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To Identify Left Ventricular Ejection Fraction of Less than or Equal to 40 Percent by Quantitative Troponin T Measurement after First Episode of ST Elevation Myocardial Infarction

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Introduction

Myocardial infarction is a syndrome arising from injury to the myocardial tissues due to imbalance in the perfusion and demand with the major cause being coronary atherosclerosis with a superimposed coronary thrombus. When a myocardial injury occurs, various enzymes are being released in to the blood after two hours and they are detectable in the blood by various assays. Cardiac troponin T, troponin I, creatine kinase MB (CK-MB) are all important biomarkers of myocardial injury and when elevated, signify myocardial damage with good sensitivity and specificity[1,2]. CK-MB has a lot of false positive values as they can be elevated in conditions associated with skeletal muscle injury. Troponin T and I are more specific than CK-MB for cardiac injury. CK-MB starts decreasing by 12 hours and at 24 hours, the sensitivity of Troponin is very high[3]. Troponins can detect very small degrees of myocardial damage. Troponin T has practical advantages over CK-MB in the assessment of left ventricular ejection fraction. Troponin T starts to rise by 3-12 hours and peaks at 12 hours from the onset of pain. However the plateau phase lasts up to 48 hours. Thus, there is a large time window for the peak value. So unlike CK-MB, multiple measurements are not needed in determining the peak value. Also its concentration is unaffected by thrombolysis after the first 12 hours. Thus its measurement directly correlates with the infarct size which is inversely proportional to the ejection fraction.

Materials and Methods

This study was conducted in kanyakumari government medical college and hospital in the department of medicine between March and August 2016. Fifty consecutive patients with first attack of ST elevation of myocardial infarction were selected and observed. Myocardial infarction was diagnosed by the following criteria

1] Typical cardiac chest pain
2] Presence of ST segment elevation of more than 2mm in chest leads or more than 1mm in 2

contiguous limb leads or presence of Q waves in two consecutive leads.

3] Elevated Creatinine Kinase levels more than twice from the baseline.

