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A Study of the Correlation between Hs-Troponin I and NT-proBNP in Patients with Atrial Fibrillation

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A B S T R A C T

Background: Atrial fibrillation is associated with an increased risk of cardiovascular events, and the role of myocardial injury in this condition remains unclear. This study aimed to investigate the relationship between hs-troponin I and NT-proBNP levels in patients with atrial fibrillation.

Methods: A cross-sectional study was conducted on 41 patients with atrial fibrillation. Serum levels of hs-troponin I, NT-proBNP, and other relevant biomarkers were measured. Correlation analysis and multivariate regression were performed to assess the relationship between these biomarkers and clinical characteristics.

Results: Serum hs-troponin I levels among study participants were 22.5 (10.8-103) pg/mL. An elevated hs-troponin I level, defined as a value exceeding the 99th percentile, was observed in 39% of the cohort. Concurrently, median NT-proBNP levels were 108.9 (59.3-370.6) pmol/L, with only 2.4% of participants exhibiting values below the lower reference limit of 14.75 pmol/L. Hs-troponin I exhibited a significant positive correlation with CK-MB. Conversely, NT-proBNP demonstrated significant inverse correlations with HGB and eGFR. While hs-troponin I was significantly correlated with EF and EDV, no such association was observed between NT-proBNP and these echocardiographic parameters. Univariate analysis demonstrated a positive correlation between hs-troponin I and NT-proBNP. However, this relationship was no longer significant after adjusting for confounding factors.

Conclusions: Our findings suggest that both hs-troponin I and NT-proBNP are elevated in a significant proportion of patients with atrial fibrillation, indicating potential myocardial involvement. While a positive correlation was observed between these biomarkers in univariate analysis, this association was not confirmed after multivariate adjustment.

Keywords:
hs-troponin I, NT-proBNP, atrial fibrillation

BACKGROUND

Atrial fibrillation, a prevalent cardiac arrhythmia particularly affecting the elderly population, is characterized by irregular and rapid atrial electrical activity [1]. This arrhythmia not only manifests with distressing symptoms such as palpitations and dyspnea but also carries a significant risk of adverse outcomes [2, 3]. Notably, thromboembolic events, primarily stroke, constitute a major complication arising from atrial thrombus formation. Moreover, atrial fibrillation is associated with an increased incidence of heart failure, reduced exercise tolerance, and mortality [1, 2, 4].

While traditionally considered a primary arrhythmia, atrial fibrillation is increasingly recognized as a complex pathology involving myocardial structural and functional alterations [5, 6]. Myocardial damage can contribute to ventricular remodeling, leading to impaired cardiac output and the progression of heart failure [5-7].

Hs-troponin I and NT-proBNP are established biomarkers reflective of myocardial injury [8, 9]. To assess the extent of myocardial damage, researchers frequently employ these indicators. Hs-troponin I, a cardiac-specific protein, is released into the bloodstream upon myocardial cell necrosis. Its elevation is a hallmark of acute myocardial injury [10]. NT-proBNP, a precursor to the natriuretic peptide BNP, is secreted by ventricular cardiomyocytes in response to volume or pressure overload [11]. Elevated NT-proBNP levels are commonly associated with heart failure and ventricular dysfunction [12].

Previous investigations have reported elevated hs-troponin I and NT-proBNP levels in a substantial proportion of patients with atrial fibrillation, implying prevalent myocardial involvement in this patient population [13-16]. Nonetheless, the intricate relationship between these biomarkers and other clinical covariates within the atrial fibrillation cohort remains inadequately elucidated.

The study aimed to quantify hs-troponin I and NT-proBNP levels in patients with atrial fibrillation and to assess the correlation between these biomarkers and other clinical and subclinical variables. By elucidating the relationship between hs-troponin I, NT-proBNP, and atrial fibrillation, this study contributes to a deeper understanding of the underlying pathophysiology of atrial fibrillation and myocardial injury.

SUBJECTS

The study population comprised atrial fibrillation patients managed at the Arrhythmia Treatment Department of Cho Ray Hospital between December 2023 and April 2024.

