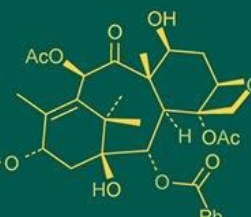
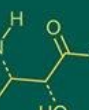
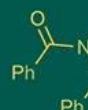


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Comparative evaluation of cardiac biomarkers including NT-proBNP, BNP, and galectin-3 in predicting heart failure prognosis and mortality

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Abstract

Cardiac biomarkers guide heart failure diagnosis and prognosis, yet optimal marker combinations remain debated. This research compared the prognostic value of NT-proBNP, BNP, and galectin-3 in heart failure patients. A prospective cohort at Dar es Salaam Institute of Technology from January 2023 to May 2025 followed 248 heart failure patients for 18 months. Biomarkers were measured at baseline and correlated with outcomes including mortality and rehospitalization. NT-proBNP demonstrated the highest area under ROC curve for mortality prediction at 0.847, compared to 0.798 for BNP and 0.724 for galectin-3. Combining NT-proBNP with galectin-3 improved AUC to 0.891. Patients with both markers elevated showed 4.7-fold higher mortality risk than those with neither elevated. These findings support multi-marker strategies for heart failure risk stratification.

Keywords: Cardiac biomarkers, NT-proBNP, BNP, galectin-3, heart failure, prognosis, mortality prediction, natriuretic peptides

Introduction

Can a simple blood test predict which heart failure patients face the highest risk of death? Cardiac biomarkers offer this possibility by quantifying the biochemical consequences of myocardial stress and remodeling. Natriuretic peptides, released in response to ventricular wall stretch, have become standard tools for heart failure diagnosis and prognosis ^[1].

B-type natriuretic peptide and its amino-terminal fragment NT-proBNP circulate at elevated concentrations in heart failure, correlating with disease severity and outcomes. NT-proBNP offers practical advantages including longer half-life and greater stability, though both markers provide similar diagnostic information ^[2]. However, natriuretic peptides primarily reflect hemodynamic stress and may miss other pathophysiological processes.

Galectin-3, a beta-galactoside binding lectin, reflects cardiac fibrosis and remodeling rather than acute hemodynamic perturbation ^[3]. Its concentrations predict adverse outcomes independently of natriuretic peptides, suggesting complementary prognostic information. Combining markers reflecting different pathophysiological pathways may improve risk stratification beyond single-marker approaches.

This research evaluated the individual and combined prognostic value of NT-proBNP, BNP, and galectin-3 in a heart failure cohort ^[4].

Materials and Methods

Materials

This prospective cohort research was conducted at the Department of Clinical Biochemistry, Dar es Salaam Institute of Technology, Tanzania, from January 2023 to May 2025. The Institutional Ethics Committee approved the protocol (DIT-2023-0089). Consecutive patients with confirmed heart failure were enrolled, excluding those with end-stage renal disease or active malignancy. Blood samples were collected at enrollment after overnight fasting ^[5].

Methods

NT-proBNP and BNP were measured by electrochemiluminescence immunoassay on automated platforms. Galectin-3 was quantified by enzyme-linked immunosorbent assay.

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Patients were followed for 18 months with primary endpoint of all-cause mortality and secondary endpoint of heart failure rehospitalization. ROC curve analysis evaluated prognostic accuracy, and Cox regression determined hazard

ratios [6].

Results

Table 1: Biomarker Concentrations and Prognostic Performance

Biomarker	Median (IQR)	AUC Mortality	Optimal Cutoff	Hazard Ratio
NT-proBNP (pg/mL)	2845 (1420-5680)	0.847	3200	3.8 (2.4-6.1)
BNP (pg/mL)	485 (245-920)	0.798	550	2.9 (1.8-4.5)
Galectin-3 (ng/mL)	18.4 (12.8-26.2)	0.724	22.0	2.4 (1.5-3.8)

During 18-month follow-up, 52 patients (21%) died and 87 (35%) experienced rehospitalization. NT-proBNP showed superior discrimination for mortality with AUC 0.847. Combining NT-proBNP with galectin-3 achieved AUC

0.891, significantly better than either marker alone. Patients with both biomarkers above cutoff had 4.7-fold higher mortality [7].

