



Exercise-Induced Right Bundle Branch Block: A Not-So-Benign Finding

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Abstract

Exercise-Induced (EI) Right Bundle Branch Block (RBBB) is an uncommon electrocardiographic finding, with a hitherto unknown clinical significance. We discuss the appearance of EI-RBBB during stress tests in 3 male patients with perfusion abnormalities in SPECT, obstructive lesions in coronary angiography and treatment with percutaneous coronary angioplasty.

Introduction

Right Bundle Branch Block (RBBB) is defined as an intraventricular conduction disorder in which electrical activity through the His-Purkinje system is deranged and consequently, the right ventricle is depolarized slower by the myocardial propagation of the left ventricle's electrical activity [1,2]. In general, a distinction is drawn between complete (cRBBB) and incomplete RBBB (iRBBB) [2,3]. cRBBB reveals a QRS duration >0.12 sec, a secondary R wave (R') in V1 or V2, and a wide slurred S wave in leads I, V5, and V6, in some cases with an ST-segment depression and T-wave inversion in right precordial leads [1]. In contrast, iRBBB exhibits a QRS duration of <0.12 seconds with R' >R in lead V1 or V2,3 and it has not been associated with adverse outcomes [2,3], whereas cRBBB tends to increase all-cause of mortality and cardiovascular events [1-3].

Furthermore, exercise-induced bundle-branch block is defined as the bundle branch block only during treadmill exercise testing [4]. According to the study by Williams et al. [5] it occurred in 0.5% of the studied population. In that study, a high prevalence of Coronary Artery Disease (CAD) in patients with exercise-induced bundle-branch block (EI-RBBB) was found. Furthermore, all patients with EI-RBBB and 70% of patients with EI-left BBB had CAD. Similarly, occurred in the study of Wayne et al. [6] where the prevalence was 87% and 72%, respectively.

In our case series we will discuss the appearance of EI-RBBB during the stress test with modified Bruce protocol in 3 male patients aged above 50 years and with cardiovascular risk factors, the results of Technetium-99m -Sestamibi SPECT and coronary angiography and the PTCA.

Case Series

Patient 1

A 74-year-old man with long term hypertension, diabetes, and dyslipidemia was admitted for intermittent angina. He had a previous exercise stress test that reported nonspecific changes in the recovery phase and a Myocardial Perfusion Imaging (MPI) that ruled out ischemia two years earlier.

Echocardiography did not show suggestive findings of ischemia, so a new stress myocardial perfusion imaging (MPI) with radionuclides was performed. During the stress test with the modified Bruce protocol, the patient presented chest pain that remitted with rest; his maximum blood pressure was 170/70 mmHg and his maximum heart rate 163 bpm. The resting electrocardiogram was normal but in the maximum stress showed a wide QRS complex with RBBB. Furthermore, ST segment depression was observed in DI, DII, aVF, V3, V4, V5 and V6, as well as ST segment elevation in aVR (Figure 1A, 1B). MPI-SPECT showed an apical infarction with severe ischemia in the basal and anteroseptal segments (territory of the left anterior descending

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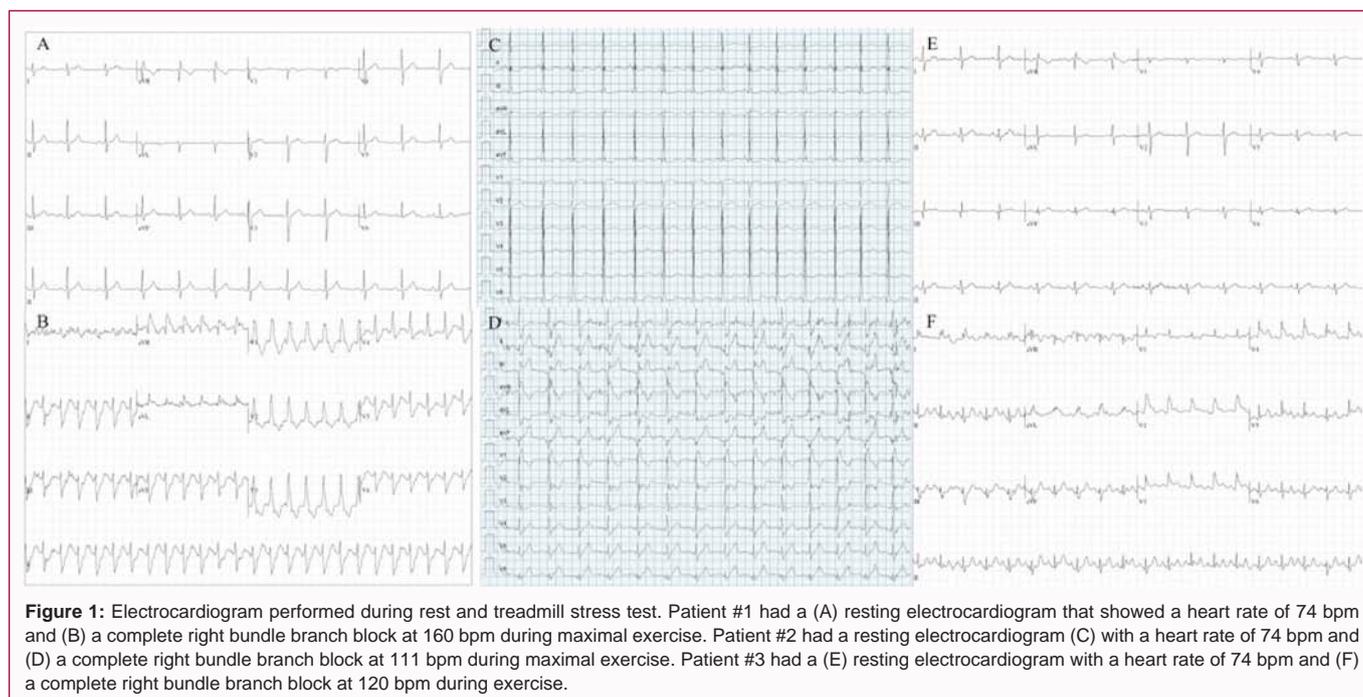


