

Original research article

## Serum BNP level's importance in the tertiary hospital's heart failure study with preserved ejection fraction

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### Abstract

**Background and Objective:** In order to investigate the significance of serum B type Natriuretic peptide levels in individuals who exhibit acute left heart failure while maintaining their ejection fraction

**Method:** This study included 40 patients with a diagnosis of diastolic dysfunction who presented to emergency department. BNP values, a thorough 2D Echo, and standard blood samples were obtained. The chi-square test, percentage, and standard error of proportion were used in the statistical study.

**Result:** In the current study, 40 HFPEF patients were included, with a mean age group of 64.86 years. The majority of the patients (65%) were female, and their mean BMI was 25.24 kg/m<sup>2</sup>. They were overweight, with concomitant comorbidities including diabetes mellitus (64%) and hypertension (70%). The majority of the patients in the current study had higher BNP levels, which were significantly correlated with all the criteria, including age, sex, comorbidities, LA size (p-0.001), Diastolic Dysfunction type (p-0.033), and NYHA grade.

**Conclusion:** Monitoring the preclinical course of diastolic illness and preventing hospitalisation for heart failure should be the main priorities. Therefore, research needs to be done to determine whether patients would benefit from more monitoring and stricter management of their risk factors.

**Keywords:** Serum BNP level, heart failure, ejection fraction, echocardiography

### Introduction

Heart failure is a medical condition characterised by a specific group of symptoms associated with the accumulation of fluid in the lungs and veins. This is caused by the heart's reduced ability to circulate blood in response to the body's metabolic needs. This leads to the typical symptoms of exhaustion and shortness of breath, as well as signs of heart failure such as crackles and swelling. The incidence of heart failure (HF) in the Western population is approximately 2%, with a significant increase from 1% in individuals under 40 to 10% in those over 75. Among individuals aged 65 and older, it is the primary reason for hospitalisation. This condition is very incapacitating and imposes significant financial and public health burdens. It has a high mortality rate and requires frequent hospital visits. Currently, HFpEF leads to clinical heart failure in 50% of instances, frequently necessitating hospitalisation and posing a significant risk of morbidity and mortality<sup>[1-3]</sup>.

In obese people with both chronic lung illness and respiratory distress, echocardiography is not beneficial for managing the condition, and it becomes more challenging to diagnose heart failure in patients with a normal ejection fraction. In order to overcome these constraints, an accurate diagnosis and prognosis necessitate the utilisation of biochemical markers that clearly differentiate the occurrence and severity of heart failure. B-type natriuretic peptide (BNP) is widely utilised as a laboratory test due to its demonstrated clinical utility in diagnosing and evaluating the prognosis of heart failure, as supported by several research. Elevated levels of B-type natriuretic peptide (BNP) in the bloodstream correspond to the exacerbation of heart failure symptoms, whereas a decrease in BNP levels indicates an improvement in heart failure symptoms. Individuals with heart failure, especially those with stable heart failure, have greater levels of BNP compared to individuals with normal cardiac function<sup>[4-6]</sup>.

Congestive heart failure is characterised by the presence of lung crepitations, pulmonary edoema, ankle swelling, hepatomegaly, dyspnea during exertion, and weariness. It is essential to distinguish between various forms of dyspnea, such as nocturnal or effort-related, in order to accurately identify and diagnose them. In Heart Failure with Preserved Ejection Fraction (HFNEF), dyspnea commonly serves as the primary indication of pulmonary congestion. Managing heart failure with diastolic dysfunction might be hard due to its less well-defined nature compared to heart failure with systolic dysfunction. Therefore, study is necessary. An investigation will be conducted to determine the significance of elevated levels of

brain type natriuretic peptide (BNP) in individuals with heart failure with preserved ejection fraction (HFpEF), who were identified using echocardiography (ECHO). The results of this study, particularly the ECHO and clinical data, will help to elucidate the diastolic dysfunction syndrome, offer guidance, and support the creation of enhanced care strategies for patients affected by it [7-9].

**Material and Methods**

A cross-sectional investigation was carried out at Department of General Medicine, Government Siddhartha Medical College, Vijayawada, Andhra Pradesh, India from November 2022 to December 2023. At the time of enrollment, informed and written consent was acquired from all eligible patients.

**Inclusion Criteria**

- Over the age of eighteen and willing to give consent.
- LVEF >50% on a comprehensive examination by transthoracic echocardiography.
- The presence of LV Dystolic Issues.

**Exclusion Criteria**

- People having an LVEF of 55 mm.
- People experiencing cardiac arrhythmias.
- Patients who refuse to provide permission.

