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Correlation of Serum 25-Hydroxy-Vitamin D Levels with Angiographic Severity of Coronary Artery Disease: A Case-Control Study Using Gensini Score

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Abstract: ***Background**: Vitamin D deficiency has been increasingly recognized as a potential cardiovascular risk factor. Its association with angiographic severity of coronary artery disease (CAD) remains under investigation. **Objective**: To evaluate the correlation between serum 25-hydroxy-vitamin D [25(OH)D] levels and angiographic severity of CAD assessed using the Gensini score. **Methods**: This hospital-based case-control, cross-sectional study was conducted at NRI Institute of Medical Sciences between June 2021 and November 2022. A total of 300 patients aged 30–70 years undergoing coronary angiography were enrolled. Patients with abnormal angiograms (n=150) were categorized as cases, and those with normal angiograms (n=150) served as controls. Serum 25(OH)D levels were measured and CAD severity was quantified using the Gensini scoring system. Statistical analysis included chi-square test, independent t-test, ANOVA, and Pearson correlation. **Results**: Mean serum vitamin D levels were significantly lower in cases compared to controls (23.4 ± 7.4 ng/mL vs 28.6 ± 6.3 ng/mL, p<0.001). Vitamin D levels progressively decreased with increasing vessel involvement (p<0.001). Mean Gensini score was significantly higher in cases (35.78 ± 49.66) compared to controls (1.06 ± 0.52, p<0.001). A strong negative correlation was observed between serum vitamin D levels and Gensini score (r = −0.622, p<0.001). **Conclusion**: Vitamin D deficiency is significantly associated with both the presence and angiographic severity of CAD. Lower 25(OH)D levels correlate with higher Gensini scores and multivessel disease, suggesting a potential role of vitamin D in CAD pathophysiology.*

Keywords: Vitamin D, 25(OH)D, Coronary artery disease, Gensini score, Angiographic severity.

1. Introduction

Coronary artery disease (CAD) remains the leading cause of mortality worldwide. Despite advances in pharmacologic and interventional therapies, cardiovascular disease continues to pose a significant public health burden, particularly in developing countries such as India.

Vitamin D, traditionally known for its role in calcium homeostasis and bone metabolism, has recently gained attention for its extra-skeletal effects. Vitamin D receptors are expressed in cardiomyocytes, vascular smooth muscle cells, and endothelial cells, suggesting potential cardiovascular involvement.

Several mechanisms have been proposed linking vitamin D deficiency with CAD, including:
- Activation of the renin–angiotensin–aldosterone system
- Endothelial dysfunction
- Increased inflammation
- Insulin resistance
- Dyslipidemia

However, data correlating serum vitamin D levels with angiographic severity of CAD using validated scoring systems such as the Gensini score remain limited. This study was undertaken to evaluate the relationship between serum 25(OH)D levels and the severity of CAD assessed by Gensini score.

2. Materials and Methods

Study Design and Setting
This was a hospital-based case-control, cross-sectional study conducted at NRI Institute of Medical Sciences over 18 months (June 2021–November 2022).

Study Population
A total of 300 patients aged 30–70 years undergoing coronary angiography were included.
- Cases (n=150): Patients with angiographically proven CAD
- Controls (n=150): Patients with normal coronary angiograms

Inclusion Criteria
- Age 30–70 years
- Diagnosed with STEMI, NSTEMI, unstable angina, or chronic stable angina
- Provided informed consent

Exclusion Criteria
- Vitamin D supplementation
- Chronic liver or kidney disease
- Heart failure
- Osteoporosis
- Pregnancy

Measurement of Variables
Serum 25(OH)D levels were measured at admission.

Vitamin D status was categorized as:
- <20 ng/mL: Deficient
- 20–30 ng/mL: Insufficient
- 30 ng/mL: Sufficient

Assessment of CAD Severity
CAD severity was assessed using the Gensini score, which considers:
- Degree of luminal narrowing
- Anatomical location of lesions
- Weighting factors based on myocardial territory supplied

Statistical Analysis

Data were analyzed using SPSS software.

- Continuous variables: Mean ± SD
- Categorical variables: Percentage
- Independent t-test for two-group comparisons
- ANOVA for multiple-group comparisons
- Pearson correlation for relationship between Vitamin D and Gensini score
- $p<0.05$ considered statistically significant

3. Results

Baseline Characteristics

- Mean age was significantly higher in cases (56.0 ± 7.0 years) vs controls (54.1 ± 8.6 years) ($p=0.036$).
- Male gender predominated among cases (70%).
- Diabetes, hypertension, smoking, alcoholism, elevated LDL, and higher BMI were significantly more common in cases ($p<0.05$).

Angiographic Findings

Among cases:

- Single vessel disease: 69%
- Double vessel disease: 22%
- Triple vessel disease: 9%

Vitamin D Levels

Mean vitamin D:

- Cases: 23.4 ± 7.4 ng/mL
- Controls: 28.6 ± 6.3 ng/mL

($p<0.001$)

Vitamin D levels significantly decreased with increasing number of diseased vessels:

- Single vessel: 27.1 ng/mL
- Double vessel: 15.5 ng/mL
- Triple vessel: 13.0 ng/mL

($p<0.001$)

Gensini Score

Mean Gensini score:

- Cases: 35.78 ± 49.66
- Controls: 1.06 ± 0.52

($p<0.001$)

Correlation Analysis

A strong negative correlation was observed between vitamin D levels and Gensini score:

$r = -0.622$

$p < 0.001$

Lower vitamin D levels were associated with greater angiographic severity.

4. Discussion

This study demonstrated a significant inverse association between serum vitamin D levels and angiographic severity of CAD.

The findings suggest that vitamin D deficiency is not merely associated with CAD presence but also correlates with disease burden.

Possible mechanisms include:

1) Endothelial dysfunction
2) Increased vascular inflammation
3) Activation of RAAS
4) Increased vascular calcification
5) Insulin resistance and metabolic syndrome

Our results align with previous studies demonstrating lower vitamin D levels in multivessel CAD patients.

The strong negative correlation ($r = -0.622$) suggests a clinically meaningful relationship.

Interestingly, vitamin D levels did not differ significantly among clinical subtypes (STEMI, NSTEMI, CSA, UA), suggesting that vitamin D relates more to anatomical severity rather than clinical presentation.

5. Clinical Implications

- Vitamin D deficiency may serve as a marker of severe CAD.
- Screening for vitamin D deficiency may help in cardiovascular risk stratification.
- Vitamin D supplementation as preventive strategy requires further randomized trials.

6. Limitations

- Single-center study
- Cross-sectional design
- No follow-up outcomes
- Limited age range
- Cannot establish causality

7. Conclusion

Low serum 25(OH)D levels are significantly associated with both the presence and severity of CAD.

Vitamin D levels show a strong negative correlation with Gensini score and are markedly reduced in multivessel disease.

These findings suggest that vitamin D deficiency may play an important role in CAD pathophysiology and could serve as a potential biomarker of disease severity.