Original Research Article

A Hospital-Based Study Assessing Association of Vitamin D with HbA1C Levels in Patients with Type 2 Diabetes Mellitus

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Abstract

Aim: The aim of the study was to find out whether this correlation between vitamin D and Diabetes is present or not and have tried to correlate Vitamin D with HbA1C levels in patients with Type 2 diabetes mellitus mainly.

Material & Methods: The present cross -sectional study was conducted in the Department of Physiology, Patna medical college and Hospital, Patna, Bihar, from October 2022 to April 2023, on newly detected and known patients with T2DM. Total 200 participants were included in the study, out of which 100 type 2 diabetic patients were included as case (Group A) & 100 healthy people as control (Group B).

Results: Among diabetic patients having abnormal Vitamin D level, majority (65%) were having insufficiency, only 20% were having overt vitamin D deficiency in Diabetic patients. In the study population, the mean age of group A (case) was 50.45±10.42 years while that of group B (control) was 46.74±10.42 years. 65% of group A were male and 35% female. Group B (control) had 42% males and 58% females. In patients with controlled diabetes as per HbA1C criteria, the prevalence of sufficient, Insufficient and Deficient Vitamin D was 12, 28 and 8 respectively, where in patients with uncontrolled diabetes it was 5, 35 and 12 respectively. There was a significant association between the maintenance of euglycemia and severity of Vitamin D level in diabetic patients, as the p value is less than 0.05. Hypertension was most common co-morbidity found in diabetic group followed by ischemic heart disease.

Conclusion: There was an inverse association between Vitamin D and HbA1C in patients with type -2 Diabetes Mellitus. Lower Vitamin D levels are associated with poor glycemic control. That means in case of low Vitamin D the study reveals high HbA1C. Vitamin D deficiency is prevalent in Diabetes mellitus Type 2 so by supplementation of vitamin D can improve glycemic controls in patients of Diabetes mellitus Type 2.

Keywords: HbA1c, Type 2 Diabetes Mellitus, Vitamin D.

Introduction

HbA1c is the most important laboratory parameter indicating glycemic control. [1] Clinicians aim to achieve the HbA1ctarget level in diabetes mellitus treatment steps. The general target of HbA1c is ≤7% for glycemic control. [2] HbA1c values over 7% show poor glycemic control. Vitamin D is a pleiotropic hormone known to play an immunomodulatory role in addition to Calcium and bone metabolism. [3] Receptors for its activated form have been identified on pancreatic β-cells and immune cells. [4] It not only regulates calcium homeostasis and bone health, [3] but also relates to many chronic diseases such as metabolic syndrome (MetS), type 2 diabetes mellitus (T2DM), cardiovascular disease, cancer and dementia.

Vitamin D deficiency is generally defined as having a serum 25 hydroxy vitamin D [25(OH) D] level <20 ng/mL (50 nmol/L), and severe deficiency is defined as 25(OH) D <10 ng/mL (25 nmol/L). Vitamin D is a steroid hormone that might contribute to prevent type 2 diabetes mellitus (DM). Vitamin D is a crucial factor in development of type 2 DM because it regulates adipogenesis during adipocyte differentiation, stimulates insulin synthesis, protects pancreatic B cells and decreases insulin resistance in muscles. [5]

The lack of vitamin D and type 2 diabetes have similar risk factors including race, obesity, high age, place of residence, and lack of physical

activity. [6] Vitamin D affects the production and secretion of insulin as well as insulin sensitivity. [7] Vitamin D is likely to indirectly affect insulin secretion and insulin sensitivity through beta cells and environmental tissues that are the targets of insulin. The immunomodulatory features of vitamin D in relation to T cells activity is effective for some immune processes leading to type 1 diabetes. [8] The role vitamin-D in T2DM suggested by Pittas et al. [9] in his study, documenting that insulin sensitivity is improved by as much as 60% when levels of 25-Hydroxy vitamin-D3 are increased from 25 to 75 nmol/L and this was also quoted by few of the studies done in India. Vitamin-D helps in insulin secretion by stimulating Beta cells secretions or it may facilitate the conversion of pro-insulin to insulin. Vitamin-D improves sensitivity and promotes beta -cells survival by modulating the effects of cytokines.

