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ORIGINAL RESEARCH ARTICLE

Impact of Vitamin D Deficiency on Angiographic Severity in Patients with Acute Coronary Syndrome

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ABSTRACT

Introduction: Acute coronary syndrome (ACS) is a leading cause of morbidity and mortality, with modifiable risk factors like hypertension, diabetes, and smoking being well-established contributors. Recent evidence suggests vitamin D deficiency may also play a significant role in the pathogenesis of coronary artery disease (CAD). This study aims to assess the impact of vitamin D deficiency on angiographic severity in ACS patients.

Material and Methods: This prospective cross-sectional study was conducted at Shri Ram Murti Smarak Institute of Medical Sciences (SRMSIMS), Bareilly, over 18 months (August 2022 to January 2024). A total of 101 patients diagnosed with ACS, including unstable angina, STEMI, and NSTEMI, were included. Serum vitamin D levels were measured, and coronary angiography was performed to assess the severity of CAD. Statistical analysis was conducted using SPSS, with *p-values* <0.05 considered significant.

Results: The study found a significant association between low serum vitamin D levels (<20 ng/mL) and more severe coronary involvement. Of the 101 patients, 43.56% had vitamin D levels <20 ng/mL. Significant associations were observed between low vitamin D levels and abnormal angiographic findings in the left main artery (p <0.001), LAD, LC, and RCA. Additionally, low vitamin D levels were linked to triple-vessel disease (60.30%) in ACS patients (p <0.0001).

Conclusion: Vitamin D deficiency is strongly associated with more severe coronary artery disease and acute coronary syndrome, suggesting its potential role in risk stratification and management. Further studies are needed to explore the therapeutic benefits of correcting vitamin D deficiency in CAD patients.

Keywords: Acute coronary syndrome, vitamin D deficiency, angiographic severity, coronary artery disease, risk factors, triple-vessel disease, serum 25-hydroxyvitamin D.

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INTRODUCTION

Acute coronary syndrome (ACS) remains a leading cause of morbidity and mortality worldwide, underscoring the need to identify modifiable risk factors and potential therapeutic targets. While traditional risk factors such as hypertension, dyslipidemia, diabetes mellitus, and smoking play a pivotal role in the pathogenesis of coronary artery disease (CAD), emerging evidence suggests that micronutrient deficiencies, particularly vitamin D deficiency, may also contribute significantly to cardiovascular health.[1,2]

Vitamin D, traditionally recognized for its role in calcium homeostasis and bone health, has garnered attention for its extra-skeletal effects, including anti-inflammatory, anti-thrombotic, and endothelial protective properties.[3] Low serum levels of vitamin D have been linked to a heightened risk of cardiovascular diseases, including hypertension, myocardial infarction, and heart failure. Moreover, vitamin D deficiency has been associated with adverse outcomes in patients with established CAD.[4]

Angiographic severity of coronary artery disease, as assessed by tools like the Gensini or SYNTAX scores, provides a quantitative measure of the extent and complexity of atherosclerosis.[5] The relationship between vitamin D levels and angiographic severity in ACS patients remains a topic of growing interest, with potential implications for risk stratification and management.[6]

This study aims to explore the impact of vitamin D deficiency on the angiographic severity of coronary artery disease in patients presenting with ACS, contributing to the understanding of its role in cardiovascular pathology.

MATERIAL AND METHODS

This prospective cross-sectional study was conducted in the Cardiology Unit of the Department of Medicine at Shri Ram Murti Smarak Institute of Medical Sciences (SRMSIMS), Bareilly, over 18 months, from August 1, 2022, to January 31, 2024. The study aimed to assess the

impact of vitamin D deficiency on angiographic severity in patients with acute coronary syndrome (ACS). Patients aged over 25 years and diagnosed with ACS, including unstable angina, ST-segment elevation myocardial infarction (STEMI), and non-ST-segment elevation myocardial infarction (NSTEMI), were included. Patients with conditions such as pregnancy, malignancy, parathyroid disease, thyroid disorders, end-stage liver or renal disease, known vitamin D or calcium deficiency, or those who refused participation were excluded. A non-probability purposive sampling method was used to select participants, and the required sample size was calculated as 101, accounting for a 10% non-response rate.

Data collection involved a self-designed semi-structured proforma to gather demographic information, medical history, and clinical findings. Diagnostic tools included electrocardiograms (ECG), troponin T levels, echocardiography, coronary angiography, and laboratory assessments such as lipid profiles, liver function tests, complete blood counts, renal function tests, and serum electrolytes. Vitamin D levels were measured using commercial enzyme-linked immunosorbent assay (ELISA) kits, with vitamin D deficiency defined as levels below 20 ng/mL and insufficiency as levels between 20 to 29 ng/mL.

