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Original Article

Study of Cardiac Troponin I level in Acute Coronary Syndrome and its correlation with Left Ventricular Systolic Function

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Key Words : *HD, Acute coronary syndrome, Troponin I, LV function*

Abstract:

Background: *In the diagnosis of acute coronary syndrome, cardiac troponin I is highly reliable and widely available biomarker. Serum level of cardiac troponin I is related to amount of myocardial damage and also closely relates to infarct size. Our aim of the study is to find out the relationship between cardiac troponin I and left ventricular systolic function after acute coronary syndrome.*

Methods: *Total of 132 acute coronary syndrome patients were included in this study after admission in coronary care unit of Sir Salimullah Medical College, Mitford Hospital. Troponin I level was measured at admission and left ventricular ejection fraction (LVEF) was measured by echocardiography between 12-48 hours of onset of chest pain.*

Results: *There was negative correlation between Troponin I at 12 to 48 hours of chest pain with LVEF in these study patients. With a cutoff value of troponin I e"6.8 ng/ml in STEMI patients there is a significant negative relation between 12 to 48 hrs troponin I and LVEF (p<0.001). Sensitivity of troponin I e" 6.8 ng/ml between 12 to 48 hours of chest pain in predicting LVEF <50% in STEMI was 93.75% and specificity was 77.78%. In NSTEMI sensitivity of troponin I e" 4.5 ng/ml between 12 to 48 hours of chest pain in predicting LVEF <50% was 65% and specificity was 54.05%.*

Conclusion: *Serum troponin I level had a strong negative correlation with left ventricular ejection fraction after acute coronary syndrome and hence can be used to predict the LVEF in this setting.*

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Introduction:

Coronary artery disease is the most common cause of heart disease and the single most important cause of premature death in world.[1]Over the last decade, cardiovascular disease (CVD) has become the single largest cause of death worldwide. In 1990, CVD accounted for 28% of world's 50.4 million deaths and 9.7% of the 1.4 billion loss disability-adjusted life years (DALYs). By 2001, CVD was responsible for 29% of all deaths and 14% of the 1.5 billion lost DALYs. By 2020, the world's population will grow to 7.8 billion and 32% of all deaths will be caused by CVD; by 2030, when the population is expected to reach 8.2 billion, 33% of all deaths will be caused by CVD.[2]In 2006, CVD is more prevalent in China and India than in all developed countries combined.[3]Cardiovascular disease is becoming significant burden on health care services in Bangladesh.[4]

Acute coronary syndrome (ACS) is a unifying term representing a common end result, acute myocardial ischemia. It encompasses acute MI (resulting in ST-segment elevation or non–ST-segment elevation) and unstable angina.[5]

After acute myocardial infarction (AMI), a patient's prognosis is closely related to the extent of irreversibly damaged myocardium.[6,7]The cardiac Troponin I (cTnI) has been found to have excellent sensitivity and specificity and is superior to creatine

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kinase—MB (CK-MB) as indicator of myocardial necrosis. cTnI is uniquely located in the myocardium and its release closely relates to infarct size; therefore, inversely correlates with left ventricular ejection fraction.[6]

Methods:

The cross-sectional analytic study was carried out in the Department of Cardiology, Sir Salimullah Medical College, Mitford Hospital, Dhaka from June 2015 to May 2016. A total 132 patients of acute coronary syndrome were included in this study after fulfillment of inclusion &exclusion criteria. Informed written consent was taken from all selected patient or from legal guardian. Meticulous history and clinical examinations of study populations were performed and recorded in a predesigned data sheet. 12 leads ECG were done at admission. Troponin I level was measured at admission and between 12-48 hours of onset of chest pain. Echocardiography was performed between 12 -48 hours of onset of chest pain. Serum troponin I level was determined by ADVIA centaur XP Random Access Multi-Batch Immunoassay Analyzer. Cutoff value was considered for AMI: 0.12 ng/ml and above.

Left ventricular ejection fraction (LVEF) was estimated by using a modified biplane Simpson's method from apical four chamber and two chamber views. LVEF <50% was considered as LV systolic dysfunction. Data were recorded in data collection sheet and were analyzed by SPSS (Statistical Package for Social Science) software version 22.

Results:

Total 132 cases were included in the study on the basis of predefined enrollment criteria. Minimum age was 24 years, maximum age was 80 years & mean age was 55.09 (±13.56) years. Among 132 patients, majority 87(66%) was male. 41(31.1%) patients were STEMI, 57 (43.3%) patients were NSTEMI and 34 (25.8%) were unstable angina. Major risk factors were hypertension (54.5%), smoking (52.3%), dyslipidemia (50.8%), family history of IHD (25%) and diabetes mellitus (24.2%).

