Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 9 (2025): September 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i9.1999
Original Article

An observational cohort study to determine the clinical profile, angiographic profile, and outcomes of patients with left bundle branch block without previous heart disease from a tertiary care centre in north India.

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Abstract

Background:

Left Bundle Branch Block (LBBB) is a significant electrocardiographic finding often associated with structural heart disease and adverse cardiovascular outcomes. It alters ventricular activation and may mask or mimic myocardial infarction on ECG. Early identification and evaluation are essential for prognosis and management. This study aimed to analyze clinical, echocardiographic, and angiographic profiles of patients with LBBB.

Methods:

This was a prospective, observational cohort study conducted over two years at a tertiary care cardiology center. One hundred patients with complete LBBB and stable hemodynamics were enrolled via random sampling. Data were collected through structured proformas, clinical exams, 2D echocardiography, and coronary angiography. Statistical analysis was done using SPSS, with significance set at $p < 0.05$.

Results:

Among 100 participants (mean age 58 ± 8.5 years; 67% male), chest pain (73%) and hypertension (62%) were the most common findings. Mean cholesterol and triglyceride levels were 203.6 mg/dL and 109.5 mg/dL, respectively, with an average BMI of 25.3 kg/m². Significant associations were found for chest pain, hypertension, and angiographic disease patterns ($p < 0.001$). Cholesterol showed a strong positive correlation with triglycerides ($r = 0.96$, $p < 0.001$), indicating elevated cardiovascular risk in patients with LBBB.

Conclusion:

LBBB is strongly associated with cardiovascular risk factors and may indicate underlying coronary artery disease and systolic dysfunction.

Recommendation:

Regular cardiovascular screening and timely coronary evaluation are recommended for patients with LBBB to detect and manage underlying ischemic heart disease early.

Keywords: *LBBB, coronary artery disease, echocardiography, hypertension, ejection fraction, cholesterol, angiography.*
Submitted: *July 20, 2025* ***Accepted:*** *August 29, 2025* ***Published:*** *September 30, 2025*

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Introduction

Left Bundle Branch Block (LBBB) is a significant electrocardiographic finding closely associated with increased morbidity and mortality, especially in patients with underlying cardiovascular disease [1,2]. Although it can occasionally be seen in asymptomatic individuals with structurally normal hearts, LBBB often coexists with conditions such as hypertension, coronary artery disease (CAD), valvular disorders, and dilated cardiomyopathy [3,4]. It alters the normal pattern of ventricular activation, leading to mechanical dyssynchrony, mitral regurgitation, and impaired left ventricular function [5]. In the context of

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myocardial infarction (MI), the presence of LBBB complicates diagnosis due to obscured ST-segment changes on ECG, often leading to delayed or inappropriate treatment [6]. While guidelines recommend treating new or presumed new LBBB as STEMI-equivalents, emerging data suggest this approach may not always be accurate, as many such patients lack coronary occlusion and may instead have heart failure or non-cardiac causes of symptoms [7,8].

Despite its clinical significance, LBBB remains a diagnostic and therapeutic challenge in both emergency and outpatient settings. The incidence of LBBB rises with age, and its presence is a marker of advanced cardiac disease and poor prognosis in patients with MI and heart failure [9]. However, not all cases of LBBB lead to adverse outcomes, and its prognostic value may depend on comorbidities, QRS duration, and the presence of symptoms such as chest pain or dyspnea [10]. Therefore, this study aims to evaluate the clinical, echocardiographic, and angiographic profiles of patients presenting with LBBB, assess the coexistence of CAD, and determine the role of various parameters, including comorbidities and treatment modalities, in predicting outcomes.

Methods

Study Design and Setting

This was a prospective, observational, single-center, cohort study conducted over two years (April 1st, 2022, to April 1st, 2024) at the Department of Cardiology, LPS Institute of Cardiology (LPSIC), GSVM Medical College, Kanpur.

