Persistent giant U wave inversion with anoxic brain injury

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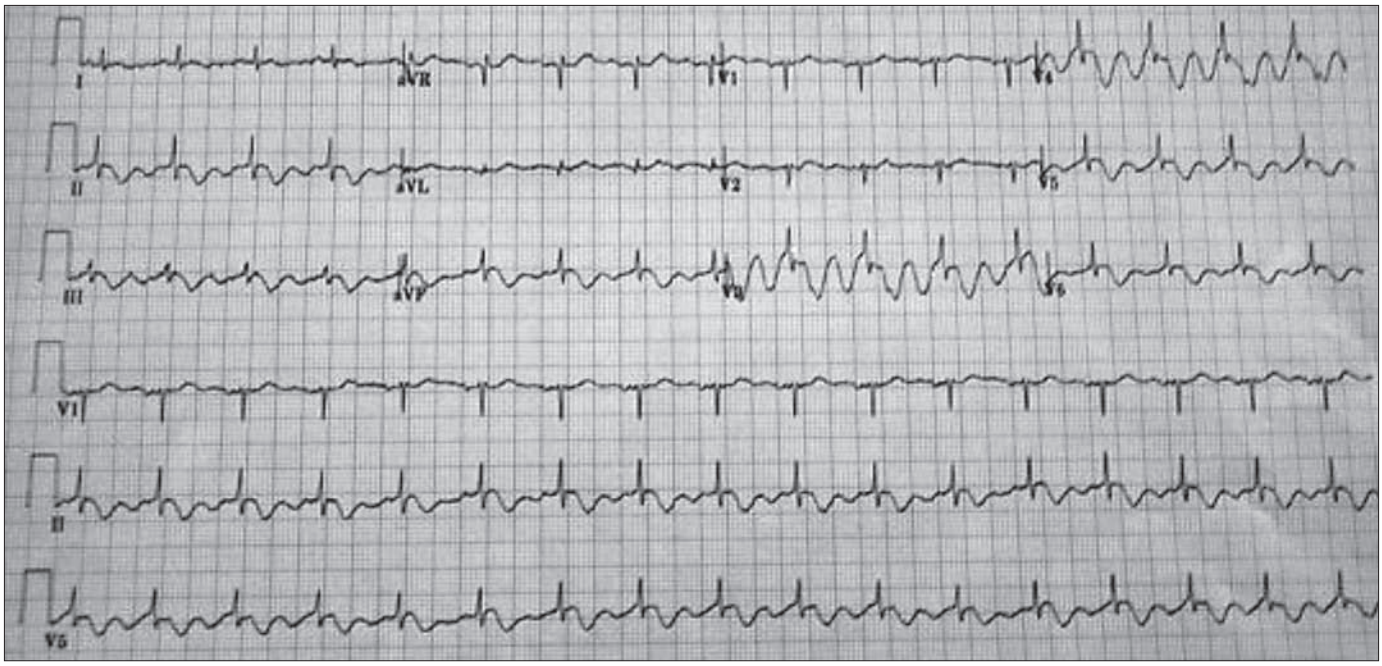

Figure. Electrocardiogram revealing deeply inverted U waves, most notable in the lateral precordial leads, V3–V5.

Various electrocardiographic changes have been reported in the setting of acute neurological events, among them large, upright U waves. In contrast, the occurrence of inverted U waves is strongly suggestive of cardiovascular disease, most commonly hypertension, coronary artery disease, or valvular abnormalities. Presented herein is the case of a 29-year-old man with previous anoxic brain injury (but without apparent cardiovascular disease) whose electrocardiogram demonstrated persistent giant inverted U waves.

