Section: Biochemistry

Original Research Article

STUDY OF RELATIONSHIP OF VIT D AND GLYCEMIC CONTROL IN TYPE 2 DIABETES MELLITUS

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ABSTRACT

Background: Recent studies suggest that decreased vitamin D level is common in patients with type 2 diabetes mellitus. Low vitamin D may result in early cardiovascular complications in patients with type 2 diabetes mellitus. as vitamin D appears to influence several pathways that have been linked to coronary artery disease, such as inflammation, vascular calcification, proliferation of smooth muscle cells in vascular tissue, myocyte hypertrophy, arterial intimal thickness, renin-angiotensin system, blood pressure control and insulin resistance at periphery. **Aim:** the aim of this study was to investigate the levels of 25-hydroxy Vitamin in patients with T2DM and in nondiabetic healthy controls and to ascertain the impact of levels on glycemic control in T2DM patients.

Materials and Methods: The present study was done at Ayaan Institute of Medical sciences, Hyderabad after getting approval by Institutional Ethics committee of Ayaan Institute of Medical sciences, Hyderabad. Type 2 diabetic patients and controls attending General Medicine Department was recruited into this study. A total of thirty cases, diagnosed as type 2 Diabetes and 120 normal controls during February 2024 to September 2024 were included in the study.

Results: In the present study, serum vitamin D, fasting blood sugar, postprandial blood sugar and Glycated Hb has been estimated in type 2 diabetic patients and compared to controls. Serum vitamin D levels are significantly low in diabetic cases as compared to controls. Serum vitamin D levels are very low in uncontrolled cases (Hba1C is high). It has been seen that; there exists inverse relation between glycemic control and vitamin D levels. Thus; it shows the role of vitamin D in pathogenesis of onset of disease and its complications possibly due to antioxidant property. A highly significant correlation was found between serum vitamin D, blood glucose and glycated hemoglobin in type 2 diabetic subjects.

Conclusion: The present study suggests that estimating vitamin D and timely supplementing in the deficient cases can provides a better glycemic control; thus delaying the onset of complications in type 2 diabetic subjects. Thus vitamin D has plays its role in the control of glycemia and its complications through its antioxidant properties.

Keywords: Diabetes Mellitus, Vitamin D, Hb A1c, Glycemic Control, Antioxidant.

INTRODUCTION

Diabetes Mellitus is a metabolic endocrine disorder characterized by chronic hyperglycemia with disturbances in metabolism of carbohydrates, fats and proteins , due to defects in either insulin secretion or insulin utilization or both.[1] The long term hyperglycemia in Diabetic patients will result in macro vascular complications like coronary artery disease, cerebrovascular attacks and micro vascular complications like neuropathy, retinopathy and nephropathy.[2] These complications progress and lead to end stage outcomes such as, myocardial infarction, renal failure, loss of vision and amputations.[3]

Glycated hemoglobin indicates an average blood glucose levels over the last 3 months (6 -8 weeks).6 Amongst the various markers of Glycemic control, HbA1c is considered as gold standard for monitoring long-term glucose control and thus effectiveness of treatment in people with diabetes mellitus, especially with Type 2 Diabetes mellitus(T2DM) patients.[4]

Vitamin D is a group of fat-soluble vitamin. It plays key role in the absorption of calcium, iron, magnesium, phosphate and zinc in the small intestine. Two major forms of Vitamin D are vitamin D3 (cholecalciferol) (―sunshine vitamin‖) and vitamin D2 (ergocalciferol).[5]1,25(OH)2D. (calcitriol) is the metabolically active form of vitamin D hormone.The mechanism of vitamin D photosynthesis in the skin is by the action of solar UVB on 7- dehydrocholesterol which is converted to Vitamin D3 subsequently.[6]

HypovitaminosisD is an emerging health problem that affects approximately one billion globally and its growth is still increasing.[7]Vitamin D is an important hormone of calcium homeostasis and bone integrity and it also has several extraskeletal pleiotropic effects, including the endocrine system.[8] Vitamin D deficiency is an important risk factor for a variety of common diseases, including severe asthma in children; osteoporosis, cardiovascular disease, cancer, autoimmune diseases and cognitive impairment in older adults.[9]

Based on available clinical and epidemiological data, the positive effects of vitamin D seem to be primarily related to its action on insulin secretion and sensitivity and secondary to its action on inflammation. Since the activation of inflammatory pathways interferes with normal metabolism and disrupts proper insulin signaling, it is hypothesized that vitamin D could influence glucose homeostasis by modulating inflammatory response.

