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Prognostic Significance of 1-Month Postdischarge BNP in Identifying Patients at High Risk of Mortality and Readmission After Decompensated Heart Failure

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ABSTRACT

Background: The current study relates to the utility of the levels of B-type natriuretic peptide (BNP) as a biomarker in the management and diagnostic evaluation of heart failure in various patient populations.

Methods: A comparison of BNP levels between patients with different types of heart diseases was conducted using ROC curve analysis to assess how well BNP could predict the degree of heart failure.

Results: The results established an important correlation between increased BNP, with risk of elevated BNP levels, and increased severity of the heart failure, proposing effectiveness of the peptide in the risk stratification and clinical decision-making.

Conclusion: Our findings confirm the necessity of BNP level testing implementation in practical clinical activity to provide enhanced options for shortening the diagnosis time and further treatment beginning among the heart failure patient population in order to improve their prognosis. The research in the future is assessing the potential of BNP in terms of this prediction in relation to different population demographics and, therefore, conducting a modification in terms of broader clinical applications. This study's findings add to strong and growing evidence-based support for BNP as a functional biomarker in cardiovascular health.

Key words: B-type natriuretic peptide, heart failure, biomarker, diagnostic accuracy, ROC curve, risk stratification, clinical practice.

I. INTRODUCTION

Heart failure is an important public health challenge. Most morbidity and mortality due to heart failure occur in populations of elderly individuals[1]. After an episode of decompensated heart failure, which is a state where the ability of the heart to pump blood is seriously impaired, patients are often at increased risk for subsequent hospital readmissions and mortality[2].

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 8, 2024

Adverse outcomes such as these compromise patient quality of life, consume a lot of healthcare resources, and hence necessitate an effective method for risk stratification after hospitalization[3].

B-type natriuretic peptide has recently emerged as one of the more useful biomarkers in the assessment and management of heart failure. It is synthesized in the ventricles and released in response to myocardial wall stretch and volume overload, thus serving as an index of cardiac dysfunction severity[4]. Several studies have shown that high BNP levels are proportional to severity and could turn out to be a predictor of outcomes in patients with heart failure. However, the exact timing of BNP measurement relative to patient discharge and its prognostic value over the critical post-discharge period remain active areas of investigation[5].

It is currently emerging that, in addition to Risk Score at discharge, measurement of BNP levels one month post-discharge may further help in elucidating a patient's risk profiling so that healthcare providers can identify patients who have a greater risk for mortality and readmission[6]. This period is critical since it actually represents a transition phase where, with the risk of decompensation higher, effective intervention strategies might make major differences in patient trajectories[7].

The present study is aimed at examining the prognostic significance of I-Month post-discharge BNP levels in patients hospitalized for decompensated heart failure. At this point, we hypothesized that an elevated BNP level would help spot high-risk patients for adverse outcomes, and then specific risk management strategies for improving clinical outcomes and reducing healthcare use could be implemented[8]. In this study, we would like to contribute to the current fast-growing literature in heart failure management and provide some insights that would help raise clinical practice in such a vulnerable patient population[9].

II. METHODS

Study Design and Population

The current study adopted a prospective cohort study design. It was intended to ascertain the prognostic value of the blood level estimation of B-type natriuretic peptide at one month after discharge in decompensated heart failure patients. The study population comprised adult patients who were admitted to Heritage Hospitals Lanka from January 2023 to December 2023 with a diagnosis of decompensated heart failure. The hospital at which this study is conducted is a tertiary care center, so most of the patients transferred here are complex and difficult to manage.

Inclusion Criteria

The study enrolled patients who fulfilled the following criteria:

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 8, 2024

- Aged ≥ 18 years
- Diagnosed with decompensated heart failure according to the American College of Cardiology/American Heart Association
- Admitted for a decompensation episode of acute heart failure
- Discharged alive and able to attend a follow-up visit within one month from discharge.
- Written informed consent to take part in the study was obtained.

Exclusion Criteria

Patients with any of the following criteria were excluded from the study:

- Presence of severe non-cardiac comorbidities, instigating a distinctly unfavorable prognosis, such as terminal stage malignancy or severe end-stage renal disease;
- Myocardial infarction within the last 30 days;
- Cardiac surgery in the last three months;
- Patient is currently enrolled in other investigational clinical trial;
- Patient is without formal, written consent and follow-up assessment.

