Journal of
HYPERTENSION RESEARCH
www.hypertens.org/jhr

Original Article

J Hypertens Res (2017) 3(3):90–97

From left bundle branch block to cardiac failure

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Received: August 14, 2017, Accepted: September 8, 2017

Abstract

Left bundle branch block (LBBB) is a frequent pathology in our practice and its implications are becoming increasingly studied. It may induce abnormalities in the left ventricular performance due to abnormal asynchronous contraction patterns which may aggravate preexisting left ventricular pumping performance or even induce it. With a view to assessing the current incidence and meaning of the left bundle-branch block associated with cardiac heart failure, we prospectively studied the anamnestic, clinical, paraclinical, electrocardiographic, echocardiographic and angiographic data of 477 LBBB patients admitted from January 2011 to December 2013 in Georgescu Institute of Cardiovascular Diseases. According to the chronicity of LBBB, patients were divided in two groups: left bundle branch block not otherwise known to be old (new or presumably new LBBB) (n = 319) or LBBB known to be old (n = 158). We found statistically significant differences in terms of baseline characteristics in prior congestive heart failure, myocardial infarction, angina pectoris and prior revascularization, common in patients with chronic LBBB. Also, patients with chronic LBBB had an impaired left ventricular systolic function, the majority of them having a severe systolic disfunction and only 30.38 % of them had an ejection fraction (EF) > 50%. This study is among the few studies that have evaluated the association of AV block in patients with left bundle branch block, the risk of these conduction disorder being double in patients with chronic left bundle-branch block. Our results show that patients with chronic left bundle branch have a more reserved prognosis due to left ventricular systolic dysfunction, the severity of coronary lesions and arrhythmic risk.

Keywords: prognostic, LBBB, cardiac failure, ejection fraction

Introduction

The presence of left bundle branch block (LBBB) on a 12-lead electrocardiogram poses multiple important questions to the healthcare provider. Its presence has far reaching consequences in acute clinical care, such as in the setting of acute myocardial infarction, and in chronic conditions, such as heart failure (HF), where it can be helpful in guiding the management of stable coronary artery disease and cardiac resynchronization therapy (CRT) [1-3]. LBBB provides prognostic information [4], but it also poses challenges in therapeutic management.

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Left bundle-branch block may be associated with a poor prognosis compared to normal intraventricular conduction, as it may be the first manifestation of a diffuse myocardial injury [3,4]. Mechanical dyssynchrony, in turn, results in significantly greater left ventricular end-systolic volume, and inefficient contraction, a combination that is detrimental in patients with HF, who already have compromised left ventricular systolic function. The discordant mechanical stretch leads to altered cellular calcium transport, resulting in a pro-arrhythmic state. All these factors probably contribute to the increased mortality observed in patients with HF and LBBB compared to those without LBBB [3].

Methods

To identify the significance of left bundle-branch block associated with cardiac heart failure in patients with different pathologies, we analyzed the anamnestic, clinical, paraclinical, electrocardiographic, echocardiographic and angiographic data of 477 LBBB patients admitted from January 2011 to December 2013 in Georgescu Institute of Cardiovascular Diseases. According to the chronicity of left bundle branch block, patients were divided in two groups: left bundle branch block not otherwise known to be old (new or presumably new LBBB) (n = 319) or LBBB known to be old (n = 158). LBBB chronicity was determined by comparison with the most recent ECG available. If no prior ECG was available for comparison, patients were classified as having a presumably new LBBB.

Our data include basic demographic information, characteristics of chest pain and associated symptoms, cardiac history and risk factors (age, sex, smoking, alcohol consumption, body mass index, lipid profile, dynamics of myocardial cytolisis enzymes), medications, treatment, disposition, ECG, echocardiography, cardiac markers and angiographic data.

Patients younger than 18 years, vulnerable patients, such as comatose patients or pregnant women were not included in our study. All patients were informed about the study and if they decided to participate, they signed an informed consent.

The 17.0 SPSS was used for data analysis. Data are presented as mean (M) ± standard deviation (SD), as median (interquartile range), or as frequencies and percentages. Comparisons were made among patients with chronic LBBB and new or presumably new LBBB. Relative risks and 95% confidence intervals (CIs) are also presented. A p-value of 0.05 was statistically significant.