CASE PRESENTATION

A 29-year-old Caucasian man with previous anoxic brain injury presented to our facility with a 3-day history of nausea and vomiting. According to his mother, he had overdosed on alprazolam in an apparent suicide at the age of 17 and was in a coma for several days. During the subsequent year, he had daily seizures and was started on levetiracetam, eventually becoming seizure free. Current medications (all of which were administered via percutaneous endoscopic gastrostomy tube) included twice-daily levetiracetam, daily 20 mg citalopram, and daily 40 mg esomeprazole. Initial vital signs were all within normal limits. His blood pressure was 100/70 mm Hg. He was nonverbal. Complete blood count, complete metabolic profile, and thyroid studies were within normal limits. A chest radiograph revealed no evidence of acute cardiopulmonary processes, and an abdominal radiograph revealed a nonobstructive bowel gas pattern. An initial electrocardiogram (ECG) demonstrated deep, symmetric T wave inversions in the inferior and lateral leads followed by large negative deflections, of varying amplitude, most prominent in the lateral precordial leads *(Figure)*. Three sets of cardiac troponins separated by 6 hours each were <0.05 g/dL. A transthoracic echocardiogram showed a normal left ventricular ejection fraction, normal intracardiac chamber sizes,

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and no regional wall motion abnormalities. Repeat ECGs over the subsequent 36 hours revealed a similar pattern. An ECG when he was 26 years old (9 years following the anoxic brain injury) appeared almost identical. After 24 hours of intravenous fluid administration and cessation of tube feedings, the patient demonstrated marked clinical improvement and 12 hours later was discharged.

DISCUSSION

The T wave and U wave are thought to represent the terminal component of ventricular repolarization. While the mechanism of U wave genesis remains uncertain, the clinical specificity of a negative U wave (defined as any discrete negative deflection >0.05 mV within the T-P segment) for heart disease is high (1). Occurring in only 1% of all hospital ECGs, the presence of an inverted U wave suggests the presence of coronary artery disease, valvular heart disease, or hypertension (2). Historically, the correlation of negative U waves with acute myocardial infarction has been felt to be important, given the ability of negative U waves to precede typical ECG changes of acute myocardial infarction by several hours (1). When combined with the presence of T wave inversion, a negative U wave has specificity for coronary artery disease as high as 88% (1). In the presence of myocardial ischemia, U wave vectors are typically directed away from the akinetic or dyskinetic myocardial segment (1). It is difficult to assess whether or not U wave vectors would have similar orientation in the presence of ischemia without wall motion abnormalities because these two entities usually occur in tandem and subsequent revascularization typically leads to the complete disappearance of inverted U waves (1). While association with ischemic heart disease has been regarded as the most clinically important cause of negative U waves, the most common cause (according to a 1982 study of 488 patients with negative U waves) has been found to be hypertension (39.5%), followed by coronary artery disease (33.2%) and valvular heart disease (15.4%). Other less common causes of negative U waves include congenital heart disease (2.5%), hyperthyroidism (1.4%), primary cardiomyopathy (0.8%), and in 7.2%, no manifestations of heart disease (2).

Association between ECG changes and acute neurological events is well known, with causes including subarachnoid hemorrhage, subdural hematoma, neoplasm, infection, epilepsy, and cerebrovascular accident (3). Associated ECG changes include prolonged QT interval, deep, symmetrical T wave inversions, pathologic Q waves, and tall, upright U waves. Cardiac insult related to an acute neurological event is thought to be related to alterations in the autonomic nervous system. Specifically, release of norepinephrine from sympathetic nerve terminals causes widespread opening of calcium channels within the myocardium and subsequent calcium ion influx (4). Consequently, ECG changes do not typically persist past the acute setting.

We believe that the occurrence of persistent giant negative U waves in the absence of apparent cardiac disease is a unique clinical finding and likely somehow related to our patient's previous anoxic brain injury. The possibility of artifact was also considered but deemed unlikely given the fact that multiple ECGs obtained during the patient's hospitalization as well as an ECG obtained from 3 years prior appeared nearly identical. The actual mechanism of these findings is uncertain. His current medications have not been reported to produce any such abnormalities. Coronary artery disease cannot be completely excluded as an etiology (since coronary arteriography was not performed), but we think it very unlikely in a 29-year-old person without other evidence of heart disease. It is possible that the changes may be related to ongoing autonomic nervous system dysfunction, especially in light of his hypotension, although this explanation is purely speculative at the present time.

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