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Is it possible to differentiate between Takotsubo cardiomyopathy and acute anterior ST-elevation myocardial infarction?

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Abstract

Introduction: Several studies have investigated the ability of the twelve-lead electrocardiogram (ECG) to reliably distinguish Takotsubo cardiomyopathy (TC) from an acute anterior ST-segment elevation myocardial infarction (STEMI). In these studies, only ECG changes were required – ST-segment deviation and/or T-wave inversion – in TC whereas in acute anterior STEMI, ECGs had to meet STEMI criteria. In the majority of these studies, patients of both genders were used even though TC predominantly occurs in women. The aim of this study is to see whether TC can be distinguished from acute anterior STEMI in a predominantly female study population where all patients meet STEMI-criteria.

Methods: Retrospective analysis of the ST-segment changes was done on the triage ECGs of 37 patients with TC (34 female) and was compared to the triage ECGs of 103 female patients with acute anterior STEMI. The latter group was divided into the following subgroups: 46 patients with proximal, 47 with mid and 10 with distal LAD occlusion. Three ST-segment based ECG features were investigated: (1) Existing criterion for differentiating anterior STEMI from TC: ST-segment depression >0.5 mm in lead aVR + ST-segment elevation ≤ 1 mm in lead V1, (2) frontal plane ST-vector and (3) mean amplitude of ST-segment deviation in each lead.

Results: The existing ECG criterion was less accurate (76%) than in the original study (95%), with a large difference in sensitivity (26% vs. 91%). Only a frontal plane ST-vector of 60° could significantly distinguish TC from all acute anterior STEMI subgroups ($p < 0.01$) with an overall diagnostic accuracy of 81%. The mean amplitude in inferior leads II and aVF was significantly higher for patients with TC compared to all patients with acute anterior STEMI ($p < 0.01$ and $p < 0.05$ respectively) and the mean amplitude in the precordial leads V1 and V2 was significantly lower compared to proximal and mid LAD occlusion ($p < 0.01$).

Conclusions: Given the consequences of missing the diagnosis of an acute anterior STEMI the diagnostic accuracy of the ECG criteria investigated in this retrospective study were insufficient to reliably distinguish patients with TC from patients with an acute anterior STEMI. To definitely exclude the diagnosis of an acute anterior STEMI coronary angiography, which remains the gold standard, will need to be performed.

Keywords: Acute coronary syndrome; Takotsubo cardiomyopathy; Acute anterior myocardial infarction

Introduction

In 1–3% of patients suspected of an acute myocardial infarction the diagnosis of Takotsubo cardiomyopathy (TC) is made [1]. It is a clinical syndrome characterized by

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transient left ventricular wall motion abnormalities most often involving the apical and mid ventricular region, is frequently associated with emotional or physical stress and approximately 90% of these cases are seen in postmenopausal women [1]. The most widely used criteria to diagnose TC are the Mayo Clinic Criteria [2]: (1) transient hypokinesis, akinesis, or dyskinesis of the left ventricular mid segments with or without apical involvement. The regional wall motion abnormalities extend beyond a single epicardial vascular distribution. A stressful trigger is often, but not always present; (2) absence of obstructive coronary disease or angiographic evidence of acute plaque rupture; (3) new ECG abnormalities – either ST-segment deviation and/or T-wave inversion – and/or elevated cardiac troponin; (4) absence of pheochromocytoma or myocarditis.

Both the symptoms and the electrocardiographic changes seen in TC mimic those of an acute anterior ST-elevation myocardial infarction (STEMI), making it difficult to accurately diagnose TC. In the acute setting the twelve-lead electrocardiogram (ECG) is easily accessible and widely used. It would be useful if this diagnostic tool could be used to recognize TC and separate it from acute anterior STEMI; firstly because the treatment for patients with TC is supportive [1,3]. Secondly, no cardiac catheterization would have to be performed as these patients have normal coronary arteries. Finally these patients have complete normalization of the left ventricular function [1], whereas this is not the case in patients with an acute anterior STEMI. Several studies [4–8] have investigated the ability of the twelve-lead ECG to differentiate between TC and acute anterior STEMI and the most accurate finding was: ST-segment depression >0.5 mm in lead aVR and ST-segment elevation of ≤1 mm in lead V1 [6]. In these studies only ECG changes – ST-segment deviation and/or T-wave inversion – were required on the ECGs of patients diagnosed with TC, whereas the ECGs of patients diagnosed with an acute anterior STEMI ECGs had to meet STEMI-criteria. It is important to know whether the ECG has the ability to distinguish TC from acute anterior STEMI if TC ECGs also meet STEMI criteria. Also, in the majority of these studies [4–7], patients of both genders were included, even though TC predominantly occurs in women. This led to a vast majority of female patients in the TC group and a vast majority of male patients in the anterior STEMI groups. In this retrospective study we investigated whether TC could be distinguished from acute anterior STEMI in a predominantly female study population where all ECGs met STEMI-criteria.

