aspartate transaminase and lactate dehydrogenase as compared to the twenty-five healthy control subjects. The level of cardiac Troponin-T and the activities of the enzymes total creatine kinase, creatine kinase-MB, aspartate transaminase and lactate dehydrogenase was found to be higher in "Q" wave myocardial infarction patients as compared to the non-"Q" wave and the controls. Since cardiac Troponin-T has been shown to increase in unstable angina and renal failure without cardiac disease and creatine kinase-MB activity has been found to be normal in patients with unstable angina and increase very slightly in patients with renal failure, it was concluded that a combination of cardiac Troponin-T and creatine kinase-MB activity was sufficient for the early diagnosis of acute myocardial infarction.

KEY WORDS: AMI, cardiac Troponin-T, serum cardiac markers.

INTRODUCTION

Acute myocardial infarction (AMI) continues to be a major cause of morbidity and mortality. Acute myocardial infarction is usually caused by thrombotic occlusion of a coronary artery (1). The size of the infarct depends mostly on the distribution of the occluded artery, though the collaterals may limit it to the subendocardial layer (2). Early thrombolytic treatment limits the size of the infarct (3,4). Therefore early identification and confirmation of AMI are essential for rapid and correct decision making and patient care.

Clinical history and electrocardiographic (ECG) findings can accurately diagnose AMI in the majority of the patients, but there is a significant minority in which this is not possible. The factors that limit diagnosis by ECG are the extent of myocardial injury, the age of the infarct and its location (there are 'silent' electrocardiographic areas of the heart, high lateral or posterior where the surface ECG is not effective in diagnosing AMI), the presence of conduction defects, previous infarction, acute pericarditis or

change in electrolyte concentration. Serum cardiac markers are considered the "gold standard" for the diagnosis of AMI and are particularly important in non-diagnostic ECG patients (5). Generally the biochemical parameters used for diagnosing myocardial infarction are total creatine kinase (total CK), creatine kinase-MB (CK-MB), aspartate transaminase (AST) and lactate dehydrogenase (LDH). Poor specificity is a problem with these standard markers.

The 1990s have been a period of active evolution for the treatment, monitoring and assessment of the acute coronary syndromes, including AMI (6). The cardiac troponins, more recently, have gained attention as very specific markers of myocardial cell injury. Troponin-T (a component of the troponins) is present in cardiac as well as skeletal muscle. However, the cardiac and the skeletal muscle isoforms are encoded by different genes. Thus, monoclonal antibodies against cardiac Troponin-T have been developed which have little or no cross-reactivity with its respective skeletal muscle isoforms (7, 8). The present study was carried out with the aim of measuring the level of cardiac Troponin-T (cTnT) along with the serum activity of total CK, CK-MB, AST and LDH in patients with non-"Q" wave and "Q-wave" myocardial infarction and comparing the

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results between non-"Q" wave and "Q-wave" patients and the control group. Selecting a single or the best combination amongst the above mentioned markers for early diagnosis of AMI was another objective of the study.

MATERIALS AND METHODS

Twenty-five acute myocardial infarction male patients between 40 to 70 years (12 with non-"Q" wave and 13 with "Q" wave infarction) admitted to St. John's Medical College within 24 hours of onset of symptoms, diagnosed by 12-lead ECG and clinically by a cardiologist, were selected for the study. The diagnosis of 'Q' wave infarction was made by a history of chest pain > 30 minutes in duration and serial ECG showing pathological 'Q' wave (more than 0.04 seconds in width and 25% deeper than the height of the following 'R' wave). In case of non-'Q' wave infarction, the patient's history and typical pattern in the ECG showing abnormal ST segment depression in all the leads except aV_F which showed ST segment elevation, was considered for the diagnosis. The control group comprised of twenty-five healthy males within the same age group as the patients. None of the selected patients were suffering from hepatic, skeletal disease or trauma, renal disease or any heart disease other than uncomplicated AMI.