Sample Selection

Patients aged 18 years or older with complete LBBB on ECG (QRS duration ≥120 ms), stable hemodynamics, and willingness to participate were included. Exclusion criteria were contraindication to coronary angiography (CAG), participation in another trial, or established coronary artery disease (CAD) or previous myocardial infarction.

Sample Size and Sampling Method

Using the formula $N = Z^2P(1-P)/d^2$ with Z = 1.96, P = 0.07 (7%), and d = 0.05, the calculated sample size was 100. A random sampling method was employed to recruit eligible participants.

Study Tools and Data Collection

A structured questionnaire (Performa) was used to record patient data. All enrolled patients underwent baseline history-taking, physical examination, 2D-echocardiography, and laboratory investigations. Each patient also underwent coronary angiography with or without revascularization, based on clinical indications. Guideline-directed medical therapy was provided as per the treating cardiologist's discretion. Patients were followed up for monitoring treatment and outcomes.

Bias and Quality Control

To minimize selection bias, random sampling was used during participant recruitment. Information bias was reduced by using a standardized questionnaire and ensuring data collection by trained cardiology residents under senior supervision. Observer bias was mitigated by having independent cardiologists interpret echocardiographic and angiographic findings without knowledge of patients' clinical profiles.

Ethical Considerations

The study was approved by the Institutional Ethics Committee of LPS Institute of Cardiology, GSVM Medical College, Kanpur. Written informed consent was obtained from all participants. Confidentiality and ethical standards were strictly maintained throughout the study.

Reliability Assessment

The internal consistency of the questionnaire was assessed using Cronbach's Alpha, which was 0.96 based on 5 items, indicating excellent reliability of the instrument used.

Statistical Analysis

Data analysis was performed using IBM SPSS version 26. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as counts and percentages. Descriptive analysis was carried out, and comparisons were made using Chi-square tests. A p-value of <0.05 was considered statistically significant.

Results

A total of 128 patients presenting with complete or suspected left bundle branch block (LBBB) during the study period were initially screened for eligibility. Of these, 112 patients met the preliminary inclusion criteria and underwent further evaluation. After applying exclusion criteria—such as incomplete or intermittent LBBB (n = 6), prior history of myocardial infarction or established coronary artery disease (n = 4), and contraindications to

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coronary angiography (n = 2)—100 participants were found to be eligible and enrolled in the study. All enrolled participants provided written informed consent and completed baseline and follow-up assessments. There were no dropouts or losses to follow-up, and thus, all 100 participants were included in the final analysis.

Among the 100 study participants, the mean age was 58 years, with most individuals falling in the 50–60 year age group (44%). The majority were male (67%) and reported chest pain (73%) as the most common symptom, followed by dyspnea (22%). Comorbidities such as hypertension (62%) and diabetes (34%) were prevalent, alongside notable proportions of smoking (26%), tobacco use (19%), and dyslipidemia (34%). Regarding lipid profile, 34% had elevated total cholesterol (>200 mg/dL), and 35% had raised triglycerides (>100 mg/dL), highlighting a significant burden of cardiovascular risk factors in the cohort (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (N = 100)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD	–	58 ± 8.51
	Median	–	59
	Range	–	36–70
	<40	6	6
	40–50	13	13
	50–60	44	44
	>60	37	37
Gender	Male	67	67
	Female	33	33
Chest Pain	Yes	73	73
	No	27	27
Dyspnea	Yes	22	22
	No	78	78
Palpitation	Yes	1	1
	No	99	99
Syncope	Yes	4	4
	No	96	96
Hypertension	Yes	62	62
	No	38	38
Diabetes	Yes	34	34
	No	66	66
Tobacco Use	Yes	19	19
	No	81	81
Smoking	Yes	26	26
	No	74	74
Dyslipidemia	Yes	34	34
	No	66	66
Total Cholesterol	150–200 mg/dL	66	66
	>200 mg/dL	34	34
Triglycerides	70–100 mg/dL	65	65
	>100 mg/dL	35	35

The mean total cholesterol among participants was 203.6 mg/dL, slightly above the recommended threshold, while triglyceride levels averaged 109.48 mg/dL. The mean BMI was 25.3 kg/m², indicating a tendency toward

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overweight status. Participants had an average heart rate of 90.44 beats per minute, with a standard deviation of 5.89. The mean LVIDd was 4.704 cm, suggesting relatively preserved left ventricular dimensions across the cohort. These values reflect a profile of mild dyslipidemia and elevated cardiovascular risk markers (Table 2).

