

Ventricular Fibrillation Associated With Dynamic Changes in J-Point Elevation in a Patient With Silent Thyroiditis

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A J wave is a common electrocardiographic finding in the general population. Individuals with prominent J waves in multiple electrocardiogram (ECG) leads have a higher risk of lethal arrhythmias than those with low-amplitude J waves. There are few reports about the relationship between thyroid function and J-wave amplitude. We report the case of a 45-year-old man who had unexpected ventricular fibrillation (VF). He had dynamic J-point elevation in multiple ECG leads. Possible early repolarization syndrome was diagnosed. He also had thyrotoxicosis caused by silent thyroiditis, and his J-wave amplitude decreased according to changes in thyroid function because of spontaneous remission of silent thyroiditis. There was a positive correlation between serum triiodothyronine levels and J-wave amplitudes. The findings in case suggested silent thyroiditis may contribute to the occurrence of VF in a patient with dynamic changes in J-point elevation in multiple ECG leads. Thyrotoxicosis is a relatively common endocrine disease; therefore, clinicians should pay attention to J-wave amplitude in the ECG of patients with thyrotoxicosis.

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1. Case Report

A 45-year-old man had visited his local hospital because of paroxysmal atrial fibrillation that had started 9 years earlier. He had been taking 80 mg of verapamil and 100 mg of pilsicainide each day. His electrocardiogram (ECG) showed J-point elevation in multiple leads (II, aVF, I, aVL, V3-V6) during outpatient visits [Fig. 1(A)]. His thyroid function had been within the normal range. His mother and his brother also had J-point elevation in multiple ECG leads.

The patient was found in cardiopulmonary arrest by his wife in the early morning. Basic life support was performed immediately. An automated external defibrillator detected ventricular fibrillation (VF), and a defibrillation shock was delivered by ambulance attendants. He was transported to Kanazawa University Hospital. On arrival, his Glasgow Coma Scale score was 6 (E1V1M4); physical examination revealed a blood pressure of 125/68 mm Hg, heart rate

Abbreviations: BS, Brugada syndrome; ECG, electrocardiogram; ERS, early repolarization syndrome; FT3, free triiodothyronine; FT4, free thyroxine; JWS, J-wave syndromes; TSH, thyroid-stimulating hormone VF, ventricular fibrillation.

