



Journal homepage: <http://www.journalijar.com>
Journal DOI: [10.21474/IJAR01](https://doi.org/10.21474/IJAR01)

INTERNATIONAL JOURNAL
OF ADVANCED RESEARCH

RESEARCH ARTICLE

CHANGES OF SERUM CARDIAC MARKERS AFTER ACUTE ATTACK OF MYOCARDIAL INFARCTION

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Manuscript Info

Abstract

Manuscript History:

Received: 17 February 2016
Final Accepted: 29 March 2016
Published Online: April 2016

Key words:

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Introduction:-

Acute myocardial infarction (AMI) is one of the most common diagnosis in hospitalized patients in industrialized countries. The early (30 days) mortality rate from AMI is approximately 30 percent, with more than half of these deaths occurring before individual reaches the hospital¹. So it has become one of the major causes of mortality in the world at present, and it is for this reason various researches are being done for its diagnosis and prognostic assessment. Serum enzyme estimation is an important tool for it².

In recent years, the incidence of MI has increased in the population because of change in lifestyle, urbanization, increase in mental stress, inadequate physical exercise and diet rich in lipid. It has also been observed that there is sudden increase in acute MI in young subjects mostly in second and third decades of life who show increased morbidity and mortality. Hence, this will become a dreadful condition for the next millennium.²

AMI accounts to cause about 1/3rd of total deaths in united states. So it has become very much necessary for us to diagnose AMI as quickly as possible because earlier diagnosis of attack of MI has great impact on treatment and its outcome. The use to 3 diagnostic methods to aid in clinical diagnosis of AMI, which includes electrocardiogram, enzyme analysis, non-invasive techniques and others which could help to provide early diagnosis of AMI.³

Accuracy of ECG diagnosis of AMI is not more than 80 percent and it is often found that in cases of early AMI the ECG could be normal. So the enzyme estimation has become of immense utility in early diagnosis.

Rapid appearance of CK-MB in the serum after AMI and improves specificity for myocardial injury provided by measurement of MB isoenzyme quickly established in the clinical setting⁴.

Troponin (cardiac troponin I and T) are very sensitive and specific indicators of damage to heart muscle (myocardium). They are measured in the blood to differentiate between unstable angina and myocardial infarction in patients with chest pain or acute coronary syndrome. A patient who had suffered from AMI would have an area of damaged heart muscle and so would have elevated cardiac troponin level in blood⁵.

In our study, we collected samples of 100 patients admitted for complain of chest pain to measure Troponin I, CK-MB, hsCRP, LDH and to see changes in these cardiac biomarkers with primary end point of sensitivity and specificity of these cardiac biomarkers.

Aims and objective:-

1. To study changes in serum cardiac markers after acute attack of MI.
2. To determine the sensitivity and specificity of Troponin I, CK-MB, hsCRP, LDH.
3. To establish usefulness of enzymes in early diagnosis of AMI.

Material and methods:-

Patients are selected from those attending department of medicine, G.G. Hospital, M.P. Shah Medical College, Jamnagar. Blood samples of patients were taken to measure the serum LDH, Troponin I, CRP, CK-MB levels by ELISA (enzyme linked immunosorbent assay) and their levels are compare with clinical condition, ECG changes and prognosis of the patients.

Observation and results:-

Demographic profile of the patients

Table 1:

Age group (yrs)	Num of Male patients	Num of Female patients	Total number of patients
21-30	02	02	04
31-40	06	00	06
41-50	14	02	16
51-60	28	10	38
61-70	14	04	18
71-80	09	04	13
81-90	03	02	05
Total	76	24	100

Incidence of risk factors

Table 2:

Risk factor	Num of positive cases			Num of negative cases		
	Male	Female	Total	Male	Female	Total
Smoking	58	0	58	18	24	42
Hypertension	54	20	74	22	4	26
IHD	50	22	72	26	2	28
Diabetes mellitus	32	23	55	44	1	45

Table 3:

Condition	Male	Female	Total
Acute MI	36	19	55
Unstable angina	19	06	25
LRTI	06	04	10
COPD	06	00	06
GERD	03	01	04

