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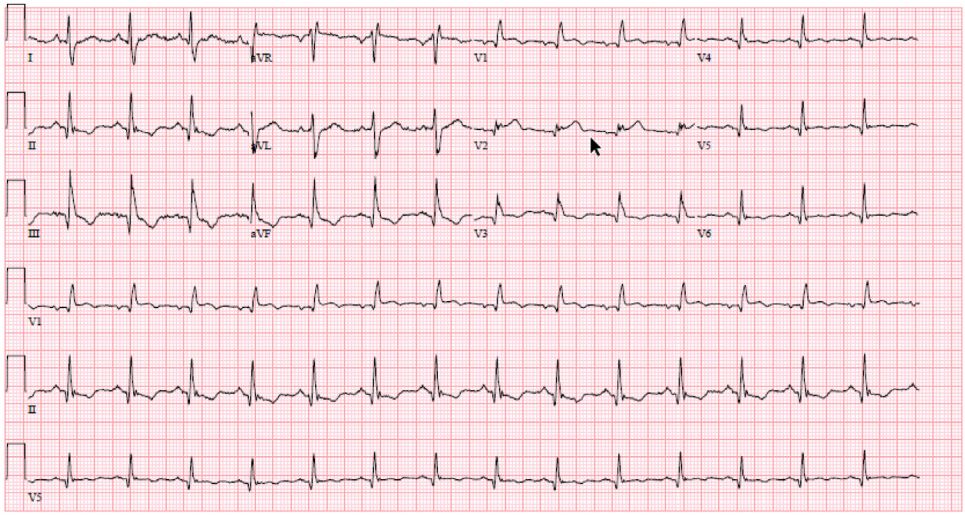

Figure 1. Presenting ECG.

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A 60-year-old woman with multivessel coronary artery disease status-post percutaneous coronary intervention with a drug-eluting stent to the left anterior descending and circumflex arteries 1-year prior presented to the emergency department with unrelenting chest pain intermittently relieved with sublingual nitroglycerin that started abruptly 3 days prior. She also had a history of ischemic heart failure with reduced ejection treated with furosemide 40 mg, metoprolol succinate 50 mg, and losartan 50 mg. A 12-lead ECG was obtained on presentation (Figure 1).

For the diagnosis and teaching points, see page 220.
To view the entire collection of ECG of the Month, visit www.annemergmed.com

ECG OF THE MONTH

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CLINICAL QUESTION

How should we interpret an ECG in a patient with ischemic symptoms and right bundle branch block?

ECG INTERPRETATION

The presenting ECG showed sinus rhythm with a wide QRS and a qR' diagnostic of the right bundle branch block in the presence of infarction (either new or old). There is ST-segment elevation of 0.5 mm, 1.5 mm, and 1.0 mm in leads V1 to 3, respectively.

CLINICAL COURSE

The initial troponin I concentration was elevated to 4.5 ng/mL and peaked at 6.4 ng/mL before the patient had nonurgent coronary angiography for a presumed non-ST elevation myocardial infarction (NSTEMI). Echocardiography demonstrated a reduced left ventricle ejection fraction of 40% to 44% (previously 55% to 60%) and akinesis of the distal anterior, anteroseptal, and apical segments. Coronary angiography revealed subtotal in-stent restenosis of a proximal to mid-left anterior descending stent and 80% to 85% occlusion of the ostial first diagonal (D1) branch, with TIMI-0 flow to the distal/apical left anterior descending in addition to chronic total occlusion of the right coronary artery that filled through first septal collaterals proximal to the left anterior descending lesion. Perfusion was improved after percutaneous coronary intervention with intra-coronary tPA and laser atherectomy of the mid-left anterior descending and balloon angioplasty of both the mid-left anterior descending and D1 lesions.

DISCUSSION

The right bundle branch block is characterized by a QRS duration $\geq$120 ms, rSR' in leads V1 to 3, and an S-wave of greater duration than the R-wave in leads I and V6. Patients with known acute coronary syndrome and right bundle branch block have poorer prognoses, likely because of its association with severe ischemic left anterior descending artery disease.[1] Thus, the most up-to-date guidelines suggest that patients with right bundle branch block (whether known prior or presumed new) and suspected ischemia should be managed with urgent coronary angiography, with or without percutaneous coronary intervention, as indicated. However, patients with right bundle branch block who present to the ED with chest pain are no more likely to have an acute coronary syndrome than patients without right bundle branch block necessitating the need for more specific criteria for assessing patients with ischemic symptoms and right bundle branch block.[2]

Figure 2. Spectrum of ST-depressions and T-wave inversions that may be present in patients with non-ischemic RBBB. RBBB, right bundle branch block.

The non-ischemic ECG with right bundle branch block usually has an rSR', or in the presence of an old infarct, a qR complex. The R'-wave is the part of the QRS representing abnormal conduction and is usually followed by discordant ST-depression and a negative T-wave that is proportional in the degree to the R'-wave. The corresponding ST-depression at the J-point is usually no more than 1 mm. Figure 2 presents the spectrum of ST-changes that are seen in the setting of non-ischemic right bundle branch block. The magnitude of ST-depression may be greater when larger R'-waves are present, as seen with right ventricular hypertrophy or right axis deviation. Therefore, an isoelectric ST-segment following the R'-wave suggests *relative* ST-elevation, and *any* actual ST-elevation is unusual and should alert the interpreter to the possibility of left anterior descending occlusion. Although ST-elevation below the threshold needed for ST-elevation myocardial infarction (STEMI) diagnosis has been noted in at least 15% of left anterior descending occlusions, it is the norm in right bundle branch blocks.[2,3] The presence of a qR rather than rSR'-wave represents either a right bundle branch block in the setting of a left ventricular aneurysm, ie, old infarction and persistent ST-elevation, or right bundle branch block with acute STEMI, and either new or old Q-waves.[4]

The use of the acute occlusion myocardial infarction (OMI) vs non-OMI ECG paradigm has greater sensitivity for diagnosing acute coronary occlusion than the conventional STEMI vs NSTEMI dichotomy.[5] In the patient presented here, the degree of ST-elevation in the anterior leads was below the threshold for STEMI in a woman. The upright T-waves further suggested that the ST-elevation was acute. The interpretation was complicated by a lack of confidence in how to treat ST-elevation in the setting of a right bundle branch block. An updated criterion based on the occlusion myocardial infarction paradigm may improve diagnostic certainty. For now, it is important for clinicians to consider any degree of ST-elevation in leads V1 to V3 on an ECG of a patient with a right bundle branch block and ischemic symptoms to be suggestive of acute occlusion of the left anterior descending artery.

TEACHING POINTS

1. Most patients with a right bundle branch block have ST-depressions and T-wave inversions in leads V1-V3.
2. *Any* actual ST-elevation is unusual and should alert the interpreter to the possibility of left anterior descending artery occlusion.

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