Recent studies suggests that decreased vitamin D level is common in patients with type 2 diabetes mellitus.[10]Low vitamin D may result in early cardiovascular complications in patients with type 2 diabetes mellitus,[11,12] as vitamin D appears to influence several pathways that have been linked to coronary artery disease, such as inflammation, vascular calcification, proliferation of smooth muscle cells in vascular tissue, myocyte hypertrophy, arterial intimal thickness, renin-angiotensin system, blood pressure control and insulin resistance at periphery.[13-15]

To further examine this, we sought to determine the prevalence of hypovitaminosis D in patients with type 2 diabetes mellitus and investigate the relationship between vitamin D levels and variables indicative of glycemic control.

Aims

Therefore, the aim of this study was to investigate the levels of 25-hydroxy Vitamin in patients with T2DM and in nondiabetic healthy controls and to ascertain the impact of levels on glycemic control in T2DM patients.

Objectives

1. To measure Serum Levels of Vit.D; FBS;PLBS and Hba1c.
2. To determine the relation between Serum levels of Vit.D and HbA1c

MATERIAL AND METHODS

Study center

The present study was done at Ayaan Institute of Medical sciences, Hyderabad after getting approval by Institutional Ethics committee of Ayaan Institute of Medical sciences, Hyderabad. Type 2 diabetic patients and controls attending General Medicine Department was recruited into this study. A total of thirty cases, diagnosed as type 2 Diabetes and 120 normal controls during February 2024 to September 2024 were included in the study.

Study site

Blood samples of type 2 Diabetic mellitus patients and controls were collected for the estimation of Fasting blood Sugar (FBS), Postprandial blood sugar (PPBS), Glycated Hemoglobin and vitamin-D at CDL biochemistry laboratory, Ayaan Institute of Medical sciences to Ayaan Institute of Medical sciences, Hyderabad.

Study Period

One and half year from February 2024 to September 2024.

Study Type

Observational study

Sample Size: 150 (30 cases and 120 healthy controls)

- 30 cases of type 2 Diabetes mellitus and 120 controls were selected
- Type of Samples used for this study - blood samples

Selection criteria of the patients: Study population Clinically diagnosed patients of T2DM from general medicine and endocrinology departments were selected for the study. Consent was taken and questionnaire filled up.

Ethical issues

The study was conducted after approval from institutional Ethics Committee of Gandhi hospital. After explaining the coarse of study in their own language; informed written consent was obtained from each patient regarding their participation in the study. Patient confidentiality was respected and any specification reflecting the identity of the person was omitted from the data.

Inclusion Criteria

Cases:

- Clinically diagnosed cases of type 2 diabetes between the age group of 35 -55 years either sex.
- The diagnosis of type 2 diabetes mellitus was established in accordance with the recommended criteria of American Diabetes Association and based on detail clinical history.

Controls

- Non diabetic people
- Age group of 35- 55 yearseither sex

Exclusion Criteria

- Other types of diabetes like type1 and gestational diabetes
- Recent or ongoing treatment with vit D or multivitamins.
- Patients on calcium supplements or calcium channel blockers.
- Patients with recurrent infections.
- Patients with malabsorption syndromes
- Post bariatric patients
- Patients on anticonvulsants
- Patients on drugs like antiretrovirals, rifampicin, cholestyramine, orlistatand steroids
- Chronic kidney disease
- Pregnant and lactating women

Clinical variables

Individualized interview was taken to collect data regarding age, gender, self- reported race, time of diagnosis of diabetes, medications in use, any complications od diabetes and comorbidities.