Venous blood was collected (without the application of a tourniquet) immediately after admission. The blood was centrifuged at 3000 rpm within 30 minutes of collection and immediate serum analysis was carried out for total CK, CK-MB and LDH and serum samples for AST and cTnT were stored in a deep freeze (after centrifugation) until their assay was carried out. Cardiac Troponin-T, total CK and CK-MB were estimated under automated test conditions, cTnT on Elecsys 1010, and the other two on Dade Dimension System. Quality control sera were run during the analysis to check precision and accuracy of the estimation. AST activity was estimated by colorimetric method of Bergmeyer and Brent (9) and LDH by two-point colorimetric method (10). Results were statistically analysed by student's 't' test. A 'p' value < 0.001 was considered statistically highly significant; a 'p' value < 0.05 (but 'p' value $\geq$ 0.001) was considered significant; and a 'p' value > 0.05 was considered insignificant.

RESULTS AND DISCUSSION

The level of cardiac Troponin-T and the

serum activity of total CK, CK-MB, AST and LDH in the serum of healthy controls and the two groups of myocardial infarction (non-"Q" wave and "Q" wave) are shown in Table-1.

With the exception of the activity of LDH, which was found to be statistically insignificant ($p > 0.05$) within the first 12 hours, all the other enzymes and cTnT showed a highly significant rise in their levels ($p < 0.001$), when compared with the controls. However, the increase in the serum LDH activity after 12 hours but within 24 hours was found to be statistically highly significant ($p < 0.001$) in both non-"Q" wave and "Q" wave MI patients as compared to the controls. Other workers have also shown similar results (11, 12). The activity of all the four enzymes and the level of cTnT were found to be higher in the 'Q' wave infarction group as compared to the non-'Q' wave group.

The mean value of serum total CK obtained in this study was 87.72 ± 4.81 U/L which is in comparison to the reported value by White *et al.* (13). The range of serum total CK activity in our study (both, non-'Q' wave and 'Q' wave infarction combined) is in comparison to that reported by Irvin *et al.* (14) and Strauss and Robert (15). Release of CK from organs, other than the heart, could distort the estimation of the extent of myocardial injury. Hence, it is considered to be non-specific.

In this study, in the control group the mean of CK-MB activity was found to be 4.41 ± 0.24 U/L which is comparable to the study by Gerhardt and Waldenstrom (16); and Berstein (17) in which the mean was 6 U/L and 6.7 ± 3.9 (SD) U/L respectively. The range of the serum CK-MB activity in our study (both non-'Q' wave and 'Q' wave infarction) is in comparison to that reported by Irvin *et al.* (14) and Strauss and Roberts (15).

The challenge to CK-MB is from the protein marker, cTnT, which is detectable early in the serum after the onset of AMI and remains elevated for 10 - 14 days. Cardiac TnT determination was carried out with the second-generation cTnT assay which has been found to be highly cardiospecific. In the control group, the level of serum cTnT was insignificant and undetectable which is comparable to the study by Katus *et al.* (18) and Antman *et al.* (19). Mair *et al.* (20) found that the serum cTnT was high in both non-'Q' wave and 'Q' wave

infarctions, which is similar to our study. The measurement of cTnT was found to be 100 % sensitive and specific in our study, since patients with other systemic disorders were excluded.

However, there are reports that patients with minor myocardial damage, such as unstable angina (6) and renal failure without cardiac disease (21) show

an increase in the level of cTnT although CK-MB activity has been found to be normal in patients with unstable angina and increase very slightly in patients with renal failure. Hence, it was concluded from the study, that a combination of cTnT with CK-MB activity was sufficient for the early diagnosis of AMI.

Table-1
Levels of serum cardiac markers in control and MI patients

Study Group	cTnT (ng/ ml) < 24 hours	Total CK (U/ L) < 24 hours	CK-MB (U/ L) < 24 hours	AST (I. U./ L) < 24 hours	LDH (I. U./ L)	
					< 12 hours	> 12 hours < 24 hours
Controls (n = 25)	0 ± 0	87.72±4.81	4.41±0.24	6.52±0.25	177.20±5.63	177.20±5.63
Non-"Q" MI (n = 12)	*1.072±0.102	*766.17±46.23	*76.25 ±5.90	*53.76±2.46	#166.78±17.83 (n = 6)	*604.20±72.26 (n = 6)
"Q" MI (n = 13)	*3.735±0.340	*2630.54±216.96	*224.00±15.44	*111.59±8.19	#197.67±10.24 (n = 6)	*753.24±41.81 (n = 7)

The values expressed are Mean ± SEM,

* p < 0.001 (highly significant),

p > 0.05 (insignificant)

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