

INFLAMMATORY AND METABOLIC PREDICTORS OF CHRONIC HEART FAILURE PROGRESSION: CLINICAL AND DIAGNOSTIC SIGNIFICANCE

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Abstract: *Chronic heart failure (CHF) remains one of the leading causes of hospitalization, disability, and mortality worldwide. Recent studies emphasize the important role of inflammatory and metabolic disturbances in the progression of myocardial dysfunction and adverse cardiovascular outcomes. The present study aimed to evaluate the clinical significance of inflammatory and metabolic predictors in patients with chronic heart failure and to assess their association with disease severity and prognosis. The study included 48 patients diagnosed with CHF who underwent clinical, biochemical, and echocardiographic evaluation. Elevated levels of C-reactive protein (CRP), NT-proBNP, low-density lipoproteins (LDL), and insulin resistance markers were significantly associated with reduced left ventricular ejection fraction and worsening functional status. Statistical analysis demonstrated a strong correlation between NT-proBNP and NYHA functional class ($r = 0.74$; $p < 0.001$), as well as between CRP and ejection fraction reduction ($r = -0.61$; $p < 0.01$). The findings confirm the prognostic importance of inflammatory and metabolic abnormalities in CHF progression and highlight the value of integrated diagnostic assessment.*

Keywords: *chronic heart failure, inflammation, NT-proBNP, metabolic syndrome, prognosis, cardiovascular risk*

INTRODUCTION

Chronic heart failure is a complex clinical syndrome characterized by the inability of the heart to maintain adequate blood circulation according to the metabolic demands of the body. Despite advances in modern cardiology, CHF continues to represent a major public health problem due to its high prevalence and mortality. According to international epidemiological data, more than 64 million people worldwide suffer from heart failure, and approximately 1–2% of the adult population in developed countries is affected by this condition [1]. The prevalence increases significantly with age, exceeding 10% among

individuals older than 70 years. The progression of chronic heart failure is associated not only with hemodynamic disturbances but also with neurohormonal, inflammatory, and metabolic changes. Persistent activation of inflammatory cytokines contributes to myocardial remodeling, endothelial dysfunction, and worsening ventricular performance. Elevated levels of inflammatory markers such as C-reactive protein and interleukin-6 have been identified as independent predictors of poor prognosis in CHF patients [2]. Metabolic abnormalities, including dyslipidemia, insulin resistance, and obesity, also play a substantial role in the pathogenesis of heart failure. Patients with metabolic syndrome demonstrate accelerated progression of ventricular dysfunction and increased cardiovascular mortality. Furthermore, elevated NT-proBNP levels reflect myocardial wall stress and remain one of the most important biomarkers for diagnosis and prognostic assessment. The combination of inflammatory activation and metabolic imbalance creates a vicious cycle that accelerates myocardial injury and functional decline. Therefore, early identification of these predictors may improve risk stratification and optimize treatment strategies in patients with CHF.

MATERIALS AND METHODS

This study was conducted at the cardiology department of a multidisciplinary clinical center and included 48 patients diagnosed with chronic heart failure according to ESC clinical guidelines. The mean age of the patients was 61.8 ± 8.4 years. Men accounted for 29 cases (60.4%), while women represented 19 cases (39.6%). Patients older than 65 years comprised 41.7% of the study population.

All patients underwent comprehensive clinical examination, including assessment of NYHA functional class, blood pressure measurement, electrocardiography, echocardiography, and biochemical analysis. Laboratory evaluation included serum levels of NT-proBNP, C-reactive protein, total cholesterol, low-density lipoproteins (LDL), triglycerides, fasting glucose, and insulin resistance markers. Echocardiographic examination was performed to determine left ventricular ejection fraction (LVEF), ventricular dimensions, and structural abnormalities. Reduced ejection fraction was defined as LVEF below 40%.

Statistical analysis was conducted using variation statistics and Pearson correlation analysis. Quantitative variables were expressed as mean $\pm$ standard deviation ($M \pm SD$). Statistical significance was accepted at $p < 0.05$.