We have measured Fasting blood sugar, postprandial blood sugar, HbA1c and serum vitamin D levels in the present study in 30 cases and 120 controls by the following methods

1. Fasting blood sugar: hexokinase G-6-PDH method.
2. Postprandial blood sugar: hexokinase G-6-PDH method
3. Hb A 1 c: Cation - exchange HPLC
4. Serum vitamin D:ChemiluminescenceMicroparticle Immunoassay(CMIA).

RESULTS

This study was done at Gandhi hospital ,secunderabad. It involved 150 subjects of which 30 were type 2 diabetic cases who attended medicine and endocrinology departments and also fulfilled the inclusion criteria and the other 100 were normal subjects without diabetes. After recruiting the patients , blood samples were collected to estimate fasting blood sugar(FBS); postprandial blood sugar (PPBS); glycated hemoglobin (HbA1C); Serum vitamin –D levels . Both fasting blood sugar and post prandial blood sugar were estimated by glucokinase method in autoanalyzerbeckman coulter; glycated hemoglobin by HPLC in BIO-RAD D-10 hemoglobin analyzer and vitamin –D bychemiluminiscencemicroparticle immunoassay in siemens centaur XPT system. Results on continuous measurements are presented on mean and SD and results on categorical measurements are presented in number (%). Significance is measured at 5% level of significance.

Distribution of study sample according to Gender

In the present study included 150 subjects of which 120 are controls and 30 are type 2 diabetic cases. Of the 30 type 2 diabetic cases, 12 were males and 18 were females and among controls, 65 were males and 55 were females.

Distribution of Diabetic patients according to the duration of diabetes

The distribution of the Diabetic patients was done based on duration of diabetes shown in Table 2 and graphically represented in Graph 4. The cases were divided into 3 groups based on Duration of diabetes: <5 yrs, 5 to 10 yrs and > 10 yrs. [Table 1]

Distribution of serum vitamin D (ng/ml) levels between cases and controls

Comparison of Serum vitamin D levels between cases and controls is shown in table 3 and graphically represented in graph 1. All the controls were within normal serum vitamin D levels except for 5 controls were with decreased serum vitamin D levels (4%). Among cases; only two cases was within normal range (7%) . Majority among cases 28 (93%) were with decreased vitamin D levels. [Table 2]

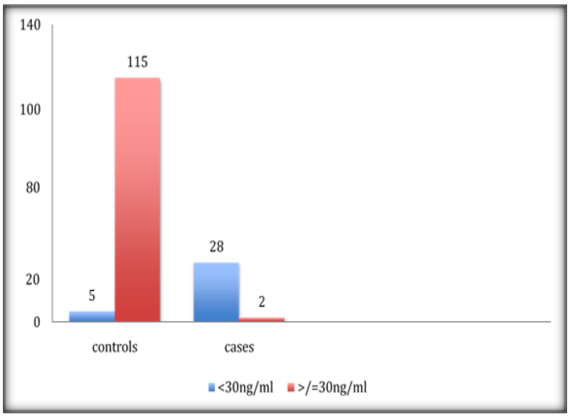

Figure 1: Distribution of study group based on vitamin D levels

The above graph shows that diabetic cases are having lower vitamin D levels

Mean ± SD of Serum Vitamin D levels for cases is 14.36 ± 7.35 and for controls is 35.5 ± 3.7 and difference of means between cases and controls is 21.1. Mean ± SD of serum vitamin D between the two groups is statistically significant (P<0.01).

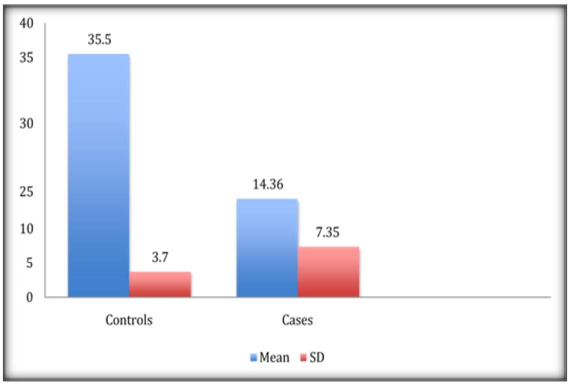

Figure 2: Comparison of Mean and Standard Deviation of Serum Vitamin D levels between two Groups

