

Association between Level of Malondialdehyde and Vitamin C

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Abstract

Background: The oxidative stress is imbalance between antioxidants and pro-oxidants. MDA is product of lipid peroxidation, which increases due to increased oxidative stress that can be induced by iron. Vitamin C acts as antioxidant.

Objective: The goal of our study is to verify the association between MDA level and vitamin C.

Subjects and Method: 200 volunteers were participated in this study, 121 of them were supplemented with ferrous sulphate capsule and were considered as case group and 79 participants didn't take iron preparation and were considered as control group. The case group of 121 individuals were undergo further subgroup, they were include, firstly 80 subjects were administered with iron, without vit C. Out of them, we took only 43 participants to compare with the second subgroup: 41 subject administered iron plus vit C. MDA, S. iron, vitamin (vit) C were measured.

Results: Biochemical data showed significant higher level for malondialdehyde (MDA) and serum iron in supplemented group compared with non-supplemented group. Also, the results revealed higher level, but non-significant, of serum iron, significant lower MDA level and significant higher level for vit C in subgroup supplied with vit C plus iron compared with the other subgroup.

Conclusion: Vit C has antioxidant effect through decrement of MDA level that results from lipid peroxidation, which is enhanced by iron.

Key words: Iron, Oxidative stress, MDA, Vitamin C.

INTRODUCTION

Iron is an important transitional metal. It is a component of different metalloproteins. Critical biochemical processes require iron, such as oxygen transport within tissues. During process of respiration allocated in mitochondria, the iron participates in the electron transfer reactions ⁽¹⁾.

The quantity of iron in the cell must be regulated. However, when available in excess tissue and cells, iron will disrupt the redox-homeostasis and will stimulate advancing the (ROS) resulting in oxidative stress phenomena (OS) ⁽²⁾.

The excess of (ROS) will deplete the antioxidant system and this shifts to raising of (OS). ROS are high reactive compounds ⁽²⁾ that could involve in development of different disease as polycystic ovarian syndrome, induced insulin resistance, cancer, lipid peroxidation and others ⁽³⁻⁵⁾.

Lipids have significant role as structural components of cell membranes, energy store and act as signaling molecules ⁽⁶⁾. The lipids are very sensitive to oxidation ⁽⁷⁾.

Peroxidation of lipid usually occurs due to oxidative stress, which can be developed due to role of iron through Fenton reaction, which causes lipid oxidation of the cell membrane lipid bilayers ⁽⁸⁾. The MDA is generated during the lipid peroxidation and widely utilized as a marker of oxidative-stress ⁽⁹⁾.

The antioxidant system may be an enzymatic antioxidants or non-enzymatic antioxidants such as vitamin C ⁽¹⁰⁾. Vit C is a critical biomolecule, which is involved in protection of components of the cell against oxidative harmful effect caused by toxic (ROS) ⁽¹¹⁾.

Vitamin C has powerful antioxidant activity, it donates atom of hydrogen and the net compound is

ascorbyl free radical, which is relatively stable. Vitamin C is able to decrement the oxidative damage and consequently lowering the risk of certain chronic diseases ⁽¹²⁾. Vitamin C enhances intestinal iron absorption through reduction of the iron from Fe³⁺ to Fe²⁺ state. In the presence excess ions, vitamin C acts as antioxidant and decreases the formation of hydroxyl free radicals, that could induce oxidation of protein, lipid and DNA ⁽¹³⁾.

SUBJECTS AND METHODS METHOD

A case control study enrolled 200 volunteers; 121 of them were supplemented with 150 mg of ferrous sulphate capsule twice/day and were considered as case group and 79 participants didn't take iron preparation and were considered as control group. The case group (121) were further divided into two subgroups.

The first subgroup: 80 subjects were administered with iron, without vit C. Out of them, we took only 43 participants (as in table two) to compare with the second subgroup: 41 subject administered iron plus vit C 1000 mg/day

The blood samples were drawn from both groups after (28 days) from time of starting the iron and vit C supplementation. Patient with thalassemia, bleeding, or pregnant women were excluded. Serum iron, MDA and vit C were measured for all participants.