Results

A sum-total of 477 patients with left bundle branch block was admitted between January 2011 and December 2013 in Georgescu Institute of Cardiovascular Diseases, aged between 21 and 81 years, the median age was 66 ± 11 years. Only 158 patients had a chronic left

Table 1. Baseline characteristics of patients with left bundle branch block.

Variable	New LBBB (n=319)	Chronic LBBB (n=158)	P value
Arterial hypertension	162 (50.78%)	73 (46.20%)	0.328
Diabetes mellitus	68 (21.31%)	34 (21.51%)	0.960
Current/previous smoker	148 (46.39%)	61 (38.60%)	0.175
Congestive heart failure	144 (45.14%)	108 (68.35%)	< 0.001
Myocardial infarction	13 (4.07%)	17 (10.76%)	0.005
Angina pectoris	14 (4.38%)	16 (10.12%)	0.010
Myocardial revascularization	19 (5.95%)	24 (15.19%)	0.001

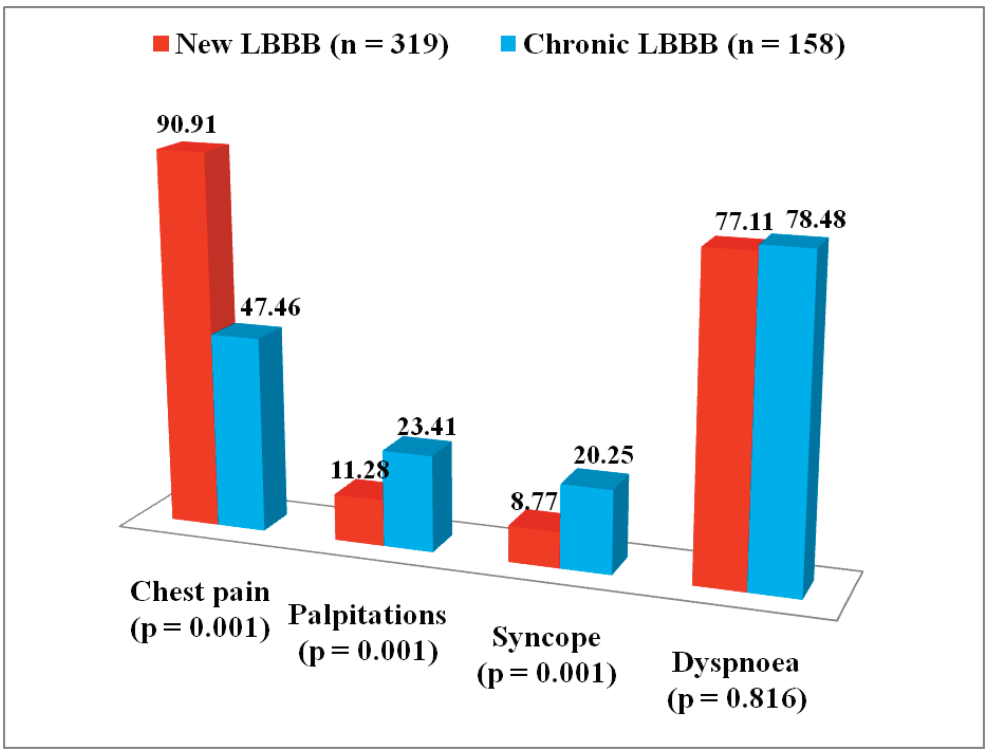

Figure 1. Admission symptoms in patients with left bundle branch block

bundle branch block and 319 had a new or presumably new LBBB on their electrocardiograms.

In terms of baseline characteristics, we found statistically significant differences in prior congestive heart failure, myocardial infarction, angina pectoris and prior revascularization, common in patients with chronic LBBB (Table 1). Patients with chronic left bundle branch block were older, the median age of them being 69.6 ± 11.88 years. Analyzing the distribution of patients according to their age, we found that almost 9 of

