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A 66-Year-Old Woman with Intermittent Chest Pain and Dyspnea Who Underwent Continued ST-Segment Monitoring to Identify Occult ST-Segment Elevation that Expedited Coronary Angiography and Revascularization

Authors' Contribution:

Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Conflict of interest: None declared

Patient: Female, 66-year-old
Final Diagnosis: Coronary artery disease
Symptoms: Chest discomfort
Medication: —
Clinical Procedure: Coronary angiography • percutaneous coronary intervention
Specialty: Cardiology

Objective: Challenging differential diagnosis

Background: In patients admitted to the hospital owing to suspected acute coronary syndrome and where the first electrocardiogram (ECG) is non-diagnostic of ST-elevated myocardial infarction (STEMI), international guidelines recommend that sequential ECGs are performed to identify new or intermittent ST-deviations. Continued monitoring for ST-segment alterations is rarely performed, in contrast to the continued monitoring for arrhythmias. Continued monitoring for ST-segment alteration may detect intermittent ST-segment elevations not captured by routine 12-lead ECGs. We present a case in which continued ST-segment monitoring revealed intermittent ST-segment elevations and led to expedited coronary angiography and revascularization.

Case Report: A 66-year-old woman was admitted to a regional hospital in Denmark with intermittent retrosternal chest pain and dyspnea. Her risk profile included a family history of cardiovascular disease, hypercholesterolemia, active smoking, and obesity. The results of 3 sets of high-sensitivity cardiac troponins and sequential 12-lead ECG measurements were normal. Because of clinical suspicion of unstable angina, the patient remained admitted. Continued rhythm and ST-segment monitoring was initiated. During continued ST-segment monitoring, asymptomatic intermittent ST-elevations in the inferior leads were detected. The patient was referred for an acute coronary angiography at the nearest cardiac center. Coronary catheterization showed right coronary artery stenosis, and complete revascularization was obtained by percutaneous coronary intervention with stent implantation.

Conclusions: Continued ST-segment monitoring can detect intermittent ST-segment elevations and thereby substantiate the need for acute coronary angiography.

Keywords: Acute Coronary Syndrome • Angina Pectoris • Electrocardiography • Myocardial Ischemia

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Background

A key symptom of acute coronary syndrome (ACS) is acute chest discomfort, which typically is described by the patient as pain, pressure, tightness, or burning [1]. Together with the patient's medical history, an electrocardiogram (ECG) is one of the cornerstones in the diagnostic workup of acute coronary syndrome (ACS). ST-segment elevation myocardial infarction (STEMI), in contrast to non-ST-segment elevation ACS (NSTEMI-ACS), is defined by persistent ST-segment elevations in the ECG. NSTEMI-ACS is categorized as unstable angina in the absence of increased troponin levels, or as non-ST-segment elevation myocardial infarction (NSTEMI).

When the first ECG in a patient suspected for acute coronary syndrome is without ST-segment elevations, it is recommended to either perform sequential conventional 12-lead ECGs or to continuously monitor the ST-segment to identify new or intermittent ST-elevations [1,2]. Continuous ST-segment monitoring is not routinely used in patients admitted with symptoms suggestive of NSTEMI-ACS, in contrast to the continuous monitoring for arrhythmias.

Case Report

A 66-year-old woman was admitted to the hospital because of retrosternal chest pain. Her cardiovascular family

history included a father with an unspecified heart condition. Modifiable cardiovascular risk factors included obesity (body mass index of 38.5 kg/m²), active smoking since the age of 10 years (50 pack-years), and untreated hypercholesterolemia. Her medical history included universal muscle and joint pain. She self-administered tablets of paracetamol, ibuprofen, oxycodone, and oxazepam. The extent to which the patient took non-aspirin non-steroidal anti-inflammatory drugs in the weeks leading up to her hospital admission was unclear.

The patient had several instances of dyspnea and chest pain during the previous 6 weeks, typically lasting 2 to 5 min, with a maximum of 10 min, and often in relation to physical activity and at night-time. She characterized the chest pain as a pressing and squeezing sensation with radiation to the right arm and the center of the neck, which was typically accompanied with dyspnea. The pain and dyspnea disappeared when the patient was at rest. Her general practitioner had prescribed a proton-pump inhibitor without effect, and after a couple of weeks, the pain had become more frequent and sometimes appeared at rest. Her general practitioner admitted her to the hospital on the suspicion of ACS. Upon admission, she had a slight pressing pain which soon spontaneously resolved.

