Journal of Electrocardiology 75 (2022) 66–69

Contents lists available at ScienceDirect

Journal of Electrocardiology

journal homepage: www.jecgonline.com

Non-specific intraventricular conduction delay or atypical LBBB - How to predict acute coronary occlusion?

Kjell Nikus, MD [a,b,*], Essi Ryödi, MD [a,b], Andrés Ricardo Pérez-Riera, MD [c,d], Jani Rankinen, MD [a]

[a] Faculty of Medicine and Health Technology, Tampere University, Tampere, Finland
[b] Heart Center, Department of Cardiology, Tampere University Hospital, Finland
[c] Design of Studies and Scientific Writing Laboratory, Centro Universitário Saúde ABC, Santo André, SP, Brazil
[d] Medical Clinic, Universidade Uninove campus Mauá, Mauá, SP, Brazil

ARTICLE INFO

Keywords:
Non-specific intra-ventricular conduction delay
Bundle branch block
Broad QRS
Acute coronary syndrome
Myocardial infarction

ABSTRACT

We describe two patient cases with acute coronary syndrome (ACS) and broad QRS in the acute phase electrocardiogram (ECG). The patients' ECG findings resembled left bundle branch block (LBBB), but with atypical features. Broad QRS not fulfilling the criteria for LBBB or right bundle branch block (RBBB) is diagnosed as non-specific intraventricular conduction delay (NSIVCD). The case report deals with the challenges of predicting acute coronary occlusion in patients with NSIVCD in their acute phase ECG. In one of the cases, the ECG changed from typical LBBB to NSIVCD or atypical LBBB with the development of systolic dysfunction and clinical heart failure.

Cases

Case 1. An 88-year-old man with hypertension had coronary artery bypass grafting to all three main coronary artery branches in 1999. Chronic heart failure (CHF) with an ejection fraction (EF) of 35% and broad QRS was diagnosed in 2019. In April 2021, the patient underwent drug-eluting balloon therapy for a total occlusion in the mid-part of the left circumflex coronary artery (LCx), which had resulted in a non-ST-elevation myocardial infarction. Fig. 1a shows an ECG recorded post-PCI during the hospital stay. Fig. 1b shows an ECG recorded during acute chest pain nine months later, at the time of ACS. An echocardiogram immediately before the angiography showed an EF of 25% with no valvular disease. The patient was hemodynamically stable. Coronary angiography & percutaneous coronary intervention (PCI): Restenosis with total occlusion (100%) in the mid-LCx, no other new lesions. The patient underwent PCI with a drug-eluting stent (DES), and normal coronary flow was achieved.

Case 2. A 73-year-old female patient with hypertension and type II diabetes. Ten years before the acute event, an ECG (Fig. 2a), showing typical LBBB, was recorded during a routine control for hypertension. Two years before the acute event, the patient developed clinical heart failure with an EF of 35%. Fig. 2b shows an ECG recorded three months before and 2c during the ACS episode. On pre-angio echocardiography the EF was 15%, and there was biventricular enlargement, moderate mitral valve regurgitation, and severe tricuspid valve regurgitation. Coronary angiography & PCI: Single vessel disease with total occlusion of the posterior descending branch of a dominant right coronary artery. A DES was implanted with good angiographic result.

Discussion

Bundle branch blocks result in secondary ST-T changes, which need to be distinguished from ischemia-induced (primary) ST-T changes. Several ECG scores have been developed for the identification of acute coronary occlusion in patients with LBBB [1,2]. However, there are no guidelines for the prediction of acute coronary occlusion in the presence of NSIVCD, and the guidelines even fail to mention the existence of this ECG pattern [3]. NSIVCD is defined as prolonged QRS duration (≥ 110 ms) [4] not fulfilling the criteria of LBBB or RBBB. Regional myocardial scarring as a result of fibrosis, previous myocardial infarction and left ventricular hypertrophy (LVH) have been considered as background factors for this conduction delay, which frequently results in secondary ST-T changes. In patients with suspected ST-elevation myocardial infarction, this ECG pattern was independently associated with high

