The effects of omega-3 on blood pressure and the relationship between serum visfatin level and blood pressure in patients with type II diabetes

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Abstract

BACKGROUND: Hypertension is a condition normally detected in people with type II diabetes. It eventually leads to cardiovascular diseases in the patient. Visfatin is an adipocytokine which is secreted from adipose tissue and can affect the inflammatory reaction and also serum lipid levels. Additionally, omega-3 inhibits the accumulation of fat and formation of insulin resistance. The current study tried to investigate the effects of omega-3 on blood pressure compared to placebo and the relationship between serum visfatin levels and blood pressure.

METHODS: A total number of 71 women with type II diabetes were randomly assigned to 2 groups to receive either omega-3 capsules or placebo capsules. In the first step, a questionnaire consisting age, height, weight, waist and hip circumferences, and systolic and diastolic blood pressure was filled out for each subject. Blood samples were then collected for laboratory tests. The next step was to conduct 8 weeks of intervention. All variables, except age, were measured again after the intervention. Hip circumference was considered as the maximum circumference of the buttocks. Waist circumference was measured by placing a tape horizontally across the abdomen at the end of a normal exhalation. Laboratory tests included the assessment of visfatin, glucose, and glycated hemoglobin (HbA1c) concentrations. Lipid profile, i.e. low density lipoprotein (LDL), high density lipoprotein (HDL), triglyceride (TG), and cholesterol, was also assessed. Using $SPSS_{18}$, data obtained from the study was analyzed by a variety of appropriate statistical tests.

RESULTS: There was a significant change in mean differences of systolic and diastolic blood pressure. Blood pressure showed a significant reduction in the omega-3 group compared to the placebo group. However, no significant changes were observed in systolic and diastolic blood pressure before and after the intervention ($P > 0.05$).

CONCLUSION: Based on the results of this study, a daily consumption of omega-3 is suggested for patients with type II diabetes.

Keywords: Omega 3, Visfatin, Hypertension, Type 2 Diabetes Mellitus.

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Introduction

According to the World Health Organization (WHO), 150 million people are currently suffering from type II diabetes. This figure is predicted to be doubled by the year 2025.[1] Today, the disease is detected in all age groups, including women and high risk groups. Mortality rates in diabetic individuals after adjusting for age is 1.5-2.5 times more than total population.[2] Since in most cases, insulin resistance and diabetes are associated with obesity, obesity and overweight are considered as the major causes of diabetes and insulin resistance.[3]

In addition, hypertension is common in people with diabetes and its prevalence increases substantially over time. On the other hand, omega-3 intake may reduce blood pressure.[4] Alpha lipoic acid reduces hypertension in people with type II diabetes.[5] The prevalence of hypertension increases with age in both sexes.[6,7] In 1989, one fourth of America's total population and one third of its adults suffered from high blood pressure. At the same time, hypertension developed in 30% of urban community adults in the East Mediterranean region.[8] Visfatin is an adiponectin with insulin-like function[9,10] which was discovered in adipose tissues by Fukuhara et al. in 2005.[11] Omega 3 increases visfatin secretion in patients with type II diabetes.[12] Obesity can lead to hyperplasia and hypertrophy of fat cells which secrete a variety of compounds with exert

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critical roles in the pathogenesis of diseases such as metabolic syndrome, hypertension, insulin resistance, and cardiovascular diseases.[13]

Omega-3 fatty acids have been demonstrated to reduce cholesterol, triglycerides, inflammation, cardiovascular diseases, and cancer. They may also prevent insulin resistance. Omega-3 fatty acids downregulate the expression of genes and hormones (such as leptin) involved in obesity. They also prevent the construction of omega-6 compounds. In type II diabetics, consumption of over 4 grams of eicosapentaenoic acid (EPA) or docosahexaenoic acid (DHA) can increase serum glucose and reduce triglyceride.[14]

Visfatin is a regulator of fat metabolism[15] which has a direct relation with body mass index (BMI).[16] Being directly relate with waist to hip ratio (WHR), serum visfatin level is higher in diabetics compared to normal healthy people.[11]

This study was designed to investigate whether omega-3 lowers blood pressure in diabetics and if there is any significant relationship between serum visfatin level and blood pressure in people with type II diabetes.

