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Research Article

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The Effects of Apple Vinegar on Fasting Blood Sugar (FBS) and Glycosylated Hemoglobin in Patients with Type 2 Diabetes

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Abstract

Introduction: Diabetes is a chronic heterogeneous disease. Hyperglycemia is one of its features, and it can cause fatal complications. Measurement of FBS and glycated hemoglobin is one of the diagnostic criteria of diabetes. Thus the purpose of this study is investigating the effects of apple vinegar on fasting blood sugar (FBS) and glycosylated hemoglobin in patients with type2 diabetes.

Methods: This study is semi-experimental and interventional. 74 patients with diabetes, who are eligible for the study, were randomly divided into two groups of test and control groups. At first FBS and HbA1c were measured. Then, the test group received daily 20 cc of apple cider vinegar for 8 weeks. And at the end the data was analyzed using independent and paired t-test and the Bonferroni test.

Results: Results showed that in test group reduced the biochemical markers measured are significantly higher than the control group. The mean of FBS in the experimental group before and after intervention were 186/52 ± 23/24 and 158/01 ± 17/62 mg DL. This means there was a statistically significant difference between variables in the two groups after the intervention (P<0/001).

Conclusion: The findings of this study suggest that consumption of apple cider vinegar leads to a significant reduction in glycosylated hemoglobin levels, fasting blood sugar levels in type2 diabetics. However, further clinical studies are suggested to confirm the results.

Keywords: Diabetes type 2; Fasting blood sugar (FBS); Glycosylated hemoglobin

Introduction

Diabetes is a chronic heterogeneous disease which is characterized by chronic hyperglycemia, impaired metabolism of carbohydrates, lipids and proteins that is caused by shortage of secretion or insulin function. Hyperglycemia is a main factor of creating acute, short-term and late coming side effects that involve all organs of the body [1]. This disease is an increasingly stressful disease in the world, and according to the survey of 2010, 285 million people worldwide have diabetes and it is predicted that by 2030 this number reaches to 439 million. Of these 90-95% is diagnosed with type 2 diabetes [2]. In fact, it can be concluded that diabetes is a metabolic disorder that have affected more than 350 million people worldwide and 90% of patients are with type 2 diabetes and about 2.5 million diabetes are not aware of that [3,4].

Unlike diabetes type1, diabetes type 2 has a slower process and it starts with a problem of insulin resistance [5]. Obesity is associated with increased insulin resistance and increased blood glucose level, controlling type 2 diabetes gets more complicated. Insulin resistance is caused by impaired insulin signal transduction in target tissues that is a common cause of type2 diabetes [6]. One of the criteria for a diagnosis and controlling diabetes is measurement of glycated hemoglobin in blood [7]. Sugar binds to hemoglobin forms a stable combination of glycated hemoglobin and has found a gesture for clinical application of the control of diabetes. As well as glycated hemoglobin as a major factor in the prediction of long-term complications of diabetes mellitus, have partly reflected the short-term control of the disease as well [8].

Although diabetes is considered as a multifactorial disorder, but it is known that diet plays a major role in exacerbating or prevention of the disease [9]. Considering the side effects of drug consumption, particularly in the long term, there is also contraindicated in some patients, finding more effective nutritional compounds for the treatment of diabetes and reducing complications is considered [9,10]. One of the natural ingredients that have been known for hundreds of years and is beneficial to health is apple cider vinegar. The phenolic compounds in apple cider vinegar make antioxidant activity [11]. Apple cider vinegar contains a variety of flavonoids, such as gallic acid, catechin, caffeic acid and ferulic acid [12]. Citric acid is the main component of apple vinegar, which recently the effects of reducing postprandial blood glucose levels and reduced glycemic index of foods have been shown [13]. Due to the limited number of studies on the effects of apple cider vinegar, especially on humans, this study is aimed to investigate the effect of vinegar on FBS and glycosylated hemoglobin level in patients with type 2 diabetes.

Methods

This is a quasi-experimental study. The statistical population of this study included all patients with type2 diabetes; including 88 admitted to hospital aged 18-65 years, to diabetes clinic of Imam Khomeini (RA) in Zabol with medical records and history, and their health and disease process were assessed monthly or every three months, for participating in the study patients must have the following conditions: type2 diabetes, the diagnosis is at least a year, not smoking and drinking alcohol, non-pregnant, using non-herbal supplements oxidant chemistry during the last 3 months not having any special diet, lack of chronic and acute renal disease, liver disease and cardiovascular disease. After an explanation about how the study is done, written consent letters was obtained from each individual. These people had the possibility of withdrawal at any stage of the study. Of the total population, 74 people had the above conditions as well as their willingness to participate in the study and were introduced to the laboratory to measure FBS and HbA1c. At first, the questionnaire on demographic information such as gender, age, type of medication,

dietary choices for all patients was completed. Then the patients were randomly divided into 2 groups of 38 subjects of test and control groups. The amount of apple cider vinegar daily consumption of 20 ml was selected (equivalent to four tablespoons).The experiment group had two tablespoons of apple cider vinegar (10 ml) dissolved in a glass of water before lunch and another two tablespoons before dinner with a glass of water. At the same time they were asked to consume apple cider vinegar they had to mark and record it on the sheet that was given to them. The control group did not use any vinegar. The brand of apple cider vinegar was Golchegan Zamani Mashhad. Also there was a weekly visit to ensure the continuation of the drinking apple cider vinegar. At the end of 8 weeks, FBS and HbA1c were measured again [11]. If the patient did not have constant conditions including diet, change in dose, lowering blood glucose drugs, irregular use of apple cider vinegar they would exclude from the study. In this study, blood glucose was measured by enzymatic glucose oxidase method and using Technicon RA-1000 the amount of natural 75-100 mg per DL was considered. Also for measuring HbA1cthe colorimetric method of WHO was used by Sismex K800 device. After collecting data, it was analyzed by SPSS v20 software and the final analysis was performed on 74 patients. Kolmogorov-Smirnov test was conducted before the intervention to match the two groups, and data distribution was normal (sig = 0.8). Descriptive statistics was used to describe the data frequency and independent and paired t-test and Pearson correlation coefficient were used for comparing data. The significant level for all tests was 0.05.

