



Markedly Elevated Troponin in Diabetic Ketoacidosis without Acute Coronary Syndrome

Diyabetik Ketoasidozda Akut Koroner Sendrom Olmaksızın Belirgin Troponin Yüksekliği

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Abstract

Troponin gives excellent accuracy in the identification of myocardial necrosis, however, it may elevate also in a series of non-atherosclerotic heart diseases. We report the case of a 58-year-old woman with diabetic ketoacidosis (DKA). She had markedly increased levels (90 fold) of cardiac biomarkers (troponin I and CK-MB) and initial electrocardiography changes compatible with myocardial infarction. She had normal a coronary angiogram. This case shows that nonspecific myocardial injury may occur in DKA with the findings mimicking myocardial infarction including increased level of cardiac biomarkers and electrocardiography changes.

Keywords: Diabetic ketoacidosis, troponin, acute coronary syndrome, diabetes mellitus

Öz

Troponin miyokard hasarını göstermekte mükemmel doğruluğa sahiptir, ancak troponinin bazı non-aterosklerotik kalp hastalıklarında da yükselebildiği bilinmektedir. Biz 58 yaşında diyabetik ketoasidozlu bir kadın olguyu sunmak istiyoruz. Hastanın elektrokardiyografik değişiklikleri miyokard infarktüsü ile uyumlu ve kardiyak belirteçleri (troponin I ve CK-MB) belirgin derecede (90 kat) yüksekti. Koroner anjiyografisi normal saptandı. Bu olgu bize diyabetik ketoasidozda, elektrokardiyografik değişikliği ve kardiyak belirteç yüksekliği ile miyokard infarktüsünü taklit eden nonspesifik miyokard hasarının ortaya çıkabileceğini göstermektedir.

Anahtar kelimeler: Diyabetik ketoasidoz, troponin, akut koroner sendrom, diabetes mellitus

Introduction

Diabetic ketoacidosis (DKA) and myocardial infarction (MI), which are the leading coexisting causes of death in ketoacidosis, are both major medical emergencies. Troponin is the most valuable indicator of myocardial necrosis, but it is known that it may also elevate in a series of non-cardiac situations. DKA may imitate electrocardiogram (ECG) findings of MI (pseudoinfarction pattern). DK is a serious complication requiring emergent medical therapy. DKA may be the initial manifestation of type 1 diabetes mellitus (DM) or may result from increased insulin requirements in patients with type 1 DM during the course of infection, myocardial infarction, surgery or trauma. Mortality rate for DKA varies between 2% and 0% with age (1,2). MI is a well recognized precipitating cause and the leading coexisting cause of death in this entity. However, DKA may imitate some electrocardiographic findings similar to MI (pseudoinfarction pattern) (3).

We aimed to present the case of a patient with DKA whose initial electrocardiography (ECG) showed ST segment depression in the

lateral and inferior derivations and who had significant positive troponin values with no obstructive lesion in the coronary arteries.

Case Report

A 58-year-old woman presented to the emergency department with confusion, nausea and vomiting. Her medical history showed that she had type 1 DM for 33 years treated with intensive insulin therapy and hypertension for 2 years treated with ramipril. Coronary angiography, which was performed 3 years ago, showed a non-obstructive mid-left anterior descending (LAD) lesion. The patient described cough, sore throat and fever for the past 3 days. She was using antibiotics during this time. There was no history of chest pain or dyspnea.

On her physical examination, she was inclined to sleep and dehydrated. Blood pressure was 110/55 mm Hg, heart rate was 90 beats per minute, respiration rate was 30 breaths per minute, and oxygen saturation rate was 98%. Cardiovascular and pulmonary examination revealed a grade 2/6 apical pansystolic murmur and

bilateral basal crackles. There was no pretibial edema or jugular venous distention. At admission, the serum glucose level that measured with a glucometer was extremely high. Arterial blood gas test revealed the following: pH: 7.159, bicarbonate (HCO_3): 5.8 mEq/L, partial pressure of carbon dioxide (PCO_2): 15 mmHg, Na: 123 mEq/L, K: 6.3 mEq/L. Ketonuria was detected by urine test. Blood chemistry test showed prerenal azotemia and electrolyte abnormalities (BUN: 51 mg/dL; kreatinine: 2.32 mg/dL; Na: 121 meq/L, and K: 6.4 meq/L). Initial cardiac biomarkers were: CK-MB: 1.2 ng/mL (0.6-6.3 ng/mL) and troponin I: 0.07 ng/mL (≤ 0.06 ng/mL). The diagnosis of DKA was established and intravenous saline 0.9% with intravenous 0.15 IU/kg bolus insulin and 0.1 IU/kg/h infusion was started. The first measured glucose level during infusions was 522 mg/dL. The initial ECG demonstrated ST segment depression in the lateral and inferior derivations and ST segment elevation in aortic valve replacement (Figure 1). In the serial measurements of cardiac biomarkers, it was observed that CK-MB and troponin I increased (90 fold) (CK-MB: 9.5 ng/mL; troponin I: 5.43 ng/mL). Antiplatelet and anticoagulant therapies were started. There was no wall motion abnormality on echocardiography, but there was second degree mitral regurgitation and trivial pericardial fluid. Nine hours after starting the treatment of DKA, the following results were obtained: serum glucose: 152 mg/dL, pH: 7.381, PCO_2 : 32 mmHg, HCO_3 : 18 mEq/L, Na: 133 mEq/L, K: 4.2 mEq/L. ECG was repeated and ST segments were in isoelectric line, but there were negative or flattened T waves in the lateral and inferior leads. After acute treatment of DKA and resolution of renal dysfunction, coronary angiography was performed on the third day. Non-obstructive LAD and RCA lesion were confirmed. Medical management for coronary artery disease was planned. When she was discharged eighth day after admission, both her ECG and biochemical results were normal (Figure 2).

