Vitamin D status and its association with diabetes mellitus in population of Udaipur

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Abstract

Studies have shown that Vitamin D is necessary for normal insulin secretion. Vitamin D reduces insulin resistance through regulation of the insulin receptor gene and its effects on calcium and phosphorus metabolism. Therefore, deficiency of vitamin D results in decreased insulin secretion and increased insulin resistance, both of which are characteristics of type 2 Diabetes mellitus. The predisposition of Vitamin D deficiency to Glucose intolerance via altered insulin secretion may be done either through a direct action via Vitamin D receptor (VDR) activation or indirectly via calcemic hormones and also via inflammation. The study is aimed to measure and correlate Vitamin D status with serum level of fasting and postprandial Glucose, Total Cholesterol and Triacylglycerol level in individuals of Udaipur. The study was carried out on total 300 vegetarian subjects, out of which 190 were females and 110 were males with an average age of 54.25±8.94 years. Subjects were divided into two categories depending upon their serum total Vitamin D value. Category A included subjects with total Vitamin D value below 10 ng/ml and category B included subjects with total Vitamin D value between 30-70 ng/ml. The subjects with total Vitamin D value between 10-30 ng/ml were excluded from the study. Results clearly indicated that Category A with Vitamin D value below 10 ng/ml had significantly higher serum fasting, post prandial Glucose, Total Cholesterol and Triacylglycerol level as compared to subjects with Vitamin D value between 30-70 ng/ml (category B) with significance (p value <0.05). Vitamin D deficiency can lead to dysregulation of Glucose and lipid metabolism. Supplementation of Vitamin D in Vitamin D deficient individuals may reduce the risk of Diabetes mellitus and dyslipidaemia by improving insulin secretion and Glucose tolerance.

Keywords: Vitamin D, Insulin Resistance, Dyslipidaemia, Type 2 Diabetes mellitus

Introduction

Diabetes has been diagnosed in more than 62 million individuals in India.This gives a potential epidemic status to this disease.[1,2] Prevalence of Diabetes is predicted to double globally with the figures jumping from 171 million in 2000 to 366 million in 2030, with a significant increase in India,[3,4] estimated to reach approximately 80 million by the year 2030.[5] In this way India is facing threefold rise in the diabetic prevalence in rural as well as urban areas.[6,7] Its prevalence is rapidly increasing in both developing and developed countries. After cancer and cardiovascular disease, diabetes is regarded as the 3rd killer of mankind because of its high prevalence, morbidity and mortality.[8,9] Diabetes mellitus is characterized by hyperglycaemia, metabolic abnormalities and long term complications that affect eyes, kidneys, nerves and blood vessels.[10]

Vitamin D is a part of complex steroid hormone system. There are two forms of vitamin D, Vitamin D3 (Cholecalciferol), produced from the conversion of 7-dehydrocholesterol in skin and Vitamin D2 (Ergocalciferol), produced in mushrooms and yeast. The major circulating form of Vitamin D is 25-hydroxycholecalciferol with low biological activity. The biologically active form of Vitamin D is 1, 25 dihydroxycholecalciferol. The nutritional status of Vitamin D is reflected by the concentration of serum25-hydroxycholecalciferol. Besides its classical actions such as calcium balance and bone metabolism, it plays a key role in non- classical actions like promoting insulin action and secretion, immune modulation and lung development.[11-17] Many studies have shown that Vitamin D is necessary for normal insulin secretion. Vitamin D reduces insulin resistancethrough regulation of the insulin receptor gene and its effects on calcium and phosphorus metabolism. Therefore, deficiency of vitamin D results in decreased insulin secretion and increased insulin resistance, both of which are characteristics of type 2 Diabetes mellitus. The predisposition of Vitamin D deficiency to Glucose intolerance via altered insulin secretion may be done either through a direct action via Vitamin D receptor (VDR) activation or indirectly via calcemic hormones and also via inflammation.[18] There are studies indicating relationship between type 2 diabetes and subclinical inflammation.[19] The immune-modulating properties of 1, 25-Dihydroxycholecalciferol are responsible for facilitating the correlation between Vitamin D, low-intensity chronic inflammation and insulin resistance in type 2 diabetes by downregulating the production of pro-inflammatory cytokines (20). Considering the above facts, the present study will focus on the effect of total serum Vitamin D status onfasting Glucose, post prandial Glucose, Total Cholesterol and Triacylglycerol in population of Udaipur.

Materials and Methods

The study was conducted on 300 vegetarian subjects, out of which 190 were females and 110 males with an average age of 54.25± 8.94 years. The informed

consent was taken before study and statistical significance was calculated by using p value with confidence limit of 95%.

