Serum Malondialdehyde, Total Cholesterol, High Density Lipoprotein and Vitamin C in Welder Workers

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Abstract

Objective: We tested the hypothesis that the serum Malondialdehyde (MDA) total cholesterol (TC) high density lipoprotein cholesterol (HDL-C) and vitamin C concentration are affected in welder workers relative to non-welder subjects, and to clarify the relationship of MDA as marker of oxidative stress with these lipoproteins and vitamin C as antioxidant.

Study design: A prospective case control study conducted at Basrah Province through a period of two months from the first of March till the end of April 2005.Venous blood samples were collected for sixty welder workers, who were classified into 3 groups according to their age and to another 3 groups related to their duration of working, and another sixty non welders workers saved as a control group whose aged range (20 - 60) years.

Serum was analyzed for concentrations of MDA, TC, HDL – C and vitamin C using standard methods.

Result: The results of the study showed significant increase in the concentrations of serum MDA, TC and HDL- C levels and significant decreases in the concentration of vitamin C ($P<0.05$) with advancing age in welders relative to non welder workers. Further more, there were significant gradual increase $p<0.05$ in the concentration of MDA and TC levels and significant gradual decrease $p<0.05$ in the concentration of vitamin C with increase the duration of working in the welder group.

The effect of fruits and vegetable intakes and smoking habits on the above biochemical parameters in each group revealed significant decreases in the concentrations of MDA and TC and significant increases in the concentration of HDL-C and vitamin C $p<0.05$ with the increase the intake of both fruits and vegetables and give the adverse effect on both parameters due to the smoking habit in welder workers related to control subjects and to those having negative smoking habit.

Conclusion*:* The increase in the concentrations of MDA and TC levels and the decreases in the concentration of vitamin C in welder workers with advancing age or with the increase of duration revealed that those subjects were at high risk of oxidative stress which might lead to increase the incidence of many cardiovascular and inflammatory diseases. This effect had not been seen as soon as possible due to the increased in HDL-C level.

مستويات المالونداي الديهايد،الكلولسترول الكلي،البروتينات الدهنيه عالية الكثافة وفيتامين ج في مصل دم عمال اللحيم

ألخلاصة

الهدف: فحصت فرضية كون تراكيز المالونداي الديهايد MDA ، الكلولسترول الكلي TC، البروتينات الدهنية عالية الكثافة-HDL C وفيتامين ج قد تتأثر عند عمال اللحيم مقارنة ببقية العمال غيرالعاملين باللحام ولتوضيح العلاقة بين MDA كونه مّؤعلم للجهد المؤكسد مع بعض البروتينات الدهنية وفيتامين ج كمضاد للأكسدة.

نمط الدراسة: صممت هذه الدراسة في مدينة البصرة وامتدت على نحو شهرين ابتداء" من الأول من شهر مارس إلى نهاية أبريل للعام ٢٠٠٥ .

تظمنت الدراسة الحالية ١٢٠ شخصا ، منهم ستون شخصا من عمال اللحيم الكهربائي تم توزيعهم على ثلاث فئات عمرية والى ثلاث فئات أخرى استنادا للفترة الزمنية التي يمارسون فيها العمل ، وكذلك ستون شخصا من العمال الذين لا يمارسون هذه المهنة . وقد سحبت عينات من دم الأشخاص المشمولين بالدراسة ليتعين مستويات MDA و TC و HDL-C وفيتامين ج باستخدام الطرق القياسية.

النتائج:أظهرت نتائج الدراسة ارتفاعا معنويا بمستويات MDA و TC و HDL-C وانخفاضا معنويا بمستوى فيتامين ج ($P<0.05$) عند مجموعة عمال اللحيم الكهربائي وذلك بتقدم عمر العمال من جهة وزيادة مدة التعرض من جهة أخرى، أوعند مقارنة النتائج مع مجموعة العمال غير العاملين باللحام (المجموعة الضابطة). كما وان تأثيرزيادة تناول الفواكه والخضروات والتدخين على العوامل المقاسة سابقا أظهرت انخفاضا معنويا بمستويات MDA و TC ($P<0.05$) وارتفاعا معنويا بمستويات HDL-C و فيتامين ج ($P<0.05$). كما وأظهر تأثير التدخين نتائج سلبية على العوامل البيوكيميائية المقاسة لدى عمال اللحيم الكهربائي المدخنين مقارنة بغير المدخنين منهم أوعند المقارنة مع المجموعة الضابطة من غير المدخنين .

