Study of Some Markers of Oxidative Stress Statues in Cardiovascular Disease Patients

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Abstract

The oxidative stress is one of the main cause for cardiovascular diseases and also one of the results of these diseases, its development. The aim of this study was to investigate the relationship between of some oxidative stress markers and cardiovascular diseases. This study involved 84 samples matched ages and sex divided into groups; 28 samples cardiovascular and 28 hypertensive in addition to 28 healthy control group. The following analysis were done: lipid profile, malondialdehyde (MDA), and albumin. The results show there is a significant increase in lipid profile between each group and control group. MDA was significantly higher in patients compared to controls whereas no significant difference was found in albumin between patient and control groups. The increase in MDA which is a product of lipid peroxidation is attributed to destruction in body cell caused by free radicals and resulting oxidative stress. It has been concluded that the assessing the lipid ratios is important even in a normal individual as it is one of the factors for development of cardiovascular diseases and their complications. There is a positive relation between oxidation results from these diseases and their developments.

Keywords: Hypertension, Cardiovascular, Malondialdehyde, Reactive oxygen species.

Introduction

Blood pressure is a measure of the force that the circulating blood exerts on the walls of the main arteries [1], macrophages had been assumed to be the source of the most ROS in the vessel's wall, However, it has become clear that virtually all the cells in the vessel wall produce ROS in different amounts and in response to diverse stimuli [2]. Cardiovascular is a pathological condition interrelated with cardiac valves, Oxidative stress promotes vascular smooth muscle cell proliferation and hypertrophy and collagen deposition, leading to thickening of the vascular media and narrowing of the vascular lumen. It has been shown that mechanical stretch to vessel wall induces ROS release, this suggests the possibility that high blood pressure itself increases ROS independent of renin angiotensin system activity [3]. In addition, increased oxidative stress may damage the endothelium and impair the endothelium-dependent vascular relaxation and increases vascular contractile activity [4]. Reactive oxygen species (ROS) are highly reactive intermediates of the oxygen metabolism, which are constantly being generated and destroyed. ROS may originate from both exogenous and endogenous sources [5].

Exogenous sources include environmental agents, radiation, therapeutic agents, and tobacco smoke. Endogenous sources include mitochondria, peroxisome and inflammatory cell activation [5]. When there is an imbalance between the generation of ROS and the antioxidant defense system so that the latter becomes overwhelmed, oxidative stress occurs [2]. Oxidants and free radicals are inevitably produced during most physiological and metabolical processes, and the human body has defensive antioxidant mechanisms, these mechanisms vary according to the cell and tissue type and they may act antagonistically or synergistically [6]. Oxidative stress has beenimplicated in a wide variety of disease processes includingatherosclerosis, diabetes, pulmonary fibrosis, neurodegenerative disorders, and arthritis, and is believed to be a major factor in aging [7]. In physiological conditions, lowlevels of ROS play a protective role in the organism, while increased generation of free radicals is associated with tissue or DNA damage [8]. The lipid profile is a group of tests that are often ordered together to determine the risk of heart disease. These tests are good indicators of whether someone is likely to have a heart attack or stroke caused by the blockage of blood vessels or hardening

of the arteries. The lipid profile, Total cholesterol high levels of cholesterol in blood circulation are strongly associated with progression of heart disease [9].Several studies have implicated impaired lipid metabolism as one of the crucial factors in the development of this disease [5,9] observed significantly higher total cholesterol (TC) and triglyceride (TG) levels and lower high-density lipoprotein cholesterol (HDL) in cardiac patients[10]. Malondialdehyde (MDA) is an end-product of the radical-initiated oxidative decomposition of polyunsaturated fatty acids; therefore, it is frequently used as a biomarker of oxidative stress [11], a studyby Ramprasad 2014 [12] recorded a significant increase in MDA values in cardiac patients and Tripti *et al.* 2013 observed an increase in MDA with hypertension [13]. Malondialdehyde, in fact, is not only an end-product of lipid peroxidation, but also the oxidative product of amino acids, carbohydrates, and DNA [14]. Albumin represents the most abundant protein in thecirculatory system with a significant antioxidant activity [15], the antioxidant activity of albuminresult from its ability to bind bilirubin, homocysteineand lipids [16]. Several observational studies did not find an association between serum albumin and CVD. It has been suggestedthat the relation between serum albumin and CHD may vary across sex, age, and level of serum cholesterol. Corti andcolleagues found an association between serum albuminand CVD among older women but not among older men [17].

