

Hyperacute T waves in inferior leads as a dynamic sign of evolving STEMI

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Akutní infarkt myokardu s elevacemi úseku ST
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SOUHRN

Úvod: Elektrokardiogram (EKG) je běžně používaným nástrojem v diagnostice akutního infarktu myokardu. Mezi EKG známky akutní ischemie myokardu mohou jako nejčasnější a jediná EKG známka infarktu myokardu s elevacemi úseku ST (STEMI) patřit vysoké a široké vlny T, označované rovněž jako hyperakutní vlny T.

Cíl: Zdůraznit význam časného rozpoznání hyperakutních vln T jako ekvivalentu STEMI s cílem zabránit dalšímu poškození myokardu odpovídající léčbou.

Kazuistika: Na oddělení urgentního příjmu byla pro bolest na hrudi dopravena 65letá žena. Vyšetření EKG prokázalo přítomnost vysokých a širokých T vln ve spodních svodech, inverzi T vlny ve svodech D₁-aVL a depresi úseku ST ve svodech V₄-V₅-V₆. Bolest na hrudi téměř úplně vymizela po podání kyseliny acetylsalicylové, ticagreloru a sublingválním užití nitroglycerinu; zároveň došlo k vymizení vysokých vln T a zmírnění deprese úseku ST ve svodech V₄-V₅-V₆. Přibližně o 15 minut později došlo u pacientky k recidivě bolesti na hrudi s následnou těžkou hypotenzí a sinusovou bradykardií. Emergentní koronarografické vyšetření prokázalo kompletní trombotický uzávěr středního segmentu pravé koronární tepny (RCA). Byla provedena balonková angioplastika s umístěním lékového stentu v postižené tepně.

Závěr: Hyperakutní vysoké a široké symetrické vlny T jsou přechodné, a nejsou tedy častým jevem, mohou však představovat první EKG důkaz úplného uzávěru koronární tepny a transmuralní ischemie. Časné rozpoznání tohoto tvaru EKG křivky je naprosto nezbytné pro stanovení diagnózy a optimální léčbu pacientů se STEMI, založenou na okamžité reperfuzi primární angioplastikou.

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ABSTRACT

Introduction: Electrocardiogram is a commonly used tool in the diagnosis of acute myocardial infarction. Among ECG signs of acute cardiac ischemia, tall and broad-based T waves, called hyperacute T waves, may be the earliest and the only ECG sign of ST-elevation myocardial infarction (STEMI).

Objective: To underline the importance of early recognition hyperacute T waves as one STEMI equivalent in order to prevent further damage to the myocardium by appropriate treatment.

Case report: A 65-year-old female was admitted to the emergency department for chest pain. An electrocardiogram revealed the presence of tall and broad-based T waves in inferior leads, T-waves inversion in D₁-aVL and ST-segment depression in V₄-V₅-V₆. Aspirin, ticagrelor, and sublingual nitroglycerin almost fully resolved the patient's chest pain which coincided with the resolution of the tall T waves and improvement of ST-segment depression in V₄-V₅-V₆. Approximately 15 min later, the patient experienced recrudescence of chest pain followed by severe hypotension and sinus bradycardia. Emergent coronary angiography disclosed a complete thrombotic occlusion in the mid-right coronary artery (RCA). Balloon angioplasty and placement of a drug-eluting stent in RCA was performed.

Conclusion: Hyperacute tall and broad-based symmetric T waves are transient and thus uncommonly seen, but they can be the very first ECG evidence of total coronary occlusion and transmural ischemia. Early recognition of this ECG pattern is crucial to ensure diagnosis and optimal treatment of patients with STEMI, which consist in immediate reperfusion by primary angioplasty.

Introduction

According to ECG presentation, acute coronary syndromes are classified as STEMI (i.e. ST-segment elevation acute myocardial infarction) and NSTEMI (i.e. non-ST-segment elevation acute myocardial infarction).¹ Whereas ST-segment elevation (STE) is an indication for immediate coronary reperfusion, in NSTEMI a tailored invasive approach is recommended.² Transient tall, broad-based and symmetric T waves have been occasionally described immediately before the occurrence of anterior STEMI.^{3,4} We report herein the case of a patient with acute complete thrombotic occlusion in the mid-right coronary artery (RCA) and atypical ECG finding of transient hyperacute T waves in inferior leads.

Case report

A 65-year-old female was admitted to the emergency department (ED) for chest pain. An ECG recorded two

months before admission was normal (Fig. 1). Upon arrival to the ED, her vital signs were within normal limits. Cardiac and lung fields auscultation revealed normal heart and breath sounds. An ECG showed the presence of tall, broad-based, and symmetric T waves associated with T waves inversion in D1–aVL and down-sloping ST-segment depression in leads V4–V5–V6 (Fig. 2). A transthoracic echocardiogram obtained immediately in the ED indicated overall preserved left ventricular systolic function (ejection fraction, 62%).

