The Correlation between Lipid Profile and Lipid Peroxidation in Patients with Acute Myocardial Infraction

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Abstract
To measure the association between risk factor of cardiovascular disease (CVD) and lipid peroxidation in patients with acute myocardial infarction (AMI) and healthy controls, twenty six patients (17 males, 9 females) with AMI clinically diagnosed admitted to Merjan Teaching Hospital in Hilla city and fifty two (25 males, 27 females) apparently healthy persons as a controls subject to present study.

Determination of serum total cholesterol (TC), triacylglycerol (TG), high density lipoprotein (HDL)-cholesterol, serum glutathione and serum lipid peroxidation were performed using colorimetric methods. Very low density lipoprotein (VLDL) and low density lipoprotein (LDL) was determined using mathematically method.

TC and TG of males with AMI found to be significantly increased and total cholesterol of females with AMI found to be increased when compared with healthy controls. HDL-cholesterol of patients found to be decreased, whereas risk factor was significantly increased. VLDL of patients with AMI found to be significantly decreased, whereas LDL found to be significantly increased. Lipid peroxidation was increased, but serum glutathione was declined significantly in patients with AMI when compared with healthy controls. The correlation between lipid peroxide and TG shows a positive relationship of oxidation product excretion at higher levels of TG.

We conclude that patients with elevated levels of serum TG and cholesterol are at increased risk of oxidative damage due to lipid peroxidation.

الخلاصة
لغرض تقدير الترابط المشترك بين عامل الخطورة للأمراض القلبية الشريانية و برو كسيدات الشحوم تم في هذه الدراسة قياس كل من الكليسيسات ثلاثية الأشب و الكولسترول الكلي و عالي الكثافة و واطئ الكثافة و واطئ الكثافة جدًا والكولسترول–ب. و برو كسيدات الشحوم في أخصائي مرضي مصابين باحتشاء العضلة القلبية أضاح إلى مجموعة سيطرة. أظهرت النتائج ارتفاعًا معنويًا في مستويات الكولسترول الكلي و واطئ الكثافة والكليسيسات ثلاثية الأشب، بينما قللت مستويات الكولسترول عالي الكثافة و واطئ الكثافة جدًا والكولسترول–ب. كما وجد بأن عامل الخطورة و مستويات برو كسيدات الشحوم قد ازدادت. وأظهر النتائج المشترك بين برو كسيدات الشحوم والكليسيسات ثلاثية الأشب إرتفاعًا موجباً من نتائج هذه الدراسة تستنتج بأن المرضى الذين يعانون ارتفاعًا في مستويات الكليسيسات ثلاثية الأشب و الكولسترول فاتهم في خطر الإجهاد التاكسيدي الناتج من عملية إنتاج برو كسيدات الشحوم.
Introduction

Epidemiologic studies have verified a relationship between increased intake of antioxidant and reduced morbidity and mortality from cardiovascular disease (CVD). This relationship has been elucidated on the basis of the “oxidative-modification hypothesis” of atherosclerosis, which suggests that atherogenesis is initiated by oxidation of the lipids in low-density lipoprotein (LDL). As a result to this hypothesis, antioxidants that inhibit lipid peroxidation in LDL ought to limit atherosclerosis and its clinical manifestations, such as myocardial infarction (MI) and stroke.[1]

Other case-control studies indicated that patients with angina pectoris have lower plasma vitamin E concentrations than normal subjects [2] and that reduced concentrations of vitamin C and other antioxidants such as glutathione and uric acid in the plasma and leukocytes are predictive of angiographically evident CVD. [3-5]

According to the oxidative-modification hypothesis, LDL initially accumulates in the extracellular subendothelial space of arteries and, through the action of resident vascular cells, is mildly oxidized to a form known as minimally modified LDL. [6] The minimally modified LDL produces monocyte chemotactic protein [2], granulocyte and macrophage colony-stimulating factors by inducing local vascular cells. These factors stimulate monocyte recruitment and differentiation to macrophages in arterial walls. [7] The accumulating monocytes and macrophages stimulate further peroxidation of LDL. The products of this reaction make apolipoprotein B-100 (protein component of LDL) more negatively charged. By asset of its increased negative charge, this completely oxidized LDL is recognized by scavenger receptors on macrophages and internalized to form so-called foam cells.[8]

