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Original Research Article

Correlation between Glycemic Indices and Vitamin D in Patients with Type 2 Diabetes Mellitus

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Conflict of interest: Nil

Abstract

Introduction: The incidence of type 2 DM is increasing worldwide and results from a lack of insulin or inadequate insulin secretion following increases in insulin resistance. The potential role of vitamin D in insulin resistance and type 2 diabetes mellitus is multifactorial. These effects of vitamin D deficiency, either acting in concert or alone, all serve to increase insulin resistance.

Objectives: To estimate and compare the levels of Vitamin-D, HbA1c, fasting blood sugar and 2hour post prandial blood sugar levels in type 2 diabetes mellitus patients and healthy controls and to find any correlation between Vitamin D level and glycemic variables.

Methodology: It is an observational descriptive, case control, hospital-based study conducted on 160 T2 DM patients and 50 healthy controls.

Results: Glycemic variables, body weight and BMI were significantly high in diabetic group. Most of the study population was Vitamin D deficient.

Conclusions: A significant inverse correlation was found between glycemic variables and vitamin D level. Most of the Indian population was Vitamin D deficient.

Keywords: Glycemic variables, Vitamin D, Type 2 diabetes mellitus.

Introduction

Diabetes mellitus is a metabolic disorder in which there is high blood sugar levels (hyperglycaemia) persisted almost over life span. Diabetes is due to either the pancreas not producing enough insulin or the cells of the body not responding properly to insulin produced. Diabetes mellitus, particularly Type 2 DM is now emerging as one of the main public health concerns for 21st century both in developed and developing countries. [1] The global prevalence of diabetes is estimated to increase from 8.3% in 2013 to 10.1% in 2035. In India it is estimated that by year 2035, 109.0 million people will be suffering from diabetes. Type -2 diabetes accounts for 85% to 95% of all diabetics in high income countries

and may account for even higher percentage in low to middle income countries. [2] Although the relationship between vitamin D status and insulin resistance has been explored by many researchers, the underlying mechanism requires further insight. Vitamin D plays an important role in glucose homeostasis via different mechanisms that act directly or indirectly on beta cells of pancreas and targets organs of body. The potential role of vitamin D deficiency in insulin resistance has been proposed to be associated with inherited gene polymorphisms in vitamin D-binding protein, receptors, and 1alpha-hydroxylase gene. It helps in improving insulin sensitivity of the target cells i.e., liver, skeletal muscle, and adipose tissue. It not only enhances but also improves *β*-cell function. Vitamin D helps directly or indirectly in protecting *β*-cells from detrimental immune attacks of body immune system by regulating local immune responses. The maintenance of serum calcium via PTH and vitamin D following changes in dietary calcium and obesity has been proposed to mediate the effects of vitamin D on insulin resistance. These effects of vitamin D deficiency, either acting in alone or concurrently, all serve to increase insulin resistance. [3,4]

Aims and Objectives

This study was planned to estimate the fasting blood sugar levels, 2 hour post prandial blood sugar levels, HbA1c and vitamin D level and diabetic and healthy control and to find correlation between vitamin D level and glycemic variables.

Material and Method

It is an observational descriptive, case control, hospital-based study and conducted at tertiary care centre in central Rajasthan. The present study has been conducted on type 2 diabetes mellitus patients and healthy controls of either gender and age (>40 years) attending/ admitted in out-patient departments/ in-patients wards of the hospital after obtaining ethical clearance from college ethical committee. The subjects have been considered as type 2 DM based on the American Diabetes Association guidelines (ADA) 2015. [5] The final sample size was taken 160 for cases as per prevalence of diabetes mellitus taken as 11.8 as per result of national diabetes and diabetic retinopathy survey. [6] and 50 age and gender matched healthy controls were included in the study. Age more than 40 and type 2 diabetic patients old or newly diagnosed were inclusion criteria and Age less than 40 years, type 1 diabetes mellitus, gestational diabetes mellitus patients with pancreatic diseases, hepatic diseases, bone diseases malignant diseases were excluded as they may impair vitamin D and Ca^{+2} metabolism.