Based on the clinical data collected, the patient was initially diagnosed with suspected NSTEMI and treated with aspirin, ticagrelor, and nitrates with subsequent complete resolution of symptoms. A new ECG showed normalization of the tall T waves and improvement of ST-segment depression in V4–V5–V6 (Fig. 3). Approximately 15 min later, the patient experienced recrudescence of chest pain and hemodynamic instability with severe hypotension and sinus bradycardia resolved by atropine and saline solution infusion. The



Fig. 1 – ECG obtained 2 months before admission showing normal sinus rhythm without ST segment or T wave abnormality.

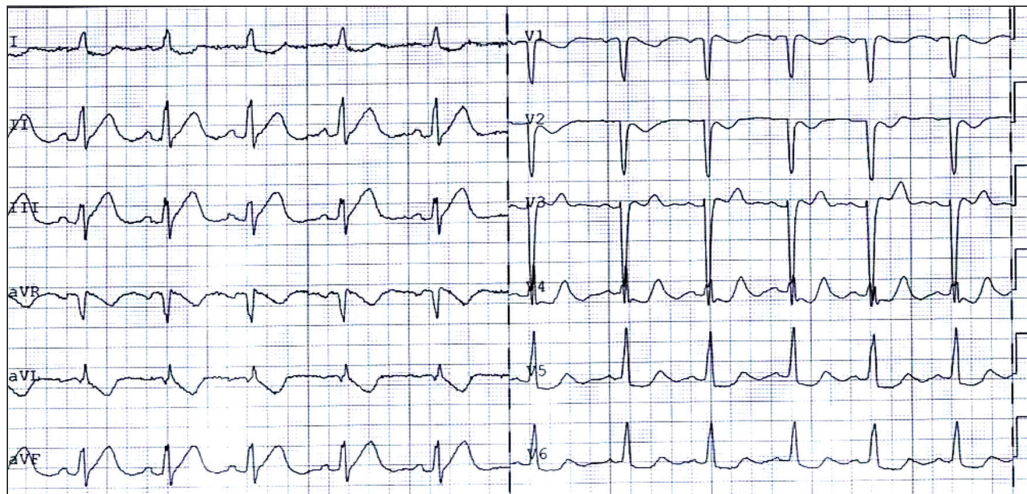


Fig. 2 – ECG at presentation. Note the presence of tall and broad-based T waves in inferior leads, T-waves inversion in D1–aVL and ST-segment depression in V4–V5–V6.

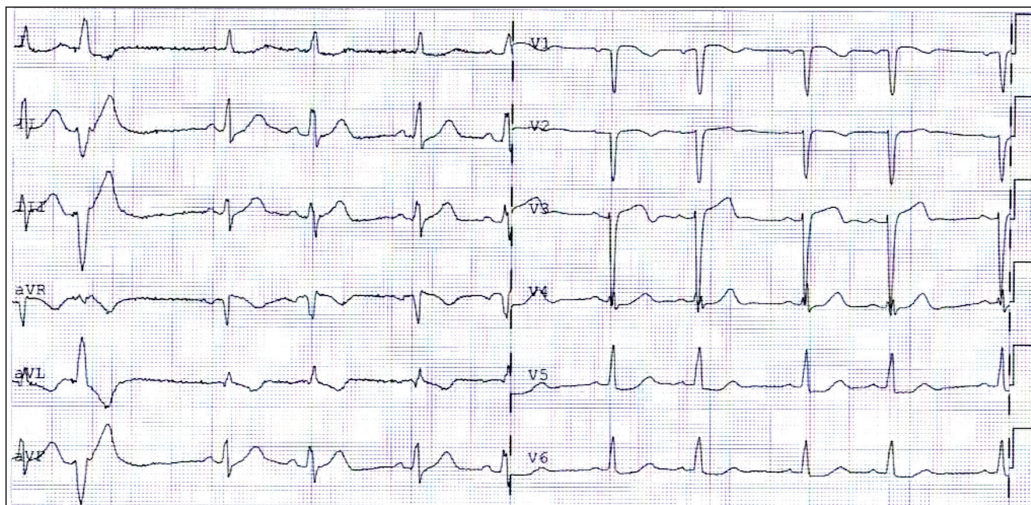


Fig. 3 – ECG after medical treatment showing resolution of the tall T waves and improvement of ST-segment depression in V4–V5–V6.

