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Is Vitamin D Superior to Albumin in Predicting Length of Stay and Mortality in Veterans of Long-Term Care Facilities?

Vitamin D as a Predictor of Outcomes in Long-Term Care

By Dima A. Youssef, MD; Beth A. Bailey, MD; Todd Manning; and Alan N. Peiris, MD(Lon), FRCP(Lon)

ABSTRACT

Aim: The increase in the geriatric population will increase use of long-term care facilities. Few studies have addressed contributory factors to outcomes in long-term care in veterans. Many abnormal biochemical parameters including vitamin D deficiency could contribute to adverse outcomes. The present study was undertaken to determine if vitamin D status was superior to serum albumin in predicting length of stay and mortality among veterans in long-term care facilities.

Methods: Data were collected via retrospective chart review at six Veterans Administration Medical Centers in the Southeast United States on patients admitted to long-term care facilities.

Results: In the study group (n=131), vitamin D status did not predict length of stay in the facility. However, serum albumin was the strongest predictor of mortality at one month and one year. Serum creatinine and alkaline phosphatase provided a secondary contribution to one-month mortality, and serum triglycerides accounted for additional variance in one-year mortality.

Conclusions: Clinicians should be aware that serum albumin level is superior to vitamin D status in predicting adverse outcomes in long-term care. This contrasts with prior reports indicating that vitamin D was a significant predictor of mortality in admissions to intensive care unit. However, given the multiple complex factors that interact and evolve to determine length of stay and mortality, additional study of this apparent paradox is warranted. While vitamin D was not predictive of either length of stay or mortality in this long-term care population, the other benefits of vitamin D replacement make a vitamin D-replete state desirable.

INTRODUCTION

With the continuing increase in the geriatric population, a greater demand for long-term care facilities can be expected. Studies in the United Kingdom suggest that demands for long-term care are expected to accelerate, reaching a peak after 2040.1 In the United States, with the ongoing military operations, we can expect an increased influx of younger patients with a need for long-term care as a result of brain and other traumatic injuries.

A stay in long-term care is costly. Identification of patients needing greater care at the time of admission to long-term care facilities will enable development of cost-effective strategies. Vitamin D status may be one such indicator of greater need. Vitamin D deficiency has reached pandemic proportions.2 Low 25(OH)D values have also been associated with nursing home admissions and possibly mortality.3 We explore the role of vitamin D status as a potential marker for outcomes in veterans in long-term care, and we compare its utility to serum albumin. The two primary questions of interest were: 1) which factors predict length of long-term care stay; and 2) which factors predict mortality within the first month and the first year of long-term care admission.

MATERIALS AND METHODS

Participants and Procedures

The study was conducted at a Veterans Affairs Medical Center in the Southeastern United States. The Research and Development Committee at the VA Medical Center, as well as the Institutional Review Board at the affiliated University, approved the study. Patient data from six VA Medical Centers located...
in the Southeastern U.S. in Veterans Integrated Service Network 9 were included. Age, body mass index (BMI), season/quarter of admission, latitude, number of medications at admission, number of missed appointments in six months prior to admission, tobacco use, and vitamin D (both level and status) were recorded, as were creatinine, calcium, albumin, total cholesterol, triglycerides, SGPT, SGOT, alkaline phosphatase, and bilirubin levels at admission. Latitude was based on Zip code of residence. Vitamin D status was assessed by 25(OH)D measurement. Serum 25(OH)D was determined via immunochemiluminometric assay (Labcorp, Burlington, NC). Vitamin D was examined as both a continuous and dichotomous variable with deficiency classified as 25(OH)D < 20 ng/mL. Gender and race were not used due to lack of variability in this sample. The final sample contained 131 patients admitted to long-term care between October 2002 and June 2010. Of the 131, 44 (33.6%) were admitted for hospice care, with the rest admitted for long-term nursing home. All had complete data on the variables of interest, including vitamin D values obtained less than one year before admission.

Data Analysis
Statistical analyses were performed using PASW (SPSS Inc., version 18.0; Chicago, IL). All variables were checked for outliers and normality of distribution before analyses were performed. Many variables had one or more outliers (three or more standard deviations above the mean). These outliers were recoded to the value of three standard deviations above the mean for analysis. No variable had more than four statistical outliers. Correlations, logistic regressions, t-tests, and \( \chi^2 \) analyses were used to evaluate relationships between biochemical and demographic parameters and outcomes data. Significance was determined at the \( p < 0.05 \) value.

Results
The sample was predominantly male, representative of the veterans’ population, and elderly as shown in Table 1. Approximately 50% were smokers. Elevated serum creatinine and alkaline phosphatase, with decreased serum albumin, were noted in the study sample. Approximately 43% were deficient in vitamin D. The average length of stay in long-term care was 71 days with an average cost of $91,000.

Relationships between potential predictors and length of stay were performed first for the full sample. Additionally, analyses were rerun only for those who survived the first year after admission (n=55), so as not to confound length of stay with mortality. Pearson correlations were computed for continuous predictors while r point-biserial correlations were used for dichotomous predictors. None of the background variables or laboratory values from Table 1 were significantly associated with length of long-term care stay, for either the full sample or the surviving sample.

