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The Relationship between Ejection Fraction and Cardiac Biochemical Parameters in Left Bundle Branch Block Patients

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Abstract

Introduction: This study evaluates the correlation between ejection fraction (EF) and many biochemical cardiac markers in patients with left bundle branch block (LBBB). The heart's ability to pump blood can be negatively affected by LBBB, a frequent conduction defect. An essential measure of cardiac function, EF, is the amount of blood pushed out of the left ventricle during each contraction. Aim: This study aims to better understand the relationships between EF and cardiac biochemical markers in individuals with LBBB and the biological implications of these findings. Material and methods: A case-control study was performed with 140 participants (70 LBBB patients and 70 healthy controls). The diagnoses were verified by clinical and laboratory testing, and serum samples were analyzed for cardiac biomarker levels. In addition, participants' ages, sexes, BMIs, employment statuses, and occupations were analyzed in addition to other demographic data. Results: Age, body mass index, employment and occupational status were all shown to be significantly different between LBBB patients and healthy controls. In addition, h-FABP, myoglobin, troponin, NT-proBNP, and CK-MB were considerably greater in LBBB patients than in healthy controls. These biomarkers have the potential to serve as indications of cardiac dysfunction in LBBB patients, as shown by a correlation matrix revealing substantial connections between them. Conclusions: In LBBB patients, these biomarkers may indicate cardiac dysfunction, as shown by these results. This work contributes to risk classification, prognosis evaluation, and therapeutic decision-making in LBBB patients by shedding light on the connection between EF and cardiac biochemical markers. Further investigation needs to be conducted to confirm these results and investigate possible approaches for improved patient care.

Keywords

cardiac biochemical markers, LBBB and Ejection fraction.

A common conduction anomaly known as left bundle branch block (LBBB) is defined by a delay or obstruction in the electrical impulses that pass through the left bundle branch of the heart's electrical system. As a result, a distinctive electrocardiogram (ECG) pattern is produced, and heart function may be significantly impacted. Therefore, it is essential to comprehend the association between LBBB and cardiac biochemical markers for individuals with this illness to be managed properly [1].

Ejection fraction (EF), one of the many variables evaluated to determine how well the heart works, is particularly significant. A dependable measure of overall cardiac performance, EF indicates the percentage of blood pushed out of the left ventricle with each contraction [2]. A change in EF in LBBB patients may result from inappropriate electrical

signal conduction, which may compromise heart function.

Apart from EF, cardiac biochemical measures may provide data on the fundamental physiological processes in LBBB patients. These criteria include biomarkers such as hormones, enzymes, proteins, and compounds that indicate different heart functions and health elements [3]. Assessing the causal connection between EF and various biochemical indicators in LBBB patients can provide a thorough understanding of the fundamental mechanisms that lead to cardiac disease in this group of patients[2].

To better understand LBBB, this article examines the correlation between EF and certain biochemical measures of the heart. We aim to clarify these connections' potential associations, interactions, and clinical implications by analyzing relevant studies and determining the available literature. Important implications for risk classification, prediction assessment, and medical choices in patients with LBBB may arise from the results of this study.

Understanding the connection between EF and cardiac biochemical markers in LBBB patients could improve our overall comprehension of the condition and help practitioners provide the best potential care for their patients. Particular treatments and individualized approaches to treatment may be developed; as a result, leading to better results and quality of life for those with LBBB.

Materials and Methods

The subjects of this case-control study included a total of 140 participants. The control group comprised 70 healthy individuals (36 males and 34 females), while the cases consisted of 70 patients diagnosed with left bundle branch block (31 males and 39 females). All participants had received healthcare at AL-Rabeea Heart Center, and their ages ranged from 24 to 80 years old. The diagnoses of the patients were confirmed through a comprehensive evaluation conducted by medical specialists, which involved a combination of clinical and laboratory tests.

Each patient had a participating cardiologist provide a clinical information questionnaire to collect data. This study's questionnaire was designed from the clinical form shown in Table-1. Subjects in the control group had never been diagnosed with a heart condition and whose electrocardiograms (ECGs) showed no evidence of a left bundle branch block. Nasiriyah, a city in southern Iraq, was the study site conducted between November 2022 and July 2022. Additionally, an echocardiography was performed by a cardiologist in all instances.

Methods for Collecting and Processing Samples

Each patient and control subject took five millilitres of human blood via venipuncture. After removing anticoagulants, the blood was transferred to a gel tube with a clot activator serum separation agent. The test tube was incubated at 37^0 C for half an hour. Next, the sample was centrifuged at 3000 rpm for 15 minutes following the coagulation step. The serum was easily separated from the remainder of the blood components due to this centrifugation process. Finally, the collected serum was removed carefully and frozen at -20^0 C for later analysis.

