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Chest pain: The importance of serial ECGs

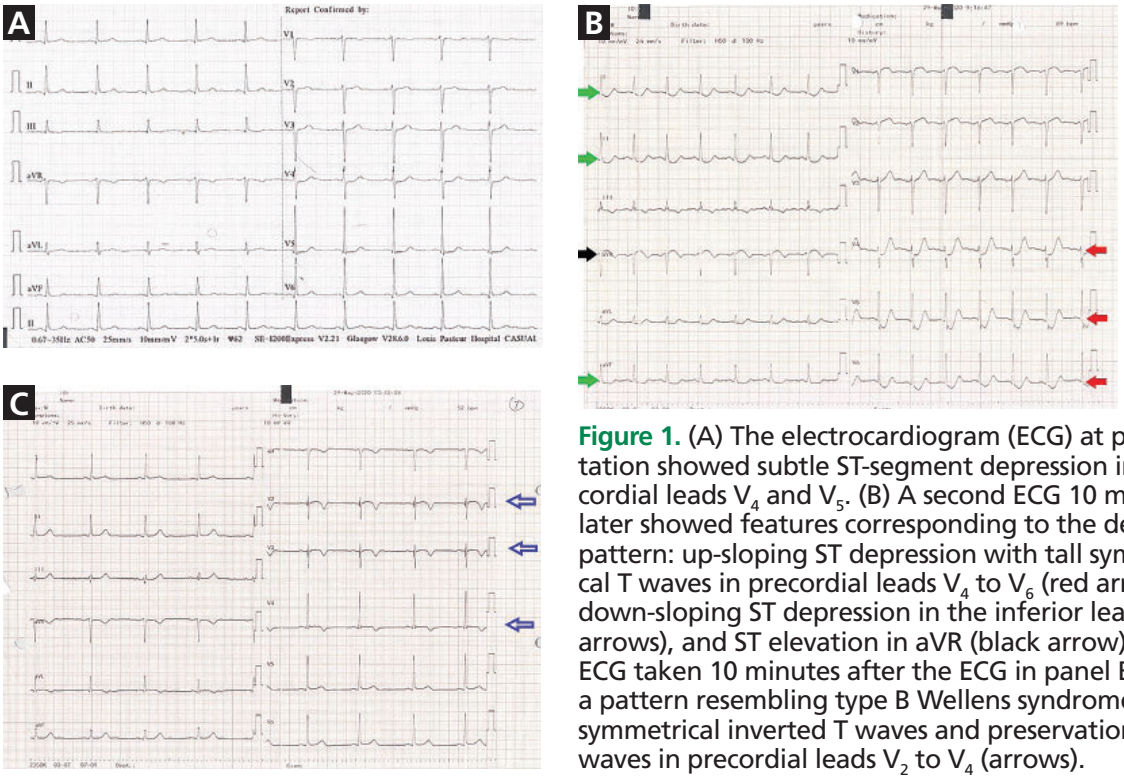

Figure 1. (A) The electrocardiogram (ECG) at presentation showed subtle ST-segment depression in precordial leads V_4 and V_5. (B) A second ECG 10 minutes later showed features corresponding to the de Winter pattern: up-sloping ST depression with tall symmetrical T waves in precordial leads V_4 to V_6 (red arrows), down-sloping ST depression in the inferior leads (green arrows), and ST elevation in aVR (black arrow). (C) An ECG taken 10 minutes after the ECG in panel B showed a pattern resembling type B Wellens syndrome, with symmetrical inverted T waves and preservation of R waves in precordial leads V_2 to V_4 (arrows).

A 44-YEAR-OLD MAN, previously well, presented to the emergency department with severe hypertension and a 4-hour history of typical angina-like chest pain with associated diaphoresis. He had dyslipidemia, a 5-pack-year history of smoking, and, likely, undiagnosed hypertension.

On arrival, his blood pressure was 200/110 mm Hg, representing a hypertensive emergency. A clinical examination was unremarkable. A blood sample was sent for troponin analysis, and a nitroglycerin infusion was started.

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An initial ECG showed minimal ST-segment changes in the precordial leads (**Figure 1a**). However, the patient's typical chest pain prompted a second ECG (**Figure 1b**) 10 minutes later, which showed features corresponding to a de Winter ECG pattern including the following features:

- Up-sloping ST-segment depression at the J point, with tall symmetrical T waves in precordial leads V_4 to V_6
- Down-sloping ST-segment depression in the inferior leads
- ST-segment elevation in aVR.

The de Winter ECG pattern is highly

predictive of acute proximal left anterior descending artery (LAD) occlusion.[1]

A third ECG (**Figure 1c**) taken 10 minutes after the second ECG showed a pattern resembling that in type B Wellens syndrome, ie, symmetrical inverted T waves with preservation of R waves in precordial leads V_2 to V_4. Wellens syndrome is also associated with transient proximal LAD occlusion or critical LAD stenosis.[2] Our patient likely experienced reperfusion after the ECG that showed the de Winter pattern.

Taken together, the serial ECGs demonstrated progression seen during acute myocardial infarction.