Of the 131 patients admitted, 21.4% (n=28) died within one month of admission, while 58.0% (n=76) died within one year of admission. Associations between predictive factors and mortality status at one month and one year are presented in Table 2. As can be seen, only serum creatinine, albumin, and alkaline phosphatase levels were significantly associated with mortality at one month. Tobacco use, seasonal quarter of admission, albumin and triglyceride levels were significantly associated with mortality at one year. Vitamin D levels were not significantly associated with either mortality variable. Multiple regression analyses were performed to determine the relative importance and contribution of significant predictors to mortality. Two separate regression equations were computed – one with mortality status at one month as the dependent variable, and the other with mortality status at one year as the dependent variable. Significant bivariate predictors from Table 2 were entered stepwise in each equation. Results are presented in Table 3. As can be seen, a lower albumin level was the strongest predictor of mortality status at both one month and one year, accounting for 6% of the variance in mortality status at one month, and 8% of the variance in mortality status at one year. At one month, lower creatinine and higher alkaline phosphatase levels were also predictive of mortality accounting for an additional 7% of variance, for a total of 13% of variance in one-month mortality status accounted for
by these three laboratory values. In addition to albumin levels, lower triglyceride levels accounted for an additional 4% of the variance in mortality status at one year, for a total of 12% of variance in one-year mortality status accounted for by these two predictors.

Since it was possible the hospice patients were very different from those admitted for long-term hospital care without terminal conditions, all analyses were rerun excluding the hospice patients. There was little difference between these analyses and those detailed above for the full sample. Vitamin D was still not associated with any of outcomes of interest and the same general pattern of associations persisted.

DISCUSSION
To our knowledge, this is the first study to attempt to predict length of stay and mortality in a long-term care sample of veterans, while incorporating a comprehensive biochemical profile including vitamin D status, and allowing for seasonal bias and latitude.

Vitamin D deficiency has been reported in a significant number of veterans in long-term care, with evidence indicating that effective monitoring and intervention to maintain an adequate vitamin D status is lacking.\(^4\) Multiple studies allude to the adverse outcomes linked to vitamin D deficiency in acutely ill patients.\(^5,6\) As such, we were surprised by the lack of emergence of vitamin D level as a significant predictor of length of stay or mortality in the current study. This apparent paradox could be explained by the existence of an advanced chronic disease burden in our study group. It appears that past hospitalizations for exacerbation of chronic medical conditions rather than biochemical parameters may better predict death.\(^7\) Visser et al., reported lower 25(OH)D was associated with higher mortality risk, but this association was not significant when adjusted for frailty indicators.\(^3\) In contrast, Pilz et al., reported increased mortality linked to vitamin D deficiency in female residents of a nursing home.\(^8\) The current sample in our study is mostly male, which may explain the study differences. The lack of predictive value for determining length of stay and mortality from vitamin D status is perhaps not surprising given the multiple complex and multifaceted contributors to outcomes in long-term care.

The predictive value of other parameters such as serum albumin and creatinine, alkaline phosphatase and triglyceride levels may be consistent with the belief that co-existing disease determines outcomes in this group. Serum albumin has been used to identify varying degrees of frailty in older nursing home residents.\(^9\) In a study of 1.7 million people, serum albumin discriminated between all-cause mortality risks independent of other laboratory tests.\(^10\) Our findings extend previous studies reports to include serum creatinine and alkaline phosphatase as aiding prediction of one-month mortality. Higher serum creatinine values were linked to reduced mortality at one month in the current study. These findings contradict prior reports indicating elevated serum creatinine values are associated with adverse health outcomes and mortality.\(^11\) Independent relationships between elevated alkaline phosphatase and cardiovascular and all-cause mortality were found in the Third National Health and Nutrition Survey.\(^12\) Raised alkaline phosphatase is an independent predictor of C-reactive protein levels\(^13\) and may be a marker for increased cardiometabolic risk. As for triglyceride levels, lower values were also predictive of one-year mortality in our study. Others have reported low triglyceride values to be an independent predictor of mortality after ischemic stroke.\(^14\) However, some studies have reported elevated triglycerides to be linked to increased cardiovascular and all-cause mortality.\(^15\)

The present study reinforces the difficulties in predicting outcomes in long-term care among veterans. The relatively low percentage of mortality variance (< 15%) predicted by albumin and commonly obtained laboratory parameters suggests a complex interaction between multiple predictive factors. Some hard to quantify factors such as social engagement, self-esteem, depression, cognitive impairment and behavioral issues may play a much bigger role in determining outcomes in this population.
The current study is not without limitations. A single measurement of the biochemical parameters, including vitamin D, is likely insufficient to accurately portray the health status of veterans in long-term care. Finally, the current study, which was confined to the Southeastern part of the United States, comprised only 2% of the long-term care admissions largely due to the low rate of sampling for vitamin D. As such, we cannot exclude a selection bias and our findings may not generalize to all veterans in long-term care.

CONCLUSION
While vitamin D was not as good a predictor of outcomes in long-term care as albumin, no biochemical parameters accounted for a large amount of variance when estimating mortality and length of stay. Given the prevalence of vitamin D deficiency in this population and the documented benefits of vitamin D replacement, we advocate maintaining adequate vitamin D reserves in long-term care patients.

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