A study for Malondialdehyde and lipid profile levels in ischemic stroke patients with and without diabetes mellitus

Majid Abdulwahab Maatook*[1], Dheyaa Sh. Hammad[2]

[1] Southern Technical University, Health and Medical Technology College. Basrah, Iraq
[2] South Technical University, Basrah, Iraq

Corresponding author:
Majid Abdulwahab Maatook
Southern Technical University
Health and Medical Technology Collrge
Basrah, Iraq
M.maatook@stu.edu.iq

Abstract

The current study has focused on the levels of Malondialdehyde as lipid peroxidation marker and lipid profile in ischemic stroke patients with and without diabetes. The study was conducted on 118 subjects, 32 ischemic stroke patients with diabetes, 36 ischemic stroke patients without diabetes, and 50 healthy subjects as normal control. Serum Malondialdehyde (MDA), total cholesterol (TC), High-density lipoprotein cholesterol (HDL-C), Low-density lipoprotein cholesterol (LDL-C), very low-density lipoprotein (VLDL) and Triglyceride (TG) were assessed in all three groups. The diabetic and non-diabetic ischemic stroke patients demonstrated a significant increase of MDA, LDL, VLDL, TG, and total cholesterol when compared with control subjects, but with more increases in diabetic ischemic stroke patients. The study has also revealed that there is a significant decrease in the activity of HDL in both patient groups when compared with the healthy control group, but with less decrease in the HDL in the diabetic ischemic stroke group. We conclude that the assessment of MDA and lipid profile may be useful in early detection and monitoring diabetic patients with an increased risk of ischemic stroke.

Key words: Ischemic stroke; lipid peroxidation; Malondialdehyde lipid profile

How to cite this article: Maatook MA, Hammad DS (2020): A study for malondialdehyde and lipid profile levels in ischemic stroke patients with and without diabetes mellitus, Ann Trop Med & Pub Health; 23:S401. DOI: http://doi.org/10.36295/ASRO.2020.23115

Introduction

Ischemic stroke is the most common type of stroke. It occurs when a blood clot blocks the flow of blood to the brain. It includes thrombotic and embolic strokes (1). A thrombotic stroke occurs when a blood clot forms in one of the arteries that supply blood to the brain. A clot may be caused by fatty deposits (plaque) that build up in arteries and cause reduced blood flow (atherosclerosis) (2, 3). An embolic stroke occurs when a blood clot forms away from the brain (commonly in the heart) and when break up it escape through the bloodstream to lodge in narrower brain arteries (4, 5). Certain modifiable risk factors for ischemic stroke include diabetes, dyslipidemia, smoking, and hypertension. Diabetics often also have high blood pressure and high blood cholesterol which increases their risk for stroke (6, 7, 8). Diabetes mellitus produces lipid profile disturbances making the cells more liable to lipid peroxidation (9, 10). The polyunsaturated fatty acids in the cell membrane have multiple bonds that make them more susceptible to be attacked by free radicals (11). During the intermediate radical reactions, highly reactive and toxic lipid radicals generate which make damage to the cell membrane (12, 36). In diabetic patients a major factor that is responsible for enhanced free radical generation is hyperglycemia through auto-oxidation of glucose; it may be an important risk factor for cardiovascular disease (13). A critical biomarker of oxidative stress is lipid peroxidation which is the most explored area of research when it comes to ROS (14). Malondialdehyde (MDA) is a stable end product of free radicals induced by lipid peroxidation. Thus MDA serves as a reliable marker for the assessment of free radical-induced damage to tissues (15, 16). In the present study, the serum level of Malondialdehyde and lipid profile was measured in ischemic stroke patients with and without diabetes and healthy subjects. The primary aim was to ascertain whether there is alteration in the levels of these parameters and if they had been implicated in the pathogenesis of ischemic stroke.

©Annals of Tropical Medicine & Public Health S401
Materials and Methods
The study group comprised sixty-eight ischemic stroke patients from Basra province in Iraq (32 diabetic and 36 non-diabetics) between the age group of 38-84 years of both sexes (46 males and 22 females). The control group consisted of 50 (age and sex-matched) healthy individuals with no known history of stroke, diabetes, and cardiovascular disease. Venous blood samples were collected from stroke patients and control subjects. After separation of the serum by centrifugation, the following methodologies were used for the estimation of MDA, lipid profile, and blood sugar concentrations.

