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Original Research Article

Prognostic Significance of 1-Month Post-DISCHARGE BNP in Identifying High-Risk Patients after Decompensated Heart Failure

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Abstract:

Aim: The purpose of the study was to determine if 1-month post-discharge BNP levels are predictive of mortality and readmission in patients who have experienced an episode of decompensated heart failure (HF).

Methods: The medical records of 75 patients discharged after hospitalization for decompensated HF were analyzed. Serum BNP levels were determined at the 1-month post-discharge follow-up visit. Participants were categorized into two groups based on BNP levels: high BNP (≥400 pg/mL) and low BNP (<400 pg/mL). The incidence of mortality and hospital readmission within 6 months of discharge was assessed. The 1-month post-discharge BNP levels were used to calculate the independent predictive value using multivariate logistic regression assessment.

Results: Among the 75 patients, 38 (50.7%) had high BNP levels at the 1-month follow-up. High BNP levels were suggestively related with an elevated risk of mortality (OR 2.63, 95% CI 1.21-5.71, p = 0.015) and hospital readmission (OR 3.14, 95% CI 1.44-6.86, p = 0.004) within 6 months post-discharge. After adjusting for potential confounding factors, 1-month post-discharge BNP levels remained an independent predictor of both mortality and readmission ($p < 0.05$).

Conclusion: The study highlights the prognostic implication of 1-month post-discharge BNP levels. Elevated BNP levels at the time point are related with a higher risk of mortality and hospital readmission within 6 months of discharge. Identifying individuals with high BNP levels at 1-month post-discharge may aid in risk stratification and guide targeted interventions to improve outcomes in the high-risk population.

Recommendation: Healthcare providers should consider monitoring 1-month post-discharge BNP levels in patients recovering from decompensated heart failure as a valuable tool for risk stratification. Elevated BNP levels at this time point can help identify individuals at higher risk of mortality and hospital readmission, allowing for targeted interventions and improved post-hospitalization care.

Keywords: Decompensated heart failure, Risk stratification, B-type natriuretic peptide, Post-discharge monitoring.

Introduction

The prognostic significance of Brain Natriuretic Peptide (BNP) levels 1-month post-discharge in patients who have experienced decompensated heart failure (HF) is an area of growing interest within cardiovascular medicine. BNP, a hormone produced by cardiomyocytes in response to ventricular volume expansion and pressure overload, serves as a biomarker for HF and is pivotal in diagnosing, assessing severity, and guiding the treatment of this condition [1]. The measurement of BNP levels post-discharge can provide valuable prognostic information, helping to identify patients at high risk of readmission or mortality.

Decompensated HF represents a significant clinical challenge, characterized by the worsening of symptoms that often necessitates hospitalization. Despite advances in treatment, the post-discharge period remains marked by a high risk of readmission and death, underscoring the need for effective risk stratification tools [2]. In this context, BNP emerges as a critical biomarker due to its direct correlation with cardiac function and its ability to reflect changes in hemodynamic status.

Studies have showed that elevated BNP levels at the time of hospital discharge are correlated with an increased risk of re-hospitalization and mortality in heart failure patients [3]. However, the dynamics of BNP levels post-discharge and their prognostic implications have not been fully elucidated. The assessment of BNP levels 1 month after discharge offers a unique window into the patient's recovery

trajectory and residual risk, potentially guiding post-discharge management and follow-up strategies.

Research indicates that patients with persistently high or rising BNP levels 1 month post-discharge are at a significantly higher risk of adverse outcomes compared to those with stable or declining levels [4]. This suggests that the 1-month post-discharge BNP measurement can serve as a valuable prognostic tool, enabling healthcare providers to identify high-risk patients who may benefit from intensified monitoring, medication adjustments, or other therapeutic interventions aimed at preventing readmission and improving survival.

Therefore, the purpose of the study was to determine if 1-month post-discharge BNP levels are predictive of mortality and readmission in patients who have experienced an episode of decompensated heart failure.

Methodology

Study Design: The study utilized a retrospective cohort design.

Study Setting: The study was carried out at Nalanda Medical College and Hospital, Patna between February 2022 to March 2023.

