

## Type 2 Diabetes and Vitamin D Status

Rachidi Meriem<sup>1, \*</sup>, Tali Abdelali<sup>1</sup>, Zahire Hanane<sup>1</sup>, El Ansari Nawal<sup>2</sup>, Chabaa Laila<sup>1</sup>

<sup>1</sup>Laboratory of Biochemistry, Arrazi Hospital, Mohammed VI Hospital Center of Marrakech, Marrakech, Morocco

<sup>2</sup>Department of Endocrinology, Arrazi Hospital, Mohammed VI Hospital Center of Marrakech, Marrakech, Morocco

### Email address:

toubibrachidi@gmail.com (R. Meriem)

\*Corresponding author

### To cite this article:

Rachidi Meriem, Tali Abdelali, Zahire Hanane, El Ansari Nawal, Chabaa Laila. Type 2 Diabetes and Vitamin D Status. *American Journal of Laboratory Medicine*. Vol. 4, No. 4, 2019, pp. 70-73. doi: 10.11648/j.ajlm.20190404.11

**Received:** January 31, 2019; **Accepted:** July 3, 2019; **Published:** July 19, 2019

**Abstract:** Vitamin D (Vitamine D), classically recognized as an important player in bone and phosphocalcic metabolism, has shown, through recent studies, its involvement in the pathogenesis of insulin resistance in case of deficiency. The aim of this work is to describe the profile of vitamin D in a type 2 diabetic population and to correlate the vitamin D status with the different metabolic parameters in this population admitted in the University Hospital of Marrakech. It is a descriptive cross-sectional study of a population of type 2 diabetic patients, coming for a follow-up assessment of diabetes and having performed an evaluation of the level of 25 hydroxy vitamin D3 in blood. Demographic, clinical, evolutionary and biological data were collected. The mean of 25 (OH) vitamin D3 was  $12.55 \pm 8.14$  ng / ml for the group, and was  $13.15 \pm 8.93$  ng / ml for women and  $11.82 \pm 7.31$  ng / ml for men. These patients were classified into three groups: Group 1: 25 (OH) D < 10 ng / ml objectified in 37 patients (44%); group 2: 25 (OH) D between 10 and < 29 ng / ml in 43 patients (51.2%) and group 3: 25 (OH) D > 30 ng / ml present in 4 patients in this population (4, 8%). Several studies have reported an association between vitamin D status and the development of type 2 diabetes. Experimental studies have suggested that vitamin D deficiency decreases insulin sensitivity, carbohydrate tolerance and  $\beta$ -pancreatic function. The data of this work underline the high frequency of vitamin D deficiency in the Moroccan population suffering from type 2 diabetes.

**Keywords:** Vitamin D, Type 2 Diabetes, Insulin Resistance

## 1. Introduction

Vitamin D (Vitamin D) has long been considered an essential hormone for regulating phosphocalcic metabolism and bone mineralization. The progression of the fundamental and clinical knowledge made it possible to conclude to its implication in the pathogenesis of insulin-resistance in the event of deficiency [1]. This insulin resistance is a major risk factor for diabetes contributing to its pathogenesis and decreased glucose tolerance [2-4].

The concomitant association of vitamin D deficiency with insulin resistance and their important metabolic consequences has led to the hypothesis of a possible role of vitamin D in the pathogenesis of type 2 diabetes [1].

The purpose of this work is to describe the blood levels of vitamin D in a population of type 2 diabetes patients referred to the Marrakech University Hospital Center for assessment and to establish a correlation between the status of vitamin D

and the various metabolic parameters, as well as degenerative complications in this population.

## 2. Patients and Methods

This is a descriptive cross-sectional study of a population of patients with type 2 diabetes who performed outpatient assessments at the laboratory's collection room. This work was done at Mohamed VI University Hospital in Marrakech.

We included all the patients coming for a follow-up report of the diabetes and having benefited from a dosage of vitamin D. The demographic, clinical, evolutionary and biological data were collected.

The clinical parameters studied were: age; sex; age of diabetes, body mass index, blood pressure (measured with a standard mercury manometer), degenerative complications.

Information on smoking and the use of medications (including oral antidiabetic drugs, insulin, antihypertensives,

lipid-lowering drugs) was obtained from all participants by questionnaire. The biological assessment was performed on venous blood sample, the morning after 12 hours of fasting, the measurement of serum hydroxy-vitamin D (D2 + D3) [25 (OH) vitamin D3] was performed by electro-chemiluminescence (Elecys Vitamin D total test, Roche, Cobas 6000). 25 (OH) deficiency Vitamin D3 was defined by a serum 25 (OH) vitamin D3 level < 10 ng / ml, and the deficiency of 25 (OH) vitamin D3 by a serum level of 25 (OH) vitamin D3 between 10 and 29 ng / ml. The glycated hemoglobin (HbA1c) was measured by electrophoretic method on capillary automaton (SEBIA 2), normal value [VN] from 4.0 to 5.9%.