Multiple comparison of troponin I with different types of ACS patients show that troponin I was more raised than NSTEMI and no change of troponin I level in unstable angina (F value - 39.44) and p value was <0.001.

Table shows ejection fraction in different types ACS. Total 41 patients had STEMI, among them 78% had EF < 50% and 21.95% had EF > 50%. Out of 57 patients of NSTEMI, 35% patients had EF < 50% and 65% patients had EF >50%. Among 34 unstable angina, most of the patients (94.11%) had EF > 50%.

In this study cutoff value of troponin I was detected by constructing ROC curves between troponin I in 12 to 48 hours of chest pain and LVEF. Cutoff value of troponin I was 3.6 ng/ml in ACS, 6.8ng/ml in STEMI and in NSTEMI it was 4.5 ng/ml.

Table-I

Mean difference of troponin I at admission and between 12 to 48 hours of chest pain according to different types of ACS (N=132).

Types of ACS	Troponin-I (ng/ml)		p value
	At admission	Within 12 to 48 hours	
STEMI	21.88(±19.74)	32.21 (±30.37)	< 0.001
NSTEMI	10.25(±15.89)	16.32(±25.23)	< 0.001
Unstable Angina	0.07(±0.09)	0.07(±0.10)	0.37

Data was analyzed by paired t test

Table-II

Comparison of mean troponin I level between 12 to 48 hours of chest pain in different types of ACS.

	Types of ACS			F	p value
	STEMI (n=41) mean ±SD	NSTEMI (n=57) mean ±SD	Unstable Angina (n=34) mean ±SD		
Troponin I (ng/ml)	32.21(±30.37)	14.57(±21.96)	0.07(±0.10)	39.44	<0.001

Data was analyzed by ANOVA test

Table-III

LV ejection fraction according to different types of ACS (N=132).

Types of ACS	LVEF		Total
	< 50 %	≥50 %	
STEMI	32(78.05)	09(21.95)	41 (100)
NSTEMI	20(35.08)	37(64.91)	57(100)
Unstable Angina	02(5.88)	32(94.11)	34(100)
Total	54(40.9)	78(59.1)	132(100)

Table-IV

Relation of troponin I between 12 to 48 hours of chest pain with LVEF in ACS (N=132)

Troponin I(ng/ml)	LVEF		Total	p value
	< 50 %	≥ 50 %		
< 3.6	15(27.8)	53(67.9)	68	< 0.001
≥3.6	39(72.2)	25(32.1)	64	
Total	54(100)	78(100)	132	

Data was analyzed by Chi-Square Tests

Table shows relation between troponin I with LVEF. Out of 132 patients of ACS, 54 had EF <50%. Among them 27.8% patients had troponin I <3.6 ng/ml and 72.2% patients had troponin I ≥3.6 ng/ml. Out of 78 patients with EF ≥50%, among them 67.9% patients had troponin I <3.6 ng/ml and 32.1% patients had troponin I ≥3.6 ng/ml (p<0.001). These results is suggested that low troponin I (<3.6 ng/ml) is significantly associated with ≥50 % LVEF conversely high troponin I (≥3.6 ng/ml) is significantly associated with < 50% LVEF (p<0.001).

Table showed out of 41 STEMI patients, 32 patients (93.75%) patients had serum troponin I ≥6.8 ng/ml and LVEF was < 50 %. Among 09 patients with ≥50% ejection fraction had serum troponin I <6.8 ng/ml. P-value was highly significant (p = <0.001).

Table shows that in STEMI sensitivity of troponin I ≥6.8 ng/ml between 12 to 48 hours of chest pain in predicting LVEF <50%was 93.75%, specificity 77.78%, accuracy 90.24%, positive and negative predictive values were 93.75% and 77.78% respectively.

Table VI showed out of 20 NSTEMI patients with <50% ejection fraction, 13(65%) patients had serum troponin I ≥4.5 ng/ml and 7(35%) patients had serum troponin I <4.5 ng/ml. Among 37 NSTEMI patients with ≥50% ejection fraction, 20(54.05%) patients had serum troponin I <4.5 ng/ml and 17(45.95%) patients had serum troponin I ≥4.5 ng/ml.

