Iranian Heart Journal; 2017; 18 (3)

Original Article

Structural Heart Disease in Patients With Left Bundle Branch Block: State of Knowledge

Amir Hossein Yazdi[1], MD; Ehsan Khalilipur[2]*, MD;
Mohammad Hossein Taghdiri[1], MD; Mohammad Ali Seifrabiee[1], MD;
Neda Mehralizadeh[2], MD

ABSTRACT

Background: One common electrocardiographic abnormality every physician comes across frequently is left bundle branch block (LBBB), which is found usually in asymptomatic patients with some complaints of unknown significance. This study was conducted to find patterns of structural heart disease in patients with LBBB.

Methods: This descriptive analytic cross-sectional study was conducted in Ekbatan Hospital in Hamadan over a period of 12 months. Symptomatic patients were included and were divided into 2 groups of patients with LBBB and patients without LBBB. All the patients underwent transthoracic echocardiography and coronary angiography, and the known coronary artery disease risk factors were evaluated. A *P* value below 0.05 was considered meaningful.

Results: From 80 patients enrolled in our study, those with LBBB were significantly older than the ones without LBBB (mean age = 71 y vs 62 y). The known coronary artery disease risk factors were more prevalent among the LBBB group (with *P* values of 0.002, .006, and 0.007 for diabetes mellitus, dyslipidemia, and hypertension—respectively). Echocardiographic abnormality, defined as left ventricular systolic dysfunction, was more prevalent in the LBBB group (just 3 patients with a normal left ventricular function in the LBBB group vs 13 patients in the non-LBBB group). Valvular heart disease was seen in 57.5% of the patients in the LBBB group and 17.5% of the patients in the non-LBBB group. Obstructive coronary artery disease was reported more frequently in the patients with LBBB. (Normal coronary artery disease was reported in 2 patients in the LBBB group and in 8 patients in the non-LBBB group.)

Conclusions: There is a high likelihood of structural heart abnormalities in patients with LBBB, and this is a predictive finding even in asymptomatic patients. ***(Iranian Heart Journal 2017; 18(3):6-12)***

Keywords: Left bundle branch block, Angiography, Transthoracic echocardiography, Coronary risk factor, Structural heart disease

[1] Department of Cardiology, School of Medicine, Hamadan University of Medical Sciences, Hamadan, I. R. Iran
[2] Rajaie Cardiovascular, Medical, and Research Center, Iran University of Medical Sciences, Tehran, I.R. Iran

***Corresponding Authors:** Ehsan Khalilipur, MD; Rajaie Cardiovascular, Medical, and Research Center, Iran University of Medical Sciences, Tehran, I.R Iran.
E-mail: ehsankhalilipur@gmail.com **Tel:** 09125055884

Received: May 14, 2017 **Accepted:** July 20, 2017

The presence of left bundle branch block (LBBB) has been a new entity since the advent of biventricular pacing, and our attitude toward its implications has changed over the years. We have passed decades since physicians first defined the morphologic features of LBBB, but lately we have thought about its role in devastating cardiac conditions such as coronary artery disease and heart failure. [1] Historically, we define the left bundle branch of the His conductance system as follows: a predivisional segment, an anterior fascicle that crosses the left outflow tract and terminates in the Purkinje system, a posterior fascicle that fans inferiorly and posteriorly into Purkinje fibers, and in some hearts a median fascicle to the interventricular septum.[2-6]

The LBBB criteria are fulfilled when both left anterior and left posterior fascicles are blocked and the duration of QRS exceeds 120 ms. The block of the left bundle results in abnormal septal depolarization and deranged patterns of ventricular synchrony at the time of ventricular contraction. [7] It also causes a delay in the ventricular vector and reveals pathognomonic electrocardiographic features of LBBB, which are comprised of loss of septal Q wave in leads 1, aVL, V_5, and V_6; secondary ST–T wave changes in leads 1, V_5, and V_6; and myocardial contraction abnormality, which just affects the left ventricle (LV). [8] Complete LBBB, though diagnosed rarely in healthy individuals, is usually a consequence of other cardiac abnormalities. [9] The Framingham study, which is one of the largest cardiovascular cohort studies ever conducted, followed up patients for 18 years and reported that 48% of the patients with LBBB developed overt coronary artery disease. [7] Other epidemiologic studies have reported that the LBBB prevalence rate in the general population is about 1% (range = 0.2%–1.1%). [10-14] Although the prevalence of LBBB increases with age, overt structural heart disease is also detected more frequently in older patients. [15, 16] A study conducted at Royal Canadian Air Force reported that the 5-year incidence rate of sudden cardiac death was 10 times greater in the patients who had developed LBBB than that in those without LBBB. [17] Another recently noticed substantial feature of LBBB in cardiac patients has been documented in patients with systolic dysfunction who meet the criteria for cardiac resynchronization therapy, which helps more cardiac synchronized contractions. [18, 19]