The rest of the biochemical parameters were determined by spectrophotometric method (Cobas 6000-Roche).

In addition, the search for diabetes-related complications has been realized and we have selected: nephropathy in the presence of micro-or macroalbuminuria; retinopathy in the presence of fundus abnormalities, possibly supplemented by retinal angiography; peripheral neuropathy in the presence of neuropathic pain according to the DN4 questionnaire (see appendix) or in case of neurological test abnormalities.

He was considered to be a hypertensive patient with AS > 140 mmHg, or diastolic BP > 90 mmHg, or on antihypertensive therapy, and all patients received an electrocardiogram, supplemented if necessary by appropriate cardiac investigations.

Statistical analysis and data entry were performed by Microsoft Office Excel 2007.

### 3. Results

Eighty-four patients participated in the study. The average age of the patients was 56 +/- 11, with a female predominance (sex ratio: H/F: 0.68). The average body mass index of this population was 27.83 ± 2.43 kg / m<sup>2</sup> and 20.23% of patients were smokers. The mean duration of diabetes was 8.9 ± 7.8 years and the mean HbA1c was 9.08 ± 2.28%. The average value of 25 (OH) vitamin D3 was 12.55

± 8, 14 ng / ml with an average rate of 13.15 ± 8.93ng / ml for women and 11.82 ± 7.31 ng / ml for men. (Table 1)

**Table 1.** Mean values of some characteristics of the studied population.

Characteristics of the population	Results
<b>abetes (Demographics)</b>	
- Age (years)	56 ans +/- 11
- Sex (men / women)	34/50
- Duration of diabetes (years)	8,9 ± 7,8 ans
- Smoking (%)	20,23%
- BMI (kg / m <sup>2</sup> )	27,83 ± 2,43 kg/ m <sup>2</sup>
<b>Biology</b>	
- 25 (OH) D (ng/ml)	12,55 ± 8,14 ng/ml
- HbA1c (%)	9,08 ± 2,28 %
*% Patients with HbA1c ≤ 7 (Well Balanced): 16.67%	
*% Patients with HbA1c > 7 patients (poorly balanced): 83.33%	
- CT (g/l)	1,72 ± 0,79
- TG (g/l)	1,77 ± 1,08
- HDL-C (g/l)	0,39 ± 0,08
- LDL-C (g/l)	0,94 ± 0,67
<b>Complications</b>	
- Diabetic retinopathy	46,4 %
- Diabetic neuropathy	11,9 %
- Diabetic nephropathy	33,3 %
- Ischemic coronary artery disease	21,4%
- AOM	14,2%
<b>Treatments</b>	
- ADO	51,2%
- Insulin	48,8%

BMI: body mass index; (OH) D: 25-hydroxy vitamin D3; HbA1c: A1C glycated hemoglobin; CT: total cholesterol; TG: triglycerides; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol; ADO: oral antidiabetic agents.

These patients were classified into three groups: Group 1: 25 (OH) vitamin D3 < 10 ng / ml objectified in 37 patients (44%); group 2: 25 (OH) vitamin D3 between 10 and < 29 ng / ml in 43 patients (51.2%) and group 3: 25 (OH) vitamin D3 > 30 ng / ml present in 4 patients in this population (4.8%). (Table 2)

**Table 2.** Stratification of the study population according to the circulating levels of 25 (OH) vitamin D3 and description of their clinical and biological parameters.

Characteristics of the population	25 (OH) vitamine D3 < 10 ng/ml (44%) (N) = 37	25 (OH) vitamine D310 and < 29 ng/ml (51, 2 %) (N) = 43	25 (OH) vitamine D3 > 30 ng/ml (4, 8 %) (N) = 4
<b>Demographics</b>			
- Age (years)	60± 2 ans	60± 1 ans	39± 1 ans
- Sex (men / women)	13/24	12/28	0/3
- Duration of diabetes (years)	9,78 ans	8,23 ans	10ans
- Smoking (%)	8 %	18 %	100 %
- BMI (kg / m <sup>2</sup> )	28,13 kg/m <sup>2</sup>	27,43 kg/ m <sup>2</sup>	21kg/m <sup>2</sup>
<b>Biology</b>			
- 25 (OH) D (ng/ml)	5,38 ± 3,06 ng/ml	16,94 ± 4,78 ng/ml	31,72 ± 1,8 ng/ml
- HbA1c (%)	16,14 %	8,9 %	10,26 %
- CT (g/l)	1,63	1,8	2
- TG (g/l)	1,63	1,87	2,5
- HDL-C (g/l)	0,40	0,38	0,36
- LDL-C (g/l)	0,83	1,85	1,14
<b>Complications</b>			
- Diabetic retinopathy	45,9 %	39,5 %	66,7 %
- Diabetic neuropathy	24,32%	11,6 %	0 %
- Diabetic nephropathy	32,4 %	30,2 %	0 %

