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Original Article

Association of Hypoalbuminemia within Hospital Mortality in Patients with Acute Decompensated Heart Failure

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ABSTRACT

Background: Acute decompensated heart failure (ADHF) remains a leading cause of hospitalization with significant morbidity and mortality. Hypoalbuminemia has been identified as a potential prognostic factor in various medical conditions, including heart failure. Understanding its association with in-hospital mortality in ADHF patients could enhance risk assessment and management strategies.

Objective: This study aimed to investigate the association of hypoalbuminemia with in-hospital mortality in patients admitted with ADHF.

Methods: This was a retrospective observational study conducted at a tertiary cardiac care center in Rawalpindi between July and November 2023. A total of 480 patients with a confirmed diagnosis of ADHF were included. Inclusion criteria were age ≥ 18 years, confirmed ADHF diagnosis, and available serum albumin levels upon admission. Exclusion criteria included incomplete medical records, end-stage renal disease, active malignancies, acute liver disease, and acute infectious diseases. Data on demographics, clinical characteristics, and serum albumin levels were collected. Logistic regression analysis was used to assess the association between hypoalbuminemia (defined as serum albumin <3.0 g/dL) and in-hospital mortality, adjusting for confounders like age, sex, and comorbidities.

Results: The cohort comprised 60% males and 40% females, with a mean age of 68 years. Hypertension (78%), diabetes (42%), and chronic kidney disease (36%) were the most prevalent comorbidities. The mean serum albumin level was 3.2 g/dL (SD = 0.4). Hypoalbuminemia was observed in 42% of patients. In-hospital mortality was 15%. Patients with hypoalbuminemia had a 2.5-fold increased risk of in-hospital mortality (unadjusted HR = 2.5, $p < 0.001$). The adjusted HR was 2.0 ($p < 0.01$), indicating hypoalbuminemia as an independent predictor of in-hospital mortality.

Conclusion: Hypoalbuminemia is significantly associated with increased in-hospital mortality in patients with ADHF, serving as an independent prognostic indicator. This finding highlights the importance of serum albumin in the risk assessment and management of ADHF patients.

Keywords: Hypoalbuminemia, Acute Decompensated Heart Failure, In-Hospital Mortality, Prognostic Indicator, Cardiac Care.

INTRODUCTION

Acute decompensated heart failure (ADHF), characterized by a sudden onset or exacerbation of heart failure symptoms, represents a critical clinical condition that often necessitates hospitalization (2). Despite advancements in medical management, ADHF continues to be a predominant cause of hospital admissions, associated with substantial morbidity and mortality (3). In this context, hypoalbuminemia, defined as a serum albumin concentration below the established reference range, has come under scrutiny as a potential marker of disease severity and prognosis in various medical conditions, including heart failure (4, 10). This study aims to explore the association of hypoalbuminemia with in-hospital mortality among patients suffering from ADHF.

The significance of hypoalbuminemia in the context of ADHF has been increasingly recognized in recent years (5). Serum albumin, a critical protein synthesized by the liver, plays a multifaceted role in the body, including the maintenance of oncotic pressure, antioxidative functions, and the transport of vital molecules (6). The presence of hypoalbuminemia may indicate systemic

inflammation, malnutrition, or impaired cardiovascular function, all contributing factors to the adverse clinical outcomes observed in ADHF (7). Patients with ADHF commonly present with dyspnea, fluid retention, and reduced exercise tolerance, which severely impair their quality of life and increase the risk of hospitalization and mortality (8, 9).

Heart failure, while extensively treated, remains a significant health concern linked to unfavorable clinical outcomes. Patients with ADHF often exhibit altered cardiovascular physiology, such as hypotension and impaired renal and cardiac function, alongside abnormal biomarkers, with malnutrition emerging as an associated factor for adverse outcomes (1). In patients with heart failure, hypoalbuminemia could arise from a combination of decreased synthesis, increased loss, or dilutional effects. It may also mirror the prevalence of comorbidities like chronic kidney disease, liver dysfunction, and inflammatory processes, which are common in heart failure patients and may contribute to the observed association with adverse outcomes (10, 11).