In contrast to the uptake of unoxidized LDL by the LDL receptor on macrophages, the uptake of oxidized LDL by the scavenger-receptor pathway is not subject to negative-feedback regulation and consequently results in massive uptake of cholesterol (that present in oxidized LDL) by the macrophages. The formation of foam cells and oxidized LDL has direct chemotactic activity for monocytes [9] and stimulates the binding of monocytes to the endothelium.[10]

The evidence that LDL oxidation occurs in vivo and contributes to the clinical manifestations of atherosclerosis supports the oxidative - modification hypothesis.[1]

This study was designed to measure the association between risk factor of CVD by mean of lipid profile and lipid peroxidation (products of oxidative stress of lipid) in patients with AMI and healthy controls.

Patients and Methods

Twenty six patients (17 males, 9 females) with AMI clinically diagnosed admitted to Merjan Teaching Hospital in Hilla city (2003) and fifty two (25 males, 27 females) apparently healthy persons as a controls subject to present study. The mean age of patients males were \((51.35 \pm 21.45\) years) and \((52 \pm 9.91\) years) for patients females, whereas those of healthy persons were \((52 \pm 12.3\) years) for males and \((50.32 \pm 12.1\) years) females.

Nine of males patients and five of females patients subject to present study suffering of hypertension. Also,
fourteen males patients and six of females patients are smokers. Determination of serum TC, TG, HDL-cholesterol was determined using commercially available kits (Biomegreb kit, Morocco).

Very low density lipoprotein (VLDL) was determined using the following formula:

\[ \text{VLDL-cholesterol} = \frac{\text{TG}}{5} \]

Low density lipoprotein (LDL) was determined using the following equation:

\[ \text{TC} = \text{HDL-cholesterol} + \text{VLDL-cholesterol} + \text{LDL-cholesterol} \]

Serum glutathione was determined using modified Ellman’s procedure in which 5,5- Dithiobis (2-nitrobenzoic acid)(DTNB) reduced by sulfhydryl group of glutathione to produce an intensely yellow compound [11].

Serum lipid peroxidation levels were determined by the colorimetry thiobarbituric acid (TBA) method. Under the acid and heating conditions of the reaction, the lipid peroxides break down to form malondialdehyde (MDA) which react with (TBA) to form a pink complexes [12].

**Statistical Analysis**

All values were expressed as mean± standard deviation (SD). Student’s t-test was used to estimate differences between the groups and differences were considered significant when the probability was (p < 0.05).

**Results**

Age of participates, serum total cholesterol , HDL- cholesterol , triacylglycerol, malonyldialdehyde, glutathione and the risk factor of cardiovascular disease of patients with AMI and healthy controls subject to present study are listed in Table 1

### Table 1

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>AMI</th>
<th>Control</th>
<th>Male</th>
<th>AMI</th>
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<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>No</td>
<td>Mean</td>
<td>SD</td>
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<tr>
<td><strong>Age (year)</strong></td>
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<td>21.45</td>
<td>25</td>
<td>52</td>
<td>12.3</td>
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<tr>
<td><strong>Total cholesterol</strong></td>
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<td>29.7</td>
<td>25</td>
<td>244</td>
<td>30.66</td>
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<td>(mg/dL)</td>
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<tr>
<td><strong>HDL- cholesterol</strong></td>
<td>41.13</td>
<td>1.55</td>
<td>25</td>
<td>40.46</td>
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<td><strong>VLDL- cholesterol</strong></td>
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<td>15.26</td>
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<td>(mg/dL)</td>
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<tr>
<td><strong>LDL- cholesterol</strong></td>
<td>98.51</td>
<td>14.27</td>
<td>25</td>
<td>171.98</td>
<td>11.95</td>
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<td>(mg/dL)</td>
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<td><strong>Risk index</strong></td>
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<td>25</td>
<td>6.03</td>
<td>17</td>
<td>3.47</td>
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<tr>
<td><strong>Triacylglycerol</strong></td>
<td>197.81</td>
<td>69.4</td>
<td>25</td>
<td>157.8</td>
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<td>(mg/dL)</td>
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<tr>
<td><strong>Malonyldialdehyde</strong></td>
<td>8.18</td>
<td>1.86</td>
<td>25</td>
<td>10.63</td>
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<td>(µ M)</td>
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<tr>
<td><strong>Glutathione (µ M)</strong></td>
<td>29.18</td>
<td>10.7</td>
<td>25</td>
<td>15</td>
<td>5.94</td>
</tr>
</tbody>
</table>

