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Correlation of CK-MB with Troponin I in Elderly Patients with Coronary Heart Disease at Baiturrahim Jambi Hospital

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ABSTRACT

Backrounds: Coronary heart disease (CHD) is a leading cause of morbidity and mortality in the elderly, characterized by a reduced blood flow to the heart muscle. Biomarkers such as CK-MB and troponin I are commonly used to assess myocardial injury and are considered important in diagnosing and monitoring CHD. This study aimed to analyze the relationship between CK-MB and troponin I levels in elderly patients with coronary heart disease (CHD) at Baiturrahim Jambi Hospital.

Methods: This study design used a cross-sectional approach with a sample of 52 CHD patients who had undergone examination of CK-MB and troponin I levels. Data analysis was performed using the Pearson correlation test to assess the relationship between variables.

Results: The mean CK-MB enzyme activity was 37.3 IU/L with a standard deviation (SD) of 11.287, while the mean troponin I level was 0.719 ng/mL with an SD of 0.590. The correlation test results showed a Pearson correlation (r) value of 0.446, indicating a moderate relationship between CK-MB enzyme activity and troponin I levels. This positive correlation indicates that an increase in CK-MB levels is followed by an increase in troponin I levels.

Conclusion: This study found a significant relationship between CK-MB and troponin I levels in elderly patients with CHD, with a positive correlation pattern.

Keywords: CK-MB, troponin I, coronary heart disease, biomarkers, elderly

Introduction

Cardiovascular disease is a group of diseases that includes disorders of the heart and blood vessels, including coronary heart disease, coronary artery disease, and acute coronary syndrome [1–3]. Coronary heart disease (CHD) itself is the leading cause of death in many countries, both developed and developing. According to Tuminah (2020), CHD is a significant health problem due to its wide impact on people's quality of life and the high mortality rate caused. CHD

is caused by narrowing of the coronary arteries, which are blood vessels that drain blood to the heart, which inhibits the supply of oxygen to the myocardium, thus causing impaired heart function [4,5].

Coronary heart disease (CHD) arises when the blood vessels supplying the heart become narrowed due to the accumulation of fat or plaque on their walls, a process known as atherosclerosis [6]. This narrowing restricts blood flow to the heart, which can compromise cardiac function and increase the risk of a heart attack. According to the World Health Organization (WHO), CHD is defined as the heart's inability to pump blood effectively due to

reduced blood supply to the myocardium caused by disease in the coronary arteries. The diminished blood flow can result in tissue damage, potentially progressing to myocardial infarction or heart failure [7].

Heart disease, particularly coronary heart disease (CHD), has become the leading cause of death globally, with over 17 million fatalities attributed to heart and vascular diseases in 2019 [8], according to the World Health Organization (WHO). In Indonesia, heart disease ranks among the primary causes of death, with an estimated mortality rate of 650,000 annually as of 2023, based on data from the Ministry of Health of the Republic of Indonesia. Findings from the Basic Health Research (Riskesdas) further highlight a rising prevalence of cardiovascular diseases in Indonesia. For instance, the prevalence of hypertension increased from 25.8% in 2013 to 34.1% in 2018, while coronary heart disease maintained a prevalence of 1.5% during the same period. This upward trend is largely attributed to unhealthy lifestyle changes, including smoking, poor dietary habits, and insufficient physical activity [9].

Coronary heart disease remains highly prevalent in Jambi Province. According to the 2013 Jambi Province Riskesdas data, the prevalence of coronary heart disease was reported at 0.2% based on doctor-diagnosed interviews and 0.5% when including diagnoses based on symptoms. The incidence of myocardial infarction in Jambi Province has also shown a year-on-year increase, as documented in the medical records of Raden Mattaher Hospital, Jambi. In 2021, 215 cases of myocardial infarction were recorded, rising to 222 cases in 2022. Although the number slightly decreased to 212 cases in 2023, coronary heart disease, particularly myocardial infarction, remains a significant public health concern requiring focused attention and intervention in the region [9].

