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Evaluation of biochemical parameters in acute myocardial infarction and angina patients

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Abstract:

Background: Acute myocardial infarction (AMI) and angina pectoris are significant clinical manifestations of cardiovascular diseases, necessitating prompt diagnosis and management. Although traditional biomarkers like troponins and creatine kinase are valuable, additional biochemical parameters may enhance diagnostic accuracy and aid in risk stratification. This study aims to evaluate the role of specific biochemical markers in AMI and angina patients compared to healthy controls in the Mangalorean population.

Methods: A cross-sectional study was conducted, recruiting AMI and angina patients from major hospitals in Mangalore, along with age and sex-matched healthy controls. Biochemical parameters, including cardiac enzymes, inflammatory markers, lipid profiles, and others, were measured. Statistical analyses assessed differences between groups, correlations with disease severity, and predictive accuracies of biomarker combinations.

Results: Significant elevations in troponin I, creatine kinase-MB, myoglobin, C-reactive protein, total cholesterol, and triglycerides were observed in both AMI and angina patients compared to healthy controls ($p < 0.05$). Troponin I exhibited the highest sensitivity and specificity in distinguishing patients from controls. Moreover, biochemical markers showed associations with disease severity and short-term prognosis in AMI patients ($p < 0.05$). Population-specific variations were observed in certain biomarkers between South Indian and North Indian participants ($p < 0.05$).

Conclusion: The study highlights the diagnostic and prognostic significance of specific biochemical markers in AMI and angina patients. Troponin I and myoglobin demonstrated

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superior diagnostic accuracy. These findings could enhance early diagnosis, risk stratification, and patient management in cardiovascular diseases.

Keywords: Acute Myocardial Infarction, Angina Pectoris, Biochemical Markers, Diagnostic Accuracy, Prognosis, Population-Specific Variations

Introduction:

Cardiovascular diseases (CVDs) continue to be a major global health burden, accounting for a significant proportion of morbidity and mortality worldwide. Amongst the various manifestations of CVDs, acute myocardial infarction (AMI) and angina pectoris stand as prominent clinical entities, representing critical conditions that demand immediate attention and management. AMI, commonly known as a heart attack, arises from the sudden occlusion of a coronary artery, leading to irreversible myocardial damage. On the other hand, angina pectoris, characterized by chest pain and discomfort, is caused by transient myocardial ischemia due to reduced coronary blood flow.[1,2]

Despite substantial advancements in diagnostic and therapeutic approaches for cardiovascular disorders, AMI and angina continue to present significant challenges to healthcare providers and researchers alike. The early and accurate identification of these conditions, along with their underlying pathophysiological changes, remains a pivotal goal to enhance patient outcomes and reduce the burden of CVDs on healthcare systems.[3]

The significance of understanding the biochemical profiles of AMI and angina patients lies in the potential to refine existing diagnostic methods and improve patient care. Traditional diagnostic tools such as electrocardiography and cardiac enzyme assays, like troponins and creatine kinase, have been valuable in identifying myocardial injury and guiding clinical decision-making. However, there remains a need to explore additional biochemical markers that could enhance the sensitivity and specificity of diagnostics, allowing for early detection and prompt intervention. Moreover, the population-specific variability in biochemical parameters must also be taken into account, as genetic and environmental factors can influence the expression and response of various biomolecules.[4,5]

This research investigate the role of specific biochemical markers in the diagnosis, prognosis, and management of AMI and angina patients. By comprehensively assessing these biochemical parameters, we seek to gain deeper insights into the molecular processes underlying these conditions and to identify potential indicators that could aid in risk stratification and treatment decisions.

Aims & Objectives:

The primary aim of this research article is to evaluate and compare the biochemical parameters in acute myocardial infarction (AMI) and angina patients with those of healthy controls in the population of Mangalore.

The specific objectives of this study are:

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE8, 2023

- To assess and compare the levels of key biochemical markers associated with AMI and angina patients, including cardiac enzymes (troponins, creatine kinase-MB, myoglobin), inflammatory markers (C-reactive protein), lipid profiles, and other relevant biomolecules.
- To investigate potential differences in the biochemical profiles of AMI and angina patients, aiming to identify specific markers that may aid in distinguishing between these two conditions.
- To explore the association between the levels of biochemical parameters and the clinical outcomes of AMI and angina patients, including disease severity, prognosis, and the occurrence of major adverse cardiovascular events (MACE).
- To assess any population-specific variations in biochemical markers among the Mangalorean population, considering potential genetic, environmental, and lifestyle factors that might influence the expression and response of these biomolecules.
- To provide valuable insights into the potential utility of specific biochemical markers as adjuncts to existing diagnostic tools, aiding in the early and accurate identification of AMI and angina, thereby facilitating timely interventions and improved patient outcomes.

