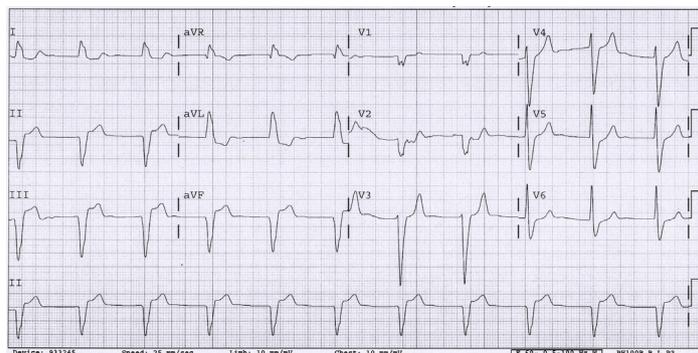


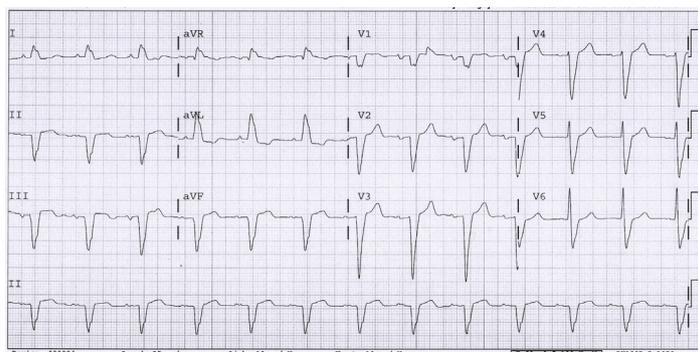


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**Figure 1.** An accelerated junctional rhythm, with ventricular rate of approximately 65 beats/min. There is 1 mm of ST-segment depression in lead V2, meeting Sgarbossa's criteria for the diagnosis of acute myocardial infarction.



**Figure 2.** The patient's previous ECG, obtained 9 months earlier, demonstrates a sinus rhythm with occasional premature atrial complexes and pulse rate of 75 beats/min, with a left bundle branch block pattern. The ST segment in V2 is isoelectric.

[Ann Emerg Med. 2019;73:409-412.]

An 84-year-old man with a history of coronary artery disease drove himself to the emergency department with severe, aching chest pain radiating to both arms, beginning 3 hours before arrival. He took an aspirin and carvedilol before arrival, with partial relief. He described intermittent chest pain during the previous 2 weeks. The pains were similar to those of a previous myocardial infarction he experienced 20 years ago.

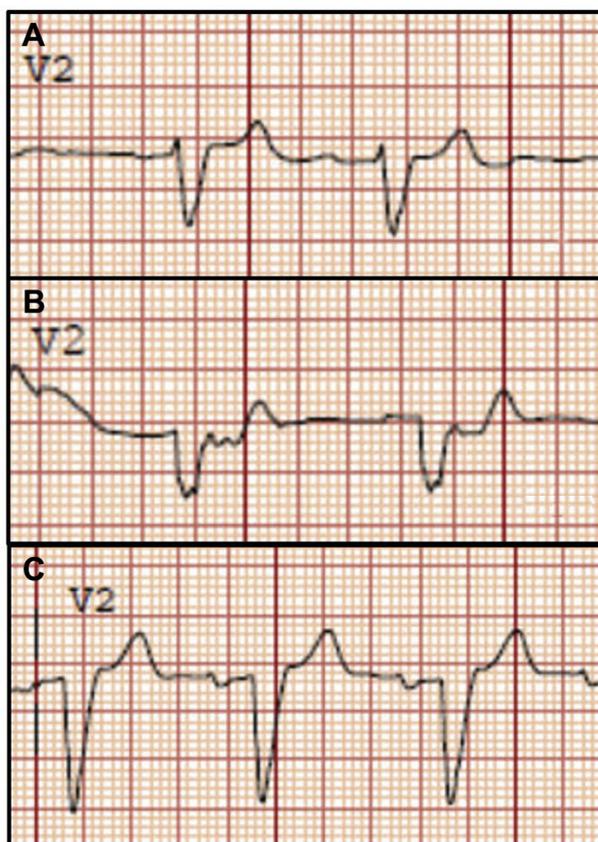
His medical history was significant for a quadruple coronary artery bypass graft performed after his first myocardial infarction, hypertension, and hyperlipidemia. His medications included daily aspirin, carvedilol, and atorvastatin.

A 12-lead ECG was obtained and compared with a previous ECG from 9 months earlier (Figures 1 and 2).

Are there any findings that support the need for emergency catheterization laboratory activation?

*For the diagnosis and teaching points, see page 410.*

*To view the entire collection of ECG of the Month, visit [www.annemergmed.com](http://www.annemergmed.com)*



**Figure 3.** Comparison of lead V2 demonstrating an isoelectric ST segment on a previous EKG (A), concordant ST depression on presentation (B), and resolution of the concordant ST depression after reperfusion therapy (C).

## ECG OF THE MONTH

(continued from p. 409)

### DIAGNOSIS:

#### Interpretation

The ECG demonstrated a regular, wide QRS complex rhythm, with ventricular rate at approximately 65 beats/min. Given lack of perceptible P waves and identical QRS morphology on a previous ECG while the patient was in sinus rhythm, this was most likely an accelerated junctional rhythm.

