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Association of serum vitamin D levels with coronary artery angiographic findings; A cross-sectional study

Naser Aslanabadi¹, Nader Jangioskouei², Negar Jafari², Azin Pakmehr³, Amirreza Khalaji³, Azam Esmailnejad², Mohammadreza Moslemi^{4*}, Shahin Khabbazi⁵

¹Cardiovascular Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

²Department of Cardiovascular Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

³Department of Internal Medicine, School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

⁴Kidney Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

⁵Urmia University of Medical Sciences, Urmia, Iran

Correspondence to:

Mohammadreza Moslemi, Email:
moslemi_mohammadreza@
yahoo.com

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Abstract

Introduction: Coronary artery diseases (CADs) are a global health issue. In addition, several researchers have reported a correlation between serum vitamin D levels and different aspects of cardiovascular diseases. It has been reported that vitamin D can modulate atherothrombosis.

Objectives: This study aimed to investigate the correlation between 25-hydroxyvitamin D and CAD severity. **Patients and Methods:** This is a cross-sectional study. The study sample consisted of patients undergoing elective coronary angiography. To assess 25-hydroxyvitamin D levels, fasting samples were collected from patients. Patients were included in this study based on the number of involved coronary vessels and SYNTAX classification.

Results: The serum levels of 25-hydroxyvitamin D were significantly lower in the group of patients with CAD and cardiovascular disease than in the control group ($P < 0.001$). This study showed, severe vitamin D deficiency caused significantly higher SYNTAX scores ($P < 0.001$).

Conclusion: The results of our study showed, vitamin D deficiency might have an essential relationship with the severity and incidence of CAD; however, we recommend further studies to investigate the preventing effects of vitamin D supplementation, primarily through intervention studies.

Introduction

Coronary artery disease (CAD) is a global health issue accounting for the leading cause of death and mortality worldwide (1,2). Several studies have investigated risk factors associated with CAD, such as dyslipidemia, hypertension, diabetes and smoking (3-5). In addition, several other studies have reported the relationship between serum levels of vitamin D and different aspects of cardiovascular diseases (4,6,7).

Vitamin D is of great importance in human health and about one billion individuals have been reported to have vitamin D deficiency (8). Despite its traditional effects on the musculoskeletal system, its deficiency causes the severe increase of inflammatory markers, dysregulation of the renin-angiotensin-aldosterone system (RAAS) and disturbances in electrolyte homeostasis precipitating endothelial impairment in CAD (5,8,9). However, there remains insufficient evidence in favor of or against this concept.

Accordingly, we hypothesized that vitamin D serum levels affect the extent of

Key point

In a cross-sectional study, we found serum levels of 25-hydroxyvitamin D3 were significantly lower in the group of patients with coronary artery diseases and cardiovascular disease than in the control group.

CAD. Using a standard scoring system (the SYNTAX score) seemed necessary to test our idea (6).

Objectives

In Iran, hypovitaminosis D is a common disorder, and at the same time, CAD is also very common and associated with high mortality and morbidity. This study aimed to investigate the relationship between the serum level of vitamin D and the severity of CAD in a cross-sectional survey of 120 Iranian patients who underwent coronary angiography.

Patients and Methods

Study design

The authors designed this cross-sectional study, including 120 subjects who underwent

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coronary artery angiography following acute coronary syndrome or positive exercise test between July 2017 and June 2018 at Taleghani hospital affiliated with Urmia university of medical sciences. According to the guidelines, the diagnosis and need for angiography were made (10).

A total of 120 patients with a body mass index (BMI) of 25 to 29.9 kg/m² were enrolled in this study and they ranged in age from 30 to 60 years old. The exclusion criteria were recent vitamin D replacement therapy, glucocorticoid administration and any underlying disorders involving renal (creatinine >2 mg/dL) and hepatic failure. Furthermore, patients were categorized into the case group with angiographic stenosis and the control group without angiographic findings. Age, gender, BMI and the presence of hypertension, diabetes and also cigarette smoking were recorded. Both groups were identical in number, age, BMI and the distribution of hypertension, diabetes and cigarette smoking. Each subject's blood sample was taken to assess serum 25-hydroxyvitamin D concentration using an enzyme-linked immunosorbent assay [25-OH-D ELISA (enzyme-linked immunosorbent assay); EIA Kit, IDA, UK]. Additionally, participants were categorized as normal (>30 ng/mL), mild deficiency (20-30 ng/mL), moderate deficiency (10-20 ng/mL) and severe deficiency (<10 ng/mL). Among patients with confirmed CAD on the angiogram (>50% stenosis in at least one main coronary artery), a SYNTAX score was applied to determine the severity of the disease (the SYNTAX score algorithm is available on the official website) (11). Eventually, patients were categorized into three groups according to the SYNTAX score (<22, 23-32, >33).

Data analysis

Data were analyzed using SPSS version 20 (SPSS Inc., Chicago, Ill., USA). The independent *t* test and chi-square were utilized to analyze quantitative and qualitative variables, respectively. Monte-Carlo and logistic regression tests were also applied to detect the correlation between vitamin D deficiency and the severity of CAD.

