CASE REPORT

V1–V2–V3–V4 T wave inversion: left or right ventricle?

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SUMMARY

An 84-year-old woman, affected by Alzheimer's disease, presented to the emergency department with intense dyspnoea. Since ECG was showing T wave inversion in anterior leads and troponin-T was high, the patient was admitted to our unit with a diagnosis of anterior non-ST elevation myocardial infarction. However, the patient's medical history and a further review of the ECG led us to suspect a pulmonary embolism (PE) as a possible differential clinical diagnosis. We tested this alternative hypothesis: echocardiography as well as contrast-enhanced CT scan confirmed the diagnosis of PE. We describe these misleading ECG findings together with a brief discussion of electrocardiographical changes in pulmonary embolism.

BACKGROUND

ECG represents the first instrumental examination in patients admitted to the emergency department (ED) because of dyspnoea. Pulmonary embolism (PE) is a relatively common and life-threatening condition. A clinically oriented interpretation of ECG findings is necessary for the differential diagnosis of left versus right ventricle diseases.

CASE PRESENTATION

An 84-year-old woman, affected by Alzheimer's disease, was brought to the ED by her caregiver, who referred that the patient had been suffering from intense dyspnoea for the past 2 days. The patient was dependent in the activities of daily living and had a history of total gastrectomy for gastric neoplasm in 2003. Her drug therapy included pantoprazole, furosemide, amitriptyline and ursodesoxycholic acid. At admission, her blood pressure was 130/80 mm Hg, pulse rate was 107 bpm oxygen saturation (SatO₂) was 88%.

Figure 1 The 12-lead ECG of the patient showing T wave inversion in leads V1, V2 and V3.

INVESTIGATIONS

The result of a 12-lead ECG is shown in figure 1.

Question: What are these ECG alterations suggestive of? Do they suggest an electric disturbance of the left or of the right ventricle?

In ED, high-sensitivity T troponin was elevated (0.212 ng/mL; n.v. <0.014 ng/mL). This finding, in association with clinical symptoms (acute dyspnoea in a patient with Alzheimer's disease) and ECG abnormalities, led to a diagnosis of an anterior NSTEMI and to the admittance of the patient to our Internal Medicine Division.

In our unit the patient was confirmed to have low SatO₂ (SatO₂ 85–88%), with hypoxia and hypocapnia at blood gas analysis, in the absence of clinical or radiological evidence at the chest X-ray of a pulmonary oedema. Further clinical details collected from the caregiver, showed a history of deep venous thrombosis (DVT).

DIFFERENTIAL DIAGNOSIS

The only *subjective* symptom of this old female patient was dyspnoea. However, this is not specific for acute coronary syndrome (ACS). All these data drew our attention to the hypothesis of PE in a bedridden patient not receiving anticoagulant prophylaxis. A cardiac ultrasound showed a left ventricle with normal global and regional kinetic, a dilated and hypokinetic right ventricle, a tricuspid insufficiency and pulmonary hypertension. Based on these findings, a contrast enhanced chest CT scan, which confirmed the diagnosis of PE, was performed (figures 2 and 3).

A lower extremity Doppler ultrasonography was performed showing a thrombosis of the right superficial and common femoral veins.

Figures 2 Contrast-enhanced chest CT scan showing contrast filling defect, with embolus localised in the distal tract of the right pulmonary artery.

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Figure 3 Contrast-enhanced chest CT scan showing contrast filling defect, with embolus localised in the distal tract of the right pulmonary artery.

TREATMENT

Anticoagulant treatment was started, and a 12-lead ECG confirmed previous findings (figure 4).

OUTCOME AND FOLLOW-UP

The patient was discharged with anticoagulant prescription. A 12-lead ECG after 3 months of anticoagulant treatment shows the normalisation of T wave inversion (figure 5).

DISCUSSION

These ECG show T wave inversion in leads DIII, V1, V2, V3 and V4. Differential diagnosis for these findings includes myocardial ischaemia/infarction of the anterior left ventricle region, or a right ventricle overload. In ED, a diagnosis of acute coronary syndrome (ACS) was formulated. However, in elderly patients, particularly when cognitive impairment is present, presentation of the disease could be atypical.

This ECG may be due to ischaemia, especially when associated to chest pain or to dyspnoea caused by pulmonary oedema. However, in the absence of pulmonary oedema, the association of dyspnoea with the above ECG abnormalities may recognise a different aetiology and thus deserves careful evaluation. Moreover, the absolute normality of the T wave in V5 and V6 and the transition aspect in V4 would not suggest an ACS but do not exclude PE.

A variety of ECG changes have been described in patients with suspected PE. The typical pattern of *acute cor pulmonale*, firstly described by McGinn and White in 1935, is the S1Q3T3

Figure 4 The 12-leads ECG of the patient, showing T wave inversion in leads DIII, V1, V2, V3 and V4.

Figure 5 The 12-leads ECG of the patient, showing regression of T wave inversion in leads DIII, V1, V2, V3 and V4 after 3 months of anticoagulant treatment.

pattern, but this is classically found only in individuals with massive PE.¹ Additional ECG changes which may be associated with PE include atrial arrhythmias, right bundle branch block, inferior Q waves, precordial T wave inversion, and ST segment changes.^{2,3} These findings are also associated with poor prognosis.^{2,3} Our patient presented with T wave inversions in DIII, V1, V2, V3 and V4 leads, and elevated troponin T. According to Ferrari and coworkers, these findings may correlate with severe right ventricular dysfunction.²

The collection of clinical history, together with a clinically oriented interpretation of ECG, chest X-ray and instrumental examinations, may help to orientate the diagnosis and to explore alternative hypotheses.⁴

Learning points

- ▶ ECG represents the first instrumental examination in patients admitted to the emergency department with dyspnoea.
- ▶ T wave inversion, along with increased levels of high sensitivity-T troponin, does not represent a specific ECG finding, being not specific for left ventricle ischaemia and may be also found in patients with pulmonary embolism and right ventricle overload.
- ▶ Clinical history collection and a clinically oriented interpretation of instrumental examinations are mandatory to orientate the diagnosis.

Contributors AM, LS, RP and RL took part in the diagnostic process. All authors participated in the revision and writing of the paper.

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