HYPERTENSIVE EMERGENCY AND ECG PATTERNS

A hypertensive emergency may present with T-wave inversion, ST-segment displacement, or even asymmetrical tall T waves, indicative of cardiac injury that necessitates prompt intervention. Hypertensive emergency causes a sudden increase in afterload, which increases myocardial oxygen demand and workload, resulting in myocardial ischemia.

Changes on ECG related to hypertensive emergency usually revert to baseline once the blood pressure is controlled. In hypertensive crisis with associated chest pain, it is important to look for ischemic triggers and actively exclude target-organ damage. Serial ECGs can help identify myocardial ischemia and monitor response to blood pressure treatment.[3]

The de Winter syndrome

The de Winter syndrome is reported in 2% of patients with anterior myocardial infarction and should not be missed.[1] In initial reports in the literature, the ECG changes noted in de Winter syndrome were static and did not progress to ST-segment elevation. However, the evolution of the de Winter ECG pattern to an ST-segment elevation myocardial infarction (STEMI) pattern has been well documented.[4] The electrophysiologic mechanism to explain the absence of ST elevation remains unclear, and multiple hypotheses have been postulated.[1,5,6]

Wellens syndrome

Wellens syndrome is associated with a critical stenosis of the proximal LAD. It is classified as type A or type B. Type A is characterized by biphasic T waves in precordial leads V_2 to V_3. Type B is classified by deep symmetrical T waves in the anterior precordial leads.[2]

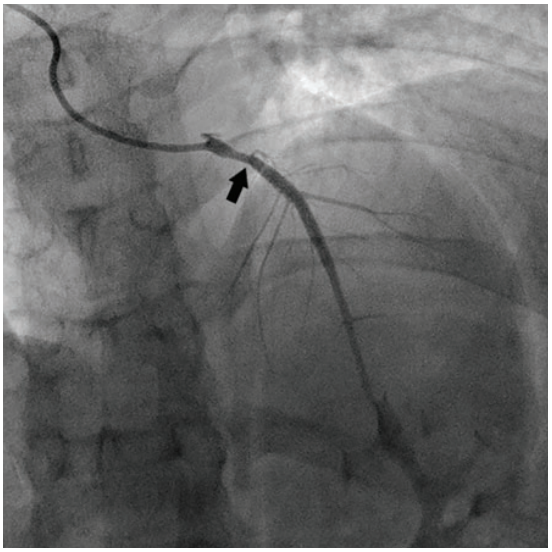

Figure 2. Coronary angiography confirmed significant stenosis of the proximal left anterior descending artery (arrow).

The role of serial electrocardiography

The ECGs in our patient highlight the importance of serial ECGs in a patient presenting with ongoing chest pain and a normal or inconclusive initial ECG. They demonstrate progression to 2 high-risk ECG patterns hinting at critical coronary stenosis or occlusion, often referred to as STEMI-equivalents. Measurement of troponins is of the utmost importance in the diagnosis of myocardial infarction, but not in STEMI. Awaiting a troponin result in this patient would have led to a costly delay of urgent revascularization.[7]

Taken together, the serial ECGs demonstrated progression seen during acute myocardial infarction

MANAGEMENT

Current American Heart Association/American College of Cardiology and European Society of Cardiology guidelines do not specifically address the management of acute coronary syndrome in patients with the de Winter ECG pattern. They do however suggest percutaneous coronary intervention in patients with possible ongoing myocardial ischemia and an early invasive strategy in high-risk patients.[8–10] The proximal LAD occlusion associated with this ECG pattern means it can be treated as an STEMI-equivalent.

Good reperfusion success rates have been reported with initial thrombolytic therapy.[4,11] In a setting with limited resources or during the current pandemic, when access to many procedures may be limited, initial thrombolytic therapy coupled with early angiography (within 2 to 24 hours) as part of a pharmacoinvasive approach should be considered in patients with de Winter ECG pattern.

OUR PATIENT'S TREATMENT

The patient received guideline-directed medical therapy.[10] In STEMI, a presenting blood pressure of 200/110 mm Hg is a relative contraindication to thrombolytic therapy, but he responded well to nitroglycerin infusion.[7] His initial troponin I level was 230 ng/L (rule-in value for acute coronary syndrome > 300 ng/L) and went up to 14,139 ng/L.

He underwent urgent coronary angiography, which confirmed critical stenosis of the proximal LAD (**Figure 2**). A drug-eluting stent was placed. He was discharged 2 days later on dual antiplatelet therapy (lifelong aspirin and 12 months of clopidogrel) and lifelong atorvastatin, enalapril, and atenolol.

TAKEAWAYS

- The de Winter and the Wellens ECG patterns carry a life-threatening prognosis, yet they are underrecognized by clinicians. Awareness of these high-risk patterns and STEMI-equivalents can lead to earlier diagnosis and treatment, which may improve clinical outcomes and prognosis.
- Serial ECGs can help identify dynamic ECG changes when the initial ECG is normal, and can help diagnose life-threatening ischemia and acute coronary syndrome, allowing early intervention and prevention of complications.
- Primary percutaneous coronary intervention or initial thrombolytic therapy coupled with early angiography (within the first 2 to 24 hours) as part of a pharmacoinvasive approach should be initiated as soon as possible when a patient presents with a de Winter pattern on ECG.

DISCLOSURES

The authors report no relevant financial relationships which, in the context of their contributions, could be perceived as a potential conflict of interest.

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