Serum lipid Peroxidation product, Malondialdehyde (MDA), was measured by a kit supplied by Elabscience, USA.

- Total cholesterol was measured using the kit from Biolabo SA, Malzy, France depending on enzymatic method described by Allain and al. (17).
- Triglyceride (TG) was measured using the kit from Biolabo SA, Malzy, France depending on Fossati and Prencipe method associated with Trinder reaction (18).
- High-density lipoprotein (HDL) was measured using the kit from Biochains (19).
- Low-density lipoprotein cholesterol (LDL) was calculated by Friedwald and Frederickson formula from the following equation: (20)
\[
LDL = \text{total cholesterol} - \text{HDL} - \frac{\text{TG}}{5}
\]
- The glucose assay was performed based on the colorimetric enzyme method (21).

Data were expressed as the mean ± SD. The comparisons between groups were performed with analysis of variance (ANOVA). The student’s t-test was used to examine the difference in mean of parameters between two groups. Confidence limits equal or higher than 95% were considered to be statically significant p<0.05, while confidence limits equal or higher than 99% were considered to be statically highly significant p<0.01 (22).

Results
The main characteristics of all study subjects are shown in table 1. There was no significant difference in age and sex distribution between all study groups. Glucose levels were significantly higher in diabetic ischemic stroke group (DIS) compared with non-diabetic ischemic stroke group (NDIS) and control groups. Moreover, there was no statistical difference in glucose levels between NDIS and control groups. Systolic and diastolic blood pressure was significantly higher in two patients groups compared with control subjects. The difference in systolic and diastolic blood pressure between the two patients groups was insignificant.

<table>
<thead>
<tr>
<th>characteristics</th>
<th>Diabetic ischemic stroke patients (32)</th>
<th>Non diabetic ischemic stroke patients (36)</th>
<th>Control subjects (50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>63.2 ± 12.6</td>
<td>61.5 ± 10.2</td>
<td>62.3 ± 9.5</td>
</tr>
<tr>
<td>Male/Female</td>
<td>18 /14</td>
<td>24 / 12</td>
<td>32 / 18</td>
</tr>
<tr>
<td>FBS (mmo/l)</td>
<td>8.37 ± 1.9</td>
<td>5.37 ± 1.2</td>
<td>4.8 ± 0.8</td>
</tr>
<tr>
<td>SBP (mm Hg)</td>
<td>154 ± 21.6</td>
<td>149 ± 20.2</td>
<td>105 ± 36.1</td>
</tr>
<tr>
<td>DBP (mm Hg)</td>
<td>93 ± 14.7</td>
<td>91 ± 15.1</td>
<td>73 ± 25.7</td>
</tr>
</tbody>
</table>

Table 1. The clinical characteristics of all study groups (Data are reported as mean ± SD or as numbers).

Abbreviations: FBS: fasting blood sugar; SBP: systolic blood pressure; DBP: diastolic blood pressure; SD: standard deviation.

Table 2 demonstrates the mean±SD of Malondialdehyde and serum lipids activities in all study groups. The study found that the increase in MDA levels in group 1 is highly significant when compared to group 2 and group 3 (p<0.01 for group 2 and p<0.001 for group 3). There is a significant increase in the activity of MDA in group 2 when compared with the healthy control group (p<0.01). This indicates that lipid peroxidation is significantly increased in both ischemic stroke patient groups (ISPs) with more increase in MDA levels in ISPs with diabetes. Group 1 represent an abnormal lipid profile with significantly higher serum level of TC, LDL, VLDL, and TG compared to group 2 and group 3 (p<0.05 for group 2 and p<0.01 for group 3). There is a significant decrease in the activity of HDL in group 1.
and group 2 when compared with the healthy control group (p<0.05), and there is also decreased in the HDL in group 1 compared with group 2 but was no statistically significant.

