Research Paper

Volume : 2 | Issue : 12 | December 2013 • ISSN No 2277 - 8179

Comparison of Vitamin C Status in Type 2 Diabetic Patients and Normal Controls

Medical Science

KEYWORDS : Diabetes mellitus (DM), Fasting blood sugar (FBS), Post prandial blood sugar (PPBS), Oxidative stress (OS)

Shailaza Shrestha — Department of Biochemistry, Goldfield institute of medical sciences and research Chhainsa, Ballabhgarh, Faridabad

Rahul Rai — Department of Anatomy, Career institute of medical sciences and hospital, Sitapur hardoi bypass road, Lucknow-226020

ABSTRACT

Our aim was to evaluate the levels of vitamin C, an antioxidant, as a marker of oxidative stress in type 2 diabetes and to correlate them with glycemic control. Antioxidant status in terms of vitamin C was estimated in 30 controls and 30 type 2 diabetic mellitus (DM) patients. Analysis was done using student's't' test for comparison between two groups and One Way ANOVA (F-test) for multiple group comparison. FBS, PPBS and HbA1c levels of diabetic patients were significantly higher (p<0.001), whereas vitamin C levels were significantly lower relative to their controls (p<0.001). Vitamin C showed statistically significant decrease with glycemic control and it was also negatively correlated with HbA1c (r = -0.47, p<0.008).

Type 2 DM is associated with OS causing depletion in antioxidant levels. As it might lead to diabetic complications, antioxidants can be supplemented as a therapeutic measure to type 2 DM patients.

Introduction

Type 2 diabetes mellitus has reached global epidemic proportions. The disease affects over 150 million people worldwide, a number that is expected to double by 2025 [1]. Every fifth diabetic in the world is an Indian, making India a diabetes capital of the world. By 2025 India alone would have 57 million diabetics mainly of type 2 [2]. Clinical complications of T2DM include both micro vascular diseases (e.g., retinopathy, nephropathy, and neuropathy) and macrovascular complications (e.g., myocardial infarction, peripheral vascular disease and stroke) [1].

Recent research has shown that free radicals have important roles in pathogenesis of diabetes and a relationship between oxidative stress and secondary complications of diabetes exists [3]. OS, a decrease in endogenous antioxidant defenses, is induced by reactive oxygen species (ROS) generated by hyperglycaemia [2, 4].

The potential sources of free radical production in diabetes include auto-oxidation of plasma glucose, leucocytes activation and increased transition metal bioavailability [3]. ROS has the ability to react with all biological molecules like lipids, proteins, carbohydrates, DNA etc and exert cytotoxicity on cellular components. Thus increased ROS and impaired antioxidant defence contributes for initiation and progression of micro and macro vascular complications in diabetics.

A variety of natural antioxidants exist to scavenge oxygen free radicals and prevent oxidative damage to biological membranes. These antioxidants include enzymatic antioxidants (superoxide dismutase, glutathione peroxidase and catalase) and non enzymatic antioxidants derived by dietary intake (vitamin A, C, E and carotenoids. Vitamin C, structurally identical to glucose, is an important antioxidant capable of scavenging oxygen-derived free radicals [2].

Several studies showed decreased basal vitamin C level in diabetic patients [5]. The age, sex and season standardized prevalence of vitamin C deficiency is reported to be 73.9% in north India and 45.7% in south India [6].

In a view of widespread deficiency of vitamin C in India and increasing prevalence of DM type 2, it is considered worthwhile to assess vitamin C status of patients with type 2 DM.

Material and methods

30 patients of both sexes suffering from type 2 diabetes mellitus were selected from OPD and IPD of Teerthanker Mahaveer Medical College & Research Center. 30 age and sex matched normal individuals were selected as controls. Patients with renal, hepatic disease, any chronic or acute inflammatory illness, emotional or physical stress, smokers and malnutrition that could alter serum vitamin C levels were excluded.

Overnight fasting blood sample was collected for estimation of FBS. Blood samples were also collected 2 hours after meal for estimation of PPBS. Fasting, PP blood glucose were estimated by GODPOD (Glucose oxidase peroxidise) method and HbA1c by Boronate affinity chromatography using Nycocard reader. Serum vitamin C was estimated by 2,4 – dinitrophenyl hydrazine (DNPH) method [7].

Statistical analysis was done using 't' test, for comparison between two groups and One way ANOVA(F-test) for multiple group comparison. Difference in means were considered significant statistically at p<0.05. Association between vitamin C and HbA1c was studied by Pearson's correlation analysis. Statistical analysis was done on SPSS 11.5.