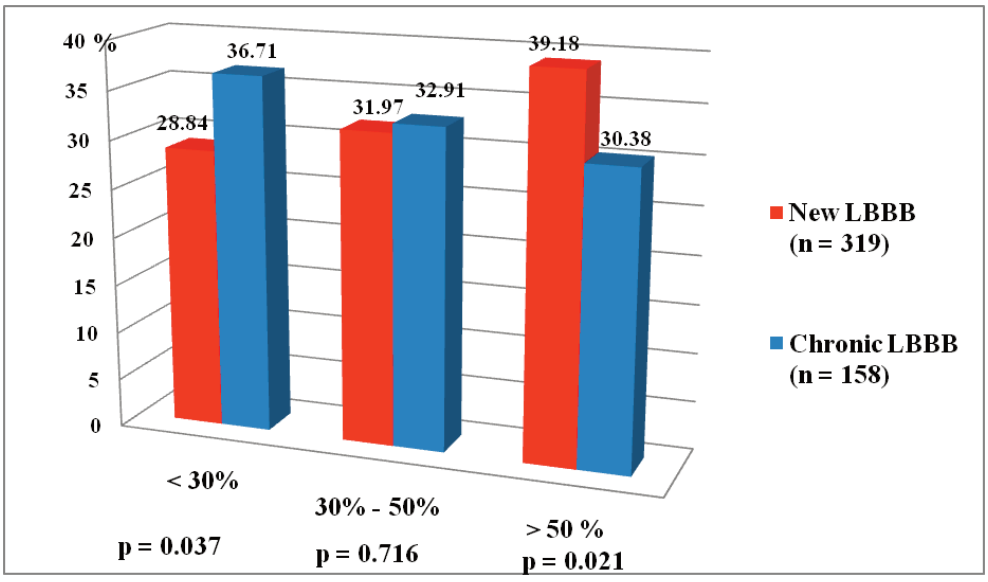

Figure 2. Distribution of patients with left bundle branch block based on the value of left ventricular ejection fraction

10 patients with chronic left bundle branch block had more than 60 years.

Chest pain was the most frequent symptom at presentation. The other symptoms, in order of frequency, were dyspnoea, palpitations and syncope, with statistically significant differences, except dispnoea, which was more common in patients with chronic left bundle-branch block (Figure 1).

Depending on the left ventricular systolic function, patients were divided in three groups: 1. EF < 30 %; 2. EF 30-50 %; 3. EF > 50 %.

In general, patients with new left bundle branch block had no impaired left ventricular systolic function or whether it was present it was not significant, so that 39.18% of them had an EF> 50% and 31.97% have had an EF between 30 and 50% (Figure 2).

We also observed that if cardiac failure occurred in only about half of the patients with left bundle branch block, in the case of those with chronic left bundle branch block, heart failure was present in about 7 of 10 patients (45.14% vs. 68.35 %, p < 0.0001). Regarding the distribution in the NYHA functional class, we observed a predominance of NYHA class II and III in both patient groups.

Regarding the coronary angiography, it was performed in 80.56% of patients with new left bundle branch block, and only in 18.35% of patients with chronic left bundle branch block.

Approximately 80% of patients with chronic left bundle branch block (79.11%) did not have significant angiographic coronary lesions, and when they were present they most commonly involved all three main coronary arteries (10.76%). Bicoronary lesions were found in 6.33% of patients and unicoronary lesions in 3.79% of patients.

Almost half of patients with new left bundle branch block had significant coronary lesions, most frequently being one- or two coronary lesions (15.67% and 12.22%), frequently localized on the left descendent artery (32.91%) (Figure 3).

Most of the percutaneous coronary interventions were performed on the left descendent artery in patients with both new or presumably new LBBB, also in those with chronic LBBB, and the differences between