RESULTS

The study demonstrated that patients with chronic heart failure exhibited significant inflammatory and metabolic disturbances associated with worsening cardiac function. The mean NT-proBNP level was 1860 ± 420 pg/mL, which was markedly elevated in patients with NYHA III–IV functional class. A strong positive correlation was identified between NT-proBNP concentration and severity of heart failure symptoms ($r = 0.74$; $p < 0.001$). The mean CRP level reached 8.6 ± 2.4 mg/L, exceeding normal reference values approximately 3–4 times. Elevated CRP levels were associated with reduced left ventricular ejection fraction and increased ventricular remodeling. Correlation analysis revealed a significant inverse relationship between CRP and LVEF ($r = -0.61$; $p < 0.01$). Metabolic abnormalities were

identified in the majority of patients. Elevated LDL cholesterol levels (>3.0 mmol/L) were detected in 68.7% of patients, while hypertriglyceridemia was observed in 54.1%. Obesity ($\text{BMI} \geq 30$ kg/m²) was present in 43.7% of cases, and insulin resistance markers were elevated in 39.5% of patients. Men demonstrated more pronounced dyslipidemia compared to women. Mean LDL levels in men reached 4.2 ± 0.5 mmol/L versus 3.7 ± 0.4 mmol/L in women ($p < 0.05$). In elderly patients older than 65 years, NT-proBNP concentrations were approximately 28% higher than in younger individuals, and severe ventricular dysfunction was significantly more frequent. Patients with combined inflammatory and metabolic abnormalities showed worse clinical outcomes. Hospitalization frequency among patients with elevated CRP and NT-proBNP was increased by 36%, while reduced ejection fraction below 35% was observed in 47.9% of these individuals.

DISCUSSION

The findings of this study confirm the major role of inflammatory and metabolic mechanisms in the progression of chronic heart failure. Elevated CRP levels indicate persistent systemic inflammation, which contributes to endothelial dysfunction, oxidative stress, and myocardial fibrosis. Previous studies have demonstrated that inflammatory cytokines directly impair myocardial contractility and accelerate ventricular remodeling [3]. The significant increase in NT-proBNP levels observed in this study reflects increased myocardial wall tension and hemodynamic overload. The strong correlation between NT-proBNP and NYHA functional class confirms its importance as a prognostic biomarker.

Metabolic disturbances further aggravate cardiac dysfunction. Dyslipidemia and insulin resistance promote vascular inflammation and accelerate atherosclerotic progression, increasing myocardial ischemia and ventricular impairment. Obesity additionally contributes to neurohormonal activation and increased cardiac workload.

Gender and age differences identified in this study suggest that male sex and advanced age are associated with more severe metabolic and inflammatory alterations. These findings correspond with previous international studies demonstrating higher cardiovascular risk among elderly male patients with CHF [4].

The integration of inflammatory and metabolic biomarkers into routine clinical assessment may improve early risk stratification and allow more individualized therapeutic strategies.

CONCLUSION

Chronic heart failure is strongly associated with inflammatory activation and metabolic disturbances that significantly influence disease progression and prognosis. Elevated levels of NT-proBNP, CRP, LDL cholesterol, and insulin resistance markers correlate with worsening ventricular dysfunction and increased clinical severity. The findings of this study demonstrate that combined inflammatory and metabolic abnormalities are associated with poorer functional status, increased hospitalization frequency, and reduced ejection fraction. Early identification and correction of these factors may improve clinical outcomes and reduce cardiovascular complications in patients with chronic heart failure.

REFERENCES:

1. McDonagh T.A., et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. *European Heart Journal*. 2021;42(36):3599–3726.
2. Mann D.L. Inflammatory mediators and the failing heart. *Circulation Research*. 2015;116(7):1254–1268.
3. Braunwald E. Heart failure. *JACC: Heart Failure*. 2013;1(1):1–20.
4. Ziaeian B., Fonarow G.C. Epidemiology and etiology of heart failure. *Nature Reviews Cardiology*. 2016;13(6):368–378.
5. Ponikowski P., et al. Heart failure: preventing disease and death worldwide. *ESC Heart Failure*. 2014;1(1):4–25.