

DIAGNOSTIC EFFICACY OF CARDIAC TROPONIN-T IN ACUTE MYOCARDIAL INFARCTION PATIENTS ADMITTED IN INTENSIVE CARDIAC CARE UNIT

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ABSTRACT

INTRODUCTION

Myocardial infarction is a common and severe manifestation of ischaemic heart disease (IHD). Acute myocardial infarction (AMI) is the result of death of heart muscle cells following either from a prolonged or severe ischaemia. The World Health Organisation emphasises IHD as our "Modern Epidemic" and AMI as common cause of sudden death.

AIM

The present study has been undertaken with the aim to assess the role of cardiac Troponin-T in early diagnosis of AMI and to evaluate its positive roles over CK-MB and LDH enzyme assays. The study also aims to find out the role of cardiac Troponin-T test, where ECG changes are nondiagnostic and inconclusive for AMI.

MATERIAL & METHOD

One hundred cases of provisionally diagnosed AMI, who were admitted during June 2012 to July 2015 in ICC Unit of TMC & Dr. BRAM Teaching Hospital, formed the subjects for the study. Those patients reported 2 to 10 hours after onset of chest pain were included in this study.

Patients reported beyond 10 hours after onset of chest pain of AMI cases and patients having chest pain of non-AMI causes are excluded from the study.

The provisional diagnosis of AMI was done on the basis of the history, chest pain, clinical findings and ECG changes. Trop-T test (Troponin-T sensitive rapid test by Muller Bardoff, et al, 1991) as well as CK-MB (creatin kinase-MB isoenzyme-assays were performed immediately for each and every patient. Trop-T test was repeated in some selective cases where the early changes were insignificant and the results were compared with those of CK-MB, at different period of the disease onset.

RESULTS

The rapid cardiac Troponin-T test (CTn-T) has 100% specificity for AMI whereas CK-MB and LDH have specificities of 80% and 60% respectively. The CTn-T has diagnostic efficiency of 92% for AMI but ECG has only 69% sensitivity and 80% specificity. The overall diagnostic efficacy of cardiac Troponin-T is higher than that of CK-MB, LDH and ECG (94% versus 92%, 91 % and 72% respectively). So, cardiac Troponin-T test done between 4 to 10 hours following onset of the disease is an excellent marker for evaluating chest pain of AMI or ACS.

CONCLUSION

It is therefore, concluded that cardiac Troponin-T test done between 4 to 10 hours following onset of the disease is an excellent marker for evaluating chest pain of AMI or ACS.

KEYWORDS

Cardiac Troponin-T (CTn-T), AMI, CK-MB, LDH.

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INTRODUCTION: Acute myocardial infarction (AMI) is the result of death of heart muscle cells following either from a

prolonged or severe ischaemia. Myocardial infarction is a common and severe manifestation of ischemic heart disease (IHD). The World Health Organisation emphasises IHD as our "Modern Epidemic" and AMI as common cause of sudden death.⁽¹⁾ Heart disease is the leading cause of death Worldwide and the mortality rate of IHD alone exceeds cancer deaths. The mortality rate of AMI is approximately 30% with more than half of deaths occurring before the patients reach hospitals.⁽²⁾

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The advent of thrombolytic therapy and its clear benefits in early intervention of AMI patients has evolved the need for a rapid and more specific diagnostic procedure of AMI and other ACS (acute coronary syndrome) patients. Recently, the contractile protein, troponins have been introduced as a marker of cardiac injury and other myocardial abnormalities.⁽³⁾ Both cardiac troponin-T (37 kDa) and troponin-I (21 kDa) have smaller molecular weights as compared to the enzyme creatine kinase (86 kDa). This two proteins have structural similarity for cardiac muscle and hence the two get released and detected earlier in the serum following onset of myocardial cell necrosis.⁽⁴⁾ Again, these two troponins are not detected in the blood of normal healthy individual, but their levels may shoot up to twenty times higher than the cut-off values of 0.1 nanogram (CTnT) and 1.5 ng/mL(CTn-I) respectively. Further, cardiac troponin-T is considered to be more specific marker of myocardial damage as this protein is released more independently after myocardial cell damage whereas troponin-I and C come in complex forms.^(5,6)

AIM AND OBJECTIVES: The present study has been undertaken with the aim and objects to assess the role of cardiac Troponin-T in early diagnosis of AMI and to evaluate its positive roles over CK-MB and LDH enzyme assays. The study also aims to find out the role of cardiac Troponin-T test, where ECG changes are nondiagnostic and inconclusive for AMI.

MATERIALS AND METHODS: One hundred cases of provisionally diagnosed AMI, who were admitted during June 2012 to July 2015 in ICC Unit of TMC & Dr. BRAM Teaching Hospital, formed the subjects for the study.