Data Collection

The demographic characteristics, baseline data, clinical features, including details of the current admission regarding duration of heart failure, NYHA functional class, comorbidities, and laboratory parameters, were recorded at the time of admission. Immunoassay of BNP level, by specific technique or by commercially available kit, was done at the time of admission and was repeated 1 month after discharge on an outpatient basis. I-month BNP levels were obtained following the standard protocols adhered to through Heritage Hospitals Lanka.

Follow-up

Patients were followed for a period of one year after discharge. Clinical data on all cause mortality and readmissions related to heart failure were found in electronic medical records and in follow-up appointments. In this case, an event of readmission applies to any hospitalization within 30 to 180 days after discharge due to heart failure exacerbation.

Outcomes

The primary study endpoints were evaluated based on the findings of the outcome of all-cause mortality rates and non-planned readmission rates. The secondary endpoints were measured

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 8, 2024

based on timing and causes of readmissions, and changes to patient functional status measured during the follow-up visits using the NYHA classification.

Statistical Analysis

Descriptive statistics for the demographic and clinical characteristics of the study population were first calculated. Continuous data were expressed as either mean and standard deviation or median and interquartile range, as appropriate, and categorical data were expressed as frequency and percentage. The multivariable Cox regression hazard model was used to assess the association between I-Month BNP levels with the outcome after adjustment for possible confounders, including age, gender, baseline ejection fraction, comorbid conditions, and prior hospitalization for heart failure. The ROC curves were employed to test the predictive value of BNP levels in I-Month on mortality and rehospitalization, with cut-off points formulated for optimal risk stratification.

Ethics Statement

This research adhered to the Declaration of Helsinki and was approved by the Institutional Review Board of Heritage Hospitals Lanka Written informed consent was obtained from all participants.

We try to describe the role of I-MONTH post-discharge BNP in predicting ADVERSE outcomes in patients with decompensated heart failure using a robust methodology and, hopefully, will contribute to an improved patient management strategy in clinical practice.

III. RESULTS

Study Population

A total of 250 patients with decompensated heart failure were screened. After the inclusion and exclusion criteria were applied, 210 patients of average age 68.4 ± 12.3 remained for the study. Their demographic and clinical characteristics are represented in Table 1.

Table.1: Baseline Characteristics of the Study Population

Characteristic	***Total (N = 210)***	***Percentage (%)***
Age (years)	*68.4 ± 12.3*	
Gender		

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 8, 2024

- Male	*115*	*55.0*
- Female	*95*	*45.0*
Ethnicity		
- Caucasian	*125*	*59.5*
- African American	*30*	*14.3*
- Hispanic	*55*	*26.2*
Comorbidities		
- Hypertension	*147*	*70.0*
- Diabetes Mellitus	*105*	*50.0*
- Chronic Kidney Disease	*63*	*30.0*
NYHA Functional Class		
- Class I	*15*	*7.1*
- Class II	*40*	*19.0*
- Class III	*95*	*45.2*
- Class IV	*60*	*28.6*
Baseline Ejection Fraction (%)	*35.6 ± 10.2*	

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 8, 2024

Correlation of BNP Levels with Clinical Outcomes

The I-Month BNP levels were taken at an average of 30.2 ± 5.4 days postdischarge. In Fig. 1, the distribution curve of the I-Month BNP levels is shown. The mean I-Month BNP level was 520 ± 180 pg/mL.

Figure.1: Distribution of I-Month BNP Levels

Mortality, Readmission Rates

Within the 12-month follow-up, 15% of the cohort died, and 25% were readmitted for heart failure. There was a highly positive significant correlation between elevated BNP levels and mortality or readmission rates.

Table.2: Correlation of BNP Levels with Mortality and Readmission Rates

BNP Level (pg/mL)	*Mortality Rate (%)*	*Readmission Rate (%)*
< 300	*3.0*	*6.0*
300 - 600	*12.2*	*22.0*
> 600	*36.0*	*50.0*

Risk Stratification by BNP Levels

Receiver Operating Characteristic analysis was constructed to measure the predictive performance of BNP levels for mortality and readmission in the 12-month follow-up period. The AUC for BNP levels with regard to mortality prediction was 0.81, with 95% CI 0.75-0.87, reflecting good predictive capability. The optimal cut-off value for BNP was 480 pg/mL, producing sensitivity of 85% and specificity of 75%.

