COMPARATIVE ANALYSIS OF SENSITIVITY AND SPECIFICITY OF CARDIAC SPECIFIC TROPONIN I AND CK-MB FOR DIAGNOSIS OF ST SEGMENT ELEVATION MYOCARDIAL INFARCTION

Sandipkumar R. Patel, Hariom Sharma, Bhavika Vanani

3rd Year Resident, Biochemistry Department, Government Medical College, Bhavnagar, Gujarat, India.

ABSTRACT

Background: Study is designed to see correlation of cardiac specific Troponin I and Creatine Kinase-MB level to diagnose ST segment elevation myocardial infarction.

Aim and Objectives: To access the diagnostic importance of cardiac specific Troponin I over Creatine Kinase-MB in patient of ST-segment elevation myocardial infarction.

Materials and Methods: A comparative study was carried out in 100 patients, having ST segment elevation myocardial infarction. A group of 100 normal healthy individuals, age and sex matched from the same population served as controls. Troponin I and Creatine Kinase-MB levels were estimated in both the groups.

Results: Results of present study shows that cardiac specific Troponin I and CK-MB levels were significantly higher in STEMI patients compared to healthy subjects with 'p' value of <0.0001. Pearson's correlation test show positive correlation between Troponin I and CK-MB in STEMI patients. 17% of STEMI patients had normal CK-MB levels, but there Troponin I levels were elevated significantly.

Conclusion: Troponin I level is more specific for confirming the diagnosis of acute myocardial infarction where CK-MB fails to do so.

Key Words: Troponin I, ST-segment elevation myocardial infarction (STEMI), Creatine Kinase – MB (CK-MB)

INTRODUCTION

Acute myocardial infarction occurs when coronary blood flow decreases abruptly after a thrombotic occlusion of a coronary artery previously affected by atherosclerosis and is the most common contributor of morbidity and mortality worldwide. Slowly developing, high-grade coronary artery stenoses do not typically precipitate ST-segment elevation myocardial infarction (STEMI) because of the development of a rich collateral network over time. [1]

In India, incidence of cardiovascular diseases was about 7% in 1970 and increased up to 32% in 2011 and 31.7% of deaths occur due to myocardial infarction. The huge burden of coronary artery disease in Indian subcontinent is the consequence of large population and high prevalence of cardiovascular risk factors like smoking, tobacco chewing, alcohol, low fruit and vegetable intake, lack of physical activity, obesity, high blood pressure, abnormal lipid levels and diabetes. [2]

Cardiac specific troponin I is present in three isoforms namely cardiac, skeletal slow-twitch and skeletal fast-twitch, encoded by three separate genes. However, cardiac specific Troponin I is expressed as a single isoform in adult heart but not in skeletal muscle. [3] Creatine Kinase, which is a cytosolic carrier protein for high-energy phosphates, has three isoenzymes: CK-MM (skeletal muscle), CK-BB (brain), and CK-MB (heart and skeletal muscle). Creatine Kinase - MB is most abundant in the heart. [4]

Corresponding Author:

Dr. Sandip R. Patel, 3rd Year Resident, Biochemistry Department, Government Medical College, Bhavnagar - Gujarat (India).
E-mail: dr.sandippatel1110@gmail.com

Jagannadha Rao Peela et al. reported that troponins have ushered in a new era of highly specific and sensitive cardiac markers for diagnosis of myocardial infarction.[5]

So, the present study was designed to measure and compare the changes in Creatine Kinase – MB and Troponin I level in patients of ST-segment elevation myocardial infarction.

MATERIALS AND METHODS

The present study was conducted at Department of Biochemistry, Government Medical College and Sir Takhtsinhji General Hospital, Bhavnagar in which 100 cases of ST-segment elevation myocardial infarction were included. The myocardial infarction patients were primarily diagnosed by cardinal symptoms like chest pain and 12-lead ECG (Echocardiogram). A group of 100 normal healthy individuals, age and sex matched from the same population served as controls. Inclusion criteria were both male and female above 18 years of age. Exclusion criteria were age less than 18 years and patients, not willing to give informed consent. The study was reviewed and approved by Human Ethics Committee of Government Medical College, Bhavnagar.

 Venous blood sample was collected in plain vacutainer from patients of ST-segment elevation myocardial infarction and from healthy controls and after centrifuging, were analyzed for CK-MB and Troponin I. CK-MB was estimated by using Fully auto analyzer I-Lab 650. Troponin I was estimated by using iMark Micro plate Absorbance Reader (Elisa Reader). Quality controls were done before analyzing both parameters. Methods of estimating CK-MB: Immuno-Inhibition method, Troponin I: ELISA (The enzyme-linked immunosorbent assay) method.

