



Original Article

Correlation of Serum Nt-Probnp and 2d Echocardiographic Parameters in Patients with Heart Failure with Preserved Ejection Fraction

Dr. Magan Solanki¹, Dr. Nirmal Vyas², Dr. Anil Sankhla³, Dr Roopsingh Meena⁴

¹Senior Resident, Department of Medicine, Dr. S.N. Medical College, Jodhpur, Rajasthan

²Associate Professor, Department of Medicine, Dr. S.N. Medical College, Jodhpur, Rajasthan

³Associate Professor, Department of Medicine, Dr. S.N. Medical College, Jodhpur

⁴Senior Resident, Department of Medicine, Govt. Medical College, Karauli, Rajasthan

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ABSTRACT

Corresponding Author:

Dr. Magan Solanki

Senior Resident, Department of
Medicine, Dr. S.N. Medical
College, Jodhpur, Rajasthan

Email: maganslnk0@gmail.com

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Background: Heart failure with preserved ejection fraction (HFpEF) accounts for nearly half of heart failure cases. NT-proBNP is a useful biomarker, but its correlation with echocardiographic parameters in HFpEF remains underexplored.

Aim: To correlate serum NT-proBNP levels with 2D echocardiographic parameters in patients with HFpEF.

Methods: A cross-sectional observational study was conducted in 75 patients diagnosed with HFpEF at Dr. S.N. Medical College, Jodhpur. NT-proBNP levels were measured and compared with 2D echocardiographic parameters. Statistical analysis was performed using SPSSv22.

Results: Mean age was 64.8±13.2 years, with female predominance (58.7%). NT-proBNP levels were <400 pg/mL in 22.7%, 400–1200 pg/mL in 29.3%, and >1200 pg/mL in 48% of patients. NT-proBNP levels showed significant correlation with systolic blood pressure (p=0.041) and left atrial size (p=0.025). Higher NT-proBNP was associated with greater prevalence of hypertension, diabetes, and advanced NYHA class (p<0.05).

Conclusion: Serum NT-proBNP correlates with left atrial enlargement and severity of HF symptoms in HFpEF patients. Combining NT-proBNP with echocardiography enhances diagnostic and prognostic accuracy.

Keywords: Heart Failure, NT-proBNP, Echocardiography, HFpEF, Biomarkers.

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INTRODUCTION

Heart failure (HF) is a complex clinical syndrome characterized by impaired ventricular filling or ejection. HF with preserved ejection fraction (HFpEF) accounts for nearly half of all HF cases and is increasing in prevalence. Heart failure is defined as a complex clinical syndrome that results from structural or functional impairment of ventricular filling or ejection of blood, which in turn leads to the cardinal symptoms of dyspnea and fatigue and signs of HF, namely edema and rales.² Heart failure (HF) affects about 2% of the western population, with the prevalence increasing sharply from 1% in 40-year-old individuals to 10% above the age of 75 years. It is the most common cause of hospitalization in patients over 65 years of age.^{1,3,4} It is a debilitating condition with frequent hospitalization with a very high mortality rate with economic and public health burden. Heart failure once thought to arise primarily in the setting of depressed left ventricular (LV) ejection fraction (EF). However, epidemiologic studies have shown that approximately one-half of the patients who develop heart failure (HF) have a normal or preserved ejection fraction (EF>50%).⁵ Diagnosing HFpEF is challenging as echocardiographic parameters may not always clearly differentiate it. NT-proBNP, a biomarker secreted by cardiomyocytes in response to wall stress, offers diagnostic and prognostic value. This study aimed to correlate serum NT-proBNP levels with echocardiographic parameters in patients with HFpEF.⁶ The level of NTproBNP in the blood increases when heart failure symptoms worsen and decrease when the heart failure condition is stable. The NTproBNP level in a person with heart failure even someone whose condition is stable is higher than in a person with normal heart function.¹¹ Signs or symptoms of congestive heart failure include lung crepitations, pulmonary oedema, ankle swelling, hepatomegaly, dyspnea on exertion, and fatigue. Different modes of presentation of dyspnea (i.e. effort related or nocturnal) need to be distinguished.¹² In HFpEF, breathlessness is frequently the earliest symptom due to pulmonary congestion.

MATERIALS AND METHODS

This cross-sectional observational study was conducted at Dr. S.N. Medical College, Jodhpur, in 75 patients meeting Framingham's criteria⁷ for heart failure with EF $\geq 50\%$. Patients with valvular heart disease, CKD, anemia, or thyroid disease were excluded. NT-proBNP levels were measured using ELFA technique. Echocardiography was performed to assess left atrium size, LV dimensions, EF, and diastolic dysfunction grade.

Statistical Analysis: Statistical analysis was done using SPSS v22. Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics. Continuous variables were expressed as mean \pm standard deviation (SD) for normally distributed data and median with interquartile range (IQR) for non-normally distributed data. Categorical variables were presented as frequency and percentage. $P < 0.05$ was considered statistically significant. Ethical statement: Ethical clearance was obtained from the institutional ethics committee.

