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Leverage Use of a Combination of High-Sensitivity C-Reactive Protein and Homocysteine Results as a Protocol for Urgent and Emergency Diagnosis of Ami Cases

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Abstract

Heart attack or acute myocardial infarction is a deadly medical condition that caused by abruptly cut off of blood flow to the heart muscle leading to myocardium tissue death. This study explores the efficacy of combining the results of high-sensitivity C–reactive protein (hs- CRP) and homocysteine (Hcy) as an emergency protocol to diagnose the acute myocardial infarction for patients admitted to intensive care units with chest pain compared to troponin I (cTnI) and serum low-density lipoproteins (LDL-C). The study included 122patients (78 males and 44females) also 80 healthy volunteers (40 males and 40 females). The blood samples are collected from all patient within the first 3 hours after chest pain, regardless the type of the disease. Serum Hcy, hs-CRP, and cTnI were analyzed by enzyme linked immunosorbent (ELISA) technique, whilst the quantitative analysis of LDL-C was done by automated spectrophotometric method. Within 12-15 hours, as a result of various chemical tests and nursing measurements, the cause of the chest pain was determined. Accordingly, the patients were divided into two groups, the AMI group (68 patients) and the non-AMI group (57 patients). AMI cases elevated the serum hs-CRP significant when compared to control as well as non-AMI cases. While serum levels of Hcy and cTnI were significantly elevated in AMI only. Moreover, the level of LDL-C showed no variations between the three groups. In conclusion, this study supports the use of the results of hs-CRP with Hcy as a feasible protocol for recognizing AMI from non-AMI patients as for urgent and emergency diagnosis.

Keywords: *acute myocardial infarction, homocysteine, hs-CRP, cTnI, LDL-C*

Introduction

Regardless of the improvement in control of complications of hypertension, diabetes mellitus, and cancers, still acute myocardial infarction (AMI) remains challenging to predict. Myocardial infarction is defined as myocardial necrosis in a clinical setting consistent with myocardial ischemia. There is remarkable and necessary interest in new testing methods to single out people at risk for AMI. Measurements of several biomarkers synchronously will enhance the determination of AMI [1].

A patient is diagnosed with AMI when there is elevated troponin along with supporting evidence in the form of typical symptoms, suggestive changes in other lab results or electrocardiogram (ECG), or imaging evidence of new viable myocardial loss or abnormality in the regional wall movement. But reliance on family history and clinical symptoms leads to diagnostic uncertainty because the sign and symptoms of AMI are categorically nonspecific. Similarly, routine laboratory tests and ECG cannot always be counted as an accurate diagnosis. Despite these challenges, the ability to diagnose AMI has recently improved with the discovery of the interference of many factors that influence the disease [2]. Now, some new tests are involved to be a good diagnostic tool for AMI. Homocysteine (Hcy) and high-sensitivity C–reactive protein (hs-CRP) tests are not products of an effect for one risk factor, they are greater than that. The hs-CRP and Hcy tests have been found for diagnosis of CAD [3]. Only few researches have been carried out to discuss the combination of hs-CRP and Hcy biomarkers in diagnosis of AMI in Africa [4]. However, CRP and HyC levels should be used in certain populations wisely. Some types of pulmonary inflammations can cause high plasma CRP but do not alter the Hyc, which is increased in a lot of disorders those do not alter CRP [5]. Yanying Miao and James Liao [6] determined that serum level of Hyc altered slightly whatever the type of the heart disease, but it did not change in cases of minor cases; nevertheless, CRP level is significantly raised in all types of inflammations and in AMI. And on the contrary, a statement of Nahid B and Mohsen J revealed that Hyc levels were elevated in all types of CVD and acute inflammations [7]. Furthermore, Karen Pesqueda-Cendejas et al [8] reported that the definite interpretation of combining the results of hs-CRP and Hyc should be studied and evaluated with precaution by doing more prospective studies.

Levels of hs-CRP were affected by age, blood pressure and blood glucose, while the plasma Hyc may be an independent risk factor in AMI patients. Several epidemiological studies strongly suggest that the CRP and/or Hyc can be valid indicator for heart attack [9].

The present study aimed to evaluate the validity of combined hs-CRP with Hyc to determine acute MI as the emergency diagnosis compared to cTnI and LDL-C.

Materials and Methods

This study was a cross-sectional study carried out in Khartoum State–Sudan, included 122 patients (78 males and 44 females) in mean age of 53.1±7.58 years. All the patients of either sex admitted in critical care unit (CCU). The blood specimens were collected from volunteers at the moment they were hospitalized in CCU with chest pain, despite the reason of the disease. Other 80 healthy volunteers (40 males and 40 females), with age matching of (48.9±9.14 years) were participated as a control group. In addition, all participants were non-diabetics, nonsmokers, and without recent history of surgery or trauma; moreover, they had no history of cardiac disorders, malignancy, or serious inflammatory problems. To avoid other disconcert factors, we excluded obese subjects and those who had a disorders in folic acid or vitamin B complex, and renal problems. A written informed consent was gained from each subject, and then ready prepared questionnaire was used to collect the subjects' data, including their health status, family and clinical histories, and the prescribed drugs. 6 ml venous blood samples were taken from all participants in clot activator gel tube (red top tube). The samples were taken from the patients within the first 3 hours after chest pain, but collected after overnight fasting from the control group. Serum was obtained after 20 minutes and the tests were performed directly by enzyme linked immunosorbent (ELISA) techniques. The homocysteine levels were measured using AXIS-SHIELD ELISA kit (England) [1]; while hs-CRP levels were run by quantitative kit of DRG HS-ELISA [3]; meanwhile, cardiac troponin I (cTnI) was determined as described by Abdelsalam, K.E [2], whereas low-density lipoprotein (LDL-C) was performed by automated spectrophotometric method as manufacturer procedure. Less than 24 hours later, as a result of various medical measurements, the cause of chest pain was determined. Then the patients were split into two groups, AMI group (68 patients as 40 men and 28 women) and non-AMI group (57 patients; 35 men and 22 women).

