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Is exercise-induced U-wave inversion predictive of proximal left anterior descending coronary artery disease?

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Abstract A 66-year-old patient with a recent history of chest pain was submitted to exercise test. The rest electrocardiogram was normal, but during effort, a striking U-wave inversion in the chest leads occurred, not associated with any ST-segment change. Coronary angiogram demonstrated a severe proximal narrowing of the left anterior descending coronary artery. Effort-induced U-wave inversion in the precordial leads has long been recognized as a marker of stenosis of the left anterior descending coronary artery, but this pattern is seldom taken into account.

Keywords: Electrocardiogram; Coronary artery disease; U wave

Introduction

Although changes in U-wave amplitude or polarity have been reported as a possible manifestation of myocardial ischemia or infarction,[1-7] U-wave analysis is seldom used to recognize coronary artery disease. This report is focused on a case of unstable angina in which a striking U-wave inversion in the chest leads occurred during stress test, being the sole electrocardiogram (ECG) manifestation of myocardial ischemia.

Case report

A 66-year-old man, with diabetes mellitus as a unique risk factor, was admitted for a recent history (20 days) of chest pain, occurring both at rest and during effort, and lasting a few minutes. On admission, he was asymptomatic, physical examination was unremarkable, and ECG, echocardiogram, and laboratory data were normal. During the night after admission, while the patient was in a drug-free state, a brief chest pain episode occurred at rest, not associated with any ECG change. An exercise stress test was then performed. The rest ECG was normal (Fig. 1), whereas at 60 W, the U wave became inverted in leads V_2, V_3, and V_4 in the absence of chest pain; by continuing the exercise, at 100 W, the usual pain occurred, and the ECG showed deep negative U waves in leads V_2 to V_4, not associated with any ST-segment abnormality (Fig. 2). At first glance, the large negative deflections that follow the T waves and are best seen in leads V_2 to V_4 could be interpreted as premature ectopic P waves rather than as U waves; the suspicion is raised by the presence of atrial extrasystoles. On several occasions, however, a negative wave is immediately followed by a sinus P wave (see, eg, the second beat in the enlarged section of V_3 and V_4 in Fig. 2), making this hypothesis untenable.

During recovery, both the pain and the U inversion disappeared, and the ECG became normal. Coronary angiography demonstrated a severe proximal narrowing of the left anterior descending coronary artery (Fig. 3), which was treated with bypass surgery (implantation of the left internal mammary artery).

Discussion

Both the origin and the clinical significance of U wave are debated. Hypotheses on U-wave origin include late repolarization of Purkinje fibers, late repolarization of some regions of the left ventricle, and late afterdepolarizations.[8]