A physical examination upon admission was normal, apart from a muffled sound on the right side of the chest. A chest X-ray showed no pathology. The initial conventional 12-lead ECG showed a sinus rhythm of 80 beats per min, without signs

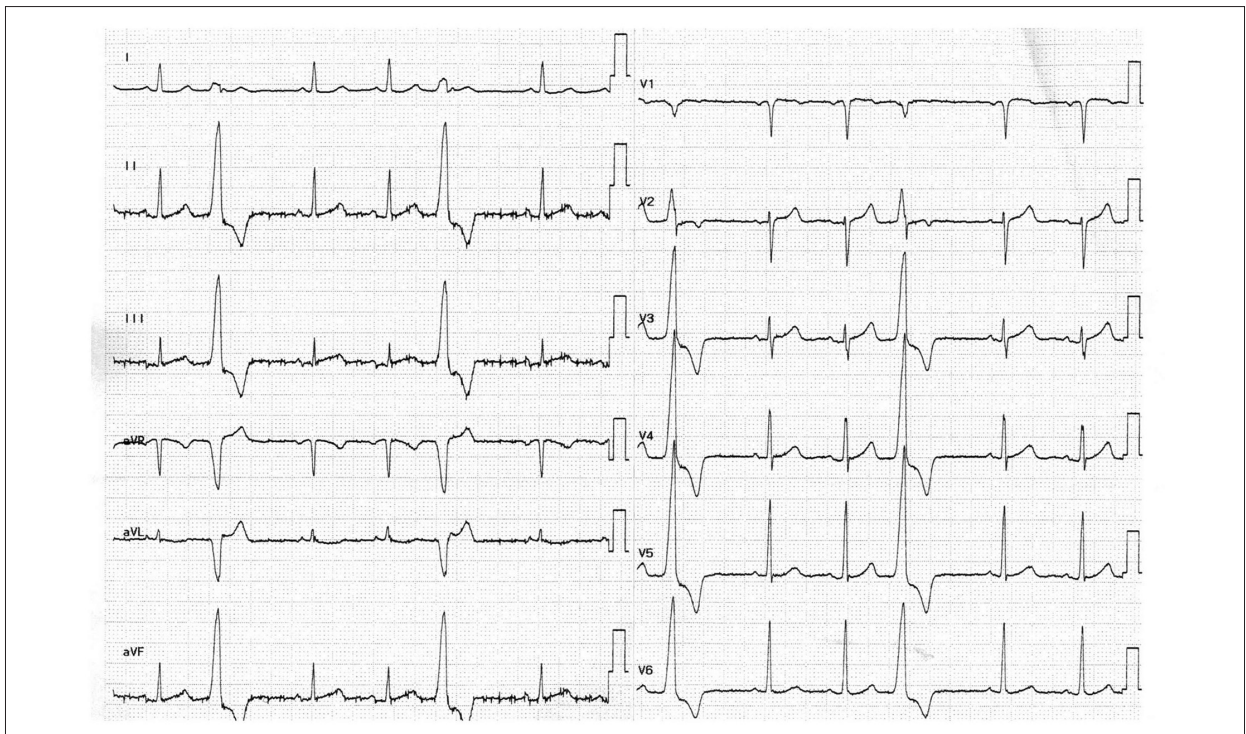


Figure 1. Initial 12-lead electrocardiogram.