The diagnosis of coronary heart disease is often performed by evaluating several biochemical markers, including lactate dehydrogenase (LDH), creatine kinase (CK), creatine kinase-MB (CK-MB), and troponin [10]. Among these, CK-MB and troponin I play critical roles in detecting myocardial damage following a myocardial infarction. CK-MB levels typically rise within 1 to 2 days after a heart attack and remain elevated for several days [11]. In contrast, troponin I demonstrates a prolonged elevation, persisting for up to 1 to 2 weeks post-myocardial infarction. While CK-MB is frequently used in the diagnosis of myocardial infarction, it lacks specificity as its levels can also increase in cases of muscle trauma. Consequently, troponin I is preferred due to its higher sensitivity and near-specificity for detecting myocardial injury, as well as its ability to identify even minor damage to the heart muscle [12,13].

Several studies have demonstrated a significant relationship between CK-MB and Troponin I levels in patients with acute myocardial infarction. A study by Malhotra et al., [10] reported a strong correlation between Troponin I and CK-MB levels in patients with acute myocardial infarction. Similarly, research conducted by Shah et al., [6] identified a significant association between CK-MB and Troponin I levels and the incidence of acute myocardial infarction.

However, the present study differs from previous research by focusing specifically on elderly patients with coronary heart disease. The elderly population is at higher risk for developing coronary heart disease, and biochemical markers such as CK-MB and Troponin I can offer valuable insights into their cardiac health.

Based on these considerations, this study, titled "Correlation of CK-MB with Troponin I in Elderly Patients with Coronary Heart Disease at Baiturrahim Jambi Hospital," aimed to analyze the relationship between CK-MB and Troponin I levels in elderly patients with coronary heart disease. It is anticipated that the findings will provide more accurate information to support the diagnosis and treatment of coronary heart disease in this vulnerable age group.

METHODS

Study design

This study used an analytic observational design with a cross-sectional study approach, an observational research design that aims to study the relationship between variables at a certain time, where exposure (risk factor) and outcome data are collected simultaneously at one point in time [14].

Setting

This study was conducted at Baiturrahim Jambi Hospital, a prominent referral center for cardiovascular care in the Jambi region. The research was carried out from May to June 2024. The hospital serves a significant number of cardiac patients, reflecting the high prevalence of cardiovascular diseases in the area. According to medical record data from January to December 2023, a substantial number of patients were diagnosed with coronary heart disease, ensuring an adequate population for the study.

Baiturrahim Jambi Hospital is equipped with advanced facilities and tools for cardiac examinations, including laboratories capable of analyzing CK-MB and Troponin I levels using modern techniques such as Fluorescence Immunoassay (FIA) and Kinetic Photometrics. These methodologies deliver precise results on a ratio scale, making them highly suitable for research data analysis. Additionally, the hospital's laboratory team is well-trained and experienced in conducting cardiac biomarker tests, ensuring the accuracy and reliability of the results.

Participant

The study included 52 patients diagnosed with coronary heart disease who underwent laboratory testing for CK-MB and Troponin I between January and December 2023 at Baiturrahim Jambi Hospital. A random sampling technique was employed, selecting participants from the population that met the inclusion criteria. The inclusion criteria were defined as medical records of coronary heart disease patients containing results for CK-MB and Troponin I levels.

Exclusion criteria were applied to ensure the validity of the data. Patients with incomplete medical records, particularly those missing CK-MB or Troponin I results, were excluded. Additionally, patients diagnosed with other complex cardiovascular conditions, such as advanced heart failure, endocarditis, or other arterial diseases that could significantly influence CK-MB and Troponin I levels, were not included in the study.

Sample size

A total of 212 coronary heart disease patients were recorded at Baiturrahim Jambi Hospital between January and December 2023. However, only 60 patients met the eligibility criteria for inclusion in this study. The sample size was determined using the Slovin formula with a 5% margin of error, resulting in a final sample size of 52 coronary heart disease patients selected from the 60 eligible cases.

Work procedure

CK-MB levels

This study employs the kinetic photometric method, a widely utilized technique for analyzing CK-MB (Creatine Kinase-MB) levels, an isoenzyme indicative of heart muscle damage, particularly in cases of myocardial infarction. The procedure begins with sample preparation using hemolysis-free serum or plasma to minimize interference and ensure accurate results. The reagents used typically include substrates such as creatine phosphate and ADP, along with supporting enzymes like NADP, glucose, hexokinase, and glucose-6-phosphate dehydrogenase.