* Corresponding author at: Faculty of Medicine and Health Technology, Tampere University, Finland, Arvo Ylpön katu 34, 33520 Tampere, Finland.
E-mail address: kjell.nikus@tuni.fi (K. Nikus).

https://doi.org/10.1016/j.jelectrocard.2022.09.007

Available online 21 September 2022

mortality rates, comparable to those with LBBB [5]. Thus, NSIVCD should be considered as a high-risk ECG pattern predicting poor prognosis despite "modern" treatment of STEMI with primary PCI. NSIVCD is not a uniform ECG pattern. In a subgroup of patients, there may be only slightly altered QRS morphology despite a prolonged QRS duration. In NSIVCD, the proximal conduction system is usually unaffected, but concomitant left anterior fascicular block (LAFB) may be present, resulting in left axis deviation. These patients often have LVH in their ECG (ECG-LVH) (Fig. 1a).

In some patients with NSIVCD, the QRS complex resembles LBBB but the criteria for typical LBBB are not met, and the findings are sometimes referred to as atypical LBBB (Fig. 2b). In these cases, there is typically a wide fragmented QRS complex, a marker of myocardial scar and increased mortality risk in known or suspected coronary artery disease.

In our first case, the ECG findings were not compatible with typical LBBB, but represent either atypical LBBB or NSIVCD (Fig. 1a). The ECG findings consist of LVH and fragmentation of the QRS complex in the lateral extremity leads. An ECG recorded during chest pain showed new concordant inferolateral ST segment elevation, ST depression in leads V2—V3, and excessively discordant ST segment elevation in lead III (Fig. 1b), all in agreement with the original and modified Sgarbossa criteria for the prediction of acute coronary occlusion in ACS patients