Total **100 patients** having **chest pain** were studied out of which **55** were diagnosed as having **acute attack of MI** and were treated accordingly. **Conditions associated with chest pain**

Table 4:

Serum cardiac markers done	Num of positive cases	Num of negative cases	Total no. Of cases
Trop-i	55	00	55
CK-MB	49	06	55
Hs-CRP	40	15	55
LDH	36	19	55

Table 5:

	Troponin I	CK-MB	P value	Significance
Sensitivity	100%	89.1%	0.002	HS
Specificity	100%	88.8%	0.0017	HS

NS – Non significant, S – significant, HS – Highly significant

When applying chi-square $\{X_2\}$ test to compare sensitivity and specificity of Troponin I and CK-MB the difference was statistically highly significant. (P value <0.05).

Table 6:

	Troponin I	hs-CRP	P value	Significance
Sensitivity	100%	72.7%	<0.0001	HS
Specificity	100%	62.2%	<0.0001	HS

NS – Non significant, S – significant, HS – Highly significant

When applying chi-square $\{X_2\}$ test to compare sensitivity and specificity of Troponin I and hs-CRP the difference was statistically highly significant. (P value <0.0001).

Table 7:

	Troponin I	LDH	P value	Significance
Sensitivity	100%	65.4%	<0.0001	HS
Specificity	100%	60%	<0.0001	HS

- NS – Non significant, S – significant, HS – Highly significant

When applying chi-square $\{X_2\}$ test to compare sensitivity and specificity of Troponin I and hs-CRP the difference was statistically highly significant. (P value <0.0001).

Discussion:-

Changes in Troponin I in patients complaining of chest pain:-

In present study, it was found that out of 55 patients who actually diagnosed to have acute myocardial infarction, Troponin I was elevated in all 55 patients. While in 45 patients who diagnosed to have other condition than acute myocardial infarction, Troponin I was elevated in none of them. (table 4).

In present study, sensitivity and specificity of Troponin I for diagnosis of acute myocardial infarction was 100%.

These results are comparable to other studies:

Adams JE 3rd et al⁶ (1993), evaluated cardiac Troponin I as a marker with high specificity for cardiac injury. They concluded that elevations of cTnI are highly specific for myocardial injury. Use of cTnI should facilitate distinguishing whether elevations of MBCK are due to myocardial or skeletal muscle injury.

Adams JE 3rd et al⁷ (1994), done a study on comparable detection of acute myocardial infarction by creatine kinase MB isoenzyme and cardiac troponin I. They concluded that cTnI and CK-MB had statistically indistinguishable diagnostic accuracies for the detection of acute myocardial infarction.

Brogan GX Jret al⁸ (1997), done a study on evaluation of a new assay for cardiac Troponin I vs Creatine kinase-MB for the diagnosis of acute myocardial infarction. They concluded cTn-I was as sensitive and specific for AMI as was CK-MB in ED patients who presented within 24 hours of symptom onset. However, cTn-I was more sensitive in patients who presented > or = 24 hours after symptom onset. Elevations of either marker within 6 hours of symptom onset predict an increased risk of complications and/or need for interventions.

Shazib Pervaiz et al⁹ (1997), done a comparative analysis of cardiac Troponin I and Creatine Kinase-MB as markers of acute myocardial infarction. They concluded that cTnI is an excellent marker for detecting and ruling out AMI, because it has better specificity and a wider diagnostic window than the accepted standard, CK-MB.

Durdi Qujeq¹⁰ (1999), done a study on rapid diagnosis of acute myocardial infarction. Consecutive 150 patients admitted to the coronary care unit was studied. They concluded that measurement of cTn-I accurately detects MI in patients and should facilitate the diagnosis and management of such patients.

Ross G et al¹¹ (2000), done a study on Troponin I-sensitivity and specificity for the diagnosis of acute myocardial infarction. They concluded that when a troponin I level greater than 0.6 ng/mL was used as a positive value, compared to CK-MB and ECG using either time zero or time 6 hours, the sensitivity was 94% and specificity was 81%. When troponin I greater than 2.0 ng/mL was used to define a positive test, the sensitivity was 85% and specificity was 91% when compared to CK-MB and ECG.

