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Research Article

The relationship between liver and kidney dysfunction with acute myocardial infarction

Salama Rabie Abd El-Raheim[1], Noha Anwar Hussein Hassuna[2], Doha Ibrahim Mohamed Hider[1] and Heba Ibrahim Mohamed Marey[1].

[1] Department of Medical Biochemistry, Faculty of Medicine, Minia University, Minia, Egypt.
[2] Department of Microbiology and Immunology, Faculty of Medicine, Minia University, Minia, Egypt

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Abstract

Background: In both developed and developing countries, coronary artery disease (CAD) is a major public health concern. One of the main reasons people die on a global scale is acute myocardial infarction (AMI). The narrowing or blocking of the arteries that feed blood to the heart muscle as a result of atherosclerosis and its complications, or any other condition that causes an oxygen supply demand mismatch, is what causes coronary artery disease. There are a number of risk factors that can affect the prognosis of coronary artery disease, including arterial hypertension, dyslipidemia, diabetes mellitus, obesity, smoking, and genetic factors. These factors are associated with the injury of endothelial cells and the advancement of atherosclerosis. Unfortunately, diagnostic techniques for CAD prognosis are lacking in both simplicity and efficacy. **Aim of the study;** In light of this, the present research set out to use the data we gathered from our retrospective analysis to assess the usefulness of liver and kidney function tests in predicting the prognosis of patients with acute myocardial infarction (AMI). **Methods:** Minya University Hospital's Critical Care Unit accepted 30 patients with acute myocardial infarction. Samples of peripheral venous blood were drawn when the patient was admitted. Fresh samples were tested for liver and kidney function using (FLEXOR Pro XL, ELI Tech, France). **Results:** There is a strong link between hepatic and renal dysfunction and AMI. **Conclusion:** The findings supported that hepatic and renal dysfunction were applicable to the prediction of risk in acute myocardial infarction patients.

Keywords: Liver function tests, Kidney function tests, Acute myocardial infarction.

Introduction

Approximately 31% of all fatalities worldwide are attributable to cardiovascular disease (CVD), and this proportion is projected to stay stable until 2030 [1]. Patients suffering from coronary artery disease (CAD) are seeing an increase in the use of percutaneous coronary procedures (PCI). Medical advancements have not eliminated coronary artery disease which continues to be a major consumer of healthcare resources and a major cause of disability and mortality globally [2]. People who already have heart disease or are at high risk for cardiovascular disease -because of hyper-tension, diabetes, hyperlipidemia, or other risk factors- are considered high-risk and have a less favourable prognosis for coronary artery disease [3].

Serological atherosclerosis biomarkers, genetic markers, and imaging biomarkers are among the many other biomarkers that have shown beneficial in coronary artery disease [4]. Unfortunately, there aren't many straightfor-ward methods for assessing CAD prognosis. Kidney and liver function tests may provide a predictive model for individuals with coronary artery disease, since total bilirubin and creatinine have been shown to be independent risk factors for predicting prognosis in CAD

patients [5,6]. Given the importance of kidney and liver function tests in predicting the prognosis of patients with CAD, we set out to conduct this research using data from our retrospective analysis to determine their significance.

Subject and methods

1-Study design

The present study included 30 patients, aged between (30 and 75) years old and of both sexes, all diagnosed clinically by their manifestations (typical chest pain) and then confirmed by ECG as AMI. Thirty healthy volunteers were included in the research as a control group, and they were matched with patients in terms of age and sex. All participants provided their clinical information and signed written permission forms. The research was done from May 2022 to November 2022 according to the criteria for the use of human subjects' materials according to the "Declaration of Helsinki" and recognized by the Research Ethics Committee (REC) of Minia University Hospital. Egypt.No. 338:05/2022.

2- Data collection

Samples of peripheral venous blood were drawn when the patient was admitted. Recordings from the echocardiography and laboratory tests were made, and the samples were tested for renal and liver function utilising (FLEXOR Pro XL, ELI Tech, France). Two doctors took the patient's vitals, including their age, sex, smoking status, hypertension and diabetes history, and other demographic and clinical details. Participants' clinical follow-up data was gathered via in-person and over-the-phone interviews with patients and their families, as well as outpatient assessments.

Statistical analysis of data

For non-parametric data, we used the Mann-Whitney U test; for categorical variables, we used the Chi-square test or Fisher's exact test. We reported the data as median and interquartile range (IQR). We used Spearman correlation analysis to look for connections between all of the factors. Statistical significance was given to results when $p < 0.05$. The statistical package software IBM SPSS 28.0 was used for data analysis (IBM; Armonk, New York, USA).

Results

1- Liver function tests

Liver function tests in the form of ALT, AST, albumin, total bilirubin and direct bilirubin were measured in both groups and the results showed a statistically significant difference between two groups (P value = 0.0001) regarding all the data except albumin **(Table 1)**.