**Result**

**Table 1:** BNP'S Importance in HFPEF Patients with Dyslipidemia and Those Without

BNP	Less than 100 pg/ml	100-400 pg/ml	>400 pg/ml	Grand Total
Normal	5 (16%)	7 (21%)	20 (63%)	32
Dyslipidemic			8 (100%)	8
Grand Total	5 (12%)	7 (18%)	28 (70%)	40

**Table 2:** Patients with HFPEF: The Importance of BNP with Nyha Grading

BNP	Less than 100 pg/ml	100-400 pg/ml	>400 pg/ml	Grand Total
NYHA Grade 3	5 (25%)	5 (25%)	10 (50%)	20
NYHA Grade 4		5 (25%)	15 (75%)	20
Grand Total	5 (12.5%)	10 (25%)	25 (62.5%)	40

**Table 3:** Patients With HFPEF: BNP Relevance with Left Atrial Diameter

LA Diameter	Less than 100 pg/ml	100-400 pg/ml	>400 pg/ml	Grand Total
30-40 mm	3 (20%)	4 (27%)	8 (53.3%)	15
>40 mm		4 (16%)	21 (84%)	25
Grand Total	3 (7.5%)	8 (20%)	29 (72.5%)	40

**Table 4:** Variables of Doppler Echocardiography for 40 Cases

Doppler Variables	Mean ± SD
E Velocity	1.16 ± 0.65 m/s
A Velocity	0.95 ± 0.36 m/s
E/A Ratio	1.75 ± 0.65
E/e' Ratio	16.64 ± 7.5

**Table 5:** Percentage of BNP in Patients with HFPEF Related to E/A Ratio

E/A	Less than 100 pg/ml	100-400 pg/ml	>400 pg/ml	Grand Total
<1	1 (7.1%)	3 (21.4%)	10(71.42%)	14
>1	2 (7.7%)	3 (11.5%)	21 (80.8%)	26
Grand Total	3 (7.5%)	6 (15%)	31 (77.5%)	40

**Table 6:** In Patients with HFPEF, The Relevance of BNP with Diastolic Dysfunction Type

Diastolic Dysfunction Type	Less than 100 pg/ml	100-400 pg/ml	>400 pg/ml	Grand Total
DD Type 1	4 (21%)	6 (31%)	9 (48%)	19
DD Type 2	2 (20%)	2 (20%)	6 (60%)	10
DD Type 3		2 (18%)	9 (82%)	11
Grand Total	6 (15%)	10 (25%)	24 (60%)	40

## Discussion

Heart failure with preserved ejection fraction (HFPEF) is linked to significant morbidity and mortality. Based on the available statistics, there is a clear upward trend in the number of individuals being diagnosed with heart failure with a decreased ejection fraction (HFPEF) over time. Furthermore, there has been an increase in both hospitalisation and mortality rates. Research should be conducted to determine the appropriate diagnostic criteria for HFPEF, in order to precisely identify persons with the illness and distinguish between cardiac patients and dyspnea induced by non-cardiac causes. The findings of our investigation revealed a strong correlation between age and BNP levels. Increasing age frequently leads to elevated BNP levels. Kayzer JM *et al.* did an analysis of variance which demonstrated that age had a significant effect on BNP readings ( $p < 0.001$ )<sup>[10-12]</sup>.

Recent research findings reveal that 62% of patients diagnosed with HFPEF were female, suggesting a greater occurrence of diastolic dysfunction in women. This result aligns with the conclusions of other studies, such as those conducted by Devereux *et al.*, who found that 84% of female patients had the same condition, Lee *et al.*, who found a prevalence of 65% among female patients, and Bursi *et al.*, who found a prevalence of 57% among female patients. The results of our investigation demonstrated a distinct association between gender and BNP value. Females demonstrated a higher BNP value in comparison to males, with 62% of the subjects being females and 38% being males. A study conducted by Roongsritong C *et al.* revealed that women had significantly elevated BNP levels compared to males with diastolic dysfunction ( $p=0.002$ ). Kayzer *et al.* discovered that gender had a noteworthy impact on BNP measurements ( $p=0.002$ )<sup>[13-15]</sup>.

In our present investigation, 56% of the individuals under examination had excess weight, as indicated by body mass indices (BMIs) falling within the range of 23 to 27.4 kg/m<sup>2</sup>. The observed variation can be ascribed to the initial discrepancies in the patients' height, weight, and ethnicity. Merely 12% of the participants in the present study with a high BMI exhibited BNP values that fell within the normal range. A study conducted by Dal K *et al.*, discovered a clear association between increased BNP levels and elevated HbA1C and FBS values. The results indicate that patients with diabetes have a higher occurrence of diastolic dysfunction compared to those without diabetes. This dysfunction is linked to increased levels of B-type natriuretic peptide (BNP). The majority of patients in our study did not show signs of anaemia. However, those with low levels of haemoglobin demonstrated elevated BNP values. More precisely, of the eight female patients with anaemia, five of them exhibited B-type natriuretic peptide (BNP) values over 400 pg/ml. Similarly, all five male patients with anaemia demonstrated B-type natriuretic peptide (BNP) levels over 400 pg/ml. Hirofumi Ueno and his colleagues conducted a study including 185 patients with heart failure to investigate the relationship between anaemia, BNP levels, and the occurrence of serious adverse cardiac events<sup>[16-18]</sup>.