In NSTEMI sensitivity of troponin I ≥4.5 ng/ml between 12 to 48 hours of chest pain in predicting LVEF <50% was 65%, specificity 54.05%, accuracy 57.89%, positive and negative predictive values were 43.33% and 74.07% respectively.

This study showed that negative correlation of troponin I between 12 to 48 hours of chest pain with LVEF in ACS patients. If troponin I is increased than LVEF is decreased and it was statistically significant. Pearson's Correlation coefficient value r was-0.621 and p value

Table-V

Relation of troponin I between 12 to 48 hours of chest pain with LVEF in STEMI patients (N=41).

Troponin I (ng/ml)	LVEF		Total	p value
	< 50 %	≥ 50%		
• < 6.8	02(6.25)	07(77.78)	09	<0.001
• ≥6.8	30(93.75)	02(22.22)	32	
Total	32(100)	09(100)	41	

Data was analyzed by Chi-Square Tests

Table-VI

Performance of troponin I in predicting LVEF <50% in STEMI.

STEMI	Sensitivity	Specificity	PPV	NPV	Accuracy
Troponin I ≥6.8 ng/ml	93.75%	77.78%	93.75%	77.78%	90.24%

PPV = Positive predictive value, NPV =Negative predictive value

Table-VII

Relation of troponin I between 12 to 48 hours of chest pain with LVEF in NSTEMI patients (N=57).

Troponin I (ng/ml)	LVEF			p value
	< 50 %	≥ 50%	Total	
• < 4.5	07(35)	20(54.05)	27	0.26
• ≥ 4.5	13(65)	17(45.95)	30	
Total	20(100)	37(100)	57	

Table-VIII

Performance of troponin I in predicting LVEF <50% in NSTEMI (N=57)

NSTEMI	Sensitivity	Specificity	PPV	NPV	Accuracy
Troponin I ≥4.5 ng/ml	65%	54.05%	43.33%	74.07%	57.89%

PPV = Positive predictive value, NPV =Negative predictive value

Table-IX

Correlation of troponin I measured between 12 to 48 hours of chest pain with LVEF

	Pearson's Correlation Co-efficient "r"	p value
ACS (n=132)	-0.621	<0.001
STEMI (n=41)	-0.471	0.002
NSTEMI (n=57)	-0.516	<0.001

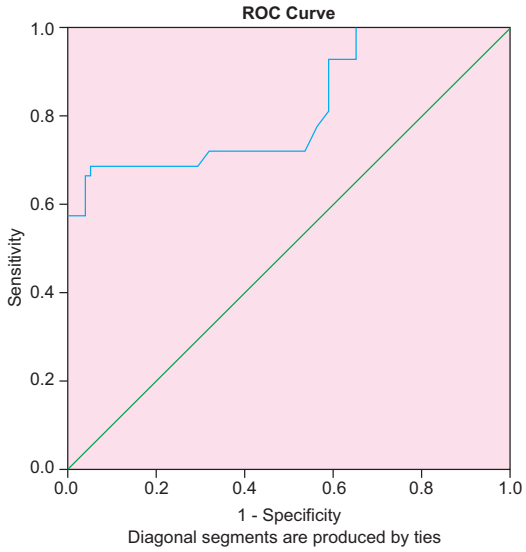

Fig.-1: *ROC curve of troponin I and LVEF in patients of ACS (n=132).*

was<0.001. There was also negative correlation of troponin I between 12 to 48 hours of chest pain with LVEF in both STEMI and NSTEMI. Pearson's Correlation coefficient value r was -0.471 and p value was 0.002 in STEMI and r was -0.516 and p value was <0.001 in NSTEMI.