Inclusion criteria for study participants consisted of patients aged 18 years or older with a confirmed diagnosis of atrial fibrillation based on medical records, electrocardiogram, or Holter monitoring. Exclusion criteria encompassed patients with acute myocardial infarction, chronic obstructive pulmonary disease, severe comorbidities posing a significant mortality risk, pregnancy, and estimated glomerular filtration rate (eGFR) ≤ 30 mL/min/1.73m² [17].

METHODS

Research Methods: Descriptive cross-sectional study.

Data collection method:

Study participants were randomly selected from the patient population of the Arrhythmia Treatment Department at Cho Ray Hospital. Data collected included demographic characteristics (age, sex, height, weight, BMI), vital signs (blood pressure), echocardiographic parameters, and laboratory findings. Atrial fibrillation diagnosis adhered to the ESC 2020 criteria [18].

Serum hs-troponin I concentrations were determined using a three-position sandwich immunoassay with direct chemiluminescence detection on the ADVIA Centaur system (Siemens). The assay exhibited a linear dynamic range of 2.50-25,000 pg/mL, with intra- and inter-assay coefficients of variation below 10% and 12%, respectively. NT-proBNP concentrations were measured using a sandwich luminescent immunoassay on the ADVIA Centaur system (Siemens). The assay demonstrated a dynamic range of 4.13-4130 pmol/L, with intra- and inter-assay coefficients of variation below 7% and 10%, respectively.

Laboratory analyses were conducted in accordance with the standard operating procedures of the Biochemistry Department at Cho Ray Hospital and adhered to the Ministry of Health's regulations. To ensure data reliability, the department participated in regular external quality assessment programs organized by the Quality Control Centre for Medical Laboratory of University of Medicine and Pharmacy at Ho Chi Minh City.

Data processing and analysis:

Quantitative variables were summarized using median and interquartile range, while categorical variables were

described as percentages. The Wilcoxon rank-sum test was employed for intergroup comparisons of quantitative variables, and the chi-square test for categorical variables. Spearman's correlation coefficient assessed the bivariate associations between continuous variables. Statistical significance was defined as a p-value < 0.05. Data analyses were performed using R statistical software version 4.3.1.

Medical Ethics:

The study protocol was approved by the Ethics Committee of Biomedical Research at the University of Medicine and Pharmacy at Ho Chi Minh City according to Decision No. 806/HDĐĐ-ĐHYD dated September 22, 2023. Written informed consent was obtained from all study participants after a comprehensive explanation of the study objectives and procedures.

RESULTS

Data were collected from 42 patients diagnosed with atrial fibrillation. One patient with an eGFR < 30 ml/min/m² was excluded from statistical analyses, resulting in a final study population of 41 patients.

1. Baseline patient characteristics

Table 1: Baseline characteristics of patients with atrial fibrillation (n = 41)

Characteristic	**N Value (%) or Median (Quartile Range)**
Demographics	
Age (years)	72 (64-78)
Women	15 (36.6)
Clinical	
Weight (kg)	57 (53-67)
Height (m)	1.60 (1.55-1.65)
BMI (kg/m2)	22.7 (20.8-24.0)
Systolic BP (mmHg)	128 (120-137)
Diastolic BP (mmHg)	74 (70-80)
Medical history and comorbidities	
Hypertension	27 (65.9)
Smoking	6 (14.6)
Diabetes mellitus	13 (31.7)
Dyslipidemia	23 (56.1)
Family history of early coronary artery disease	6 (14.6)
Stroke	1 (2.4)
Heart failure	13 (31.7)
Myocardial infarction	7 (17.0)
Chronic kidney disease	7 (17.0)
Echocardiography	
LA (mm)	40.5 (37.2-43.5)
EF (%)	61 (50-69)
EDP (mL)	106 (85-166)
ESV (mL)	36 (27.5-94)
LVEDD (mm)	45 (42-56)
LVESD (mm)	30 (27-38)
Laboratory tests	
HGB (g/L)	129 (112-137)
WBC (G/L)	7.3 (6.4-8.4)
PLT (K/mcL)	156 (128-208)
Creatinin (mg/dL)	0.96 (0.81-1.19)
eGFR (ml/min/m2)	71 (58-84)
TSH (mIU/L)	1.44 (0.78-2.16)
FT4 (pg/mL)	13.4 (12.0-14.7)
CK-MB (UI/L)	22.1 (16.8-28.9)