Figure 1: Electrocardiogram performed during rest and treadmill stress test. Patient #1 had a (A) resting electrocardiogram that showed a heart rate of 74 bpm and (B) a complete right bundle branch block at 160 bpm during maximal exercise. Patient #2 had a resting electrocardiogram (C) with a heart rate of 74 bpm and (D) a complete right bundle branch block at 111 bpm during maximal exercise. Patient #3 had a (E) resting electrocardiogram with a heart rate of 74 bpm and (F) a complete right bundle branch block at 120 bpm during exercise.

artery). The Left Ventricular Ejection Fraction (LVEF) decreased by 10% during the stress test and presented transient ischemic dilation (1.34), suggesting multivessel disease (Figure 2A). Coronary angiography revealed a 90% obstructive lesion in the proximal third of the left anterior descending artery. He was managed with Percutaneous Coronary Angioplasty (PTCA) and stent placement, with improvement of the symptoms (Figures 3A- 3D).

Patient 2

A 51-year-old male patient with hypertension, diabetes, dyslipidemia, and CAD came to our department for MPI evaluation. A 99mTc-MIBI stress test was performed with a modified Bruce protocol, which was stopped at minute 2 due to chest pain; the blood pressure response was flat, and the electrocardiogram showed RBBB, and the maximum heart rate was of 111 bpm, reaching 4.6 METs.

In the recovery phase, there was depression of the ST segment from V1 to V6 and negative T waves in II, III and aVF (Figure 1C, 1D). The test was positive for ischemia and negative for arrhythmia. The MPI showed severe ischemia in the apical, anterior, and septal walls (Left Anterior Descending artery [LAD] territory), the ischemic myocardium was quantified as 45% (Figure 2B). The LVEF decreased from 74% to 59% during the stress test and she presented transient ischemic dilatation. Coronary angiography demonstrated an 80% stenosis of the LAD in its middle portion, immediately before the origin of the first diagonal artery.

The patient was treated with PTCA and placement of a drug-eluting stent in the LAD (Figures 3E-3H) and he is asymptomatic in the follow-up.

Patient 3

A 61-year-old man with hypertension was referred to MPI for some episodes of oppressive chest pain that remitted with rest. A stress test was performed with MPI-SPECT, which was suspended at minute 6 due to chest pain, the electrocardiogram presented RBBB and elevation of the ST segment in leads V2, V3 and V4, which appeared

at minute 5 and persisted until the 10th minute of the recovery phase (Figure 1E, 1F). The MPI-SPECT demonstrated severe ischemia in the apex and septum (territory of the LAD artery); moderate ischemia in the inferolateral wall and preserved LVEF (70%) (Figure 2C). These findings suggested multivessel disease.

A coronary angiography was performed and revealed a severe obstruction at the proximal segment of the LAD. A drug-eluting stent was placed (Figures 3I-3K).

Discussion

The clinical significance and prognostic value of an EI-RBBB is still debated among peers. Stein et al. [7] conducted a prospective study where they evaluated the prognostic significance of EI-RBBB vs. exercise-induced ST depression in 8,407 male individuals. They found that patients with EI-RBBB had higher cardiovascular death rates compared to those with exercise induced ST depression and normal electrocardiographic response; nonetheless, these patients were older and more overweight. These characteristics, the authors remarked, could explain the higher prevalence of CAD, heart failure, and hypertension. This study concluded that EI-RBBB is associated with aging without increasing cardiovascular risk to patients who possess it, and consequently, could be considered as a benign finding.

