The effect of ascorbic acid on peak expiratory flow rate, lipid profile & oxidative stress of asthmatic patients

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Abstract

This study has been performed to evaluate the role of vitamin C as an antioxidant in the treatment of bronchial asthma in adult patients. The specific objectives of this study are to evaluate the therapeutic effect of vitamin C in the treatment of bronchial asthma in adult patients. Thirty asthmatic patients were participated in this study. The study was conducted in Sammarra drug factory from the first of November 2008 till the beginning of April of 2009. Their ages ranges between 18 to 45 years. The patients were received vitamin C (tablet of 500mg / day) for 2 months duration. The results revealed that; there was a significant increase in peak expiratory flow rate after treatment with vitamin C, as compare with before treatment. Also a highly significant decrease in serum malondialdehyde was recorded after treatment with vitamin C. Also, there is significant increase in the value of serum glutathione after one month of treatment with vitamin C (119 ± 4.7) comparing with before treatment (115 ± 8.0), & there is a 3.4% gain in serum glutathione after treatment with ascorbic acid. However, there is significant reduction in the value of serum cholesterol after one month of treatment with vitamin C (173 ± 11.2) comparing with before treatment (185 ± 7.7), & there is a 6% reduction. Moreover, there is a significant reduction in the value of triglycerides after treatment with ascorbic acid (125 ± 15.7) comparing with before treatment (148 ± 21), with a 15.5% reduction in the value of serum triglyceride. There is significant reduction in the value of serum LDL after one month of treatment with vitamin C (116 ± 8.9) comparing with before treatment (132 ± 7.7), & there is a 12.1% reduction in the serum of LDL after treatment with ascorbic acid. There is significant increase in the value of serum HDL after one month of treatment with vitamin C (33 ± 1.8) comparing with before treatment (27 ± 1.3), & there is a 22.2% gain in serum HDL after treatment.

Introduction

Asthma is a chronic inflammatory disease of the respiratory tract of unknown etiology. An inflammation is often associated with an increased generation of reactive oxygen species (ROS). Oxidative stress describes the damage that occurs when ROS overwhelm the antioxidant defenses of the host. Oxidative stress may play an important role in the pathophysiology of asthma, and may be a final common pathway leading to tissue damage (1-3).

Many reports suggest that oxidant stress causes inflammation and tissue damage in the respiratory system and derangements of the immune system; lowered cellular reducing capacity represents a risk factor for the development of bronchial asthma (4).

Antioxidants such as vitamin E & C act to protect the cells against the effects of free radicals, which are potentially damaging by-products of energy metabolism, free radicals can damage cells and may contribute to the development of cardiovascular disease and cancer (4,5).

Vitamin C is also an effective antioxidant, it protect indispensable molecules in the body, such as proteins, lipid, carbohydrates, and nucleic acids (DNA and RNA) from damage by free radicals and reactive oxygen species that can be generated during normal metabolism). Vitamin C may also able to regenerate other antioxidants such as vitamin E (6).

Malondialdehyde is an aldehyde considered to be the terminal compound and the most important marker for monitoring lipid peroxidation and oxidative damage induced by ROS which is strongly associated with the development of serious disease, it is also considered as a thiobarbituric reactive substance (7, 8). Studies have evaluated the relations between diminished pulmonary function in children and inadequate dietary intake of anti-oxidant vitamins (2). The experimental evidence on these topics is

controversial; some studies have failed to show a positive correlation between regular dietary supplements of antioxidants and clinical benefits in asthma (3). Several asthma mediators (eg, platelet activating factor, chemokines, adhesion molecules, and eosinophilic granule proteins are potential promoters of ROS production (9-13).

Many studies have reported increased indices of oxidative stress in the blood and airways of asthmatic subjects (15-16). Gilliland et al investigated the relation between pulmonary function and the intake of fruit, vegetables, juices, and vitamins A, C, and E by examining cross-sectional data from a Children's Health Study that involved 2,566 children. Low total intake of vitamins A, C, and E was associated with deficits in spirometric parameters (forced vital capacity [FVC], forced expiratory flow at 1 sec [FEV1], and forced expiratory flow (25–75%) [FEF]) (2). Other studies have likewise demonstrated lower lung function levels in children with inadequate dietary intake of antioxidant vitamins (17, 18). The aim of this study is to investigate the effect of oral used of ascorbic acid on PEFR & lipid profile in asthmatic patients.

