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Original Article

Relationship between vitamin D and glycemic control in patients with type 2 diabetes mellitus

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Abstract: Herein I investigated the impact of vitamin D on glycemic control in patients with type 2 diabetes mellitus. 128 patients with type 2 diabetes mellitus were enrolled in this study (mean (S.D) age: 57.7±10 years, 26.6% were female). It was collected clinical and laboratory characteristics of patients from hospital records retrospectively. Patients were divided into two groups according to the HBA1c values: good glycemic control (HbA1c≤7%) and poor glycemic control (HbA1c>7%). It was compared 25 hydroxyvitamin (OH) D and other collected laboratory parameters between the two groups. The vitamin D deficiency rate was 98.3%. In the result with ROC curve analyzes and Mann Whitney U test vitamin D was'nt significantly associated with glycemic control (*P* value >0.05). Among other parameters result with ROC curve analyzes and student t test RDW-CV was found to be significantly associated with glycemic control (*P* value <0.05). Although high level of vitamin D deficiency, present study indicated that vitamin D was'nt significantly related to glycemic control in type 2 diyabetes mellitus. Even so RDW-CV was significantly related to glycemic control.

Keywords: HbA1c, vitamin D, diabetes mellitus, glycemic control

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 steroid hormone that might contribute to prevent type 2 diabetes mellitus (DM). Vitamin D is an 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 [3].

In this study I aimed to investigate whether there is any relationship between glycemic control and vitamin D levels in type 2 DM.

Methods and statistics

HbA1c, vitamin D, white blood cells (WBC), hemoglobin, platelet count, neutrophil, lymphocyte, RDW, MPV, total cholesterol, triglyceride, low density lipoprotein (LDL), high density lipoprotein (HDL), alanine transaminase (ALT), creatinine values, and the demographic features of the patients with type 2 diabetes mellitus were documented from the hospital records retrospectively.

The patients were divided into two groups according to the HBA1c values: good glycemic control (HbA1c≤7%) and poor glycemic control (HbA1c>7%). The collected parameters were compared between thesegroups.

All the analyses were performed using the SPSS for Windows (version 21.0; SPSS/IBM, Chicago, IL). Normality was tested using the Kolmogrow-Smirnow Test and analysed using T-tests and the Mann-Whitney U-test. The Descriptive statistics, T test, Mann Whitney-U, and ROC curve regression tests were used when suitable. The statistical significance level was accepted as a *P* value of less than 0.05.

Results

128 patients with diabetes mellitus were enrolled in this study. 73.4% of the patients were male, 26.6% were female respectively.

Table 1. Baseline Characteristics of the patients

Parameters	HbA1c≤7 group	HbA1c>7 group	All patients
Age Mean ± SD	57.5±10.7	57.8±9.7	57.7±10
Gender (Female/Male), n/%	27 (75%)/9 (25%)	67 (72.8%)/25 (27.2%)	94 (73.4%)/34 (25.6%)
HbA1c Mean ± SD	6.3±0.4	10.2±2.1	9.18±2.52
Vitamin D Mean ± SD	9.6±3.9	8.9±3.6	8.9±3.6
Vitamin D deficiency (<20 ng/mL), n/%	36 (100)	90 (97.8)	126 (98.4)

Table 2. Relationship between glycemic control and laboratory parameters. Normality was tested using the Kolmogrow-Smirnow Test and analysed using T-tests and the Mann-Whitney U-test

Parameters	HbA1c≤7 group	HbA1c>7 group	*P* value
Vitamin D (ng/mL)	9.67±3.92	8.97±3.6	0.33
LDL (mg/dL)	128.9±29.5	124.6±36.1	0.55
HDL (mg/dL)	39.2±8.3	40.1±9.8	0.66
Total cholesterol (mg/dL)	201.7±36.8	213±53.3	0.26
Triglyceride (mg/dL)	158.1±76.1	237.7±204.7	0.01
WBC (K/mm^3)	7.48±1.76	8.76±2.32	<0.01
Neutrophil (K/mm^3)	4.2±1.4	4.9±1.9	0.01
Lymphocyte (K/mm^3)	2.41±0.76	2.88±0.79	<0.01
Hemoglobin (gr/dL)	13.2±1.4	13.9±1.5	0.01
Platelets (K/mm^3)	240.2±80.1	265.2±67.6	0.07
MPV (fL)	7.63±1.04	7.56±1.77	0.84
RDW-CV (%)	12.5±1.6	11.9±0.8	0.02
ALT (IU/L)	16.6±8.2	19.9±11.4	0.12
Creatinine (mg/dL)	0.75±0.1	0.79±0.1	0.11

Table 3. Model selection with ROC curve estimation in regression analysis for blood glucose regulation (reference line for HbA1c≤7 and >7)

Parameters	Asymptotic 95% Confidence Interval		*P* value
	Lower Bound	Upper Bound	
Lymphocyte	0.48	0.73	0.09
MPV	0.35	0.59	0.69
Neutrophil	0.45	0.69	0.24
Platelets	0.42	0.68	0.38
RDW-CV	0.25	0.48	0.04
Hemoglobin	0.48	0.71	0.10
Vitamin D	0.35	0.61	0.80
WBC	0.49	0.73	0.07
HDL	0.42	0.66	0.45
ALT	0.47	0.70	0.16
Total cholesterol	0.37	0.61	0.90
Triglyceride	0.42	0.68	0.35
Creatinine	0.48	0.72	0.08
LDL	0.32	0.57	0.42

The mean age of the patients were 57.7±10. The mean HbA1c values of the patients were 9.18±2.52. The mean vitamin D values of the patients were 9.17±3.7. The vitamin D deficiency was in 98.3% of the patients. The baseline characteristics of the patients are shown in **Table 1**.