Table 2: Mean and Standard Deviation of Selected Clinical and Biochemical Parameters (N = 100)

Parameter	Mean	Standard Deviation (SD)
Total Cholesterol (mg/dL)	203.6	37.59
Triglycerides (mg/dL)	109.48	35.59
Body Mass Index (BMI) (kg/m²)	25.3	3.92
Heart Rate (beats/min)	90.44	5.89
Left Ventricular Internal Diameter in Diastole (LVIDd) (cm)	4.704	0.53

At baseline, the majority of patients (65%) had an ejection fraction (EF) in the 55–60% range, which significantly declined at follow-up, with only 10% remaining in this range. A corresponding increase was observed in the lower EF categories, suggesting worsening systolic function in some participants. LVIDD measurements remained stable, with 77% of participants having dimensions between 4–5 cm. BNP levels improved slightly at follow-up, with 90% within normal limits compared to 84% at baseline, indicating a reduction in cardiac stress or volume overload in some patients over time (Table 3).

Table 3: Comparative Distribution of Study Participants' Baseline and Follow-Up Parameters

Characteristics	Baseline (N)	Baseline (%)	Follow-Up (N)	Follow-Up (%)
Ejection Fraction (EF)				
15%–20%	10	10%	6	6%
20%–25%	10	10%	5	5%
25%–30%	1	1%	1	1%
30%–35%	12	12%	12	12%
40%–45%	12	12%	2	2%
55%–60%	65	65%	10	10%
Echocardiography (LVIDD)				
4–5 cm	77	77%	77	77%
>5 cm	23	23%	23	23%
BNP				
Elevated	16	16%	10	10%
Within Normal Limits (WNL)	84	84%	90	90%

Chi-square analysis revealed significant associations for variables like chest pain ($\chi^2 = 177.6$, $p < 0.0001$), hypertension ($\chi^2 = 15.705$, $p = 0.000074$), and angiographic findings such as LM disease and triple vessel disease ($p < 0.0001$), suggesting their strong relationship with LBBB presentation. However, variables like tobacco use, smoking, and follow-up complaints (angina, dyspnea, palpitation) did not show statistically significant associations with outcomes, indicating they may not independently impact prognosis in this cohort (Table 4).

Table 4: Chi-Square Analysis of Clinical Characteristics and Outcomes Among Study Participants

Category	Variable	Yes (N, %)	No (N, %)	Chi-Square	p-value
Presentation	Chest Pain	73 (73%)	27 (27%)	177.6	<0.0001

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	Dyspnea	22 (22%)	78 (78%)		
	Palpitation	1 (1%)	99 (99%)		
	Syncope	4 (4%)	96 (96%)		
Comorbidities	Hypertension	62 (62%)	38 (38%)	15.705	0.000074
	Diabetes	34 (34%)	66 (66%)		
Addictions	Tobacco Use	19 (19%)	81 (81%)	1.405	0.2358
	Smoking	26 (26%)	74 (74%)		
Angiography Results	LM Disease	7 (7%)	93 (93%)	94.028	<0.0001
	SVD	16 (16%)	84 (84%)		
	DVD	11 (11%)	89 (89%)		
	TVD	16 (16%)	84 (84%)		
	Normal CAG	56 (56%)	44 (44%)		
Follow-Up Complaints	Angina	7 (7%)	93 (93%)	0.3546	0.8375
	Dyspnea on Exertion	6 (6%)	94 (94%)		
	Palpitation	5 (5%)	95 (95%)		

Pearson's correlation analysis revealed a strong and significant positive correlation between total cholesterol and triglycerides ($r = 0.96$, $p < 0.0001$), indicating that increases in one are closely mirrored by the other. BMI was moderately correlated with both cholesterol ($r = 0.65$) and triglycerides ($r = 0.66$), and also showed a weak but significant correlation with LIVDD ($r = 0.31$, $p = 0.0016$). No significant correlations were observed between heart rate and any of the other variables, suggesting its independence from lipid profile and cardiac dimensions in this cohort (Table 5).

