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CLINICAL UTILITY OF B-TYPE NATRIURETIC PEPTIDE (BNP) IN THE EARLY DIAGNOSIS OF HEART FAILURE: A RESEARCH-ORIENTED REVIEW

Abstract: Heart failure (HF) is a major cause of morbidity and mortality worldwide, requiring early and accurate diagnosis for optimal management. Clinical evaluation alone is often insufficient due to nonspecific symptoms. B-type natriuretic peptide (BNP) has emerged as a key biomarker reflecting myocardial stress. This review evaluates the diagnostic performance, clinical applications, and limitations of BNP in early HF detection. Evidence demonstrates that BNP testing provides high sensitivity for ruling out HF and improves diagnostic accuracy, particularly in patients presenting with acute dyspnea. Integration of BNP into clinical algorithms enhances early diagnosis and risk stratification.

Keywords: BNP, NT-proBNP, heart failure, biomarkers, early diagnosis, natriuretic peptides

Introduction

Heart failure is a complex clinical syndrome characterized by impaired ventricular function, leading to insufficient cardiac output and/or elevated intracardiac pressures. It represents one of the leading causes of hospitalization among adults and is associated with significant healthcare burden.

Early diagnosis remains challenging due to overlapping symptoms such as dyspnea, fatigue, and fluid retention, which are not specific to HF and may occur in pulmonary diseases, anemia, or renal dysfunction.

Biomarkers, particularly natriuretic peptides, have transformed the diagnostic approach. BNP is released from ventricular myocardium in response to increased wall stress and volume overload. Current international guidelines strongly recommend BNP measurement as part of the diagnostic algorithm for suspected HF, particularly in patients presenting with unexplained dyspnea.

Pathophysiological Basis of BNP

BNP is synthesized as pre-proBNP and cleaved into biologically active BNP and inactive NT-proBNP. Its secretion is triggered by:

- ✓ Ventricular stretch
- ✓ Pressure overload
- ✓ Myocardial ischemia
- ✓ Neurohormonal activation

At the molecular level, BNP gene expression is upregulated in response to increased myocardial wall tension via signaling pathways involving calcium influx and stretch-activated ion channels.

Physiological Effects:

- ✓ Natriuresis and diuresis
- ✓ Vasodilation via cyclic GMP pathways
- ✓ Inhibition of RAAS
- ✓ Suppression of sympathetic nervous system

These mechanisms collectively act as a compensatory response to volume overload, making BNP a direct biochemical marker of cardiac stress and dysfunction.

BNP vs NT-proBNP: Clinical and Biological Differences

Although both BNP and NT-proBNP originate from the same precursor, their clinical utility differs:

Parameter	BNP	NT-proBNP
Biological activity	Active hormone	Inactive fragment
Half-life	~20 minutes	60–120 minutes
Stability	Lower	Higher
Renal clearance	Moderate	Significant
Clinical preference	Acute settings	Chronic monitoring

NT-proBNP is often preferred for long-term monitoring due to its greater stability, whereas BNP is commonly used in acute care settings.

Methods

This article is a narrative research-style review based on analysis of:

- ✓ PubMed-indexed clinical trials
- ✓ ESC and AHA guidelines
- ✓ Observational and diagnostic accuracy studies
- ✓ Inclusion criteria
- ✓ Studies evaluating BNP/NT-proBNP in HF diagnosis
- ✓ Studies reporting sensitivity, specificity, predictive values
- ✓ Guidelines published after 2015

Results

Diagnostic Accuracy of BNP

BNP demonstrates high diagnostic utility, especially in acute care settings:

- ✓ Sensitivity: up to 94%
- ✓ Specificity: ~74%
- ✓ Diagnostic accuracy: ~86% in dyspneic patients

At a threshold of 100 pg/mL, BNP shows high sensitivity (~0.95), making it particularly useful for ruling out HF.

Clinical Cut-off Values and Interpretation

Clinical Setting	BNP Level (pg/mL)	Interpretation
Chronic HF	<35	HF unlikely
Chronic HF	>125–150	HF likely
Acute HF	<100	HF unlikely
Acute HF	100–400	Grey zone
Acute HF	>400	HF very likely

Role in Differential Diagnosis

BNP is especially valuable in distinguishing:

- ✓ Cardiac dyspnea (HF) vs pulmonary dyspnea (COPD, asthma)
- ✓ HF vs pulmonary embolism
- ✓ HF vs renal-related fluid overload

This reduces unnecessary imaging and improves diagnostic efficiency.

Prognostic Value of BNP

BNP is not only diagnostic but also prognostic:

- ✓ Higher BNP levels correlate with increased mortality
- ✓ Predicts risk of hospitalization
- ✓ Reflects severity of ventricular dysfunction

Serial BNP measurements are useful for monitoring disease progression.

BNP-Guided Therapy

Emerging evidence supports BNP-guided treatment strategies:

- ✓ Adjusting diuretics and HF medications based on BNP levels
- ✓ Reducing rehospitalization rates
- ✓ Improving long-term outcomes

However, results remain variable, and guideline recommendations are cautious.

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Discussion

The integration of BNP into clinical practice represents a major advancement in cardiology. Compared to traditional diagnostic approaches based solely on symptoms and physical examination, BNP provides an objective, quantitative marker of cardiac dysfunction.

One of the most important strengths of BNP is its high negative predictive value, allowing clinicians to confidently exclude HF in patients with low levels. This is particularly useful in emergency departments where rapid decision-making is essential.

However, BNP interpretation must consider confounding factors:

- ✓ Factors Increasing BNP
- ✓ Renal dysfunction (reduced clearance)
- ✓ Advanced age
- ✓ Pulmonary hypertension
- ✓ Sepsis and systemic inflammation
- ✓ Factors Decreasing BNP
- ✓ Obesity (increased clearance and reduced secretion)
- ✓ Early-stage HF

Another limitation is variability between BNP and NT-proBNP assays, which may affect interpretation across different laboratories.

Despite these challenges, BNP remains one of the most validated and widely used biomarkers in cardiovascular medicine.

Future Directions

Future research is focusing on:

- ✓ Multi-biomarker strategies (BNP + troponin + ST2 + galectin-3)
- ✓ Integration with artificial intelligence for early prediction
- ✓ Use in asymptomatic high-risk populations
- ✓ Personalized medicine approaches using BNP-guided therapy

Conclusion

BNP testing is a powerful tool for the early diagnosis of heart failure. Its high sensitivity, rapid availability, and strong guideline support make it indispensable in modern clinical practice. When combined with clinical evaluation and imaging, BNP significantly improves diagnostic accuracy, enables early intervention, and enhances patient outcomes.

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