Diagnosis of AMI was done by the concerned physician on the basis of history, clinical finding, ECG changes at the time of admission and only those patients reported 2 to 10 hours after onset of chest pain were included in this study. Trop-T test (Troponin-T sensitive rapid test by Muller Bardoff et al, 1991)⁽⁷⁾ as well as CK-MB (creatin kinase-MB isoenzyme- from Dr Reddy's Lab Hyderabad, India assays were immediately performed for each and every case. Trop-T test was repeated in some selective cases where the early (0 – 4 hours) trop- T test results were either negative or faintly positive making the result insignificant and the results were compared with those of CK-MB, at different period of the disease onset.

Finally, all the cases were subjected to LDH assay (lactate dehydrogenase enzyme estimation-using reagent kit of Span Diagnostics, Surat, India).

The results of various examinations and tests were tabulated and statistically analysed.

Exclusion Criteria: Patients reported beyond 10 hours after onset of chest pain of AMI cases and patients having chest pain of non-AMI & ACS causes are excluded from the study.

Inclusion Criteria: Patients of provisionally diagnosed AMI & ACS were included in this study group.

RESULTS: All 100 cases included in the study, are subjected to cardiac Troponin-T test besides serial ECG, CK-MB and LDH enzyme assays. The results are expressed in terms of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), efficiency of test (ET), Chi-square test (χ^2) and probability value (P value) were applied. The results are displayed in the following tables from table I to table IV. Now in table I, age, sex and religion wise occurrence of AMI cases, in table 2 risk factors like smoking habit, life style and association of others diseases with AMI like hypertension, diabetes mellitus are depicted. The results of diagnostic efficiency of Troponin-T test compared with other biochemical markers are shown in table III and table IV.

DISCUSSION: It is gathered from the table-I that maximum AMI occurs in the mean age group of 60 ± 12 years, ranging from 36-85 years. About 90% patients are in the age group of 50 to 65 years whereas in Western countries, the disease affects mostly older people of above 65 years. Males are affected more than females in 36 to 85 age group with a ratio of 7:3(M: F). The table also shows the religion-wise distribution of cases as Hindus (86), Christians (8), Muslims (6) respectively and this indirectly reflects the population ratio of Tripura (North-East India) where non-tribal(Bengali) and tribal Hindus constitute about three-fourth of total population.

From table-II, it is evident that among major risk factors of AMI, heavy smoking (44) and hypertension (36) were responsible in maximum number of patients. Other predisposing factors of the disease include alcoholics (22) and diabetes (16). Another significant finding from the study is that AMI is more common among the people with light work (56) than moderate workers (38) and hard workers (6) and this may be due to the latter's more exposure to physical activity. In one of the studies of Lal BH and Caroli RK,⁽⁸⁾ they found that AMI was more common among higher income and sedentary worker group than in poor and hardworking people.

In table-III, the diagnostic efficacy of Troponin-T is compared with each of ECG, CK-MB and LDH. Here, the results of all four tests are analysed in different statistical parameters and indices. The sensitivity value of cardiac Troponin-T is 92% whereas for ECG, CK-MB and LDH, the values are 69%, 94% and 91% respectively. Troponin-T test has excellent specificity (100%) for AMI than CK-MB (81%), ECG (81%) and LDH (63%). The test also has same percent PPV (100%) for AMI whereas ECG, CK-MB and LDH have lower values, 93%, 94% and 90%. The NPV (78%) of cardiac Troponin-T test is comparatively low to CK-MB (81%) and LDH (100%). Besides, overall test efficiency of cardiac Troponin-T (94%) is superior to ECG (72%), CK-MB (92%) and LDH (91 %). Further, troponin-T along with CK-MB detects the outcome better and early in acute chest pain patients of either ischaemia or infarction without a definite ECG.⁽⁹⁾ The test can detect micro-infarctions where ECG changes are insignificant and inconclusive. Cardiac-troponin-T, is therefore, a better biochemical marker for

various cardiac abnormalities including cases of acute coronary syndrome (sub-endocardial myocardial infarction and unstable angina).⁽¹⁰⁾

Table- IV dictates the comparative diagnostic efficiency values between Troponin-T and CK-MB, following onset of myocardial infarction. During early hours (0-4 hours), Troponin-T has slightly lower test sensitivity value than CK-MB (60% versus 80%) but beyond 4 hours of the attack its sensitivity increases and maximum between 8 to 10 hours (100%). Hence, patients reported between 4 to 10 hours after acute attack are better evaluated by Troponin-T test. Tucker J E et al. in 1997 also reported the similar results indicating that cardiac troponins are of benefit in identifying AMI > or = 6 hours presentation.⁽¹¹⁾ The test has 100% specificity for AMI all through but CK-MB has specificities of only 50% (2-4 hrs.) and 87% (8-10 hrs.). Troponin-T test has 100% PPV of AMI whereas for CK-MB the values are 78% (2-4 hrs.) and 95%(8-10 hrs.) respectively.