Table 5: Pearson's Correlation Among Study Variables (2-Tailed Test)

Variables	T CHOL	TG	BMI	LIVDD	HEART RATE
T CHOL	1	0.96017*	0.65047*	-0.00577	-0.03776
p-value	--	<0.0001	<0.0001	0.95454	0.70919
TG	0.96017*	1	0.66337*	-0.00597	-0.03748
p-value	<0.0001	--	<0.0001	0.95302	0.7112
BMI	0.65047*	0.66337*	1	0.31107*	0.00926
p-value	<0.0001	<0.0001	--	0.00163	0.92717
LIVDD	-0.00577	-0.00597	0.31107*	1	0.05337
p-value	0.95454	0.95302	0.00163	--	0.59795
HEART RATE	-0.03776	-0.03748	0.00926	0.05337	1
p-value	0.70919	0.7112	0.92717	0.59795	--

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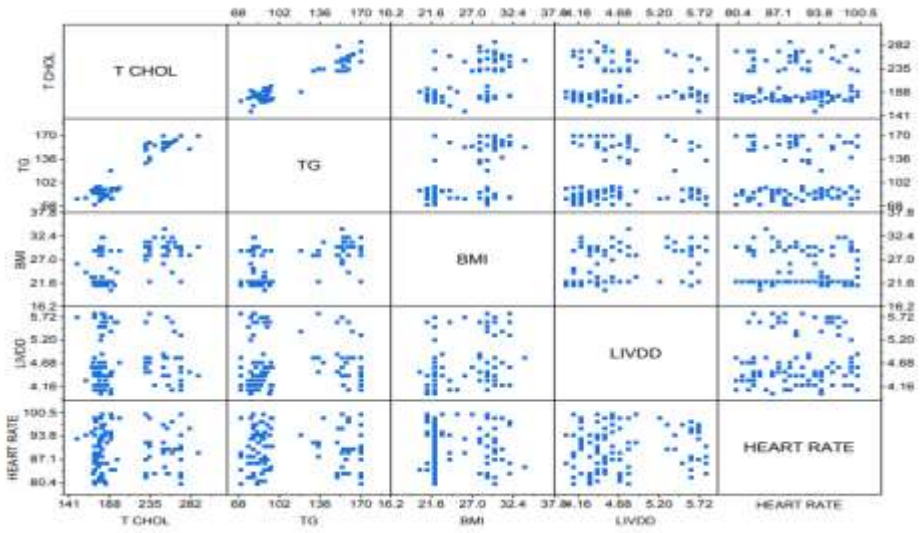

Figure 1: Scatter Pearson's plot showing correlation among study variables

Discussion

In this prospective observational study at the LPS Institute of Cardiology, Kanpur, a total of 100 individuals diagnosed with left bundle branch block (LBBB) were assessed. Most participants were men (67%) and aged between 50 and 60 years (44%), with a median age of 59 years. This demographic distribution is comparable to the Framingham study, which documented a mean onset age of approximately 62 years among LBBB patients [11]. The higher prevalence of LBBB in older individuals may reflect age-related degenerative and atherosclerotic changes, influenced by risk factors such as reduced HDL levels, central obesity, and insulin resistance—factors commonly observed in the Indian population [11]. Chest pain (73%) and dyspnea (22%) were the predominant presenting symptoms, while hypertension (62%) and diabetes mellitus (34%) were the most frequent comorbidities. These findings are consistent with prior evidence linking LBBB to hypertensive and ischemic heart diseases [11]. The study also revealed significant correlations between body mass index (BMI) and left ventricular internal diameter in diastole (LVIDD), as well as between dilated cardiomyopathy, hypertension, and coronary artery disease (CAD), indicating their potential pathophysiological interplay.