Materials and Methods

The present study comprised 84 women [namely control (28), hypertensive (28) and cardiovascular diseases (28)] aged between 25–60 years. These patients were hospitalized at educational laboratories in the Ibn Alnafese hospital. They were divided into groups of healthy as control group, hypertensive and cardiovascular diseasedpatients. Blood sample were collected and centrifuged at [4000 xg] for 5 min after clotting .The resultant serum were separated and stored at [-40]°C until used. Serum lipid profile was measured as follows: the serum cholesterol and triglyceride and High density lipoprotein was measured using kits supplied by Randox company. Estimation

of serum albumin was done using kit provided by BioSystems company. Friedwald equationused to estimate LDL-cholesterol

[LDL-Chol] = [Total Chol] - [HDL] –[VLDL]

Serum malondialdehide MDA is typically quantified from plasma samples with the mostpopular method being a colorimetric assay based on the reactionbetween MDA and thiobarbituric acid (TBA) described by Shah and Walker[18].

Statistics

The Statistical Analysis System-SAS (2012) was used to determine of different factors in studied parameters, P-value used to significant compare between means in this study.

Results and Discussion

Eighty four sample subjects comprising of 56 patients and 28 healthy were included in the present study, Table (1) shows the means and standard deviation of age, body mass index (BMI), cholesterol, triglyceride , high density lipoprotein (HDL), malondialdehyde (MDA) in addition to albuminlevels for the control and patients groups.

Table (1)
Characteristics of the Hypertension (HT) and control group (mean ± SD).

Characteristic	HT patient group N=28	Control group N=28	P value
Age (year)	46.8±8.2	43.4±9.3	>0.1
BMI (kg/m^2)	31.48 ± 0.95	27.27 ±0.97	<0.05
Cholesterol mmol/L	5.2 ± 0.9	4.23 ± 0.24	<0.01
Tri glyceridemmol/L	2.4 ±1.03	1.31 ± 0.09	<0.05
HDL mmol/L	1.1 ±0.4	1.42 ± 0.09	0.01
LDLmmol/L	4.13±1.2	3.53 ± 0.17	<0.01
LDL/HDLmmol/L	4.3±1.2	2.83 ± 0.24	<0.05
MDAµmol/L	6.35 ± 0.71	3.31 ± 0.26	<0.01
Albumin g/L	35.52 ± 1.84	44.18 ±2.20	<0.01

Data in Table (2) show that there are high significant differences in mean value of cholesterol, triglyceride and malondialdehyde for patients group in comparison with control group, and as shown in same table the albumin was highly significantly decreasedin the patient compared withcontrol mean values (group).

Table (2)
*Characteristics of the Cardiovascular diseases and control group (Mean ± SD).*

Characteristic	CDV. patient group N=28	Control group N=28	P value
Age (year)	52.3±9.3	43.4±9.3	>0.1
BMI (kg/m^2)	32.59±6.36	31.4±4.85	<0.05
Cholesterol mmol/L	4.62 ± 0.25	4.23 ± 0.24	<0.01
Triglyceridemmol/L	2.209 ± 0.17	1.31 ± 0.09	<0.01
HDL mmol/L	1.15 ± 0.06	1.42 ± 0.09	<0.01
LDLmmol/L	4.13 ± 0.23	3.53 ± 0.17	<0.05
LDL/HDLmmol/L	3.86 ± 0.29	2.83 ± 0.24	<0.01
MDAµmol/L	5.49 ± 0.94	3.31 ± 0.26	<0.01
Albumin g/L	35.49 ± 1.47	44.18 ±2.20	>0.01

The significant difference ($p<0.05$) in lipid profiledue to cholesterol plaque causes the muscle cells to enlarge and form a hard cover over the affected area. This hard cover is what causes a narrowing of the artery, blood flow will be reduced and increasing blood pressure. Plaques are covered with a fibrous cap and it creates a bump on the artery wall of hypertension patients. Decreased HDL-C in patients indicates decreased rate of reverse cholesterol transport and therefore accumulation of TG rich lipoproteins leading to increased risk of atherosclerosis and CVD in all groups. The LDL lipoprotein increase atherogenicity and available data suggest that LDL is more atherogenic than other lipoproteins. CVD have been generally described as having high levels of oxidative stress. And this agree with other studies [19,10].
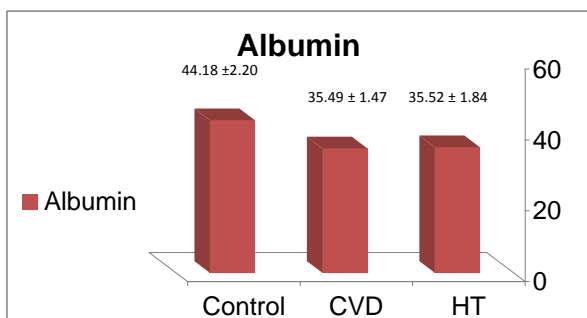
The LDL/HDL cholesterol ratio appears to be as useful as the total/HDL cholesterol ratio.