The objective of our study was to determine echocardiographically defined structural abnormalities and abnormal angiographic findings in patients with LBBB in comparison to a control group, matched in terms of gender, age, and symptoms. We also evaluated the known coronary risk factors—comprising diabetes mellitus, hypertension, dyslipidemia, and cigarette smoking—in an Iranian population with LBBB.

METHODS

This descriptive analytic cross-sectional study was conducted in Ekbatan Hospital, Hamadan, Iran. From February 2014 to February 2015, patients candidated for coronary angiography according to the current guidelines on catheterization were included based on their symptoms, strong family history, positive exercise tolerance test, and significant perfusion imaging defects. Patients with past history of myocardial infarction, known LV systolic dysfunction, past history of coronary angiography, recent admission due to chest pain in the preceding 6 months, known ischemic heart disease, known valvular heart disease, and past history of bypass surgery were excluded from our study. We primarily defined 2 groups of patients in terms of the diagnosis of LBBB according to the available criteria and matched the 2 groups with respect to their age, gender, and symptoms.

The enrolled patients were then evaluated for their clinical status, and their blood samples were collected for the diagnosis of dyslipidemia (high total cholesterol, high triglyceride, high LDL cholesterol, low HDL cholesterol, or mixed abnormalities). The patients' past history was recorded for the diagnosis of diabetes mellitus, hypertension, and cigarette smoking, and their blood samples were analyzed for the diagnosis of diabetes mellitus (fasting blood sugar > 126 mg/dL). Additionally, the patients' blood pressure was recorded at the time of hospitalization (> 140/90 mm Hg in 2 successive measurements).

Our cardiologist, who was not informed about the patients' categories, performed echo-cardiography and recorded the results in a predefined data sheet. The patients' LV systolic function was evaluated using the Simpson method. LV ejection fractions between 45% and 55% were defined as mild systolic dysfunction, between 30% and 45% as moderate dysfunction, and less than 30% as severe dysfunction. Furthermore, the severity of the patients' valvular heart disease was reported based on the available echocardiography guidelines. All the patients thereafter underwent coronary angiography by our interventional cardiologist, who reported their coronary artery obstructive lesions without being informed about the patients' status. Obstructive coronary artery disease was considered lesions with more-than-mild severity, and each coronary artery vessel was reported separately. The data were analyzed using IBM SPSS, version 23. A *P* value less than 0.05 was considered meaningful.

RESULTS

From February 2014 to February 2015, a total of 80 patients were enrolled in our study. All the objectives of the present study were assessed in the entire patient population. The mean age of the study population was 66.82 years (69.55 for the women and 64.47 for the men). There was no relation between the patients' sex and LBBB (22 women out of 43 patients and 18 men out of 37 patients; $P = 0.11$ for sex and $P = 0.11$ for LBBB). The mean age of the patients with LBBB was considerably higher than that of the patients without LBBB (mean age in the LBBB patients = 71 y and mean age in the patients without LBBB = 62 y; $P = 0.004$). In the presence of major coronary artery disease risk factors, in the patients with LBBB, diabetes mellitus, dyslipidemia, and hypertension were observed significantly more frequently ($P = 0.002$, $P = 0.006$, and $P = 0.007$, respectively) (Table 1).

