Electrical Alternans of the T-U Wave without Change in the QRS Complex

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A patient with myelocytic leukemia who showed electrical alternans of the T-U wave with no change in the QRS complex following chemotherapy is described. Electrocardiogram taken 4 days later showed ventricular quadrigeminy in which the T-U wave of the first sinus beat after the ventricular premature contraction was markedly less prominent compared to the successive two sinus beats which showed marked prolongation and inverted T-U waves. The causative factors for alternans of T-U waves may include hypochloremic alkalosis with hypopotassemia and myocardial damage by anticancer drugs such as daunomycin and aclarubicin chloride used for the underlying disease.

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Introduction

Alternans of the T-U wave with no change in the QRS complex is extremely rare (1-6). Here we report a patient with acute myelocytic leukemia for who upon chemotherapy treatment showed electrical alternans of T-U waves.

Case Report

A 61-year-old man with acute myelocytic leukemia was admitted for the purpose of further evaluation and therapy. On admission, his heart and lungs were clear and his electrocardiogram (ECG), chest x-ray and serum levels of Na, K, Cl, and Ca were normal. Combination interval chemotherapy with aclarubicin chloride, daunomycin chloride, enocitabine, and mercaptopurine had been repeated three times. In the morning (am 10:50) of July 13, he suddenly lost consciousness with convulsion and fell into shock which was thought to be due to ventricular fibrillation because the pulse was not palpable and during resuscitation frequent premature ventricular complexes with couplets were seen on the monitor. He was resuscitated successfully. He was given phenitoin for his ventricular premature beats, and subsequently no bouts of ventricular tachycardia or fibrillation were noted. Laboratory data on the day before his cardiac arrest showed RBC 293 × 10^6, Hb 8.5 g/dl, WBC 7,700, serum Na 132 mEq/l, K 4.0 mEq/l, Cl 99 mEq/l, Ca 4.3 mEq/l, inorganic P 3.8 mg/dl, ALAT 33 IU, ASAT 25 IU, LDH 163 IU, CPK 69 IU, total protein 7.1 g/dl with albumin of 3.6 g/dl. An ECG taken two weeks before (Fig. 1) showed sinus rhythm with a heart rate of 83, QT interval 0.40 seconds, positive U waves in leads VI and V2, and negative U waves in leads V5 and V6. The prolongation of repolarization in the limb leads represents the combination of T and U waves. An ECG taken immediately after the successful resuscitation (Fig. 2) revealed a sinus rhythm with a heart rate of 110 and alternans of the T-U waves without any change in the QRS complex. Arterial blood gas analysis on that day showed PaO₂ 98.2 torr, paCO₂ 25.2 torr, and a pH 7.518 on room air. ECG taken 4 days later (Fig. 3) revealed sinus rhythm with a heart rate of 94. In the precordial leads, end-diastolic premature ventricular complexes were noted almost every fourth beat forming ventricular quadrigeminy. The T-U wave of the first sinus beat was markedly less prominent compared to the successive two sinus beats which showed marked prolongation and inverted T-U waves. An ECG taken two days later showed sinus rhythm with a heart rate of 92. The Q-U intervals were markedly prolonged but no T-U alternans was present. Since that tracing the patient's ECGs have essentially been the same and no alternans was evident.
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The serum potassium level two days after the cardiac arrest decreased to 3.1 mEq/l. Electrolyte imbalance and respiratory alkalosis continued thereafter inspite of the therapy. He died 18 days later as a result of pneumonia and sepsis.

Discussion

Electrical alternans of the T-U wave with no change in the QRS complex is reported to be rare (1–6). There are three types of alternans of T and U waves: T waves alone, U waves alone and a combination of T-U waves (1–6). The present case showed the rare combination type of alternans.

The pathogenetic conditions observed in such patients are reported to be: (a) renal failure with hypocalcemia (1, 2), (b) acute/chronic alcoholism with hypomagnesemia (3), (c) hypokalemia with or without hypochloremic alkalosis (4, 5) and (d) the long QT syndrome (6). Although most of these patients have severe organic
heart diseases with heart failure, some had only reversible functional disorder without organic heart disease (4, 5). The present case had no underlying heart disease before chemotherapy for acute myelocytic leukemia, and showed only marginal multiple serum electrolytes abnormalities on the day before he had the syncopal attack. Among the four drugs used for his chemotherapy, daunomycin and aclarubicin chloride are known to produce myocardial toxicity (7, 8). However, on the days that the ECGs revealed T-U alternans waves, the serum electrolytes showed multiple abnormalities. We postulate that the causative factors for alternans of T-U waves, include (a) myocardial damage from those two anticancer drugs, and (b) multiple electrolyte imbalance. This is the first report suggesting that certain anticancer drugs may cause alternans of T-U waves without a change in QRS configuration.

To our knowledge this is the first demonstration of normalization of a markedly negative T-U wave in every fourth beat as seen in Fig. 3. Three possibilities can be considered; (a) post extrasystolic T-U changes, (b) three to one electrical change of the T-U wave, and (c) a combination.

References