To Study the Level of Cardiac Biomarkers in Patients under Going Acute Myocardial Infaraction

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Abstract: Myocardial infarction is a condition which is mainly happens due to blockage in the flow of blood circulation e.g: in veins, arteries, blood vessels. Cardiac Biomarkers are substances that get released into the blood when the heart is damaged. Cardiac biomarkers can be detected in blood by a specialized immunoassay. They are used to help diagnosis, evaluate, and monitor patients with suspected acute coronary syndrome (ACS). Cardiac biomarkers are not necessary for the diagnosis of patients who present with ischemic chest pain and diagnostic ECG with ST segment elevation. But cardiac biomarkers are very useful in patients of non-diagnostic ECG.

Material and Method: The two groups were generated from a total of 50 subjects in my research projects. 27 abnormal, 23 control-normal/ borderlines. The Mindray 200 Fully Auto Biochemistry Analyzer tested the patients' biochemistry by measuring the levels of cardiac biomarkers in the acute myocardial infarction tested like CK (Creatine kinase), CK-MB (Creatine kinase-MB), LDH (Lactate Dehydrogenase) by enzymatic reaction and Trop-I by card method. Result: The results were expressed as Mean ± SD. The statistical analysis of the data was carried out with statistical package of social sciences (SPSS), version 20.0. The comparison between two groups was tested by 't' test. In most of the cases males are more affected. The values of CK in males groups of patients seen in increased levels, on the other hand the value of CK-MB in females groups of patients remined normal on or borderline, where as some of the patients from both groups shows positive results in trop-I card method test. Conclusion: it is found that appropriate study of cardiac markers like Total CK, CK-MB, LDH, , cTn-T, cTn-I is significant for the study and evaluation of myocardial infarction. Males are at higher risk than female for cardiac disease and also from my study it is found that cTn –Tis the reliable markers . Troponin-T is the best cardiac marker for detection of Myocardial Infarction (MI).

I. INTRODUCTION

A biomarker is a measurable substance used as an indicator of a biological state. It can objectively signify normal biological processes, pathogenic changes, or responses to therapeutic interventions. In cardiovascular diseases, biomarkers are essential tools for diagnosing acute coronary syndrome (ACS) and acute myocardial infarction (AMI), which are among the leading causes of mortality worldwide [1, 2].

Cardiac biomarkers are substances released into the bloodstream when the heart is damaged. These include enzymes such as creatine kinase (CK), isoenzymes like CK-MB, proteins such as lactate dehydrogenase (LDH), and troponins T and I. Troponins, particularly, are considered the gold standard for detecting myocardial injury due to their high specificity to cardiac tissue. Troponin levels rise within 4–6 hours after the onset of symptoms, peak at 12–24 hours, and remain elevated for up to 10 days, making them reliable for diagnosing both acute and recent cardiac injury [3, 4].

Globally, cardiovascular diseases remain a leading cause of death. An estimated 17.9 million deaths are attributed to these conditions annually, with AMI accounting for a significant portion. In the United States alone, approximately 1 million individuals experience heart attacks each year, with nearly 50% being fatal [5, 6]. Advances in diagnostic technologies, including the use of high-sensitivity cardiac biomarkers, have significantly improved the early detection and management of AMI. However, timely diagnosis remains a challenge, particularly in patients presenting with atypical symptoms or non-diagnostic ECG findings [7, 8].

Integrating cardiac biomarkers with clinical assessment has revolutionized the approach to diagnosing AMI. While ECG remains a critical tool for identifying ST-segment elevation myocardial infarction (STEMI), its sensitivity in detecting non-ST elevation MI (NSTEMI) is limited. In such

cases, biomarkers like TROP-I, CK, CK-MB, and LDH provide crucial diagnostic and prognostic information, enabling more accurate patient risk stratification and tailored therapeutic interventions [9, 10].