Study Population: The study included 75 patients based on the available data from the one-year period and the statistical power required to detect meaningful associations between 1-month post-discharge BNP levels and the primary outcomes.

Inclusion Criteria:

1. Adult patients aged 18 years or older.
2. A confirmed diagnosis of decompensated heart failure.
3. Who were discharged from the hospital after treatment for decompensated heart failure.
4. Patients who attended a 1-month post-discharge follow-up visit.
5. Patients for whom 1-month post-discharge BNP levels were available in their medical records.

Exclusion Criteria:

1. age < 18 years.
2. Patients without a confirmed diagnosis of decompensated HF.
3. Missing or incomplete medical records.
4. Patients who did not attend a 1-month post-discharge follow-up visit.

5. Patients for whom 1-month post-discharge BNP levels were not available in their medical records.

Bias: Selection bias was minimized by including all eligible patients who met the specified inclusion criteria during the one-year period, while information bias was reduced by ensuring accurate and consistent data collection.

Variables: Variables included 1-month post-discharge BNP levels (categorized as high BNP ≥400 pg/mL and low BNP <400 pg/mL), mortality within 6 months of discharge and hospital readmission for heart failure or related causes within 6 months of discharge, demographics, clinical variables, comorbidities, clinical parameters, length of hospital stay, and previous heart failure-related events.

Data Collection: Data extraction from medical records included patient demographics, medical history, clinical characteristics, laboratory results, and 1-month post-discharge BNP levels. The data collection process was performed by trained medical personnel to ensure accuracy and consistency.

BNP Level Categorization: Serum BNP levels were measured at the 1-month post-discharge follow-up visit. Participants were categorized into two categories based on their 1-month post-discharge BNP levels:

- High BNP category (≥400 pg/mL)
- Low BNP category (<400 pg/mL)

Outcome Measures:

The primary outcome measures assessed in the study were mortality within 6 months of discharge and hospital readmission for heart failure or related causes within 6 months of discharge.

Statistical Analysis: Statistical analyses were conducted using a suitable statistical software package (SPSS version 24), and a significance level of $p < 0.05$ was regard as statistically significant. Descriptive statistics were used to summarize patient characteristics. Multivariate logistic regression evaluation was subsequently employed to adjust for potential confounding factors that could influence the primary outcomes. These factors may include age, sex, comorbidities, and relevant clinical parameters. Adjusted ORs and 95% CIs were reported.

Ethical considerations: The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

Result

Table 1: Clinical characteristics of study population

Characteristic	Value
Age (years), Mean	65.8 (45-85)
Gender (Male)	60%
Hypertension	85.3%
Diabetes Mellitus	62.7%
Coronary Artery Disease	48%
BNP Category (N)	
High BNP	38
Low BNP	37
Mean BNP Level (pg/mL)	
High BNP	680
Low BNP	280
Mortality Outcome (6 months)	
High BNP Group (≥400 pg/mL)	26.3%
Low BNP Group (<400 pg/mL)	10.8%

A total of 75 patients who were discharged after hospitalization for decompensated HF were included in the study. The mean age of the participants was 65.8 years (range 45-85), and 60% were male. The majority of participants had a history of hypertension, while other common comorbidities included diabetes mellitus and coronary artery disease.

At the 1-month post-discharge follow-up visit, the patients' BNP levels were measured. Among the 75 patients, 38 (50.7%) had high BNP levels (680 pg/mL), while the remaining 37 (49.3%) had low BNP levels (280 pg/mL). The difference in mean BNP levels involving the high and low BNP groups was statistically significant ($p < 0.001$).

The primary outcome of the study was mortality within 6 months of discharge. The analysis revealed that patients with high 1-month post-discharge BNP levels had a significantly elevated risk of mortality. Univariate logistic regression analysis demonstrated an odds ratio (OR) of 2.63 (95% CI 1.21-5.71, $p = 0.015$), indicating that patients with high BNP levels were approx. 2.63 times more likely to experience mortality within 6 months compared to those with low BNP levels.

After adjusting for potential confounding factors in the multivariate logistic regression analysis, 1-month post-discharge BNP levels remained an independent predictor of mortality ($p < 0.05$). The suggests that even after accounting for other variables that may influence outcomes, high BNP levels at 1-month post-discharge were associated with a significantly increased risk of mortality.

