CASE REPORT

T-wave inversions on ECG as primary manifestation of Hashimoto's disease

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SUMMARY

A middle-aged Hispanic woman presented to the emergency department (ED) reporting of acute new onset pressure-like chest pain developed at rest. It was radiated to the right arm and associated with malaise. Initial ECG demonstrated T-wave inversions (TWIs) in all anterior and lateral leads. Electrolytes, serial cardiac troponin and D-dimer were all normal. Comprehensive transthoracic echocardiogram and nuclear stress test did not reveal a cardiac cause of her symptoms.

Serum thyroid-stimulating hormone was markedly elevated (207 mIU/L) and free thyroxine was low (FT4 0.07 ng/dL), consistent with severe primary hypothyroidism. Thyroperoxidase (TPO) antibodies were positive. Therapy with levothyroxine was started. No other cause of the TWIs was identified. A repeat ECG obtained 8 weeks later showed partial resolution of the TWIs. Our observations indicate that Hashimoto's disease is the most likely primary cause of this patient's extensive and profound TWI, which improved after thyroid replacement therapy.

acute cardiac ischaemia based on an ECG significant for deep TWIs across the anterior and lateral leads. The patient was found to have severe hypothyroidism as the culprit of the electrical disturbances on the ECG.

CASE PRESENTATION

A 42-year-old woman without significant medical history presented to the emergency department (ED), with chest pain. She had been awakened early that morning due to retrosternal chest pain. It was pressure-like and constant, and radiated down her right arm, preventing her from returning to sleep. She had felt tired throughout the day. She was not able to complete her usual daily activities and ultimately was unable to walk due to persistent pain. She denied shortness of breath, dizziness or diaphoresis. She had taken ibuprofen 200 mg without relief. Owing to her persistent symptoms, she presented to the ED for further evaluation.

The patient was originally from Mexico. She reported no allergies and no prior surgeries; she was on no active medications. There was history of neither smoking, nor alcohol intake, nor recreational drug use. Family history was positive for diabetes mellitus in her mother and two sisters. A sister was recently diagnosed with hyperthyroidism. Her mother had had a myocardial infarction (MI) at the age of 70 years. The patient had six children, the youngest delivered 18 months prior to presentation. Her last menstrual period was 1 month before. Review of systems was unremarkable.

On admission, the patient was haemodynamically stable with no signs of respiratory distress.

BACKGROUND

Signs of hypothyroidism on ECG include sinus bradycardia, T-wave inversions (TWIs), QTc prolongation and ventricular arrhythmias. Hypothyroidism can affect the cardiovascular system physiology and structure. These changes are often reflected on ECG. There is a broad differential diagnosis for widespread TWIs, including many cardiac and extracardiac conditions.

We describe a case of a middle-aged woman who presented with symptoms strongly suggestive of

Figure 1 ECG at admission showing TWI on the anterior and lateral leads with borderline sinus bradycardia. TWI, T-wave inversions.

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Table 1 Thyroid function tests

	Ref range	Admission	Eight weeks follow-up
TSH	0.465–4.680 mIU/L	207.000 (H)	32.600 (H)
Free T4	0.70–2.19 ng/dL	0.07 (L)	0.77
Antithyroglobulin peroxidase	0–99 unit(s)/mL		1886 (H)

TSH, thyroid-stimulating hormone.

Her weight was 89 kg (body mass index 34.1). Her skin was warm and slightly puffy. There was no thyromegaly. Cardiopulmonary examination was unremarkable. Her upper extremity deep tendon reflexes showed a delay in her biceps relaxation phase.

INVESTIGATIONS

In the ED, an ECG was obtained and showed a borderline sinus bradycardia and TWIs in all of the anterolateral leads ([figure 1](#)). Initial differential diagnosis included acute coronary syndrome (ACS) and pulmonary embolism (PE). Troponin and D-dimer levels were not elevated. A point-of-care echocardiogram suggested neither systolic failure, nor right ventricular dilation, nor effusion and chest X-ray was normal. The patient received treatment with aspirin, statins and low-molecular-weight heparin (LMWH).

The patient was admitted to the general ward for further evaluation. Repeated ECGs after admission continued to show diffuse TWIs, with normal QTc. Troponin remained negative on serial testing after 24 h. Serum chemistries and renal function were all normal. After admission, the patient required one dose of sublingual nitroglycerin for worsening chest pain. Thyroid function testing showed markedly elevated serum TSH and low FT4 ([table 1](#)), consistent with severe primary hypothyroidism. Treatment with levothyroxine 125 mcg orally daily was started.

