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EVALUATION OF BNP, CPK-MB AND TROPONIN-I LEVEL IN ACUTE MYOCARDIAL INFARCTION

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ABSTRACT **Introduction:** Acute myocardial infarction (AMI) is one of the greatest causes of death and morbidity around the globe. **Methods:** This study was conducted in the Department of Biochemistry at IGIMS, Patna during Dec 2021 to Jun 2022 as a case-control study. Total 80 individuals were considered for the study, 40 each in case and 40 in control groups. BNP and Troponin I was measured by Chemilumniscence immunoassay (CLIA).CPK-MB was measured by fully automated analyzer. **Results:** As present study show the BNP Levels were increased significantly (P<0.001) in the AMI (2200±601.30) as compared in controls (90.20±3.20). The mean values of serum CK-MB and troponin I were significantly (P<0.001) higher in the AMI (165±47.21, 1.48±0.45) as compared to those in the healthy controls (11.50±0.80± 3.250, 0.03±0.01) respectively. **Conclusions:** In my study Troponin-I is found to be better reliable cardiac marker for the diagnosis of non-ST-elevation myocardial infarction as compared to BNP and CK-MB, but combined detection of CK-MB, Troponin I and BNP levels will contribute more significantly to the early detection and in acute phase it reduces AMI mortality.

KEYWORDS : Troponin I, AMI, BNP, CPK-MB.

INTRODUCTION:

Evaluation of cardiac enzymes have been in use since the mid 20th century in the patients with suspected acute myocardial infarction (AMI), and it is considered as the most important cause of death worldwide [1]. Electrocardiography (ECG) is commonly used in the clinical setting for the diagnosis of AMI, but it has low specificity and sensitivity in identifying the region of ischemia, as the criteria for AMI were established by the European Society of Cardiology (ESC) and the American College of Cardiology (ACC)[2,3]. Numbers of biomarkers are available for the diagnosis of AMI with different diagnostic efficacy. Aspartate aminotransferase (AST) is the first biomarker used for the diagnosis of AMI, and it is released from cardiomyocytes during necrosis proposed by Ladue et al in 1954 [4],it increases in the blood within 3-4 hrs and reach at the peak in 16-29 hrs and finally return to normal in 3-5 days. In recent years, a newer cardiac marker such as troponins-I has been evaluated against conventional cardiac markers such as creatine kinase MB isomer (CKMB), and it is not an ideal marker for detecting acute MI as it lacks tissue specificity for cardiac tissue increases in non-cardiac conditions such as skeletal muscle injury, chronic renal failure, hypothyroidism and severe exercise and is only detectable in the circulation in a relatively short time-frame[5,6],CK-MB comes to normal after 48 to 72 hours after myocardial ischemia (vs. troponins, which can persist for days), it can be useful in evaluating re-infarction if levels rise again after declining.

Cardiac troponin is the first-line test for monitoring patients with suspected acute MI. In September 2000 the European Society of Cardiology and American College of Cardiology released a guidelines, For the diagnosis of AMI a patient has to have at least two of the following: typical symptoms, characteristic increase or decrease pattern in cardiac markers such as (CK-MB isoenzymes), and serum troponins (cTnI or cTnT), or a typical ECG trace with Q waves [7,8],it also defined AMI as an increase of serum troponin greater than the level that expected from the 99 percentile of a healthy reference people included the signs and symptoms of cardiac ischemia[9]. Troponin is found in cardiac (TnT and TnI) and skeletal muscles, a type of contractile protein comprised up of three subunits, troponin C (binding to calcium), troponin I blocking actin–myosin interaction) and troponin T TnT (bound to tropomyosin), because they are present in heart and skeletal muscle, it is specific and sensitive biomarkers of cardiac myocyte injury [10], and interact with tropomyosin to form the main structure of the striated heart muscle. The levels of Troponin T and troponin I in the blood rise as early as 4 hours from the onset of AMI symptoms, and reaches at the peaks in 24 to 48 hours, and remain rose for multiple days thereby making them useful for detecting initial ischemic events but not useful to detect re-infarction [11].