Discussion

DKA is one of the serious complications of DM. Cardiac complications during the course of DKA include arrhythmias (due to electrolyte imbalance), acute MI, pulmonary edema and cardiodepresant effects of acidosis. DM is one of the major risk factor for acute MI. Accelerated atherosclerosis and plaque rupture are more frequently seen in diabetics. Therefore, aggregation-antiaggregation balance was abnormal because of increased fibrinogen, plasminogen activator inhibitor, thromboxane A2 levels and endothelial dysfunction. In DKA, metabolic derangements, fluid shifts, tachycardia, and increased sympathetic tone may trigger focal myocardial necrosis and troponin I release due to cardiac ischemia from supply-demand mismatch, especially in patients with coronary artery disease (4). Hyperkalemia occurs in early stages of DKA and is associated with intraventricular conduction defect and fatal ventricular arrhythmias. Severe acidosis can cause negative inotropic effects and vasodilatation. Cardiac biomarker leakage may be explained by acidosis and free fatty acids. Acidosis can promote intracellular free radicals damaging cell membrane. Free fatty acids can also be responsible for disruption of myocardial plasma membrane by both direct and indirect effects.

Insulin plays a major role in regulating the balance of metabolic demands received by myocardium. In insulin deficiency and acidosis, increased availability of fatty acids leads to beta oxidation at the expense of pyruvate oxidation in cardiac myocytes. Insulin deficiency and high levels of ketones and free fatty acids inhibit glucose uptake and utilization. Therefore, long-chain fatty acids lead to a switch in Krebs cycle which causes excessive production of free radicals enhancing damage to myocardium (5). On the other hand, high circulating levels of free fatty acids in ketoacidosis may lead to fatty acid incorporation and micelle formation in the myocardial plasma membrane causing membrane destabilisation and disruption and subsequent troponin leakage.

In our patient, the criteria for MI were fulfilled because there were severe elevations in cardiac troponin T and CK-MB levels together with initial ECG changes indicative of MI. On the other hand, there was no history of chest pain, no segmental wall motion abnormality on echocardiography; coronary angiography revealed subclinical atherosclerotic plaques and the initial ECG changes could be affected by hyperkalemia or acidosis, compatible with the concept that MI was not present. In this case, metabolic ischemia in myocardial cells led to subendocardial ischemic changes in ECG and troponin release to the blood without any obstructive lesion in coronary arteries.

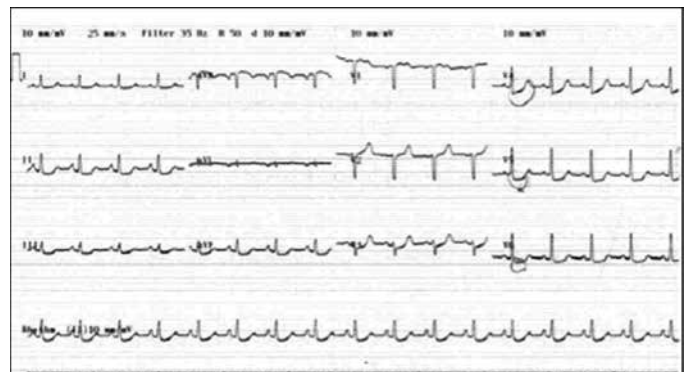


Figure 1. Electrocardiography on admission at early decision. Electrocardiography showing ST segment depression in lateral and inferior leads; ST segment elevation in a virtual lead

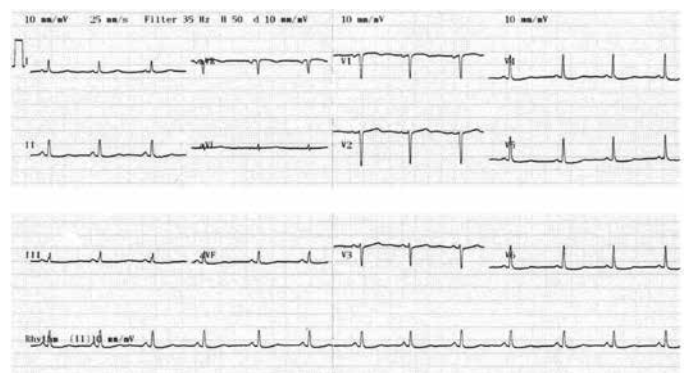


Figure 2. Electrocardiography at discharge. Electrocardiography was seen as normal

Conclusion

Our findings show that diagnosis of MI and the appropriate therapy is a clinical challenge in case of severe DKA. Since myocardial injury may occur in patients without any evidence of atherosclerotic coronary disease, the first thing to do should be correction of metabolic acidosis and other metabolic abnormalities. The diagnosis of MI should be reevaluated with transthoracic echocardiogram, cardiac biomarkers, and repeating ECG during the follow-up period. Starting antiplatelet and anticoagulant therapies or proceeding to cardiac catheterization before metabolic abnormalities are corrected may thus expose the patient to unnecessary treatment along with its attendant risks.

Ethics

Informed Consent: Consent form was filled out by all participants.
Peer-review: Internally peer-reviewed.

Authorship Contributions

Concept: Demet Menekşe Gerede, Eralp Tutar, *Design:* Eralp Tutar, *Data Collection or Processing:* Volkan Kozluca, *Analysis*

or Interpretation: Kerim Esenboğa, *Literature Search:* Berna İmge Aydoğan, *Writing:* Demet Menekşe Gerede.

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