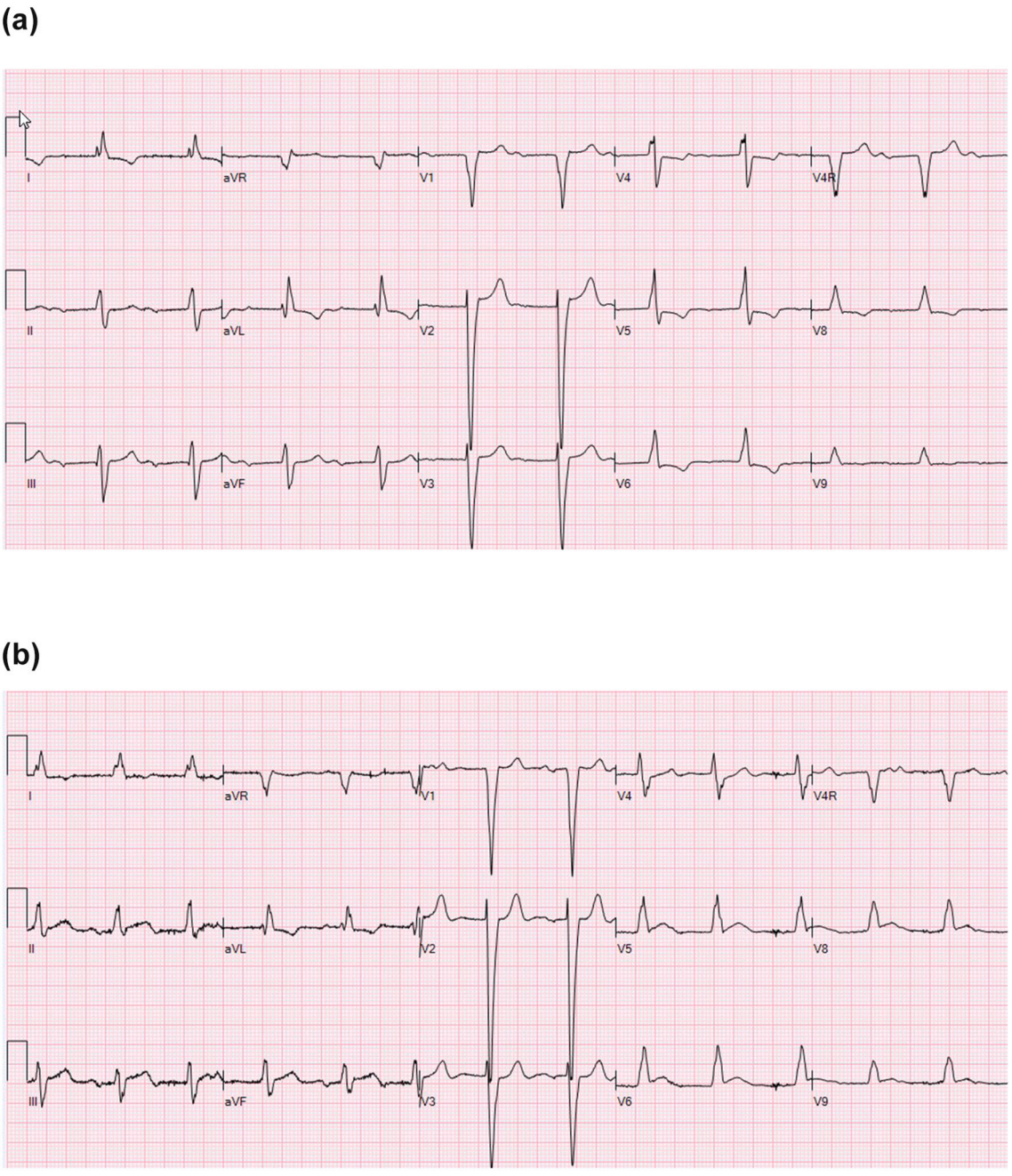

Fig. 1. (a) A 12-lead ECG of an 88-year-old man recorded eight months before an ACS episode. There are wide, biphasic P waves indicating advanced inter-atrial block, a severely prolonged PQ interval and a broad QRS of 142 ms. There are notches in the proximal part of the QRS complex in leads I, aVL, V1 and V4-V6, secondary ST-T changes, left axis deviation and increased voltage indicating left ventricular hypertrophy. In (b) there are 1 mm ST elevations in the leads II, III, aVF, V5-V6, and V8—V9. The ST elevation is concordant in leads II, aVF, V5—V6, and V8—V9. Leads V2 and V3 show 1 mm ST depression. QRS duration is 136 ms. Compared with the previous ECG there are clear changes in the QRS complex: the frontal QRS axis is normal (+ 24°) and there is more evident QRS fragmentation in the extremity leads.