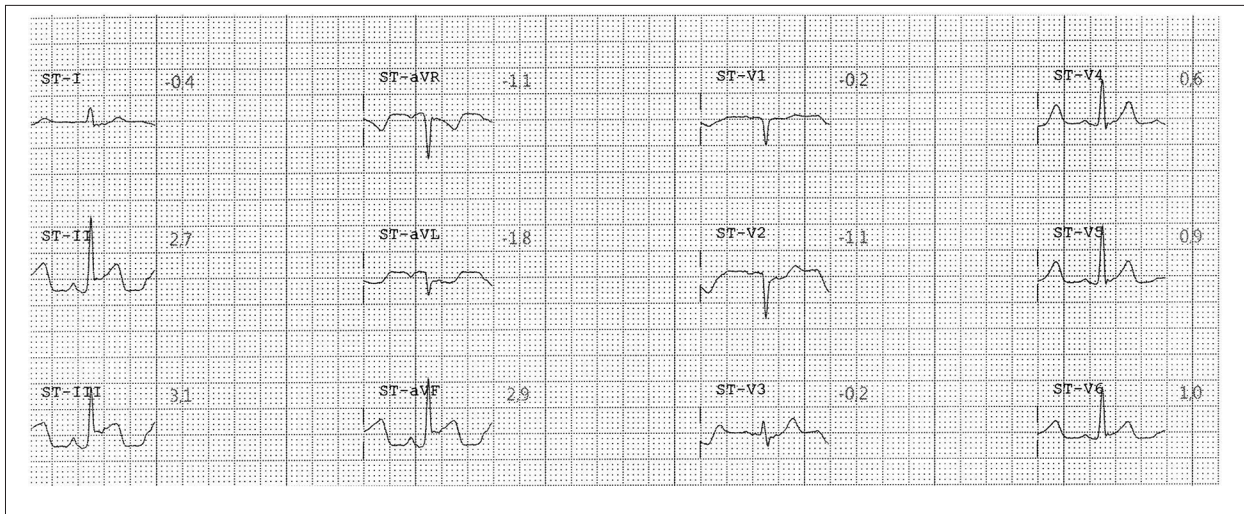


Figure 2. Derived 12-lead electrocardiogram from continued ST-segment Monitoring in patient with occult inferior ST-segment elevation.

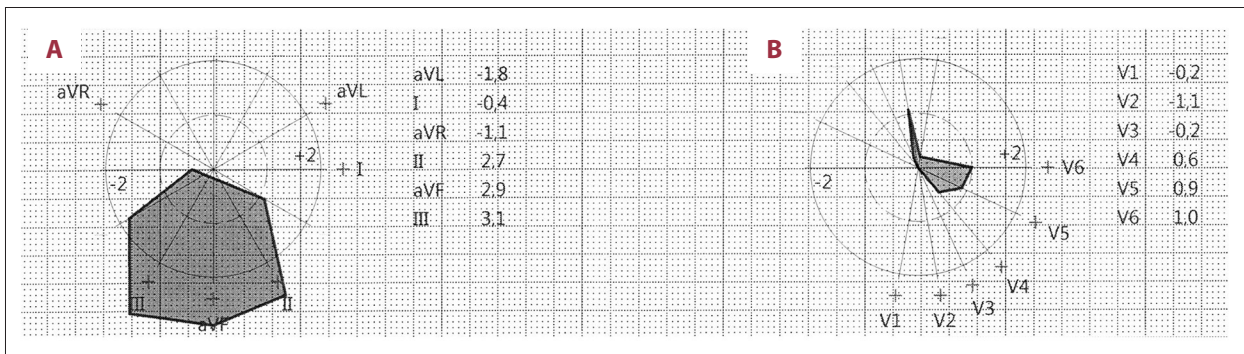


Figure 3. ST-segment map from continued ST-segment monitoring in a patient with occult inferior ST-segment elevation. Two multi-axis graphs representing derived 12-lead electrocardiogram with limb leads in panel (A) and chest leads in panel (B). The radius of the circle is the ST value at the J point. ST values are connected to create the shaded area (ST-segment map).

of ischemia (Figure 1). A normal echocardiographic examination was performed. Laboratory blood examination showed hypercholesterolemia with total P-cholesterol of 6.8 mmol/L and low-density lipoprotein of 4.1 mmol/L. At admission, the high-sensitivity cardiac troponin I level was normal (99 percentile <24 ng/L) at 14 ng/L, and was 12 ng/L after 3 h. The creatine kinase MB (CK-MB) level (reference value <4 µg/l) was stable but elevated at 7.6 µg/L and 7.3 µg/L, respectively.

As the conventional ECG showed no signs of ischemia, and high-sensitivity cardiac troponin I levels were also normal, the treating physician had no strong clinical suspicion of ACS. An ambulatory follow-up with coronary computed tomography (CT) angiography was therefore planned, to rule out underlying chronic coronary artery disease. The patient remained admitted over night for rhythm and continuous ST-segment monitoring with a 5-electrode vector-based ECG, EASI system (Philips IntelliVue central monitoring system information center ix, Andover, MA, USA). For continued monitoring of the

ST-segment, the ST index was used. The ST index is the sum of the absolute value of the ST-segment in leads V2, V5, and aVF.

The patient had no discomfort, chest pain, or dyspnea during the continuous ST-segment monitoring. However, between the time of admission at 3: 00 p.m. and 7: 00 a.m. the following day, 10 spikes on the ST index were observed. At 7: 00 a.m., 1 additional set of cardiac markers, troponin I and CK-MB, remained unchanged to the first 2 sets. Between 7: 00 a.m. and noon, an additional 8 spikes were observed. On the derived 12-lead ECG, there were ST-elevations in leads II, III, and aVF and ST depression in leads V2 and V3 (Figures 2, 3). The patient was therefore referred for an acute coronary angiography on the indication of STEMI. After immediate transfer to the nearest cardiac center, coronary catheterization was performed and showed a significant stenosis on the second segments of the right coronary artery. Stent implantation and revascularization were performed (Figure 4). The patient was discharged the following day without any symptoms.