Inclusion Criteria

1. Patients with a confirmed diagnosis of left bundle branch block (symptomatic or asymptomatic) were included.
2. Increased time over 120 ms for the QRS complex
3. Patients in sinus rhythm.
4. Between the ages of 18 and 80 is the age range

Exclusion Criteria

1. Patients under 18 or over 80 who have left bundle branch block will not be considered.
2. Patients suffering from arrhythmias, such as atrial fibrillation.

Estimating the Body Mass Index (BMI)

In this study, individuals' BMIs were determined using the following formula: Body mass index (BMI) is calculated as follows: BMI = kg/m2.

Ethical Considerations

Both Al-Hussein Teaching Hospital and AL-Rabeea Private Hospital provided permission to perform this study. As a result, each patient and their relatives received the required care. Participants submitted an informed permission form or verbalized approval before testing.

Determination of Cardiac biomarkers parameters

Nipigon Health Corp. (Canada) supplied the following items to evaluate cardiac biomarker parameters; human serum myoglobin (MYO) detection kit (catalogue number: 0320503404), human serum H-FABP (heart-type fatty acid-binding protein) detection kit (catalogue number: 0320503704), human serum troponin I (Tn I) detection kit (item no. 0320503304), human serum

NT-proBNP detection kit (Item 0320503604), and human serum Creatine Kinase (CK-MB) detection kit (catalogue number: 0320503504). These reagents can be used immediately to evaluate human serum for specific cardiac biomarkers.

The results

The demographic characteristics of the study participants about their clinical and biochemical condition

The table-1 provides an overview of the demographic characteristics of the patients and healthy controls in the study. The variables included in the table are sex, age, body mass index (BMI), job condition, and occupation condition. The sex distribution is similar between patients and controls, with slightly higher proportions of females in the patient group. The mean age of patients (65.63±9.35) is significantly higher than that of the controls (44.53±12.60) ($p<0.0001$). The age distribution shows that a majority of patients (80%) fall within the 62-80 age range, while the majority of healthy controls (57.14%) are in the 20-40 age range. The BMI of patients (35.32±4.48) is significantly higher than that of controls (30.66±5.98) ($p<0.0001$). In terms of job condition, a higher proportion of employed individuals is observed in the control group compared to the patient group ($p=0.001$). Occupation condition indicates that a larger proportion of patients reside in urban areas compared to controls ($p<0.0001$). Overall, the table provides an overview of the demographic characteristics and highlights significant differences between the patient and control groups for various variables.

Table-1: Demographic Characteristics of Patients and Healthy Controls

Variable	Patient (n= 70)	Control (n= 70)	P value
	No. and %	No. and %	
Sex			
Male	31 (44.29%)	36 (51.43%)	0.999
female	39 (55.71%)	34 (48.57%)	
Age (mean±SD)	65.63±9.35	44.53±12.60	<0.0001
20 − 40	2 (2.86%)	40 (57.14%)	0.023
41 − 61	12 (17.14%)	19 (27.14%)	
62 − 80	56 (80%)	11 (15.72%)	
BMI	35.32±4.48	30.66±5.98	<0.0001
Job condition			
employer	15 (21.43%)	39 (55.72%)	0.001
unemployed	55 (78.57%)	31 (44.28%)	
Occupation condition			
rural	20 (28.57%)	26 (37.14%)	<0.0001
Urban	50 (71.43%)	44 (62.86%)	<0.0001

Note: The data is presented as mean ± SD. A significance level of $p<0.05$ was used to draw conclusions.

Distribution of LBBB Patients by Age

The table-2 presents the number of LBBB patients within each age group, along with the corresponding percentage. It is evident that the majority of LBBB patients (80%) are within the age range of 62 to 80. Additionally, a smaller proportion of patients (17.14%) fall within the age group of 41 to 61, while a minimal number (2.86%) are observed in the 20 to 40 age group. This distribution provides valuable insights into the age profile of LBBB patients, highlighting the higher occurrence of LBBB among older individuals.

Table-2: Displays the distribution of LBBB (Left Bundle Branch Block) patients based on their age.

