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Research Article

Vitamin D and Glycemic Control in Impaired Fasting Glycemia

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ABSTRACT

Impaired Fasting Glycemia (IFG) is defined as elevated fasting plasma glucose concentration ≥100mg/dl and <126 mg/dl. IFG is considered to be an intermediate state in the development of diabetes and cardio vascular diseases. Vitamin D and calcium homeostasis may also play a role in the development of type 2 Diabetes Mellitus (DM). The aim of the study was to correlate the levels of serum 25hydroxy vitamin D with the glycemic parameters in a group of subjects with Impaired Fasting Glycemia. The study included 30 participants with IFG. Fasting Blood Glucose (FBG) & Post-Prandial Blood Glucose (PPBG) were estimated by Glucose Oxidase Peroxidase method, Glycated Hemoglobin (HbA1c) levels were estimated by Ion exchange HPLC method using Biorad analyzer. Serum Vitamin D levels were estimated by competitive ELISA kit (DLD Diagnostika GmbH). Correlation between the levels of Serum 25 hydroxy Vitamin D with FBG, PPBG and HbA1c was analysed by Pearson's Correlation. There was a negative correlation between Vitamin D levels and FBS, PPBS and HbA_{1c} in subjects with IFG. The correlation between Vitamin D levels and FBG and the correlation between Vitamin D and HBA1C in subjects with IFG was found to be statistically significant. The results of this study have shown that IFG is associated with decreased levels of 25 (OH) Vit D.

Keywords: Diabetes Mellitus, Impaired Fasting Glycemia, Glycated Hemoglobin , Vitamin D.

INTRODUCTION

Impaired Fasting Glycemia (IFG) represents intermediate stages of abnormal glucose regulation that exists between normal glucose homeostasis and diabetes [1]. IFG is defined as elevated fasting plasma glucose concentration ≥100mg/dl and <126 mg/dl [2]. IFG is considered to be an intermediate state in the development of diabetes and cardio vascular diseases [3-5].

Vitamin D insufficiency has long been suspected as a risk factor for type 1 diabetes based on animal and human observational studies [6]. More recently, there is accumulating evidence to suggest that altered vitamin D and calcium homeostasis may also play a role in the development of type 2 Diabetes Mellitus (DM) [7].

An association between vitamin D deficiency and β cell dysfunction has been reported in healthy and glucose-tolerant subjects [8], non diabetic people [9], and patients with type 2 diabetes [10]. Interestingly, many studies have revealed that Vitamin D3 (Calcitriol) has a role in the synthesis and the secretion of insulin by receptor mediated molecular mechanisms [11, 12]. Identifying preventable risk factors associated with IFG is important in the prevention of progression to diabetes mellitus.

There are several lines of evidence supporting a role for vitamin D in pancreatic β-cell function [13, 14]. The circulating concentration of 25-hydroxyvitamin D [25(OH) D] is the common biomarker used to assess vitamin D status [15].Therefore the aim of the study was to correlate the levels of serum 25hydroxy vitamin D with the glycemic parameters in a group of subjects with Impaired Fasting Glycemia.

MATERIALS AND METHODS

The study was performed in accordance with the approval of the Institutional ethics committee (EC No: 353/IEC/2012) and informed written consent was taken from all subjects. The study included 30 participants with IFG who were attending the out patient department of SRM Medical College Hospital & Research Centre. IFG is defined as elevated fasting plasma glucose concentration ≥100mg/dl and <126 mg/dl.Individuals with hypercalcemia, intake of Vitamin D supplements, osteomalacia , end stage renal failure and pregnancy were excluded from the study.

Blood samples were drawn after 10-12 hrs of overnight fasting and collected into appropriate vaccutainers and processed in the laboratory immediately after collection. Fasting Blood Glucose (FBG) &Post-Prandial Blood Glucose (PPBG) were estimated by Glucose Oxidase peroxidase method using Beckman Coulter auto analyzer. Glycated Hemoglobin (HbA1c) levels were estimated by Ion exchange HPLC method using Biorad analyzer. The serum sample was stored at – 20 ^{0} C and estimation of Vitamin D levels were carried out using competitive ELISA kit (DLD Diagnostika GmbH).