All the cases are with type 2 diabetes and all the controls are normal without diabetes. Mean ± SD for fasting blood Glucose levels for cases is 157 ± 14.2 and for control is 88.9 ± 9.9and the difference of mean of cases and control is 68.1. Mean ± SD of Blood Glucose is higher in cases than in controls and the mean difference is statistically significant ($p < 0.01$). [Table 5]

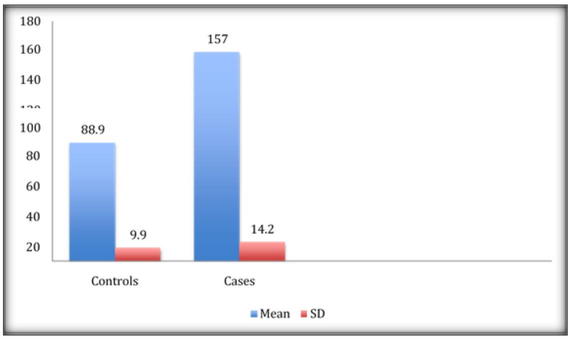

Figure 3: Comparison of Fasting Blood Glucose Levels between Controls and Cases

Comparison of Serum Vitamin D levels in relation to Fasting Blood Glucose Levels

Comparison of Serum Vitamin D and Fasting blood Glucose levels between cases and controls are shown in Table 6. All the controls were having normal blood Glucose levels (non diabetics) and normal vitamin D levels except for 5 controls with decreased Vitamin D levels (4%).

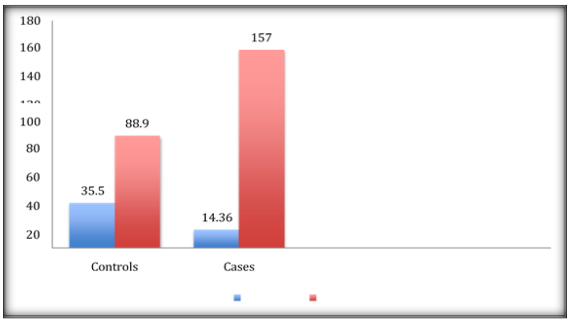

Figure 4: Comparison Serum vitamin D and Fasting Blood Glucose Levels of Both the Groups

The above graph shows that mean value of vitamin D is less in diabetic cases and fasting blood sugars are high

Table 7: Comparison of Mean ± SD of Postprandial Blood Glucose (mg/dl) levels between two Groups

All the cases are with type 2 diabetes and all the controls are normal without diabetes. Mean ± SD for postprandial blood Glucose levels for cases is 355.6 ± 75.1 and for control is 135 ± 9.1 and the difference of mean of cases and control is 220.6. Mean ± SD of Blood Glucose is higher in cases than in controls and the mean difference is statistically significant ($p < 0.01$).

Comparison of Serum Vitamin D levels in relation to Postprandial Blood Glucose Levels

Comparison of Serum Vitamin D and Postprandial blood Glucose levels between cases and controls are shown in Table 7. All the controls were having normal blood Glucose levels (nondiabetics) and normal vitamin D levels except for 5 controls with decreased Vitamin D levels (4%).

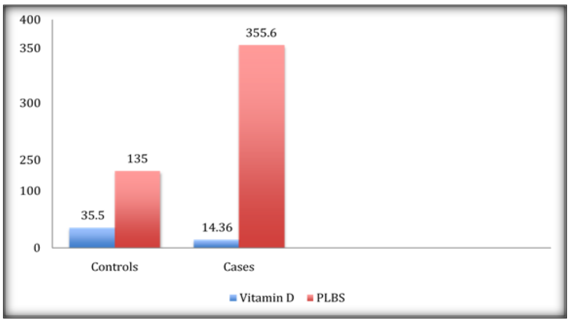

Figure 5: Comparison Serum vitamin D and Postprandial Blood Glucose Levels of Both the Groups

The above graph shows that mean value of vitamin D is less in diabetic cases and postprandial blood sugars are high

All the cases are with type 2 diabetes and all the controls are normal without diabetes. Mean ± SD for Glycated hemoglobin for cases is 8.85 ± 0.9 and for control is 5.1 ± 0.39.Mean ± SD of Glycated hemoglobin is higher in cases than in controls and the mean difference is statistically significant ($p<0.01$).