Their similarity can be explained by the fact that approximately two thirds of plasma cholesterol are found in LDL and, consequently, total and LDL cholesterol are closely relatedthe significant difference between risk factor ratio (LDL/HDL) is also found by (Millan J. *et al* 2009) [20] who found the LDL/HDL cholesterolratio was a powerful predictor of cardiovascular risk.

MDA

6.3 ±2.0

5.54 ± 2.6

3.31 ± 0.26

■MDA

HT   CVD   control

8
6
4
2
0
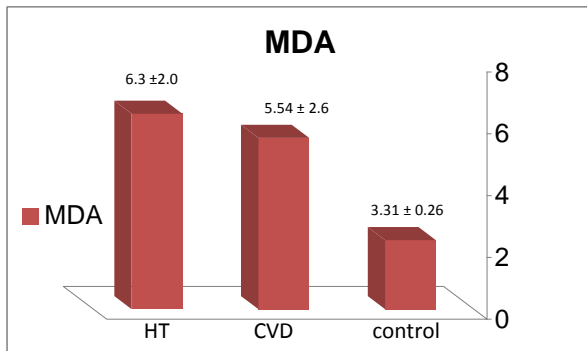
Fig. (1) Mean conc. (µ mol/L) of oxidative marker MDA for studied groups.

The highly significant difference (p<0.01) of MDA in CV patient may due to high oxidative stress which generally causes damage to the membrane polyunsaturated fatty acids leading to the generation of MDA. This result agree with study of (Jawalekar S. *et al* 2010) [21].

Albumin

44.18 ±2.20

35.49 ± 1.47   35.52 ± 1.84

■Albumin

Control   CVD   HT

60
40
20
0

Fig. (2) Mean conc. (g/L) of albumin in the studied groups.

Albumin contains a free sulfhydryl group, this forms a disulfide with several compounds like cysteine, homocysteine, or glutathione, Albumin is able to scavenge hydroxyl radicals [22], the decrease in albumin in patient is agreed with results of (Durga V. *et al* 2014) [23] who suggested that result is may be due to its function as antioxidant activity so the non-oxidized albumin is decrease in addition to negative acute phase protein, so inflammation

is considered the principle cause of a decrease in the serum albumin [22].The weak negative correlation (r=-0.1)between MDA and albumin in cardiovascular disease patient and control group agreedwith (Al Fartosi k. *et al.* 2010) who found a negative correlation between MDA and Albumin [24]. There is an evidence for a significant antioxidant activity of the represent the major and predominant circulating antioxidant in plasma known to be exposed to continuous oxidative stress. There was no correlation between BMI and MDA and this agree with (Ali P. *et al* 2008) [25].

A positive correlation observed between MDA and LDL- cholesterol and this result also shown by (Venkata Rao *et al* 2011) and (Ogunro P. *et al* 2009) [26,27].

Conclusion

Based on result of this study it may be concluded that the importance of assessing the lipid ratios even in a normal individual as it is one of the factors for development of cardiovascular diseases and there is a positive relation between oxidation results from cardiovascular and hypertension diseases and their developments.

Acknowledgements

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الخلاصة

الجهد التاكسدي هو احد الاسباب الرئيسية لامراض القلب واوعيته وهو ايضا احد نتائج تقدم هذه الامراض والتحطم الناتج منها. هدف هذه الدراسة هو بحث العلاقة بين مؤشرات الجهد التاكسدي وامراض القلب واوعيته. هذه الدراسة استلزمت 84 عينة من النساء قسمت الى 28 عينة مرضى بامراض القلب واوعيته و 28 بأمراض ضغط الدم بالإضافة الى 28 من الاصحاء كمجموعة سيطرة. التحليلات التالية اجريت لكل العينات: صورة الدهون، المالون داي الديهايد، والالبومين. النتائج اظهرت ان هناك زيادة معنوية في مستويات صورة الدهون بين كل مجموعة ومجموعة السيطرة. المالوندايالديهايد اعلى بشكل معنوي في المرضى مقارنة بمجموعة السيطرة بينما لم يظهر اي فرق معنوي في الالبومين. الزيادة في المالون داي الديهايد والذي هو ناتج فوق اكسدة الدهون يعزى الى التحطم في خلايا الجسم بسبب الجذور الحرة الناتجة من الجهد التاكسدي. الاستنتاج: اهمية تقييم نسب الدهون حتى في الاصحاء كونها احد عوامل تطور امراض القلب واوعيته وتعقيداته. هذه العلاقة الموجبة بين الاكسدة الناتجة من هذه الامراض وتفاقمها. وبالتالي يقترح زيادة تناول مضادات الاكسدة للحد من هذه الامراض او تفاقمها.