Age Group	Males 31 cases	Females 39 cases	all cases 70 cases
20 − 40	1 (3.23%)	1 (2.56%)	2 (2.86%)
41 − 61	9 (29.03%)	3 (7.69%)	12 (17.14%)
62 − 80	21(67.74%)	35 (89.74%)	56 (80%
Total	31 (100%)	39 (100%)	70 (100%)

Comparison of Cardiac Biomarkers between LBBB Patients and Control Group

The table-3 provides a comparison of cardiac biomarker levels between LBBB patients and healthy individuals. The cardiac biomarkers assessed include H-FABP, myoglobin, troponin, NT-proBNP, and CK-MB. All biomarkers exhibit statistically significant differences between LBBB patients and the control group, as indicated by the

p values. LBBB patients have significantly higher levels of H-FABP (9.614±8.402) compared to healthy individuals (2.490±1.409) (p<0.0001). Similarly, myoglobin levels are significantly elevated in LBBB patients (78.321±45.222) compared to the control group (51.808±15.928) (p<0.000). Troponin levels are also significantly higher in LBBB patients (0.194±0.482) compared to healthy individuals (0.0258±0.029) (p=0.003). NT-proBNP levels show a substantial difference between LBBB patients (1706.154±2545.949) and the control group (68.942±24.281) (p<0.0001). Additionally, CK-MB levels are significantly higher in LBBB patients (3.939±2.292) compared to the control group (1.921±1.160) (p<0.0001). These findings indicate that LBBB patients have elevated levels of cardiac biomarkers compared to healthy individuals. These biomarkers may serve as important indicators of cardiac dysfunction associated with LBBB.

Table-3: Levels of Cardiac Biomarkers in LBBB Patients and Healthy Individuals

Parameter	LBBB Patients (n=70)	Control Group (n=70)	P value
H-FABP	9.614±8.402	2.490±1.409	< 0.0001
Myoglobin	78.321±45.222	51.808±15.928	< 0.0001
Troponin	0.194±0.482	0.0258±0.029	0.003
NT-pro BNP	1706.154±2545.949	68.942±24.281	< 0.0001
CK- MB	3.939±2.292	1.921±1.160	< 0.0001

Note: The data is presented as mean ± SD. A significance level of p<0.05 was used to generate conclusions.

The correlation coefficients between various cardiac biomarkers in LBBB patients

The correlation table-4 presents the correlation coefficients between various cardiac biomarkers in LBBB patients. H-FABP shows a strong positive correlation with myoglobin (r=0.781, p<0.01), indicating a significant association between these two biomarkers. NT-proBNP exhibits a moderate positive correlation with H-FABP (r=0.529, p<0.01) and myoglobin (r=0.402, p<0.01), suggesting a relationship between these biomarkers. Troponin demonstrates a weak positive correlation with H-FABP (r=0.245, p<0.05) and CK-MB (r=0.312, p<0.01). CK-MB displays a moderate positive correlation with NT-proBNP (r=0.574, p<0.01 (. Myoglobin exhibits a weak positive correlation with CK-MB (r=0.198), although it is not statistically significant.

Table-4: Correlation Matrix of Cardiac Biomarkers in LBBB Patients

Biomrker	H-FBP	Myoglobin	Troponin	NT-proBNP	CK-MB
	1	0.781**	0.245*	0.529**	0.363**
Myoglobin	0.781**	1	0.173	0.402**	0.198
Troponin	0.245*	0.173	1	0.087	0.312**
NT-proBNP	0.529**	0.402**	0.087	1	0.574**
CK-MB	0.363**	0.198	0.312**	0.574**	1

Note: Correlation coefficients are displayed. *p<0.05, **p<0.01 (two-tailed)

Relationship between Ejection Fraction and Cardiac Biochemical Parameters

This table-5 examines the relationship between ejection fraction (EF) and various cardiac biomarkers. The patient's group (n=70) is divided into three subgroups based on EF ranges: EF 56-65% (n=19), EF 43-55% (n=19), and EF ≤42% (n=32). The table presents the mean ± standard deviation (SD) of the cardiac biomarkers for each EF subgroup, along with the p-values. Troponin levels show a significant difference between the EF subgroups (p=0.001), with the EF ≤42% subgroup exhibiting the highest mean value (0.1723±0.334).

CK-MB levels also display a significant difference among the EF subgroups (p<0.0001), with the EF ≤42% subgroup having the highest mean value (3.898±1.728). NT-proBNP levels exhibit a significant difference across the EF subgroups (p<0.0001), with the EF ≤42% subgroup showing the highest mean value (968.513±1002.5). Similarly, H-FABP levels demonstrate a significant difference among the EF subgroups (p<0.0001), with the EF ≤42% subgroup having the highest mean value (10.392±5.676).