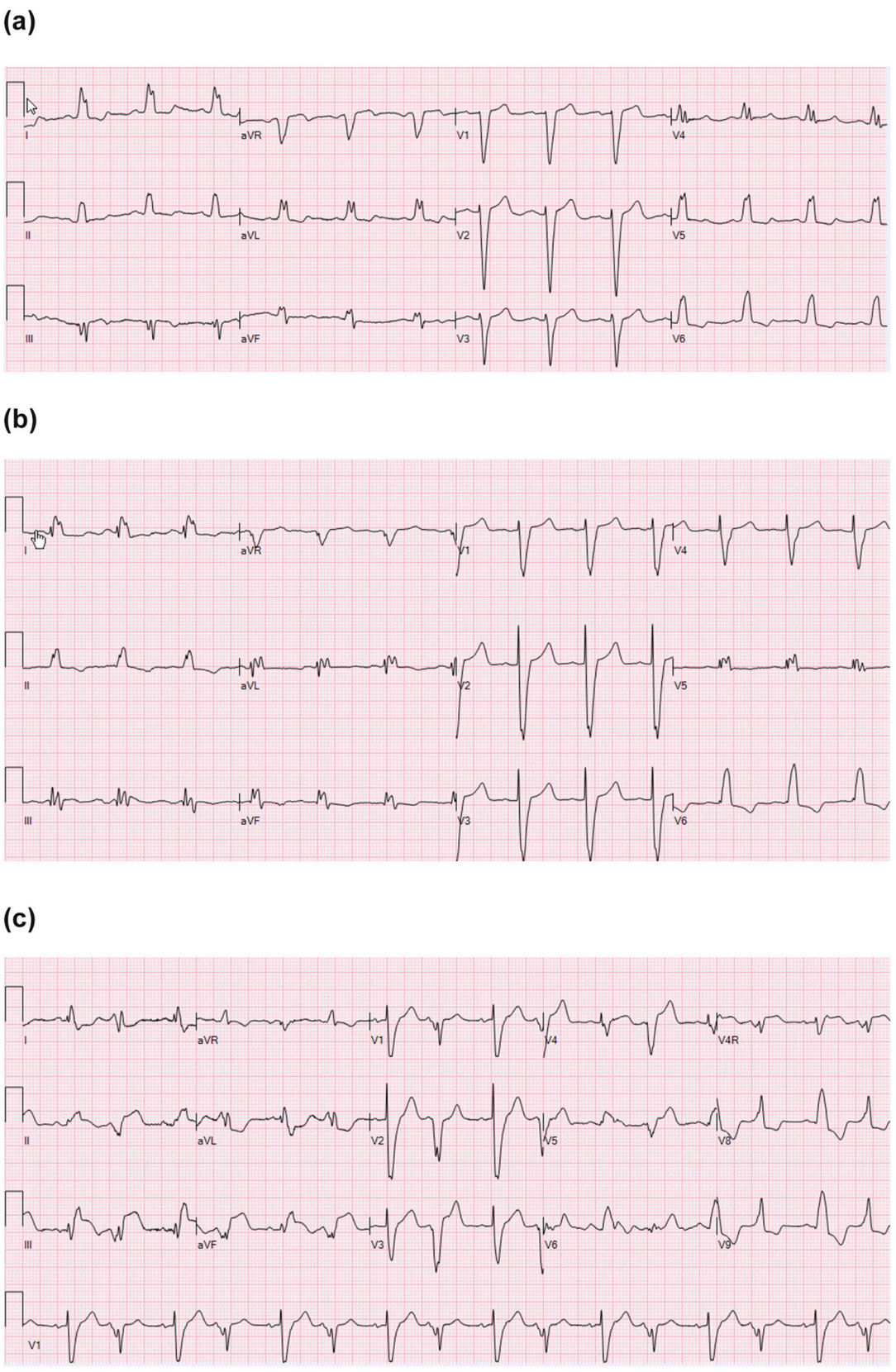

Fig. 2. 12-lead ECGs of a 73-year-old woman. (a) shows an ECG ten years before an ACS episode. There is typical LBBB with a QRS duration of 142 ms, low R waves in leads V1—V3, mid-QRS notching and absence of q waves in the lateral leads and secondary ST-T changes. (b) was recorded three months before the episode. The QRS morphology has undergone significant changes. As a result, there are several changes atypical for LBBB. The QRS duration is 164 ms and instead of the mid-QRS notch, there is QRS fragmentation in the leads I, III, aVL and V5. The R-wave amplitude in the leads V1 (3 mm), V2 (11 mm) and V3 (9 mm) has increased. (c) was recorded during chest pain and shows ventricular extrasystoles in bigeminy. The QRS duration is 172 ms and there is a concordant ST elevation of 2 mm in lead II, 3 mm in lead aVF, and <1 mm in V5 and V6. In lead III there is excessively discordant ST elevation both in the normal beat and in the ventricular extrasystole.

with LBBB [1,2]. Interestingly, also the posterior leads V8-V9 showed concordant ST elevation, a feature that is not included in the Sgarbossa criteria. We think that the changes of the QRS complexes between the two recordings represent different degrees of left ventricular remodeling.