After obtaining consent from all the eligible subjects they were enrolled for the study. On a pre scheduled morning, the subjects were requested to arrive after overnight fast (at least 10 hours) to provide the fasting blood samples via venepuncture. After collecting the fasting blood sample subjects were advised to give blood sample 2 hours after meals. After 30 minutes of collection, the blood sample were centrifuged for 10-15 minutes at 3000 rpm to obtain the serum. Serum Glucose was estimated via Glucose -Oxidase – Peroxidise end point assay, Glycosylated Hemoglobin (HbA1c) via Ion Exchange Resin Method and vitamin D measured by ELISA (Enzyme-linked Immunosorbent Assay) Method**.** Data was stored in MS office Excel spread sheet and the data were checked for normality before statistical analysis using Kolmogorov Simonov test. The unpaired t test (for quantitative data to compare two independent observations) was applied. The chi square test was used for qualitative data comparison of all clinical indicators. Pearson correlation test was also done. Level of significance was set at $P \leq 0.05$.

Observation and Results

This study was conducted to correlate the levels of fasting blood sugar, 2 hour post prandial blood sugar, HbA1c and serum levels of vitamin D in type 2 diabetes mellitus patients. This study has been conducted on type 2 diabetes mellitus patients of either gender and age (>40 years). Total 210 subjects were enrolled out of which 160 were type 2 diabetic patients (cases) and 50 were healthy control (control). The mean age of case group was 55.41± 8.783 years and mean age of control group was 57.74 ± 5.924 years. The difference in mean age of both the group is nonsignificant. Table 1 shows the various observation. In this study total male patients were 53.1% and female were 46.9% in case group. In control group both male and female were 50%. The male to female ratio is 1.13, which indicate higher prevalence of male patients in our study. According to our study, 31.2% of cases were resident of rural area where as 68.8 % were resident of urban area in case group. In control arm 18% were rural and 82% were urban showing higher prevalence rate in urban area than rural area. A statistically significant higher BMI was observed in case group than control group. (29.23 ± 4.21 Kg/ m^2, 27.39 ± 4.57 Kg/ m^2 respectively, p-value-< 0.05). The mean fasting blood sugar level in cases was 222.41 ± 87.38 mg/dl and for control was 90.704 ± 8.73. The difference in fasting sugar level is highly significant (p value-<0.0001). The mean 2hour post prandial sugar level in case group was 275.506 ± 73.95 mg/dl and in control group it was 110.58 ± 12.98 mg/dl. The difference in both the group is highly significant (p value- <0.0001). Our observation showed HbA1C in case arm 9.47 ± 2.07 % and in control arm 5.73 ± 0.42 %. The difference in both the arm is highly significant (p value- <0.0001). In case group the mean serum Vitamin D level was 17.225 ± 8.03 ng/dl and in control group 20.58 ± 7.06 ng/dl. The difference in both the groups was statistically significant. (p-value –< 0.05). Serum levels of Vitamin D were deficient in 125 patients (78.1%) insufficient in 22 patients (13.8%) and sufficient in 13 patients (8.1%) in case group. Whereas in control group 4 subjects (8.0%) were deficient, 19 subjects (38.0%) were insufficient and 27 subjects (54.0%) were having sufficient level of Vitamin D. Our observations showed statistically significant negative correlation between glycemic variables and serum vitamin D level. Fasting blood sugar level and HbA1c were significantly inversely correlated with vitamin D level (r= -0.186, p-value <0.05 and r= - 0.103, p-value <0.05 respectively). Whereas 2hour post prandial sugar was highly significantly inversely correlated with vitamin D level (r= -0.348, p-value <0.000) as shown in figure 1.

Table 1: Various character and observation of study population

Character	Case (160)	Control (50)	P value
Age (years)	55.41 ± 8.783	57.74± 5.924	
Male	53.1%	50%	
Female	46.9%	50%	
Rural	31.2%	18%	
Urban	68.8%	82%	
BMI (Kg/m2)	29.23 ± 4.57	27.93 ± 4.57	< 0.05
Fasting blood sugar(mg/dl)	222.41± 87.38	90.704 ± 8.73	<0.0001
Post prandial sugar (mg/dl)	275.506 ± 73.95	110.58 ± 12.98	<0.0001
HbA1c %	9.47 ± 2.07	5.73 ± 0.42	<0.0001
Vitamin D (ng/dl)	17.225±8.03	20.58±7.06	<0.05