الخلاصة: أن الارتفاع المعنوي بتراكيز MDA و TC من جهة والانخفاض المعنوي لتركيز فيتامين ج من جهة أخرى لدى مجموعة عمال اللحيم الكهربائي بتقدم العمر ، أو بزيادة الفترة الزمنية للتعرض يوحي بأن هؤلاء الأشخاص يتعرضون لعوامل الأختطارمن الجهد المؤكسد ربما يؤدي إلى زيادة نسبة الإصابة بأمراض القلب التاجية والالتهابات المرضية. وأن هذا الاختطار قد لا يؤثر على المدى القريب وذلك بسبب ارتفاع نسبة البروتينات الدهنيه عالية الكثافة والتي تعمل على حماية الجسم ضد هذه الأمراض .

Introduction

Welders are groups of subjects who work in welding and can be exposed to high active radical that might be formed from oxygen due to a very high temperature of welding that may reached more than 1000ºC which is enough to ionized the molecular oxygen in (O_2) radical that has high oxidizing activity and can oxidized the lipid mainly fatty acids in to MDA.

Malondialehyde (MDA) is a natural product formed in all mammalian cells as a product of lipid per oxidation; it produced as by-product of poly unsaturated fatty acid peroxidation and arachidonic acid metabolism[1]. It is a marker of lipid peroxidation had strong correlation with oxidative stress, which had many effects on airway functions including airway smooth muscle contraction, induction of airway hyper responsiveness, mucus hyper secretion, epithelial shedding and vascular exudation [2, 3].

Vitamin C is an essential micronutrient required for normal metabolic functions as the healing of wounds, production of digestive enzymes and connective tissue, brain and nerve function and for formation of teeth and bone[4,5]. Also facilitates non–heme iron absorption, and has protective effect on pulmonary fxn, CVD mortality and used to protect against protein oxidation in eye [3].

The major sterol in the body is cholesterol, which accounts for almost all the plasma sterol. While HDL is the smallest lipoproteins particles and composed of an outer layer containing free cholesterol, phosphor lipids and various apo lipoproteins[6]

The relationship between abnormal levels or composition of blood lipoproteins and cardio vascular disease in adults is well established in both epidemiological and prospective studies[7-9].

Therefore, our aims were to measur MDA (which is considered as marker for estimation the degree of oxidative damage) TC and HDL (due to their close relation with cardio vascular disease).Vitamin C (due to it's activity as antioxidant vitamin, that reversed and reduced the oxidation) serum levels in welder subjects from Basrah in relation to those of non welder workers and to clarify the relationship between these biochemical parameters

and the duration of working in welding.

Material and Methods

Prospective case control study was conducted at Basrah province a through period of two months from the first of March till the end of April 2005.

Sixty male welders were participated in the study, who was working at Alnajeebiyaa, South Oil Company and Al- Sinaeyaa of Hamadan; they was classified into 3 groups according to their age and to another 3 groups related to their duration of working. Other matched healthy male non welders whose age ranged from 20 to 60 years are served as a control group.

From each worker a full information was obtained includeing name, age, duration of working, fruit and vegetable intake per week and smoking habit. As well as the following questions about not receiving any medical treatment, and had no of diseases (including diabetes mellitus, coronary heart disease hypertension and chronic renal failure).

Venous blood sample (5ml) was collected from each worker participated in the study for measurement of MDA, TC, HDL-C (after precipitation with sodium phospho tung state- $MgCl_2$) and were determined enzymatically using kits from Bio-Merieux, France. All procedures were followed according to instructions of manufacture. Quality control sera from Bio-Merieux were included in each assay batch for all above analytes. Vitamin C level was measured by the reduction of colored dye 2,6-di hydro phenol indophenols from blue to colorless, and the amount of de colorization was determined spectrophotometrically[10].

Statistical analysis with each group of subjects was performed by the analysis of variance (ANOVA), and the results were expressed as mean ± SD. A P values of less than 0.05 was considered as statistically significant.

Results

The basic characteristic of all subjects participated in this prospective study regarding their ages duration of working, fruit and vegetable intake and smoking habit are presented in Table1.