*S = Significant, NS = Not significant

As shown in table 1 total cholesterol and TG of males with AMI found to be significantly increase and total cholesterol of females with AMI
found to be increase and TG of females was significantly increase when compared with healthy controls.

HDL- cholesterol of patients with AMI found to be decrease when compared with healthy controls. Thus, risk factor of cardiovascular disease of patients with AMI was significantly increased when compared with healthy controls. VLDL of patients with AMI found to be significantly decreased, whereas LDL found to be significantly increased. While the lipid peroxidation was increased by indication of the elevated levels of serum malonyldialdehyde whereas; serum glutathione was decline significantly in patients with AMI when compared with healthy controls.

The correlation between lipid peroxide and triacylglycerol was plotted and show a positive relationship of oxidation product excretion at higher levels of polyunsaturated fatty acids that found in triacylglycerol, as shown in Figure 1 and 2.

![Figure 1](image1.jpg) The correlation between lipid peroxide and triacylglycerol in male patients with AMI.

![Figure 2](image2.jpg) The correlation between lipid peroxide and triacylglycerol female patients with AMI.
Discussion

The most common cause of death in the most countries in the world is cardiovascular disease. One of the major risk factors is hyperlipidaemia [13,14]. More than 961000 persons died from cardiovascular disease or stroke in 1998 and more than 58 million Americans have one or more types of cardiovascular disease, such as coronary artery disease, hypertension, stroke, and rheumatic heart disease [15].

Oxidative stress occurs when this balance is disrupted by extreme production of reactive oxygen species, including superoxide, hydrogen peroxide and hydroxyl radicals, and/or by insufficient antioxidative defences,[16] including superoxide dismutase (SOD), catalase, vitamins C and E, and reduced glutathione (GSH) [17]. Oxidative stress causes damage to several cellular components. One example of this oxidative damage is lipid peroxidation. The lipid peroxides break down to form malondialdehyde (MDA). [18] MDA may be used as a biomarker of oxidative stress [19].

Antioxidants could limit or prevent the clinical expression of coronary artery disease by causing the regression or slowing the progression of coronary atherosclerotic lesions. The relation between antioxidant intake and the progression of coronary artery disease was investigated in several studies These studies support the hypothesis that increased intake of antioxidants inhibits the oxidation of LDL in the vascular wall [1,20].

Previous study shows the potential for increased lipid peroxidation risk for patients in whom elevated plasma polyunsaturated fatty acid (PUFA) concentrations are found. [21] Whether the plasma PUFA increase is due to high fat, low carbohydrate diet or PUFA supplementation, measurements of serum antioxidants and a marker of antioxidant insufficiency allow the detection and management of risk from elevated rates of oxidative damage. It is very difficult to use only clinical observations to discover fatty acid imbalances and increased rates of lipid peroxidation insults. Both phenomena produce multiple, subtle, nonspecific tissue effects that have few predictable short term symptomologies.[21] This result agrees with the results of present study.

Impaired status of antioxidants such as vitamin C and glutathione in patients with coronary artery disease may be a manifestation of PUFA peroxidation effects.[22] Also, this result agrees with the results of present study.

We conclude that patients with elevated levels of serum TG and cholesterol are at increased risk of oxidative damage due to lipid peroxidation. Laboratory evaluation of the status of specific antioxidant vitamins and markers of peroxidative damage along with profiling of plasma fatty acids allow significant improvements in patient management. Corrections may include adding antioxidant nutrients (vitamin E, N-acetylcysteine, curcumin, vitamin C, or others), or increasing other antioxidant categories such as the trace elements selenium, zinc, copper, and molybdenum.
References
21- Richard S. Land J. Alexander B., Integrative Medicine, 2003, 1, 1, 38.