Exclusion criteria

1] Patients with previous history of myocardial infarction

2] Severe renal impairment

3] History of cardiac failure

Troponin T levels are measured 12 to 48 hours after admission so as to obtain its peak value. All patients received standard therapy like anti platelets, anti lipidemics, anti coagulation with heparin, fibrinolytics (if the criteria for administering these drugs are met) and supportive care. Two dimensional Echocardiography was done 3 to 4 weeks later and ejection fraction was measured.
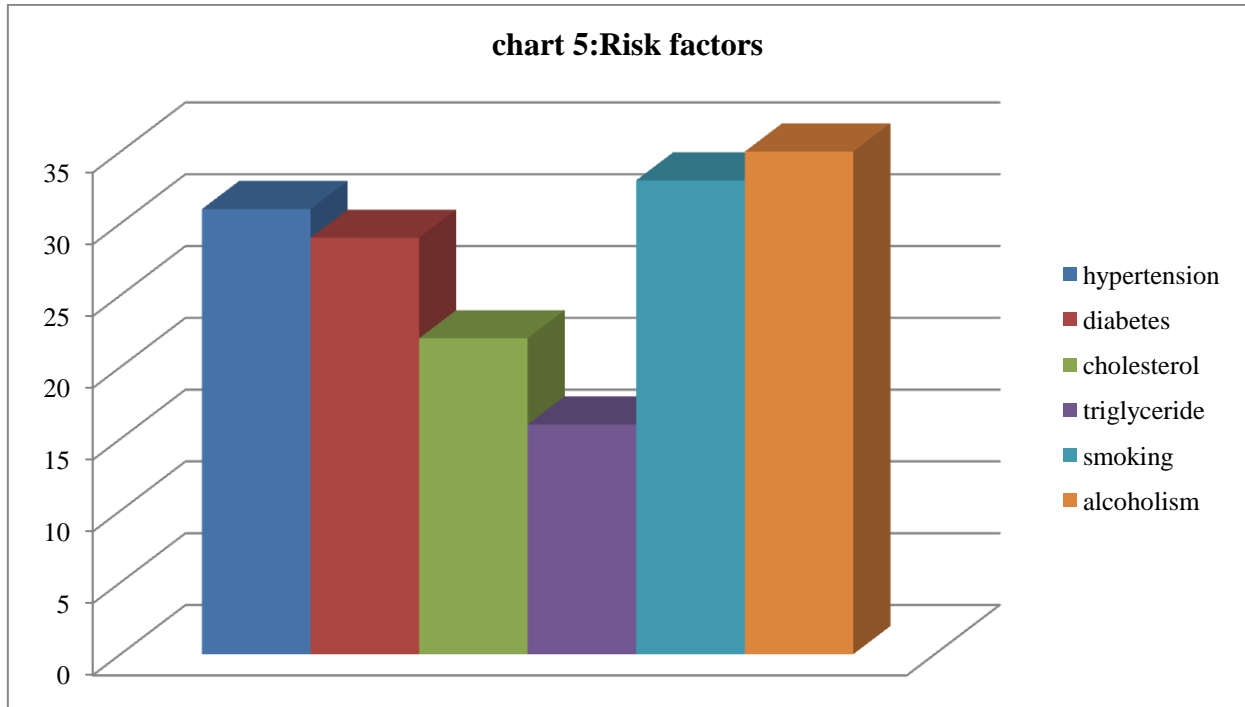
The relationship between left ventricular ejection fraction and troponinT concentration was studied using spearman's correlation coefficient. The relation between Troponin T concentration and ejection fraction was examined by constructing a receiver operator characteristic (ROC) curve. Patients were initially categorised in to two groups; those with ejection fraction of less than 40 percent and those with ejection fraction more than 40 percent. Then sensitivity and specificity of Troponin was determined. Sensitivity was plotted against 1- specificity and ROC curve was produced. The test is better if the curve is near the top left corner. The point of inflection of the ROC curve allows selection of the best trade off between sensitivity and specificity.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
age	50	28	80	54.34	12.356
sugar	50	73	347	145.90	45.903
urea	50	22	84	42.16	17.171
creatinine	50	.3000	2.2000	1.144000	.3855343
cholesterol	50	127	378	207.90	50.477
TGL	50	73	329	182.66	66.199
ejn frction	50	30	65	43.28	8.636
SHT(yrs)	50	0	20	4.66	4.830
SBP	50	100	176	144.20	19.518
DBP	50	30	110	88.04	15.761
diabetes(yrs)	50	0	15	4.18	4.543
trop T levels	50	.2340	10.0000	5.644920	3.3080123
Valid N (listwise)	50				

The mean cholesterol value is 207.90mg/dl, blood sugar level 145.90 mg/dl, Triglyceride- 182.66mg/dl, ejection fraction- 43.28, mean systolic blood pressure is 144.20mm Hg (mini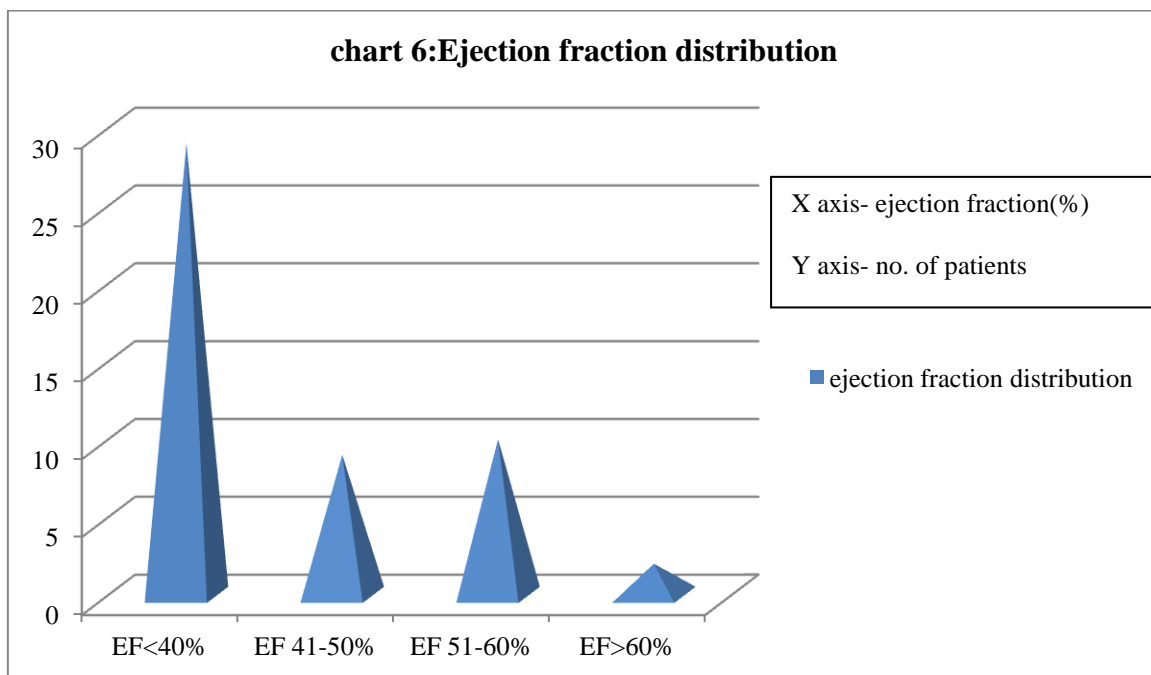mum 100 mmHg; maximum 176 mm Hg), mean diastolic blood pressure is 88.04mmHg (min-30 mm Hg and max-110 mm Hg). The mean Troponin level was 5.644 with the lowest value being 0.234 and the greatest value being10.

