DOI: https://doi.org/10.53350/pjmhs2023172689

ORIGINAL ARTICLE

Correlation of Serum Galectin-3 Levels with Ejection Fractions in Healthy Subjects and Heart Failure Patients

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ABSTRACT

Objective: The purpose of this study was twofold: (1) to evaluate Galectin-3's use as a prognostic or predictive biomarker in HF, and (2) to compare eject fractions (EF) in healthy individuals to those in HF patients by analysing the correlation between blood Galectin-3 levels and EF.

Study Design: The study was a cross-sectional observational analysis of two groups with similar demographics (n=150 each): healthy people and HF patients. Transthoracic echocardiography was used to assess EF, while enzyme-linked immunoassay assay (ELISA) was used to assess galectin-3 levels.

Study Setting and Duration: The study was carried at Fatima Jinnah Medical University Lahore over a 12-month period from January 2022 to December 2022.

Results: Serum Galectin-3 levels were significantly higher in HF patients (mean±SD: 26.4±7.2 ng/mL) compared to healthy subjects (mean±SD: 12.1±2.8 ng/mL; p<0.001). There was a strong inverse correlation between Galectin-3 levels and EF in HF patients (r=-0.72, p<0.001), while a weak correlation was observed in healthy subjects (r=-0.26, p=0.002). A receiver operating characteristic (ROC) curve analysis demonstrated that Galectin-3 could distinguish HF patients from healthy subjects with an area under the curve (AUC) of 0.92 (95% CI: 0.89-0.95, p<0.001), suggesting its potential as a diagnostic biomarker. Moreover, elevated Galectin-3 levels were independently associated with a higher risk of HF-related hospitalizations and mortality (HR: 1.35, 95% CI: 1.12-1.63, p=0.002), indicating its prognostic value.

Conclusion: Serum Galectin-3 levels were shown to be significantly inversely correlated with EF in both healthy people and HF patients, with the connection being higher in the latter group. More exploration in bigger cohorts and prospective studies is warranted since galectin-3 emerges as a viable diagnostic and prognostic biomarker in HF.

Keywords: Galectin-3, ejection fraction, heart failure, biomarker, diagnosis, prognosis, transthoracic echocardiography, enzyme-linked immunosorbent assay.

INTRODUCTION

The enigmatic symphony of the human heart has long fascinated scientists and clinicians alike. As the relentless engine that drives life, the heart's well-being is paramount for overall health. Among the myriad of cardiac conditions that threaten this biological marvel, heart failure (HF) stands as a formidable challenge. As the world's population ages and the prevalence of chronic diseases increases, the burden of HF is projected to soar in the coming years, posing an urgent need for enhanced diagnostic and prognostic strategies.

In the quest for identifying novel biomarkers that shed light on the complex pathophysiology of HF, the scientific community has recently turned its attention to Galectin-3—a versatile and intriguing protein with a multitude of functions. Galectin-3, a β-galactoside-binding lectin, is known for its roles in inflammation, fibrosis, and immune regulation, all of which are pivotal processes in the development and progression of HF. Thus, unveiling the enigmatic relationship between Galectin-3 and the heart's performance could open up new horizons in the battle against this debilitating condition.

Ejection fraction (EF), a key measure of heart function, has been used extensively as a predictive and therapeutic tool in the field of HF for quite some time. Studies in healthy persons and patients with HF have shown intriguing evidence for a link between blood Galectin-3 levels and EF. Yet, the size and clinical significance of this connection are unknown, calling for more research.

By shedding light on the fascinating affiliation among blood Galectin-3 tiers and EF both in healthy individuals and HF patients, the objective of our cutting-edge research is to look into the possible role of Galectin-3 as a predictive and diagnostic biomarker for HF. This will be accomplished by comparing the levels of Galectin-3 in the blood of HF patients to those of healthy individuals. It is possible that we might be capable of laying the path for ground-breaking new treatments in this important area of medicine if we are successful in determining the connection between this enigmatic protein and the function of the heart.

MATERIALS AND METHODS

As expert biostatisticians, evaluate the association between blood Galectin-3 levels with ejection fraction (EF) in healthy persons and HF patients, we took great care in planning and carrying out this study's approach.

Study Population: Patients with HF and healthy volunteers were selected for this study and matched for age, sex, and number of co-morbidities. Between January 2022 and December 2022, patients from the cardiology department of a tertiary care hospital were enrolled in a row. Patients with HF were required to have been diagnosed with the condition in accordance with ACC and AHA standards, whereas those in the control group needed only to be free of any known risk factors for cardiovascular disease.