This study aims to evaluate the diagnostic and prognostic utility of cardiac biomarkers in patients experiencing AMI. By analyzing CK, CK-MB, LDH, and TROP-I levels in patient and control groups, this research seeks to contribute to the optimization of AMI detection and management protocols

Aim of the Study

The primary aim of this study is to evaluate the levels of specific cardiac biomarkers in patients undergoing acute myocardial infarction (AMI).

Objectives of the Study

1. To assess the levels of cardiac biomarkers including CK (Creatine Kinase), CK-MB (Creatine Kinase-MB), LDH (Lactate Dehydrogenase), and TROP-I (Troponin I) in patients suspected of having AMI.
2. To analyze the correlation between biomarker levels and AMI diagnosis in patients with different clinical presentations, including those with non-diagnostic ECG findings.
3. To compare biomarker levels between control groups and AMI patients to identify significant variations.
4. To evaluate gender-based differences in the presentation and biomarker levels in AMI patients.
5. To utilize these findings to enhance diagnostic accuracy and improve the clinical management of AMI cases.

II. METHODOLOGY

Study Design and Setting

This was an observational, analytical study conducted to evaluate the levels of cardiac biomarkers in patients presenting with acute myocardial infarction (AMI). The research was carried out in apex diagnostic centre jalandhar equipped with advanced biochemistry analysis tools.

Study Population

The study included a total of 50 participants divided into two groups:

1. AMI Patients (Case Group): 27 patients with suspected myocardial infarction based on clinical symptoms and initial diagnostic tests.
2. Control Group: 23 individuals with no significant cardiac issues or borderline results to serve as a baseline for comparison.

Inclusion and Exclusion Criteria

- Inclusion: Patients with suspected acute myocardial infarction based on symptoms such as chest pain, abnormal ECG findings, or initial clinical assessment. Control subjects were selected to have no history of cardiac events.
- Exclusion: Patients with coexisting severe infections, advanced renal or liver diseases, or those already undergoing treatment for chronic heart conditions were excluded.

Sample Collection

- Venous blood samples were collected aseptically from all participants.
- Serum was separated immediately by centrifugation and analyzed promptly or stored at 2–8°C if delayed. Care was taken to avoid hemolysis or contamination.

Biochemical Assays Conducted

1. CK (Creatine Kinase):
   - CK activity was measured using an enzymatic reaction catalyzing creatine phosphate conversion.
   - NADPH production during the reaction was quantified spectrophotometrically at 340 nm.
2. CK-MB (Creatine Kinase-MB):
   - An immunoinhibition method was employed to specifically quantify CK-MB levels.
   - Absorbance changes at 340 nm were recorded, and results were expressed in U/L.
3. LDH (Lactate Dehydrogenase):

- LDH activity was determined using the enzymatic conversion of pyruvate to lactate.
- The assay monitored NADH oxidation spectrophotometrically at 340 nm.

4. TROP-I (Troponin I):

- A rapid, immunochromatographic card test was used to detect cardiac-specific troponin I levels.
- The presence of bands indicating cTnI concentrations was interpreted semi-quantitatively.

Instruments Used

- Analyzer: Mindray 200 Fully Auto Biochemistry Analyzer for precise biochemical measurements.
- Troponin Card Test: A qualitative kit specifically designed for cardiac troponin detection.

Statistical Analysis

- Data were processed and analyzed using SPSS (version 20.0).
- Results were expressed as Mean ± Standard Deviation (SD).
- The comparison between the case and control groups was conducted using an independent t-test.
- A p-value of <0.05 was considered statistically significant.

Outcome Variables

- Biomarker levels (CK, CK-MB, LDH, TROP-I) in AMI patients compared to controls.
- Variations in biomarker levels between male and female participants.
- Diagnostic reliability and predictive value of TROP-I for AMI detection

Demographic Characteristics

The demographic analysis revealed that males were more frequently affected by AMI than females. The differences in distribution were statistically insignificant.