Patients and methods

Thirty asthmatic patients were participated in this study. The study was conducted in Sammarra drug factory from the first of November 2008 till the beginning of April of 2009. Their ages ranges between 18 to 45 years, presented with signs and symptoms of asthma, and they had been checked for their age, height, body weight, and the severity of asthma.

Severe asthma, those who were on steroid therapy, those who were smokers, and those who were escaped were excluded from this study. Body weight was measured to the nearest 500 gm & height was measured to the nearest cm. Peak expiratory flow rate was measured by standard peak expiratory meter (Harlow, London), before & after daily treatment with 0.5 gm ascorbic acid for two months. Three milliliters of venous blood sample were aspirated for the measurement of serum. Serum MDA before starting treatment and after 1 & 2 months after treatment with ascorbic acid. Malondialdehyde level was analyzed in the sera of both groups by the Uchiyama and Mihara method (19).

This method is based on the formation of a pink colored compound, which emits maximum absorbance at 535 nm upon the reaction of thiobarbarbituric acid with MDA. Lipid profile (cholesterol, triglyceride, HDL & LDL) were measured in the serum of asthmatic patients before & after treatment with ascorbic acid according to standard procedures (20). Statistical analysis was performed using the statistical package SPSS versions 10.0. Comparison of continuous variables was applied using student t-test and person correlation test. Data were presented as mean and standard deviation and a p-value < 0.05 is considered significant.

Result

Body weight, height & BMI were shown in Table 1. Also, table 2 shows the mean & standard deviation of peak expiratory flow rate before & after one & two months of treatment with 0.5 gm ascorbic acid. There is a significant difference in PEFR value after one month of treatment with ascorbic acid (405 ± 23.5) comparing with PEFR value before treatment (323 ± 20), $P<0.05$, with improvement in PEFR 20.25%. Also, a gain in PEFR value after two months of treatment with ascorbic acid equal to 32%, and there is a significant difference between the value of PEFR after 2 month (476 ± 19 L/min) comparing with the value before treatment, (table 2).

Table 3 Show the serum concentration of MDA & glutathione in the serum of asthmatic patients before & after treatment with ascorbic acid.

On the other hand, the serum MDA level exhibited significant decrease in the patients treated with vitamin C. There is significant reduction in the value of serum MDA after one month of treatment with vitamin C (4.2± 0.37) comparing with before treatment (5.9 ± 0.74), & there is a 28.8% reduction in the serum of MDA after treatment with ascorbic acid. There is significant increase in the value of serum glutathione after one month of treatment with vitamin C (119 ± 4.7) comparing with before treatment (115 ± 8.0), & there is a 3.4% gain in serum glutathione after treatment with ascorbic acid. Table 4 Show the

concentration lipid profile in the serum of asthmatic patients before after treatment with ascorbic acid.

There is significant reduction in the value of serum cholesterol after one month of treatment with vitamin C (173 ± 11.2) comparing with before treatment (185 ± 7.7), & there is a 6% reduction. While, there is a significant reduction in the value of triglycerides after treatment with ascorbic acid (125 ± 15.7) comparing with before treatment (148 ± 21), with a 15.5% reduction in the value of serum triglyceride.

There is significant reduction in the value of serum LDL after one month of treatment with vitamin C (116 ± 8.9) comparing with before treatment (132 ± 7.7), & there is a 12.1% reduction in the serum of LDL after treatment with ascorbic acid.

There is significant increase in the value of serum HDL after one month of treatment with vitamin C (33 ± 1.8) comparing with before treatment (27 ± 1.3), & there is a 22.2% gain in serum HDL after treatment.

Discussion

Vitamin C is an important water-soluble vitamin that is present in 2 biologically active forms: ascorbic acid and its oxidized derivative, dehydroascorbic acid. Vitamin C can act as a hydrogen donor to reverse oxidation and therefore functions as an antioxidant that reacts with free radicals (FRs) and deactivates them before they cause damage to proteins or lipids (19). Epidemiological studies indicate that elevated dietary intake of vitamin C may be associated with a reduced risk of asthma. Furthermore, vitamin C levels are diminished in mild asthma (20, 21).