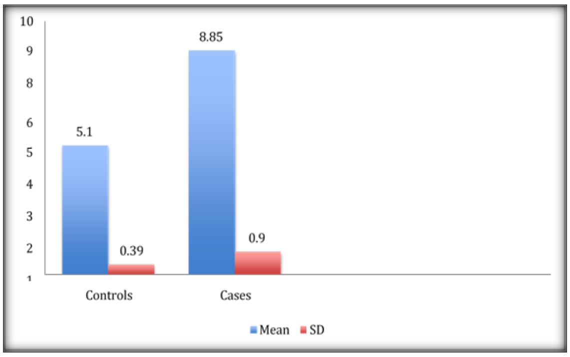

Figure 6: Comparison of Glycated hemoglobin Levels between Controls and Cases

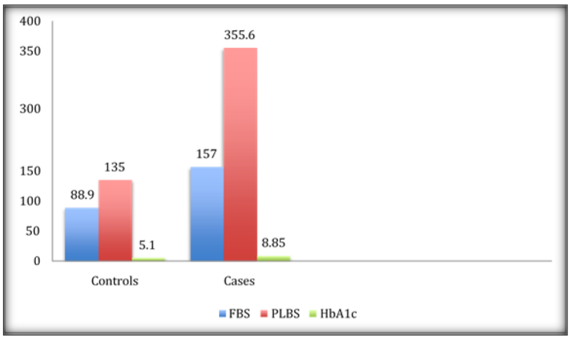

Figure 7: Comparison of Fasting blood Glucose and Postprandial blood Glucose and Glycated Hemoglobin Levels of Both the groups

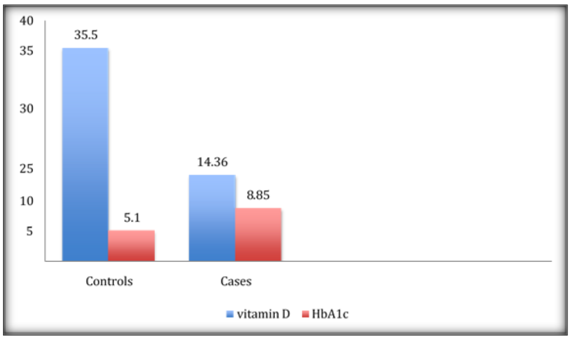

Figure 8: Comparison Serum Vitamin D and Glycated hemoglobin of Both the groups

It is seen in the above graph that glycemic control is poor in with lower vitamin D levels

The distribution of the diabetic cases was done based on the Glycemic control shown in Table 11 and graphically represented in Graph 8. The cases were divided into 3 groups based on glycated hemoglobin (HbA1c). There were 2 cases with good Glycemic control (< 7 %), 15 cases with moderate Glycemic control (7-9%) and 13 cases with poor Glycemic control (> 9%), and then compared with the serum vitamin D levels within three groups.

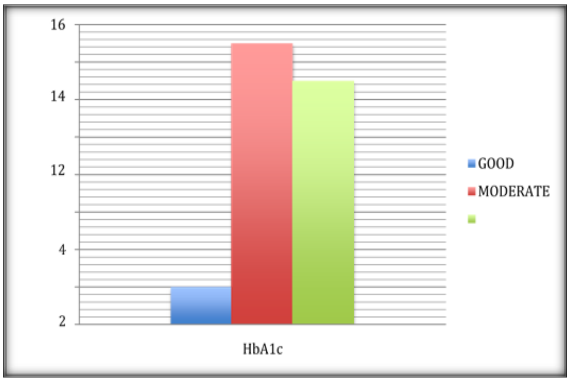

Figure 9: Distribution of cases based on HbA1c levels

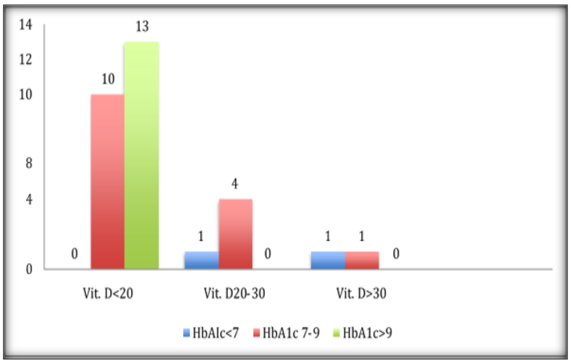

Figure 10: Serum vitamin D levels in Diabetic Patients According to the Glycemic control