STATISTICAL METHODS

Results of the present study were analyzed by using Graph Pad in Stat version 3.0. In data analysis, comparison of these parameters for ST segment elevation myocardial infarction patients were carried out by applying unpaired t-test and their correlation were studied by applying Pearson Correlation test. Interpretation of the test result was done according to p value ($p < 0.05$ – significant, $p < 0.001$ – highly significant and $p \geq 0.05$ – not significant).

RESULTS

Present study includes 100 healthy controls and 100 STEMI patients. Control subjects include 34% females and 66% males, while STEMI patients comprise 23% females and 77% males. Mean age in STEMI patients was 47.33 ± 9.949

years which include 31 patients (31%) between 30-40 years, 36 patients (36%) between 41-50 years, 25 patients (25%) between 51-60 years and 8 patients (8%) between 61-70 years of age. The maximum number of patients belongs to age group between 41-50 years.

In healthy control mean of age was 46.66 ± 13.10 years which include 44 patients (44%) between 30-40 years, 16 patients (16%) between 41-50 years, 26 patients (26%) between 51-60 years and 14 patients (14%) between 61-70 years of age. The maximum number of patients belongs to age group between 30-40 years. (Table – 1)

The mean level of Troponin I was 1.428±0.960 ng/ml in STEMI patients and 0.0492±0.022 ng/ml in healthy subjects. The mean level of CK-MB was 99.48±41.33 U/L in STEMI patients and 28.67±9.219 U/L in healthy subjects. STEMI patients have significantly higher Troponin I and CK-MB level than healthy subjects. (Table – 2, 3)

Troponin I and CK-MB levels in STEMI patients were statistically highly significant with 'p' value of <0.0001. Pearson's correlation test shows significant positive correlation (0.6276) between Troponin I and CK-MB in STEMI patients. (Figure 1, Table – 4)

This study shows that 80% patients of STEMI have significantly higher Creatine Kinase - MB level and 97% patients of STEMI have significantly higher level of Troponin I. In 20 STEMI patients, CK-MB level was in the normal range (mean: 40.1 ± 5.76 U/L), out of this 17 patients had significantly high Troponin I level (mean: 0.88 ± 0.65 ng/ml), whereas 3 patients had normal Troponin I level in this group. (Table 5, 6)

DISCUSSION

Myocardial infarction is the most common contributor of morbidity and mortality worldwide. [2] India has the highest burden of acute coronary syndrome in the world. Patients with acute coronary syndromes in India tend to be young and from low socioeconomic groups, and to have a higher rate of STEMI than do patients in developed countries. [6]

The mean age of STEMI patients was 47.33±9.949 years (Table -1). Serum Troponin I and CK-MB levels were significantly higher in STEMI patients in comparison to healthy subjects (Table – 2, 3). A positive correlation was observed between Troponin I and Creatine Kinase – MB in STEMI patients with a Pearson correlation coefficient of 0.6276 (Figure- 1)(p<0.0001). This study shows that 80% of total 100 patient of STEMI have significantly higher Creatine Kinase - MB level while 97% of patient of STEMI have significantly higher level of Troponin I. However, 17 % of patients who had an Acute Myocardial Infarction had CK-MB levels

not significantly different from controls. In the same patients Troponin-I levels had been elevated. Hence, Troponin I is more specific for confirming the diagnosis of AMI.

Troponin I have emerged as sensitive and more cardiac specific clinical indicator for diagnosis of AMI. This is consistent with the studies conducted by previous researchers. S Joarder et al. [7] reported that Serum cTnI is better and more characteristic biomarker than CK-MB for risk prediction and prognosis evaluation in AMI patients. Allan S. Jaffe et al. [8] reported that Cardiac troponins (I or T) are the preferred markers for the diagnosis of myocardial injury.

CONCLUSION

From the present study it is concluded that cardiac specific Troponin I and Creatine Kinase - MB levels were significantly higher in STEMI patients in comparison to healthy subjects. However, in certain STEMI patients CK-MB show less predictive value as compared to Troponin I, therefore Troponin I can be used as a more sensitive and specific marker to detect myocardial infarction.

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Table 1: Age Distribution in STEMI patients and Healthy controls

Age in Years	STEMI patients	Percentage (%)	Healthy controls	Percentage (%)
30-40	31	31	44	44
41-50	36	36	16	16
51-60	25	25	26	26
61-70	8	8	14	14
Total	100	100	100	100
Mean ± SD	47.33±9.949		46.66 ±13.10	

Table 2: Cardiac specific Troponin I concentration in STEMI patients and control.

Statistics	Troponin I (R.I. = <0.1 ng/ml) (n=100)	
	STEMI Patients	Control
Mean	1.428	0.0492
Standard Deviation (SD)	0.960	0.022
Standard Error of Mean (SEM)	0.0960	0.001
Minimum	0.06	0.01
Maximum	4.7	0.1
Significance	*** p < 0.0001	

Table 3: Creatine Kinase-MB concentration in STEMI patients and control.

