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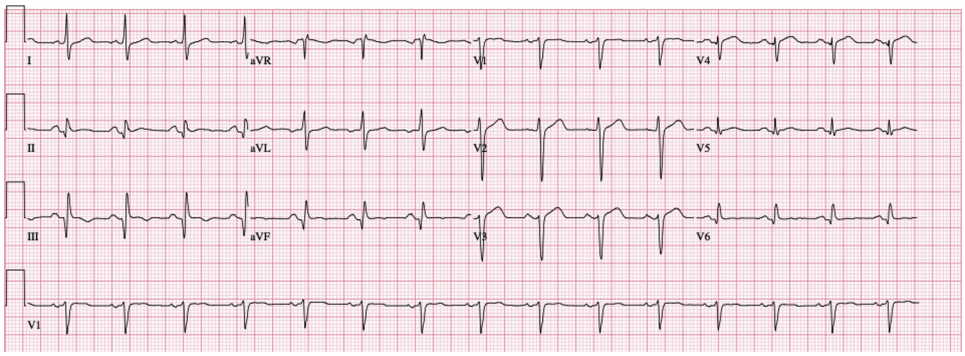

Figure 1. ECG on arrival.

[Ann Emerg Med. 2021;77:593-596.]

A 60-year-old man with diabetes, hypertension, and hyperlipidemia presented to the emergency department (ED) after nearly 24 hours of chest pain. He denied a history of heart disease but acknowledged that his father had died from a heart attack at aged 62 years. He reported a "normal" stress test result 7 years before. An ECG was obtained within 7 minutes of arrival (Figure 1).

Is the anterior ST-segment elevation owing to left anterior descending artery occlusion or benign early repolarization?

For the diagnosis and teaching points, see page 594.
To view the entire collection of ECG of the Month, visit www.annemergmed.com

ECG OF THE MONTH

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DIAGNOSIS:

Interpretation

Occlusion myocardial infarction of the left anterior descending artery. The initial ECG showed sinus rhythm at 90 beats/min. There was subtle ST-segment elevation and Q waves in leads II, III, and aVF. These inferior wall changes suggested an infarct of indeterminate age but did not meet current ST-segment elevation myocardial infarction (STEMI) criteria.[1] The anterior leads were also concerning and provided the essential clue to the ultimate diagnosis. There was R-wave regression between V2 and V3, concerning for infarcted or hibernating myocardium. However, lead reversal can also cause this and should be double-checked. Leads V3 to V4 had ST-segment elevation that could be considered a normal variant, particularly because of the abnormal R-wave regression. The small Q waves in V5 to V6 could have been normal and caused by septal depolarization but had to be considered pathologic when not found in the prior ECG. In combination, these findings were highly concerning for acute occlusion myocardial infarction[2] involving the anterolateral and inferior walls, which suggested a large left anterior descending artery occlusion.

The prior ECG (Figure 2) showed no Q waves except in lead III and very slight ST-segment elevation in V1 to V3, which were appropriate and benign in the context of the normal R-wave progression and ST-segment morphology. Overall, this prior ECG confirmed that the suspicious findings explained earlier were new since last evaluation.

Furthermore, when the patient's prior ECG was compared with the one at presentation, the morphology and magnitude of the ST segment in V3 were similar but were now proportionally larger, with more area under the segment, and this was consistent with his occlusion. The same can be said for V4, but the J point also had at least 0.5 mm of new ST-segment elevation. A magnified side-by-side comparison highlights these findings in Figure 3.

CLINICAL COURSE

Cardiology was consulted for emergency cardiac catheterization. The initial cardiac troponin T level was 0.18 ng/mL (99% reference limit <0.01 ng/mL). Pain continued despite aspirin and sublingual nitroglycerin. The patient began receiving heparin and nitroglycerin infusions while waiting to go to the catheterization laboratory. A 100% thrombotic occlusion of the distal left anterior descending artery was found and stented after thrombectomy. Preintervention TIMI flow was 0; postintervention, it was 3. Also noted were 60% stenosis of the mid left anterior descending artery, 90% stenosis of the mid right coronary artery, and 80% stenosis of the distal right coronary artery. Both anterolateral and inferior ST-segment elevation worsened and eventually met STEMI criteria. Troponin T level peaked at 2.05 ng/mL. Staged percutaneous coronary intervention occurred the next day, with remaining lesions all stented. Echocardiography performed after the second catheterization showed normal global function and an ejection fraction of 55%. The patient was discharged on day 3 of hospitalization.