The above graph shows that as vitamin D levels are increasing glycemic control is improving (HbA1c is decreasing)

Table 1: Gender distribution among cases and controls

Gender	Cases		Controls		Total
	No	%	No	%	
Male	12	40	65	54.1	
Female	18	60	55	46.9	
Total	30		120		150

Table 2: Cases distribution according to the duration of diabetes

Duration of Diabetes	No. of patients	Percentage
<5 yrs	18	60%
5to 10 yrs	7	23%
>10 yrs	5	17%

Table 3: Distribution of Serum vitamin D (ng/ml) Controls and Cases. N=150

VitaminD (ng/ml)	Controls		Cases	
	No.	%	No.	%
<30	5	4	28	93
>/=30	115	96	2	7
Total	120	100	30	100

Table 4: Comparison of Mean and Standard Deviation of Serum Vitamin D levels (ng/ml) between two Groups

Group	Mean	SD	p-Value
Controls(120)	35.5	3.7	
Cases(30)	14.36	7.35	<0.01

Table 5: Comparison of Mean ± SD of Fasting Blood Glucose (mg/dl) levels between two Groups

Group	Mean	SD	p-Value
Controls(120)	88.9	9.9	<0.01
Cases(30)	157	14.2	

Table 6: Mean ± SD of Serum Vitamin D (ng/ml) and Fasting Blood Glucose (mg/dl) among cases and controls

Parameters	Cases		Controls		p-Value
	Mean	SD	Mean	SD	
VitaminD	14.36	7.35	35.5	3.7	<0.01
Fasting bloodGlucose	157	14.2	88.9	9.9	<0.01

Table 7: Comparison of Mean ± SD of Postprandial Blood Glucose (mg/dl) levels

Group	Mean	SD	p-Value
Controls(120)	135	9.1	<0.01
Cases(30)	355.6	75.1	

Table 8: Mean ± SD of Serum Vitamin D (ng/ml) and Postprandial Blood Glucose (mg/dl) among cases and controls

Parameters	Cases		Controls		p-Value
	Mean	SD	Mean	SD	
VitaminD	14.36	7.35	35.5	3.7	<0.01
PostprandialbloodGlucose	355.6	75.1	135	9.1	<0.01

Table 9: Comparison of Mean and Standard Deviation of Glycatedhemoglobin (%) between Controls and Cases

Group	Mean	SD	p-Value
Controls(120)	5.1	0.39	<0.01
Cases(30)	8.85	0.9	

Table 10: Mean ± SD of Glycated hemoglobin (%) and Blood Glucose (mg/dl) among cases and controls

Parameters	Cases		Controls		p-Value
	Mean	SD	Mean	SD	
Glycatedhemoglobin	8.85	0.9	5.1	0.39	<0.01
FastingbloodGlucose	157	14.2	88.9	9.9	
Postprandial bloodGlucose	355.6	75.1	135	9.1	<0.01

Table 11: Mean ± SD of Serum Vitamin D(ng/ml) Glycated Hemoglobin (%) and among cases and controls

Parameters	Cases		Controls		p-Value
	Mean	SD	Mean	SD	
VitaminD	14.36	7.35	35.5	3.7	<0.01
Glycatedhemoglobin	8.85	0.9	5.1	0.39	<0.01

Table 12: Distribution of Diabetic patients according to the Glycemic control

GlycemicControl	HbA1c	No. Of Patients
Good	<7	2
Moderate	7to9	15
Poor	>9	13

Table 13: Serum vitamin D levels in Diabetic Patients According to the Glycemic control

SerumvitaminD (ng/ml)	HbA1c<7		HbA1c 7-9		HbA1c>9	
	n=2	%	n=15	%	n=13	%
<20	0	0	10	32	13	55
20-30	1	50	4	56	0	27
>30	1	50	1	12	0	13

DISCUSSION

Diabetes mellitus is the most common endocrine metabolic disease. It is characterized by high levels of blood glucose due to defects either in insulin secretion, or peripheral insulin resistance, or in both.92 There is progressive destruction of beta cells.