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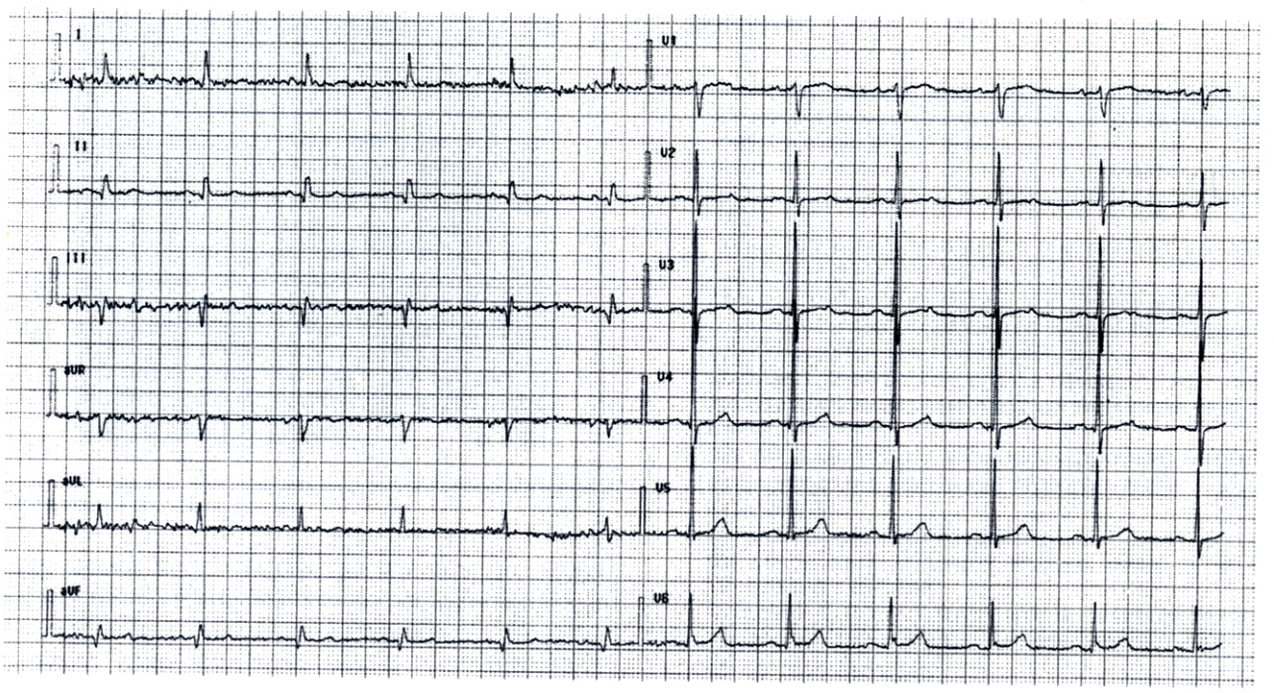

Fig. 1. Twelve-lead ECG recorded at rest immediately before the effort test.

The U wave has usually the same polarity as the T wave. Prominent U waves are often observed during hypokalemia or marked bradycardia; at times, they are caused by drugs, such as amiodaron. Exercise-induced U-wave inversion is predictive of proximal left anterior descending coronary artery disease,[1] whereas exercise-induced U-wave voltage increase in the chest leads suggests myocardial ischemia due to disease of either the circumflex or the right coronary artery.[4] In this situation, U-wave voltage increase has been interpreted as a reciprocal change of U-wave inversion in the posterior leads associated with posteroinferior ischemia. Also, resting U-wave inversion in the anterior leads has been reported as highly suggestive of left anterior descending artery stenosis of 75% or greater.[2]

In our case, the unique ECG sign of myocardial ischemia was the transient U-wave inversion in leads V_2 to V_4, in the absence of any ST-T abnormality; it is worth noting that U-wave changes occurred at a relatively low heart rate (<100 per minute): a further rate increase could have resulted in ST-segment abnormalities, but the chest pain made impossible continuation of the exercise.

As expected, U-wave inversion in the anterior leads corresponded to a severe left anterior descending coronary