Methodology:

Study Design:

This research employs a cross-sectional study design, enabling the simultaneous assessment of biochemical parameters in AMI and angina patients and healthy controls at a single time point. The cross-sectional approach allows for a comprehensive evaluation of biomarker levels in the study population without the need for longitudinal follow-up.

Study Participants:

A carefully selected cohort of AMI and angina patients will be recruited from major hospitals and healthcare facilities in Mangalore. Additionally, age and sex-matched healthy individuals without any history of cardiovascular diseases will be included as the control group. The study population included 100 acute myocardial infarction (AMI) patients, 100 angina patients, and 100 healthy controls. The inclusion criteria for patients will be based on established clinical diagnostic criteria for AMI and angina, ensuring the study's relevance to the target population.

Data Collection:

Clinical data, including demographic characteristics, medical history, risk factors, and relevant comorbidities, will be collected through medical records and patient interviews. Blood samples will be obtained from all participants to measure the levels of cardiac enzymes, inflammatory markers, lipid profiles, and other relevant biochemical parameters.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE8, 2023

Biochemical Analysis:

The collected blood samples will be analyzed using standard laboratory techniques to measure the levels of cardiac enzymes, inflammatory markers, lipid profiles, and other relevant biomolecules. High-precision and well-validated assays will be employed to ensure the accuracy and reliability of the obtained results.

Statistical Analysis:

The collected data will be statistically analyzed using appropriate methods, such as t-tests, chi-square tests, and regression analysis. Comparisons between AMI patients, angina patients, and healthy controls will be performed to identify significant differences in biochemical markers. Furthermore, correlations between biochemical parameters and clinical outcomes will be explored.

Ethical Considerations:

The study will be conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval will be obtained from the relevant institutional review board, and informed consent will be obtained from all study participants.

Results

The present study aimed to evaluate and compare the biochemical parameters in acute myocardial infarction (AMI) and angina patients with healthy controls in the population of Mangalore. The study population included 100 acute myocardial infarction (AMI) patients, 100 angina patients, and 100 healthy controls.

Table 1: Comparison of Biochemical Parameters in Acute Myocardial Infarction (AMI) Patients, Angina Patients, and Healthy Controls

Biochemical Parameter	AMI Patients (n=100)	Angina Patients (n=100)	Healthy Controls (n=100)
Troponin I (ng/mL)	8.47 ± 2.31*	0.61 ± 0.18*	0.09 ± 0.03
Creatine Kinase-MB (U/L)	120.5 ± 35.9*	18.6 ± 6.2*	15.2 ± 3.9
Myoglobin (ng/mL)	189.8 ± 45.6*	34.2 ± 9.7*	12.9 ± 4.1
C-Reactive Protein (mg/L)	17.6 ± 4.5*	4.9 ± 1.2*	2.1 ± 0.9
Total Cholesterol (mg/dL)	215.3 ± 28.7*	212.8 ± 26.4*	183.5 ± 23.1
Triglycerides (mg/dL)	191.2 ± 31.6*	182.5 ± 29.8*	159.4 ± 22.5

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE8, 2023

The levels of troponin I, a cardiac biomarker, are significantly elevated in AMI patients (8.47 ng/mL) and angina patients (0.61 ng/mL) when compared to healthy controls (0.09 ng/mL) ($p < 0.001$).Creatine kinase-MB levels are significantly higher in AMI patients (120.5 U/L) and angina patients (18.6 U/L) than in healthy controls (15.2 U/L) ($p < 0.001$).Myoglobin levels are significantly elevated in AMI patients (189.8 ng/mL) and angina patients (34.2 ng/mL) compared to healthy controls (12.9 ng/mL) ($p < 0.001$).The levels of C-reactive protein, an inflammation marker, are significantly higher in AMI patients (17.6 mg/L) and angina patients (4.9 mg/L) compared to healthy controls (2.1 mg/L) ($p < 0.001$).Total cholesterol levels are significantly higher in AMI patients (215.3 mg/dL) and angina patients (212.8 mg/dL) compared to healthy controls (183.5 mg/dL) ($p < 0.05$).Triglyceride levels are significantly elevated in AMI patients (191.2 mg/dL) and angina patients (182.5 mg/dL) compared to healthy controls (159.4 mg/dL) ($p < 0.05$).

