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ECG for Students and Associated Professionals

Q wave and ST segment elevation in inferior leads: What is the diagnosis?

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1. Case presentation

A 78-year-old obese woman consulted our cardiology department immediately after open cholecystectomy because of substernal and epigastric pain radiating to the back, accompanied by nausea and vomiting.

She had acute cholecystitis that was operated on urgently, 3 h before her new substernal and epigastric pain appeared. She also had diabetes mellitus and hypertension. Her drug history included losartan, hydrochlorothiazide, metformin, and atorvastatin.

A 12-lead ECG revealed negative P wave and Q and ST segment elevation in leads II, III, and aVF, and ST depression in leads V4–V6 (Fig. 1). The repeated ECG showed the same abnormalities. Emergent bed side echocardiography showed an ejection fraction of 40%, mild diastolic dysfunction, inferior and posterior wall hypokinesia, and mild mitral regurgitation. Her hemodynamics was stable. Cardiac and lung examinations produced unremarkable results.

Because of her clinical state; the Q and ST segment elevation in leads II, III, and aVF; and hypokinesia of posterior and inferior walls in echocardiography, the patient was planned for emergent coronary angiography. She was transferred to the catheterization laboratory and underwent coronary angiography, which showed no significant coronary artery disease.

2. Commentary

According to the sinoatrial node position (right upper part of the right atrium) and the propagation of the electrical impulse in the atriums during the normal sinus rhythm, the P wave will be positive in leads I, II, V5, and V6, and will be negative in lead aVR [1]. However, owing to the possibility of other nonsinus rhythms, presence of situs abnormalities, and presence of atrial abnormalities, the use of P wave morphology alone can be difficult for detecting lead misplacement.

Evaluating the orientation of the vectors in each lead in standard 12-lead ECG can offer a guide for this purpose. As shown in Fig. 2, when the limb and precordial leads are placed in their standard location, the aVR and V5 or V6 leads are in the same alignment but have deflections in the opposite polarity; thus, these leads are in a reciprocal relation to each other.

In the first ECG taken from our patient, the abnormal P wave axis (negative in lead I and inferior and positive in aVR) is a good clue to lead misplacement. The polarity of the P wave and the QRS polarity should be different in aVR and V6. This is not what we saw in this ECG, and this confirms the misplacement of the leads.

However, what was the mistake? In this ECG, we could easily exclude displacement of the ground cable (right leg electrode). Swapping this electrode with one of the arm electrodes will result in a flat line in the bipolar electrogram recorded from the electrodes attached to both legs. This is not what we saw in our ECG.

As the positive pole for augmented leads is the exploring electrode, in this ECG the augmented lead that can be the true aVR lead is the aVF, which has a negative P and QRS, reciprocal to

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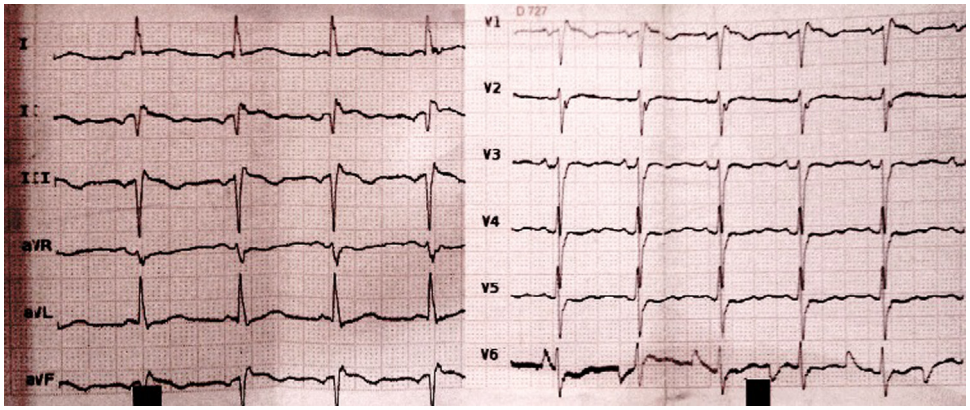

Fig. 1. The initial ECG negative P wave and Q and ST segment elevation in leads II, III, and aVF, and ST depression in leads V4–V6.