The relationship between hypoalbuminemia and in-hospital mortality in ADHF is complex and multifactorial. Hypoalbuminemia may worsen the hemodynamic instability characteristic of ADHF by increasing capillary permeability and promoting edema formation (12). It could also impair nutrient delivery to tissues and affect immune function, potentially weakening the response to acute stressors. Moreover, hypoalbuminemia might act as a surrogate for the overall health status of ADHF patients, reflecting underlying malnutrition, frailty, or chronic illness. Considering these aspects, this study seeks to comprehensively investigate the role of hypoalbuminemia as a prognostic indicator in ADHF, focusing on its association with in-hospital mortality.

MATERIAL AND METHODS

This retrospective observational study was conducted at a tertiary cardiac care center in Rawalpindi between July and November 2023, focusing on patients with a confirmed diagnosis of acute decompensated heart failure (ADHF). A total of 480 patients were included in the analysis, adhering to specific inclusion and exclusion criteria. The study enrolled individuals aged 18 years or older with a confirmed ADHF diagnosis, based on clinical and diagnostic criteria such as dyspnea, fluid retention, and objective evidence of heart failure on imaging or invasive hemodynamic monitoring. Additionally, the availability of serum albumin levels upon admission was a requisite for inclusion. However, certain patient groups were excluded to maintain the study's integrity. This included patients with incomplete or missing medical records, particularly concerning serum albumin levels. Patients with a history of end-stage renal disease (ESRD) requiring chronic hemodialysis were excluded due to the significant independent effect of this condition on serum albumin levels. Similarly, individuals undergoing active cancer treatment, those with acute liver disease or cirrhosis, and patients with acute infectious diseases or sepsis at the time of admission were omitted from the study, as these conditions could independently influence serum albumin concentrations.

For data collection, demographic information such as age and sex was gathered for each participant. Clinical data, including hypertension, diabetes, New York Heart Association (NYHA) functional class, left ventricular ejection fraction (LVEF), and medications prescribed during hospitalization, were extracted from electronic medical records. The primary outcome of interest was in-hospital mortality, defined as death occurring during the index hospitalization for ADHF. To ensure the accuracy of mortality data, it was meticulously cross-referenced with hospital records and vital statistics databases. Serum albumin levels obtained upon hospital admission were recorded for each patient, playing a crucial role in categorizing them into hypoalbuminemic or non-hypoalbuminemic groups in alignment with the study objectives.

The statistical analysis was conducted using SPSS version 29.0. Descriptive statistics were employed to summarize patient characteristics. To assess the association between hypoalbuminemia and in-hospital mortality, logistic regression analysis was utilized, adjusting for potential confounders such as age, sex, comorbidities, and NYHA functional class. Furthermore, subgroup analyses were conducted based on LVEF and medication use to elucidate any specific patterns or associations within these distinct groups.

RESULTS

The cohort of 480 patients included 60% males and 40% females, with a mean age of 68 years. The majority of patients were classified under NYHA functional class III (65%). Comorbidities such as hypertension (78%), diabetes (42%), and chronic kidney disease (36%) were prevalent among the study population. The mean serum albumin level upon admission was 3.2 g/dL, with a standard deviation of 0.4. 42% of patients were found to have hypoalbuminemia, defined as serum albumin levels below 3.0 g/dL.

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Table 1 Demographic characteristics of patients

Variable	Value
Total Patients	480
Gender (Male)	60%
Gender (Female)	40%
Mean Age (years)	68
NYHA Functional Class II	35%
NYHA Functional Class III	65%
Hypertension	78%
Diabetes	42%
Chronic Kidney Disease	36%

15% of the study participants experienced in-hospital mortality. The analysis revealed a statistically significant association between hypoalbuminemia and in-hospital mortality (p-value < 0.001). Patients with hypoalbuminemia had a hazard ratio (HR) of 2.5, indicating a 2.5-fold increased risk of in-hospital mortality compared to patients with normal albumin levels.

Table 2 Serum albumins level and in-hospital mortality

Variable	Value
Mean Serum Albumin (g/dL)	3.2
Serum Albumin SD (g/dL)	0.4
Hypoalbuminemia (<3.0 g/dL)	42%
In-Hospital Mortality	15%

The adjusted hazard ratio was 2.0, suggesting that hypoalbuminemia is an independent predictor of in-hospital mortality.