The data obtained are expressed as mean values ± SD. Statistical analyses were performed using Statistical Package for Social Sciences (SPSS). t-test was used to test for differences in means of continuous variables between patients and controls.

Results

The hs-CRP and Hyc levels in control and AMI groups and the average of their ages are shown in table 1.

Levels of hs-CRP were raised significantly in both groups of AMI and non-AMI when compared to control group (P=0.00); while the levels of Hyc, when compared to control group, showed a significant increasing only in AMI group (P=0.00). The level of cTnI also displayed a significant increase only in AMI group when compared to control, but in p value of 0.047 only. LDL-C changed insignificantly between the three groups. Levels of hs-CRP, Hyc, cTnI and LDL-C were compared between AMI and non-AMI patients in table 2.

Levels of hs-CRP, Hyc, and cTnI were significantly higher in AMI group than non-AMI group (P<0.05). The results of AMI males when compared with the results of AMI females showed significant increasing in cTnI (P=0.044) and insignificant higher levels of both results of hs-CRP and Hyc (P>0.05) as in Table 3.

	Control	AMI	Non-AMI
hs-CRP (mg/l)	2.46±2.09	13.77±4.04*	5.32±1.91*
Homocysteine (µ.mol/L)	9.11±2.32	19.46±3.81*	10.15±6.17
Troponin I (ng/ml)	0.45	8.63 *	2.02 *
LDL-C (mmol/L)	94.8±11.1	108 ±7.4	110±8.7

*Significant change when compared to control (p value<0.05)

Table 1: Homocysteine and hs-CRP in controls, AMI and non-AMI patients (mean ± SD)

	AMI	Non-AMI	P value
Number of cases	68	57	-
hs-CRP (mg/l)	13.77±4.04	5.32±1.91	0.001
Homocysteine (µ.mol/L)	19.46±3.81	10.15±6.17	0.001
Troponin I (ng/ml)	8.63	2.02	0.000
LDL-C (mmol/L)	108 ±7.4	110±8.7	0.70

Table 2: Homocysteine and hs-CRP in all cases between patients of AMI and non-AMI patients (mean ± SD)

	AMI males	AMI females	P value
Number of cases	40	28	-
hs-CRP (mg/l)	14.59±5.35	12.95±1.76	0.067
Homocysteine (µ.mol/L)	21.04±2.97	17.88±3.32	0.053
Troponin I (ng/ml)	8.98	6.43	0.044
LDL-C (mmol/L)	100.9±10.18	109.6±7.77	0.70

Table 3: Homocysteine and hs-CRP in all patients between males and females

Discussion

Several scientists have tested a high sensitivity C-reactive protein in the determination of many cardiovascular diseases. Some researchers elucidated that hs-CRP is a prognostic indicator of future risk for cardiac disorders for healthy individuals, as well as among patients with acute coronary syndromes [9].

The serum results of the present study show that levels of hs-CRP and Hcy were significantly augmented (p-value<0.001) in all CCU patients comparing to the control results. Levels of hs-CRP and Hcy in AMI subjects exhibited significant raise when compared to the control. These results are consistent with the report of Edward C. Jauch et al [10], which showed that Hyc level increases significantly in AMI disease. Although the non-AMI cases necessitated treatment inside the intensive care unit, but it caused insignificant elevation in Hcy comparing to the control. On the other hand, Hcy levels showed significant elevation in AMI subjects when compared to non-AMI subjects.These outcomes were harmonious with Huai Tao et al [7], where they find out that acute and chronic heart diseases increase CRP distinctly, while the levels of Hyc were increased unsteadily, as Hyc is affected by several minor factors and may not be affected by some cases of chronic heart disease.

Furthermore, the results illustrated that serum hs-CRP were significantly elevated in all CCU subjects with cardiac problems, but in much higher in AMI patients comparing to the control group. Ruitao Liu et al [11] assumed that acute coronary syndrome and chronic ischemia are both cause high serum Hcy concentration, while Yide Yang et al [12] recommended that moderate hyperhomocysteinemia was correlated with coronary artery diseases (CAD) and acute MI. There are increasing debates concerning the conceivable role of Hcy with more theories about elevated plasma Hcy concentration as a consequence of CAD. [13].

The present study stated the insignificant elevation of hs-CRP and Hcy levels in AMI men when compared to AMI women (P>0.05). There was a noticeable similarity between our results with the report of Aashiq A Shukkoor, et al [14], generally in the effect of age and gender on CRP levels; while the levels of Hyc appeared important indicators for ischaemic stroke patients.

The level of cTnI was significantly higher (P<0.05) in AMI men when compared to AMI women. These results were agreed with Yuen-Kwun Wong et al [15] who concluded that high cTnI in males are more than females in healthy persons. Moreover, levels of LDL-C in AMI males made clear insignificant reduction in AMI male patients when compared to AMI female patients (P>0.05). This result was in line with that of Lei Feng et al [16] who reported that the concentrations of LDL-C were similar in women and men.

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