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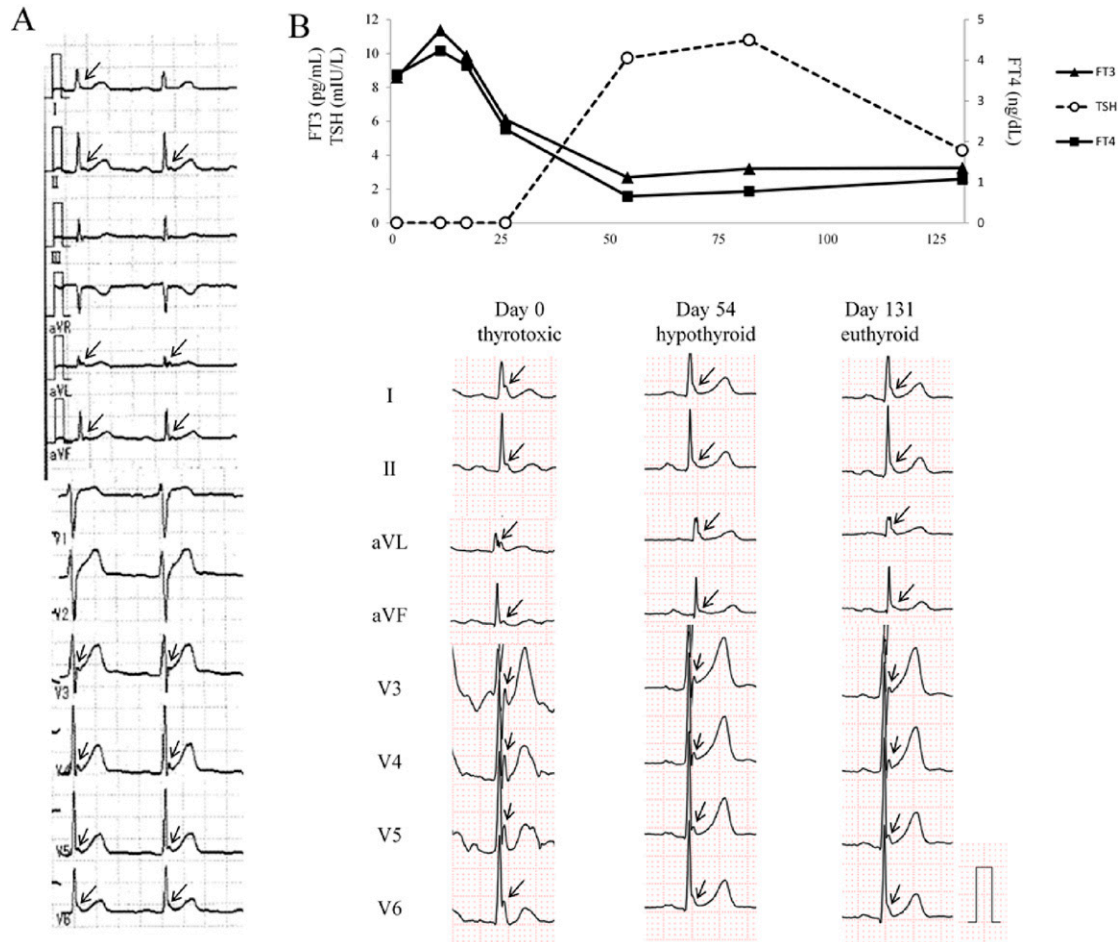


Figure 1. Electrocardiography. (A) Twelve-lead electrocardiogram recorded in the local hospital. (B) Dynamic J-wave changes associated with thyroid function. Arrow points to J wave.

of 108 beats/minute, and body temperature of 36.3°C. He had no obvious thyroid swelling or exophthalmos. Laboratory data, including complete blood cell counts, and cardiac enzyme, renal function, and electrolyte levels were also within normal limits. The patient's C-reactive protein level was 0.6 mg/dL. A thyroid function test showed the following levels: free triiodothyronine (FT3), 8.6 (range, 2.3 to 4.0) pg/mL; free thyroxine (FT4), 3.7 (1.0 to 1.8) ng/dL; thyroid-stimulating hormone (TSH), <0.01 (0.27 to 4.20) mIU/L; TSH receptor antibody, 0.6 (<2) IU/L; thyroglobulin, 2.0 (3.5 to 77) ng/mL; TSH-stimulating receptor antibody, 105% (<120%); thyroperoxidase antibody, 354 (<16.0) IU/mL; and thyroglobulin antibody, 575 (<28.0) IU/mL. His serum thyroid hormone levels indicated thyrotoxicosis. Thyroid ultrasonography and Tc-99m scintigraphy were performed and showed results compatible with silent thyroiditis.

The clinical course of his thyroid function and ECG are shown in [Fig. 1(B)]. Compared with the 12-lead ECG recorded in the outpatient clinic, his ECG on day 11 after admission showed increased J-point elevation (>0.1 mV) in multiple leads (II, aVF, I, aVL, V2-V6). According to the Proposed Shanghai Score System for diagnosis of early repolarization syndrome (ERS), he had 4.5 points in total and was possible ERS was diagnosed [1]. Echocardiography and coronary angiography showed no unusual findings. A sodium-channel blocker infusion test did not result in the typical ECG pattern of Brugada syndrome (BS), and the test attenuated J-point elevation in the inferolateral leads.