Kiran R. Bagaleet al¹²(2014), done a study on Role of CK-MB and Troponin-I in Diagnosing Non-ST-Elevation Myocardial Infarction. They concluded that Troponin-I can identify the minimal cardiac damage which will be useful for the physician to start immediate intervention.

Table 8:studies on sensitivity and specificity of troponin I

Authors	Year	Sensitivity	Specificity
Adams JE 3 rd et al ⁸⁴	1994	96.6%	94.9%
Apple FS et al ⁸⁵	1995	100%	91.9%
Jaffe AS et al ⁸⁷	1996	90%	---
Shazib Pervaiz et al ⁹⁰	1997	95%	97.4%
Ross G et al ⁹⁴	2000	85%	91%
Mahalaxmi S. Petimani et al ⁹⁸	2013	96%	98%
In present study	---	100%	100%

These data suggest that Troponin I is very sensitive and specific cardiac biomarker in diagnosis of acute myocardial infarction.

Changes in CK-MB in patients complaining of chest pain:-

In present study it was found that out of 55 patients who actually diagnosed to have acute myocardial infarction, CK-MB was elevated in all 49 patients. In 6 patients in spite of having acute myocardial infarction it remained in normal range. While in 45 patients who diagnosed to have other condition than acute myocardial infarction, CK-MB was elevated in 5 patients and in 40 patients it remained in normal range. (table 4).

In present study sensitivity and specificity of CK-MB for diagnosis of acute myocardial infarction was 89.1% and 88.8% respectively. When applying chi-square $\{X_2\}$ test to compare sensitivity and specificity of CK-MB with Troponin I the difference was statistically highly significant. (P value <0.05, table 7).

These results are comparable to other studies:

Adams JE 3rd et al⁷ (1994), done a study on comparable detection of acute myocardial infarction by creatine kinase MB isoenzyme and cardiac troponin I. They concluded that cTnI and MBCK had statistically indistinguishable diagnostic accuracies for the detection of acute myocardial infarction.

Brogan GX Jr et al⁸ (1997), done a study on evaluation of a new assay for cardiac Troponin I vs Creatine kinase-MB for the diagnosis of acute myocardial infarction. Patients who had elevations in either CK-MB or cTn-I within 6 hours of symptom onset were at increased risk for cardiovascular complications and/or interventions (CK-MB, OR 5.8; cTn-I, OR 6.3). So they concluded cTn-I was as sensitive and specific for AMI as was CK-MB in ED patients who presented within 24 hours of symptom onset. However, cTn-I was more sensitive in patients who presented > or = 24 hours after symptom onset. Elevations of either marker within 6 hours of symptom onset predict an increased risk of complications and/or need for interventions.

Shazib Pervaiz et al⁹ (1997), done a comparative analysis of cardiac Troponin I and Creatine Kinase-MB as markers of acute myocardial infarction. They concluded that cTnI is an excellent marker for detecting and ruling out AMI, because it has better specificity and a wider diagnostic window than the accepted standard, CK-MB.

Janice Zimmerman et al¹³(1999), done a diagnostic marker cooperative study for the diagnosis of myocardial infarction. They found that with each marker as the diagnostic standard, CK-MB subforms and myoglobin remained the most sensitive for early diagnosis. So they concluded that the CK-MB subform assay alone or in combination with a troponin reliably triages patients with chest pain and should lead to improved therapy and reduced cost.

Bock JL et al¹⁴(1999), done an evaluation of CK-MB isoform analysis for early diagnosis of myocardial infarction. They concluded that analysis of CK-MB by high-voltage electrophoresis is an effective method for rapid diagnosis of MI, with the isoform analysis enhancing early sensitivity.

Table 9: studies on sensitivity and specificity of ck-mb.

Authors	Year	Sensitivity	Specificity
Apple FS et al ⁸⁵	1995	100%	85.6%
Fitzgerald RL et al ⁸⁶	1996	81%	97%
Shazib Pervaiz et al ⁹⁰	1997	96.4%	85.8%
Janice Zimmerman et al ⁹¹	1999	91%	89%
Bock JL et al ⁹²	1999	92%	92%
In present study	---	89.1%	88.8%

These data suggest that CK-MB is very sensitive cardiac biomarker for diagnosis of acute myocardial infarction but its sensitivity and specificity are not as much as Troponin I. As CK-MB reaches its normal value within 2-3 days it is helpful in diagnosis of reinfarction.

