|| ISSN(online): 2589-8698 || ISSN(print): 2589-868X ||
International Journal of Medical and Biomedical Studies
Available Online at www.ijmbs.info
PubMed (National Library of Medicine ID: 101738825)
Index Copernicus Value 2018: 75.71
Original Research Article
Volume 3, Issue 11; November: 2019; Page No. 252-255

ROLE OF VITAMIN C IN TYPE 2 DIABETES MELLITUS CASES, A STUDY IN VEDANTA INSTITUTE OF MEDICAL SCIENCES

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Article Info: Received 28 October 2019; Accepted 26 November. 2019
DOI: https://doi.org/10.32553/ijmbs.v3i11.775
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Conflict of interest: No conflict of interest.

Abstract

INTRODUCTION: Diabetes is one of the largest emerging global health problem with 415 million people between the ages of 20 and 70 worldwide estimated as having diabetes in 2015 and Type 2 DM (T2DM) accounts for at least 90% of all cases of diabetes. Vitamin C is naturally present in fruit and vegetables, is often added as a preservative to foods/beverages, and is also used as a dietary supplement. As vitamin C is water-soluble, it has a relatively short half-life in the body due to rapid renal clearance and a regular and adequate intake is required to prevent deficiency. In T2DM patients Vitamin C levels are usually low as blood glucose may compete with vitamin C for uptake into cells due to its structural similarity to the oxidised form, and increased oxidative stress may deplete antioxidant stores. **MATERIAL AND METHODS**: A total of 206 T2DM patients were included in the study and were divided randomly in to 2 groups of 103 each. Participant's demographic and physical activity was noted. Anthropometric data including the body mass index (BMI) and waist and hip circumference were collected. Glycated haemoglobin (HbA1c) was determined in EDTA blood by standard methods. Fasting glucose was measured in blood collected in fluoride oxalate tubes. The vitamin C concentration of the processed samples was determined. Drug (Vitamin C and Placebo) was issued to patients for duration of thirty days at a time all patients were maintained on their usual dietary pattern while limiting their consumption of vitamin C-rich foods throughout the study. **RESULTS**: Mean age in Vitamin C group was 46.87 ± 6.77while in placebo group it was 42.11 ± 6.46. There were 56 male and 44 female in Vitamin C group. In Placebo group male and female were 60 and 40 respectively. No statistical significance was observed in both the group.At 12 weeks fasting blood sugar levels were decreased by -23.74± 2.74 in patients receiving Vitamin C while in placebo group reduction was -5.44± 3.77. Post meal blood sugar was reduced by -21.72± 2.45in vitamin C group while in placebo it was -8.11± 2.45.**CONCLUSION:**Supplementation of Vitamin C in T2DM patients can significantly reduce the blood glucose levels and HbA1C levels.

Introduction

Diabetes is one of the largest emerging global health problem with 415 million people between the ages of 20 and 70 worldwide estimated as having diabetes in 2015 and Type 2 DM (T2DM) accounts for at least 90% of all cases of diabetes[i].

DM is characterized by oxidative stress, inflammation, and insulin resistance[ii].Diabetes mellitus (DM) is one of the major metabolic disorders associated morbidity and mortality due to microvascular complications like retinopathy, nephropathy, and neuropathy and macrovascular complications likeMyocardial infarction, peripheral vascular disease, and strokeand economic cost. It is shown that there is a role of of free radical-mediated pathology in diabetes mellitus[iii].

Vitamin C is naturally present in fruit and vegetables, is often added as a preservative to foods/beverages, and is also used as a dietary supplement. As vitamin C is water-soluble, it has a relatively short half-life in the body due to rapid renal clearance and a regular and adequate intake is required to prevent deficiency. Vitamin C is an essential micronutrient with potent antioxidant properties and it can protect important biomolecules from oxidation by participating in oxidation-reduction reactions and it is readily oxidized to dehydroascorbic acid, which in turn is reduced back to ascorbate. Vitamin C is often added as a preservative to foods and beverages, is naturally present in fruit and vegetables and can be used as a dietary supplement[iv].

In T2DM patients Vitamin C levels are usually low as blood glucose may compete with vitamin C for uptake into cells due to its structural similarity to the

oxidised form, and increased oxidative stress may deplete antioxidant stores[v]. Studies have shown that due tosupplementation of vitamin C there is an improvement in blood glucose level and glycosylated haemoglobin (HbA1c).