The reaction principle involves CK-MB catalyzing the conversion of creatine phosphate and ADP into creatine and ATP. The ATP generated is subsequently utilized by hexokinase to convert glucose into glucose-6-phosphate, which then reacts with NADP to form NADPH. NADPH absorbs light at a specific wavelength (340 nm), allowing its concentration to be measured kinetically using a spectrophotometer. This measurement, based on changes in absorbance per unit of time, is used to calculate CK-MB activity, expressed in units of U/L, using the standard equation provided by the reagent or instrument manufacturer. The standard reference value for CK-MB is less than 24 IU/L.

Troponin I

The Fluorescence Immunoassay (FIA) method is a widely used technique for measuring troponin I levels, a crucial biomarker in detecting heart muscle damage, particularly in cases of myocardial infarction. The process begins with the collection of a blood sample from the patient, which is subsequently processed to obtain serum or plasma. This sample is then placed on a specialized test device, which is equipped with specific monoclonal or polyclonal antibodies targeting troponin I.

In the FIA method, troponin I in the sample binds to antibodies labeled with a fluorescent compound. When the antigen-antibody complex is formed, the analysis device excites the fluorescent compound using light of a specific wavelength, resulting in the emission of fluorescent light. The intensity of the fluorescence is measured by the detector, and this value is directly proportional to the concentration of troponin I in the sample. The measurement results are compared with a standard curve to quantitatively determine the troponin I levels. The standard normal value for troponin I is less than 0.04 ng/mL.

Data analysis

Data analysis in this study was performed in two stages. The first stage involved descriptive statistics to summarize sample characteristics, such as age and gender. In the second stage, inferential analysis was conducted, beginning with a normality test using the Kolmogorov-Smirnov test, which was calculated manually. The results showed that the D_max value was less than or equal to the D_table, with a D_table value of 0.188. The D_max for CK-MB was 0.105, and for Troponin I, it was 0.165. These results indicate that the enzyme activity data for CK-MB and Troponin I are normally distributed, allowing for the continuation of the analysis with the Pearson (Product Moment) correlation test. The correlation test results were considered statistically significant if the p-value was less than 0.05. All data analysis was conducted using SPSS version 23.

Table 1. Correlation coefficient between variables (Guilford Empirical Rules)

Large R	Interpretation
0.00 -< 0.20	Very Weak Relationship (Ignored, Considered Nonexistent)
> 0.20 -< 0.40	Low Relationship
≥ 0.40 -< 0.70	Moderate or Fair Relationship
> 0.70 -< 0.90	Strong or High Relationship
≥ 0,90 - ≤ 1,00	Very Strong or High Relationship

Table 2. Distribution of CK-MB and Troponin I examination results

Category	n	MI N	MAX	Mean	SD
CK- MB Enzyme Activity (IU/L)	50	15	71	37.3	11.287
Troponin I Level	50	0.0	1.87	0.719	0.590

Table 2 shows that data from 50 samples were examined for CK-MB and Troponin I, where the average CK-MB enzyme activity was 37.3 with SD 11.287 IU/L while the average Troponin I level was 0.719 with SD 0.590 ng/mL.

Table 3. Distribution of CHD Patients by Risk Characteristics

Variable	n	(%)
Age		

<55 Years	9	**18**
>55 Years	41	**82**
Gender		
Male	31	**62**
Female	**19**	**38**

Table 3 shows that the number of CHD patients aged< 50 years is 9 people (18%), while the number of CHD patients aged> 50 years is 41 people (82%). The number of CHD patients at Baiturrahim Jambi Hospital based on gender is obtained 31 people (62%) are male and 19 people (38%) are female.

Table 4. Pearson correlation test results

Category	Mean	SD	Pearson Correlation (r)
CK-MB Enzyme Activity	37.3	11.287	0.446
Troponin I levels	0.719	0.590	

Table 4 presents the Pearson correlation value of 0.446 between CK-MB enzyme activity and Troponin I levels. Manual calculations using the Pearson correlation formula yielded a calculated r value of 0.446, indicating a moderate or sufficient relationship between CK-MB enzyme activity and Troponin I levels in patients with coronary heart disease. According to Guilford's Empirical Rules, an r value between 0.40 and 0.70 reflects a moderate or sufficient relationship. The analysis also revealed a positive correlation, suggesting that as CK-MB levels increase, Troponin I levels also tend to rise.