There was left axis deviation, and the QRS duration was prolonged, at 0.15 msec, with a monomorphic R wave in lead I and QS in lead V1, consistent with left bundle branch block. Criteria to diagnose left bundle branch block include a QRS duration of at least 0.12 seconds in the presence of sinus rhythm or a supraventricular rhythm, a QS or rS complex in lead V1, and an R-wave peak time of at least 0.06 second in leads I, V5, or V6, associated with the absence of a Q wave in the same lead.<sup>1</sup>

Compared with the previous ECG, there was new (from previous) discordant ST-segment elevation in leads II, III, and aVF. However, this ST-segment elevation was not diagnostic of acute coronary occlusion in the setting of left bundle branch block.

There was also new, concordant ST-segment depression of 1 mm in lead V2, which, according to both the original and modified Sgarbossa criteria, is diagnostic for acute coronary occlusion in the setting of left bundle branch block. This dynamic abnormality was noted to normalize in a repeated ECG performed after revascularization

(Figure 3). Dynamic change during a short period in a patient with suspected acute coronary syndrome is strongly suggestive of acute coronary syndrome as well.

### CLINICAL COURSE

A failure to initially recognize the “ST-segment elevation myocardial infarction equivalent” findings led to a 33-minute delay in catheterization laboratory activation after the initial ECG was obtained. When his troponin level reached 11.73 ng/mL, he was taken urgently to the cardiac catheterization laboratory. His saphenous vein to the right coronary artery bypass graft was found to be occluded with extensive thrombus between 2 focal regions of 70% stenosis. The thrombosis was removed and the areas of stenosis were successfully treated with deployment of 2 drug-eluting stents. The patient had an uneventful hospital admission and was discharged in stable condition. The ST-segment depression noted in lead V2 was completely resolved on a follow-up ECG 1 week later.

### DISCUSSION

In 1996, Sgarbossa et al<sup>1</sup> first described ST-segment criteria for the diagnosis of myocardial infarction in the setting of left bundle branch block. These criteria were subsequently modified by Smith et al<sup>2</sup> and have been shown to be highly specific (and moderately sensitive) for acute coronary artery occlusion. The Sgarbossa criteria with the Smith modification are ST-segment elevation greater than or equal to 1 mm and concordant with the QRS complex in at least one lead; ST-segment depression greater than or equal to 1 mm in any of leads V1 to V3; and the most negative ratio of ST/S less than  $-0.25$  (in lieu of 5-mm ST-segment elevation) and at least 1 mm of ST-segment elevation in at least one lead. Presence of any of these findings is strongly suggestive of myocardial infarction, although their absence does not exclude myocardial infarction.

The admission ECG revealed new ST-segment elevation in leads 2, 3, and aVF that was discordant with the primarily negative QRS complex deflection in these leads. However, this ST-segment elevation was not diagnostic of acute coronary occlusion in the setting of left bundle branch block, given that its degree was less than 25% of the height of the S wave (18% in lead 2, 20% in lead 3, and 19% in lead aVF). In lead V2, there was 1 mm of ST-segment depression and a primarily negative QRS complex deflection. Concordant ST-segment deviation in one or more of the V1 to V3 leads is highly predictive of acute myocardial infarction. A 2008 meta-analysis<sup>3</sup> reported that this finding has a positive likelihood ratio of 7. Comparison with the previous ECG revealed this ST-segment deviation to be new.

The 2013 American College of Cardiology Foundation/American Heart Association ST-segment elevation myocardial infarction guideline revision<sup>4</sup> updated the approach to diagnosis of acute myocardial infarction in patients with left bundle branch block. “New or presumably new [left bundle branch block] at presentation occurs infrequently, may interfere with ST-elevation analysis, and should not be considered diagnostic of acute myocardial infarction...in isolation. Criteria for ECG diagnosis of acute [ST-segment elevation myocardial infarction] in the setting of [left bundle branch block] have been proposed,” with a reference to the original Sgarbossa criteria.<sup>5</sup> More recently, a validation study of the modified Sgarbossa criteria found the modification to be more sensitive and similar in specificity.<sup>6</sup> The recognition of these ECG abnormalities provides an opportunity to give reperfusion to patients with acute coronary artery occlusion who might not otherwise have received it because of the presence of left bundle branch block while potentially reducing false cardiac catheterization laboratory activation. It behooves the emergency physician to recognize the ECG abnormalities of the Sgarbossa criteria, as well as the modified criteria, which can be somewhat varied and subtle in appearance.

### PEARLS

In the setting of left bundle branch block, either 1-mm ST-segment elevation concordant with the QRS complex in any lead or 1-mm ST-segment depression concordant with a negative QRS complex in any of leads V1 to V3 is strongly predictive of acute coronary occlusion.

In the setting of left bundle branch block, discordant ST-segment elevation in at least one lead with a primarily negative QRS complex deflection that is 25% or more of the height of the S wave in that lead is strongly predictive of acute coronary occlusion.

The absence of these 2 ST-segment criteria does not exclude acute coronary occlusion.

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Dr. Tabas is the section editor of ECG of the Month for *Annals of Emergency Medicine*.

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