On the other hand, Williams et al. [5] evaluated a total of 16,500 exercise treadmill tests, in which 7 patients who presented EI-RBBB had CAD. Williams et al. [5] evaluated 10,176 exercise treadmill tests and found a total of 13 patients with EI-RBBB, all of whom had CAD.

EI-RBBB has been associated with CAD and heart failure; nonetheless, these associations remain controversial [7]. There are few published studies that evaluate EI-RBBB, whereas EI-left BBB has been extensively studied [4-6,8].

Conclusion

Exercise-induced bundle branch block remains a rare finding during treadmill testing, the prognostic significance of which

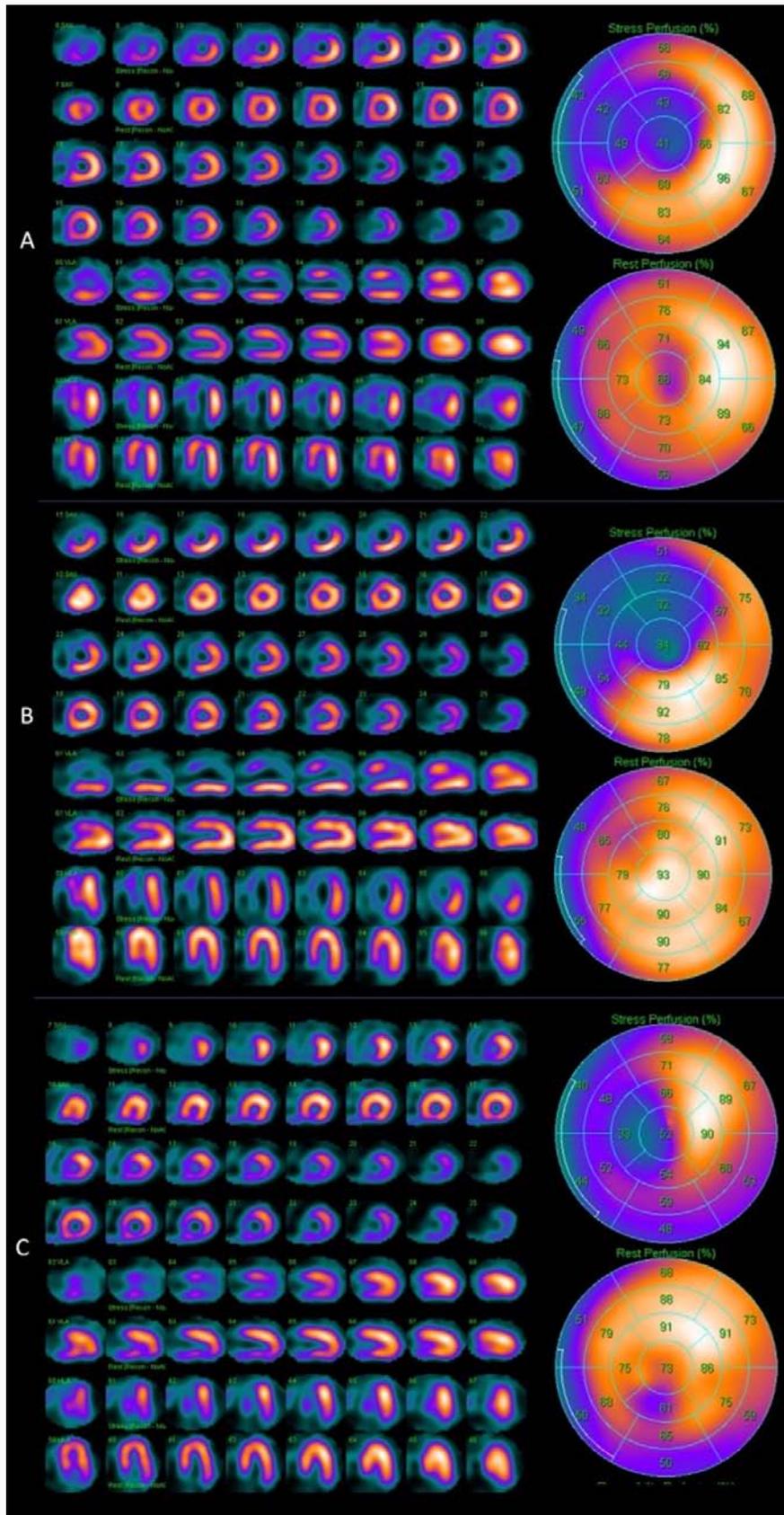
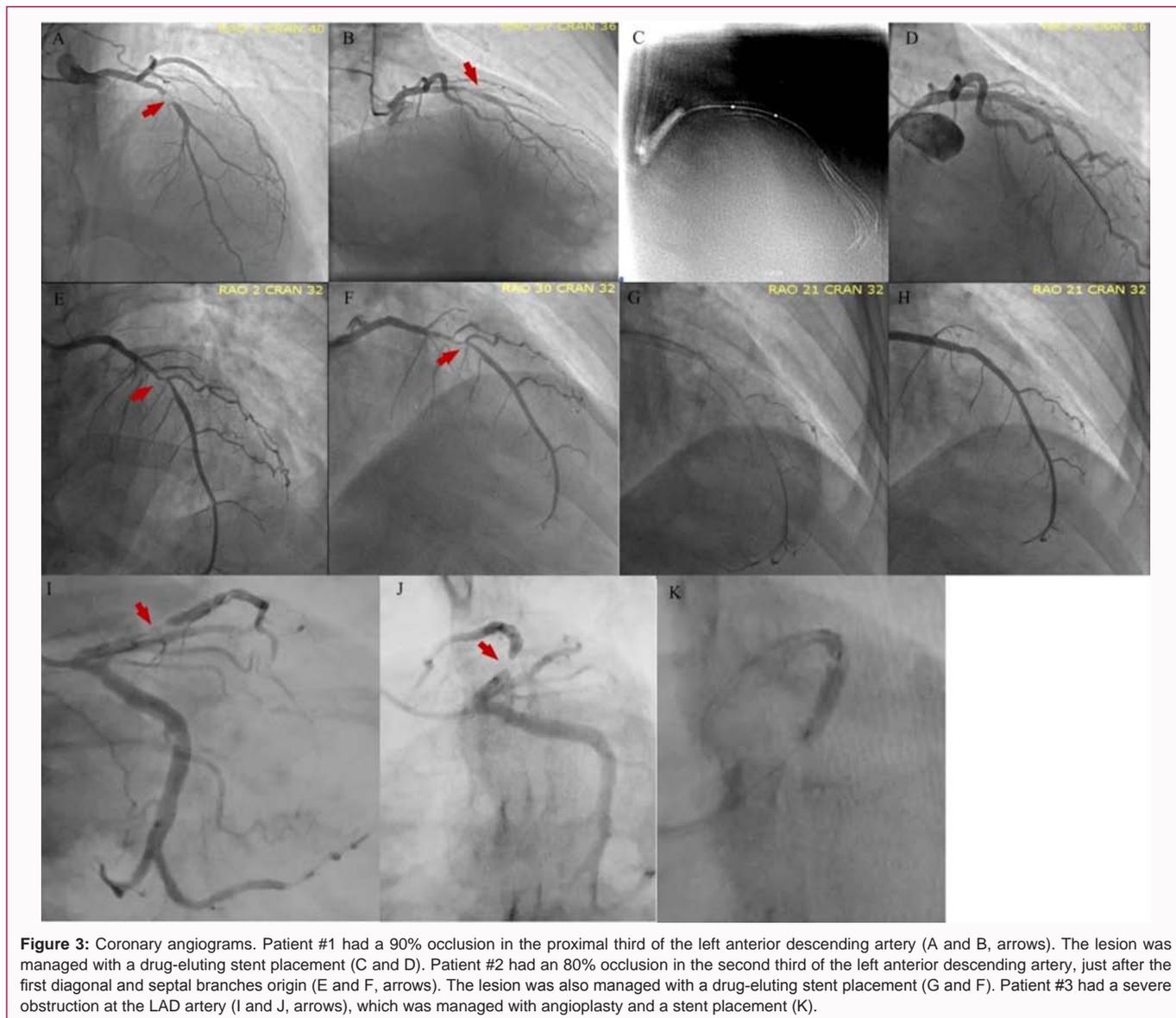


Figure 2: Single photon emission computed tomography for myocardial perfusion imaging. Patient #1 presented an apical infarction and severe ischemia at basal and anteroseptal segments, which are located in the LAD artery territory. Patient #2 presented severe ischemia at the apical, anterior and septal regions, which are irrigated by the left anterior descending artery. 45% of ischemic myocardium was quantified. Patient #3 presented severe ischemia at the apical and septal regions (LAD artery territory) as well as the inferior wall (circumflex or right coronary artery territory).



represents an interesting point of investigation. In the past, several case series on EI-left BBB have been published, pointing to an association with major adverse cardiac events and a higher prevalence of CAD. However, the EI-RBBB study has been less extensive, with contradictory results, mentioning on the one hand a significantly high prevalence of CAD and also denoting it as a benign event, mainly associated with aging.

Through the analysis of 3 patients who developed EI-RBBB, its relationship with ischemia in the LAD territory and reduced LVEF was observed. More observational studies are needed to determine the importance of EI-RBBB and its relationship to CAD and major adverse cardiac events.

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