



IMPACT OF VITAMIN-D DEFICIENCY ON CLINICAL OUTCOMES AND MICROBIAL DYNAMICS IN ACUTE EXACERBATIONS OF COPD: A COMPARATIVE STUDY

General Medicine

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ABSTRACT

Chronic Obstructive Pulmonary Disease (COPD) is a progressive lung condition characterized by persistent symptoms and airflow limitation. Acute exacerbations of COPD worsen lung function, thereby increasing hospitalization and mortality. Vitamin D is essential for respiratory health, and its deficiency could affect the course of the disease. Our study evaluates the impact of baseline Vitamin D levels on the clinical outcomes and microbial profiles in COPD patients presenting with acute exacerbations. **Methodology** : This comparative study was conducted on 178 COPD patients admitted from August 2022 to February 2024 at K.S. Hegde Charitable Hospital, grouped as Vitamin D deficient (n=89) (<20 ng/mL) and Vitamin D sufficient (n=89) (≥ 20 ng/mL). Data of demographics, hospital outcomes, microbial profiles, and antibiotic, antifungal sensitivities was collected. Statistical analysis was conducted using SPSS v21, with a p-value of <0.05 being considered as significant. **Results**: The mean patient age was 50.2 ± 16.1 years. Vitamin D deficient patients had more risk factors such as smoking and biomass exposure, and worse outcomes, including longer hospital stays (10.4 vs. 7.8 days), higher ICU admission rates, and increased mortality (12.4% vs. 6.7%), while fungal colonization by *Aspergillus* and *Candida* was lower in the sufficient group. Antibiotic sensitivity was better in the sufficient group, to fluoroquinolones and cephalosporins, with resistance being higher in the deficient group. **In conclusion**, Vitamin D deficiency is linked to worse outcomes in COPD exacerbations, including higher mortality and ICU admissions. Deficiency also correlates with more resistant microbial profiles. Addressing Vitamin D deficiency could improve outcomes in high-risk COPD patients.

KEYWORDS

Vitamin D deficiency, COPD exacerbations, Clinical outcomes, Microbial profile

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory condition characterized by irreversible airflow limitation, chronic inflammation, and acute exacerbations that contribute significantly to morbidity and mortality worldwide^[1,2]. Acute exacerbations, defined as sudden worsening of respiratory symptoms, accelerate the decline in lung function, reduce quality of life, and increase the risk of hospitalization and mortality^[3,4].

Vitamin D, a fat-soluble vitamin obtained from sunlight exposure and dietary sources, is essential for calcium and phosphorus homeostasis and has immunomodulatory effects that influence both innate and adaptive immunity^[5]. It plays a critical role in maintaining respiratory epithelial integrity and modulating inflammation, with studies suggesting that Vitamin D deficiency is associated with increased susceptibility to respiratory infections and worsened outcomes in COPD^[6,7]. Despite abundant sunlight, Vitamin D deficiency is widespread in regions like India due to lifestyle factors and limited sun exposure^[8]. This study aims to evaluate the relationship between Vitamin D levels and clinical outcomes, microbial profiles, and antibiotic sensitivity in COPD patients admitted with acute exacerbations.

MATERIALS AND METHODS:

This cross-sectional observational study was conducted at K.S. Hegde Charitable Hospital, Mangalore, from August 2022 to February 2024. A total of 178 patients diagnosed with COPD and admitted to the ICU and wards for acute exacerbations were enrolled. All patients were divided into two groups based on their serum Vitamin D levels:

- Vitamin D deficient group (n=89) with serum levels <20 ng/mL
- Vitamin D sufficient group (n=89) with serum levels ≥ 20 ng/mL

Inclusion Criteria:

- COPD patients aged 30 to 90 years
- Admitted with acute exacerbations to the ICU or wards

Exclusion Criteria:

- Patients on Vitamin D supplementation
- Patients with diseases affecting Vitamin D or calcium metabolism (e.g., chronic kidney disease, parathyroid disorders)

Spirometry was not performed as these patients presented with acute

exacerbations.

Data Collection:

Data collected included demographics (age, sex, smoking history), clinical outcomes (hospital stay duration, complications, mortality) and laboratory results (Vitamin D levels, sputum microbiology). Sputum samples were analyzed for bacterial and fungal colonization. Antibiotic and antifungal susceptibility testing was performed using standardized methods.

Statistical Analysis:

Statistical analysis was conducted using SPSS v21. Descriptive statistics, including means and percentages, were calculated. Differences between the Vitamin D deficient and sufficient groups were assessed using chi-square tests for categorical data and Student's t-test for continuous variables. A p-value <0.05 was considered statistically significant.