2- Kidney function tests

Kidney function tests in form of creatinine and urea were measured in both groups and the results showed a statistically significant difference between creatinine in two groups (P value = 0.0001) **(Table 2)**

Table (1): Liver function tests of control group and AMI patients' group

	Control (N=30)	Acute MI patients (N=30)	p value
ALT (U/L) Median (*IQR*)	30.5 (28-37)	25 (16-35)	0.01*
AST (U/L) Median (*IQR*)	31 (29-33)	45 (40-75)	<0.001*
Albumin (g/dL) Median (*IQR*)	4.2 (3.9-4.6)	4.3 (4.1-4.6)	0.559
Total Bilirubin (mg/dL) Median (*IQR*)	0.9 (0.8-1.1)	0.7 (0.6-0.8)	<0.001*
Direct Bilirubin (mg/dL) Median (*IQR*)	0.1 (0.1-0.2)	0.3 (0.2-0.4)	<0.001*

Table (2): Kidney function tests of control group and AMI patients' group

	Control (N=30)	Acute MI patients (N=30)	p value
Creatinine (mg/dL) Median (*IQR*)	1.1 (0.9-1.2)	1 (0.8-1.1)	0.017*
Urea (mg/dL) Median (*IQR*)	32 (29-40)	34 (29-40)	0.526

Discussion

Worldwide, cardiovascular disease (CVD) accounts for a disproportionate share of deaths and hospitalizations. Developed nations have seen a decline in cardiovascular disease mortality over the last 30 years, whereas middle-income and low-income nations have seen rate increases [7]. In the previous sixty or seventy years, the civilizations of the Middle Eastern countries—mostly those with high or medium incomes—have seen a dramatic shift from rural or nomadic ways of life to urban ones. Ischemic heart disease (IHD) mortality rates in Middle Eastern nations are expected to rise at a faster rate than in other parts of the globe, with a predicted 146% increase for women and 14% for men from 1990 to 2022 [8]. The purpose of this research was to examine the relationship between AMI risk and hepatic and renal impairment in both AMI patients and healthy controls.

Liver function tests, including alanine aminotransferase (ALT), aspartate aminotransferase (AST), albumin, total bilirubin, and direct bilirubin, were conducted on both groups. The results revealed a statistically significant difference (P value = 0.0001) between the two groups in all measured parameters, except for albumin. Ndrepepa & Kastrati, (2019)[9] and YADAV et al., (2022)[10] reported that there is a correlation between high levels of ALT and an increased risk of mortality attributable to cardiovascular disease. Liver enzyme assays are an economical, simple, highly responsive, and standardized approach that can aid in evaluating cardiovascular risk. Alanine aminotransferase (ALT) is primarily synthesized by the liver in response to heightened hepatic inflammation or damage, while aspartate aminotransferase (AST) is created by both liver and muscle cells and increases in cases of myocardial cell injury or hepatic dysfunction.

Li et al., (2022) [11] conducted a meta-analysis and discovered a positive correlation between total bilirubin levels and the severity of myocardial infarction. Additionally, they discovered that myocardial infarction patients with greater total bilirubin levels had an increased risk of adverse events. The degree of coronary atherosclerosis in patients with ST-elevation myocardial infarction (STEMI) is strongly correlated with higher blood levels of total bilirubin, according to Elmohr et al., (2020) [12]. Also, in patients with acute myocardial infarction, Yang et al. (2022) [13] suggested a clear correlation between early levels of total bilirubin and the chance of short-term mortality. Furthermore, patients with stable coronary artery disease had an inverse association between baseline total bilirubin levels and long-term mortality, according to a cohort research with a one-year follow-up.

It is worth noting that total bilirubin has the capacity to combat oxidative stress and inflammation, which may provide protection against coronary lesions. Acute cardiac ischemia may cause a drop in hepatic blood flow and a spike in inflammatory cytokine concentrations, which may outweigh the antioxidant effects of bilirubin in living things. In addition, it was shown that patients with new-onset NSTEMI benefited from anti-inflammatory and anti-oxidative measures because total bilirubin levels were elevated as a compensatory mechanism induced by stress-induced increases in HO-1 activity [14]. The amount of cardiac troponin I released by patients with increased blood bilirubin levels was correlated with the magnitude of myocardial infarction and the severity of

coronary atherosclerotic burden. Bilirubin further acts as an antioxidant by scavenging peroxyl radicals in human plasma with an efficacy similar to that of alpha-tocopherol. An important early step in the development of atherosclerosis that induces platelet aggregation and modifies vasomotor properties is the oxidation of low-density lipoproteins. Both conjugated and unconjugated bilirubin may suppress this process [15].

Results demonstrated a statistically significant difference in creatinine between the two groups (P value = 0.0001) when kidney function tests, including urea and creatinine, were assessed in both groups. Shared risk factors, such as advanced age, diabetes, and hypertension, increase the likelihood of cardiovascular disease in individuals with compromised renal function. In addition, renal and cardiac damage may be caused by the fast activation of the angiotensin and aldosterone systems, endothelium disturbance, and oxidation and antioxidant systems [16]. Injuries to the heart and kidneys may trigger each other, and the two conditions worsen one other when they occur together. Because of its widespread use as a measure of renal function, blood creatinine levels have a substantial impact on the prevalence of cardiovascular disease [17].

Conclusion

Further research into the correlation between particular liver and kidney diseases and the occurrence of acute myocardial infarction is necessary for assessing prognosis, which is an essential step in determining the necessity of treatment and lifestyle changes to control the risk of future coronary events, as this study found that hepatic and renal dysfunction were relevant to risk prediction in patients with acute myocardial infarction.

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