The low sensitivity value of the test in early hours may be due to the fact that Troponin-T starts releasing as early as 4 hours following onset of the disease or myocyte damage. The table also indicates that Troponin-T test has lower NPV than CK-MB (33% Vs 50%) during early hour and overall negative prediction of the test is comparatively low (78% Vs 81 %). Overall test efficiency of Troponin-T is superior to CK-MB (94% Vs 91 %), their comparative efficiencies being 71% Vs 71% (2-4 hrs.), 92% Vs 91% (5-7 hrs.) and 100% Vs 96% (8-10 hrs.) respectively. The results here show that Troponin-T is a specific, rapid and more efficient marker of myocardial injuries than CK-MB and others. Further, troponin-T is more cardiac specific than CK-MB isoenzyme and hence cross reactivity with skeletal troponin is practically nil by using the third generation troponin-T test which is having newer cardiac specific monoclonal antibody.⁽¹²⁾ Reichlin T. et al has concluded that the diagnostic performance of sensitive cardiac troponin-T assay is excellent and this assay can substantially improve the early diagnosis of acute myocardial infarction particularly in patients with a recent onset of chest pain.⁽¹³⁾

CONCLUSION: Cardiac Troponin-T test done between 4 to 10 hours following onset of the disease is an excellent marker for evaluating chest pain of AMI or ACS. The rapid sensitive Troponin-T assay by Sandwich ELISA method is a simple, efficient test that for the first time provides clinicians with a useful laboratory tool for better evaluation of patients

with chest pain of either acute myocardial infarction or acute coronary syndrome. It is therefore concluded that Troponin-T test along with CK-MB isoenzyme assay is a valid complement to ECG in evaluating and early diagnosis of AMI as well as ACS patients and also in avoiding misdiagnosis of disease.

Parameters		No. of cases & (%)
Mean age	60±12 years	-
Age range	36 to 85 years	-
Male	-	70(%)
Female	-	30(%)
Hindu	-	86(%)
Christian	-	8(%)
Muslim	-	6(%)

Table I: Age/sex and religion-wise distribution of study group (100 suspected AMI cases)

Risk factors & Life style	No. of Cases & (%)	Chi-Square (x ²)	Degree of freedom (dJ.)	P - value
Hypertension	36(%)			
Diabetes	16(%)	9.45	3	
Both hypertension & Diabetes	10(%)			
Past history of AMI	4(%)			
Smoker	44(%)			
Alcoholic	22(%)			
Both smoker & Alcoholic	14(%)	10.32	3	<0.05
Non-smoker & non-alcoholic	20(%)			
Light worker	56(%)			
Moderate worker	38(%)	19.32	2	<0.01
Hard worker	6(%)			

Table II: AMI patients (100) among major risks factors and variation of cases according to life style

Comparison of diagnostic efficacy of Troponin-T with ECG, CK-MB and LDH among AMI patients:

	Sensitivity	Specificity	PPV	NPV	E.T.
E.C.G.	69%	81%	93%	42%	72%
	(54/78)	(18/22)	(54/58)	(18/42)	(72/100)
Troponin-T	92%	100%	100%	78%	94%
	(72/78)	(22/22)	(72/72)	(22/28)	(94/50)
CK-MB	94%	81%	94%	81%	92%
	(74/78)	(18/22)	(74/78)	(18/22)	(92/100)
LDH	92%	63%	90%	100%	91%
	(72/78)	(14/22)	(76/84)	(14/14)	(90/98)

(x2)	22.51	4.88	6.39	11.09	22.82
dJ	3	3	3	3	3
P-value	<0001	>0.05	>0.05	>0.05	<0.001

Table III: Comparison of diagnostic efficacy of Troponin-T with ECG, CK-MB and LDH among AMI patients

Test & Indices	Types	Hours following onset of chest pain			Diagnostic Efficiency	(x2) value	dJ	P-value
		2-4 hrs.	5-7 hrs.	8-10 hrs.				
Sensitivity	Trop-T	60%	93%	100%	94%	9.63	2	<0.01
	CK-MB	80%	91%	100%	92%	4.74	2	>0.05
Specificity	Trop-T	100%	100%	100%	100%	-	-	-
	CK-MB	50%	100%	87%	81%	-2.16	2	>0.05
PPV	Trop-T	100%	100%	100%	100%	-	-	-
	CK-MB	80%	100%	95%	94%	4.87	2	>0.05
NPV	Trop-T	33%	50%	100%	78%	5.04	2	>0.05
	CK-MB	50%	50%	100%	51%	0.47	2	>0.05
E.T.	Trop-T	71%	92%	100%	94%	8.79	2	<0.05
	CK-MB	71%	91%	96%	91%	5.69	2	>0.05

Table IV: Time dependent diagnosis of AMI by Troponin-T and CK MB

PPV = Positive Predictive Value. NPV = Negative Predictive Value.

E. T = Efficiency Test. (x2) = Chi-square test.

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