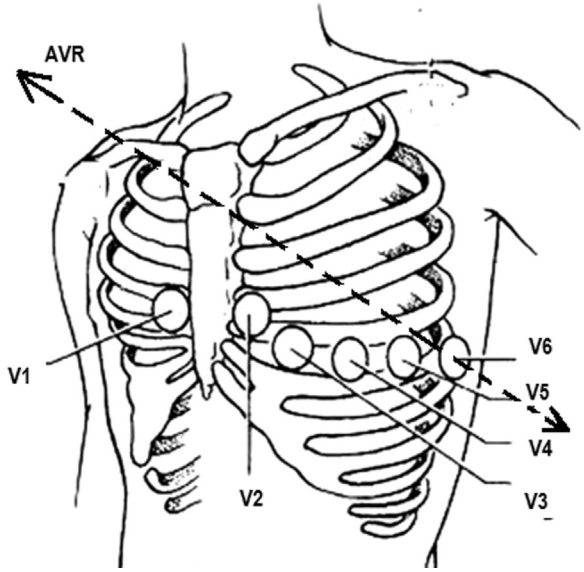

Fig. 2. aVR and V6 relation. These two leads are in the same alignment but in different polarity.

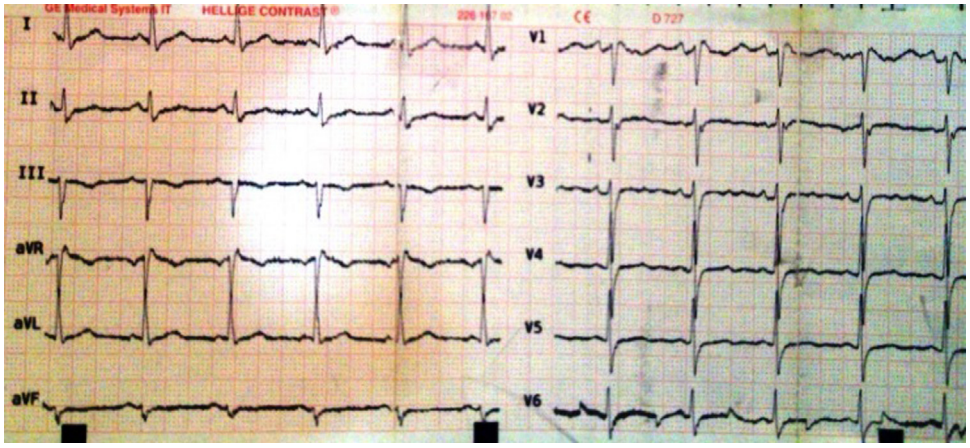

Fig. 3. ECG after the correction of the misplaced right hand and left leg electrodes. The repeated ECG revealed no significant Q and ST segment elevation in the inferior leads.

V6 [2]. This means that the left leg lead was connected to the right arm. This is possible if the left leg lead is switched with the right arm lead (more probable), or there is a clockwise rotation error.

After coronary angiography, we reviewed our ECG again. Because of some abnormal P waves in leads II, III, and aVF, we ordered a repeat ECG; during the ECG, we observed that the right hand and left leg leads were connected inversely. The leads were connected to their standard locations on the extremities, and the repeated ECG revealed no significant Q and ST segment elevation in the inferior leads (Fig. 3).

This case emphasizes the importance of misplacement of ECG leads on the clinical impression. Misplacement of right arm with

left leg is a rare event that could mimic Q wave myocardial infarction in inferior leads [3]. Misplacement of ECG leads has been reported to mimic a variety of false abnormalities, including Q wave myocardial infarction, low voltage (indicative of pericardial effusion), and ST elevation [4,5].

Conflict of interest

None of the authors have any conflicts of interest that should be disclosed.

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