Statistics	CK-MB (R.I. = 18-51 U/L) (n=100)	
	Group I STEMI Patients	Group II Control
Mean	99.48	28.67
Standard Deviation (SD)	41.33	9.219
Standard Error of Mean (SEM)	4.133	0.9219
Minimum	32	10
Maximum	230	45
Significance	*** p < 0.0001	

Table 4: Correlation of Serum Troponin I with CK-MB in STEMI Patients.

Statistics	Cardiac Biomarkers	
	Troponin I (R.I. = <0.1 ng/ml) (n=100)	CK-MB (R.I. = 18-51 U/L) (n=100)
Mean	1.428	99.48
Standard Deviation (SD)	0.9610	41.33
Std. Error of Mean (SEM)	0.0961	4.133
Minimum	0.06	32
Maximum	4.7	230
Significance	*** p < 0.0001	

Table 5: Analysis of cardiac biomarker in STEMI patients

Cardiac Biomarker	STEMI patients
Troponin I (R.I. = <0.1 ng/ml) Positive (>0.5 ng/ml) Normal (<0.1 ng/ml)	97% 3%
CK-MB (R.I. = 18-51 U/L) Positive (>51 U/L) Normal (<51 U/L)	80% 20%

Table 6: Comparison between normal CK-MB values with Troponin I in STEMI patients.

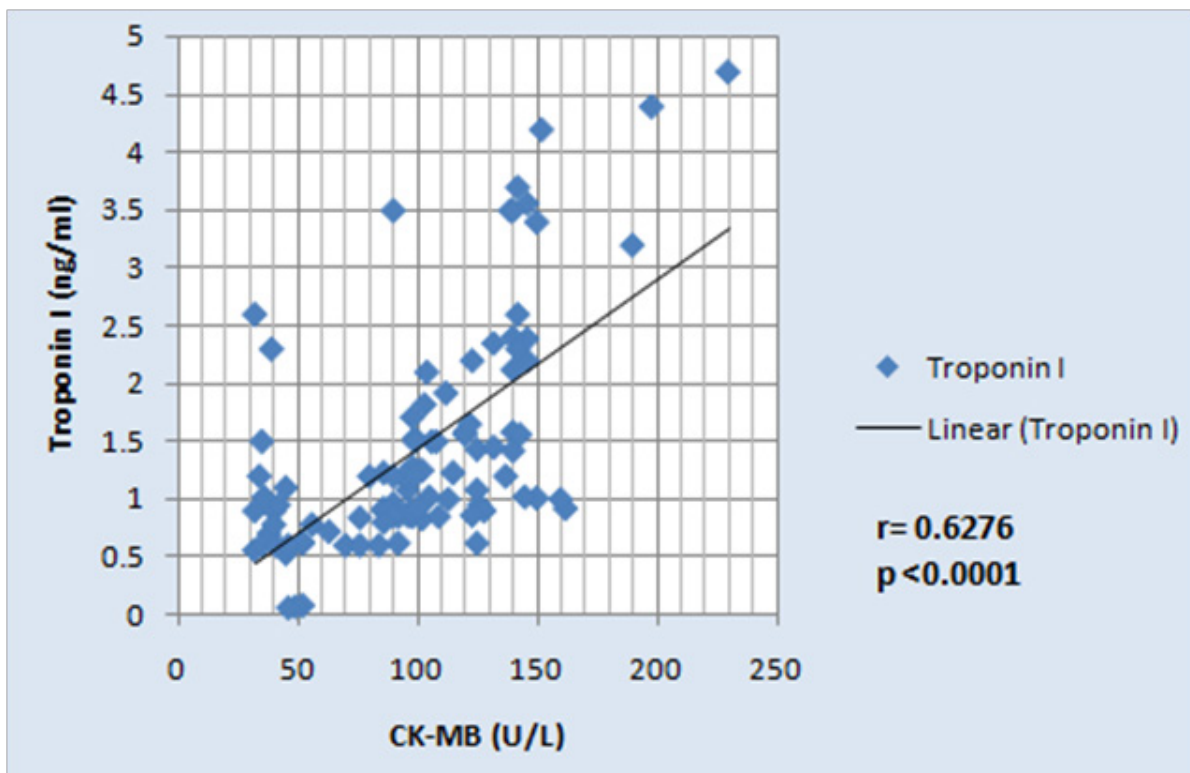| Statistics	STEMI patients	
	Troponin I (R.I. = <0.1 ng/ml) (n=20)	CK-MB (R.I. = 18-51 U/L) (n=20)
Mean ± SD	0.88 ± 0.65	40.1 ± 5.76
Positive	17	0
Normal	3	20

Figure 1: Correlation between CK-MB and Troponin I in STEMI Patients.