The study revealed that the concurrent existence of anaemia and elevated BNP levels substantially augments the probability of such incidents. An analysis was conducted on the M mode echocardiography variables of the 40 participants. In their study, Omar Issa *et al.* found that all patients diagnosed with HFPEF had an average left atrium (LA) size of 40.2 mm, indicating enlargement. This research aimed to explore the correlation between LA size and HFPEF. In a second analysis, it was found that 357 individuals with HFPEF had bigger average left atrial diameters. As remodelling takes place and the compensatory mechanism becomes increasingly weakened due to rising pressure in the left ventricle, these patients will increasingly depend on the atrial pump function in the later stages of diastole to maintain proper filling of the ventricle. This will result in an elevation of afterload and tension within the chamber. Consequently, this will result in heightened pressure within the left atrium. Patients exhibiting an enlarged left atrium (LA) size experienced a higher rate of hospitalisation in comparison to individuals with a normal LA size<sup>[19-21]</sup>.

As the condition progresses, the left atrium's ability to improve its function decreases, resulting in insufficient compensation during the later stage of diastolic filling. This leads to the advancement of heart failure and a significant deterioration of symptoms. The computed p-value of 0.049 suggests that the observed outcome has statistical significance. Wu *et al.* found that individuals with heart failure who had a higher mean B-type natriuretic peptide (BNP) level also had New York Heart Association (NYHA) classifications III and IV.

At the onset of the trial, there were a grand total of twenty-three individuals exhibiting grade I diastolic dysfunction. Twelve patients have been identified with grade II diastolic dysfunction. There were a grand total of fifteen people who exhibited grade III diastolic dysfunction. Edelmann *et al.* assessed diastolic dysfunction using a comparable approach at the start of the trial. The majority of patients displayed grade I diastolic impairment, which is consistent with our research findings<sup>[21, 22]</sup>.

Moreover, when reassessing diastolic dysfunction one year after starting spironolactone treatment, it was observed that 98% of the patients retained the same level of dysfunction, even though they had successfully managed their hypertension. Our analysis revealed a positive correlation between diastolic dysfunction and elevated levels of B-type natriuretic peptide (BNP). Diastolic Dysfunction Type 3 demonstrated significantly higher BNP values compared to Type 1 and 2, as evidenced by a statistically significant difference ( $p = 0.0333$ ). Similarly, a study conducted by Scardovi AB *et al.* found that people

with severe diastolic dysfunction had higher levels of B type natriuretic peptide ( $459\pm 462\text{pg/mL}$  vs  $142\pm 166\text{pg/mL}$ ). There has been evidence demonstrating a connection between BNP values and LA size. The results of our study indicate that the majority of patients (54%) had a mean left atrial size beyond 40 mm, while 46% had a size falling within the normal range of 30 to 40 mm. Among the 27 cases of individuals with enlarged hearts in Los Angeles, 25 exhibited B-type natriuretic peptide (BNP) values over 400 picograms per millilitre (pg/mL). The findings of our analysis indicate a statistically significant outcome, with a p-value of 0.001<sup>[22-24]</sup>.

### Conclusion

Despite our increased knowledge about the illness, diagnosing these instances and initiating prompt treatment remains a difficult task. Progress in imaging techniques, diagnostic algorithms, and the utilisation of blood test BNP will enable the prompt identification and initiation of treatment in the early stages of the illness. These individuals can derive advantages from regulating blood pressure, managing diabetes, receiving education on heart failure (including the DASH diet, exercise, and yoga), and identifying and treating additional conditions such as anaemia and obesity, which could be the primary factors contributing to HFPEF. Serum BNP can function as an indicator for the correlation in situations where a diagnosis is not completely definitive. However, to effectively address this ailment, it is important to possess comprehensive knowledge of both the sickness itself and the accompanying circumstances. This study found a significant association between left atrial diameter, hypertension, diabetes mellitus, BNP, and HFPEF. Additionally, several coexisting medical conditions, such as obesity, dyslipidemia, atrial fibrillation, and AF, were seen. Therefore, measuring blood BNP levels can assist in categorising individuals based on their prognosis. However, additional research is necessary to determine if particular patients might benefit from more rigorous treatment of risk factors and closer monitoring.

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**Conflict of Interest:** Nil.

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