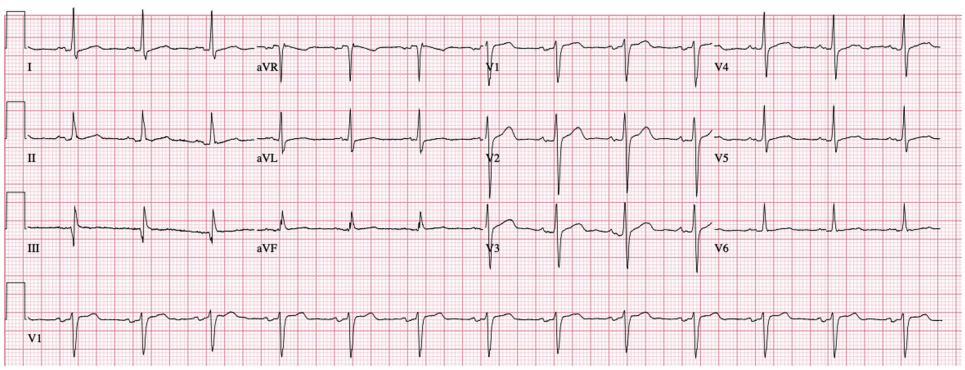

Figure 2. ECG from 5 years ago.

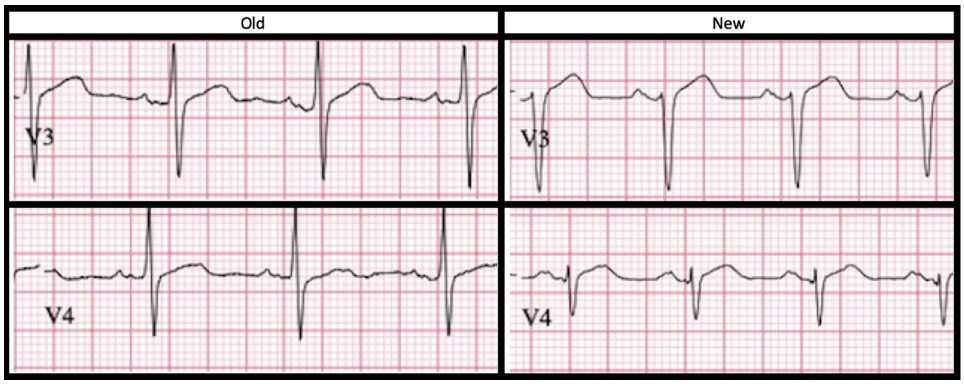

Figure 3. Leads V3 and V4 in the patient's prior and presenting ECGs magnified and presented side by side for comparison.

DISCUSSION

This patient had an occlusion myocardial infarction that did not initially meet STEMI criteria. In accordance with the initial ECG result alone, most cardiologists would not take the patient for emergency percutaneous coronary intervention. However, the first ECG had signs of ischemia in the inferior and anterior leads, concerning for left anterior descending artery occlusion, including R-wave regression and abnormal ST-segment elevation in the anterior leads, with straight ST-segment morphology. These changes are not as obvious as formal STEMI criteria but should alert physicians to a likely left anterior descending artery occlusion. Emergency physicians should be aware that there is a 4-variable formula designed to distinguish the early subtle anterior ST-segment elevation of left descending artery occlusion myocardial infarction from benign normal-variant anterior ST-segment elevation, derived by Driver et al[3] and later externally validated by Bozbeyoglu et al.[4] Online calculators[5] for a 4-variable formula to diagnose subtle anterior STEMI are readily available. The required components are Bazett-corrected QT interval in milliseconds, QRS amplitude in lead V2 in millimeters, R-wave amplitude in lead V4 in millimeters, and ST-segment elevation 60 ms after the J point in lead V3 in millimeters. The most accurate cutoff suggesting left anterior descending artery occlusion myocardial infarction is 18.2 (89% sensitivity, 95% specificity). A cutoff of 19.0 is approximately 97% specific, and 17.0 is approximately 97% sensitive.

Applying the formula to the patient's initial ECG yielded 21.01, using the measurements 1.5 mm for ST-segment elevation 60 msec after the J point, 432 msec for QTc interval as calculated by computer interpretation, 1.5 mm for R-wave amplitude in V4, and 17.5 mm for QRS amplitude in V2. Thus, within minutes of the patient's arrival to the ED, there was highly specific evidence indicating he had an acute left anterior descending artery occlusion. Early identification of the likely occlusion resulted in a good outcome.

PEARLS

When the clinical context suggests an occlusion myocardial infarction but the ECG fails to meet formal STEMI criteria, comparison with prior ECGs is essential to the interpretation of potentially acute ischemic findings.

There is a validated 4-variable formula to aid clinicians in differentiating normal-variant ST-segment elevation in the anterior leads from occlusion myocardial infarction of the left anterior descending artery.

This patient had ischemic symptoms persisting despite medical management and therefore warranted emergency angiography in accordance with the American College of Cardiology/American Heart Association guidelines,[6] even if the ECG had not shown evidence of occlusion myocardial infarction.

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