RESULTS

The mean age of participants was 64.85 ± 13.17 years; 41.3% were male and 58.7% female. Hypertension (66.7%) and diabetes (58.7%) were the most common comorbidities. NT-proBNP levels were < 400 pg/mL in 22.7%, 400–1200 pg/mL in 29.3%, and > 1200 pg/mL in 48% of patients. Significant associations were found between NT-proBNP and systolic blood pressure ($p = 0.041$), and left atrial size ($p = 0.025$). Higher NT-proBNP was associated with hypertension, diabetes, and advanced NYHA class. No significant correlation was observed with EF or LV dimensions [Table: 01].

Table 01: Demographic and Clinical Characteristics of the Study Population

Variables		Frequency (%)
Age (Mean \pm SD)		64.85 \pm 13.17
Gender	Male	31 (41.3)
	Female	44 (58.7)
Co-Morbidity	Hypertension	50 (66.7)
	Diabetes Mellitus	44 (58.7)
	Other (COPD/CVD)	27 (36)
Blood Pressure (Mean \pm SD)	SBP	147.63 \pm 27.24
	DBP	90.90 \pm 16.02

The distribution of NT-proBNP levels indicates that 17 participants (22.7%) have levels less than 400 pg/mL, 22 participants (29.3%), have levels between 400 and 1200 pg/mL, and 36 participants (48%) have levels greater than 1200 pg/mL (Table 2 & Figure 01)

Table 2: Clinical Characteristics and Echocardiographic Parameters of the Study Population

Variable	Frequency (%)
NTPROBNP	
<400	17 (22.7)
400-1200	22 (29.3)
>1200	36 (48)
ECHO Parameters	
LA (Mean \pm SD)	39.24 \pm 6.17
AO (Mean \pm SD)	27.71 \pm 4.17
LVIDD (Mean \pm SD)	43.35 \pm 7.56
LVID S (Mean \pm SD)	29.12 \pm 6.14
EF (Mean \pm SD)	57.72 \pm 3.66
IVS (Mean \pm SD)	11.33 \pm 1.69
LVPW (Mean \pm SD)	11.64 \pm 1.46
DD	
1	44 (58.7)
2	15 (20)
3	16 (21.3)

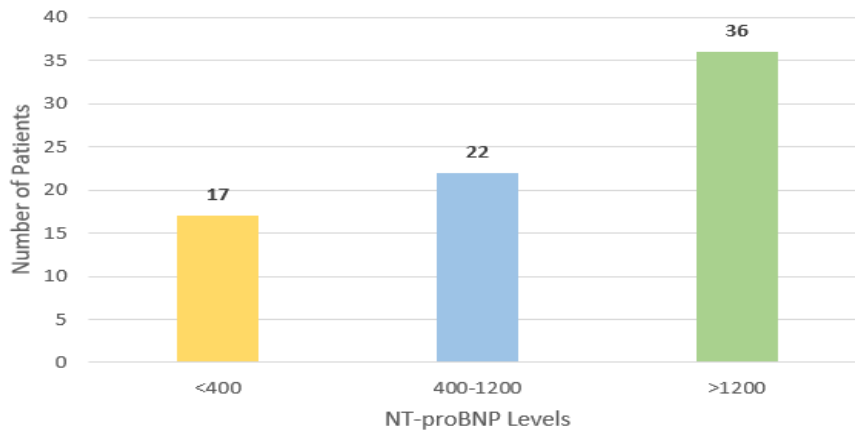


Figure 01: NT-proBNP Levels

NT-proBNP Levels in Relation to Left Atrium Size

Out of 75, 43 (57.3%) were in left atrium size of ≤ 40 mm and 32 (42.7%) were in >40 group. (Figure 02)

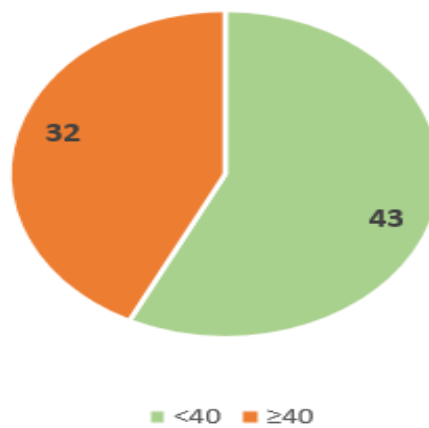


Figure 02: Left Atrium Size

Participants with a left atrium size of ≤ 40 mm have a median NT-proBNP level of 602 pg/mL (interquartile range: 220-3641.25 pg/mL). In contrast, participants with a left atrium size of >40 mm have a median NT-proBNP level of 1612 pg/mL (interquartile range: 790-4047 pg/mL). The p-value for this comparison is 0.025, indicating a significant difference in NT-proBNP levels between the two groups. Participants with a larger left atrium (>40 mm) tend to have higher NT-proBNP levels compared to those with a smaller left atrium (≤ 40 mm). (Figure 03)