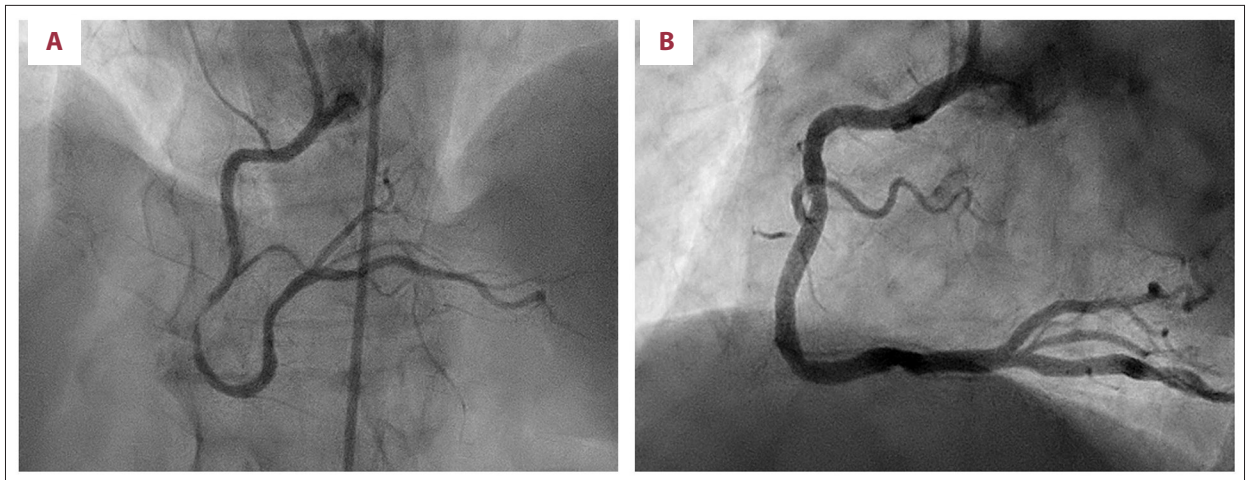


Figure 4. Coronary angiography before and after percutaneous coronary intervention. Coronary angiography showing a stenosis of the second segment of the right coronary artery in panel (A) and the results after percutaneous coronary intervention in panel (B).

After discharge, the patient participated in a rehabilitation program but declined the offered smoking cessation guidance. After completion of the rehabilitation program, she reported no chest pain or dyspnea. Today, 3 years later, she has no symptoms.

Discussion

The rhythm and continuous ST-segment monitoring system used was an EASI system. The EASI system is a 5-electrode vector-based system from which a 12-lead ECG can be generated [3]. The EASI system's ECG has been compared to a conventional 12-lead ECG and found to be equal in diagnosing arrhythmia and ST-segment changes in patients with chest pain or ACS [4-6]. The ST index has been developed by Philips Medical Systems (Andover, MA, USA) to give a single value for continued monitoring of the ST-segments and for detecting ST-segment dynamics. The leads are chosen as they represent different areas of the heart: anterior (V2), lateral (V5) and inferior (aVF).

For patients presenting with suspected STEMI, the guidelines of the European Society of Cardiology stress the need for repeated conventional 12-lead ECG or monitoring of the ST-segment to capture intermittent ST-elevations [2]. Continuous ST-segment monitoring is not mentioned in the guidelines of the American College of Cardiology for the management of STEMI or in international guidelines for NSTEMI-ACS [1,7,8]. Recognizing the development of ST-segment elevations in patients suspected

of NSTEMI-ACS is important, as the degree of myocardial infarction may be reduced by an acute percutaneous coronary intervention [1]. Continuous ST-segment monitoring may therefore be considered in all patients admitted under the suspicion for ACS and continued until the suspicion is dropped or the patient has received a coronary angiography.

Retrospectively, the current patient may also have had an element of vasospastic angina. Vasospastic angina is due to coronary artery spasm and characterized by episodes of angina at rest that typically respond well to short-acting nitrates [9]. Management of vasospastic angina includes smoking cessation and vasodilators. Supporting the suspicion of vasospastic angina, the patient fulfilled some of the Coronary Artery Vasospastic Disorders Summit diagnostic criteria for vasospastic angina: angina at night-time and transient ischemic ECG changes, as seen on the continuous ST-segment monitoring [9]. However, this patient's primary symptoms were chest pain and dyspnea during physical activity, and significant coronary artery disease was detected and treated as the result of continuous ST-segment monitoring.

Conclusions

Continued ST-segment monitoring aids in identifying intermittent ST-segment elevations in patients admitted on the suspicion for ACS and thereby aids in identifying the need of an acute coronary angiography.

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