The collected parameters were compared between good glycemic control patients (HbA1c≤7%) and poor glycemic control patients (HbA1c>7%).

Vitamin D was'nt associated with the glycemic control (*P* value > 0.05).

The results from the Student's t test and Mann Whitney-U analyzes neutrophil, RDW, trygliceride, lymphocyte, WBC, hemoglobin parameters were significantly different between the groups (*P* value <0.05). The relationship between HbA1c and the factors which were assumed to be related to the glycemic control are presented in **Table 2**.

In the results from the ROC curve analyzes only, RDW-CV was found to be significantly associated with the glycemic control (*P* value <0.05). The low RDV-CV values were associated with poor glycemic control. The model selection with the ROC curve estimation in regression analysis for the blood glucose regulation are shown in **Table 3** and **Figure 1**.

Discussion

Recently deficiency of vitamin D has been found to be a risk factor for type 2 diabetes mellitus [4-7].

In a study conducted on patients with diabetes mellitus, Bayani MA at al. demonstrated that

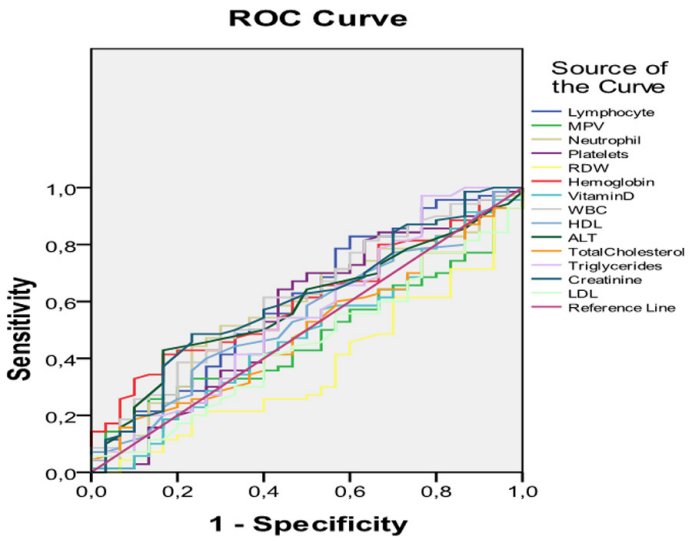

Figure 1. Diagonal segments are produced by ties.

the mean vitamin D values were significantly lower in the patients with diabetes mellitus than the healthy control, and that 89.2% of diabetic patients had insufficient vitamin D values [8].

In this present study, it was found that 98.4% of the diabetic patients had insufficient vitamin D values.

In a study conducted on patients with diabetes mellitus, Al-Timimi DJ at al. showed that vitamin D deficiency was significantly associated with glycemic control [9].

In this present study, contrary to Al-Timimi DJ at al., there wasno association between vitamin D and glycemic control.

Even though diabetic patients have lower vitamin D values than healthycontrol in the literature, there is currently inadequate evidence of the useful effect in recommending vitamin D supplementation as a means of improving glycemia or insulin resistance [10].

In this present study, RDW-CV values were significantly associated with HbA1c levels.

The red cell distrubition width (RDW) is part of a standard complete blood count (CBC) that measures the variation in either red blood cell size or volume. RDW is used along with the mean corpuscular volume to determine the causes of anemia [11]. Elevated RDW helps clinicians in the diagnosis of early nutritional deficiency such as iron, vitamin B 12 or folat as it becomes elevated earlier than other RBC parameters [12].

Hyperglycemia has multiple effects on the red blood cells, comprising of decreased deformability, a decreased life span, and glycation of hemoglobin [13].

RDW has been investigated for many diseases, but there are few studies that have been conducted on RDW and glycemic control.

In a study conducted on glycemic control patients with diabetes mellitus, Lippi G at al. showed that high RDW values were significantly associated with high HbA1c levels [14].

Conclusion

Based on the results obtained from this present study, the following conclusions can be drawn:

► Vitamin D was'nt associated with glycemic control.

► RDW-CV was significantly associated with glycemic control.

► Finally, a major limit of our study was the retrospective study that was considered. Single blood sampling was the other limitation. For these reasons, further investigations may be more beneficial to highlight the relationship between glycemic control and vitamin D.

Disclosure of conflict of interest

None.

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