Section: General Medicine

Original Research Article

CLINICAL UTILITY OF NT-PRO BNP IN MANAGING HEART FAILURE IN TERTIARY CARE SETTINGS

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ABSTRACT

Background: Heart failure (HF) is a major cardiovascular disorder in India, with rising prevalence due to aging and comorbidities. NT-proBNP is a validated biomarker for diagnosing and prognosticating HF, especially in tertiary care settings. The objective is to assess the diagnostic and prognostic value of NT-proBNP in heart failure patients and its correlation with clinical features, NYHA class, and echocardiographic findings. **Materials and Methods:** This was a cross-sectional observational study conducted over 18 months in a tertiary care hospital in Chitradurga. A total of 125 patients above 18 years presenting with HF symptoms were enrolled using convenience sampling. NT-proBNP levels were measured and correlated with NYHA class, LVEF, and other clinical and laboratory parameters. Data were analyzed using SPSS 20.0, with significance set at $p < 0.05$. **Result:** The majority (30.4%) of patients were aged 60–70 years. Most presented with NYHA Class III–IV (67.2%), and 62.4% had systolic dysfunction. NT-proBNP levels showed significant positive correlation with NYHA class ($r = 0.394$), serum creatinine ($r = 0.379$), and CKD stage ($r = 0.346$), and negative correlation with hemoglobin ($r = -0.255$). Ischemic heart disease (36%) and hypertension (27.2%) were the leading HF etiologies. **Conclusion:** NT-proBNP is a reliable biomarker for diagnosis, risk stratification, and prognosis of heart failure, particularly in resource-intensive tertiary care environments.

INTRODUCTION

Heart failure (HF) remains one of the most challenging cardiovascular disorders globally, with a rising burden in developing countries like India due to aging populations and increasing prevalence of comorbidities such as diabetes and hypertension. In tertiary care settings, where diagnostic accuracy and timely management are critical, biomarkers like N-terminal pro-B-type natriuretic peptide (NT-proBNP) have emerged as essential tools for diagnosing, stratifying, and managing heart failure patients effectively.

NT-proBNP, a byproduct of the cleavage of proBNP released by ventricular myocytes in response to volume expansion and pressure overload, has been increasingly validated as a sensitive and specific marker of heart failure severity and prognosis. Its role becomes especially vital in tertiary care hospitals, where complex cases often require swift and accurate triage.

The utility of NT-proBNP in emergency settings was emphasized in a North Indian tertiary care study, which included 150 symptomatic HF patients, where NT-proBNP not only enabled rapid diagnosis but also facilitated economic healthcare delivery by reducing unnecessary hospitalizations and costs. This biomarker was found to correlate significantly with ejection fraction and lipid abnormalities among diabetic patients with HF, underlining its dual prognostic and diagnostic utility.[1]

In a broader tertiary hospital context, NT-proBNP levels were shown to correlate with the severity of acute decompensated heart failure and predict adverse events like re-hospitalizations and mortality. A prospective Indian study highlighted that elevated NT-proBNP levels were significantly more common in ST-elevation myocardial infarction (STEMI) patients than in non-STEMI or unstable angina, proving its prognostic role across the acute coronary syndrome spectrum.[2]

Comparative research also established NT-proBNP's superiority over newer biomarkers like copeptin in predicting 90-day cardiovascular events, asserting

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that NT-proBNP remains a gold standard in HF prognosis. The data underscored that NT-proBNP was a more consistent predictor of survival and risk than copeptin alone in patients with severe HF.[3]

The significance of NT-proBNP in heart failure management extends to therapeutic monitoring. A randomized controlled pilot trial showed that serial NT-proBNP measurements during hospitalization could guide more effective therapy adjustment, shorten hospital stays, and potentially reduce complications such as renal dysfunction and electrolyte imbalances.[4]

Moreover, NT-proBNP is not only effective in diagnosing heart failure but also helps differentiate cardiac from non-cardiac causes of dyspnea in emergency settings. A study from Marmara University validated that NT-proBNP levels were significantly higher in hospitalized HF patients than in outpatients, making it a reliable criterion for hospitalization decisions.[5]

However, NT-proBNP levels should be interpreted cautiously in elderly populations. A study evaluating elderly HF patients (>75 years) found that NT-proBNP was not a consistent prognostic marker in this group, except when levels exceeded 8000 pg/mL, indicating a potential age-related variability in its prognostic power.[6]

Interestingly, NT-proBNP also plays a role in risk stratification for patients not yet diagnosed with heart failure. A Romanian study showed that among hypertensive patients without overt HF, those managed based on NT-proBNP values had significantly lower rates of progression to heart failure and fewer hospitalizations.[7]

In the pediatric population, NT-proBNP has also proven useful. In infants under three years with congenital heart disease and dilated cardiomyopathy, NT-proBNP levels were found to correlate negatively with left ventricular ejection fraction, aiding early HF diagnosis in this group.[8]

Furthermore, NT-proBNP has implications even in pre-HF stages. A pilot study demonstrated that its use in patients with hypertension or ischemic heart disease—without established HF—enabled early therapeutic intervention, potentially preventing disease progression.[9]

Finally, NT-proBNP's robust diagnostic and prognostic capabilities are especially valuable in tertiary care settings where timely interventions can significantly influence outcomes. A comprehensive review affirmed that NT-proBNP remains a stable, reliable, and cost-effective biomarker in heart failure management across diverse patient demographics, though its interpretation must consider confounding factors like renal function and obesity.[10]

NT-proBNP plays a crucial role in the diagnosis, risk stratification, and therapeutic monitoring of heart failure, particularly in tertiary care hospitals where resource optimization and timely decision-making are vital. Its consistent association with prognosis, ease of measurement, and clinical applicability make it an indispensable tool in modern cardiology.