Therefore, vitamin D deficiency may be implicated in pathogenesis of T2DM. Hence, the present study was undertaken to estimate the levels of vitamin D in patients with T2DM and correlate levels of vitamin-D with glycemic status of Diabetes Mellitus.

Material & Methods

The present cross -sectional study was conducted in the Department of physiology, Patna medical college and Hospital, Patna, Bihar, from October 2022 to April 2023, on newly detected and known patients with T2DM. Total 200 participants were included in the study, out of which 100 type 2diabetic patients were included as case (Group A) & 100 healthy people as control (Group B).

The participants were selected as per following inclusion and exclusion criteria.

Inclusion Criteria

1. Patients with type2 diabetes mellitus visited in General Medicine OPD or admitted in wards of General Medicine department, Pmch, Patna, as Group A.
2. Healthy individuals including patient's attendants, health care workers of pmch etc. as Group B.

Exclusion Criteria

1. Patients with chronic kidney disease
2. Patients taking calcium supplements or vitamin D supplements within last 3 months.
3. Patients suffering from any known chronic illness.
4. Type1 diabetes mellitus patients

After selecting the participants as per inclusion and exclusion criteria, informed consent was taken.

The participants were subjected for routine laboratory investigations like CBC, FBS, RBS, PP2BS, HbA1c, blood urea, serum creatinine, lipid profile, urine routine examination and Vitamin D3 level by standard methods in central laboratory of the Institute.

The value of serum vitamin D level was further divided in the following category: sufficient = 30-100ng/ml, insufficient =20- 29ng/ml, deficiency = less than 20ng/ml.

Statistical Analysis

The data obtained was coded and entered into Microsoft Excel Worksheet. The categorical Data was expressed as Rates, Ratio Proportions and comparison was done using chi-square test. The continuous data was expressed as mean +- standard deviation (SD) and comparison was done by two sample 't' test with unequal variance. A probability value ('p' value) of less than or equal to 0.05 was considered as statistically significant.

Results

Table 1: Severity grading of vitamin D deficiency and gender distribution in cases and controls

	Case =100	%	Control=100	%
Deficiency	20	20	0	0
Insufficient	65	65	25	25
Sufficient	15	15	75	75
Gender				
Male	65	65	42	42
Female	35	35	58	58
Mean age	50.45±10.42 years		46.74±10.42 years	

Among diabetic patients having abnormal Vitamin D level, majority (65%) were having insufficiency, only 20% were having overt vitamin D deficiency in Diabetic patients. In the study population, the mean age of group A (case) was 50.45±10.42 years while that of group B (control) was 46.74±10.42 years. 65% of group A were male and 35% female. Group B (control) had 42% males and 58% females.

Table 2: The association of severity of vitamin D level with the category of diabetes control

Diabetes control	Vitamin D Level			p-value
	Sufficient	Insufficient	Deficiency	
ControlledDiabetic (N = 48)	12	28	8	0.002
Uncontrolled Diabetic(N= 52)	5	35	12	

In patients with controlled diabetes as per HbA1C criteria, the prevalence of sufficient, Insufficient and Deficient Vitamin D was 12, 28 and 8 respectively, where in patients with uncontrolled diabetes it was 5, 35 and 12 respectively. There was a significant association between the maintenance of euglycemia and severity of Vitamin D level in diabetic patients, as the p value is less than 0.05.

Table 3: Comparison of mean vitamin D level with duration and micro vascular complication of diabetes mellitus

Parameters			Mean value of vitamin D (ng/dl)	p value
Duration of diabetes	0-5 years		26.24±6.34	0.18
	5-10 years		28±5.55	
	>10 years		26.74±3.14	
Micro- vascular complication	Diabetic retinopathy	Present	25.75±5.55	0.072
		Absent	28.02±5.75	
	Diabetic nephropathy	Present	29.41±5.80	0.050
		Absent	27.53±6.54	
	Peripheral neuropathy	Present	26.34±4.86	0.112
		Absent	28.22±5.75	

Diabetic nephropathy was the most common microvascular complication seen in type 2 diabetic patients. it was found that all three important microvascular complications: - diabetic retinopathy, diabetic nephropathy and peripheral neuropathy did not have any significant correlation with serum Vitamin D level as p value is greater than 0.05 for all three parameters.

