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Original Research Article

PREVALENCE OF VITAMIN D LEVEL IN CRITICALLY ILL PATIENTS AND ITS CORRELATION WITH PATIENT OUTCOME

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Abstract

Background: In critically ill patients, the prevalence of vitamin D deficiency has been found to range from 26% to 80%. In critically ill patients, this deficiency may exacerbate existing immunological and metabolic dysfunctions, resulting in poorer outcomes.

Aims and objectives: To study the prevalence of vitamin D level and its correlation with patient outcome.

Materials and Methods: A single-center, prospective observational study was performed, including 96 patients aged >18 years admitted to Medical Intensive Care Unit (MICU) of Netaji Subhash Chandra Medical College Jabalpur from January 2018 to September 2019. Age, sex, Sequential organ failure assessment (SOFA) score, serum bilirubin, serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), serum creatinine, total leucocyte count, platelets count, serum calcium, random blood sugar, glasgow coma scale, the requirement of mechanical ventilation, and mortality were recorded. Vitamin D level was estimated and categorized into deficiency [Serum levels of 25(OH)D < 20 ng/mL], insufficiency [levels of 25(OH)D = 20–30 ng/mL], and sufficiency [25(OH)D >30 ng/mL].

Results: Prevalence of vitamin D deficiency, insufficiency, and sufficiency was 57.3%, 19.8%, and 22.9%, respectively. Vitamin D deficient patients have a higher SOFA score (a score of >10) ($p<0.0001$), required more mechanical ventilation ($p=0.014$), and higher risk of death ($p=0.001$). Vitamin D deficiency was more prevalent in mostly 31 to 60 years of age group patients ($p=0.009$).

Conclusion: Vitamin D deficiency is prevalent among critically ill patients and is more common in those with higher SOFA scores, the requirement of mechanical ventilation, death, and old age.

Keywords: vitamin D deficiency, critically ill patients, mortality, SOFA score

Introduction:

Despite being a tropical country and having enough sunlight available, vitamin D deficiency is prevalent among India's general population and critical illness. Several large observational studies from across the globe have confirmed that vitamin D deficiency (usually defined as 25(OH) D levels below 20 ng/mL) is frequent in adult and pediatric critically ill patients. [1-6]

Vitamin D deficiency is associated with sepsis, acute respiratory distress syndrome, and acute kidney injury [7, 8], and three different meta-analyses confirm that patients with low vitamin D status have a longer Intensive Care Unit (ICU) stay and increased morbidity and mortality [7, 9, 10].

Given the significant frequency of vitamin D insufficiency and deficiency and its crucial role in human health, some studies have looked at the relationship between blood vitamin D and the fate of critically ill patients. [11] Vitamin D deficiency is linked to disease severity and mortality, hospital costs, ICU length of stay, amount of time requiring mechanical ventilation, infection rates, bacteremia, multisystem organ failure, discharge location, and both short- and long-term mortality, according to the findings of these studies. [12-14]

However, other investigations have not established this link, and the results of studies are contradictory. [11] Hence in the present study, we tried to observe the level of vitamin D in critically ill patients and their co-relationship with patient's outcome.

Materials and Methods

This was a prospective observational single-center study enrolling 96 patients admitted in the ICU of Netaji Subhash Chandra Medical College Jabalpur from January 2018 to 30 September 2019. All the patients who gave written consent were enrolled, and their demographic and clinical profile was noted. In addition, the Vitamin D level of all the enrolled patients was estimated.

The patients with a history of vitamin D intake, recent ICU admission (during the last month), and end-stage cancer were excluded.

The patients were assessed during the ICU stay, and the following data were collected: Age, sex, Sequential organ failure assessment (SOFA) score, serum bilirubin, serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), serum creatinine, total leucocyte count, platelets count, serum calcium, random blood sugar, glasgow coma scale, the requirement of mechanical ventilation, and mortality.