RESULTS AND DISCUSSION:

Baseline Characteristics

The mean age of patients was 65.2 years in the deficient group and 63.8 years in the sufficient group, with males comprising 53% of the study population. Smoking history was more prevalent in the Vitamin D deficient group, with 44.5% identified as current smokers compared to 41.2% in the sufficient group. Additional risk factors, such as biomass exposure and rural residence, were more common in the deficient group (78.9% vs. 65.4%)^[9].

Complications

Vitamin D deficient patients exhibited a significantly higher burden of complications, with 16.4% experiencing respiratory failure compared to 10.5% in the sufficient group. The occurrence of acute myocardial infarction was also greater in the deficient group (4.7%) versus the sufficient group (2.6%). Additionally, sepsis was more prevalent among vitamin D deficient patients (8.2%) compared to 4.1% in those with sufficient vitamin D levels.

Treatment Outcomes

Patients in the Vitamin D deficient group experienced significantly worse outcomes. The mean hospital stay was longer (10.4 vs. 7.8 days, $p < 0.05$), and mortality was notably higher (12.4% vs. 6.7%, $p = 0.03$) compared to the sufficient group. ICU admissions were also more frequent, with a greater proportion requiring extended ICU stays (>5

days, 22.6% vs. 15.4%, $p=0.04$)^[10].

Sputum Examination and Bacteriology

The sputum examination revealed that 40.3% of vitamin D deficient patients and 42.7% of sufficient patients exhibited normal flora. No bacterial growth was noted in 9.1% of deficient patients compared to 8.7% of sufficient patients. Multiple organisms were present in 12.8% of deficient patients versus 10.3% of sufficient patients. *Streptococcus pneumoniae* was slightly more prevalent in the deficient group (15.7%) compared to the sufficient group (14.5%). *Klebsiella pneumoniae* was found in 13.5% of deficient patients and 12.8% of sufficient patients. *Staphylococcus aureus* was detected in 8.6% of deficient patients and 8.2% of sufficient patients, while *Pseudomonas* spp. occurred in 5.7% of deficient and 4.3% of sufficient patients.

Fungal Examination And Antifungal Sensitivity:

In fungal examinations, 68.4% of vitamin D deficient patients exhibited normal fungal flora, while 61.7% of sufficient patients did. The deficient group had 18.4% with no fungal growth compared to 20.8% in the sufficient group. *Candida* was more prevalent in deficient patients (28.7%) than in those with sufficient vitamin D (24.3%). *Aspergillus* species were detected in 8.6% of deficient patients compared to 5.7% in sufficient patients. Regarding antifungal sensitivity, vitamin D sufficient patients showed higher susceptibility rates across various antifungal agents. Fluconazole had an 88.3% sensitivity rate in the sufficient group versus 71.4% in the deficient group. Itraconazole sensitivity was 85.7% in sufficient patients compared to 68.7% in deficient patients.

DISCUSSION

Our study throws light on the association between Vitamin D deficiency and adverse clinical outcomes in COPD patients during acute exacerbations. Patients in the deficient group had longer hospitalizations, increased ICU admissions, and higher mortality rates, emphasizing on the potential impact of Vitamin D on respiratory health.

The higher prevalence of pathogenic bacteria and greater antibiotic resistance in the deficient group aligns with the immunomodulatory role of Vitamin D, which is known to enhance host defense mechanisms through the regulation of antimicrobial peptides, such as cathelicidins and defensins.

The observed differences in microbial profiles and antibiotic sensitivity suggest that Vitamin D sufficiency may provide a protective effect, potentially reducing the risk of colonization by resistant pathogens.

Given the high prevalence of Vitamin D deficiency globally, particularly in countries with abundant sunlight but restricted sun exposure, routine assessment of Vitamin D levels in COPD patients could offer a practical approach to improving outcomes.

Supplementation strategies should be considered, particularly for patients with recurrent exacerbations and those at higher risk of deficiency.

CONCLUSIONS

This study reveals a significant link between Vitamin D status and patient outcomes, showing that Vitamin D deficiency correlates with higher complication rates, longer recovery times, and increased hospitalization. Patients with adequate Vitamin D levels are more prone to resistance to antibiotics and antifungals, highlighting vitamin D's critical role in immune response and treatment effectiveness. The increased prevalence of infections like *Streptococcus pneumoniae* and *Candida* in deficient patients underscores the need for targeted clinical strategies. Overall, maintaining optimal vitamin D levels is crucial for improving outcomes in infectious diseases.

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