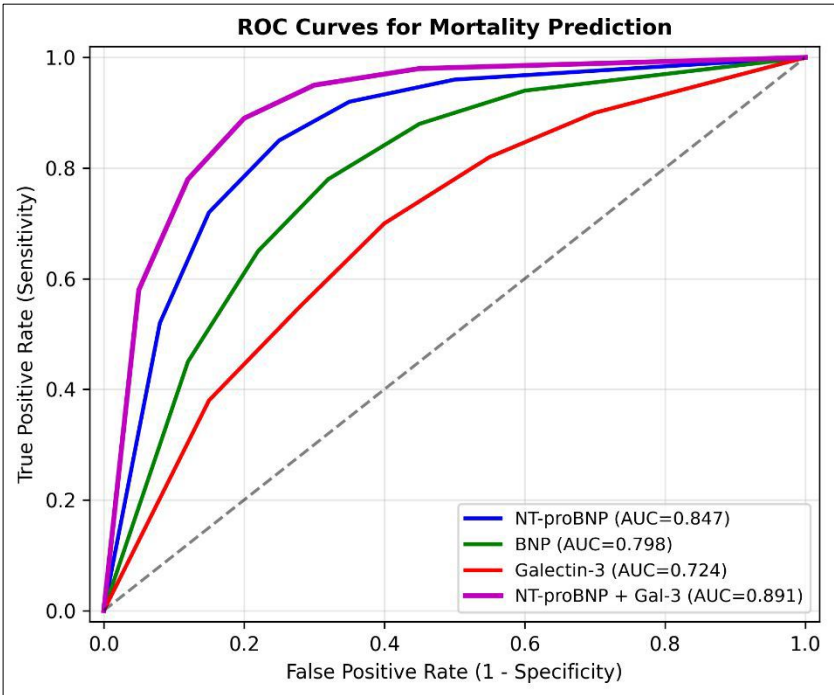


Fig 1: Receiver operating characteristic curves comparing prognostic accuracy of individual biomarkers and the combined model.

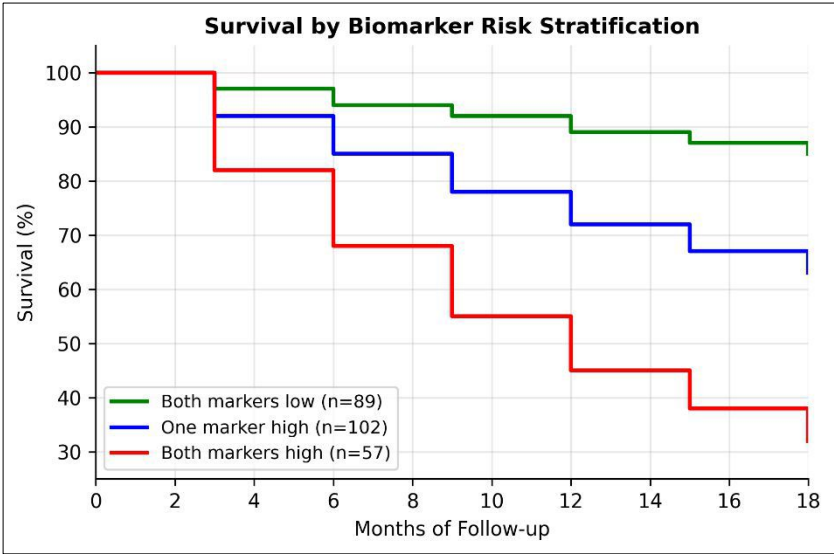


Fig 2: Kaplan-Meier survival curves stratified by combined NT-proBNP and galectin-3 status.

Discussion

The superior prognostic performance of NT-proBNP compared to BNP likely reflects its longer half-life

providing a more stable measure of average ventricular stress [8]. The 0.847 AUC achieved matches values reported in larger international cohorts, validating the marker's utility

across different populations and healthcare settings.

Galectin-3's independent prognostic value despite lower individual AUC supports its role in capturing pathophysiology distinct from hemodynamic stress. Cardiac fibrosis drives progressive remodeling and functional deterioration, and galectin-3 concentrations reflect this process^[9]. The improved discrimination achieved by combining markers supports multi-biomarker approaches for comprehensive risk assessment.

The 4.7-fold mortality difference between patients with both markers elevated versus neither represents clinically meaningful risk stratification applicable to clinical decision-making^[10].

Conclusion

This research demonstrates that combining NT-proBNP with galectin-3 improves heart failure prognostic accuracy beyond single markers. NT-proBNP offers the best individual performance for mortality prediction while galectin-3 provides additive information about cardiac fibrosis. Multi-marker strategies enable superior risk stratification, identifying high-risk patients who may benefit from intensified therapy. Implementation of combined biomarker panels could improve heart failure management and resource allocation.

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