Pro-inflammatory cytokines like Tumor necrosis factor-alpha (TNF-α), interlelukin-1 (IL-1) and interleukin-6 (IL-6) and other acute phase reactants are involved in multiple metabolic pathways relevant to insulin resistance, including regulation, reactive oxygen species, lipoprotein lipase action and adipocyte function. Therefore activated innate immunity and inflammation are relevant factors in the pathogenesis of diabetes and setting of its complications; with convincing data that type 2 Diabetes includes an inflammatory component. Insulin signaling pathway can be suppressed in response to inflammation and the process of inflammation can initiate insulin resistance.[16]

Therefore, systemic inflammation and oxidative stress plays a key role in the pathogenesis of insulin resistance and Type 2 Diabetes mellitus. Vitamin D

; which has its key role in calcium homeostasis, also has antioxidant and immunomodulatory properties; which can not only delay the onset of pathogenesis of disease and its complications but also increases efficiency of treatment and improves the prognosis.

In this background the current study has been undertaken to assess the levels of serum vitamin D and HbA1c in type 2 diabetic subjects and controls.

In the present study, statistically, there was no major difference between the average age of controls and cases. Irrespective of the sex, cases were primarily selected on the basis of Type 2 diabetic subjects and controls were without diabetes.

In the present study we had evaluated 150 subjects including 120 controls and 30 type 2 diabetic subjects. Of the 30 type 2 diabetic subjects, 12 were males and 18 were females and among controls, 65 were males and 55 were females.

The cases were divided into 3 groups based on Duration of diabetes into duration< 5 yrs (18 cases, 60%), duration 5 to 10 yrs (7 cases, 23%) and duration > 10 yrs (5 cases, 17%).

Serum Vitamin D levels among cases and controls. Out of 120 controls, 5 controls were with decreased levels (4%). Among 30 cases, 2 cases (7%) were with normal levels and remaining 28 cases (93%) were with decreased levels.

The statistical analysis of the obtained values showed that the Serum Vitamin D values are significantly lower in type 2 diabetic cases (14.36 ± 7.35 ng/ml) compared to controls (35.5 ± 3.7 ng/ml). The mean difference was significant at p-value <0.01. In present study, Serum vitamin D levels are significantly lower in cases when compared to controls thus correlating with above studies.

All the cases are type 2 diabetic and all the controls are normal without diabetes. The statistical analysis of the obtained values showed that Mean ± SD for Fasting Blood Glucose levels for cases is 157 ± 14.2 and for controls (non-diabetic) is 88.9 ± 9.9 and difference of means of cases and controls is 68.1, Mean ± SD of plasma Glucose is higher in cases than in controls and the p-value being < 0.01.

The statistical analysis of the obtained values showed that the Mean ± SD of vitamin D and Postprandial Blood Glucose levels for cases is 14.36 ± 7.35 and 355.6 ± 75.1and the Mean ± SD for controls 35.5 ± 3.7 and 135 ± 9.1. The mean difference was significant at P value <0.01.

Hyperglycemia in Diabetes mellitus is due to both increased production and reduced glucose utilization. As a consequence, there is excess accumulation of glucose rather than consumption by liver, and also there is decreased uptake of glucose into muscle and adipose tissue finally contributing to hyperglycemia.[17]

In this study, according to above observation there is inverse correlation between blood Glucose levels and Serum vitamin D levels. As the vitamin D levels are decreasing there is increase in plasma glucose levels in cases.