The patient was not treated with any antithyroid agents, thyroid hormone replacement, or β -blockers. He underwent cardioverter defibrillator implantation on day 11 and was

discharged on day 33. On day 54, FT3 and FT4 levels had changed to hypothyroid status (FT3, 2.69 pg/mL; FT4, 0.66 ng/dL; TSH, 9.73 mIU/L). J-point elevation in the ECG was decreased compared with his ECG after admission. On day 131, his serum thyroid hormone levels had returned to almost normal (FT3, 3.25 pg/mL; FT4, 1.08 ng/dL; TSH, 4.29 mIU/L), and there was no change in J-point elevation in the ECG between day 54 and day 131.

There were also correlations between FT3 levels and the J-wave amplitudes in the lateral leads [Fig. 2(A)], but there were not important correlations in the inferior leads [Fig. 2(B)]. The J-wave amplitudes were measured by a previously reported method [2].

In the outpatient clinic, interrogation of the implanted cardioverter defibrillator showed no lethal arrhythmic events.

2. Discussion

We report the case of a 45-year-old man with possible ERS who had an episode of unexplained VF and dynamic changes in J-point elevation in multiple ECG leads. Silent thyroiditis also was diagnosed, and there was a correlation between thyroid hormone levels and J-wave amplitudes.

A J-wave, which is a positive deflection immediately following the QRS complex of the surface ECG or is, in part, buried inside the QRS as notching or slurring, is often found in the general population [1]. J waves are associated with the occurrence of lethal arrhythmic events in patients with BS, ischemic heart disease, hypertrophic cardiomyopathy, and long-QT syndrome [1, 3]. J-wave syndromes (JWS) are a spectrum of ECG manifestations of prominent J waves with a risk of VF. JWS consist of ERS and BS. This patient's condition could be diagnosed as possible ERS by the Proposed Shanghai Score System and was classified as type 3 ERS based on the early repolarization (ER) in multiple ECG leads. Nam *et al.* [4] emphasized there is high risk of sudden death in type 3 ERS compared with BS.