Coronary angiographic assessment demonstrated that 56% of patients with LBBB had evidence of CAD, corroborating results from previous research by Abrol et al. and other regional studies involving similar patient cohorts [12–14]. Conversely, 40.6% of the participants had normal coronary angiograms, a finding consistent with earlier investigations that questioned a uniform association between LBBB and obstructive CAD [15]. Additionally, 63.7% of participants exhibited varying degrees of left ventricular systolic dysfunction, aligning with echocardiographic findings from prior studies on LBBB populations [16]. Chi-square analysis identified significant associations between hypertension, diabetes, and clinical presentation, supporting their contributory role in left ventricular hypertrophy and subsequent conduction abnormalities [9]. The multifactorial etiology of LBBB encompasses ischemic injury, hypertensive heart disease, conduction system fibrosis, valvular abnormalities (particularly aortic stenosis), and myocarditis [9]. These findings reinforce the importance of coronary angiography in evaluating LBBB, as non-invasive tests alone may not reliably exclude underlying ischemic heart disease.

The prognostic role of LBBB in acute myocardial infarction (AMI) remains complex and age-dependent. Prior studies indicate that LBBB prevalence rises with age, from around 2.7% in individuals under 65 years to over 10% among those above 75 years [17,18]. Older patients frequently present with atypical or absent chest pain, contributing to diagnostic delays and increased mortality risk [17–19]. In the present study, nearly two-thirds of participants exhibited clinical

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Original Article

features suggestive of heart failure, indicating that dyspnea may be a more common presentation than chest pain in this subgroup. Supporting literature suggests that patients without chest pain at presentation often have higher Killip class scores and more extensive myocardial injury [18–20]. Although LBBB has historically been regarded as a STEMI equivalent when accompanied by ischemic symptoms, our results—along with prior evidence—highlight the necessity for a comprehensive diagnostic approach incorporating cardiac biomarkers, echocardiography, and angiography to differentiate acute ischemic events from chronic structural cardiac disease in patients presenting with LBBB.

Generalizability

The findings of this single-center cohort study are primarily applicable to patients with LBBB attending tertiary cardiac care centers in North India and may not be fully generalizable to other populations or healthcare settings.

Conclusion

This study underscores the clinical and prognostic significance of Left Bundle Branch Block (LBBB) in patients presenting to a tertiary care cardiology center. The majority of patients with LBBB were elderly males with a high prevalence of cardiovascular risk factors such as hypertension, diabetes, and dyslipidemia. A significant association was found between LBBB and structural heart diseases, particularly coronary artery disease and left ventricular systolic dysfunction. While not all patients had obstructive CAD, the presence of LBBB was often linked to adverse cardiac outcomes. The findings highlight the importance of early identification, comprehensive evaluation including echocardiography and angiography, and close follow-up of patients with LBBB to guide timely intervention and improve long-term prognosis.

Limitations

This study was limited by its single-center design, relatively small sample size, and short follow-up duration, which may restrict the ability to infer long-term outcomes or establish causal relationships.

Recommendation

Regular cardiovascular screening and timely coronary evaluation are recommended for patients with LBBB to detect and manage underlying ischemic heart disease early.

Acknowledgment

The authors sincerely thank the faculty, residents, and staff of the Department of Cardiology, LPS Institute of Cardiology, GSVM Medical College, Kanpur, for their invaluable assistance in patient recruitment, data collection, and follow-up.

Source of Funding

This study did not receive any external funding and was conducted with institutional support only.

Conflict of Interest

The authors declare that there is no conflict of interest related to this study.

Availability of Data

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

Authors' Contribution

All authors contributed equally to the study design, data collection, statistical analysis, manuscript drafting, and final approval of the version to be published.

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Original Article

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https://doi.org/10.51168/sjhrafrica.v6i9.1999
Original Article

PUBLISHER DETAILS:

Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
(ISSN 3006-1059) Print
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256 775 434 261
Location: Scholar's Summit Nakigalala, P. O. Box 701432, Entebbe Uganda, East Africa