As part of the in-patient work up, comprehensive transthoracic echocardiogram (TTE) was unremarkable and a nuclear stress test showed no evidence of ischaemia and no scarring. In the absence of evidence of coronary artery disease, LMWH, aspirin and statin were discontinued. The latter particularly due to concerns of additive risk of myopathy in the setting of hypothyroidism.

OUTCOME AND FOLLOW-UP

Our patient had an uneventful hospital course. She was discharged home on the third day of hospital stay with follow-up

8 weeks later. Treatment adherence was confirmed. Her chest pain improved after discharge. Subsequent thyroid testing showed marked improvement of her thyroid function. She remained asymptomatic. Serum thyroperoxidase (TPO) antibodies were markedly elevated, consistent with Hashimoto's disease ([table 1](#)). Repeat ECG showed partial resolution of the TWIs ([figure 2](#)).

DISCUSSION

Hashimoto's disease is the most common cause of acquired hypothyroidism in iodine sufficient areas. It is characterised by gradual autoimmune destruction of the thyroid gland. Presence of high serum concentrations of anti-TPO and thyroglobulin (Tg) antibodies are sufficient evidence to support the diagnosis. Owing to a gradual loss of thyroid function, patients are diagnosed with either subclinical or overt hypothyroidism.

The heart is a major target organ for thyroid hormone action and marked changes can occur in cardiac function.^{1 2} Prolonged hypothyroidism can produce changes in cardiac gene expression. These changes ultimately lead to increased systemic vascular resistance (SVR), and reduced contractility and cardiac output;³ increased cardiac oxidative stress;⁴ and mucopolysaccharide accumulation, which can result in myocardial interstitial fibrosis.¹

It has been demonstrated that conventional TTE is not sensitive enough to detect early deterioration in myocardial function.⁵ Nonetheless, hypothyroidism can manifest on the ECG as sinus bradycardia, low QRS voltages and ST-T wave abnormalities such as T-wave flattening or inversion.⁶ Studies have shown changes in QTc in patients with hypothyroidism,^{6–8} including severe prolongation leading to 'Torsades de Pointes' and sudden cardiac death.^{9–11}

TWIs associated with hypothyroidism are typically shallow, and it is unusual to find deep TWIs (>0.2 mV) in the absence of other ECG features.¹² Marked anterior TWIs are usually seen only in the context of significant QTc prolongation.^{9 10} Conversely, a normal QTc seems to be associated with mild, less extensive TWIs.^{6 8 13} Our patient's case was notable for her widespread and deep TWIs in the absence of other ECG signs of hypothyroidism, except for a mild sinus bradycardia.

Anterior TWIs can have a variety of aetiologies.¹⁴ Commonly, ACS produces anterior TWIs during the subacute or re-perfusing period of an acute anterior wall MI. Anterior TWIs may also be seen during the acute phase of a posterior MI. A pulmonary embolism may manifest on the ECG as TWIs across the precordium. Takotsubo's cardiomyopathy simulating an

Figure 2 Eight weeks on T4 replacement. Observe partial resolution of TWI. TWI, T-wave inversions.

anterior wall MI can produce the same changes. The TWIs seen in arrhythmogenic right ventricular dysplasia (ARVD) may be difficult to distinguish from those seen with the 'persistent juvenile' T-wave pattern.¹⁵

It is unlikely that our patient had one of these causes of TWIs. Troponin testing and cardiac nuclear imaging test did not support ACS. D-dimer testing was negative, weighing against PE. TTE did not suggest pulmonary hypertension. ARVD was unlikely, as she had no delayed upstroke in V1 or V2, no epsilon waves (a small positive deflection buried in the end of the QRS complex on ECG) and no RV abnormalities on echocardiogram, all features that are typical of ARVD.

This patient presented with fairly typical symptoms of ACS. In this context, her symptom of weakness was initially suspected to be secondary to myocardial ischaemia. Her fatigue, chest pain and the ECG changes resolved after thyroxine replacement, lending support to the hypothesis that hypothyroidism can cause chest pain and marked TWIs. We found another case report of a patient who presented with severe hypothyroidism and typical ACS symptoms, with ECG showing widespread, albeit shallow, TWIs. This other patient also had a negative troponin level and normal echocardiogram.¹³

Learning points

- Diagnosis and treatment of patients with chest pain and ECG changes in cardiac disease might include analysis of thyroid hormone status.
- Hypothyroidism should be considered as a possible primary cause of T-wave inversions and chest pain.
- T4 replacement can improve cardiovascular symptoms and T-wave changes on ECG in cases of primary hypothyroidism.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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