Parameter	Total Subjects (n=50)	Males (n=27)	Females (n=23)	p-value
All Subjects	100%	56%	44%	0.34
Controls	100%	50%	50%	0.88
TROP-I Negative	100%	54.16%	45.84%	0.41
TROP-I Positive	100%	56.25%	43.75%	0.39

Comparison of Age and Weight

The average age and weight were compared among control subjects, TROP-I-negative patients, and TROP-I-positive patients. AMI patients were older and heavier compared to controls.

Subjects	Age (years)	Weight (kg)
Controls	50.7 ± 7.43	60 ± 8.23
TROP-I Negative	74.91 ± 12.76	60.16 ± 5.25
TROP-I Positive	68.5 ± 7.38	77.75 ± 9.86

Biochemical Parameters

The levels of CK, CK-MB, and LDH were significantly elevated in AMI patients compared to controls. TROP-I-positive patients exhibited the highest biomarker levels**.**

Subjects	CK (U/L)	CK-MB (U/L)	LDH (U/L)
Controls	147.3 ± 13.78	22.0 ± 2.49	277.9 ± 23.34
TROP-I Negative	268.43 ± 69.96	56.25 ± 15.83	388.20 ± 49.12
TROP-I Positive	452.0 ± 49.82	97.31 ± 10.95	758.56 ± 145.08

III. DISCUSSION

This study evaluated the diagnostic utility of cardiac biomarkers in patients with acute myocardial infarction (AMI), focusing on CK, CK-MB, LDH, and TROP-I. The findings align with existing

literature, highlighting the critical role of these biomarkers in diagnosing and monitoring AMI.

1. Gender-Distribution:
   The study observed a higher prevalence of AMI in males compared to females, consistent with global data indicating gender-based differences in cardiovascular risk. Hormonal factors, particularly estrogen, are believed to confer some degree of cardio protection in premenopausal women, which diminishes with age.

2. Age and Weight Correlation:
   Older age and higher body weight were significantly associated with TROP-I-positive cases. These findings underscore the established association between advancing age, obesity, and increased cardiovascular risk. Obesity contributes to atherosclerosis and metabolic disturbances, exacerbating myocardial ischemia.

3. Biomarker Trends:

   - CK and CK-MB: Elevated levels of CK and CK-MB in AMI patients validate their diagnostic utility. CK-MB is particularly useful for identifying myocardial necrosis, though it lacks the cardiac specificity of troponins.

   - LDH: The significant elevation in LDH levels in AMI patients reflects myocardial tissue damage. However, LDH's non-specificity limits its utility as a standalone marker.

   - TROP-I: Troponin I emerged as the most sensitive and specific biomarker for AMI diagnosis, with significantly elevated levels in affected patients. Its prolonged elevation post-AMI makes it invaluable for detecting recent infarctions.

4. Clinical-Implications:
   The results reinforce the importance of a biomarker-based diagnostic approach, especially in cases where ECG findings are inconclusive. Combining TROP-I with other markers like CK-MB enhances diagnostic accuracy, particularly in early and borderline cases.

CONCLUSION

This study highlights the critical role of cardiac biomarkers in diagnosing and managing acute myocardial infarction. The following conclusions can be drawn:

1. Diagnostic Utility of Biomarkers:
   Among the biomarkers studied, TROP-I demonstrated the highest diagnostic reliability due to its specificity and sensitivity for cardiac injury. CK-MB and LDH provide complementary information but are less specific.

2. Gender and Demographic Patterns:
   Males are at a higher risk of AMI than females, and advancing age and increased body weight are significant risk factors. These findings underscore the need for tailored prevention strategies based on demographic and clinical profiles.

3. Clinical Recommendations:

   - TROP-I should be the preferred biomarker for diagnosing AMI, particularly in non-diagnostic ECG cases.

   - CK-MB and LDH may be used as supplementary markers to confirm myocardial injury.

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