Table 3: Association between Left Atrium Size and NT-proBNP Levels

Variable	Left Atrium		p-value
	≤ 40	>40	
NT-proBNP	602 (220-3641.25)	1612 (790-4047)	0.025

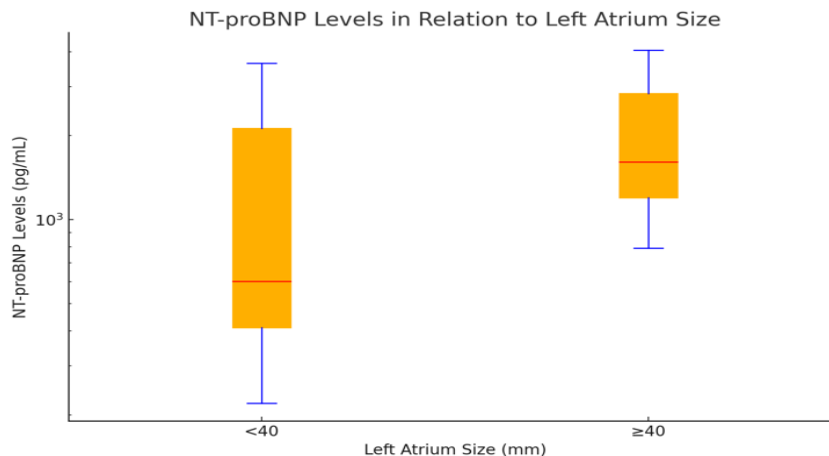


Figure 3: NT-proBNP levels in relation to left atrium size.

DISCUSSION

Our findings demonstrate that NT-proBNP levels significantly correlate with left atrial enlargement and clinical severity in HFpEF patients. Previous studies, including the Framingham Heart Study and Aldo-DHF trial⁸, also established NT-proBNP as a reliable prognostic marker. While echocardiography remains the gold standard for HF assessment, NT-proBNP adds diagnostic value, especially in obese or pulmonary comorbid patients. Limitations of our study include single-center design and relatively small sample size. Multicentric trials with larger cohorts are warranted.

M mode echocardiography variables of our 75 patients were studied. The various parameters included LA size, LVIDd, LVIDs and LVEF. Mean LA size was enlarged in all the patients with mean size of 40.41 ± 7.51 mm. In a study done by Omar Issa et al⁹ studied the correlation of LA size in HFPEF and founded that mean LA size was enlarged in all patients with HFPEF with a mean of 40.2 mm. In another study by Angela B. S. Santos et al¹⁰ studied the LA function by strain analysis using speckle tracking as a direct measure of intrinsic LA myocardial deformation in 357 patients in HFPEF and found that mean LA size was enlarged. This could be due to the alteration of LV diastolic function leading to reduced LV recoil and suction during diastole. As a result, these patients are more dependent on atrial pump function in late diastole to maintain normal ventricular filling i.e. more afterload and more chamber tension and with progressive elevation of LV filling pressure there will be remodeling and this compensatory mechanism will gradually impair resulting in elevated left atrial pressure. Patients with enlarged LA size hospitalized more as compared to normal size. Recent studies are showing that patients with HFPEF had increased left atrial contribution to LV filling as a compensatory response to impaired early LV filling during submaximal exercise and these patients have more exercise related symptoms and as the disease progresses left atrial function failed to increase, resulting in insufficient compensation during late diastolic filling and heart failure progresses and symptoms suddenly aggravates¹¹.

LIMITATIONS

The study is cross-sectional, which limits the ability to infer causal relationships between NT-proBNP levels and echocardiographic parameters. Being a single-center study with a relatively small sample size ($n=75$), the external validity and generalizability of the findings are limited.

CONCLUSION

Serum NT-proBNP correlates with clinical severity and left atrial size in HFpEF patients. A combined approach using NT-proBNP and echocardiography improves diagnostic accuracy and patient risk stratification.

To conclude, HFPEF is a major and growing health problem and has become a huge economic burden and representing half of all patients with heart failure. Despite improvement in understanding of the disease, the challenge lies in diagnosis of these cases to start early management.

Advancement in the diagnostic algorithm, imaging and blood test NTproBNP will allow early diagnosis so that treatment may be implemented early in the disease progression. All these patients can be benefited from blood pressure control, heart failure education (DASH diet, Exercising, Yoga), Diabetic management and diagnosing and treating the other comorbidities like anemia, obesity which can be the leading causes of HFPEF.

Serum NTproBNP can be used as a marker for the correlation in which diagnosis is not clear. However the awareness of this condition and associated factors is necessary to manage this condition. In this study it was seen that hypertension, diabetes mellitus, Left atrial diameter were commonly associated with HFPEF and NTproBNP¹².

So Serum NTproBNP levels helps in stratifying patients for prognosticating but further studies are required to identify patients who may get benefit from close surveillance and tighter control of their risk factors

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