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Relation of Vitamins in Diabetes Melliatus

Dr. Vaibhav D. Lotake[*1], Dr. Supriya Barsode[2]

[1]Assistant Professor, [2]Associate Professor,
Department of Medicine, Bharati Vidyapeeth (Deemed to be University) Medical College Pune

Corresponding author -

Dr. Vaibhav D. Lotake
Assistant Professor, Department of Medicine

Introduction

Diabetes is a chronic metabolic disorder which is linked to energy metabolism, particularly carbohydrate and fat. Obesity and physical inactivity are shown to be the major risk factors for type 2 diabetes (T2DM). Oxidative stress may also contribute to increase in blood glucose levels, thus contribute to the pathogenesis of T2DM by increasing insulin resistance or impairing insulin secretion.[1] The consequences and complications of diabetes are due to imbalance between free radical formation and their control by natural antioxidants.[2] Thus nutrients having antioxidant function are important in disease development and control also non oxidant vitamins have also shown relationship with diabetes.[3] Long-term treatment of diabetic patients with metformin may cause a higher risk of developing vitamin B-12 deficiency.[4] Vitamin A plays important role as antioxidant, thus helping to maintain the organism's homeostasis when subjected to various forms of stress.[5] Vitamin B_6 consists of a group of three compounds: Pyridoxal, pyridoxine and pyridoxamine, and their corresponding phosphorylase forms and the active form of this vitamin is pyridoxal-5'-phospate (PLP). In new diabetic patients lower PLP concentrations were found as compared to non-diabetic persons.[6] Niacin or B_3, Nicotinic acid is a component of NAD and NADH, which are essential for ATP production and energy efficiency at the cellular level and has been found to increase HDL-cholesterol, decreases TG and LDL cholesterol.[7] As T2DM is an oxidative stress disease; vitamin B_{12} and folic acid deficiencies in diabetic subjects have been found associated to oxidative stress so it is conceivable that vitamin B_{12} deficiency should be considered a risk factor for diabetic complications.[8] Plasma vitamin C concentrations have been inversely correlated to glycosylated hemoglobin and fasting and postprandial blood, Vitamin C has also been shown to reduce anxiety levels.[9] and supplementation for 3 months of vitamins C and E decreases hypertension, blood glucose while increasing superoxide dismutase and glutathione levels.[10] Vitamin D may play an important role in modifying the risk of diabetes.[11] The role of vitamin D in the function of pancreatic cells can be mediated by the union of 1,25-dihydroxyvitamin D to its receptors in the beta cell.[12]

Objective

To evaluate and compare vitamin B_{12} and 25-hydroxy vitamin D_3 [$25(OH)D_3$] levels in diabetic patients and normal control group.

Materials and Methods

Present study was conducted in Dept. of Medicine hospital at Bharati Vidyapeeth Medical College Pune. A total of 100 patients were enrolled in the study of which 64 were male and 59 were female.100 random subjects were taken as a control group from 25 to 65 years age group who were not suffering from the diabetes and their HbA1c level is <6.5% and not on hyperglycaemic drugs. The diagnostic criteria for type 2 diabetes were defined as a glycohemoglobin (HbA1c) ≥6.5%, fasting blood sugar ≥126 mg/dl, or glucose ≥200 mg/dl 2 hours after a 75-g oral glucose load, and patients on anti hyperglycemic drugs. We excluded patients with liver or renal disease, pregnant women, and using antioxidants or using ant vitamin supplements since last 6 months. Age group of patient selected was 25 to 65 years. Written consent was obtained from each patient to participate in the study.

Blood pressure, height, body weight, and waist and hip circumferences of each patient were measured as an anthropometric and dietary measurement. Body mass index (BMI) and ratios of waist to hip circumference was calculated. Blood pressure of each patient was measured after giving rest for at least 5 min.

Blood collection: Fasting blood samples were collected in a tube with anticoagulant, centrifuged and serums were separated. Serum total cholesterol (TC), triglyceride (TG), low density lipoprotein-cholesterol (LDL-C), and high density lipoprotein-cholesterol (HDL-C) levels were measured using an automated biochemical analyser. Serum levels of vitamin B-12 were measured by electro-chemi-luminescence immunoassay. Levels of 25-hydroxy vitamin

D_3 [25(OH) D_3] were measured by radioimmunoassay (RIA). Levels of HbA1c were measured by high-performance liquid chromatography (HPLC).

