INFLUENCE OF SMOKING ON MARKERS OF OXIDATIVE STRESS AND SERUM MINERAL CONCENTRATIONS IN MALE SUBJECTS[+]

D . Hameed M. Majid[*]

Abstract

The purpose of this study IS to examine the effect of cigarette smoking on serum oxidative damage, antioxidant status, and mineral concentrations in male subjects. Subjects were randomly chosen from different work places in Baquba city. Smoker(n=45) is defined as a person who has smoked 10 or more cigarettes/day continually for at least one year while non smoker(n=45) is a person who has no previous smoking experience. Serum oxidative defense enzyme activities (CAT and glutathione-s- transferase) and non enzymatic (glutathione, total protein, albumin and uric acid) and serum mineral (Zn, Cu and I) were evaluated. Serum glutathione was lower in smokers than in non-smokers, whereas serum uric acid was higher. Serum zinc and copper concentrations were similar in the two groups. Serum iron concentrations were higher in smokers. All other parameters were similar in both groups. These findings show that there is depletion in the non enzymatic antioxidant change depending on their co factor concentrations in tobacco smokers.

المستخلص

في دراسة لمعرفة الضرر التأكسدي للمدخنين على مكونات سيرم الدم ، مضادات الأكسدة الأنزيمية وغير الأنزيمية بالإضافة إلى تراكيز الأملاح المعدنية. أخذت عينات من الدم الوريدي من ٤٥ شخصاً مدخناً يعملون في مواقع مختلفة في مدينة بعقوبة حيث يعرف المدخن بأنه الشخص الذي يدخن (١٠) سكائر فأكثر لمدة سنة و٤٥ شخصاً غير مدخن حيث يعرف بأنه ليس له سابقة في التدخين. تم قياس فعالية سيرم الدم الأنزيمية (الكاتاليز والكلوتاثايون ترانسفيريز) وغير الأنزيمية (الكلوتاثايون البروتين الكلي ،الألبومين وحامض اليوريك). أيضا تم إجراء قياس اختبار الـ (MDA) كمؤشر على أكسدة الليبيدات في سيرم الدم بالإضافة إلى الأملاح المعدنية (الزنك، النحاس والحديد). أظهرت النتائج وجود انخفاض معنوي بمقدار٥% عند المدخنين في مستوى فعالية الكلوتاثايون مقارنة بغير المدخنين، مع ارتفاع معنوي عند المدخنين في تركيز حامض اليوريك. تراكيز الزنك والنحاس كانت متشابهة في المجموعتين كلتيهما بينما أظهرت مجموعة المدخنين وجود فروقات معنوية عالية في تركيز الحديد. أما بقية القياسات الأخرى فكانت متشابهة في المجموعتين كلتيهما هذه النتائج تشير إلى وجود استنزاف في مضادات الأكسدة غير الأنزيمية عند المدخنين نتيجة للتأثير السلبي لعامل التدخين على مكونات سيرم الدم غير الأنزيمية.

Introduction

Smoking is a widely accepted practice in Iraqi and sometimes is associated with socializing, sharing and male identity. A smoker defined as a person who has smoked 10 or more cigarettes per day continually for at least one year, while non-smoker is a person who has no

[+] **Received on 21/6/2005 - Accepted on: 18/1/2006**

[*] **Lecturer / Technical Institute / Baquba.**

previous smoking experience [1] .Although smoking is a recognized risk factor for several diseases, including emphysema ,chronic bronchitis ,cardiovascular diseases and Cancer [2] ,very little is known about the nutritional consequences of smoking .In animal models ,administration of benzo (a) Pyrene , a constituent present in cigarette smoke induced vitamin A depletion [3]. Vitamin A deficiency per se causes emphysema. Some other trace elements, such as iron, zinc, and vitamin E were found to be deficient among healthy smokers. compared to non- smokers[4].

Many antioxidant defenses depend on micronutrients or are micronutrients themselves. Superoxide dismutase (a Cuzn-or Mn- Containing enzyme) removes $O_2^{\cdot -}$ by converting it to H_2O_2 which is then removed by glutathione peroxidase (a GSH-dependant selenoprotein) or catalase (a haem enzyme). The iron transporting protein transfer is normally kept at around 30% iron saturation to ensure that no iron is available to catalyse formation of dangerous radicals such as $^{\cdot}OH$ [5].

Material and Methods

The purpose of this study is to examine the effect of cigarette smoking on serum oxidative damage, antioxidant status, and mineral concentrations (Zn, Cu and iron) in Iraqi subjects. Subjects were randomly chosen from different work places in a rural community in Baquba city.

The subjects who had a history of smoking 10 or more cigarettes per day were considered smokers, (n=45) and those who never smoked were controls (n=45). Venous blood was obtained from each subject and divided to two parts- in EDTA tube for haematological test, while the second part was drawn in a test-tube. Serum samples were separated by centrifugation, and kept stored at $4C^{\circ}$ until further analysis which include the activities of catalase, glutathione-s-transferase and glutathione in each sample spectrophotometrically. Also albumin, total protein, uric acid, Malondialdehyde (MDA) concentrations as a marker of lipid peroxidation serum zinc, copper and iron concentrations in tobacco smokers were compared with those of non- smokers.

Statistical Methods

All data are expressed as the mean value ± SE . Statistical analysis of the results was performed . Variables between smokers and non-smokers were compared by using Duncan's test .
A probability level of 5% was considered statistically significant.

Table I.S haematological parameters in the smoker Group (n=45) and control group (n=45) (Data shown as mean ± SE .)