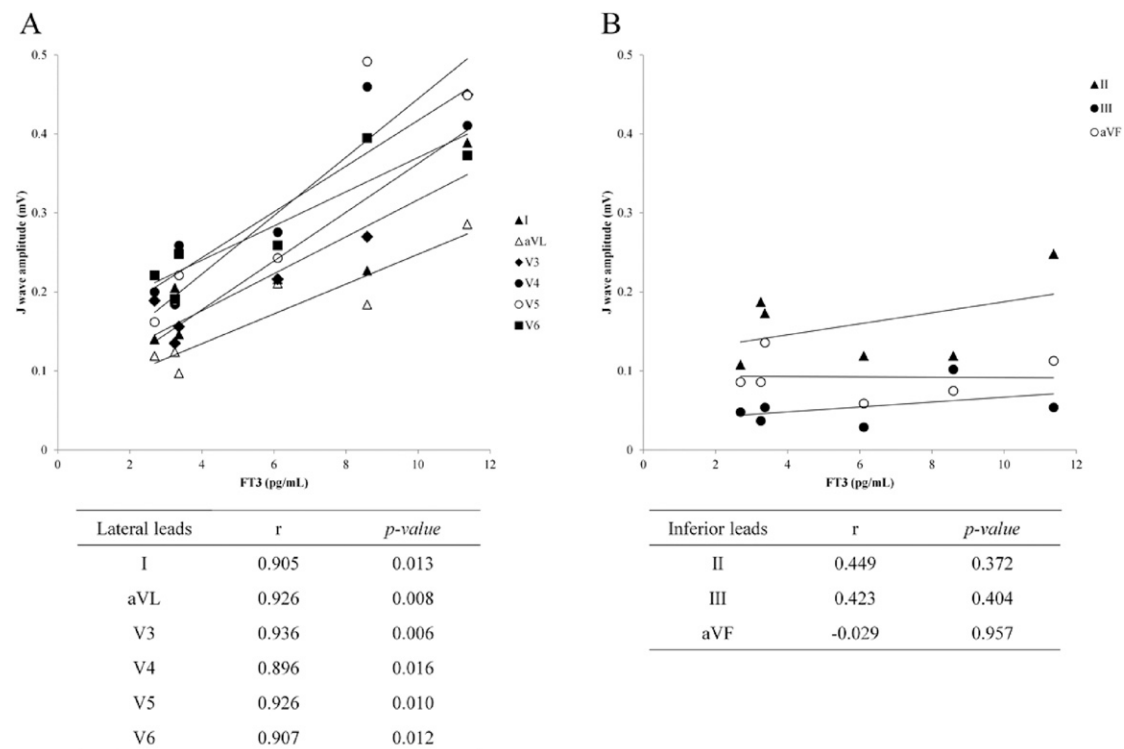


Figure 2. Correlation between free triiodothyronine levels and the amplitudes of J waves in the (A) lateral leads and (B) inferior leads.

Individuals with prominent J waves in multiple leads have a higher risk of lethal arrhythmias than those with low-amplitude J waves [1]. In this patient, thyrotoxicosis was thought to cause the increased J-wave amplitude and the occurrence of VF.

Thyroid hormone has an important effect on cardiac muscle, particularly via the sympathetic nervous system [5]. Cardiac tissue contains β 1- and β 2-adrenergic receptor subtypes. β -blockers and parasympathetic stimulation augment the elevation of J-point and ST segment; β -stimulators and sympathetic stimulation cause them to decline [6]. Hyperthyroid status leads to an increased sensitivity of the sympathoadrenal system with more β -adrenergic receptors, stimulatory guanine nucleotide-regulatory protein, and Gs proteins, so hyperthyroid status is considered to cause the decline of the J point. However, in the patient reported here, J-wave amplitudes were enhanced when the high thyroid hormone levels were increased.

There are two mechanisms thought to enhance J-wave amplitudes in this patient. First, the transient outward current is influenced by triiodothyronine. Thyrotoxicosis increases the expression of *KCND3*, the gene that encodes the α subunit ($K_{v4.3}$) of the transient outward current (I_{to}) channel. Accentuation of I_{to} may cause an ER pattern in the ECG characterized by J-point elevation [7]. Second, the J wave was observed in circadian variations [8]. The J-wave amplitude increased at night and early morning and decreased during the day in patients with JWS by changing vagal activity. VF occurred at early morning; parasympathetic stimulation might trigger enhanced J-wave amplitude. The change of J-wave amplitude is regulated by sympathetic and parasympathetic stimulation; therefore, the factors causing elevated J wave might have been dominant, as a result, in this patient.

Furthermore, Vestergaard *et al.* [9] investigated thyroid histological images in 25 cases with an unknown cause of death and diagnosed silent thyroiditis in three cases. They might suggest silent thyroiditis is considered as a differential diagnosis of cardiac arrhythmias.

Although the relationship between thyroid function abnormalities and J-point elevation was closely related, we have to consider other possibilities. The patient had been receiving verapamil before the event and the drug was stopped after the event. ER pattern was induced by adding the I_{to} agonist and the calcium channel blocker [10]. Thus, verapamil may play a role in the development of augmented J-point elevation in the thyrotoxic phase. Alternatively, the elevation of the J point after the event may have been due to the event itself and not the hyperthyroidism, and the decrease in the J-point elevation over time may be a resolution of the acute ischemia caused by the VF as well as the discontinuation of the verapamil. The other known triggers might have influenced the elevation of J-wave amplitudes; additional investigation is needed.

In summary, the present case suggested that silent thyroiditis may contribute to the occurrence of VF in a patient with dynamic J-point elevation in multiple ECG leads. His clinical course showed that there was a close relationship between thyroid function and J-wave amplitude. A J wave is a common electrocardiographic finding. Physicians should pay attention to J-wave amplitude of the ECG in patients with thyrotoxicosis, which is clinically important because of the risk of life-threatening arrhythmias.

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