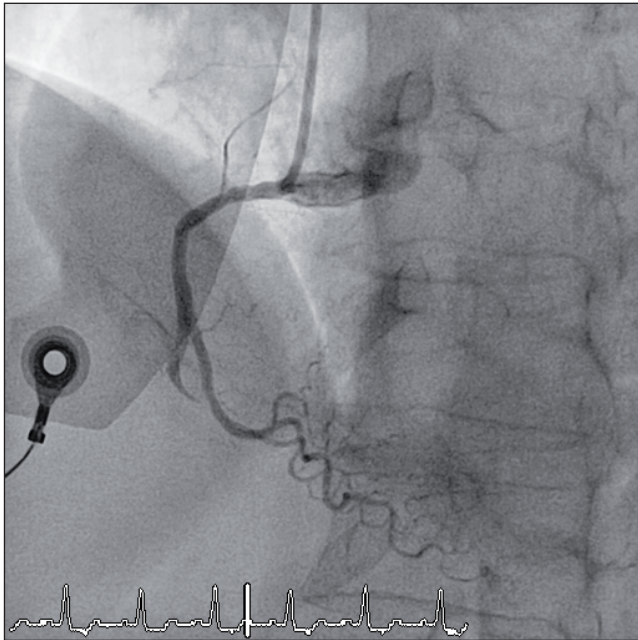


Fig. 4 – Coronary angiography showing a complete thrombotic occlusion in the mid-right coronary artery.

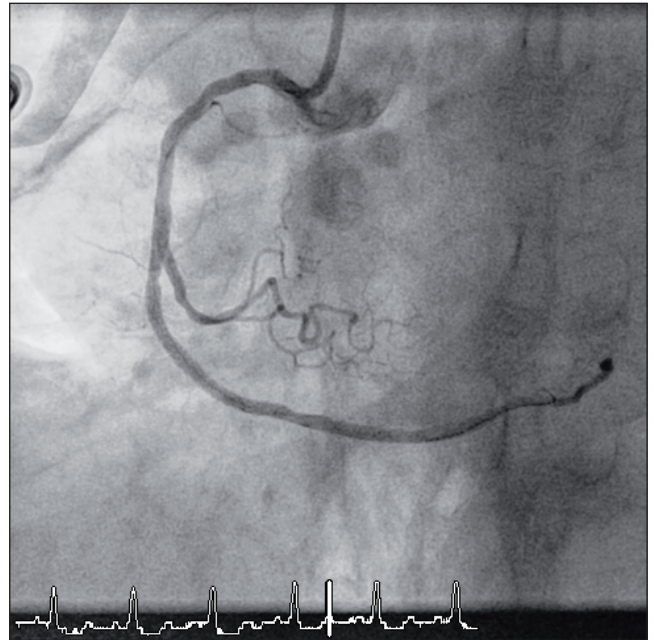


Fig. 5 – Coronary angiography showing RCA after successful coronary angioplasty and stenting.

patient was sent to the cardiac catheterization laboratory for urgent coronary angiography. She was found to have a complete thrombotic occlusion in the mid-RCA, treated by aspiration and conventional balloon angioplasty and drug eluting stent implantation (Figs. 4 and 5). After percutaneous coronary intervention, ECG showed only non-specific ST segment-T wave abnormalities (Fig. 6). The echocardiographic images obtained post-revascularization confirmed normal left ventricular systolic function with only mid-to-distal hypokinesia of the inferior wall, probably related with stunned myocardium. The rest of patient's hospital stay was uneventful.

Discussion

Patients presenting to the ED with chest pain are evaluated by taking patient's history, examination, serial ECGs and repeated assessment of hemodynamic status. Numerous important clinical decisions rely on the emergency physician's and cardiologist's ability to interpret the ECG which immediately impacts on management decisions.⁵ STE is a marker of transmural ischemia secondary to acute coronary artery occlusion with an indication for immediate coronary reperfusion. Unfortunately, a significant number of patients with acute myocardial infarction, do not show STE on the ECG.^{6,7} Other ECG abnormalities may