Figure.2: ROC Curve for BNP Levels Predicting Mortality Over 12 Months

Summary of the Findings

In patients with decompensated heart failure, it was shown in this study that higher I-Month BNP levels immediately after discharge were significantly related to mortality rate and readmission during a 12-month follow-up. The results suggest that for this patient population, I-Month BNP could be an appropriate risk stratification marker.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 8, 2024

One-month post-discharge BNP levels provide a useful index for prognosis in patients recovering from decompensated heart failure. Further studies are needed to confirm findings of the prognostic potential of BNP levels to be measured at one month post-discharge for predicting death or readmission within the next year. A targeted intervention strategy should be built on such an index in order to reduce mortality and readmissions in the next year.

IV. DISCUSSION

Recently, the evaluation of B-type natriuretic peptide levels has become a very important factor in the prognostic assessment of cardiac patients. In this research, we aimed to outline the patterns of BNP levels among various categories of patients and show how effective it is as a predictive biomarker of adverse events. Our results support that an elevated BNP correlates significantly with poor clinical outcomes, hence establishing the role of BNP in cardiovascular risk stratification[10].

It clearly explains the distribution of the BNP levels observed among patients, according to the risk levels in which they fall. Actually, the bulk fell within the intermediate range for BNP level, indicating that possibly a good percentage of the population may be predisposed to a high level of cardiovascular risks[11]. This concurs with many studies showing that an elevated BNP correlates with worsening cardiac function and poorer prognosis. The vast majority of patients with high BNP levels (> 600 pg/mL) underlines the need for focussed intervention in this subgroup, as patients in this group are exposed to a far higher risk of adverse events[12].

Moreover, analysis has shown that there was a strong relation between the BNP level and mortality risk, as evidenced by this created ROC curve. The AUC represents the predictive power of BNP in mortality assessment and establishes its applicability in a clinical setting. The findings are in accordance with those of previous studies supporting the routine clinical application of BNP testing for the evaluation of heart failure or other conditions relating to cardiac disease[13]. An established critical BNP threshold can therefore result in an improved stratification, management, and possible outcome improvement due to the timely performance of interventions.

In addition, the implications of BNP as a biomarker reach beyond diagnostic utility to include individualized patient management[14]. The BNP level may help in guiding therapeutic decision-making, risk assessment, and educating the patient about his or her heart health. Since it is such an inexpensive test, it could end up contributing significantly to reducing the burden of cardiovascular diseases if integrated into everyday clinical practice[15].

The study has several limitations. These are observational data and hence may be open to many confounding variables. Diverse ethnicity of the cohort requires careful generalization and extrapolation of results to other populations. There is a further need for studies to determine

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 8, 2024

from the longitudinal data if there are causal links between BNP levels and long-term outcome, and if interventions based on BNP measurements have a positive effect[16][17].

This clearly establishes the bottom line of this study: BNP levels in assessing cardiovascular risk and mortality. Since BNP is an easily accessible marker, with BNP testing, it potentially can become one of the cornerstones for guiding clinical decisions to help optimize patient outcomes in cardiac care. Continued research toward the optimization of BNP utilization is likely to be useful for improved management strategies in the future and lead to a reduction in cardiovascular morbidity and mortality[17][18].

V. CONCLUSION

This study points to a major role of BNP levels as a biomarker in the evaluation of heart failure and cardiovascular health. Comparison of BNP levels between different patient groups based on ROC curve diagnostic accuracy revealed high levels of BNP being correlated with the severity of heart failure[19]. The result suggests that BNP testing can help provide valuable insights into the management and risk stratification of patients, thus offering timely interventions that help in the improvement of outcomes for the patients[20].

Moreover, such findings support the necessity for BNP level assessment inclusion in routine practice since it could lead to the improvement in the early diagnosis of heart failure or even monitoring the treatment. Future studies should continue to explore the potential of BNP in diverse populations and further fine-tune its application in predictive modeling. This could provide a better insight into the fine details of BNP as a functional biomarker for heart health and clinical protocols while expanding the study scope, to achieve optimized patient care.

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