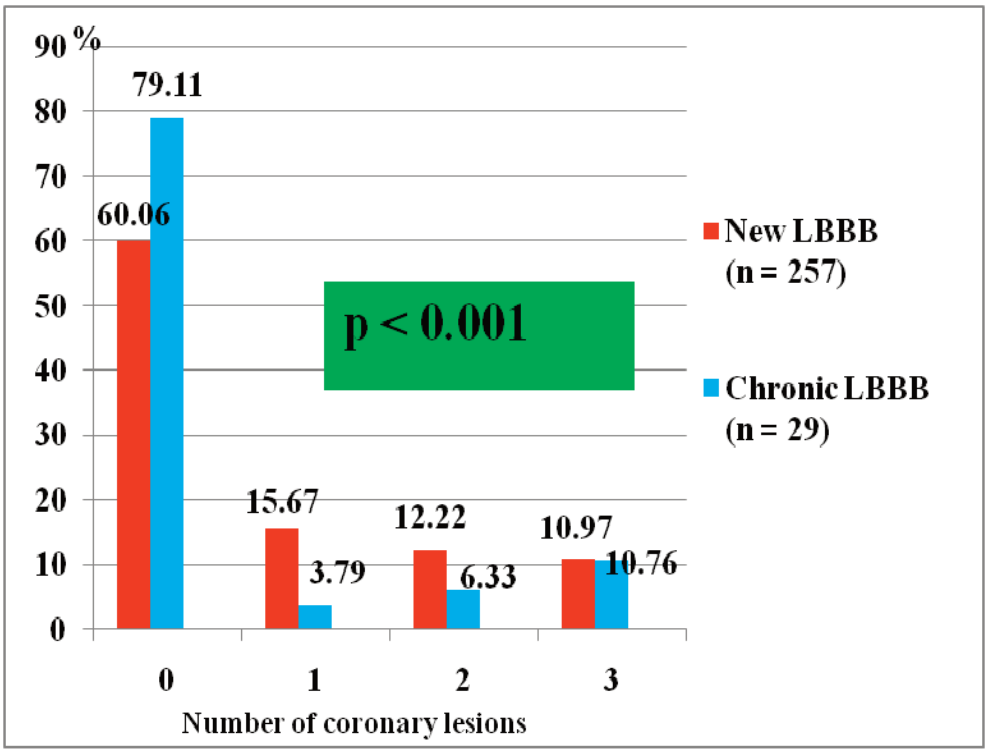

Figure 3. Coronary lesions in patients with left bundle branch block which were evaluated by coronary angiography (0 – without coronary lesions; 1 – one coronary artery disease; 2 – two coronary artery disease; 3 – three coronary artery disease)

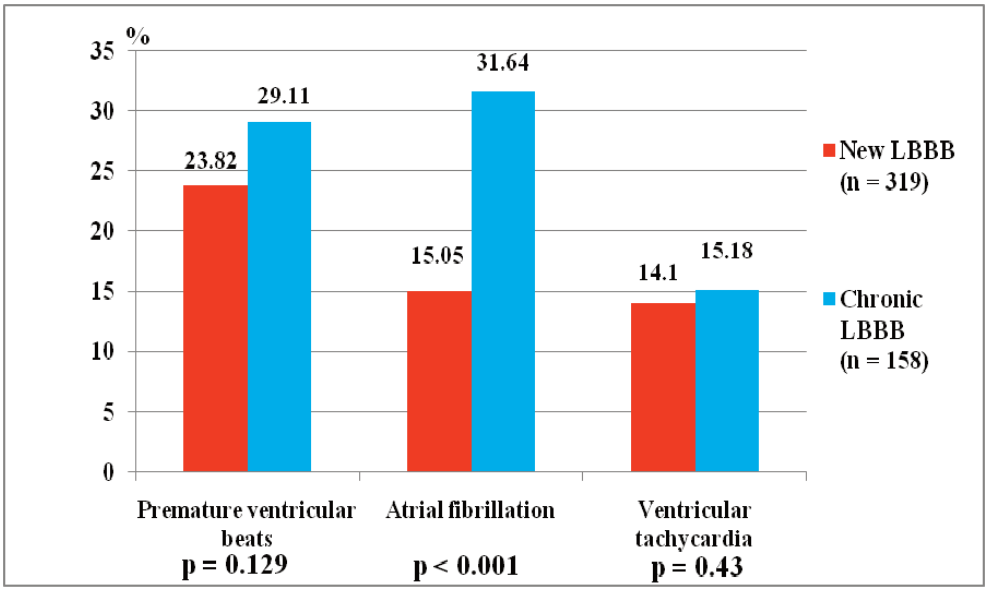

Figure 4. Cardiac arrhythmias in patients with left bundle branch block, according to the chronicity of the conduction disorder.

these two groups were statistically significant (12.22 % vs. 3.16%, p = 0.004).

Almost a third of patients with chronic left bundle-branch block had atrial fibrillation, with statistically significant differences between the two groups (31.64% vs. 15.05%, p <0.001). Also, patients with chronic left bundle-branch block had a reserved prognosis due to the higher risk of ventricular tachycardia (15.18% vs. 14.10% in patients with new left bundle branch block, p = 0.43) (Figure 4).