Table-5: Relationship between Ejection Fraction and Cardiac Biochemical Parameters

Cardiac biomarker	Control N=70	EF 56-65% N=19	EF 43-55% N= 19	EF ≤42% N=32	P-value
Troponin	0.0259±0.029	0.0276±0.004	0.1723±0.334	0.307±0.649	0.001
CK-MB	1.921±1.160	3.851±3.081	3.898±1.728	4.017±2.107	<0.0001
NT-proBNP	68.942±24.281	226.899±259.651	968.513±1002.5	3022.437±3215.83	<0.0001
H-FABP	2.490±1.409	5.032±3.713	10.392±5.676	11.874±10.579	<.0001

Statistical Evaluation

The data were analyzed using SPSS (Version 26) statistical software. Descriptive statistics, including mean and standard deviation, were calculated to summarize the data. Statistical tests, such as the Mann-Whitney U test and Pearson's correlation, were employed to examine relationships and differences between variables. All statistical tests were two-tailed, and a p-value of less than 0.05 was considered statistically significant, indicating strong evidence against the null hypothesis.

Discussion

The present study investigated the demographic characteristics, clinical parameters, and cardiac biomarkers in LBBB patients compared to a control group. The findings shed light on several important aspects of LBBB and its association with clinical and biochemical factors. Demographic characteristics of the study participants revealed that LBBB patients had an average age of 65.63, ranging from 35 to 80 years. The majority of LBBB cases (80%) were observed in the age range of 62-80 years, indicating a higher prevalence of LBBB in older individuals.

In contrast, healthy controls showed a higher proportion (57.14%) in the age range of 20-40 years. This age distribution suggests that LBBB is more common among the elderly population, consistent with previous study that have reported a higher prevalence of LBBB among older individuals [4]. This age-related nature of LBBB may be attributed to age-related changes in cardiac conduction system and structural abnormalities in the heart [5]. The higher proportion of LBBB cases in the older age range highlights the importance of age as a risk factor for developing LBBB [6]. Additionally, the LBBB patient group had a higher percentage of unemployed individuals (78.57%) compared to the control group (44.28%), indicating a potential association between LBBB and occupational status.

The significantly elevated levels of cardiac biomarkers, including H-FABP, myoglobin, troponin, NT-proBNP, and CK-MB, in LBBB patients compared to the control group corroborate findings from previous studies [7][8][9][10][11][12]. These biomarkers have been well-established as indicators of myocardial injury and cardiac dysfunction. The increased levels of these biomarkers in LBBB patients suggest ongoing myocardial damage and impaired cardiac function, as reflected by elevated levels of these biomarkers. Notably, H-FABP and myoglobin showed a strong positive correlation, indicating their potential as reliable markers of cardiac damage in LBBB patients. Similarly, NT-proBNP and CK-MB displayed a moderate positive correlation, suggesting their utility in assessing cardiac impairment in LBBB. In summary, the correlation table-4 provides insights into the relationships among the cardiac biomarkers in LBBB patients. The strong positive correlations observed between H-FABP and myoglobin, as well as between NT-proBNP and H-FABP/myoglobin, suggest that these biomarkers may collectively indicate cardiac dysfunction in LBBB patients. The positive correlations involving troponin and CK-MB also highlight potential associations between these biomarkers and cardiac impairment in LBBB. Additionally, the association between EF and biomarker levels emphasizes the importance of EF as an indicator of cardiac function in LBBB patients. Further analysis focused on exploring the relationship between ejection fraction (EF) and cardiac biomarkers. The patients group was divided into three subgroups based on EF ranges. The results indicate that as the EF decreases, there is an increase in the levels of troponin, CK-MB, NT-proBNP, and H-FABP levels among the EF subgroups. These biomarkers are known to be associated with cardiac damage and dysfunction. The significant differences observed among the EF subgroups suggest that lower EF values may be indicative of more severe cardiac impairment. As EF decreased, there was a corresponding increase in the levels of these biomarkers. These findings support the notion that reduced EF is associated with cardiac dysfunction and myocardial injury in LBBB patients. These findings are in line with previous studies that have demonstrated the inverse relationship between EF and biomarker levels in various cardiac conditions [13][14].

This study has limitations. First, the sample size was small, limiting generalizability. These findings require larger studies. Second, this study examined a specific population; therefore, its findings may not apply to other populations or clinical circumstances. Diversity and comorbidity in the LBBB study would improve knowledge. Finally, the study's case-control approach limits causal correlations between LBBB and clinical and biochemical markers. LBBB progression and effects need longitudinal research.

In conclusion, the finding of this study supports earlier LBBB studies and provides further clinical and biochemical data. Age and damage to the heart are important in LBBB patients due to their age-related prevalence and higher cardiac biomarkers. LBBB's cardiac function and biomarker expression are connected to the biomarker-EF correlation. Larger cohorts and longitudinal investigations are needed to confirm these findings and understand LBBB's processes.

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