Table 1. LBBB and cardiac risk factors

Coronary Risk Factors		LBBB		Total	*P*
		With	Without		
Diabetes mellitus	Yes	19	6	25	0.002
	No	21	34	55	
Dyslipidemia	Yes	21	9	30	0.006
	No	19	31	50	
Cigarette smoking	Yes	26	19	45	0.11
	No	14	21	35	
Hypertension	Yes	29	17	46	0.007
	No	11	23	34	

LBBB, Left bundle branch block

All our patients were examined via echocardiography by the same operator. The findings demonstrated that the patients with LBBB had more significant valvular heart disease, which was defined as higher severity than mild valvular heart disease. Twenty-three out of the 40 patients with LBBB had more-than-mild valvular heart disease, whereas only 7 patients in the non-LBBB group had more-than-mild valvular heart disease ($P = 0.001$).

The patients were also evaluated for their LV systolic function using the Simpson method, and significant LV systolic dysfunction was observed in the LBBB patients (Table 2).

Table 2. LBBB and the patients with left ventricular systolic dysfunction

Left Ventricular Ejection Fraction						
LBBB	**Normal**	**Mild Dysfunction**	**Moderate Dysfunction**	**Severe Dysfunction**	**Total**	***P*** **(Fisher exact test)**
With	3	14	12	11	40	0.001
Without	13	20	5	2	40	
Total	16	34	17	13	80	

LBBB, Left bundle branch block

Following these evaluations, the patients underwent coronary angiography and significant obstructive coronary artery disease was observed in the LBBB patients. Only 5% of the LBBB patients had normal epicardial coronary artery disease as opposed to 20% of the patients without LBBB, with the difference constituting statistical significance ($P = 0.007$) (Fig. 1).

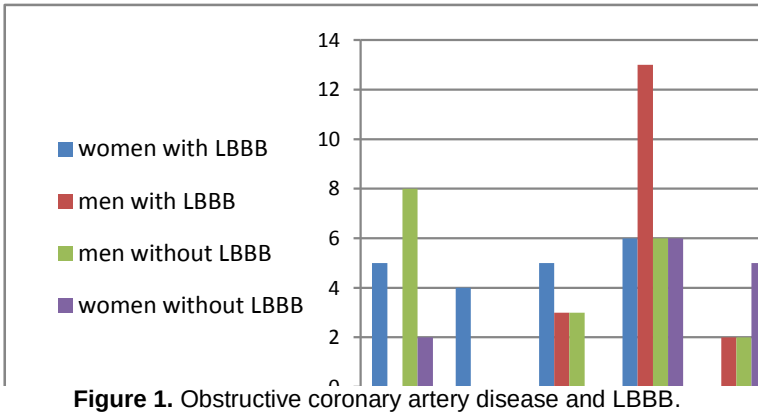

Figure 1. Obstructive coronary artery disease and LBBB.

LBBB, Left bundle branch block; LAD, Left anterior descending artery; LCX, Left circumflex; RCA, Right coronary artery; LM, Left main

DISCUSSION

Articles published thus far have documented that younger patients with LBBB have fewer considerable cardiovascular abnormalities and LBBB has a mild effect on their survival. Nonetheless, the story is markedly different in older patients with LBBB, which merits a precise evaluation of these patients' clinical and cardiac condition. [14] The mean age of our patients with LBBB was accordingly higher than that of their counterparts without LBBB. Although most of our patients were symptomatic at the time of their admission and they complained more frequently of dyspnea and chest pain, we observed—even in our asymptomatic patients with LBBB—considerable structural heart disease. In other words, having LBBB is suggestive of being at higher risk of sudden cardiac death due to coronary artery disease. [13, 20]

Our findings showed that the major coronary artery disease risk factors were significantly more prevalent in the patients with LBBB. Out of the 40 patients with LBBB, 19 (47.5%) patients had diabetes mellitus, 21 (52.5%) had some form of dyslipidemia, and 29 (72.5%) had hypertension. In our non-LBBB group, 6 (15%) patients had diabetes mellitus, 9 (22.5%) had some form of dyslipidemia, and 17 (42.5%) had hypertension. Keles et al [21] also reported a significantly higher prevalence rate of major coronary artery risk factors in their patients with LBBB. We found that a normal LV systolic function was present in only 3 (7%) patients out of the 40 patients with LBBB as opposed to 13 (32.5%) patients without LBBB. Lee et al [22] in their cohort of