Ethical approval:

The approval was obtained from the Nutritional Care Unit which allocated in AL-Sader- Hospital. All participants in our study approved to share in the study. Confidentiality and privacy of any participant was considered. This work has been carried out in accordance with The Code of Ethics of the World

Medical Association (Declaration of Helsinki) for studies involving humans.

Biostatistical analysis:

Our data were expressed as mean ± standard deviation. Student's T- test was used to verify differences between both groups. P value lower than 0.05 was considered significant. The SPSS for Windows version 23.0 was utilized to do the statistical analysis.

RESULTS

The data in (Table 1) demonstrated significant higher value of serum iron and serum MDA in case group compared with control group. While the data in (table 2) exhibited significant increment in vit C level in Fe plus vit C group while MDA and iron levels didn't differ significantly.

Table 1: Biochemical data of iron and MDA among case and control groups

Parameters	(Control group) -Fe	(Case group) +Fe	p-value
Number	79	80
Female	40	42
Male	39	38
Age (years)	33±6	32±8	0.37
S. Iron (µg/dl)	76.94 ±13.3	82.1±10.4	0.01
MDA (µM)	3.59±0.64	3.9 ±0.76	0.01

S. Iron: Serum iron, MDA: Malondialdehyde, Fe: ferrous sulphate

Table 2: Biochemical data of iron, MDA and vitamin C among case groups

Parameters	(Case group) Fe plus Vit C NO = 41	(Case group) Fe without Vit C NO =43	p-value
S. iron (µg/dl)	88.35±9.83	83.93±11.32	0.06
MDA (µM)	2.89±0.39	3.01±0.18	0.07
Vitamin C mg/dl	2.2 ± 0.51	1.93 ± 0.36	0.01

S. Iron: Serum iron, MDA: Malondialdehyde, Fe: ferrous sulphate

DISCUSSION

Iron supplementation could affect hematological parameters and disturbs body oxidative balance. Iron administration is recommended for correction or prevention of its deficiency. However, the pathological iron accumulation within the tissues can initiate the formation of (ROS) and elicit lethal effect, which is primarily correlated to (OS) (14). So, we demonstrated the role of iron on oxidative stress status through estimation the net product of lipid peroxidation (MDA), and verified the role of vitamin C on the value of serum iron as an antioxidant.

Our data illustrated significant higher level of serum iron and MDA in iron supplemented group compared with the other group.

It's not surprising that MDA levels increased in such population administered with iron. The (OS) is the principal risk factor, it is reflected by elevation in MDA and decrease in total antioxidant activity (TAA) and this oxidative stress was exacerbated by iron supplementation hence iron involved in Fenton reaction and enhance generation the free radical (15).

In our study we recorded participants who were supplemented with iron preparation plus vitamin C (41 individual), and this vitamin plays significant role; firstly, increases intestinal iron absorption (16) and secondly has antioxidant activity against oxidative stress(17).

In the presence Fe²⁺, the hydrogen peroxide (H₂O₂) undergoes Fenton reaction to produce hydroxyl radical (OH•), which is extremely very reactive radical. The Fe³⁺ that results will be reduced by vit C to Fe²⁺. Therefore, iron is a harmful metal although it is considered as an essential element (18-19).

The significant higher level of vit C displays its role on iron and MDA values, as it is associated with higher level for serum iron and low MDA level, in iron plus vit C group in comparison with the other group (iron without vit C) although statistically non-significant.

Vit C can directly capture O₂•-and OH•. Vitamin C prevents lipid oxidation by various oxygen reactive species (20). From this point we advise any individual who requires iron to use it in combination with vit C.

CONCLUSION

Oxidative stress will be exacerbated by iron supplementation, also it was notice that level of MDA will be reduced in group administered with vitamin C and this reflects role of vit C as an antioxidant.

RECOMMENDATION

To give accurate results about role of iron in oxidative stress, we recommend to:

1. Increase sample size.
2. Estimation of total iron binding capacity and transferrin saturation, which give an idea about complete iron status parameter.
3. We advise to estimate the antioxidant status like reduced glutathione (GSH) to verify its role in countering the oxidative stress, which is enhanced by iron supplementation.

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