chart 5:Risk factors

Legend:
- hypertension
- diabetes
- cholesterol
- triglyceride
- smoking
- alcoholism

Ejection fraction interval

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	29	58.0	58.0	58.0
	2.00	21	42.0	42.0	100.0
	Total	50	100.0	100.0	

Of the patients admitted, 29 of them had ejection fraction less than 40 percen t(58%) and 21 of them had ejection fraction more than 40 percent.(42%)

chart 6:Ejection fraction distribution
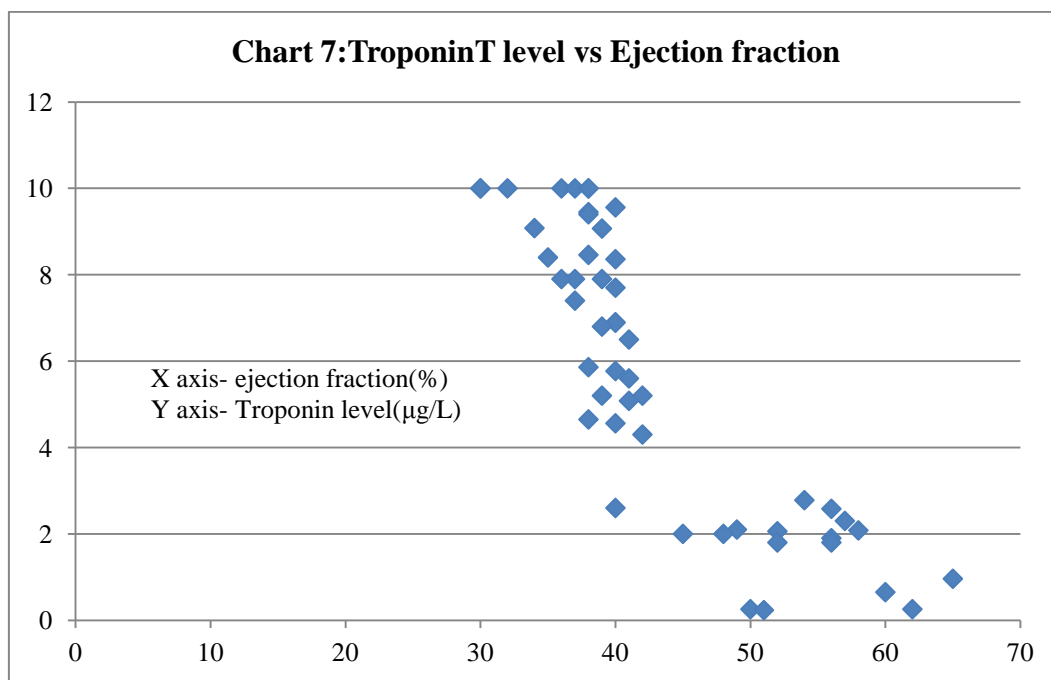

X axis- ejection fraction(%)