Results

HbA1C levels were higher in the selected group of diabetes mellitus patients mean value being 7.8 ± 0.14 %. 25(OH) D_3 levels were 18.24 ± 0.94 ng/ml. Serum vitamin B_{12} level ranged from 122 to 146 ng/ml. About 28 (28%) patients had serum vitamin B_{12} level less than 150 pg/ml while 38 (38%) had an intermediate level between 150 and 350 pg/ml. resulting in a total of 66 (66%) of the patients were diagnosed with a metabolic B_{12} deficiency. The cut-off point of serum vitamin B-12 was set at 250 pmol/L based on the medians of vegetarians and the definition of vitamin B_{12} deficiency (<150 pmol/L) and borderline deficiency (<200 pmol/L) were according on Pawlak.[13]

Table 1shows HbA1C, Serum vitamin B-12, 25(OH) D_3 levels and BMI in diabetic and control group.

Tests	Diabetes (n=100)	Control group (n=100)	P value
HbA1C (%)	7.8±0.14	5.2± 0.81	$p < 0.01$
Vit B_{12} (pmol/L)	384± 312.11	416± 254.24	$p < 0.01$
Vit D (ng/ml)	18.24± 6.43	24.28± 3.84	$p < 0.01$
BMI	26.4± 4.45	25.3± 3.43	$p < 0.01$

Discussion

In the present study, it was found that diabetic had a lower vitamin B-12 status. In the present study, Vitamin B-12 could be a useful potent antioxidant, as it can stimulate methionine synthase activity and through a glutathione sparing effect, can modify signalling molecules to decrease oxidative stress.[14,15] Also vitamin B-12 could also act as an anti-inflammation agent.[16] In the present study it was found that diabetic patients with lower vitamin B-12 status had a significantly higher level of blood glucose. Metformin which the first line drug for treatment of diabetes, has been reported to potentially decrease vitamin B-12 status.[17] As most of the people consume vegetarian diet; it may be one of the factor for vitamin B-12 deficiency in diabetic patients.

Metforminis the first line drug for treating diabetes patients and has been reported to potentially cause vitamin B-12 deficiency.[17] So patients on metformin therapy should intake vitamin B-12 as a supplement to maintain adequate vitamin B 12 levels and to prevent its deficiency. Vitamin B-12 plays a dominant role in the utilization of carbohydrates, and a lower vitamin B-12 status may cause hyperglycemia.[18] Some studies have shown that a lower vitamin B-12 status during pregnancy was associated with higher maternal and off-spring insulin resistance.[19,20] Also in our study it was found that diabetic patients having higher vitamin B-12 status were having significantly lower levels of fasting glucose and HbA1c. It is important to monitor vitamin B-12 status in patients with diabetes as a lower vitamin B-12 status may correlate with impaired glucose tolerance.

Lower 25(OH) D_3 levels were observed in a cohort of diabetes mellitus type 2 patients than in a control group. Vitamin D is related to bone metabolism, being a secosteroid synthesized in the skin by the action of ultraviolet irradiation from the sun also vitamin D induces immune tolerance.[21] The relationship between vitamin D and diabetes mellitus type 2 has been observed.[22] Also it has been observed that Vitamin D is related to glucose metabolism and the development of diabetes mellitus type 2 and the metabolic syndrome.[23,24] In a study of a general population sample in eastern Finland, an inverse association was observed between 25(OH)D_3 levels and fasting insulin, fasting glucose and 2 h glucose tolerance test glucose results.[25] In a observational study it was found that higher plasma 25(OH)D_3 was associated with a lower risk of incident diabetes in high-risk patients.[26] In a cohort studyit was observed that, initially diabetes-free, serum 25(OH)D levels were inversely associated with incident diabetes in women but not in men.[27] Also it has been shown that vitamin D ingestion may be related with a higher risk for the development of diabetes mellitus type 2 and the metabolic syndrome.[28]

In our study, lower 25(OH)D_3 levels were observed in diabetes mellitus type 2 patients than in controls. A study by Chiu et.al shows vitamin D deficiency was found to be related to a higher risk for insulin resistance and the metabolic syndrome.[29]

Vitamin D facilitates the secretion of insulin from pancreatic beta cells and regulates insulin secretion,[30] therefore vitamin D deficiency may be related to impaired insulin secretion in diabetes mellitus type 2.[31] So vitamin D supplementation is recommended to improve glucose control in type 2 diabetes mellitus patients.

Present study shows relation between diabetes and vitamin D, low levels of vitamin D was found in diabetic patients and studies shown that it is associated with autoimmunity as well as to metabolic diseases

These findings suggests the therapeutic implications of vitamin D, in patients with diabetes mellitus type 2, normal levels of vitamin D in the blood may facilitate glucose control and optimal levels of vitamin D may retard the clinical course.

Conclusions

Vitamins exert important effects on risk of diabetes mellitus as well as its progression and complications High blood glucose concentrations promote auto-oxidation of glucose to form free radicals.[32] Vitamin D and vitamin B-12 deficiency is common in type 2 diabetic persons and those having deficiency of vitamins should be given vitamin supplementation. The best recommendation is to take foods that contain sufficient vitamins to guarantee an appropriate nutritional status.

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