The study cohort comprised 41 patients with atrial fibrillation, with a median age of 72 (IQR: 64-78) years, ranging from 31 to 92 years. Hypertension and dyslipidemia were present in over 50% of participants.

2. Correlation between hs-troponin I and NT-proBNP levels

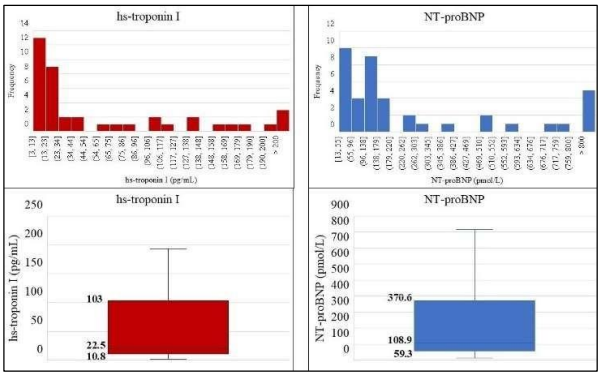

Figure 1: Distribution and concentration of hs-troponin I and NT-proBNP in patients with atrial fibrillation (n = 41)

Serum hs-troponin I levels among study participants were 22.5 (10.8-103) pg/mL. Based on the IFCC integer-based reporting format, a value exceeding 47 pg/mL is considered elevated. Of the study population, 16 cases (39.0%) exhibited hs-troponin I levels above this threshold. Concurrently, NT-proBNP levels averaged 108.9 (59.3-370.6) pmol/L, with only one case (2.4%) demonstrating a value below the limit of 14.75 pmol/L.

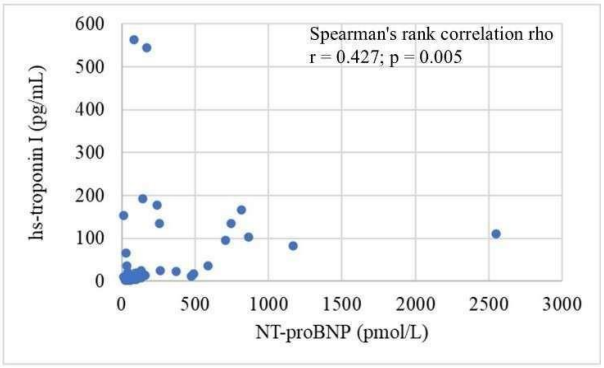

Figure 2: Correlation between hs-troponin I and NT-proBNP in patients with atrial fibrillation (n = 41)

Univariate analysis in the atrial fibrillation cohort (n=41) revealed a significant positive correlation (r=0.427, p=0.005) between hs-troponin I and NT-proBNP levels.

3. Association between hs-troponin I and NT-proBNP with some clinical and laboratory variables

Table 2: Correlation between hs-troponin I and NT-proBNP with clinical and laboratory variables

Variable	hs-troponin I		NT-proBNP	
	Spearman's rank correlation rho	**P**	**Spearman's rank correlation rho**	**p**
Age (years)	-0.055	0.730	0.234	0.140
BMI (kg/m2)	-0.016	0.919	-0.229	0.148
HGB (g/L)	-0.262	0.096	-0.312	0.046
WBC (G/L)	0.093	0.560	-0.037	0.814
PLT (K/mcL)	-0.182	0.253	-0.295	0.060
eGFR (ml/min/m2)	0.068	0.671	-0.350	0.025
CK-MB (UI/L)	0.371	0.027	0.074	0.669

Hs-troponin I demonstrated a statistically significant positive correlation with CK-MB. Conversely, NT-proBNP exhibited a statistically significant inverse correlation with hemoglobin and estimated glomerular filtration rate.