The correlation between the levels of Serum 25 hydroxy Vitamin D with Fasting Blood Glucose, Post prandial Blood Glucose and Glycated Haemoglobin was analysed by Pearson's Correlation using SPSS version 21.0.

RESULTS

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Table 1: Correlation between Vitamin D and Glycemic Parameters in subjects with IFG

Parameters	Mean ± SD	r- value (p-value)
FBG (mg/dl)	106.23 ± 3.85	- 0.418 (0.022)
Vitamin D (ng/ml)	30.8 ± 6.7	
PPBG (mg/dl)	127.06 ± 30.7	- 0.467 (0.377)
Vitamin D (ng/ml)	30.8 ± 6.7	
HbA_{1c} %	5.9± 1.5	- 0.472 (0.008)
Vitamin D (ng/ml)	30.8 ± 6.7	

$p<0.05$ considered statistically significant.

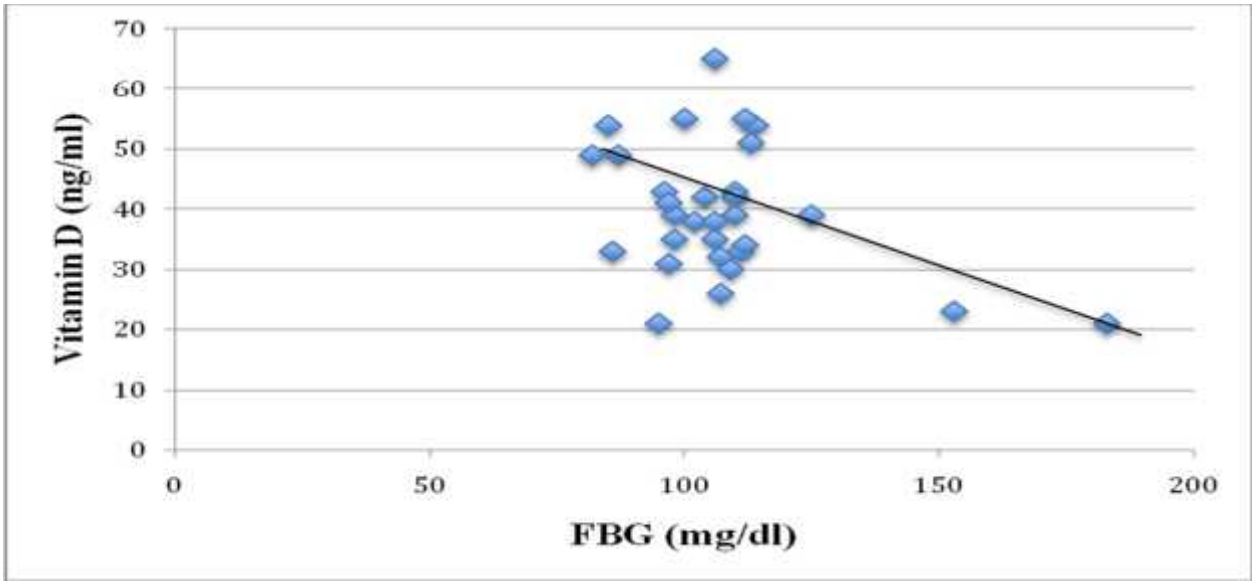

Fig. 1: Correlation between FBG and Vitamin D levels in subjects with IFG.
FBG – Fasting Blood Glucose

There was a negative correlation between Vitamin D levels and FBS, PPBS and HbA_{1c} in subjects with IFG. The correlation between Vitamin D levels and FBG and the correlation between Vitamin D and HBA1C in subjects with IFG was found to be statistically significant.

DISCUSSION

Hyperglycemia is often the consequence of insulin resistance [16].Vitamin D deficiency has found to be associated with impaired βcell function and insulin resistance [8, 17].