Sample Collection and Processing: Each person had a standardized blood sample taken while they were fasting. The serum was extracted by centrifugation and frozen at -80 degrees Celsius for further study. Following the manufacturer's instructions, blood Galectin-3 levels were measured using an enzyme-linked immunoassay assay (ELISA) kit.

Ejection Fraction Measurement: Transthoracic echocardiography was conducted by experienced sonographers, blinded to the participants' clinical status, using a standardized protocol. EF was determined using the biplane Simpson's method, and the results were expressed as a percentage.

Statistical Analysis: A normal distribution was tested for in the data using the Shapiro-Wilk procedure. Descriptive statistics included means and standard deviations (SD) for normally distributed continuous data, medians and interquartile ranges (IQRs) for non-normally different datasets, and frequencies and percentages for variables that are categorical. We compared the two groups using the t-test or the Mann-Whitney U test for

continuous variables, as well as the chi-square test or Fisher's precise test for categorical variables.

Depending on the shape of the data distribution, either Pearson's or Spearman's correlation coefficients was employed to examine the association between Galectin-3 in the blood and EF. By analysing the ROC curve, we were able to calculate the area under the curve (AUC) as well as the 95% confidence range for Galectin-3's diagnostic performance (CI). Ideal thresholds were determined using the Youden index.

The predictive significance of Galectin-3 was analysed using a Cox regression model with risk-adjustment. Results included the HR and a 95% CI. The analyses were conducted using a conventional statistical software with a threshold of significance () set at 0.05.

RESULTS

Our study carefully measured blood Galectin-3 levels and compared them to ejection fractions (EF) in both healthy individuals and those with heart failure. The most important results of our investigation are summarized here.

Descriptive Statistics: The demographic and clinical characteristics of the study cohorts were comparable, with no statistically significant differences observed in age, sex, and comorbidities. The HF patients (mean EF: 34.5% ± 7.3%) exhibited a considerably lower EF than the healthy subjects (mean EF: 61.2% ± 5.6%, p < 0.001). Serum Galectin-3 levels were notably higher in the HF cohort (mean ± SD: 26.4 ± 7.2 ng/mL) compared to the healthy subjects (mean ± SD: 12.1 ± 2.8 ng/mL; p < 0.001).

Correlation Analysis: Our analysis revealed a significant inverse correlation between serum Galectin-3 levels and EF in the HF patients (r = -0.72, p < 0.001), highlighting a strong relationship between these variables. In the healthy subjects, we observed a weak, yet statistically significant inverse correlation (r = -0.26, p = 0.002).

Table 1: Serum Galectin-3 Levels with EF among subjects.

HF patients	Healthy subjects	
Serum Galectin-3 levels	-0.72*	-0.26*
EF	-0.72*	
p-value	< 0.001**	0.002**

*Correlation coefficient (r) values indicate the strength and direction of the correlation, with negative values indicating an inverse relationship.

**p-values indicate the statistical significance of the correlation, with p < 0.05 considered significant.

Diagnostic Performance of Galectin-3: Serum Galectin-3 levels have shown promise as a diagnostic biomarker for HF, as shown by receiver - operating characteristic characteristic (ROC) curve analysis. Superior discriminatory power was shown by an AUC of 0.92 (95% CI: 0.89 - 0.95, p 0.001). Youden index analysis revealed that a cutoff value of 17.3 ng/mL for Galectin-3 was associated with an 87.3 percent sensitivity and an 84.7 percent specificity.

Table 2: Diagnostic Performance of Galectin-3

	HF diagnosis
Serum Galectin-3 levels	Yes
AUC	0.92
95% CI	0.89 - 0.95
p-value	< 0.001
Cut-off point	17.3
Sensitivity	87.3%
Specificity	84.7%

The ROC curve analysis demonstrated the diagnostic potential of serum Galectin-3 levels for HF, with an excellent discriminative ability (AUC = 0.92, p < 0.001). The optimal cut-off point for Galectin-3 was determined by the Youden index to be 17.3 ng/mL, with a sensitivity of 87.3% and a specificity of 84.7%

Prognostic Value of Galectin-3: Serum Galectin-3 levels were shown to be independently linked with an increased risk of HF-related hospitalisations and death inside the Cox proportional hazard regression model, even after controlling for age, sex, and other relevant confounders. In patients with HF, a rise in Galectin-3 levels by 1 ng/mL was related with a 35% increase in the probability of poor outcomes (hazard ratio [HR]: 1.35, 95% confidence interval [CI]: 1.12-1.63, p = 0.002).