Changes in hs-CRP in patients complaining of chest pain:-

In present study, it was found that out of 55 patients who actually diagnosed to have acute myocardial infarction, hs-CRP was elevated in all 40 patients. In 15 patients in spite of having acute myocardial infarction it remained in normal range. While in 45 patients who diagnosed to have other condition than acute myocardial infarction, hs-CRP was elevated in 17 patients and in 28 patients it remained in normal range. (table 4).

In present study sensitivity and specificity of hs-CRP for diagnosis of acute myocardial infarction was 72.7% and 62.2% respectively. When applying chi-square $\{X_2\}$ test to compare sensitivity and specificity of hs-CRP with Troponin I the difference was statistically highly significant. (P value < 0.0001, table 9).

These results are comparable to other studies:

Zohair Al Aseriet al¹⁵(2014), done a study on relationship of high sensitivity C-reactive protein with cardiac biomarkers in patients presenting with acute coronary syndrome. They concluded that high sensitivity CRP levels is a significant predictor of standard markers for myocardial damage and it may be a useful prognostic marker in acute coronary syndromes.

Table 10: studies on sensitivity and specificity of hs-crp.

Authors	Year	Sensitivity	Specificity
Reza Madadi et al ⁹⁹	2013	77%	77%
Ayman Al-Salehet et al ¹⁰⁰	2014	95%	95%
In present study	---	72.7%	62.2%

These data suggest that increase in levels of hs-CRP is well correlated with Troponin I, CK-MB. hs-CRP is a good marker of myocardial damage but it is not as much as sensitive as Troponin I in diagnosis of acute myocardial infarction.

Changes in LDH in patients complaining of chest pain:-

In present study, it was found that out of 55 patients who actually diagnosed to have acute myocardial infarction, LDH was elevated in all 36 patients. In 19 patients in spite of having acute myocardial infarction it remained in normal range. While in 45 patients who diagnosed to have other condition than acute myocardial infarction, LDH was elevated in 18 patients and in 27 patients it remained in normal range. (table 4).

In present study sensitivity and specificity of LDH for diagnosis of acute myocardial infarction was 65.4% and 60% respectively. When applying chi-square $\{X_2\}$ test to compare sensitivity and specificity of LDH with Troponin I the difference was statistically highly significant. (P value < 0.0001, table 11).

These results are comparable with other studies:

Martins JT et al¹⁶ (1996), done a study on comparison of cardiac troponin I and lactate dehydrogenase isoenzymes for the late diagnosis of myocardial injury. In this study, the sensitivity of cardiac troponin I (cTnI) and LD1/LD2 were compared as late markers of myocardial injury over a 5-day period in 36 patients admitted with a diagnosis of myocardial infarction to the coronary care unit. Over this period, the sensitivity of cTnI was significantly greater than that of LD1/LD2 (P < 0.05). They concluded that cardiac troponin I (cTnI) has greater sensitivity than lactate dehydrogenase isoenzymes for delayed diagnosis of myocardial injury and is a more cost-effective test, the authors recommend it as a test of choice in this setting.

Table 11: studies on sensitivity and specificity of ldh.

Authors	Year	Sensitivity	Specificity
Fitzgerald RL et al ⁸⁶	1996	67%	80%
Jaffe AS et al ⁸⁷	1996	90%	---
In present study	---	65.4%	60%

These data suggest that LDH is a marker of myocardial damage but not as much sensitive and specific as Troponin I, CK-MB.

Conclusion:-

Based on present study, it is concluded that acute myocardial infarction require immediate diagnosis and intervention. In early diagnosis cardiac markers are very useful to differentiate acute myocardial infarction from other conditions.

Among the cardiac markers studied Troponin I is the most specific and sensitive for diagnosis of acute myocardial infarction. As CK-MB levels become normal within 2-3 days it is helpful in diagnosis of reinfarction. hs-CRP and LDH are also the markers of myocardial damage. So for the early diagnosis and intervention of acute myocardial infarction these markers are very helpful.

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