In our study comprising of patients with Impaired Fasting Glycemia, we observed a negative correlation between Vitamin D levels and Fasting Blood Glucose, Post Prandial Blood Glucose and Glycated Hemoglobin. The correlation between Vitamin D levels and FBG and the correlation between Vitamin D and HBA1C in patients with IFG was found to be statistically significant.

Vitamin D deficiency may impair insulin secretion through an increase in parathyroid hormone levels, which may increase the intracellular calcium levels and thus impairing the calcium signal which is required for the glucose induced insulin secretion [18-20].

Chiu et al showed that there is ample evidence in animal studies that vitamin D is essential for normal insulin secretion [8].Vitamin D deficiency also reduced insulin turnover in rats [21]. Other animal models have shown that low levels of 25(OH) D impair insulin synthesis and secretion, and treatment with 25(OH) D delays the onset of diabetes [22, 23].

Daily supplementation with calcium and vitamin D attenuated increases in glycemia and insulin resistance in adults with impaired fasting glucose [24].Patients with IFG were 5 to 10 times likely to develop diabetes within one year than people without IFG [25].

Giacomo Zoppini et al [26] has found that Serum 25(OH) D levels were inversely associated with HbA_{1c} levels in 715 type 2 diabetic patients during the year 2011–2012. Shanthi et al [27] have reported vitamin D insufficiency as a poor prognostic factor which may play a vital role in impairing the glycemic control.

At the same time certain studies have not given consistent results [28]. Vitamin D3 supplementation did not reduce the risk of developing diabetes over 7 years of follow up in a randomized placebo controlled trial.

The observations by Chiu et al [8] have indicated that a

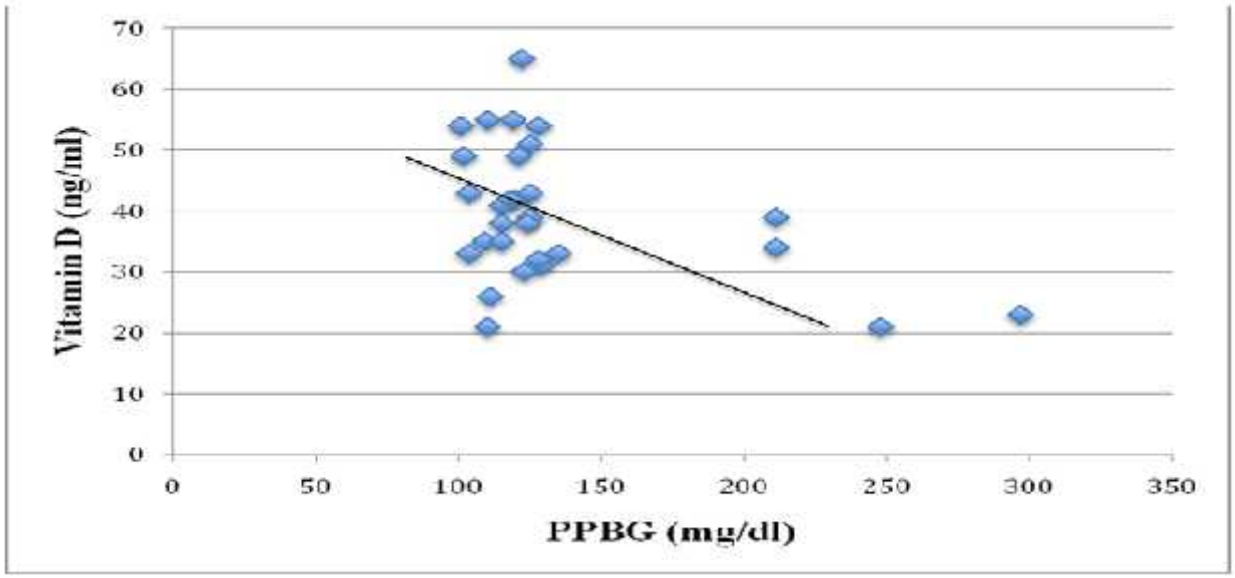

Fig 2: Correlation between PPBG and Vitamin D levels in subjects with Impaired fasting glycemia.
PPBG- Post Prandial Blood Glucose