Y axis- no. of patients

■ ejection fraction distribution

EF<40%   EF 41-50%   EF 51-60%   EF>60%

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson's R	-.860	.027	-11.656	.000[c]
Ordinal by Ordinal	Spearman Correlation	-.874	.029	-12.473	.000[c]
N of Valid Cases		50			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

There was a strong negative correlation between the left ventricular ejection fraction and Troponin T levels. Spearman's rank correlation coefficient was -0.874 with p values <0.0001

Chart 7:TroponinT level vs Ejection fraction

X axis- ejection fraction(%)
Y axis- Troponin level(µg/L)

Analysis of ROC curve produced an area under the curve of 0.970 (95% of confidence interval 0.000 to 1.000. Troponin T value more than 2.9 predicted a LV ejection fraction of <40 % with a high sensitivity and specificity.
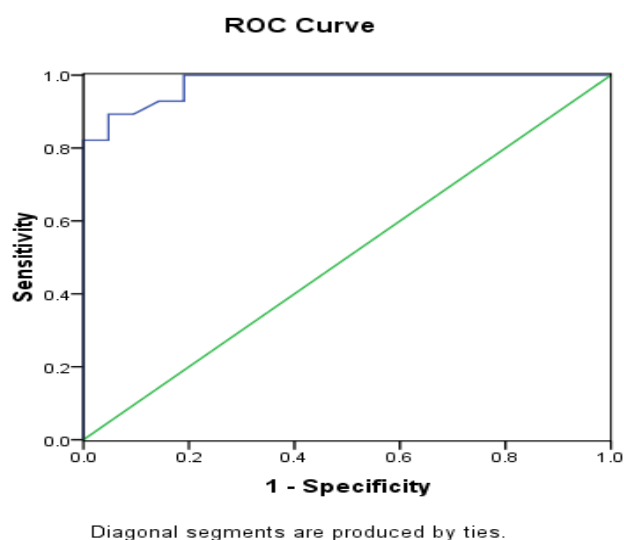
Area Under the Curve

Test Result Variable(s):trop T levels

Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.970	.019	.000	.000	1.000

The test result variable(s): trop T levels has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5

ROC Curve

Diagonal segments are produced by ties.

Discussion

Troponin is a highly reliable marker in the detection of cardiac injury. Its use is increasing in modern era in the diagnosis of acute myocardial infarction. Studies tell that the cardiac troponin T measured correlates well with the infarct size and thus indirectly denote left ventricular ejection fraction.

This study shows a strong negative correlation between troponin T measured 12 to 48 hours post MI and the ejection fraction measured by 2D echocardiography. Relation between cTroponin T and ejection fraction by ROC curve show that troponin T concentration of >2.9 is highly sensitive and specific indicator of depressed LV function (LVEF<40 percent) after a first attack of STEMI.

Troponin T forms one of the important markers in the diagnosis of myocardial infarction. It has many advantages in assessing the LV ejection fraction compared to other markers. After an episode of myocardial infarction, Trop T level raises above the baseline and peaks at about 12 hours. However, the plateau phase lasts for about 48 hours. This peak value represents the total amount of myocytes injured. After 12 to 48 hours, the peak value will be missed. Since there is a large time window, repeated sampling is not needed for quantifying the peak value. Other cardiac injury markers like creatinine kinase and myoglobin are not preferred as they need multiple sampling to determine their peak levels.

A study done by ACR Rao et al showed similar results. They selected 50 consecutive STEMI patients with a first episode of myocardial infarction and did Troponin level and ejection fraction by angiography. Patients with prior history of myocardial infarction were excluded as they may show falsely low ejection fraction. This study showed a strong negative correlation between and LV ejection fraction. Spearman's corellation coefficient was -0.72 (95 percent confidence interval) with $p<0,0001$. Analysis by ROC produced an area under the curve of 0.9773 (95 percent confidence interval 0.9409 1.0131) which was similar to our study. In their study, Trop T more than 2.8µg/L predicted an LVEF of less than 40 percent which was slightly higher in our study.

References

1. Antman EM, Tanasijevic MJ, Thompson B, et al. Cardiac specific troponin T levels to predict the risk of mortality in patients with acute coronary syndromes. N Engl J Med 1996;335;1342
2. ACR Rao et al consecutive STEMI patients with a first episode of myocardial infarction and did Troponin level and ejection fraction by angiography.