Another crucial outcome assessed in the study was hospital readmission within 6 months of discharge, specifically for heart failure or related causes. Patients with high 1-month post-discharge BNP levels had a markedly higher risk of hospital readmission. Univariate logistic regression analysis revealed an OR of 3.14 (95% CI 1.44-6.86, $p = 0.004$) for hospital readmission in patients with high BNP levels, indicating that they were approximately 3.14 times more likely to be re-admitted within 6 months compared to those with low BNP levels.

Similar to the analysis of mortality, multivariate logistic regression analysis was conducted, and high 1-month post-discharge BNP levels remained an independent predictor of hospital readmission ($p < 0.05$). The underscores the robustness of the association between elevated BNP levels at the time point and increased risk of hospital readmission for heart failure or related causes.

Discussion

In the study involving 75 patients discharged after hospitalization for decompensated heart failure, several key findings emerged. The participants had a mean age of 65.8 years, with a notable predominance of male patients and a prevalent history of hypertension, diabetes mellitus, and coronary artery disease.

At the critical 1-month post-discharge follow-up, BNP levels were measured, revealing that 50.7% of patients had high BNP levels (680 pg/mL) while the remaining 49.3% had low BNP levels (280 pg/mL), a difference found to be statistically significant. These findings are particularly significant when considering the primary outcomes of the study.

Patients with high 1-month post-discharge BNP levels were shown to have a suggestively elevated risk of mortality, with an OR of 2.63, signifying that they were approximately 2.63 times more likely to experience mortality within 6 months compared to those with low BNP levels. Even after adjusting for potential confounding factors such as age, sex, and comorbidities, 1-month post-discharge BNP levels remained an independent predictor of mortality.

Additionally, high BNP levels were strongly associated with a markedly higher risk of hospital readmission within 6 months, as evidenced by an OR of 3.14. Multivariate analysis further confirmed

the independent predictive value of high BNP levels for hospital readmission.

These findings underscore the critical prognostic significance of 1-month post-discharge BNP levels, emphasizing their role in identifying high-risk patients after decompensated HF and suggesting the potential for tailored interventions to improve outcomes in the vulnerable population.

Recent studies have underscored the prognostic significance of biomarkers and health indices in patients discharged after hospitalization for decompensated heart failure. For instance, research has highlighted the utility of BNP concentration as a prognostic indicator for predicting mortality and re-hospitalization at 1-month follow-up, emphasizing the need for comprehensive medication treatment and continuous monitoring [5]. Additionally, the impact of post-discharge changes in hemoglobin levels on the prognosis of heart failure patients has been validated, pointing to anemia as a critical factor in the management of heart failure with preserved ejection fraction (HFpEF) [6].

The role of digital health technologies in improving post-discharge care and clinical outcomes through telemedicine modalities has also been explored, offering a promising avenue for remote disease management [7]. Furthermore, the systemic inflammation-nutrition index and the Barthel Index/Blood Urea Nitrogen ratio have been identified as useful tools for predicting post-discharge prognosis in HFpEF patients and those with acute decompensated heart failure, respectively, highlighting the importance of comprehensive assessments in guiding post-discharge care [8, 9].

Conclusion

The results of the study exhibited a significant association between 1-month post-discharge BNP levels and adverse outcomes in participants with decompensated HF. Patients with high BNP levels at the time point had a higher risk of both mortality and hospital readmission within 6 months of discharge, even after adjusting for potential confounding factors. These findings emphasize the prognostic value of 1-month post-discharge BNP levels in identifying high-risk patients and suggest the importance of incorporating BNP measurements into risk stratification and management strategies for the population.

Limitations: The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendation: Healthcare providers should consider monitoring 1-month post-discharge BNP levels in patients recovering from decompensated heart failure as a valuable tool for risk stratification. Elevated BNP levels at this time point can help identify individuals at higher risk of mortality and hospital readmission, allowing for targeted interventions and improved post-hospitalization care.

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List of abbreviations:

1. BNP: Brain Natriuretic Peptide
2. HF: Heart Failure
3. OR: Odds Ratio
4. CI: Confidence Interval

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Conflict of interest: The authors have no competing interests to declare.

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