Coronary angiography was performed using Judkin's technique, and significant CAD was defined as >50% stenosis in the left main coronary artery or >70% stenosis in other coronary arteries. The severity of CAD was assessed based on the number of vessels involved (one-vessel, two-vessel, or three-vessel disease) and the percentage of stenosis. Resting ECGs were analyzed for evidence of ischemia or infarction, with serial tracings conducted to monitor progression. Echocardiography focuses on systolic and diastolic diameters and ejection fractions to evaluate cardiac function.

Ethical approval was obtained from the institutional research ethics committee, and all participants provided informed consent. A pilot study involving 10% of the sample size (n = 10) was conducted to validate the study tools and ensure the feasibility of the methodology. Data were analyzed using SPSS version 21.0, with categorical data compared using the Chi-square test, and *p-values* <0.05 were considered statistically significant. This comprehensive methodology ensured robust data collection and reliable insights into the association between vitamin D deficiency and the angiographic severity of ACS.

RESULTS

The study provides key numerical insights into the demographic, clinical, and diagnostic characteristics of 101 patients, as well as associations between serum 25-hydroxyvitamin D levels and cardiovascular conditions.

The majority of patients were aged between 51 and 60 years (32.67%), followed by those aged 61 to 70 years (29.70%). Males constituted 78.22% (79 patients) of the study population. Chest pain was reported by 91.09% (92 patients), with palpitations and breathlessness seen in 44.55% (45 patients) and 31.68% (32 patients), respectively (Table 1). Out of these patients, 38.61% (39 patients) had diabetes mellitus, 36.63% (37 patients) had hypertension, and 13.86% (14 patients) had cardiovascular disease. Smoking was reported in 28.71% (29 patients), and alcohol consumption was noted in 14.85% (15 patients). Regarding drug history, 38.61% (39 patients) were on anti-diabetic medications, and 36.63% (37 patients) were on anti-hypertensive drugs (Table 2).

Table 3 highlights that 85.14% (86 patients) had ST-segment elevation on their ECG, while 14.85% (15 patients) had NSTEMI. On 2D echo, hypokinesia was most commonly found in the LAD (72.28%, 72 patients), followed by the RCA (74.26%, 75 patients) and LCX (69.31%, 70 patients). Table 4 presents the association between coronary angiography findings and serum 25-hydroxyvitamin D levels in the study population. For the left main (LM) coronary artery, 36 patients with low vitamin D levels had abnormal findings, compared to only 8 with normal results, with a highly significant *p-value* of <0.001. Similar patterns were observed in the left anterior descending (LAD), left circumflex (LC), and right coronary artery (RCA) regions, where abnormal angiographic findings were notably higher in patients with vitamin D levels <20 ng/mL (37, 38, and 41 patients, respectively) compared to those with normal angiograms (7, 6, and 3 patients, respectively). In contrast, patients with higher vitamin D levels (20–29 and >29 ng/mL) showed fewer abnormal angiographic findings. The *p-values* for all arteries (LM, LAD, LC, and RCA) were <0.001, indicating

Table 1: Demographic and clinical data

Category	*Details*	*Frequency (n = 101)*	*Percentage (%)*
Age group (years)	41–50	21	20.79
	51–60	33	32.67
	61–70	30	29.70
	>70	17	16.83
Gender	Male	79	78.22
	Female	22	21.78
Clinical history	Chest pain	92	91.09
	Palpitations	45	44.55
	Breathlessness	32	31.68
	Giddiness	3	2.97
	Syncope	24	23.76
	Fatigue	9	8.91

Table 2: Past medical history and risk factors

Category	*Condition/Risk factor*	*Frequency (n = 101)*	*Percentage (%)*
Past medical history	Diabetes mellitus	39	38.61
	Hypertension	37	36.63
	Cardiovascular disease	14	13.86
	Cerebrovascular Disease	7	6.93
	Chronic kidney disease	1	0.99
	Chronic liver disease	1	0.99
Risk factors	Smoking	29	28.71
	Alcohol	15	14.85
Drug history	Anti-diabetic	39	38.61
	Anti-hypertensive	37	36.63
	Other drugs	13	12.87

Table 3: ECG and 2D echo findings

Category	*Details*	*Frequency (n = 101)*	*Percentage (%)*
ECG findings	ST-segment elevation	86	85.14
	NSTEMI	15	14.85
2D echo findings	Hypokinesia of LAD	72	72.28
	Hypokinesia of LCX	70	69.31
	Hypokinesia of RCA	75	74.26

Table 4: Association between coronary angiography and serum 25-hydroxyvitamin D levels

Serum 25-hydroxyvitamin D level	*<20 ng/mL*	*20-29 ng/dL*	*>29 ng/mL*	*p-value*
LM (Normal)	8	6	21	<0.001*
LM (Abnormal)	36	20	10	
LAD (Normal)	7	2	19	<0.001*
LAD (Abnormal)	37	24	12	
LC (Normal)	6	3	22	<0.001*
LC (Abnormal)	38	23	9	
RCA (Normal)	3	4	19	<0.001*
RCA (Abnormal)	41	22	12	
Total	44	26	31	