Based on the guidelines of the endocrine Society, vitamin D deficiency was defined as serum levels of 25(OH)D < 20 ng/mL, insufficiency as levels of 25(OH)D = 20–30 ng/mL, and sufficiency as 25(OH)D >30 ng/mL. [15]

All the data analysis was performed using IBM SPSS ver. 20 software. Descriptive analysis was performed to obtain the baseline parameters. Mean, and standard deviation was used to represent the quantitative data, whereas percentage and numbers were used to describe categorical data. Student t-test was used to compare the means. A p-value of <0.05 was considered significant.

Results

Prevalence of vitamin D deficiency was 57.3% (mean level was 11.49±5.20 ng/ml), vitamin D insufficient was 19.80% (mean level was 25.10±3.48ng/ml), and vitamin D sufficient was 22.90% (mean level was 36.09 ±4.98ng/ml).

Out of 96 patients, 25 (26%) patients had a SOFA score of >10, and of these, 24 patients had vitamin D deficiency. Analysis of SOFA score and vitamin D deficiency revealed that vitamin D deficient patients have higher SOFA scores (p< 0.0001).

Out of 96 patients, 37 (38.5%) patients required mechanical ventilation; among those 37 patients, 28 (75.70%) patients were vitamin D deficient, and 5 (13.5%) were vitamin D insufficient, and 4 (10.8%) were vitamin D sufficient. Vitamin D statistically correlates with the requirement of mechanical ventilation (p=0.014).

Out of 96 patients, 25 (26.04%) death occurred. Of these 25 deaths, 22 (88%) patients were vitamin D deficient, 1 (4%) patient was vitamin D insufficient, and 2 (8%) patients were vitamin D sufficient. Analysis of death and vitamin D deficiency revealed that the risk of death is more in vitamin D deficient patients, and this difference was found significant statistically p-value <0.001.

Vitamin D deficiency was found to be more in the age group of 31 years to 60 years (58.60%) followed by >60 years of age group [14 (73.70%)] patients. Vitamin D deficiency was statistically found to be higher among the elderly age group (p=0.009).

Table 1: Comparing various parameters between different vitamin D levels

Variable	Deficient	Insufficient	Sufficient	P-value
Age	50.65±16.4	49.74±17.46	39.59±17.18	0.009
Vitamin D	11.49±5.2	25.1±3.48	36.09±4.98	<0.001
SOFA	8.67±4.12	4.95±1.27	5.41±2.15	0.0001
S. Bilirubin	2.36±5.15	1.16±0.63	2.85±4.52	0.346
SGOT	81.4±62.41	138.2±186.1	109.51±135.79	
SGPT	52.73±39.95	103.43±176.56	120.02±248.05	
S. Creatinine	1.52±1.18	1.1±0.4	1.71±2.38	
TLC	11.11±4.59	10.71±6.35	12.31±6.4	
PLT	2.43±1.85	2.01±0.85	3.36±2.32	
S. Calcium	9.4±1.55	9.63±0.93	9.04±1.95	
RBS	112.72±67.44	110.11±40.73	99.65±51.76	
GCS	11.58±4.97	14.47±1.43	13.36±3.55	

GCS; Glasgow coma scale, RBS; random blood sugar, PLT; platelets count, TLC; total leucocyte count, SGPT; serum glutamic pyruvic transaminase, SGOT; serum glutamic oxaloacetic transaminase, SOFA; sequential organ failure assessment. A p-value of <0.05 is considered significant.

Discussion

In critically ill patients, vitamin D deficiency is common, and some studies have found a link between vitamin D deficiency and ICU outcomes. Vitamin D's importance in calcium and phosphorus balance is well understood. Vitamin D now has several vital roles, including influencing the innate and adaptive immunological response to infectious pathogens, anti-inflammatory capabilities, and effects on cellular development, proliferation, and apoptosis. [11]

In our study prevalence of vitamin D deficiency was 57.3 %, Vitamin D insufficiency was 19.8%, and that of vitamin D sufficiency was 22.9%. In line with this, Amrein et al. observed that out of 655 patients enrolled, 60% of patients were vitamin D deficient, 26% were vitamin D insufficient, and 14 % were vitamin D sufficient. [3] In a similar study,