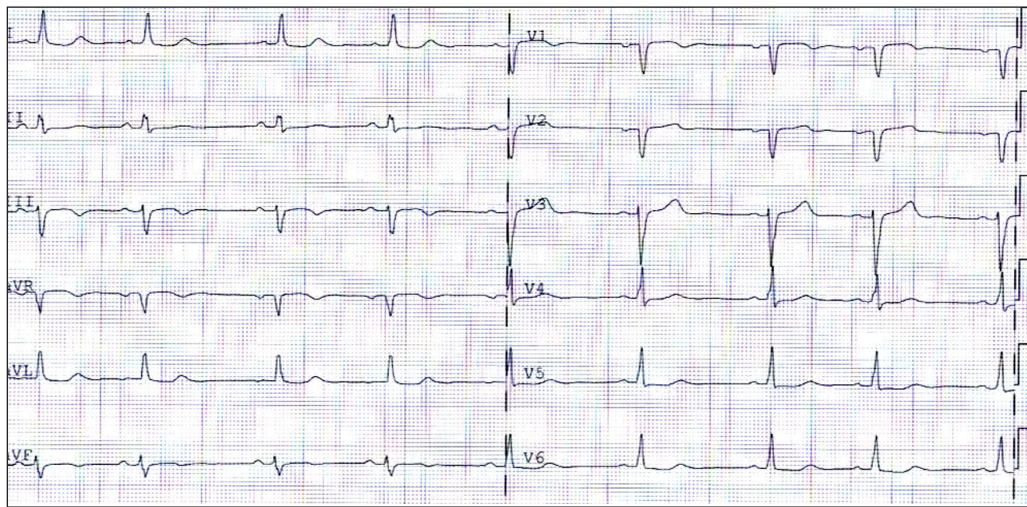


Fig. 6 – ECG after percutaneous coronary intervention showing only non-specific ST segment-T wave abnormalities.

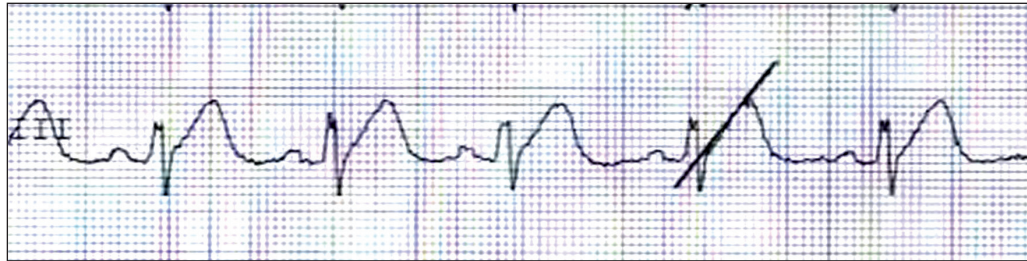


Fig. 7 – The ST/T falls directly on an ideal line marked from J point (where the QRS ends and the ST segment begins) and the apex of the ST-segment/T-wave complex (non-concave morphology).

be associated with occlusion of an epicardial coronary artery, the so-called STEMI-equivalents. Hyperacute T waves in >2 contiguous leads, amplitude >0.50 mV and 1.0 mV in the limb and precordial leads, respectively,⁸ are transient and thus uncommonly seen, but they can be the very first ECG evidence of total coronary occlusion and transmural ischemia. This ECG pattern, often associated with reciprocal ST segment depression in other electrocardiographic leads, typically evolves quickly into a classic STEMI pattern and must be considered as a dynamic sign of evolving STEMI. In our patient case, the dynamic ECG sequence of transient tall, broad-based T waves, amplitude >0.50 mV in inferior leads and reciprocal T waves inversion in D1–aVL, associated with right clinical context (chest pain followed by hemodynamic instability), was key to the diagnosis of a critical, acute ischemic occlusive coronary lesion (STEMI vs NSTEMI). The patient's initial clinical and ECG responses to antianginal and antiplatelet therapy in the ED suggest dynamic changes in blood flow secondary to a sequence of events: acute thrombosis, transient recanalization, complete re-occlusion of the affected coronary artery, and may explain the absence of STE progression and the preserved left ventricular systolic function shown by the echocardiogram. As an alternative, the presence of collateral circulation or a balanced coronary circulation, confirmed by coronary angiography, may have modulated

myocytes action potential changes in response to ischemia and preserved epicardial electrical activity thus preventing the occurrence of ST-segment elevation.⁹ Genzlinger et al. suggest analyzing the morphology, concave or non-concave, of the ST segment in order to distinguish between ischemic and benign forms of T-wave changes such as early repolarization.¹⁰ In our patient's case, the ST/T segment falls directly on an ideal line marked from J point and the apex of the ST-segment/T-wave complex (Fig. 7). This non-concave morphology, in the right clinical setting, is 97% specific for identifying STE morphology in AMI. Lastly, while hyperacute T waves pattern in anterior precordial leads have often been described,^{11,12} to our knowledge a so impressive high amplitude dynamic T-waves pattern in all inferior leads, related with thrombotic acute occlusion in the RCA, is not so frequently reported and therefore it is important for the emergency physicians and cardiologists to recognize this high-risk ECG marker of STEMI.

Conclusion

Our patient's case underscores the importance of hyperacute T waves in inferior leads as an electrocardiographic sign of early acute coronary syndromes. The emergency physicians and cardiologists ability to interpret this very

early dynamic ECG sign of evolving STEMI, not only in anterior but also in inferior leads, early and still in presence of hemodynamic stability, may impact on decision making and prognosis.

Conflict of interest

None declared.

Funding body

None.

Ethical statement

Authors state that the research was conducted according to ethical standards.

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