patients with LBBB found that the LV ejection fraction diminished 7.3% to 12% per year over a mean follow-up of 45 to 52 months. It is worthy of note that we had no information as regards the past history of the first-time diagnosis of LBBB in our patients; nevertheless, they might have had the abnormality for a long time. Further, we evaluated our patients in terms of significant valvular heart disease and the results were as we had expected. Valvular heart disease with more severity than mild valvular heart disease was present in 23 (57.5%) patients in the LBBB group and just 7 (17.5%) patients in the non-LBBB group. Waheed et al [9] reported significant valvular heart disease among their patients with LBBB. The relation between mitral regurgitation and LBBB in patients with systolic dysfunction and patients with normal LV functions has also been previously observed. [22, 23] LV dyssynchrony and its consequence, which results in papillary muscle dysfunction, gives rise to deranged mitral valve apparatus opening and closing and causes malcoapted mitral valve leaflets. [24, 25] Witt et al [26] reported poor clinical outcomes in their patients with a mildly-to-moderately reduced LV ejection fraction and LBBB, significantly worse than those in their patients without conduction system disease and this is a clue to be definitely taken into consideration.

According to coronary angiography, 2 (5%) patients in our LBBB group and 8 (20%) patients in the group without LBBB had normal epicardial coronary artery disease. Another interesting finding in our patients was the more severe coronary artery involvement in the LBBB group inasmuch as 19 (47.5%) patients had 3-vessel disease. Be that as it may, we observed 3-vessel disease in 12 (30%) patients without LBBB as well. The Heart Outcome Prevention Evaluation study (HOPE) and the Coronary Artery Surgery Study (CASS) clearly documented that the presence of LBBB is associated with a significantly higher risk of major cardiovascular events, more severe coronary artery disease, cardiovascular death, heart failure, sudden death, and all-cause mortality. [27, 28] Clerc et al [29] used coronary computed tomography angiography and assessed obstructive coronary artery disease in patients with LBBB and reported no meaningful difference in the severity of coronary artery disease in the patients with the pretest probability of mild-to-moderate severity according to the patients' age and clinical condition. Our patients were older and more symptomatic than the patients studied by Clerc and coworkers, and we were able to categorize them in moderate pretest probability.

In conclusion, LBBB is associated with structural heart disease and the prevention of future complications requires meticulous clinical and structural cardiovascular evaluations.

REFERENCES

1. Breithardt G, Breithardt OA. Left Bundle Branch Block, an Old–New Entity. J. of Cardiovasc. Trans. Res. (2012) 5:107–116.

2. Dodd KW, Elm KD, Smith SW. Comparison of the QRS Complex, ST-Segment, and T-Wave Among Patients with Left Bundle Branch Block with and without Acute Myocardial Infarction. J Emerg Med. 2016 Jul;51(1):1-8.

3. Uhley HN. Some controversy regarding the peripheral distribution of the conduction system. Am J Cardiol 1972; 30:919.

4. Hecht HH, Kossmann CE, Childers RW, Langendorf R, Lev M, Rosen KM, Pruitt RD, et al. Atrioventricular and intraventricular conduction. Revised nomenclature and concepts. Am J Cardiol 1973; 31:232.

5. Godman M.J., Lassers B.W., Julian D.G complete bundle branch block complicating

acute myocardial infarction. N Engl J Med 282:237-240.

6. Gould L., Ramana C.V., Gomprecht R.F. Left bundle branch block. Prognosis in acute myocardial infarction. JAMA 225:625-627.

7. Schneider JF, Thomav HE, Sorlie P, Kreger BE, McNamara PM, Kannel WB. Comparative features of Newly acquired left and right bundle branch block in the general population. The Framingham study. Am J Cardiol, 1994: 931 – 940.

8. Sarter BH, Hook BG, Callans DJ, Marchlinski FE. Effect of bundle branch block on local electrogram morphologic features: implications for arrhythmia diagnosis by stored electrogram analysis. Am Heart J 1996; 131:947.

9. Waheed I, Akbar AM, Naqvi SMA, Shahid HAM, Khan BZ. Symptomatology and structural heart abnormalities in patients with left bundle branch block. J Cardiovasc Dis 2013;11(2):45 -47.

10. Siegman-Igra Y, Yahini JH, Goldbourt U, Neufeld HN. Intraventricular conduction disturbances: a review of prevalence, etiology, and progression for ten years within a stable population of Israeli adult males. Am Heart J 1978; 96:669.