MATERIAL AND METHODS

This was a prospective, study. A total of 206 T2DM patients were included in the study and were divided randomly in to 2 groups of 103 each (study group and placebo group). Block randomization was used for, vitamin C and placebo with blocks. This study was carried out in the Dept. of Medicine at Vedanta Institute of Medical Sciences Dahanu Palghar, Maharashtra.

Patients from Outpatient Department with fasting blood glucose level in the range of 126 to 250 mg/dL were included in the study. At the start of the study, participant's demographic and physical activity was noted. Anthropometric data including the body mass index (BMI) and waist and hip circumferencewere collected. Patients were excluded having medical history of inflammatory bowel disease, those who had undergone a previous bowel resection.

BMI is calculated by weight in kilograms divided by height in metres square. Venous blood samples were collected 12–hour after the meals or 12 hours fast .Glycated haemoglobin (HbA1c) was determined in EDTA blood by standard methods. Fasting glucose was measured in blood collected in fluoride oxalate tubes. The vitamin C concentration of the processed samples was determined. Drug (Vitamin C and Placebo) was issued to patients for duration of thirty days at a time all patients were maintained on their usual dietary pattern while limiting their consumption of vitamin C-rich foods throughout the study.

Results were expressed as Mean ± standard Deviation (SD) Group differences were ascertained by either paired or unpaired t-test. Relationship between variables was determined by means of either Pearson's or Spearman's correlation coefficient depending on distribution of the data. Chi-square test was used for analysis of demographic data. P valuesless than 0.05 was considered as statistically significant.

RESULTS

A total of 206 T2DM patients were included in the study and were randomized into group A (Vitamin C) and Group B (Placebo) of 103 each.

Table 1: Demographic variables of each group

Variables	Group A (Vitamin C)	Group B (Placebo)	P value
Age (mean ± SD) years	46.87± 6.77	42.11 ± 6.46	NS
Male	56	66	NS
Female	44	40	

NS Not significant

Mean age in Vitamin C group was 46.87 ± 6.77while in placebo group it was 42.11 ± 6.46. There were 56 male and 44 female in Vitamin C group. In Placebo group male and female were 60 and 40 respectively. No statistical significance was observed in both the group.

Table 2: changes in blood sugar levels and HbA1c after 12 weeks

Parameter	Vitamin C group	Placebo group	P value
Fasting blood sugar	-23.74± 2.74	-5.44± 3.77	P < 0.0001
Post meal blood sugar	-21.72± 2.45	-8.11± 2.45	P < 0.0001
HbA1c	-0.66± 0.08	-0.01 ± 0.01	P < 0.0001
Plasma vitamin C *(µmol/L)	4.96± 2.85	0.11± 0.09	P < 0.001

At 12 weeks fasting blood sugar levels were decreased by -23.74± 2.74in patients receiving Vitamin C while in placebo group reduction was -5.44± 3.77. Post meal blood sugar was reduced by -21.72± 2.45in vitamin C group while in placebo it was -8.11± 2.45.

There was a significant reduction of Fasting blood sugar, Post meal blood sugar level and HbA1c, in vitamin C group. There was a significant increase in vitamin C level in group receiving vitamin C.

DISCUSSION

Due to which complications like diabetic microvascular angiopathy due to RBC fragility, as erythrocytes lack the sodium-dependent vitamin C transporters and are dependent on the glucose transporters for the uptake of vitamin C[vi].Fasting blood glucose and dietary vitamin C intake are

significant independent predictors of plasma vitamin C concentrations[6].

It has been shown that the uptake of dehydroascorbic acid, the oxidized form of vitamin C, by the glucose transporters could be competitively inhibited by elevated blood glucose levels[vii]. Also oxidative stress which may be caused by vitamin C deficiency leads to alterations in signalling pathways and to potential tissue damage[viii].

In a study by R. SrivatsanEt al it was shown that supplementation with 500 mg/day vitamin C in diabetic patients had no changes in FBG and HbA1c as compared with placebo. This may be due to use of low dose of vitamin C used in this study[ix]. Our study showed that there was significant reduction in the blood glucose levels in Vitamin C group as compared to placebo group and significant reduction in serum HbA1c was noted in patients supplemented with vitamin C for 12 weeks. Similar results were shown by P Sridulyakul et al in their study on Vitamin C supplementation could reverse diabetes-induced endothelial cell dysfunction in mesenteric microcirculation in STZ-rats[x]. Also it has shown that the increase of serum antioxidant glutathione and the decrease of glycosylated haemoglobin after long-term ascorbic acid supplementation are related to each other[xi].

CONCLUSION

Supplementation of Vitamin C in T2DM patients can significantly reduce the blood glucose levels and HbA1C levels.

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