	Smokers	Controls
Haemoglobin (g/dL)	13.607 ± 0.217	13.209 ± 0.28
Erythrocyte (10^6)	4.932 ± 0.078	5.026 ± 0.081
Leucocyte (10^6)	7.321 ± 0.343	7.239 ± 0.384
Plateletts (10^3)	149.095 ± 6.337	154.467 ± 6.492

Table II . Selected serum biochemical parameters in the smoker group (n=45) and control group (n=45). (Data shown as mean ± SE .)

	Smokers	Controls
Albumin (g/dL)	3.689 ± 0.112	3.64 ± 0.117
Total protein (g/dL)	7.033 ± 0.113	6.982 ± 0.142
Uric acid(mg/dL)	6.33 ± 0.222	5.722 ± 0.187*
GSH (n mol/L)	0.211 ± 0.015	0.257 ± 0.017*
CAT (U/L)	5.682 ± 0.41	4.659 ± 0.436
GST(U/L)	34.438 ± 3.361	30.016 ± 3.334
MDA (n mol/L)	1.523 ± 0.155	1.405 ± 0.148
Zinc (mg/dL)	113.796 ± 4.232	107.6 ± 7.587
Copper (mg/dL)	75.291 ± 5.658	79.634 ± 6.221
Iron (mg/dL)	83.119 ± 6.273	62.373 ± 3.937*

- control NS. Smoker group, P<0.05 .

Results

Table I : shows no statistical differences were observed in the haematological parameters in smoker compared with non- smoker subjects.(P>0.05).

Table II : shows that serum concentrations of glutathione (GSH) was significantly lower in smokers group compared with control group ,(P <0.05). Conversely concentrations of total protein and albumin were similar in both groups . (P>0.05).

Serum concentration of thiobarbituric acid reactive substances (TBARS) slightly increased in smoker group. The activity of catalase (CAT) and glutathione-s-transferase (GST) increased in smoker subjects but these were not significant (P>0.05).

Serum Zinc concentrations were higher in smokers , whereas serum copper concentration was lower but not significant (P>0.05).serum Iron shows highly significant differences in smoker group compared with non-smokers.

Discussion

Antioxidant defensces act as balanced and coordinated system and each relies on the action of the other.[6].

Antioxidants, which controls the oxidative stress state, represents a major line of defense regulating over all health. Human plasma contains many different non enzymatic antioxidants. Because of their number, it is difficult to measure each of these different antioxidants separately. In addition, the antioxidant status in human plasma is dynamic and may be affected by many factors.

Glutathione peroxidases are a major enzymes that remove hydrogen peroxide generated by SOD in cytosol and mitochondria, by oxidizing the tripetide glutathione (GSH) in to its oxidized from (GSSG)[7].

$$2GSH + H2O \xrightarrow{} GSSG + 2H2O$$

Increased concentrations of broken down products of uric acid in smokers compared with non smokers, suggest that uric acid does indeed react with some oxidants. However, reaction of uric acid with certain oxidizing species, such as ˙OH or peroxyl radicals, can generate uric acid radicals that are themselves capable of doing biological damage [8].

It is thought that transition metal ions released during tissue damage might catalyse the conversion of these poorly cytotoxic species into much more harmful substances[9].

$$Fe^{+2} + H2O2 \longrightarrow Fe^{+3} + OH^{-} + {}^{\cdot}OH$$

(The fenton reaction)

Conclusion

Our findings of elevated level of uric acid and decreased activities of glutathione provide further evidence of the connection between smoking and non enzymatic antioxidant system which may help to contribute to the interpretation of epidemiological studies and in planning future research.

References:

1-Kim,-S-H : Kim,-J-S; Shim,-H-S: Keen,-C-L : Influence of Smoking on Markers of Oxidative Stress and Serum Mineral Concentrations in Teenage Girls in Korea. *Nutrition*.: 19(3) : 240-3 2003 .

2-Bain C, Feskanich D, Spezeir FE, etal: Lung Cancer Rates in Men and Women with Comparable Histories of Smoking. *J Natl cancer Inst*, 96 : 826-834 2004. [PubMed Abstract].

3-Bieri JG, Yolliver TJ, Catignani GL : Simultaneous Determination of Alpha-tocopherol and Retinol in Plasma or Red Cells by High Pressure Liquid Chromatography. *Am J Clin Nutr*, 32 : 2143-21491979. [PubMed Abstract].

4-Kocyigit ,-A ; Erel,-O ; Gur,-S : Effects of Tobacco Smoking on Plasma Selenium, Zinc , Copper and iron concentrations and related antioxidative enzyme activities : *Clin . Biochem*. : 34(8) : 629-33 2001.

5-Halliwell , B. and Gutteridge , J.M; Free Radical, Antioxidants ,and Human Disease : Where are We Now? *J Lab Clin Med*: 119: 598-620 1992 .

6-Evans, P and Halliwell, B. : Micronutrients; Oxidant/ Antioxidant Status. *British J. of Nutrition*, 85.Suppl. 2,567-574 2001

7-Halliwell , B. and Gutteridge , J.M; The Antioxidant of Human Extra Cellular Fluids . *Archives of Biochemistry and biophysics*., No1.230, No1,Jully,pp-1-8 1990.

8-Kittridge , K.J., and Willson, R.L Anti Oxidant in Nutrition ,Health and Disease: FEBS : / ett . 170, 162-164 1984.

9-Halli Well .B . : Free Radical, Antioxidants ,and Human Disease: Curiosity, Cause. or Consequence? *The Lancet*,vol.344 September 10 1994.