Venkatram et al. out of 437 patients, 340 (78%) came out to be vitamin D deficient, 74 (17%) vitamin D insufficient, and 23 (5%) came out to be vitamin D sufficient. [16] Padhi et al. have observed that out of 152 patients, mostly 55 female (69%) were vitamin D deficient ($p < 0.05$). [2] Nair et al. have observed that out of 100 patients enrolled in his study, 21% were vitamin D deficient, 55% were vitamin D insufficient, and 24% were vitamin D sufficient. [17] In agreement to present study, another similar study by Lee et al. has observed that out of 42 critically ill patients, the mean vitamin D level was 16 ±9 ng/ml with a high prevalence of vitamin D deficiency in 16 (38%) patients who were vitamin D deficient, 23 (55%) patients were vitamin D insufficient, 3 (7%) patients were vitamin D sufficient. [18]

In our study, out of 96 patients, 25 patients had higher SOFA scores, and out of these 25 patients, 24 (96%) were vitamin D deficient, and this finding was statistically significant ($p<0.001$). in agreement with to present study, Moraes et al. also observed that those patients who died (non-survivor) had higher SOFA scores ($p=0.001$). [19]

Miri et al. reported that adequate vitamin D levels are necessary to regulate the function of the immune system, and its deficiency leads to an impairment of immune function. This could lead to increased risk of infections, particularly ventilator-associated pneumonia, systemic inflammation, multiple organ dysfunction syndromes, increasing the mortality rate and length of ICU stay. [20] In another study, Quraishi et al. measured plasma 25-hydroxyvitamin D levels in critically ill surgical patients on ICU admission. They concluded that 25- hydroxyvitamin D levels were inversely associated with the duration of respiratory support. [21]

In our study, out of 96 patients, 37 (38.5%) patients required mechanical ventilation; among those, 28 (75.70 %) were vitamin D deficient, and 5 (13.5%) were vitamin D insufficient, and 4 (10.8%) were vitamin D sufficient. Vitamin D statistically correlates with the requirement of mechanical ventilation. In agreement with the present study where vitamin D deficient patients had prolonged mechanical ventilation, Padhi et al. have also observed that vitamin D deficient patients needed prolonged mechanical ventilation and longer hospital stay. [2]

Out of 96 patients, 25 (26.04%) death occurred. Of these 25 deaths, 22 (88%) patients were vitamin D deficient, 1 (4%) patient was vitamin D insufficient, and 2 (8%) patients were vitamin D sufficient. Analysis of death and vitamin D deficiency revealed that the risk of death is more in vitamin D deficient patients, and this difference was found significant statistically p-value <0.001. Braun et al. observed that preadmission vitamin D deficiency can predict short-term and long-term mortality. Thirty days following ICU admission, patients with vitamin D deficiency have an odds ratio for mortality of 1.69 (95% CI= 1.28-2.23) relative to patients with vitamin D sufficiency. In his study, he predicted by SAPS II (50 vs. 74%, $p< 0.05$) that vitamin D deficiency was associated with more mortality among those with ventilator support (95% vs. 40%, $p < 0.05$). [22] Lee et al. observed that out of 7 patients having undetectable levels (<10ng/ml) of vitamin D, among them, three died. [18] Padhi et al. have observed that there is a significant correlation between vitamin D level and death. [2]

The present study is not devoid of limitations. Firstly, our study includes a smaller number of patients, so future large-scale studies are required. Secondly, follow-up of patients was not done and was performed in a single ICU. Hence results cannot be generalized to other ICU units. Further studies are needed to know whether vitamin D deficiency is the cause or merely another marker for the severity of illness.

Conclusion

India is a tropical country with sufficient sunlight exposure, despite a high prevalence of vitamin D and associated morbidity. Finally, it could be concluded the prevalence of vitamin D deficiency in critical patients is higher, mainly in the elderly age group. Patients with vitamin D deficiency had higher SOFA scores leading to the grave outcome of the patients in ICU, leading to prolonged mechanical ventilation and higher mortality. Vitamin D deficiency has a significant role in increasing the morbidity and mortality of patients. So just with proper early diagnosis and early replacement of vitamin D therapy, we can reduce the morbidity of the ICU patients and the economic burden of patients of this developing country.

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