In the second patient case, typical LBBB was present ten years before the ACS episode (Fig. 2a). Interestingly, in the ECG recorded three months before the ACS episode (Fig. 2b), there are several ECG features atypical for LBBB. An r wave ≥1 mm in V1 was predictive of residual left bundle conduction in previous studies [6], but patients with LBBB and septal MI or a large scar may develop large R waves in lead V1 from unopposed right ventricular free wall activation [7]. In this case, the development of heart failure with left ventricular systolic dysfunction and dilatation resulted in a change of the QRS morphology from a typical LBBB pattern to a QRS pattern, where the LBBB diagnosis was highly questionable. The relatively high R waves in the leads V1—V3 could partly be due to right ventricular remodeling ("hypertrophy"). In the acute stage of ACS (Fig. 2c), the ECG indicated acute inferior STEMI: there was >1 mm concordant ST elevation in leads II and aVF, and excessively discordant ST elevation both in the normal beat and in the ventricular extrasystole in lead III. In addition, there was severe fragmentation of the QRS complex in the inferolateral leads, suggestive of myocardial fibrosis or necrosis of the lateral wall. In V6, there was a pseudo-LBBB pattern - the R wave of V6 lacks the characteristic notch at the apex. The changes could represent NSIVCD, possibly with "peri-infarction" block, although atypical LBBB can't be excluded without invasive electrophysiological studies.

Conclusion

Patients with NSIVCD represent an important subgroup of STEMI patients with high mortality rates, yet they are neglected in the ACS guidelines. In ACS patients with atypical LBBB or NSIVCD, we recommend using the modified Sgarbossa criteria, which seem to be specific even with ventricular pacing [1,8]. In case of ongoing symptoms compatible with ACS despite initial medical therapy, emergent coronary angiography is recommended.

Author contributions

All authors have contributed to the interpretation of the ECG findings in the context of the clinical scenario.

All authors have contributed to the drafting of the article or revising it critically for important intellectual content.

All authors have approved the final version of the manuscript to be submitted.

Funding

None.

Declaration of Competing Interest

None.

References

[1] Sgarbossa Pinski, Barbagelata Underwood, Gates Topol, et al. Electrocardiographic diagnosis of evolving acute myocardial infarction in the presence of left bundle-branch block. N Engl J Med 1996;334:481–7.
[2] Smith SW, Dodd KW, Henry TD, Dvorak DM, Pearce LA. Diagnosis of ST-elevation myocardial infarction in the presence of left bundle branch block with the ST-elevation to S-wave ratio in a modified Sgarbossa rule. Ann Emerg Med 2012;60:766–76.
[3] Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, et al. 2017 ESC guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: the task force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J 2018;39(2):119–77.
[4] Kusumoto FM, Schoenfeld MH, Barrett C, Edgerton JR, Ellenbogen KA, Gold MR, et al. 2018 ACC/AHA/HRS guideline on the evaluation and management of patients with bradycardia and cardiac conduction delay: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines, and the Heart Rhythm Society. J Am Coll Cardiol 2018;74:932–87.
[5] Lahti R, Rankinen J, Lyytikäinen L-P, Eskola M, Nikus K, Hernesniemi J. High-risk ECG patterns in ST elevation myocardial infarction for mortality prediction. J Electrocardiol 2022;74:13–9.
[6] Perrin MJ, Green MS, Redpath CJ, Nery PB, Keren A, Beanlands RS, et al. Greater response to cardiac resynchronization therapy in patients with true complete left bundle branch block: a PREDICT substudy. EP Eur 2012;14:690–5.
[7] Pérez-Riera A, Barbosa-Barros R, Daminello-Raimundo R, Abreu L, Almeida M, Rankinen J, et al. Re-evaluating the electro-vectorcardiographic criteria for left bundle branch block. Ann Noninvasive Electrocardiol 2019;24:e12644.
[8] Dodd KW, Zvosec DL, Hart MA, Glass G, Bannister LE, Body RM, et al. Electrocardiographic diagnosis of acute coronary occlusion myocardial infarction in ventricular paced rhythm using the modified Sgarbossa criteria. Ann Emerg Med 2021;78:517–29.