Table 3: Cox proportional hazards regression model

	HF-related hospitalizations and mortality
Serum Galectin-3 levels	Yes
Hazard ratio (HR)	1.35
95% CI	1.12 - 1.63
p-value	0.002
Adjusted for confounders	Yes
Confounders	Age, sex, comorbidities

After accounting for possible confounders such age, sex, and comorbidities, the Cox proportional hazards regression model demonstrated that greater blood Galectin-3 levels were independently linked with a higher risk of HF-related hospitalisations and mortality. A 1 ng/mL rise in Galectin-3 levels was related with a 35% increase in the probability of unfavourable outcomes in HF patients, as shown by the hazard ratio (HR) of 1.35 (95% CI: 1.12 - 1.63, p = 0.002)..

Our comprehensive biostatistical study revealed a substantial inverse link between blood Galectin-3 levels with EF in both healthy people and HF patients, with the correlation being higher in the latter group. Galectin-3 has emerged as a promising biomarker for the diagnosis and prognosis of HF, suggesting that it may improve the clinical treatment of this complicated illness.

DISCUSSION

Heart failure is a debilitating ailment that can arise if the delicate balance that keeps the heartbeat, the rhythmic lifeforce of our existence, functioning normally is disturbed (HF). The need for cutting-edge diagnostic and prognostic technologies has never been greater than it is now, as HF casts a shadow over an ever-increasing population. Our ground-breaking study aimed to determine the association between Galectin-3, a protein with unknown functions, and ejection fraction (EF) in both healthy individuals and people with heart failure (HF).

Our intriguing results reveal a strong negative link between serum Galectin-3 levels and EF in both cohorts, with the relationship being more prominent in the HF population. The protein's recognised roles in inflammation, fibrosis, and immunological modulation are all important in the onset and progression of HF, therefore these findings make sense. The discovery of the complicated relationship between Galectin-3 and cardiac function sheds insight on the difficult pathophysiology of HF.

Surprisingly, our research also reveals Galectin-3's intriguing potential as a diagnostic biomarker for HF. Galectin-3's ability to identify HF patients from healthy participants is excellent, with an area under the curve (AUC) of 0.92. The addition of this novel biomarker to our diagnostic tools expands the potential for early detection and intervention in the fight against HF.

Nevertheless, that's not all Galectin-3 has going for it. Our data suggest that greater blood Galectin-3 levels may have predictive significance for HF since they are independently linked with an increased risk of HF-related hospitalisations and death. This intriguing realisation might be the catalyst for individualised treatment plans, allowing doctors to customise care based on patients' unique risk profiles.

While the results of our study provide some insight into the mysterious connection between Galectin-3 and cardiac function, it is important to note that the scope of our investigation is limited. Our findings may be limited in their applicability because of the

cross-sectional design and since we only looked at one location. Nonetheless, these intriguing findings provide a sneak peek into the future use of Galectin-3 in diagnostics and prognosis of HF.

Galectin-3 emerges as a beacon of hope as we delve further into the intricacies of the human heart, leading us to a better knowledge of HF and its treatment. Our findings pave the way for future studies that will, without a doubt, reveal even more about the mysterious heart and its reliable biomarker, Galectin-3.

Our findings add an exciting new thread to the vast tapestry of cardiovascular research by demonstrating the promise of Galectin-3 as a diagnostic and predictive tool for heart failure. Expanding on these preliminary findings, we must investigate the several elements of Galectin-3's function in the onset and progression of heart failure as we continue our quest to decode the mysterious inner workings of the human heart.

While we already know that Galectin-3 has a role in inflammation, fibrosis, and immunological modulation, further work is needed to determine how exactly this protein affects ejection fraction and cardiovascular outcomes. In order to prove causation and validate the generalizability of our findings, longitudinal research including bigger, more varied groups would be important.

Galectin-3 has potential not just as a diagnostic or predictive tool, but also as a therapeutic target. The prognosis and quality of life for heart failure patients might benefit from research into pharmaceutical therapies focused at modifying Galectin-3 levels. It is possible that a more complete and precise evaluation of heart failure risk can be achieved by integrating Galectin-3 with other recognised biomarkers.

CONCLUSION

In conclusion, our study unveils the enthralling connection between Galectin-3 and the heart's performance, unearthing its diagnostic and prognostic prowess in heart failure. As we continue to explore this enigmatic protein's potential, we pave the way for groundbreaking interventions that could transform the lives of countless individuals, ultimately harmonizing the complex symphony of the human heart.

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