### Table 2. The laboratory data for control and all ischemic stroke patients

<table>
<thead>
<tr>
<th></th>
<th>Diabetic ischemic stroke patients (group 1) (32)</th>
<th>Non diabetic ischemic stroke patients (group 2) (36)</th>
<th>Control subjects (group 3) (50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDA</td>
<td>6.24 ± 0.63</td>
<td>3.55± 0.58</td>
<td>1.97 ± 0.42</td>
</tr>
<tr>
<td>TC</td>
<td>4.90 ± 1.35</td>
<td>4.32 ± 1.38</td>
<td>3.13 ± 1.11</td>
</tr>
<tr>
<td>TG</td>
<td>1.79 ± 1.81</td>
<td>1.58 ± 1.27</td>
<td>1.16 ± 1.37</td>
</tr>
<tr>
<td>HDL</td>
<td>0.94 ± 0.38</td>
<td>1.00 ± 0.41</td>
<td>1.08 ± 0.52</td>
</tr>
<tr>
<td>LDL</td>
<td>3.09 ± 1.14</td>
<td>2.64 ± 1.26</td>
<td>2.29 ± 1.16</td>
</tr>
<tr>
<td>VLDL</td>
<td>0.82 ± 0.38</td>
<td>0.63 ± 0.29</td>
<td>0.54 ± 1.18</td>
</tr>
</tbody>
</table>

**Abbreviations:** MDA, Malondialdehyde; TC, total cholesterol; TG, triglyceride; HDL, high density lipoprotein; LDL, low density lipoprotein; VLDL, very low density lipoprotein.

**Note:** All values are given in mean ± SD, Lipid profile levels were expressed as mmol/l. MDA level was expressed as µmol/l.

**Discussion**

Diabetes is a major risk factor for the development of stroke [23]. Hyperglycemia has a role in the generation of oxidative stress leading to endothelial dysfunction in blood vessels of diabetic patients. Increasing in glucose and insulin levels along with dyslipidemia in diabetic patients develops macroangiopathies that cause oxidative stress leading to atherosclerosis (24). The results of our study show a significant increase in plasma MDA concentrations in Ischemic stroke Patients (ISPs), compared to control subjects. ISPs with diabetes showed the highest levels of MDA when compared to ISPs without diabetes. This is in agreement with a similar observation reported in another study (25). This indicates an increase in lipid peroxidation in diabetes mellitus due to the excess formation of the free radicals. The increased levels of MDA in diabetic ischemic stroke are due to an imbalance between the production of free radicals and anti-oxidant activity which leads to oxidative stress (26). Both hyperglycemia and insulin resistance increase reactive oxygen species (ROS) production (27). Increased ROS generation leads to the inactivation of endothelial nitric oxide synthase (eNOS), which reduces nitric oxide (NO) production (28). NO is a key molecule in maintaining of normal function of endothelial cells, thus allowing to endothelial dysfunction and subsequent atherosclerotic changes (29). Insulin resistance also creates a prothrombotic state which also plays an important role in the development of macrovascular complications (30). Lack of insulin also results in calcium accumulation in platelets, which enhances platelet aggregation, further contributing to CVD development (31). We also observed significantly increased TC, TG, VLDL, LDL levels and decreased HDL levels in the diabetic ischemic group compared to non-diabetic ischemic and control groups, this showed that diabetes presents a high-risk factor for developing ischemic stroke. Our study correlates with previous studies (32). Macrovascular complications, including stroke, may occur due to chronic uncontrolled hyperglycemia in diabetics (33). In diabetes, the associated hyperglycemia and insulin changes highly accelerate the progression to atherosclerosis through affecting key enzymes and pathways in lipid metabolism. Other causes a defect in insulin signaling receptors on the macrophages contribute to macrophage apoptosis and poor clearance of LDL by phagocytosis (34, 35, 36). The results of our study indicate a graded association between lipid peroxidation, lipid profile disturbance, and risk of stroke among diabetic patients. It suggests that the evaluation of Malondialdehyde and lipid profile in diabetic patients may be utilized for screening high-risk vascular complications of diabetes mellitus like ischemic stroke disease.

**References:**