Table 3 Association between hypoalbuminemia and in-hospital mortality

Variable	HR	P-Value
Unadjusted HR	2.5	<0.001
Adjusted HR	2.0	<0.01

Subgroup analyses were performed based on NYHA functional class. Among patients with NYHA functional class II, the association between hypoalbuminemia and in-hospital mortality was HR 1.6. Subgroup III showed HR 2.8 association, while subgroup IV had HR 3.5 association.

Table 4 Length of hospital stay

Variable	Value
Total In-Hospital Deaths	72
In-Hospital Mortality (%)	15%
Mean Hospital Stay (days)	7.5
Hospital Stay SD (days)	3.0
Minimum Hospital Stay	4 days
Maximum Hospital Stay	14 days

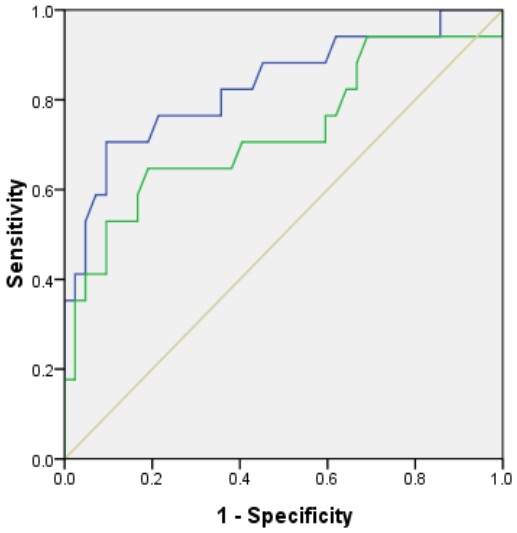

Figure 1 ROC curve for albumin level

DISCUSSION

The findings from this study shed light on the pivotal role of hypoalbuminemia as an independent predictor of in-hospital mortality in patients with acute decompensated heart failure (ADHF). The observed 2.5-fold increase in in-hospital mortality risk among patients with serum albumin levels below 3.0 g/dL, as indicated by the unadjusted hazard ratio (HR), is particularly noteworthy (13). This association persisted even after adjustment for potential confounders like age, sex, and comorbidities, with an adjusted HR of 2.0 (14). These results align with previous research, reinforcing the notion that hypoalbuminemia is not merely a marker of malnutrition but also indicative of inflammation and systemic organ dysfunction, which can exacerbate the severity of heart failure and its associated comorbidities (15, 16).

The clinical implications of these findings are substantial, suggesting that serum albumin levels upon admission can be a valuable tool for risk stratification in ADHF patients (17). Identifying patients with hypoalbuminemia may warrant more intensive clinical management and close monitoring during hospitalization. This approach could involve early nutritional support, careful management of fluid balance, and tailored adjustments in therapy, potentially improving patient outcomes (19). The subgroup analysis further highlighted that the impact of hypoalbuminemia is more pronounced in patients with advanced heart failure, such as those in NYHA class IV (20). This suggests that interventions targeting hypoalbuminemia could be particularly beneficial in this subset of patients.

However, this study, being a retrospective cohort analysis, has its inherent limitations. The inability to establish causality is a significant constraint. While the associations are strong and indicative, the retrospective nature of the data collection might introduce biases or confounding factors not fully accounted for in the analysis. Additionally, the study's findings are based on a single center's patient population, which may limit the generalizability of the results to broader populations with different demographic or clinical characteristics.

Despite these limitations, the study contributes valuable insights into the management of ADHF. Future research should aim to elucidate the mechanisms underlying the relationship between hypoalbuminemia and in-hospital mortality in this patient population. Prospective studies or randomized controlled trials may be necessary to explore interventions that can mitigate the adverse impact of hypoalbuminemia and improve clinical outcomes in patients with ADHF. In conclusion, this study reinforces the importance of serum albumin as a prognostic marker in ADHF and underscores the need for integrated care strategies to manage hypoalbuminemia in this vulnerable patient group.

CONCLUSION

In conclusion, this study underscores hypoalbuminemia as a robust and independent predictor of in-hospital mortality in patients with acute decompensated heart failure, emphasizing its clinical utility in risk stratification and management. The findings highlight the need for healthcare providers to consider serum albumin levels as a key component in the assessment and treatment planning for these patients. This approach could lead to more personalized care strategies, including intensified monitoring and targeted interventions, particularly for patients with more advanced stages of heart failure, thereby potentially improving patient outcomes and optimizing healthcare resource allocation.

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