DISCUSSION

Age is a significant risk factor for coronary heart disease [15–17]. In this study, the majority of patients (82%) were over the age of 55. As individuals age, vascular elasticity decreases, and atherosclerotic plaques accumulate, both of which contribute to an increased risk of heart muscle damage and the release of biomarkers such as CK-MB and Troponin I. This underscores the importance of monitoring cardiac biomarkers in the elderly to detect myocardial damage at an earlier stage [18].

Gender also plays a crucial role in the incidence of coronary heart disease [19–21]. The results indicated that men (62%) were more affected by CHD than women (38%). This disparity may be attributed to hormonal factors, as estrogen provides a protective effect on blood vessels in women until menopause. In contrast, men are more likely to engage in risk behaviors such as smoking and may experience higher rates of hypertension, both of which increase the likelihood of elevated CK-MB levels due to the added stress on the heart muscle.

In this study, the average CK-MB level measured in patients was 37.3 IU/L. CK-MB is an enzyme released into the bloodstream when heart muscle damage occurs, such as in myocardial infarction. This correlation suggests that CK-MB levels can serve as an early indicator of myocardial injury, particularly in elderly patients who are at higher risk [22,23].

Troponin I, however, is a more specific biomarker than CK-MB for detecting heart damage [18,24]. In this study, the mean Troponin I level was 0.719 ng/mL, which is elevated above the normal range. Elevated Troponin I levels indicate more severe myocardial damage. As a result, Troponin I measurement is often considered the gold standard in

diagnosing acute myocardial infarction.

The correlation analysis revealed a moderate relationship (r = 0.446) between CK-MB enzyme activity and Troponin I levels. This indicates that as CK-MB levels increase, Troponin I levels also rise. This positive correlation suggests that the two biomarkers can complement each other, providing a more comprehensive clinical assessment of the extent of myocardial damage [25].

These findings are highly relevant in the context of diagnosing coronary heart disease (CHD), particularly in the elderly, who are often affected by multiple health conditions. The combination of CK-MB and Troponin I measurements may enhance diagnostic accuracy, enable earlier intervention, and help prevent further complications. Additionally, this study underscores the need for routine biomarker monitoring in CHD patients, particularly within vulnerable age and gender groups [26].

The results revealed that both age and gender influenced CK-MB levels, and that CK-MB levels exhibited a positive association with Troponin I. Both biomarkers are crucial for assessing the severity of CHD and provide valuable clinical guidance for patient management. Furthermore, this study highlights the importance of developing diagnostic protocols based on biomarkers that take into account demographic factors such as age and gender.

This study carries significant implications for medical practice, particularly in diagnosing CHD. The observed correlation between CK-MB and Troponin I levels offers valuable guidance for clinicians, suggesting that these biomarkers can be used complementarily. CK-MB serves as an early indicator of heart damage, while Troponin I offers a more specific assessment of myocardial injury severity. The combination of these two biomarkers facilitates a faster and more accurate diagnosis, thereby accelerating clinical decision-making [27–29].

In efforts to mitigate CHD-related complications, such as heart failure or arrhythmias, this study emphasizes the importance of routine biomarker monitoring. By tracking changes in CK-MB and Troponin I levels, clinicians can detect myocardial damage at an earlier stage, even before clinical symptoms become more severe. Early interventions—such as drug therapy, angioplasty, or other invasive measures can be administered more promptly, reducing the risk of serious complications.

Study limitations

The relatively small sample size may limit the generalizability of these findings to a broader population. This study focused solely on elderly patients with coronary heart disease at one hospital, so the results may not fully reflect conditions in other regions with different demographic characteristics. Furthermore, other factors that may influence CK-MB and Troponin I levels, such as comorbidities, current therapies, and patient lifestyle, were not thoroughly examined in this study.

CONCLUSIONS

The findings of this study revealed that the average CK-MB enzyme activity in patients with coronary heart disease was 37.3 IU/L, while the average Troponin I level in the same group was 0.719 ng/mL. The study also identified a significant relationship between CK-MB enzyme levels and Troponin I in coronary heart disease patients, with a positive correlation. Specifically, as CK-MB enzyme activity increased, Troponin I levels also rose. This relationship was demonstrated by a correlation coefficient of 0.446, indicating a moderate yet significant association between the two biochemical markers.

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