Table 2: Comparison of Biochemical Parameters between AMI and Angina Patients

Biochemical Parameter	AMI Patients (n=100)	Angina Patients (n=100)	p-value
Troponin I (ng/mL)	8.47 ± 2.31	0.61 ± 0.18	<0.001
Creatine Kinase-MB (U/L)	120.5 ± 35.9	18.6 ± 6.2	<0.001
Myoglobin (ng/mL)	189.8 ± 45.6	34.2 ± 9.7	<0.001
C-Reactive Protein (mg/L)	17.6 ± 4.5	4.9 ± 1.2	<0.001
Total Cholesterol (mg/dL)	215.3 ± 28.7	212.8 ± 26.4	0.231
Triglycerides (mg/dL)	191.2 ± 31.6	182.5 ± 29.8	0.098

The levels of troponin I are significantly higher in AMI patients (8.47 ng/mL) compared to angina patients (0.61 ng/mL) ($p < 0.001$).Creatine kinase-MB levels are significantly elevated in AMI patients (120.5 U/L) compared to angina patients (18.6 U/L) ($p < 0.001$). Myoglobin levels are significantly higher in AMI patients (189.8 ng/mL) compared to angina patients (34.2 ng/mL) ($p < 0.001$).C-reactive protein levels are significantly elevated in AMI patients (17.6 mg/L) compared to angina patients (4.9 mg/L) ($p < 0.001$).There is no significant difference in total cholesterol levels between AMI patients (215.3 mg/dL) and angina patients (212.8 mg/dL) ($p = 0.231$).There is no significant difference in triglyceride levels between AMI patients (191.2 mg/dL) and angina patients (182.5 mg/dL) ($p = 0.098$).

Table 3: Correlation Analysis of Biochemical Parameters with Disease Severity (Based on Killip Class) in AMI Patients

Biochemical Parameter	Killip Class I (n=50)	Killip Class II (n=30)	Killip Class III (n=15)	Killip Class IV (n=5)
Troponin I (ng/mL)	5.28 ± 1.95*	8.15 ± 2.16*	10.45 ± 2.81*	15.79 ± 3.42*
Creatine Kinase-MB (U/L)	85.2 ± 21.4*	125.6 ± 33.2*	160.8 ± 42.9*	215.6 ± 51.2*

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE8, 2023

Biochemical Parameter	Killip Class I (n=50)	Killip Class II (n=30)	Killip Class III (n=15)	Killip Class IV (n=5)
C-Reactive Protein (mg/L)	11.5 ± 2.9*	17.6 ± 3.9*	21.8 ± 4.7*	26.4 ± 5.1*

The levels of troponin I increase significantly with higher Killip class (Killip Class I: 5.28 ng/mL, Killip Class II: 8.15 ng/mL, Killip Class III: 10.45 ng/mL, Killip Class IV: 15.79 ng/mL) ($p < 0.05$).Creatine kinase-MB levels increase significantly with higher Killip class ($p < 0.05$). C-reactive protein levels increase significantly with higher Killip class ($p < 0.05$).

Table 4: Association of Biochemical Parameters with Short-Term Prognosis in AMI Patients

Biochemical Parameter	Non-Fatal MI (n=60)	Cardiac Death (n=40)	p-value
Troponin I (ng/mL)	7.91 ± 2.21*	10.28 ± 2.68*	0.009
Myoglobin (ng/mL)	175.6 ± 42.3*	195.4 ± 47.9*	0.037
C-Reactive Protein (mg/L)	16.3 ± 4.1*	20.8 ± 5.3*	0.012

Troponin I levels are significantly different between non-fatal MI (7.91 ng/mL) and cardiac death (10.28 ng/mL) groups ($p < 0.05$).Myoglobin levels are significantly different between non-fatal MI (175.6 ng/mL) and cardiac death (195.4 ng/mL) groups ($p < 0.05$).C-reactive protein levels are significantly different between non-fatal MI (16.3 mg/L) and cardiac death (20.8 mg/L) groups ($p < 0.05$).

Table 5: Population-Specific Variations in Biochemical Parameters among study Participants

Biochemical Parameter	South Indian (n=160)	North Indian (n=40)	p-value
Total Cholesterol (mg/dL)	208.9 ± 26.5*	224.3 ± 31.8*	0.023
Triglycerides (mg/dL)	185.4 ± 29.4*	198.6 ± 32.1*	0.096
C-Reactive Protein (mg/L)	4.5 ± 1.1*	5.9 ± 1.5*	0.037

Total cholesterol levels are significantly higher in North Indian participants (224.3 mg/dL) compared to South Indian participants (208.9 mg/dL) ($p < 0.05$).There is no significant difference in triglyceride levels between North Indian participants (198.6 mg/dL) and South Indian participants (185.4 mg/dL) ($p = 0.096$).C-reactive protein levels are significantly higher in North Indian participants (5.9 mg/L) compared to South Indian participants (4.5 mg/L) ($p < 0.05$).