Table 4: Subgroup analysis- mean vitamin D level in diabetes patients in relation with age, gender and associated co-morbidities

Parameters		Mean value of vitamin D	p value
Age group	Below 35	26.24±5.25	0.229
	Above 35	27.03±3.47	
Gender	Male	32.16±5.35	0.022
	Female	28.22±4.52	
HTN	Yes	24.26±4.86	0.036
	No	26.34±6.54	
IHD	Yes	31.29±4.36	0.145
	No	28.32±5.65	

Hypertension was most common co-morbidity found in diabetic group followed by ischemic heart disease.

Discussion

Diabetes mellitus is the most common metabolic disease in the world. More than 150 million people suffer from this disease in the world, and it is predicted that this number will rise to 300 million in 2025. [10] The lack of vitamin D and type 2 diabetes have similar risk factors including race, obesity, high age, place of residence, and lack of physical activity. In a number of studies, it has been observed that 25‑hydroxyvitamin D serum level is significantly lower in diabetic patients than healthy individuals. [11-13] Evidence is available linking vitamin D deficiency with bacterial and viral infections. Foot infection accounts for 20% of hospitalization of diabetic patients annually. Immunological defects in addition to neuropathy and vascular abnormality are the prime contributors in the pathogenesis of diabetic foot and subsequent infections. Different studies have shown that deficiency of vitamin D leads to immune cell dysfunction, β-cell damage and impaired insulin production. [14] In addition to hyperglycaemia, vitamin D deficiency could also be linked to an altered immune system of patients with diabetes, rendering them susceptible to foot infection and unfavourable prognosis.

Among diabetic patients having abnormal Vitamin D level, majority (65%) were having insufficiency, only 20% were having overt vitamin D deficiency in Diabetic patients. In the study population, the mean age of group A (case) was 50.45±10.42 years while that of group B (control) was 46.74±10.42 years. 65% of group A were male and 35% female. Group B (control) had 42% males and 58% females. In patients with controlled diabetes as per HbA1C criteria, the prevalence of sufficient, Insufficient and Deficient Vitamin D was 12, 28 and 8 respectively, where in patients with uncontrolled diabetes it was 5, 35 and 12 respectively. Similar results were shown by Brijesh M et al. Mean level of vitamin D is low in uncontrolled diabetic patients (19.47±4.76) as compared to controlled diabetic patients (23.63±3.71). [15] Modi KD et al found that vitamin D levels in patients with controlled diabetes was 22.4±18.6 while in uncontrolled diabetic patients it was lower, 19.9±18.3 which is statistically significant. [16] There was a significant association between the maintenance of euglycemia and severity of Vitamin D level in diabetic patients, as the p value is less than 0.05. Hypertension was most common co-morbidity found in diabetic group followed by ischemic heart disease.

Study by Brijesh M et al also indicates there is a definite negative correlation between Vitamin D levels and diabetes (r= -0.94 and -0.97) and poorly controlled diabetics have further lower values of Vitamin D. [15] A study by Akshay kumar SV et al showed a negative negligible co-relation between vitamin D levels and HbA1C, which was not statistically significant (r = 0.017, p value 0.741). [17] The inverse relationship between vitamin D level and glycaemic control in this study support an active role of vitamin D in pathogenesis of type 2 diabetes mellitus. Duration of diabetes and presence of micro-vascular complication do not have effect on serum vitamin D level. No effect of increasing age was observed on vitamin D status in diabetic patients and we could not able to find such association in other studies. Female diabetic patients were having lower vitamin D level compared to male counterparts; the reason might be less exposure to sun due to household activity.

Conclusion

Diabetic individuals have a higher rate of vitamin D insufficiency than healthy people and vitamin D deficiency is more prevalent in uncontrolled diabetes than controlled diabetes. Therefore, all type 2 diabetes patients must be checked for vitamin D levels and given supplements if deficient. To avoid vitamin D insufficiency, diabetes must be strictly controlled. We recommend greater research to identify vitamin D insufficiency in the community, particularly in type-2 diabetes patients, and active initiatives to supplement the population with vitamin D.

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