In order to study the prognosis of patients with left bundle branch block, we evaluated their risk of cardiac arrhythmias. We found statistically significant differences in the risk of atrial fibrillation, ventricular tachycardia and atrioventricular blocks. Thus, almost one-third of patients with chronic left bundle branch

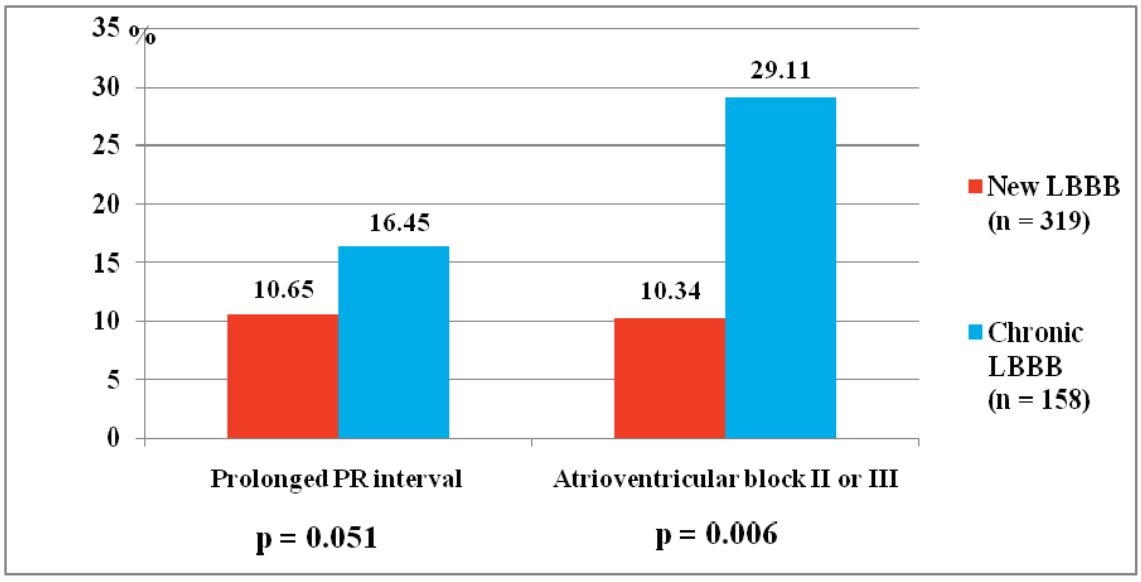

Figure 5. Presence of conduction disorders in patients with left bundle branch block.

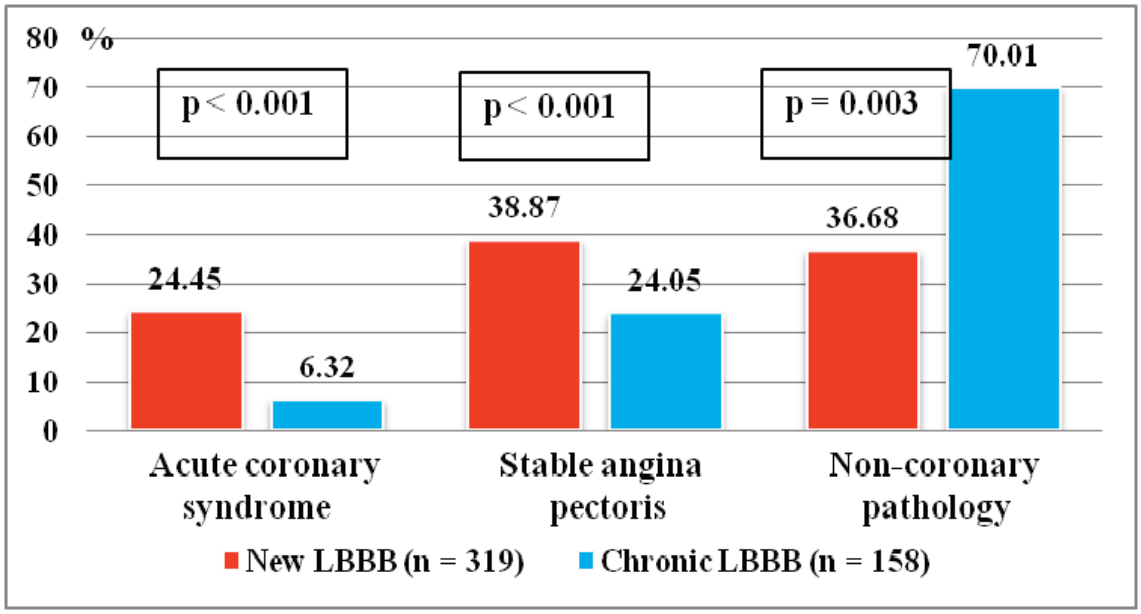

Figure 6. Final diagnostic in patients with left bundle branch block

block had atrial fibrillation, with statistically significant differences between the two groups (31.64% vs. 15.05%, p <0.0001). Also, patients with chronic left bundle branch block have a more reserved prognosis because of the higher risk of ventricular tachycardia, seen in 15.18% of patients, compared with 14.10% in patients with new left bundle branch block (p = 0.043).