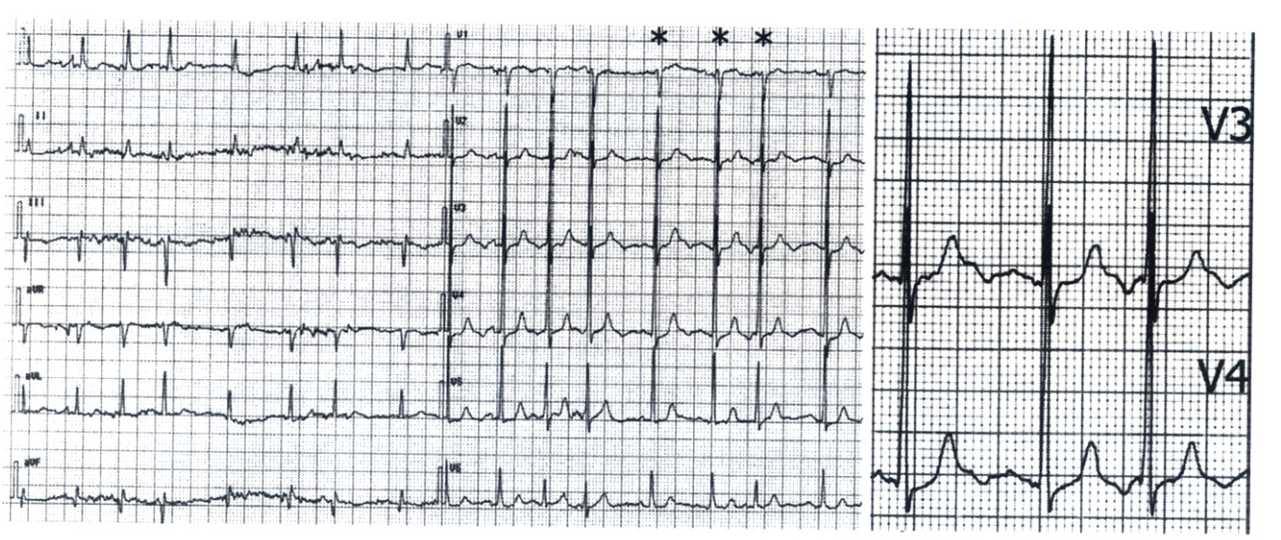

Fig. 2. Electrocardiogram recorded during stress test, with 100 W of charge. U-wave inversion is evident in leads V_2 to V_4. The right section of the figure shows a magnification of the 3 beats labeled with asterisks (leads V_3 and V_4).

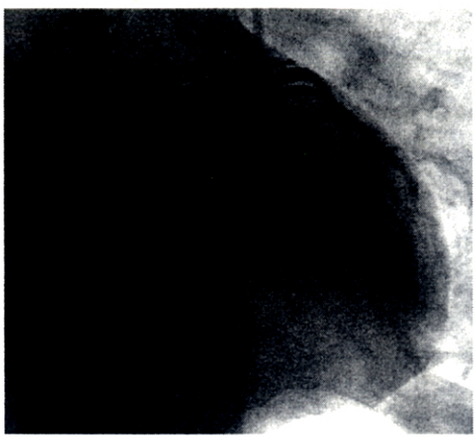

Fig. 3. Coronary angiogram demonstrating severe proximal narrowing of the left anterior descending artery.

artery stenosis. Such an ECG pattern is probably uncommon, but it is likely underscored because not every cardiologist pays a great attention to U-wave analysis.

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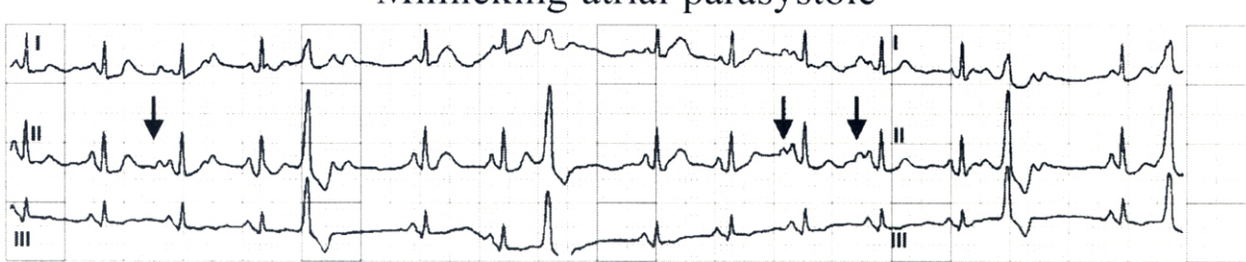
Mimicking atrial parasystole



Artifacts resembling P waves are marked with arrows. There are 2 clues that reveal that what may appear to be atrial dissociation or parasystole is actually an artifact. (1) There are no extra P waves in lead III. (2) It is impossible for these extra P waves to be followed immediately by a sinus P wave because atrial refractoriness would block impulse conduction. Stimuli within 170 milliseconds would reach the atria during the refractory phase, and thus, 2 P waves cannot follow one another.

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