Another most commonly use cardiovascular biomarkers proteins released into the circulation by the cardiac system is brain natriuretic peptide (BNP), it is a 32-amino acid peptide vasoactive neurohormones secreted primarily by cells in the ventricular wall in response to increases in wall stress [12-14] with having high diagnostic and prognostic value in predicting left ventricular systolic dysfunction, heart failure and monitoring and treatment of cardiac decompensation [15, 16].

Bassan et al reported that BNP was effective predictor of AMI, commonly in patients with chest pain and non-diagnostic ECG and creatine kinase MB (CKMB) and troponin blood levels [17].

The current study was undertaken to measure the role of these biomarkers serum cardiac Troponin-I is strongly sensitive marker than serum CPK-MB and BNP in the early diagnosis of acute myocardial infarction (AMI).

MATERIALS AND METHODS

The study was carried out in the IGIMS (tertiary care hospital), Patna. This was a hospital based cross sectional study carried out from Feb 2022 to Feb 2023.

Along with 40 control subjects, 40 AMI subjects were considered with an age group from 30 to 70 years of either sex were included in the study by using the WHO diagnostic criteria of MI, the patients with history of chest pain suggestive of AMI, selected by random method.

Inclusion criteria

Patients attending Tertiary care hospital during the study period with proved acute myocardial infarction with history of chest pain suggestive of acute myocardial infarction studied.

Exclusion criteria

Patients with Acute pericarditis, severe heart failure, acute myocarditis, Cardiac trauma, chronic renal failure, skeletal muscle disease and or trauma, Hematologic malignancies and Cerebrovascular accident were excluded from the study. Study protocol Clinical history was taken either from patient or his/ her relatives or attendant after obtaining informed consent. While taking history importance was given regarding chest pain; its site, nature, duration, radiation, relation with exertion, sweating and vomiting, gastrointestinal system and central nervous system were examined in detail. Detailed investigations including CBC, FBS, fasting lipid profile, Blood urea, serum creatinine, ECG, chest X-ray, serum CK-MB and serum cTnI were done.

A brief clinical history was taken from all cases. The estimation of serum CK-MB, BNP and trop I were performed from the blood within 12 hours of onset of symptoms of cases as well as from controls. BNP

levels were estimated by ELISA .Trop I by rapid card test, and CK-MB by fully automated autoanalyser

RESULTS:

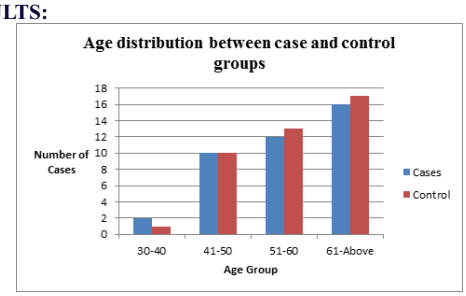

Figure 1 Age distribution in AMI patients (n=80)
Figure 1: Age distribution in case and control group

The most of the cases i.e. 16(40%) are in the age group of 61 and above years (Fig. 1). Among controls most of them i.e. 17 (42.5%) belong to 61 and above years age group.

Out of total of 40 patients in which 14 patients [35%] were Troponin-I positive and 26 patients [65%] were Troponin-I negative. Also, CK-MB was found to be increased in 25% of patients within 6 hours and in 30% within 12 hours, whereas, cTnI was positive in only 15% and 20% within 6 hours and 12 hours respectively (Table 1).

Table 1: Positive cardiac biomarkers following an episode of AMI in different time interval

Sr.No	Parameter	**0-6 hours**	**6-12 hours**	After 12 hours
1.	CK (MB)	10	12	19
2.	cTn (I)	6	8	14