11. Grand J, Thomsen JH, Kjaergaard J, Nielsen N, Erlinge D, Wiberg S, Wanscher M, et al. Prevalence and Prognostic Implications of Bundle Branch Block in Comatose Survivors of Out-of-Hospital Cardiac Arrest. Am J Cardiol. 2016 Oct 15;118(8):1194-1200

12. HISS RG, LAMB LE. Electrocardiographic findings in 122,043 individuals. Circulation 1962; 25:947.

13. Zhang ZM, Rautaharju PM, Soliman EZ, Manson JE, Cain ME, Martin LW, Bavry AA, et al. Mortality risk associated with bundle branch blocks and related repolarization abnormalities (from the Women's Health Initiative [WHI]). Am J Cardiol 2012; 110:1489.

14. 14.Badheka AO, Singh V, Patel NJ, Deshmukh A, Shah N, Chothani A, Mehta K, et al. QRS duration on electrocardiography and cardiovascular mortality (from the National Health and Nutrition Examination Survey-III). Am J Cardiol 2013; 112:671.

15. Eriksson P, Hansson PO, Eriksson H, Dellborg M. Bundle-branch block in a general male population: the study of men born 1913. Circulation 1998; 98:2494.

16. Rotman M, Triebwasser JH. A clinical and follow-up study of right and left bundle branch block. Circulation 1975; 51:477.

17. Rabkin SW, Matheson FA, Tate RB. Natural history of left bundle branch block. Br Heart J 1980;43:164–9.

18. Zareba, W., Klein, H., Cygankiewicz, I., Hall, W. J., McNitt, S., Brown, M., et al. (2011). Effectiveness of cardiac resynchronization therapy by QRS morphology in the Multicenter Automatic Defibrillator Implantation Trial–Cardiac Resynchronization Therapy (MADIT–CRT). Circulation, 123(10), 1061–1072.

19. Bilchick, K. C., Kamath, S., DiMarco, J. P., & Stukenborg, G. J. Bundle-branch block morphology and other predictors of outcome after cardiac resynchronization therapy in Medicare patients. Circulation, 122(20), 2022–2030.

20. Fahy GJ, Pinski SL, Miller DP, et al. Natural history of isolated bundle branch block. Am J Cardiol 1996; 77:1185.

21. Keles T1, Durmaz T, Bektasoglu G, Turgut O, Manduz S, Sezer H, Tandogan I. Evaluation of risk factors in predicting coronary artery disease in patients with left bundle branch block. J Int Med Res. 2009 May-Jun;37(3):822-7.

22. Haft JI, Herman MV, Gorlin R. Left bundle branch block: etiologic, hemodynamic, and ventriculographic considerations. Circulation 1971; 43(2):279-87.

23. Onea R, Verdun A. Increasing severity of functional mitral regurgitation by left bundle branch block. Heart. 2007; 93(8): 913.

24. Grines CL, Bashore TM, Boudoulas H, Olson S, Shafer P, Wooley CF. Functional Abnormalities in Isolated Left Bundle Branch Block: The Effect of Interventricular Asynchrony. Circulation 1989;79:845-853

25. Breithardt OA, Sinha AM, Schwammenthal E, Bidaoui N, Markus KU, Franke A et al. Acute effects of cardiac resynchronization therapy on functional mitral regurgitation in advanced systolic heart failure. J Am Coll Cardiol 2003; 41:765–770.

26. Witt CM, Wu G, Yang D, Hodge DO, Roger VL, Cha YM. Outcomes with left bundle branch block and mildly to moderately reduced left ventricular function. JACC HF Nov 2016;11:897-903.

27. Sumner G, Salehian O, Yi Q, et al. The prognostic significance of bundle branch block in highrisk chronic stable vascular disease patients: a report from the HOPE trial. J Cardiovasc Electrophysiol 2009; 20:781.

28. Freedman RA, Alderman EL, Sheffield LT, et al. Bundle branch block in patients with chronic coronary artery disease: angiographic correlates and prognostic significance. J Am Coll Cardiol 1987; 10:73.

29. Clerc OF, Possner M, Maire R, Liga R, Fuchs TA, Stehli J, Vontobel J, et al. Association of left bundle branch block with obstructive coronary artery disease on coronary CT angiography: a case-control study. Eur Heart J Cardiovasc Imaging. 2016 Jul;17(7):765-71.