Results

The demographic characteristics of the patients are shown in Table 1. No significant differences were observed between the case and control groups regarding demographic characteristics ($P > 0.05$), except for vitamin

D serum levels.

The mean serum vitamin D level was 10.73 ± 10.15 ng/mL in the case group and 16.72 ± 10.93 ng/mL in the control group. Among the participants with CAD, 20 had single-vessel involvement, 16 had 2-vessel involvement, and 24 had 3-vessel involvement, which was significantly associated with the serum level of vitamin D ($P < 0.001$; Table 2)

In the case group, we found that 17 patients had low SYNTAX scores, 17 patients had intermediate and 26 patients had high SYNTAX scores, which were significantly related to serum vitamin D levels ($P < 0.001$; Table 2).

Discussion

This study found that the serum 25-hydroxyvitamin D₃ level was significantly lower in the case group than in the control group. This association was also evaluated by Moradi and Foroutanfar, demonstrating a lower serum vitamin D level in patients with CAD (7). These results were similar to the results of Rokni et al, who conducted a study on 566 subjects and found that serum vitamin D was higher in patients with a positive angiogram (11).

In the present study, we employed the SYNTAX score as an indicator to assess the extent of CAD. Another critical finding was the positive correlation between vitamin D deficiency and the severity of CAD. Patients with the lowest vitamin D level were more susceptible to having a high SYNTAX score than those at an average level. The published article by Chen et al was probably the first study to use the SYNTAX score, which reported the same results, especially in patients with significant CAD (8). Baktır et al, studied serum vitamin D levels in patients with ST-segment elevation myocardial infarction (STEMI)/ non-ST segment elevation MI (non-STEMI) by SYNTAX score which revealed the same results (12). Seker et al, studied the relationship between vitamin D deficiency and other aspects of CAD, including the SYNTAX score and replicated a positive correlation (13).

Although many studies support the association between serum vitamin D levels and CAD, some studies disagree with this concept. Jarrah et al, evaluated different risk factors of CAD and found no relationship between vitamin D levels and the incidence of coronary artery stenosis (14). Safi et al demonstrated a weak and insignificant correlation between the serum vitamin D level and the

Table 1. Demographic characteristics of the study population

	Control	Patients	P value
Age (y)	50.6±6.2	51.6±7.59	0.355
Gender	F: 31 (51.7), M: 29 (48.3)	F: 33 (55), M: 27 (45)	0.714
Diabetes mellitus	15 (25)	15 (25)	1
Hypertension	23 (38.3)	23 (38.3)	1
Cigarette smoking (pack-year)	10 (16.7)	10 (16.7)	1
Vitamin D level (ng/mL)	16.72±10.93	10.73 ± 10.15	0.001

Table 2. Different serum vitamin D levels in the case and control groups

	Normal	Mild deficiency	Moderate deficiency	Severe deficiency	P value
Control	16 (26.7)	15 (25)	20 (33.3)	9 (15)	
SVD	4	8	6	2	
2VD	1	1	10	4	<0.001
3VD	1	0	10	13	
Low SYNTAX	5	8	3	1	
Intermediate SYNTAX	1	1	12	3	<0.001
High SYNTAX	0	0	11	15	

SVD, Single-vessel disease; 2VD, Two-vessel disease; 3VD, Three-vessel disease.

severity of CAD due to other risk factors associated with coronary artery stenosis in patients with CAD—but not in subjects without CAD (6).

Conclusion

To conclude, vitamin D deficiency may play an essential role in the severity and incidence of CAD. Further studies are required to investigate the preventing effects of vitamin D supplementation, primarily through intervention studies.

Limitations of the study

This study was an observational study with no intervention group, which disappointed us in answering whether vitamin D restoration affects the progression of CAD. Limited sunlight exposure due to a specific type of clothing in Iran and a low study population are the limitations of our study.

Authors' contribution

Conceptualization: MM, NA.

Methodology: NA, MM.

Validation: MM.

Formal analysis: MM.

Investigation: AP, NJaf, NJan, MM.

Resources: AP, NJaf, NJan, MM.

Data curation: MM.

Writing—original draft preparation: NA, AK, AE, MM, SK.

Writing—review and editing: All authors.

Visualization: NA, MM.

Supervision: MM, NA.

Project Administration: MM.

Conflicts of interest

The authors declare that they have no competing interests.

Ethical approval

The design of the study was explained to all patients and informed consent was obtained from all participants. The Ethics Committee of Urmia University of Medical Sciences approved the study (code: IR.umsu.rec.1395.199). The study was approved as a thesis for the MD degree (Shahin Khabazzi) at the Research Committee of Urmia University of Medical Sciences (registration number: 950167227), as well as by the Cardiology Department of this university. Besides, ethical issues (including plagiarism, data fabrication and double publication) were completely observed by the authors.

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