

A Case of Myocardial Infarction Caused by Coronary Vasospasm: Efficacy of Soluble Lectin-Like Oxidized LDL Receptor-1 for Distinguishing between Vasospasm and Plaque Rupture

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Abstract

This case illustrates the benefits of using plasma levels of soluble lectin-like oxidized low-density lipoprotein receptor-1 (sLOX-1) to distinguish between myocardial injuries caused by coronary vasospasm or coronary plaque rupture. A 62-year-old woman with a history of dyslipidemia was admitted due to chest pain of 1 hour's duration. Electrocardiography demonstrated mild ST segment elevation in leads V1-6, and blood chemistry studies on admission showed a slight increase in the serum level of troponin T; therefore, acute myocardial infarction was diagnosed. However, the plasma level of sLOX-1, a marker of plaque rupture, did not increase during hospitalization. Coronary angiography demonstrated normal coronary arteries, and intracoronary acetylcholine infusion provoked coronary artery vasospasm. We could therefore diagnose myocardial injury caused by coronary vasospasm. We propose that the cause of myocardial injury cannot be predicted with electrocardiography and measurement of troponin T but can be clarified by measuring plasma levels of sLOX-1 in the early stage of acute coronary syndrome.

(J Nippon Med Sch 2009; 76: 268–271)

Key words: soluble lectin-like oxidized low-density lipoprotein receptor-1, coronary vasospasm, coronary plaque rupture, acute myocardial infarction

Introduction

Although typical ST elevation myocardial infarction (STEMI) is caused by coronary artery plaque rupture and thrombus formation, some cases of STEMI are caused by coronary vasospasm. In particular, Japanese patients have a higher incidence of ischemic myocardial damage due to vasospasm^{1,2}.

Acute myocardial infarction (AMI) is generally distinguished by prolonged chest pain, ST elevation on electrocardiography (ECG), and elevation of myocardial necrotic markers;³ however, it is difficult to determine whether AMI is caused by plaque rupture or coronary vasospasm. A plaque rupture marker would be useful for determining the cause of AMI.

Soluble lectin-like oxidized low-density lipoprotein

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Journal Website (<http://www.nms.ac.jp/jnms/>)

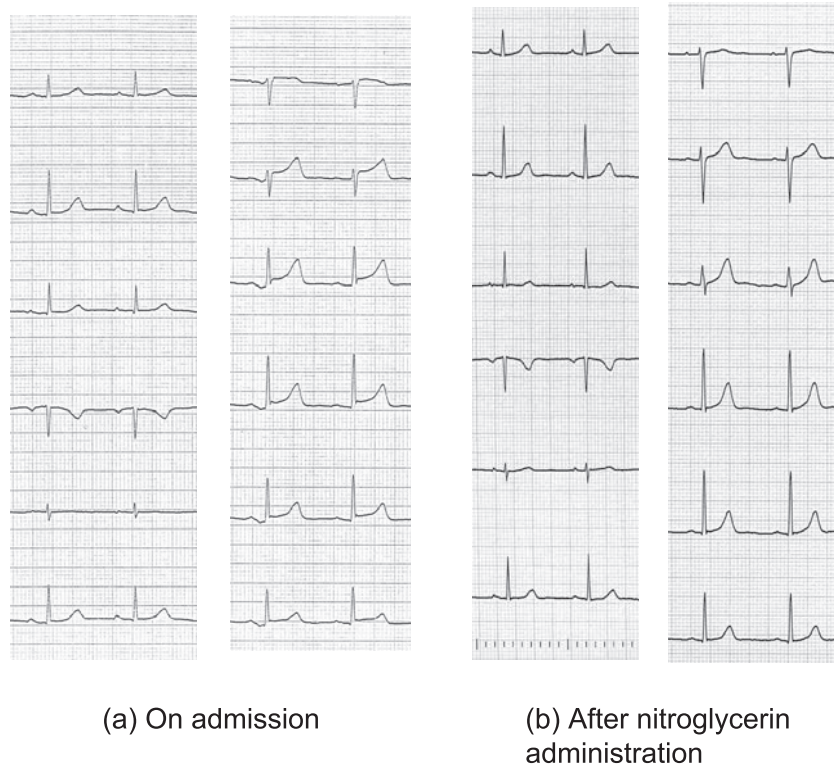


Fig. 1 ECG on admission demonstrated mild ST elevations in leads V1-6 (a); however, this condition resolved after sublingual administration of nitroglycerin (b).