In the present study, vitamin C significantly improves PEFR in asthmatic patients. There is a significant difference in PEFR value after one month of treatment with ascorbic acid (405 ± 23.5) comparing with PEFR value before treatment (323 ± 20), $P<0.05$, with improvement in PEFR 20.25%. Also, a gain in PEFR value after two months of treatment with ascorbic acid equal to 32%, and there is a significant difference between the value of PEFR after 2 month (476 ± 19 L/min) comparing with the value before treatment.

The significant increase in PEFR ($P < 0.05$) is in agreement with Seaton& Devereux in Denmark who found that risk of bronchial hyperactivity are increased seven folds among those with lowest intake of vitamin C (21). Hatch in 1995 found that low vitamin C intake causes asthma, and high doses of vitamin C relives asthma, decreased preference for food containing vitamin C and decreased concentration of vitamin C in blood are also associated with asthma (22). In the present study, the serum MDA level exhibited significant decrease in the patients treated with vitamin C . Also, there is significant increase in the value of serum glutathione after one month of treatment with vitamin C (119 ± 4.7) comparing with before treatment (115 ± 8.0), & there is a 3.4% gain in serum glutathione after treatment with ascorbic acid.

Many reports suggest that oxidant stress causes inflammation and tissue damage in the respiratory system and derangements of the immune system; lowered cellular reducing capacity represents a risk factor for the development of bronchial asthma (23). Dietary, environmental, and genetic factors that diminish the cellular reducing capacity can increase tissue vulnerability to oxidant stress and are likely to enhance asthma risk. Dietary selenium deficiency lowers erythrocyte glutathione peroxidase activity and is associated with increased risk of asthma; low dietary intake of vitamins C and E also appears to increase the risk of asthma (24).

Similar results were found in a double-blind crossover study of adults with asthma, which evaluated the effects of dietary antioxidant vitamins (C and E) on ozone-induced bronchial hyper-responsiveness (BHR), suggesting that such supplementation benefits asthmatic adults exposed to air pollutants (25). In the present study there is significant reduction in the value of serum cholesterol, triglycerides & LDL. On other hand, there is significant increase in serum HDL after one month of treatment with vitamin C comparing with before treatment.

Previous findings indicate that high plasma vitamin C associated with high plasma HDL. High plasma vitamin C may lower risk of cardiovascular disease as indicated by direct association with plasma high-density-lipoprotein (HDL) cholesterol and HDL2 cholesterol (26-27). Human studies examining the relation between ascorbic acid and serum lipids have been inconsistent. One possible explanation for the inconsistent findings is that ascorbic acid lowers total serum cholesterol levels only among individuals with elevated cholesterol levels who have less than full tissue saturation of ascorbic acid (28). Several studies have found that the administration of ascorbic acid to individuals with elevated total serum cholesterol levels (>200 mg/dl) lowers total serum cholesterol levels (29-31).

The present study suggests that there is an antioxidant deficiencies have been frequently reported in asthmatics, the antioxidant effect of vitamin C is in agreement with many previous studies. Also the present study may provide an evidence that lipid peroxidation is related to asthma severity.

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Table 1 Show the age, body weight, height & BMI of asthmatic patients

Parameters	Mean ± S.D
Age (years)	52.56 ± 5.3
Body weight (Kg)	87.25 ± 20
Body height (CM)	170.5 ± 6.6
BMI (Kg /m2)	29.69 ± 5.0

Table 2 Show the mean & standard deviation of peak expiratory flow rate before & after one & two months of treatment with 0.5 gm ascorbic acid

Parameters	Before treatment	After treatment	P value	% of Gain
PEFR L/Min	323 ± 20	405 ± 23.5	*	20.25
PEFR at 2 months	323 ± 20	476 ± 19	*	32.14

Table 3 Show the serum concentration of MDA & glutathione in the serum of asthmatic patients before & after treatment with ascorbic acid

Parameters	Before treatment	After treatment	P value
MDA (mmole/L)	5.9 ± 0.74	4.2± 0.37	*
Glutathione (umole/L)	115 ± 8.0	119 ± 4.7	*

Table 4 Show the concentration lipid profile in the serum of asthmatic patients before after treatment with ascorbic acid

Lipid Profile	Before treatment	After treatment	P value
Cholesterol (mg/dl)	185 ± 7.7	173 ± 11.2	*
Triglyceride (mg/dl)	148 ± 21	125 ± 15.7	*
HDL (mg/dl)	27 ± 1.3	33 ± 1.8	*
LDL (mg/dl)	132 ± 7.7	116 ± 8.9	*