Results

The levels of the biochemical parameters were expressed as mean ± sd. FBS, PPBS and HbA1c levels of diabetic patients were significantly higher (p<0.0001) whereas vitamin C levels were significantly lower relative to their controls (p<0.002, Table 1).

From Table 2 we found a highly significant decrease in the mean levels of vitamin C in type 2 diabetes patients (p<0.001) with poor glycemic control. We also found significant negative correlation between Vitamin C, FBS, PPBS and HbA1c (Table 3).

Table 1. Comparison of parameters between control and diabetic group (student's t test)

Variables	Control	Diabetic	p value
FBS (mg/dl)	85.9±8.66	139.90±50.08	<0.0001
PPBS (mg/dl)	118.03±7.88	219.23±78.38	<0.0001
HbA1c (%)	4.90±0.51	6.80±1.61	<0.0001
Vitamin C(mg/dl)	0.52±0.13	0.37±0.17	<0.002

p<0.05→statistically significant

Table 2.Comparison of vitamin C among diabetic patients depending on the glycemic status (one way ANOVA)

Group	HbA1c (%)	No	Vitamin C (mg/dl)	p
1	4-6	8	0.46±0.17	<0.0001
2	6-8	16	0.37±0.16	
3	8-10	4	0.26±0.15	
4	10-12	2	0.2 ±0.17	

p<0.05→statistically significant

Table 3. Pearson correlation coefficient (r) and p value between various parameters in diabetic patients

Parameters	r	p
Vitamin C-FBS	-0.38	0.02
Vitamin C-PPBS	-0.34	0.03
Vitamin C-HbA1c	-0.47	<0.008

p<0.05→statistically significant

Discussion

Increased OS is widely accepted participant in the development and progression of diabetes and its complications [8].The metabolic dysregulation associated with diabetes causes secondary pathophysiologic changes in multiple organ systems that impose a heavy burden of morbidity and mortality from macrovascular and microvascular complications [9].

Hyperglycemia has been established as a necessary factor in the development of diabetic complications. It promotes lipid peroxidation of low density lipoprotein and formation of protein glycation products causing release of free radicals, subsequently causing oxidative stress. [10].

In this study, we found a significant decrease in vitamin-C levels in diabetic group compared to controls. Decrease in vitamin-C was also reported in previous DM studies [5]. Maxwell SR et al reported significant reduction in vitamin C levels in NIDDM (non insulin dependent diabetes mellitus) patients. Likewise Ziegler D. et al also reported reduced plasma vitamin C and vitamin E levels in diabetic polyneuropathy which was similar to the findings of Sawant JM etal [11]. However, Makimattila et al reported that plasma vitamin C and E in type II diabetic patients were not significantly different from those in control groups, while vitamin A levels were significantly decreased [12].

Vitamin C serves as an antioxidant both by scavenging peroxyl radicals and regenerating reduced vitamin E defending against increased OS in diabetes. Decrease in vitamin C levels could be due to its increased utilization in the antioxidant defence against elevated lipid peroxidation due to OS. Other likely mechanism for low vitamin C is inhibition of ascorbic acid carrier that also transports glucose, by the hyperglycemia of diabetes [2].

Our study also showed significant decrease in vitamin C level with poor glycemic control. This was similar to the findings of Vivian ST etal [1]. Significant negative correlations were obtained between vitamin C, blood sugar and glycemic status. Lysy et al and Sawant JM etal showed significant inverse correlation between plasma vitamin C and HbA1c levels, a measure of glycemic control in diabetics [1, 11].

Supplementation of vitamin C is shown to lower HbA1c in diabetic patients [13]. Davie et al showed 18% reduction in HbA1c after supplementation of 1gm/day ascorbic acid for 3 months [14]. According to Rafighi Z et al, consumption of vitamin C and E resulted in significant changes in plasma levels of fasting blood sugar and HbA1c ($p<0.05$ and 0.001) [6].

Chronic administration of vitamin C has beneficial effects upon glucose and lipid metabolism in (NIDDM) [15]. Reducing free radical damage to β cells may be another mechanism by which vitamin C protects against diabetes [16].

The roles of ascorbic acid as an aldose reductase inhibitor and water soluble antioxidant in body fluids are potentially very important as adjuncts for tight glycemic control in the management of diabetes [17].

Conclusion

Increase in oxidative damage could lead to the development of complications associated with DM. So, dietary supplementation with vitamin C could be an easy, inexpensive and useful method of protecting diabetic patients from complications. Future research focusing on the therapeutic role of antioxidant supplementation may prove beneficial in diabetes.

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