Table 2 summarizes the effect of age on serum MDA, TC, HDL- C and vitamin C levels in all studied groups. We found that, the serum levels of TC, MDA and HDL-C were significantly increased ($P < 0.05$) with advancing age in studied group and as compared with control subjects. However serum vitamin C was significantly decrease ($P<0.05$) at different age groups in welders and when compared with control subjects.

The effect of duration of working on the above biochemical parameter in studied group was presented in Table 3.The levels of TC and MDA were significantly increase ($P<0.05$), whereas serum vitamin C level was significantly decrease ($P< 0.05$), however serum HDL-C level was non-significantly altered ($P >0.05$) among the increased the duration of exposure in the three different duration group.

Table 4 shows the results of the effects of fruit and vegetable intakes on the levels of TC, MDA, HDL-C and vitamin C in two studied groups. There were significant decreases ($P<0.05$) in the levels of MDA and TC levels and significant increases ($P<0.05$) in the concentrations of vitamin C and HDL-C levels with increased the intake of fruit and vegetable in studied group and also when compared with control subjects.

The effect of smoking habit on the concentrations of all measured parameters was presented in Table 5. It was show that the levels of MDA and

TC were significantly elevated ($P<0.05$), and the concentrations of HDL-C and vitamin C were significantly lowered ($P<0.05$) in welder group who have positive smoking habits related to negative smoking habit and also to the control subjects.

Discussion

Lung were exposed to high level of environment oxidant, yet they also had enriched extracellular antioxidant. This way of air had evidence of increased oxidative stress, suggesting that reactive oxygen and nitrogen species may over whelm the lung from increased oxidative stress[11].

Excessive exposure to reactive oxygen and nitrogen species during welding or due to their release to the body as by products of normal metabolism[12] or from environment exposure to air pollution[13] leads to damaging the protein, lipid and DNA. These events may cause direct tissue injury or evoke of cellular responses through the generation of secondary reactive species[14].

In the present study, there were significant increase in serum MDA levels in relation to age group, duration of welding and smoking habit. This elevation, revealed that welders exhibit disturbances in oxidative – anti oxidant balance, manifested by increased oxidative stress activity[15, 16]. However, MDA level is significantly decreased as the rate of fruit and vegetable intakes increases. This is possibly due to their higher content of vitamin C and other antioxidant compounds that would neutralize the free radical concentrations and reduced their oxidative damage.

The increase in ROS might overwhelm endogenous antioxidant nutrients such as vitamin C. This finding was illustrated in the present work by significant decreases in the levels of vitamin C in relation to age, duration of welding and smoking habit and significant increased with increased the rate of fruit and vegetables intake per week. The possible explanation for these finding was possibly due to the action of vitamin C as low molecular weight antioxidant reversed oxidation and reduces hydroxyl, super oxide alkoxyl and peroxyl radicals from attacking and damaging the cell membrane, DNA and cellular protein[4] and its action in scavenging free radicals and reconstructing the active form of vitamin E and other important anti oxidant as pro vitamin A and protection against lipid Peroxidation[3, 17, 18].

Serum HDL-C levels were significantly increased in welders as compared with control subjects of approximately of the same age and duration. This might refer to high hard work of welding and high physical stress and exercise performed by them during their work nature[19].

Also HDL-C levels were significantly increased and TC levels were significantly decreased as the rate of fruit and vegetables in takes were increased and this might be attributed to their high contents of unsaturated fatly acids and also to increase rate of lecithin acycle cholesterol transferase activity (LACT) enzyme which is responsible to enhance the rate of synthesis of HDL-C that acts as a scavenger for cholesterol[6, 7, 20, 21].

The significant increases in TC level in welder group might be attributed to the high exposure of free radicals which might be stimulated the rate limiting enzyme hydroxyl-methyl glutaryl CoA SH reductase (HMG CoASH reductase) which is responsible for liver cholesterol synthesis[6].

Therefor the present study has been constructed to throw light on the levels

of serum MDA, TC,HDL- C and vitamin C that affect and exhibit disturbances in their oxidative – anti oxidative balance through working in welding for subjects that have this work a living.

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Table1 Basic characteristic for all subjects participated in the study.