This study aimed to assess the diagnostic and prognostic value of NT-proBNP in heart failure patients, and its correlation with clinical features, NYHA class, and echocardiographic findings in a tertiary care setting.

MATERIALS AND METHODS

Study Design: This was a hospital-based cross-sectional observational study conducted to assess the relevance of NT-proBNP in patients with clinical features of heart failure.

Study Setting: The study was conducted in the Department of General Medicine, Basaveshwara Medical College and Hospital, Chitradurga, including patients from OPD, IPD, and the emergency department.

Study Duration: The study was carried out over a period of 18 months, from May 1, 2023, to October 31, 2024, ensuring adequate data collection and analysis.

Participants – Inclusion/Exclusion Criteria

Patients above 18 years with signs and symptoms of heart failure and who gave informed consent were included. Patients with valvular heart disease or non-cardiac causes of symptoms were excluded.

Study Sampling: A convenience sampling method was used to enroll all eligible and consenting patients who presented with suspected heart failure during the study period.

Study Sample Size: The sample size was calculated based on a 1% prevalence of heart failure in India, yielding a minimum of 15, and inflated to 125 for statistical validity.

Study Groups: No intervention groups were formed. Patients were stratified based on NYHA classification and NT-proBNP levels for internal comparison and analysis.

Study Parameters: The study focused on NT-proBNP levels, NYHA class, echocardiographic findings, and clinical signs and symptoms, along with other relevant laboratory parameters.

Study Procedure: Eligible patients were clinically evaluated, classified by NYHA, and underwent NT-proBNP testing, echocardiography, and supporting investigations. Findings were documented in a structured proforma.

Study Data Collection: Data were collected prospectively using a standardized form and later entered into Excel for coding and organization before statistical analysis.

Data Analysis: Data were analyzed using SPSS version 20. Chi-square tests were used for categorical variables and t-tests for continuous data. A p-value <0.05 was considered significant.

Ethical Considerations: The study was approved by the Institutional Ethics Committee. Written informed consent was obtained, and patient confidentiality was strictly maintained.

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RESULTS

Age Distribution of Study Participants: The majority of patients (30.4%) were aged 60–70 years, highlighting that heart failure predominantly affects the elderly population in this setting. Only 6.4% were under 30 years, showing lower prevalence in young adults [Table 1].

Table 1: Age Distribution of Study Participants

Age Group (years)		Frequency	Percent
Valid	20-30	8	6.4
	30-40	7	5.6
	40-50	6	4.8
	50-60	29	23.2
	60-70	38	30.4
	70-80	18	14.4
	80-90	17	13.6
	90-100	2	1.6
	Total	125	100.0

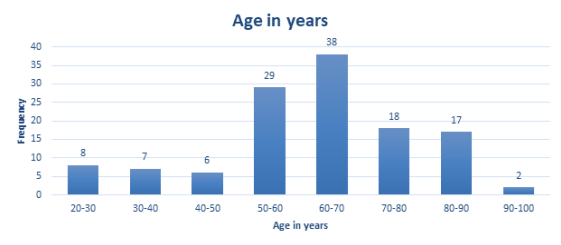

Figure 1: Age Distribution of Study Participants

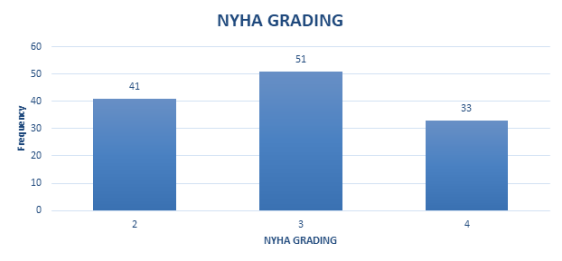

Figure 2: NYHA Functional Class Distribution

NYHA Functional Class Distribution

Over two-thirds of patients (67.2%) presented with NYHA Class III–IV, indicating that most had moderate to severe heart failure symptoms at presentation [Table 2].

Left Ventricular Ejection Fraction (LVEF) Stage

Systolic dysfunction was evident in 62.4% of cases (mild, moderate, or severe), supporting BNP as a marker of reduced cardiac contractility [Table 3].