4. Association between hs-troponin I and NT-proBNP with some echocardiographic indices

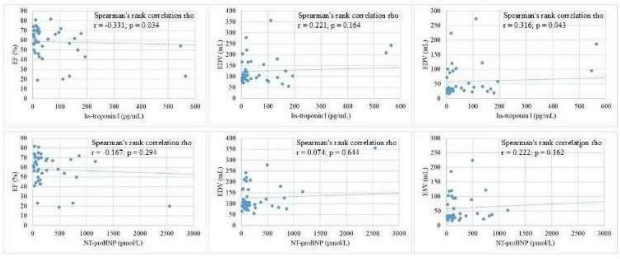

Figure 3: Correlation between hs-troponin I and NT-proBNP with some echocardiographic indices

Hs-troponin I demonstrated a statistically significant correlation with ejection fraction (EF) and end-diastolic volume (EDV), while NT-proBNP exhibited no significant correlation with these echocardiographic parameters.

5. Multivariate analysis of the relationship between hs-troponin I and NT-proBNP

Table 3: Multivariate regression analysis of correlation between hs-troponin I and NT-proBNP levels

Predictor	Regression coefficient	Standard error	p
Age (year)	-12.177	8.429	0.157
BMI (kg/m2)	3.261	28.742	0.910
eGFR (ml/min/m2)	1.047	5.535	0.851
EF (%)	-4.282	6.262	0.499
NT-proBNP (pmol/L)	-0.028	0.088	0.754

Multivariate analysis controlling for age, body mass index, estimated glomerular filtration rate, and ejection fraction revealed no significant association between hs-troponin I and NT-proBNP within the study population.

DISCUSSION

Our findings indicate a nuanced relationship between hs-troponin I and NT-proBNP among patients with atrial fibrillation. Univariate analysis demonstrated a statistically significant positive correlation between these biomarkers. However, this association attenuated upon multivariate adjustment for potential confounders, suggesting that while both hs-troponin I and NT-proBNP reflect myocardial involvement in this patient population, their relationship may be mediated by other underlying pathophysiological processes.

The detection of elevated hs-troponin I levels in 39% of atrial fibrillation patients, surpassing the upper reference limit, strongly suggests subclinical myocardial injury within this cohort. These findings align with previous research linking atrial fibrillation to myocardial damage and an augmented risk of cardiovascular events [19, 20]. The observed positive correlation between hs-troponin I and CK-MB reinforces the hypothesis of myocardial involvement in this patient population.

NT-proBNP, a commonly employed biomarker for heart failure, was also elevated in our atrial fibrillation cohort [15, 21]. Its inverse correlation with hemoglobin and estimated glomerular filtration rate suggests that NT-proBNP levels may be influenced by prevalent anemia and renal dysfunction in the elderly population, both risk factors for atrial fibrillation and heart failure [6, 22, 23]. However, the lack of a significant correlation between NT-proBNP and ventricular functional parameters indicates that factors beyond ventricular dysfunction, such as inflammation or oxidative stress, may contribute to elevated NT-proBNP levels in this patient population [24, 25].

The attenuation of the correlation between hs-troponin I and NT-proBNP following adjustment for covariates suggests a complex relationship between these biomarkers in atrial fibrillation. Potential explanations include residual confounding by unmeasured variables, distinct pathophysiological underpinnings of hs-troponin I and NT-proBNP elevation, and limitations inherent to the study sample size.

This study demonstrates elevated hs-troponin I and NT-proBNP levels in patients with atrial fibrillation, indicative of myocardial involvement. The relationship between these biomarkers is intricate and influenced by multiple factors. Concurrent assessment of both hs-troponin I and NT-proBNP may offer supplementary insights into patient status and prognosis. Nevertheless, larger-scale studies are imperative to substantiate these findings and elucidate the underlying pathophysiological mechanisms.