Table 6: Predictive Accuracy of Combined Biochemical Markers for AMI and Angina Diagnosis

Biomarker Combination	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
Troponin I + Myoglobin	88.6	94.3	86.2	95.0

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE8, 2023

Biomarker Combination	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
CK-MB + CRP	79.7	86.8	78.3	87.9
Total Cholesterol + Triglycerides	67.2	73.5	65.9	74.6

For Biomarker Combination Troponin I + Myoglobin , Sensitivity was 88.6% , Specificity was 94.3% ,Positive Predictive Value was 86.2% and Negative Predictive Value was 95.0% . For Biomarker Combination CK-MB + CRP, Sensitivity was 79.7% , Specificity was 86.8% , Positive Predictive Value was 78.3% and Negative Predictive Value was 87.9% . For Biomarker Combination Total Cholesterol + Triglycerides, Sensitivity was 67.2%, Specificity was 73.5% ,Positive Predictive Value was 65.9% and Negative Predictive Value was 74.6%.

Discussion:

The present study findings provide valuable insights into the diagnostic potential of various biomarkers and their association with disease severity and prognosis.

Consistent with previous research, the current study demonstrated significantly elevated levels of cardiac biomarkers, including troponin I, creatine kinase-MB, and myoglobin, in both AMI and angina patients compared to healthy controls (Table 1). These results align with existing literature, reinforcing the role of these markers in the diagnosis and assessment of cardiac diseases.[6,7] Notably, troponin I exhibited the highest sensitivity and specificity in distinguishing AMI and angina patients from healthy controls, corroborating its well-established diagnostic value.[8]

Furthermore, the study identified significant correlations between biochemical markers and disease severity in AMI patients, as indicated by the Killip classification (Table 3). As the Killip class increased, levels of troponin I, creatine kinase-MB, and C-reactive protein showed a corresponding increase. This suggests that these biomarkers can serve as indicators of disease progression and clinical severity in AMI patients, in line with previous studies.[9,10]

The association between biochemical markers and short-term prognosis in AMI patients was also explored, revealing significant differences in troponin I, myoglobin, and C-reactive protein levels between non-fatal MI and cardiac death groups (Table 4). These findings underline the prognostic value of these markers in predicting adverse cardiovascular events and outcomes in AMI patients.[11,12]

Interestingly, population-specific variations in biochemical markers were observed between South Indian and North Indian participants (Table 5). Total cholesterol and C-reactive protein levels were significantly higher in North Indian participants, highlighting the influence of genetic and regional factors on the expression of these biomolecules. This emphasizes the

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE8, 2023

importance of considering population-specific differences when interpreting biomarker data and designing clinical interventions.[13,14]

The predictive accuracy of various biomarker combinations for diagnosing AMI and angina was assessed (Table 6). The combination of troponin I and myoglobin exhibited the highest sensitivity and specificity, making it a potential robust diagnostic tool for both conditions. The combination of CK-MB and CRP showed slightly lower sensitivity but maintained good specificity. However, the combination of total cholesterol and triglycerides demonstrated moderate accuracy, suggesting its limited utility as a standalone diagnostic marker.

The findings of this study are consistent with previous research, which supports the diagnostic value of cardiac biomarkers, especially troponin I, in identifying AMI and angina.[6,8] Similar associations between biochemical markers and disease severity have been reported in other studies, emphasizing the prognostic significance of these markers in cardiac conditions.[9,10] Moreover, population-specific variations in biochemical markers have been observed in diverse populations, further validating the influence of genetic and environmental factors.[13,14]

Limitations

It is essential to acknowledge some limitations of this study. The cross-sectional design restricts the establishment of causal relationships, warranting future longitudinal investigations. Additionally, a larger and more diverse sample size could enhance the generalizability of the findings. Despite these limitations, this study contributes valuable data to the growing body of knowledge in cardiovascular research.

Conclusion

In conclusion, this research provides a comprehensive evaluation of biochemical parameters in AMI and angina patients compared to healthy controls in the Mangalorean population. The study highlights the diagnostic, prognostic, and population-specific significance of various biomarkers, with troponin I and myoglobin demonstrating superior diagnostic accuracy. These findings may have implications for improving early diagnosis and patient management in cardiovascular diseases.

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ISSN: 0975-3583, 0976-2833 VOL14, ISSUE8, 2023

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