The statistical analysis of the obtained values showed that Mean ± SD for Glycatedhemoglobin for cases is 8.85 ± 0.9 and for controls is 5.1 ± 0.39. Mean ± SD of Glycated hemoglobin is higher in cases than in controls and the p-value being < 0.01. This is in accordance with Shetty J.K,[18] Sathiyapriya V et al,[19] Yan R et al,[20] Dalan R et al,[21]& Singer D.E et al.[22]

Glycated hemoglobin concentration represents the integrated values of glucose over past 6 to 8 weeks since the rate of formation of HbA1c is directly proportional to the concentration of glucose in blood. It is currently considered as the best index of metabolic control for diabetic patients in clinical practice. It is as well a measure of risk for the development of micro and macro vascular complications.[23]

The most important factor governing the quantity of glycated hemoglobin formed is the prevailing plasma glucose concentration. As the plasma glucose concentration is increased in diabetic subjects, glycated hemoglobin also increases.[24]

Glycated hemoglobin levels probably reflect the degree of Glycemic control of the individual. It is considered better than fasting and post-prandial blood glucose levels.

This is because glycated hemoglobin does not depend on variables such as patient co- operation, time of the day, stress, exercise, food intake or renal threshold. This makes it better screening test in population studies.[25]

It represents the mean daily blood sugar concentration and degree of carbohydrate imbalance, better than fasting blood glucose concentrations or glucose tolerance test results. Hence it may provide a better index of control of diabetic patient without resorting to a glucose loading procedure.[26]

In the present study the statistical analysis of the obtained values showed that the Serum vitamin D values are significantly lower in diabetic cases compared to controls and the mean difference was significant at p- value < 0.05

Diabetic patients were divided into 3 groups based on the glycated hemoglobin (HbA1c). Good control as HbA1c of < 7 %(2 cases), moderate control as HbA1c of 7-9% (15 cases) and poor control as HbA1c of > 9% (13 cases). Serum vitamin D levels were compared within these three groups. Very low serum vitamin D levels were observed with poor Glycemic control.

In this study, according to above observation, there is a highly significant (p < 0.01) positive correlation existing among Fasting and Postptandial plasma glucose, Glycated Hemoglobin and vitamin D. There is a significant (p < 0.05) correlation found between vitamin D & Glycated hemoglobin.

Thus; in this study an inverse relationship between Vitamin D level and glycemic control was found which support the hypothesis of an active role of Vitamin D in pathogenesis of type 2 diabetes mellitus. These finding are also consistent with observation from other cases sectional studies that had also reported inverse association between 25 (OH) Vitamin D concentration and HBA1c level both in NHANES precipitating and in cohort from outside the USA. This study is also supported by study of Kositsawat,[27] and colleagues who showed that serum Vitamin D concentration is inversely related with HBA1c level. This study is also supported by recent study of De Boer et al,[28] indicated inverse association between serum Vitamin D and risk of type 2 diabetes mellitus; Sheena et al,[29] examined the cross sectional association between Vitamin D and beta cell dysfunction and show high prevalence of hypo vitaminosis D was noted among women with type diabetes mellitus. In 2010, Liu et al,[30]predicted Vitamin D score and incident type 2 diabetes in the Framingham offspring study that higher Vitamin D status is associated with a decreased risk of type 2 diabetes mellitus.

Thus the present study show the high prevalence of Vitamin D deficiency in patients of type 2 diabetes mellitus patients. Vitamin D level is inversely related to glycemic control in patients of type 2 diabetes mellitus. Hence, this study shows that we can improve the quality of life of patients by timely Vitamin D supplementation in patients of type 2 diabetes mellitus by improve their glycemic control and decreasing the complication of uncontrolled type 2 diabetes mellitus.

CONCLUSION

Diabetes mellitus is a chronic metabolic disease characterized by hyperglycemia. Patients with long standing and uncontrolled diabetes are at an increased risk of number of micro vascular and macro vascular complications. It has been found, from the studies that vitamin D not only delays the onset of diabetes mellitus but also delays the complications and its severity because of its antioxidant and immunomodulatory property. Evaluation of serum vitamin D levels and timely supplementing it to the deficient patients can improve the prognosis and long term outcome of the disease.

Conflict of Interest: None
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