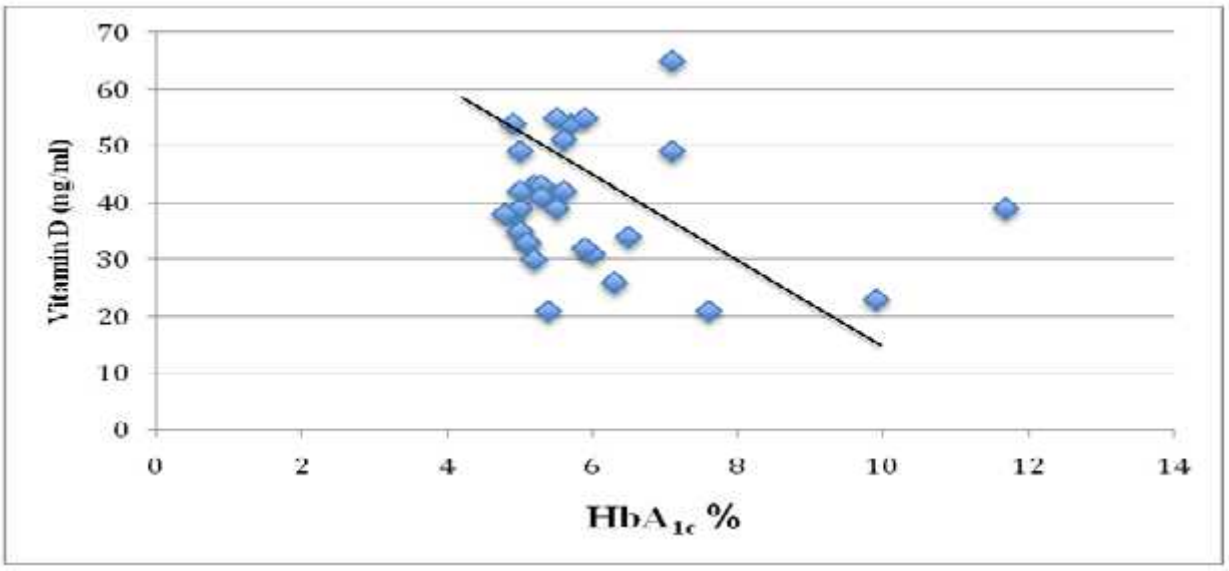

Fig 3: Correlation between HbA_{1c} and Vitamin D levels in subjects with Impaired fasting Glycemia
HbA_{1c} Glycated Hemoglobin

low 25(OH) D concentration had some effect on β cell function and prevented a proper compensatory insulin response that would keep the plasma glucose concentration similar to that in subjects with a higher 25(OH)D concentration. Therefore, subjects with a lower 25(OH) D concentration would have decompensated β cell function, which resulted in a higher plasma glucose concentration than that in subjects with a higher 25 (OH) D concentration [18]. Our study showing the presence of a significant negative correlation between the levels 25 (OH) D and Glycated Hemoglobin also support this concept.

Hypovitaminosis D was found to be associated with increased risk of metabolic syndrome [8]. Impaired Fasting Glycemia is one of the components of metabolic syndrome. The role of vitamin D in the metabolic syndrome is suggested by a recent report from the Coronary Artery Risk Development in Young Adults (CARDIA) Study, a population-based prospective study [29]. We have observed similar findings in our study involving individuals with IFG. Our results are also consistent with the findings of Shankar et al [30] who have demonstrated that lower serum 25(OH) levels were positively associated with IFG.

CONCLUSION

The results of this study have shown that IFG is associated with decreased levels of 25 (OH) Vit D. Large scale prospective studies may help us to understand the role of Vitamin D in glycemic control and the beneficial effect of Vit D supplementation in retarding the progression of Impaired Fasting Glycemia to diabetes

mellitus.

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