Materials and Methods

This was a double-blind randomized controlled clinical study. The study population included 45-65 year-old female type II diabetes patients who referred to Charity Center of Diabetes in Isfahan, Iran. Using a formula and considering 15% additional samples, the sample size in each group was calculated as 39 in each group. Women were only included if they had at least a 5-year history of type II diabetes. Exclusion criteria were injecting insulin, having secondary complications of diabetes such as ophthalmic or renal complications and amputation, and having inflammatory diseases with C-reactive protein (CRP) levels of +++ or more. Finally, 39 patients in the omega-3 group and 34 subjects in the placebo group completed the study.

This study was approved by the Ethics Committee of Tehran University of Medical Sciences, Tehran, Iran. The participants were informed about the study procedure. They were then requested to sign the consent form. The subjects were randomly divided into two groups of omega-3 supplement recipients and placebo recipients. The omega-3 group received two omega-3 capsules containing 1,000 mg omega-3, 65% EPA (360 mg), and 35% DHA (240 mg) daily for 8 weeks. The placebo group received two placebo capsules containing 1 g of cornstarch for the same period.

The current study was performed in three phases. In the first phase, all patients filled out a questionnaire including age, height, weight, waist circumference, hip circumference, and systolic and diastolic blood pressure. Blood samples were also collected for blood tests. In the second stage, after 8 weeks of intervention, the same parameters were measured and blood samples were obtained again. Hip circumference was measured at the widest part. Waist circumference was also measured by a cord at the end of a normal exhalation. Blood pressure was measured by a mercury sphygmomanometer in a sitting position and after 10 minutes of rest.

Visfatin level was measured by standard kits using enzyme-linked immunosorbent assay (ELISA) method with a sensitivity of 30 pg/ml (Human Visfatin Kit, Adipogen Inc., South Korea). Both the examiner and the participants were blinded to the intervention. Blood sampling was conducted after 10-12 hours of fasting (10 cc in each time) before taking the anti-diabetic tablets.

All the tests were conducted automatically by Hitachi 911. Data was analyzed using $SPSS_{18}$ (SPSS Inc., Chicago, IL, US). The Fisher's exact test was used to analyze qualitative data and student's t-test for quantitative data. Weight changes were analyzed by chi-square test while Pearson's correlation test was used to assess correlations. Moreover, paired t-test was used for comparing blood pressure changes before and after the intervention in both groups and independent t- test was used for comparing mean concentration changes between the two groups. To detect the correlations between variables, Pearson's regression analysis was used.

Results

The results showed no significant differences in the mean baseline values of age, socioeconomic characteristics such as educational status and occupation, health status, medication consumption and dietary intake between omega-3 and placebo groups. Therefore, these variables had probably no confounding effect. The mean age of omega-3 and placebo groups were 53.6 ± 4.3 and 53.9 ± 5.4 years, respectively. Student's t-test showed no significant differences in the mean ages of the two groups ($P = 0.79$). Table 1 presents the obtained data on BMI, weight, and systolic and diastolic blood pressure.

Although the comparison of values of before and after intervention showed no significant changes in the mean BMI within groups, there were significant differences in the mean BMI between groups. The same trend was observed for weight, as the changes

Table 1. Anthropometric data and visfatin level in the studied groups

		Omega-3	Placebo	P
Body mass index (kg/m2)	Before Intervention	27.7 ± 3.4	28 ± 3.8	0.76
	After Intervention	27.4 ± 4.1	28.7 ± 4.4	0.19
	Difference between After and Before	-0.31 ± 0.7	0.73 ± 1.2	< 0.001
Weight (kg)	Before Intervention	69.6 ± 13.2	70.1 ± 11.3	0.84
	After Intervention	68.8 ± 12.4	71.7 ± 12.8	0.33
	Difference between After and Before	-0.8 ± 1.8	1.5 ± 2.5	< 0.001
Systolic blood pressure (mm Hg)	Before Intervention	130 ± 19.2	118 ± 16.3	0.007
	After Intervention	124.3 ± 13.7	124.1 ± 13.9	0.95
	Difference between After and Before	-5.4 ± 17.6	6.2 ± 13.7	0.003
Diastolic blood pressure (mm Hg)	Before Intervention	82 ± 11.5	77 ± 10.7	0.08
	After Intervention	80.5 ± 7.6	82.6 ± 7.6	0.25
	Difference between After and Before	-1.2 ± 8.4	5.6 ± 9.4	0.002

after the intervention in each group were not significant compared to the value before the intervention but significant once comparing the two groups.