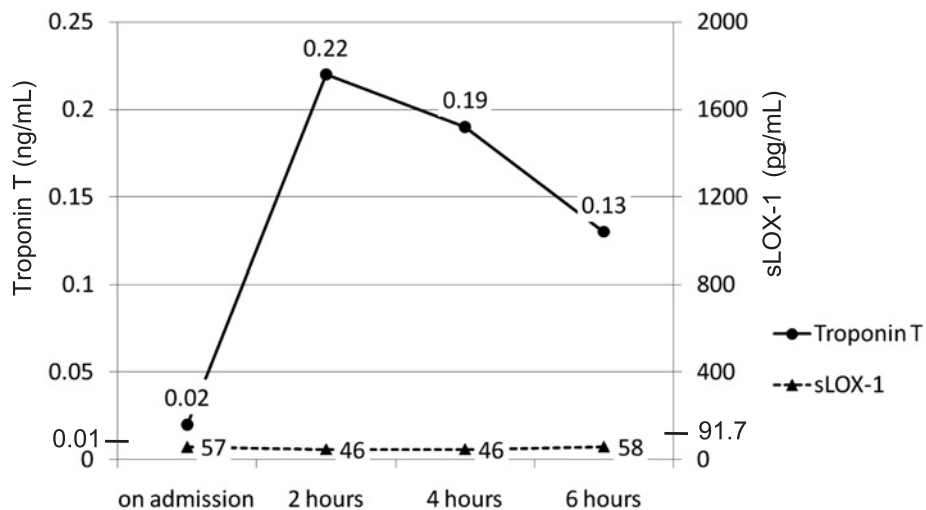
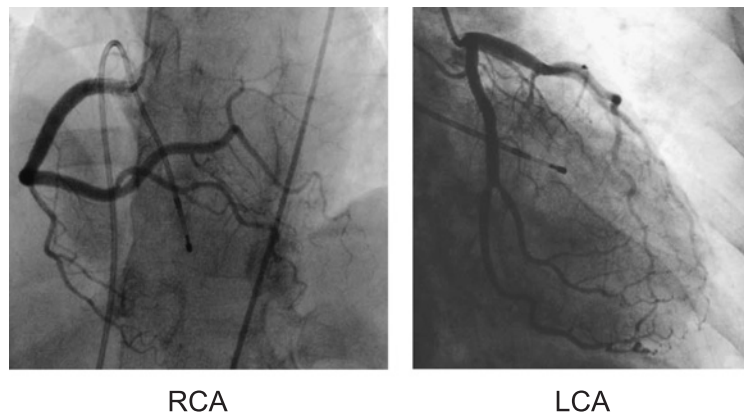


Fig. 2 Time-dependent serum levels of troponin T and sLOX-1
Troponin T was detected at admission and its levels had further increased by 2 hours after admission. However, sLOX-1 levels did not increase during hospitalization.

receptor-1 (sLOX-1) has been identified as a marker of plaque rupture or plaque instability^{4,5}, and a previous report has demonstrated that sLOX-1 levels are elevated in patients with acute coronary syndrome⁴. We have previously observed that the diagnostic cutoff value for the plasma sLOX-1 level

is 91.7 pg/mL⁶. However, we suspect that sLOX-1 levels are not elevated in patients with AMI caused by coronary vasospasm (vasospastic myocardial injury), and the cause of AMI might be determined through the use of this marker.

(a) Before acetylcholine provocation



(b) After acetylcholine provocation

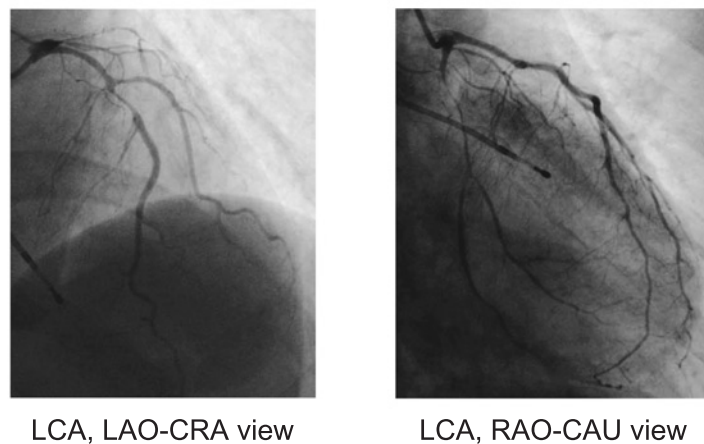


Fig. 3 Coronary angiography

Normal coronary arteries were evident before intracoronary acetylcholine infusion (a), and coronary vasospasm occurred in the left descending artery and left circumflex artery after intracoronary acetylcholine infusion (b). RCA, right coronary artery; LCA, left coronary artery; LAO, left anterior oblique; RAO, right anterior oblique; CRA, cranial; CAU, caudal.