After 12 hours of onset of chest pain, the sensitivity of both the cardiac biomarkers increases but more in favors of cTnI .Present results revealed that cardiac troponin I was more sensitive than CK-MB in overall cases admitted in between 6-24 hrs from the onset of chest pain. 6-8 hours of onset of chest pain to admission, cTnI is more sensitive than CKMB. Majority 78% of the AMI patients were admitted to ICCU department within 12 hours of onset of chest pain. Table 1 shows that in 45 percent of AMI cases were positive for CKM B (sensitivity of 45%) were as 62% of AMI cases were positive for cTnI (sensitivity 62%). This reveals that cTnI was more sensitive as compared to CKM B in detecting AMI among patients admitted between 6-24 hours of chest pain. Further the sensitivity of cTnI was better compared with CKM B during 6 to 8 hours after onset of chest pain (64%) and after 12 hours of onset of chest pain (sensitivity 75%) 28% of cases. The mean value of CK-MB, Troponin-I and BNP were higher in AMI patients group as compared to control group (Table 2).

Table No 2: Mean and standard deviation of BNP, CPK-MB, Trop-I Levels

Sr.No	**Parameter**	**Study group (AMI patient)**	**Control group (Healthy subject)**	**Standard Error**	**t-tatistics**	**Significance level**
1.	BNP (pg/ml)	1780.9±440.8	78.6±1.8	69.697	-24.42	P < 0.0001
2.	Trop-I (ng/ml)	1.32±0.4	0.03±0.01	0.063	-20.390	P < 0.0001
3.	CPKMB (IU/L)	159.8±44.8	10.9±0.7	7.084	-21.01	P < 0.0001

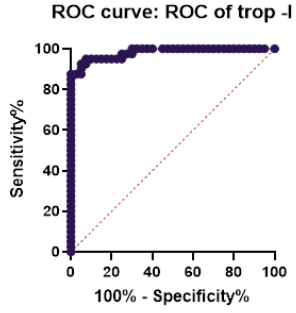

Figure 2: Receiver operating characteristic curves (ROC) of markers incase of AMI.

AUC was calculated using ROC analysis to rule out the diagnostic efficacy. Within the 1hr duration were given to spotlight the initial stages of AMI and it is very crucial to rescue the patient. The area under the curves (AUC) is shown in Figs. 2

Table 3: Area under the ROC curve, p value and the 95% confidence interval for cTnI and CK-MB levels

Parameter	Area under the curve (AUC)	P value	*95% CI*
Trop-i	0.98	<0.0001	0.9597 to 1.000
CKMB	0.97	<0.001	0.947 to 1.009

DISCUSSION:

In the acute ischemic cascade, BNP release is supported by several studies in experimental models of infarction and systolic and diastolic dysfunction is the first step in this process. Myocardial cells releases BNP when there is wall stress or overload, especially if systolic dysfunction is present **[18- 20],** previous studies have demonstrated that in AMI patients plasma BNP gene transcription increases significantly, reflecting biphasic behavior in those with large infarct and/or significant systolic dysfunction.**[21].**

CK-MB isoenzyme can be highly specific for myocardial damage and acute myocardial infarction (AMI), currently cardiac troponin (cTn) I and T are the gold standard tests [22]. The improved specificity of Troponin 1 over CK-MB is demonstrated in patients with skeletal muscle injury whereby high concentrations of CK-MB were observed in the absence of cardiac injury Troponin-I is more specific and sensitive than CK-MB specifically in case of minor myocardial damage as reported by Dawson et al and Harris et al in separate studies [23], [24], [25]. S. Gupta et al and Murray et al study was similar to our findings and noted that Troponin-I is better cardiac marker indicator [26], [27]. Robert et al also reported that troponin I future predictor of unstable angina cases [28]. In acute myocardial infarction CK-MB is a useful cardiac marker and plays an important role. With the advent of troponin I, having more sensitive and accurate than CK-MB for detecting cardiac injury, the measurement of CK-MB is not essential, and several authors recommended that CK-MB is not useful for the diagnosis of acute coronary syndrome [29, 30].

CONCLUSION:

Troponin-I is found to be an important reliable cardiac marker for the diagnosis of non-ST-elevation myocardial infarction as compared to CK-MB and BNP, but combined detection of CPK MB, BNP and Troponin I levels will contribute more significantly to the early diagnosis of AMI, and for the early diagnosis and treatment of the patient it will very useful.

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