The findings of this study revealed that the blood pressure of individuals who received placebo showed an upward trend during the intervention. However, omega-3 was able to reduce blood pressure in diabetics. Significant differences were thus detected between the two groups.

While at baseline, there were no significant changes in the mean systolic blood pressure within groups, the mean differences between groups were significant after the intervention (P = 0.003). Diastolic blood pressure had a similar trend. No significant differences within groups were observed before and after the study though, with a P of 0.002 the mean changes of DBP in omega-3 group significantly differed with what measured in placebo group. No significant changes were detected between systolic and diastolic blood pressure before and after the intervention (Tables 2 and 3).

Table 2. The relationship between visfatin and systolic (SBP) and diastolic blood pressure (DBP) at baseline

		Visfatin
Omega-3 group	SBP	R = 0.177 P = 0.28
	DBP	R = 0.166 P = 0.31
Placebo group	SBP	R = 0.041 P = 0.81
	DBP	R = 0.07 P = 0.69

Table 3. The relationship between visfatin and systolic (SBP) and diastolic blood pressure (DBP) after the intervention

		Visfatin
Omega-3 group	SBP	R = -0.121 P = 0.47
	DBP	R = -0.149 P = 0.37
Placebo group	SBP	R = -0.05 P = 0.78
	DBP	R = -0.08 P = 0.96

Discussion

The current study evaluated the efficacy of omega-3 on blood pressure in type II diabetic patients. It also assessed the relationship between visfatin and blood pressure. The results showed that consumption of omega-3 was effective in people with type 2 diabetes since it increased visfatin[12] and might have lowered blood pressure. There were no relationships between visfatin serum levels and systolic or diastolic blood pressure. Haider et al.[9] and 2 studies by Dogru et al.[17,18] reported similar results.

Unlike the studies by Berndt et al.[19] and Krzyzanowska et al.[20] but similar to the obtained results by Fukuhara et al.[11] and Chen et al.,[11] the current study indicated a significant positive relationship between the amount of abdominal obesity and serum levels of visfatin in patients with diabetes.

In addition, identical to our results, some previous studies showed no significant relationship between circulating visfatin levels and BMI.[9,10,19,21] On the contrary, the findings of the studies by Pagano et al.

on obese nondiabetics[22] and Samara et al. on nondiabetic individuals with different weights[23] showed an inverse relationship between BMI and circulating visfatin levels.

On the other hand, Chen et al. found a significant relationship between BMI and circulating visfatin levels in patients with diabetes.[9]

Generally, the amount of visceral fat or abdominal obesity and body fat, are determined by WHR and BMI, respectively.[19] Some researches have revealed that consumption of omega-3 can burn more body fat and increase metabolism, causing weight loss in patients.[24] In the present study, BMI, as measured by weight, decreased in patients taking omega-3 and increased in the placebo group. Kesavulu et al. proved that omega-3 supplements had beneficial effects on triglyceride, high-density lipoprotein cholesterol, lipid peroxidation, and antioxidant enzymes, which eventually lowered vascular complications in diabetics.[25] In 1991, Malasanos and Stacpoole conducted a study on patients with type 2 diabetes. They suggested that EPA could lower the levels of serum lipids and lipoproteins, increase fluidity of cell membranes, and reduce platelet aggregation and blood pressure.[26] Omega-3 intake has also been suggested to have a weight control effect on diabetics.[27,28]

In 2007, Dogru et al. conducted a study on 33 young patients who had recently been diagnosed with hypertension. It investigated the relationship between visfatin and blood pressure. To omit the possible confounding effects and relations between BMI and visfatin, patients with BMIs less than 25 were recruited to the study. However, no significant relationship was detected between serum visfatin level and blood pressure which was identical with the results achieved in this study.[18] It has also been shown that the insulin receptor is associated with hypertension.[13] Moreover, the insulin receptor and inflammation can be effective on the development of hypertension.[29] However, our results did not support this role for visfatin.

Recommendations

Based on the positive effects of omega-3 on hypertension, daily consupmtion of omega-3 supplements for diabetics and individuals at high risk is highly recommended.

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Conflict of Interests

Authors have no conflict of interests.

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