Future research endeavors should prioritize elucidating the underlying mechanisms responsible for elevated hs-troponin I and NT-proBNP levels in atrial fibrillation patients. Additionally, large-scale, multicenter studies are warranted to enhance the generalizability of findings. Prospective, long-term follow-up investigations are essential to establish the prognostic utility of these biomarkers in predicting cardiovascular outcomes within this patient population.

V. CONCLUSION:

This study demonstrated that both hs-troponin I and NT-proBNP are elevated in a substantial proportion of patients with atrial fibrillation, suggesting subclinical myocardial injury in this population. While univariate analysis revealed a positive correlation between hs-troponin I and NT-proBNP, this association was attenuated after adjusting for potential confounders, indicating a more complex relationship. A comprehensive assessment of both structural and functional cardiac abnormalities is essential for optimal management of patients with atrial fibrillation.

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REFRENCES

[1] Z. Nesheiwat, A. Goyal, and M. Jagtap, "Atrial Fibrillation," in StatPearls. Treasure Island (FL) ineligible companies. Disclosure: Amandeep Goyal declares no relevant financial relationships with ineligible companies. Disclosure: Mandar Jagtap declares no relevant financial relationships with ineligible companies., 2024.

[2] S. Klaveback, E. Svennberg, C. Nymark, F. Braunschweig, and M. Lidin, "Management of modifiable risk factors and comorbidities in atrial fibrillation: suggestions for improvement from a patient perspective," Eur J Cardiovasc Nurs, vol. 23, no. 2, pp. 169-175, Mar 12 2024, doi: 10.1093/eurjcn/zvad055.

[3] W. C. Lee, W. T. Chang, H. Y. Fang, H. C. Chen, M. C. Chen, and P. Y. Liu, "Incidence, Risk Factors, and Outcomes of Left Atrial Enlargement in Patients Requiring Right Ventricular Pacing: A Retrospective Study of 461 Cases from 2012 to 2020," Med Sci Monit, vol. 30, p. e944114, May 22 2024, doi: 10.12659/MSM.944114.

[4] E. Nasab Mehrabi, V. Toupchi-Khosroshahi, and S. S. Athari, "Relationship of atrial fibrillation and N terminal pro brain natriuretic peptide in heart failure patients," ESC Heart Fail, vol. 10, no. 6, pp. 3250-3257, Dec 2023, doi: 10.1002/ehf2.14542.

[5] J. R. Baman et al., "Atrial fibrillation and atrial cardiomyopathies," J Cardiovasc Electrophysiol, vol. 32, no. 10, pp. 2845-2853, Oct 2021, doi: 10.1111/jce.15083.

[6] D. Linz et al., "Atrial fibrillation: epidemiology, screening and digital health," Lancet Reg Health Eur, vol. 37, p. 100786, Feb 2024, doi: 10.1016/j.lanepe.2023.100786.

[7] H. J. Jansen, L. J. Bohne, A. M. Gillis, and R. A. Rose, "Atrial remodeling and atrial fibrillation in acquired forms of cardiovascular disease," Heart Rhythm O2, vol. 1, no. 2, pp. 147-159, Jun 2020, doi: 10.1016/j.hroo.2020.05.002.

[8] P. A. Kotta, V. Nambi, and B. Bozkurt, "Biomarkers for Heart Failure Prediction and Prevention," J Cardiovasc Dev Dis, vol. 10, no. 12, Dec 6 2023, doi: 10.3390/jcdd10120488.

[9] R. Jacob and M. Khan, "Cardiac Biomarkers: What Is and What Can Be," Indian J Cardiovasc Dis Women WINCARS, vol. 3, no. 4, pp. 240-244, Dec 2018, doi: 10.1055/s-0039-1679104.

[10] K. C. Park, D. C. Gaze, P. O. Collinson, and M. S. Marber, "Cardiac troponins: from myocardial infarction to chronic disease," Cardiovasc Res, vol. 113, no. 14, pp. 1708-1718, Dec 1 2017, doi: 10.1093/cvr/cvx183.

[11] M. Volpe, G. Gallo, and S. Rubattu, "Endocrine functions of the heart: from bench to bedside," Eur Heart J, vol. 44, no. 8, pp. 643-655, Feb 21 2023, doi: 10.1093/eurheartj/ehac759.