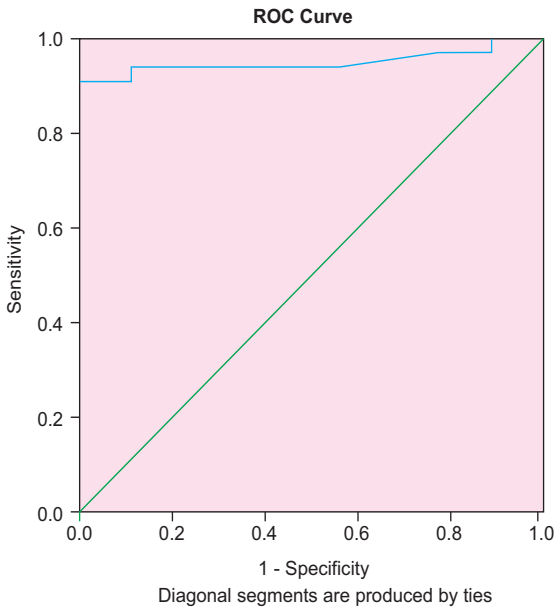

Fig.-2: *ROC curve of troponin I and LVEF in patients of STEMI (n=41).*

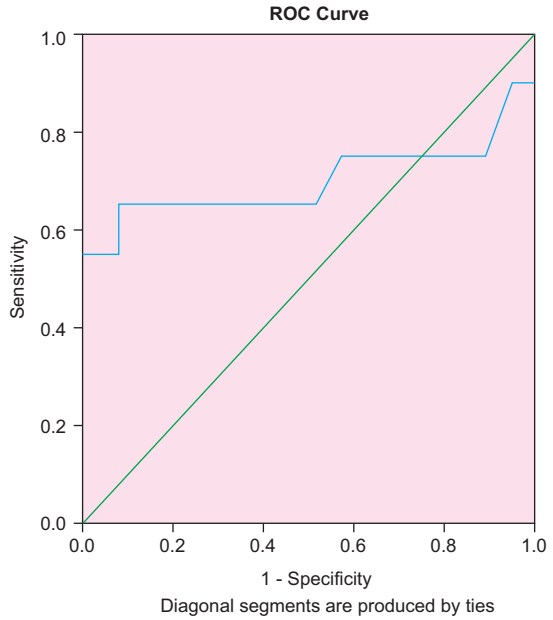

Fig.-3: *ROC curve of troponin I and LVEF in patients of NSTEMI (n=57).*

Discussion:

This study showed that in 78 STEMI patients had LVEF< 50% and 35% of NSTEMI patients had LVEF < 50%. In the Ahmad et al. study, LV dysfunction was present in 92.5% of STEMI patients;[8] however Deepak et al. observed LV dysfunction in only 48% of patient.[9] In our study with a cutoff value of troponin I 3.6 ng/ml, there is a significant negative relation with LVEF in ACS patients (p <0.001). In the study of Bodí V et al.[0] showed the correlation between troponin I and systolic function was weaker in the patients with NSTEMI which was similar to our study. In this study performance of diagnostic test in STEMI sensitivity of troponin I ≥6.8 ng/ml between 12 to 48 hours of chest pain in predicting LVEF <50% was 93.75%, specificity 77.78%, accuracy 90.24%, positive and negative predictive values were 93.75% and 77.78% respectively. In NSTEMI sensitivity of troponin I ≥4.5 ng/ml between 12 to 48 hours of chest pain in predicting LVEF <50% was 65%, specificity 54.05%, accuracy 57.89%, positive and negative predictive values were 43.33% and 74.07% respectively. In study of Bodí V et al. study, NSTEMI specificity 78%; sensitivity 44%; negative predictive value 66%; positive predictive value 58%. In STEMI specificity was 71%; sensitivity 67%; negative predictive value 40%; positive predictive value 89%.[10] In this study Pearson's Correlation coefficient value was r = -0.621 and p value was <0.001, represent negative correlation of troponin I between 12 to 48 hours of chest pain with LVEF in ACS patients. If troponin I is increased than LVEF is decreased that was statistically significant.

There was also negative correlation of troponin I with LVEF in both STEMI and NSTEMI. Pearson's Correlation coefficient value was r = -0.471 and p value was 0.002 in STEMI and r = -0.516 and p value is < 0.001 in NSTEMI. Similar findings were observed in the study of Deepak et al., Pearson's correlation coefficient between cTnI and LVEF was r = -0.69. The cTnI value was high among patients with LVEF < 50%. The difference was statistically significant (p <0.0001).[9]

Thus, the above discussion found that cardiac troponin I measured between 12-48 hours after onset of chest pain in patients with acute coronary syndrome had a negative correlation with left ventricular ejection fraction. Negative correlation is more significant in STEMI. Cardiac troponin I showed an excellent promise as a marker for assessment of LVEF.

Conclusion

The present study concludes that serum troponin I level has a strong negative correlation with left ventricular ejection fraction in patients with acute coronary syndrome and hence can be used to predict the LVEF in this setting. Estimation of troponin I offer a simple, quick &noninvasive method of identifying high risk patients.

Recommendations

This study should be done in multicenter with large sample size. Close surveillance, early intervention and aggressive treatment strategy should be offered to patients with high troponin I.

Conflict of Interest - None.

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