The following criteria were used for exclusion:

1. Muslim women following purdah system
2. Pregnant women
3. Patients suffering from hepatic, renal and cardiac disorders
4. Cancer Patients
5. Diabetic Patients
6. Subjects taking Vitamin D supplements

The study was conducted from April 2016 to August 2016 at Arth Diagnostics Private Limited, Udaipur. The blood of the subjects were collected after an overnight fast of at least ten hours. The blood was collected in plain vial for estimating serum Total Vitamin D, Total Cholesterol and Triacylglycerol. For estimating fasting Glucose blood was collected in fluoride vial.For analysis of post-prandial Glucose blood samples were collected in a fluoride vialexactlyafter two hours once the subjects were orally administered75 grams of Glucose, dissolved in water. The serum was obtainedby centrifugation, separated into aliquot and analysed. The analysis of total Vitamin D was done by Elecsys, Chemiluminiscence method (Competitive protein binding assay) on Cobas e411 (Roche). The estimation of fasting and post prandial Glucose, Total Cholesterol and Triacylglycerol was done on Fully Autoanalyser of Roche, Cobas Integra 400 Plus.

The laboratory reference range for serum totalVitamin D below 10ng/ml is considered as deficiency, 10-30 ng/ml is insufficiency and levels between 30-70 ng/ml is optimum.The normal range of serum fasting, post prandial Glucose, Total Cholesterol and Triacyl glycerol is respectively 70-110 mg/dl, 70-140 mg/dl, 100-250 mg/dl and 60-150 mg/dl respectively.

Results

Subjects were divided into two categories depending upon their serum total Vitamin D value. Category A included subjects with total Vitamin D value below 10 ng/ml and category B included subjects with total Vitamin D value between 30-70 ng/ml.The values are shown in Table 1 as below:

Table 1: Correlation of Vitamin D with biochemical parameters

Name of Parameter	Category A (Vit D less than 10ng/ml)	Category B (Vit D 30-70ng/ml)	p Value
	Mean±SD	Mean±SD	
Total Vitamin D ng/ml	5.53±3.81	48.74±11.02	< 0.05
Fasting Glucose mg/dl	103.63±9.76	89.63±7.42	< 0.05
Post Prandial Glucose mg/dl	137.33±6.58	108.54±5.49	< 0.05
Total Cholesterol mg/dl	211.95±35.37	148.62±27.3	< 0.05
Triacyl glycerol mg/dl	98.8±26.45	155.36±50.2	< 0.05

Discussion

Deficient levels of Vitamin D may cause predisposition of type 2 Diabetes mellitus Results clearly indicated that Category A with Vitamin D value below 10 ng/ml had significantly higher serum fasting, post prandial Glucose, Total Cholesterol and Triacylglycerol level as compared to subjects with Vitamin D value between 30-70 ng/ml (category B) with significance (p value <0.05). This study revealed an inverse relationship between total Vitamin D3 and fasting, post prandial Glucose, Total Cholesterol and Triacylglycerol levels. Earlier several studies have also shown similar results with Negative correlation between Vitamin D and Glucose.[21,22] Inverse relationship was reported in Middle Eastern population.[23] Age dependent inverse relationship between Vitamin D and HbA1C has also been reported in Caucasians.[24,25] In a study there was association between low level of 25(OH) D3 concentrations and hyper Triacylglycerolemia component of the metabolic syndrome.[26] The reciprocal relationship between Vitamin D and serum Total Cholesterol and Triacyl glycerol level is further supported by the study which provides evidence that Vitamin D deficiency was closely associated with increased risk of major adverse cardiovascular disease events.[27,28] This is further explained that hormonal form of Vitamin D i.e. calcitriol is able to increase the lipoprotein lipase activity in adipocytes resulting in removal of Triacyl glycerol enriched with lipoproteins from the blood.

Adequate levels of Vitamin D is required for optimum functioning of many tissues and organs. The presence of both 1-α-hydroxylase and VDR in pancreatic β cells explains the importance of Vitamin D for insulin synthesis and release.[29,30] Vitamin D induced impairment of insulin secretion and Glucose tolerance was partially corrected after Vitamin D replenishment in rats.[31,32] Improvement in insulin secretion and Glucose tolerance as a result of Vitamin D supplementation have been observed by some studies.[33-35]

Conclusion

This study concludes inverse relationship between Vitamin D and serumGlucose, Total Cholesterol and Triacylglycerol. These effects of Vitamin D are based on its non-classical actions on insulin secretion and sensitivity andalso its action in inflammation. Supplementation of Vitamin D in Vitamin D deficient individuals may reduce the risk of Diabetes mellitus and dyslipidaemia by improving insulin secretion and Glucose tolerance.

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