Case Report

A 62-year-old woman with a history of dyslipidemia was admitted because of chest pain of 1 hour's duration. Upon admission, the patient was conscious, and the vital signs were as follows: blood pressure, 140/70 mmHg; heart rate, 80 beats/minute and regular; and respiratory rate, 15/minute. Physical examination revealed no audible rales, anemia, jaundice, peripheral edema, or other abnormalities. Chest X-ray films showed no notable abnormalities, and ECG showed mild ST segment elevation in leads V1-6 (**Fig. 1a**). Blood chemistry studies on admission revealed a slight increase in the serum level of troponin T (0.02 ng/mL) and

normal levels of creatine kinase (73 IU/L) and creatine kinase MB (7 IU/L). The plasma level of sLOX-1 (57 pg/mL) was within the normal range (the cutoff value of sLOX-1 for STEMI is 91.7 pg/mL)⁶. The white blood cell count was 4,510/ μ L, and serum levels of C-reactive protein and creatinine were <0.05 mg/dL and 0.59 mg/dL, respectively. Time-dependent changes in levels of troponin T and sLOX-1 are shown in **Figure 2**. Echocardiography demonstrated mild left ventricular apical hypokinesis. Her chest pain and ST elevation on ECG resolved in several seconds after 0.3 mg nitroglycerin was administered sublingually (**Fig. 1b**). However, we performed coronary angiography because a second blood examination obtained two hours after admission showed an elevated serum

troponin T level (0.22 ng/mL) (**Fig. 2**). Conversely, the plasma level of sLOX-1 at this time was not elevated (46 pg/mL) (**Fig. 2**). Serum levels of creatine kinase and creatine kinase MB were also not elevated (72 IU/L and 9 IU/L, respectively). Because coronary angiography demonstrated normal coronary arteries (**Fig. 3a**), we performed a provocative test for coronary vasospasm and were able to provoke coronary vasospasm with chest oppression by infusion of acetylcholine (50 µg) into the left coronary artery (**Fig. 3b**). We diagnosed vasospastic myocardial injury and started treatment with an oral calcium antagonist (200 mg of diltiazem) and a statin (20 mg of fluvastatin). The symptoms of myocardial ischemia subsequently resolved, and the patient was discharged from the hospital 3 days after admission.

Discussion

The clinical diagnosis of AMI is usually based on a history of chest pain, ECG changes, and elevation of cardio-specific enzymes³. Creatine kinase-MB is the most popular biochemical marker of myocardial necrosis and was previously the gold standard for the diagnosis of AMI. However, the definition of AMI was revised by the joint European Society of Cardiology / American College of Cardiology Committee, and a diagnosis of AMI is now primarily based on the cardiac troponin level⁷. However, it is not possible to determine whether the cause of AMI is plaque rupture or vasospasm.

Lectin-like oxidized LDL receptor-1 (LOX-1) is a scavenger receptor expressed by intimal smooth muscle cells⁸ and lipid-laden macrophages in advanced atherosclerotic lesions⁹. LOX-1 is released as a soluble form (sLOX-1)¹⁰, which has been reported to be a marker of plaque rupture or instability⁴⁵. Previous studies have indicated that sLOX-1 is useful for the diagnosis of acute coronary syndrome⁴⁶. This marker should be useful for determining the cause of acute myocardial injury.

Despite the evidence of myocardial infarction in the present case, no coronary artery stenosis was observed on coronary artery angiography, and vasospastic myocardial injury was diagnosed. Serum levels of troponin T gradually increased, but plasma levels of sLOX-1 did not. Our previous study has indicated that the cutoff value of plasma sLOX-1 for diagnosis of STEMI is 91.7 pg/mL⁶, but the plasma level of sLOX-1 remained less than this value in the

present case.

Markers of plaque rupture, rather than markers of myocardial necrosis, might be useful for determining whether the cause of acute myocardial injury is vasospasm or plaque rupture in a coronary artery. A comparison of sLOX-1 levels between plaque rupture and vasospasm in more AMI cases has been recommended. We have treated minor AMI cases with plaque rupture and high plasma sLOX-1 level, so we are investigating the relationship between plasma levels of sLOX-1 and the size of myocardial infarctions.

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(Received, July 13, 2009)

(Accepted, September 9, 2009)