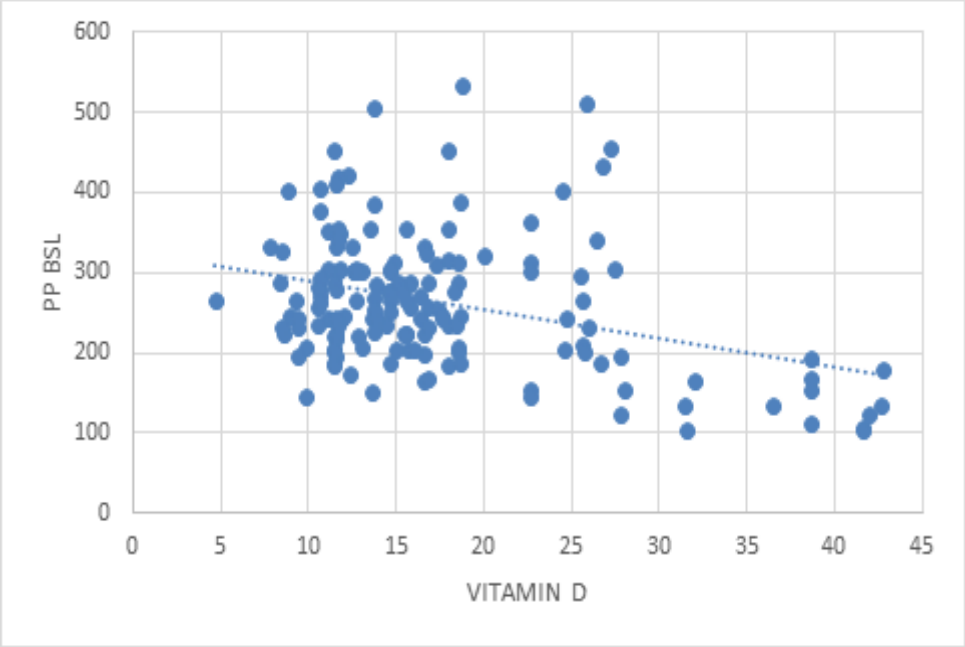

Figure 1: Correlation of serum Vitamin D levels and 2hour post prandial blood sugar levels in cases

Discussion

Higher male prevalence was seen in our study which is in accordance to other Indian studies like Sudhir Chandra Jha et al [7] who also showed male to female ratio of 1.60:1 and P Santosh Kumar et al [8] also showed high prevalence in male, with male to female ratio of 1.04. According to our results, higher prevalence of type 2 diabetes mellitus seen in urban population than rural population. Similar results were also demonstrated by other researchers like Samiramiss et al [9] they demonstrated 13.7% rural distribution and 86.3% urban distribution of study population and Ghaneemah M. Hamadi et al [10] that the prevalence of diabetes in urban (62%) was more than rural (38%). Higher prevalence in urban area may be due to poor life style, sedentary life and consumption of high sugar and fat diet. [11] Statistically higher BMI was observed in diabetic group in our study. Similar results were shown by Vaibhav Shukla et al [12], Samiramiss et al [9] and Sudhir Chandra Jha et al [7]. Mean fasting blood sugar level, 2 hour post prandial blood sugar level and HbA1c were significantly high in diabetic group than healthy control group. Deficient mean serum vitamin D level was seen more in diabetic than healthy control group. The mean vitamin D level was significantly low in diabetic group. Pokhrel et al [13] found that in Indian population the mean Vitamin D level was (17.89,12.85-26.57 ng/ml) in poorly controlled diabetic group. They also found that 83.3% of the patients were having hypovitaminosis D. In our study, negative correlation was observed with vitamin D level and fasting blood sugar, 2 hour post prandial sugar level and HbA1c. Our results are in accordance to Salih YA et al [14] they showed that the serum 25(OH)-D level was significantly lower in patients with poor glycemic control compared to those with good glycemic control. Similar results demonstrated by Sudhir Chandra Jha et al [7] they concluded that there was an inverse association between Vitamin D and HbA1C in patients with type -2 Diabetes Mellitus and lower Vitamin D levels are associated with poor glycemic control. Identical to our observations, Karuppasamy G et al [15] also showed that a significant negative correlation was found between Vitamin D level and fasting blood sugar, random blood sugar, HbA1c.

Conclusion

We conclude that hypovitaminosis D is associated with poor glycemic control in diabetic patients. Vitamin D level is inversely correlated with fasting blood sugar, 2 hour post prandial blood sugar and HbA1c levels. Every uncontrolled type 2 diabetes mellitus patient should be screened for vitamin D deficiency and treated if deficient.

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