Variable		NO.	Study group	NO.	Control group
Age/(years)	20-30	19	24 ± 3.6	22	24 ± 3.6
	31-42	21	36 ± 3.1	20	36 ± 3.5
	43 – 60	20	50 ± 4.4	18	51 ± 5.1
Duration (years)	1 - 12	22	6.6 ± 4	-	-
	13 – 25	18	17.8 ± 3.8	-	-
	26 - 40	20	32.6 ± 3.6	-	-
Smoking	Positive	29	48%	33	55%
	Negative	31	52%	27	45%
Fruit and	<3	17	28%	19	32%
Vegetable/week	3 – 5	21	35%	17	28%
	>5	22	37%	24	40%

Table 2 Effect of age on serum MDA, HDL – C, TC and vitamin C level on Both welders and non welders workers

		Welder (Study)			Non welders (control)			
Age years	MDA umol/L	HDL–C mg/dL	TC mg/dl	Vitamin C mg/dl	MDA umol/L	HDL-C mg/dL	TC mg/dL	Vitamin C mg/dL
18-30	1.31±0.2	50 ± 5	189 ± 9	0.68±0.09*[a,b]	1.27±0.13	44 ± 6	172± 11	0.9 ± 0.1
31-42	1.43±0.21	57±7*	195±10*	0.54±0.09*[a,b]	1.31±0.18	39 ± 9	175 ± 8	0.8± 0.1
43 - 60	1.67±0.19	53±9*	215±9*[a,b]	0.4 ± 0.1*[a,b]	1.36 ± 0.2	37± 11	190± 11	0.7± .0.6

Values are expressed as mean ± SD
a: Significance between study and control groups.
b: Significance between different age groups.
*P<.0.5

Table 3 Effect of duration of welding on MDA, HDL- C, TC and vitamin C levels.

Study group					Control group			
Duration years	MDA µmol/L	HDL–C mg/dL	TC mg/dl	Vitamin C mg/dl	MDA umol/L	HDL- C mg/dL	TC mg/dL	Vitamin C mg/dL
1 - 2	1.21±0.018	49 ± 4	186 ± 8	0.67 ± 0.1*				
13 – 25	1.38 ± 0.11	56 ± 6	198 ± 10	0.53 ± 0.1*				
26 - 40	1.62 ± 0.21	50 ± 7	210 ± 9*	0.33 ±0.09*				
Total	1.4 ± 0.15	52 ± 9	197 ± 10	0.51 ± 0.1	1.2 ± 0.3	43 ± 7	178±11	0.62±0.11

Value are expressed as mean ± SD
* Significant between different duration groups.
* P < 0.05

Table 4 Effect of fruit and vegetable intakes on MDA, HDLS, TC and vitamin C levels in the study and control groups.

Study group					Control group			
Fruit and vegetable/ week	MDA umol/L	HDL–C mg/dL	TC mg/dl	Vitamin C mg/dl	MDA umol/L	HDL- C mg/dL	TC mg/dL	Vitamin C mg/dl
< 3	1.75± 0.21	42 ± 3	212 ± 9	0.38±0.08*[ab]	1.3±0.11	41 ± 4	205±11	0.71±0.0
3 – 5	1.63±0.18	48 ± 5	202 ± 8	0.5±0.12*[ab]	1.23±0.13	34 ± 5	194 ± 9	0.86±0.08
> 3	1.44±0.17*[ab]	54±6*[b]	190±10*[b]	0.78±0.12*[ab]	1.15±0.23	49 ± 5	186 ± 9	1.1±0.07

Values are expressed as mean ± SD

a: Significance between study and control groups.

b: Significance between the same group with different intakes.

*p< 0.05

Table 5 Effect of smoking habit on serum MDA, HDLS, TC and vitamin C among the welders study group and non welders control group.

Study group					Control group			
Smoking habit	MDA umol/L	HDL–C mg/dL	TC mg/dl	Vitamin C mg/dl	MDA umol/L	HDL-C mg/dL	TC mg/dL	Vitamin C mg/dl
Positive	1.7±o.17*[a]	42 ± 5	225 ± 11	0.42±0. 1*[a,b]	1.32±0.13	40 ± 7	205 ± 9	0.89 ± 0.1
Negative	1.41±0.6*[a,b]	57±6*[b]	201 ± 9	0.76± 0.1 *[a,b]	1.1 ± 0.2	43 ± 6	198 ± 11	1.1 ± 0.14

Values are expressed as mean ± SD

a: Significance between study and control groups.

b: Significance between the same groups.

*p< 0.05.