Results

The study included 74 patients with type 2 diabetes who referred to the clinic. At first the patients were randomly divided into two groups of test group who used apple cider vinegar and the control group with no intervention. There were 38 participants in the test group with an average age of 49.2 ± 4.3 year age group ranging between 45 and 69 years. In this group there were 20 women (52%) and 18 men (48%) and in control group 38 with average age of 49.2 ± 4.3 and age group ranging between 34 and 68 years and there were 22 women (57%) and 16 men (47%) (Table 1). Average serum levels of FBS and glycated hemoglobin in the two groups receiving apple cider vinegar and the control group in the study at the beginning and end of study are presented in Table 2. The results show that the measured biochemical indicators, the rate of decline in the experimental group were more than the control group. This means that there was no statistically significant difference between variables in the two groups before the intervention but after the intervention, the difference was significant.

Discussion

The purpose of the study was investigating the effects of apple vinegar on fasting blood sugar (FBS) and glycosylated hemoglobin in patients with type2 diabetes. The findings showed that consumption of apple cider vinegar for 8 weeks in patients with type2 diabetes had a significant reduction in the level of HbA1c and FBS factors in the experimental group compared to control group.

The most prominent clinical sign of type2 diabetic disease is increasing blood sugar that leads to glycation of proteins in the body [14]. Also in the process of protein glycation and pathogenesis of diabetic complications is having an impact on metabolic control and in fact, this process plays an important role in the events leading to the creation of microscopic or macroscopic damage blood vessels [15]. Although many authors have reported serious complications of the disease, diabetes can be controlled by keeping blood glucose values [16,17]. Many chemical drugs used to reduce blood sugar levels are associated with undesirable side effects [14]. One of the natural ingredients that have been known for hundreds of years and is beneficial to health is apple cider vinegar. The phenolic compounds in apple cider vinegar cause antioxidant activities [11]. The results of this study showed that FBS in a group consuming apple cider vinegar had a significant reduction compared to the beginning of study. The results of this study are consistent with another study about the effect of apple cider vinegar tablets on metabolic syndrome in 2015 [18]. The study conducted by Nosrati et al. indicated a lack of effect of one dose of apple cider vinegar on FBS after a meal [19]. A study conducted in 2012 by Bollinger et al. showed that consumption of apple cider vinegar with meals has no effect on FBS [20]. Many studies have shown that taking vinegar with food can reduce blood sugar after a meal, as well as reducing insulin response which has the effect of reducing the Glycemic Index related to vinegar [13]. The possible mechanisms discussed in this context, inhibit the action of amylase in the presence of acetic acid (the most important part vinegar), but this hypothesis has been rejected by revealing the same speed of acid hydrolysis of the bread with acetic acid and without, acetic acid [21]. Other mechanisms such as the effect of acetic acid on delayed emptying in the stomach the inhibitory activity effect of acetic acid on disakarida activities and the role of acetic acid to increase tissue distribution of glucose uptake and use of glucose in glycogen synthesis have been approved [22-25]. The inhibitory effect of polyphenols on the performance of digestive enzymes (such as inhibitory effect on maltose), reducing insulin levels and specified glycemic index were determined [22]. Many studies have been identified polyphenolic compounds in apple juice and apple cider vinegar used in this study was prepared from the fruit of the apple tree thus it can be said that had polyphenolic compounds similar to apple [13,23]. HbA1c is an indicator to check the status of diabetics control blood sugar in the past two to three months [24]. Due to the effect of vinegar on reduction of the glycemic index insulin response, as well as reducing HbA1c to reduce the glycemic index of food, HbA1c reduction was expected, the decrease was observed in the experimental group with apple vinegar [13,25]. A study conducted in 2008 by Mansouri et al. represents a reduction of glycosylated hemoglobin in diabetic rats [26]. Also in Carol et al. study in 2009 they found that vinegar significantly decreased glycosylated hemoglobin in diabetic patients which are consistent with our results [27].

Variable	Control group Mean ± standard deviation		Experimental group Mean ± standard deviation		P-value
Age	4/3 ± 49/2		4/3 ± 49/2		0/001
	Number	Percent	Number	Percent	

Gender	**Man**	16	48	18	48	
	Woman	22	57	20	52	

Table 1: Comparing the average age and gender of study before intervention.

Variable		**Beginning of study**		**End of study**	
		Mean ± standard deviation	**P-value**	**Mean ± standard deviation**	**P-value**
FBS	**Test**	23/24 ± 186/52	0/11	17/62 ± 158/01	0/001
	Control	27/04 ± 181/21		58/21 ± 188/64	
HbA1c	**Test**	1/45 ± 11/02	0/43	0/92 ± 8/70	0/001
	Control	2/01 ± 11/06		2/04 ± 11/06	

Table 2: Comparing the key variables of study.

Conclusion

Due to a significant reduction in FBS level and glycosylated hemoglobin in the experimental group, Apple Cider Vinegar can be recommended to diabetes patients and by using that we reduce the side effects of this disease.

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