Table 5: Association between acute coronary syndrome (ACS) and serum 25-hydroxyvitamin D level

Serum 25 vitamin D level	*ACS*		
	Single vessel (%)	*Double vessel (%)*	*Triple vessel (%)*
<20 ng/mL	1 (7.70%)	2 (10%)	41 (60.30%)
20–29 ng/dL	2 (15.38%)	4 (20%)	20 (29.40%)
>29 ng/dL	10 (76.92%)	14 (70%)	7 (10.30%)
p-value	<0.0001		

a strong statistical significance and suggesting that low serum vitamin D levels are strongly associated with more severe coronary artery abnormalities. Overall, 43.56% (44 patients) had serum vitamin D levels <20 ng/mL, 25.74% (26 patients) had levels between 20 to 29 ng/mL, and 30.69% (31 patients) had levels >29 ng/mL. Table 5 illustrates that 60.30% (41 patients) with serum vitamin D levels <20 ng/mL had triple-vessel disease, while 76.92% (10 patients) with serum vitamin D levels >29 ng/mL had single-vessel disease. The association was statistically significant with a *p-value* of <0.0001, reinforcing the link between low vitamin D levels and more severe coronary involvement in ACS.

These findings underscore the role of low vitamin D levels in the severity of coronary artery disease and acute coronary syndrome, with clinical implications for risk assessment and management.

DISCUSSION

ACS remains one of the leading causes of mortality globally, with a particularly high burden in low- and middle-income countries, including India. In India, CHD manifests at a younger age compared to North America and Western Europe.[7] The global mortality toll from CHD is projected to reach 17.5 million annually, with 75% of these deaths occurring in low- and middle-income nations.[8] Urban India shows a higher prevalence of CHD, further emphasizing the need for identifying modifiable risk factors.[9]

Vitamin D deficiency has emerged as a potential contributor to ACS. Studies suggest its role in promoting atherosclerosis, endothelial dysfunction, and systemic inflammation.[10] Its anti-inflammatory and anti-atherosclerotic properties, along with its effects on calcium homeostasis, highlight its significance in cardiovascular health.[11,12] Low vitamin D levels have been associated with increased arterial calcification, endothelial dysfunction, and chronic inflammation, contributing to atherosclerotic cardiovascular disease (CVD) and increased post-ACS sequelae.[13,14]

Our study, aimed at evaluating the association between vitamin D deficiency and angiographic severity in ACS patients of the Rohilkhand region, revealed significant findings. The majority of patients (78.22%) were male, with the most common age group being 51 to 60 years. These demographic trends align with studies by Ismail *et al*. and Akhtar *et al*., which reported a higher prevalence of CAD in males and middle-aged groups.[15,16]

Symptomatically, chest pain (91.09%) was the most common presentation in our cohort, consistent with global patterns in ACS. Comorbid conditions like diabetes (38.61%) and hypertension (36.63%) were prevalent in our

study, comparable to findings by Mathew *et al*., though the latter found nonsignificant associations with vitamin D levels.[17]

Coronary angiography findings in our study demonstrated significant associations between vitamin D deficiency and abnormalities in the LM (65.35%), LAD (72.28%), LC (69.31%), and RCA (74.26%), with a *p-value* of <0.0001. Lower calcium levels were also strongly correlated with coronary abnormalities. These findings align with studies by Lim *et al*.[10] and Shor *et al*.,[18] who reported similar associations between vitamin D deficiency and major coronary lesions, though their cohorts differed in mean age.

Interestingly, Syal *et al*. observed a higher incidence of two- and three-vessel disease in patients with vitamin D insufficiency, further supporting our findings of increased angiographic severity in such patients.[19] However, Pilz *et al*. did not establish a direct link between vitamin D levels and coronary abnormalities, highlighting the need for further exploration in this area.[20]

Overall, our findings underscore the critical role of vitamin D in ACS severity and emphasize the potential of vitamin D as a marker for risk stratification and targeted intervention in CAD management. Further research is warranted to explore the therapeutic benefits of correcting vitamin D deficiency in reducing cardiovascular risk.

CONCLUSION

In conclusion, the study highlights a significant association between low serum vitamin D levels and increased severity of coronary artery disease in patients with acute coronary syndrome. Low vitamin D levels were linked to higher rates of multi-vessel involvement, particularly in patients with triple-vessel disease. These findings suggest that vitamin D deficiency may be an important factor in the pathogenesis of ACS and could potentially serve as a biomarker for risk stratification. Further research is needed to evaluate the therapeutic implications of vitamin D supplementation in managing CAD.

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