Methods

Thirty-seven patients with TC and 103 patients with acute anterior STEMI were retrospectively enrolled in this study from three hospitals (Copenhagen University Hospital, Denmark, TweeSteden Hospital, Tilburg, the Netherlands and St. Elisabeth Hospital, Tilburg, the Netherlands) during the period of September 2006 until February 2014.

The inclusion criteria for patients with TC were: (1) admission ECG meets STEMI criteria — new ST-segment elevation at the J-point in at least two contiguous leads of ≥2 mm (0.2 mV) in men or ≥1.5 mm (0.15 mV) in women in leads V2–V3 and/or ≥1 mm (0.1 mV) in other contiguous chest or limb leads [9]. (2) Absence of left/right bundle branch block (L/RBBB), pacemaker rhythm, ventricular tachycardia (VT), ventricular fibrillation (VF) and/or ≥2nd grade AV-block on admission ECG. (3) No angiographic evidence of a significant coronary occlusion or acute plaque rupture, defined as ≥70%. (4) Typical apical ballooning – akinesis, hypokinesis or dyskinesis of the apical and mid left ventricular wall regions – seen on left ventriculography performed during the initial coronary angiography (CAG) and/or on echocardiography performed ≤48 hours after initial presentation. (5) Absence of myocarditis and pheochromocytoma, only when these conditions seemed likely additional testing was performed. (6) No persisting wall motion abnormalities during follow-up on echocardiography, performed ≤6 months after discharge.

The inclusion criteria for patients with an acute anterior STEMI were: (1) Female. (2) Admission ECG meets STEMI criteria. (3) Absence of L/RBBB, pacemaker rhythm, VT, VF and/or ≥2nd grade AV-block on admission ECG. (4) No history of previous acute myocardial infarction and/or heart surgery. (5) No cardiac arrest. (6) Culprit lesion in the left anterior descending (LAD) coronary artery for which acute percutaneous coronary intervention (PCI) was performed. Not including occlusion of only side branches (first diagonal branch (D1) and/or second diagonal branch (D2)). (7) One-vessel disease of the LAD coronary artery. The patients with an acute anterior STEMI were divided into three subgroups: (1) Proximal LAD occlusion; proximal to D1 (segment 6). (2) Mid LAD occlusion; distal to D1 and proximal to D2 (segment 7). (3) Distal LAD occlusion; distal to D2 (segment 8) (Fig. 1).

A standard twelve-lead electrocardiogram (25 mm/s, 10 mm/mV) was obtained in all patients on whom the decision was based to perform acute coronary angiography (triage ECG). The triage ECGs were either recorded by paramedics in the pre-hospital setting or at the time of hospital admission. The TP-segment was used as baseline. If it was not possible to define the TP-segment, the PR-segment was used. The amount of ST-segment deviation (depression/elevation) was measured at J-point, according to the current AHA-guidelines [10], to the nearest 0.5 mm (1 mm = 0.1 mV) in all twelve leads using handheld calipers. Using these measurements the following electrocardiographic assessments were made: (1) Existing criterion: ST-segment depression >0.5 mm in lead aVR + ST-segment elevation ≤1 mm in lead V1 [6]. (2) Frontal plane ST-vector; represents the direction and magnitude of the ST-segment deviation [11] and can be used to determine the specific occlusion site [12] – proximal LAD: approximately −90° (Fig. 2), mid LAD: no frontal plane ST-vector (Fig. 3), distal LAD: approximately 90° (Fig. 4), Takotsubo cardiomyopathy: expected at +60° (Fig. 5). The method used to determine the frontal plane ST-vector was to (a) find the lead with an isoelectric ST segment or the lead with the least amount of ST-segment deviation, (b) find the lead perpendicular to the isoelectric lead, (c) determine whether the