Table 2: NYHA Functional Class Distribution

NYHA grading		Frequency	Percent
Valid	2	41	32.8
	3	51	40.8
	4	33	26.4
	Total	125	100.0

Table 3: LVEF Stage Distribution

LVEF stage		Frequency	Percent
Valid	MILD	32	25.6
	MODERATE	31	24.8
	Normal	47	37.6
	SEVERE	15	12.0
	Total	125	100.0

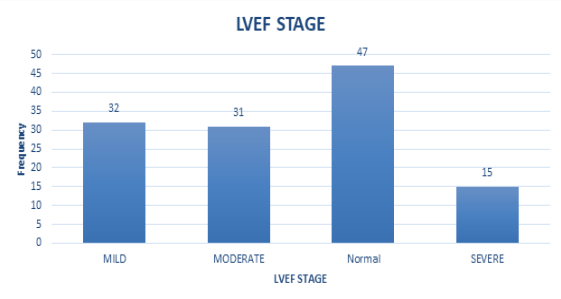

Figure 3: LVEF Stage Distribution

Correlation of BNP Levels with Clinical Parameters

BNP levels showed significant positive correlation with NYHA class, creatinine, and CKD stage, and negative correlation with hemoglobin, indicating their combined influence on BNP interpretation [Table 4].

Etiology of Heart Failure: Ischemic heart disease (36.0%) and hypertension (27.2%) were the leading causes of heart failure, reflecting their dominant role in HF burden at this tertiary center [Table 5].

Table 4: Correlation of BNP Levels with Clinical Parameters

Correlations						
		Age	NYHA grading	HB	Creatinine	CKD stage
BNP levels	Pearson Correlation	0.018	0.394	-0.255	0.379	0.346
	p value	0.421	0.000	0.002	0.000	0.000

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Table 5: Etiology of Heart Failure

Cause of Heart Failure		Frequency	Percent
Valid	ANEMIA	5	4.0
	ASD	1	0.8
	CARDIAC TAMPONADE	1	0.8
	CARDIOMYOPATHY	16	12.8
	HTN	34	27.2
	ISCHEMIC	45	36.0
	VALVULAR	23	18.4
	Total	125	100.0

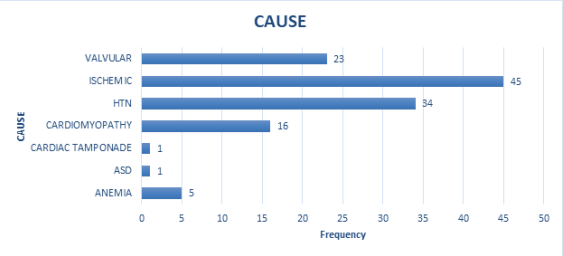

Figure 5: Etiology of Heart Failure

DISCUSSION

This study highlights key clinical and demographic features of heart failure (HF) patients in a tertiary care setting, with emphasis on age distribution, NYHA functional class, LVEF status, BNP correlation, and etiological factors.

The age distribution revealed that the majority (30.4%) of patients were in the 60–70-year age group, which is consistent with other Indian and global studies indicating HF as a disease of the elderly. For example, Joshi et al. (2024) found a mean age of 62.5 years among patients screened for occult HF using NT-proBNP, with increasing age correlating with higher NT-proBNP levels and HF risk.[11] Similarly, Siddiqui et al. (2024) reported significant heart failure morbidity among older diabetic patients.[1]

In terms of NYHA functional classification, 67.2% of our patients were in Class III–IV, indicating advanced symptoms. This aligns with findings by Athavale and Pathak (2022), who reported that most HF patients in Indian hospitals present at later stages, likely due to delayed diagnosis and poor primary care access.[12]

LVEF evaluation revealed systolic dysfunction in 62.4% of patients, supporting the role of NT-proBNP as a marker of impaired left ventricular function. Prior studies also observed this pattern. Br et al. (2014) found a >50% drop in NT-proBNP levels post-treatment in patients with systolic dysfunction, validating its role in therapy monitoring.[13]

Our study showed that BNP levels positively correlated with NYHA class, creatinine, and CKD stage and negatively with hemoglobin. Similar correlations were noted by Kv (2021), who emphasized interpreting NT-proBNP with caution in CKD patients due to renal clearance impact.[14]

Lastly, ischemic heart disease (36%) and hypertension (27.2%) were the most common HF causes in our cohort. This mirrors trends in Indian tertiary centers where IHD and HTN remain dominant HF contributors, as shown in studies by Joshi et al. (2024) and Athavale & Pathak (2022).[11,12] In summary, our findings closely reflect national trends, reinforcing the clinical value of NT-proBNP in diagnosing and managing HF in older, comorbid patients commonly presenting at late stages.

CONCLUSION

This study reinforces NT-proBNP's relevance as a powerful tool in heart failure management. Its significant correlation with NYHA class, renal function, and echocardiographic parameters demonstrates its diagnostic and prognostic utility in tertiary care settings. NT-proBNP can aid in identifying high-risk patients, guiding clinical decisions, and potentially improving outcomes. However, its interpretation must account for confounders like age, renal dysfunction, and anemia to ensure accurate clinical judgment.

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