Characteristics of the population	25 (OH) vitamine D3 < 10 ng/ml (44%) (N) = 37	25 (OH) vitamine D310 and < 29 ng/ml (51, 2 %) (N) = 43	25 (OH) vitamine D3 > 30 ng/ml (4, 8 %) (N) = 4
- Ischemic coronary artery disease	29,72%	14 %	33,3 %
- AOM treatments	21,6%	11,6 %	0 %
- ADO	49 %	56 %	33 %
- Insulin	51 %	44 %	67%

## 4. Discussion

Vitamin D deficiency is widespread worldwide including in countries with significant sunlight. This is a public health problem emerging [2].

Experimental work suggests that vitamin D is involved in many cardiovascular processes: cell proliferation, differentiation, apoptosis, oxidative stress, membrane transport, homeostasis and cell adhesion. For this reason it plays a significant role in the pathogenesis of cardiometabolic diseases (metabolic syndrome, obesity, diabetes, hypertension) [5].

Convincing studies suggest the role of vitamin D deficiency in the pathogenesis of insulin resistance and then type 2 diabetes mellitus. The mechanism of this link is incompletely understood. In fact, vitamin D deficiency is usually detected in obesity in which insulin resistance is also present. The coexistence of insulin resistance and vitamin D deficiency has generated several hypotheses [6, 7].

Several studies have reported an association between vitamin D status and the development of type 2 diabetes. Vitamin D deficiency decreases insulin sensitivity, glucose tolerance and beta-pancreatic function [2].

The relationship between vitamin D status and the different clinical and metabolic parameters of type 2 diabetic patients is less well studied; similarly, the relationship between the status of Vitamin D and the degenerative complications of T2D is less well known.

In our series, the mean value of 25 (OH) vitamin D3 was  $12.55 \pm 8.14$  ng / ml; 95.2% of our patients had a deficiency or deficiency of Vitamin D. Our results are consistent with the 25 (OH) D levels found in other studies. A study carried out at the Moulay Ismail Hospital in Meknes (Morocco) in 2015 showed that the average concentration of 25 (OH) D in diabetic patients was  $10.95 \pm 6.99$  ng / ml, with a prevalence of Vitamin D deficiency of 98.1% [2]. Nobécourt et al, [8] had in a French population composed of 638 diabetic patients, vitamin D deficiency (< 30 ng / ml) in 93% of cases, and severe (< 10 ng / ml) in 20% of cases. The same results were reported respectively by Lee et al. [9] and the Korean Yu JR et al [10].

In contrast, two US studies reported higher average values of 25 (OH) D in diabetic patients, 22.9 ng / mL 22.3 ng / mL each [11, 12]. These data show that the levels of 25 (OH) vitamin D in DT2 patients vary from country to country and from one ethnic group to another, depending on the context.

Regarding the correlation between vitamin D status and glycemic control, the different treatments for diabetes and

these degenerative complications, Suzuki et al. [2, 13], in a Japanese study of T2D patients with a mean duration of diabetes of 12 years, found a negative correlation between the levels of Vitamin D and HbA1c, proliferative diabetic retinopathy, and the type of treatment (insulin) as well as the number of microvascular complications.

Serum 25(OH) D was determined in 337 Kurd patients with DM type2 and in 146 patients without DM type2 [14]. This study indicated that low vitamin D status was present in two thirds of patients with type 2 diabetes, particularly among patients with poor glycaemic control and in those with longer diabetes durations. Vitamin D supplementation may be an effective public health intervention means, to improve the vitamin D status of the population.

In addition, a study by Yilmaz et al. [15], in 171 T2D patients, found a negative correlation between vitamin D levels (< 20 ng / ml), and duration of diabetes ( $p = 0.011$ ), fasting glucose ( $p = 0.037$ ), and HbA1c ( $p = 0.026$ ). In contrast, in this study, vitamin D is not associated with sex, age, BMI, HDL-C and LDL-C, hypertension, and smoking.

The majority of our patients had a vitamin D deficiency or deficiency, only four patients had normal vitamin D levels. It would be preferable to include a group of T2 D patients with optimal vitamin D levels in order to be able to compare these groups. and conclude on the relation between the vitamin D status and the metabolic parameters of the type 2 diabetic subject.

## 5. Conclusion

Beyond a well-demonstrated role in osteo-muscular metabolism, Vitamin D appears to be an important health parameter. Numerous epidemiological data corroborated by a theoretical rationale suggest that a vitamin D deficiency may be a risk factor for type 2 diabetes, other cardiovascular risk factors and their micro and macrovascular complications.

Further studies with similar study designs are needed to confirm these findings in the absence of systematic recommendations for supplementation in diabetics. Thus awareness and prevention measures especially in the at-risk population should be conducted.

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