Our study is among the few studies that have evaluated the association of AV block in patients with left bundle branch block, the risk of these conduction disorder being double in patients with chronic left bundle-branch block (Figure 5).

Compared to patients with new left bundle branch block that were diagnosed in nearly two thirds of cases with ischemic heart disease, patients with chronic left bundle branch block had mainly other cardiac diagnoses out of ischemic coronary artery disease (37.34% Vs. 9.4%, p = 0.005). Thus, approximately one of three patients with chronic left bundle branch block received an implantable cardiac device (22.15% a pacemaker and 8.86% cardiac resynchronization therapy). Only 6.32% of patients were finally diagnosed with acute coronary syndrome, but none of this patients experienced an acute myocardial infarction with ST-segment elevation (Figure 6).

Discussions

Left ventricular asynchrony from left bundle branch block causes an altered ventricular activation and myocardial contraction. Under normal conditions, the impulse is rapidly conduced and most of the ventricular myocardium is activated synchronously or with a delay of up to 4 ms. This results in an efficient contraction with minimal energy consumption. The left bundle branch block is present in approximately one third of patients with chronic heart failure and causes a disruption of myocardial electrical activation, characterized by a faster activation of the left ventricular septal myocardium compared to the lateral wall [6, 7]. This intraventricular electrical activation disorder causes an abnormal mechanical activation that further reduces the left ventricular ejection fraction. The ventricular dyssynchrony in the left bundle branch block causes a progressive worsening of heart failure and an increase in mortality of these patients, which is directly proportional to the duration of the QRS complex [8,9].

The number of patients with chronic heart failure is increasing in developed countries, and the pharmacological treatment of these patients, mainly based on inhibitors of the renin-angiotensin-aldosterone system and beta-blockers, significantly improved patient out-

comes. Despite the significant improvement in treatment of these patients, their prognosis continues to remain reserved [10].

Taking into account these data, patients with left ventricular systolic dysfunction and asynchronous ventricular activation should benefit from biventricular pacing to restore synchronous ventricular contraction that maintains an atrioventricular optimum interval and prolong ventricular diastole. In most patients with heart failure this leads to significant hemodynamic improvement and improvement of survival [11-13]. Numerous studies have shown that cardiac resynchronization therapy improves symptoms, exercise capacity, quality of life, left ventricular ejection fraction, survival, and reduces hospitalization of patients with heart failure (NYHA III or IV and ejection fraction <35% [12, 14,15].

In our study, we demonstrated that patients with chronic left bundle branch have a more reserved prognosis due to left ventricular systolic dysfunction, the severity of coronary lesions and arrhythmic risk.

In a recent study, Aro et al. [16] demonstrated that a delay in intraventricular conduction, including the left bundle branch block, is associated with an increased risk of arrhythmias and cardiovascular mortality. Although there were no differences in the history of myocardial infarction and angina pectoris between the two patient groups, the left bundle branch block may be a marker of subclinical coronary disease, associated with a poor prognosis.

Our study is among the few studies that assessed the risk of atrioventricular blocks in patients with the left bundle branch block and we noticed a higher but not statistically significant risk of total atrioventricular block in patients with chronic left bundle branch block. Although high-grade atrioventricular blocks are associated with an increased risk of branch blocks, in particular a left bundle branch block, the risk of sudden death secondary to bradyarrhythmias is reduced and permanent cardiac stimulation does not reduce the risk of death in these patients [1, 17].

Among the strengths of our study are the large numbers of patients, clinical and echocardiographic data obtained. Also, the diagnosis of coronary artery disease was based not only on the anamnesis and the clinical examination, but also on the basis of the coronary examination and the CT scan.

Conclusions

The present study demonstrates that patients with chronic left bundle branch block have an increased risk of arrhythmias, severe bi- or tricoronary lesions and left ventricular systolic and diastolic dysfunction.

Thus, the presence of the left bundle branch block should impose a clinical, echocardiographic and angiographic assessment, even in asymptomatic patients and there are also necessary strategies to prevent premature death in these patients.

Conflict of interest

None declared.

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