[12] S. Fu, P. Ping, F. Wang, and L. Luo, "Synthesis, secretion, function, metabolism and application of natriuretic peptides in heart failure," J Biol Eng, vol. 12, p. 2, 2018, doi: 10.1186/s13036-017-0093-0.

[13] M. Cortes et al., "High-Sensitivity Troponin T For The Risk Assessment Of Patients With Acute Atrial Fibrillation," Curr Probl Cardiol, vol. 47, no. 11, p. 101079, Nov 2022, doi: 10.1016/j.cpcardiol.2021.101079.

[14] Z. Hijazi et al., "High-sensitivity troponin I for risk assessment in patients with atrial fibrillation: insights from the Apixaban for Reduction in Stroke and other Thromboembolic Events in Atrial Fibrillation (ARISTOTLE) trial," Circulation, vol. 129, no. 6, pp. 625-34, Feb 11 2014, doi: 10.1161/CIRCULATIONAHA.113.006286.

[15] S. M. Werhahn et al., "NT-proBNP as a marker for atrial fibrillation and heart failure in four observational outpatient trials," ESC Heart Fail, vol. 9, no. 1, pp. 100-109, Feb 2022, doi: 10.1002/ehf2.13703.

[16] P. F. Brady et al., "Interactions Between Atrial Fibrillation and Natriuretic Peptide in Predicting Heart Failure Hospitalization or Cardiovascular Death," J Am Heart Assoc, vol. 11, no. 4, p. e022833, Feb 15 2022, doi: 10.1161/JAHA.121.022833.

[17] J. Savoj et al., "Utility of Cardiac Biomarkers in the Setting of Kidney Disease," Nephron, vol. 141, no. 4, pp. 227-235, 2019, doi: 10.1159/000495946.

[18] G. Hindricks et al., "2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS): The Task Force for the diagnosis and management of atrial fibrillation of the European Society of Cardiology (ESC) Developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC," Eur Heart J, vol. 42, no. 5, pp. 373-498, Feb 1 2021, doi: 10.1093/eurheartj/ehaa612.

[19] F. Biancari et al., "Income and outcomes of patients with incident atrial fibrillation," J Epidemiol Community Health, vol. 76, no. 8, pp. 736-42, Jun 15 2022, doi: 10.1136/jech-2022-219190.

[20] M. Rosso et al., "Rising Cardiac Troponin: A Prognostic Biomarker for Mortality After Acute Ischemic Stroke," J Am Heart Assoc, vol. 13, no. 4, p. e032922, Feb 20 2024, doi: 10.1161/JAHA.123.032922.

[21] A. E. Giovou, M. M. Gladka, and V. M. Christoffels, "The Impact of Natriuretic Peptides on Heart Development, Homeostasis, and Disease," Cells, vol. 13, no. 11, May 28 2024, doi: 10.3390/cells13110931.

[22] J. A. Wong, D. Conen, J. S. Healey, and L. S. B. Johnson, "Modifiable risk factors predict incident atrial fibrillation and heart failure," Open Heart, vol. 7, no. 1, Apr 2020, doi: 10.1136/openhrt-2019-001092.

[23] N. S. Shetty et al., "Titin truncating variants, cardiovascular risk factors and the risk of atrial fibrillation and heart failure," Nat Cardiovasc Res,

vol. 3, no. 8, pp. 899-906, Aug 2024, doi: 10.1038/s44161-024-00511-2.

[24] M. L. Novack and M. Zubair, "Natriuretic Peptide B Type Test," in StatPearls. Treasure Island (FL) ineligible companies. Disclosure: Muhammad Zubair declares no relevant financial relationships with ineligible companies., 2024.

[25] H. Fish-Trotter et al., "Inflammation and Circulating Natriuretic Peptide Levels," Circ Heart Fail, vol. 13, no. 7, p. e006570, Jul 2020, doi: 10.1161/CIRCHEARTFAILURE.119.006570.