Kinetics of Thallium-201 in Acute Phase of Myocardial Infarction: A Case Report

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Patient: Male, 78-year-old
Final Diagnosis: Myocardial infarction
Symptoms: Chest pain
Medication: —
Clinical Procedure: —
Specialty: Cardiology

Objective: Unusual clinical course
Background: Thallium-201 has been widely used in clinical practice for the management of coronary heart disease, but little is known regarding its kinetics in the acute phase of myocardial infarction.

Case Report: We report a 78-year-old man who developed acute inferior myocardial infarction during exercise thallium-201 scintigraphy. The patient underwent exercise testing with thallium-201 myocardial scintigraphy because of a single episode of chest pain. The workload was started with 25 watts and increased by 25 watts every 2 min on a bicycle ergometer with continuous monitoring of 12-lead electrocardiography. Thallium-201 was injected intravenously at 85% of the age-predicted maximal heart rate, and ST-segment elevations refractory to medication subsequently developed in the inferior leads, followed by chest pain. Scintigraphic image acquisition was deferred and he was transferred to the catheter laboratory in this hospital. Emergency coronary angiography showed occlusion in the right coronary artery, and stent implantation was successfully performed. The peak level of creatine kinase in the clinical course was 201 U/l. Scintigraphic images obtained 4 h after the onset of ST-segment elevation showed severely reduced activity in the left ventricular inferior wall, with partial redistribution 24 h later. Follow-up imaging performed 4 months later revealed increased accumulation of thallium-201 in the inferior wall.

Conclusions: Our case highlights the kinetics of thallium-201 during acute myocardial infarction.

Keywords: Kinetics • Myocardial Infarction • Thallium-201

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Background

Thallium-201 has been widely used in clinical practice for management of coronary artery disease [1-3], but little is known regarding its kinetics during the very acute phase of myocardial infarction except for data in experimental animal models [4,5]. We report a case of a patient who developed acute myocardial infarction during exercise thallium-201 scintigraphy.

Case Report

A 78-year-old man was referred to the Department of Cardiology in our hospital because of a single episode of chest pain. He had been well until 1 week before presentation, when he was awakened by a burning sensation in the chest at midnight, which lasted for several minutes and then disappeared spontaneously. The patient saw his physician the next day. The vital signs and physical examination were reportedly normal. An electrocardiogram showed isolated premature ventricular contractions and inverted T waves in leads II, III, aVF, V5, and V6, without pathological Q waves. The patient had hypertension that had been well controlled with amlodipine (5 mg daily) and valsartan (80 mg daily). He had undergone sigmoidectomy for sigmoid colon cancer 19 years earlier, with no recurrence. He had quit smoking more than 20 years earlier, drank alcohol occasionally, and did not use illicit drugs. He had no known allergies.

On examination, his blood pressure was 141/72 mmHg, the pulse was 68 beats per minute, the body temperature was 35.0°C, and the oxygen saturation was 97% while breathing ambient air. The jugular veins were not distended, neither heart murmur nor additional heart sound was audible, and the respiratory sound was clear. An electrocardiogram showed premature ventricular contractions and inverted T waves in inferior leads. An emergency coronary angioplasty was performed, and the patient was discharged from the hospital 2 days later.

Figure 1. Emergency coronary angioplasty. Coronary angiography shows total occlusion in the middle portion of the right coronary artery (A, arrow). After thrombus aspiration, stent implantation (B) was successfully performed, without residual stenosis (C).

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leads and lateral leads that were unchanged. A chest radiograph demonstrated a cardiothoracic ratio of 56% without pulmonary congestion. The nonfasting blood sugar level was 189 mg/dl (reference range, 70 to 109), and the blood level of brain natriuretic peptide was elevated to 302.8 pg per milliliter (reference range, ≤18.4). The complete blood count and blood levels of electrolytes, creatine kinase, and glycated hemoglobin were normal, as were tests of renal and liver function. Echocardiography showed an ejection fraction of 67% with mild hypokinesis of the inferior wall. The remainder of the echocardiographic examination was normal. He was scheduled to undergo exercise testing with thallium-201 myocardial scintigraphy 3 days later.

On the day of exercise testing, the patient reported that he had not noticed any symptoms since his first visit to this hospital. An electrocardiogram obtained before exercise testing had remained unchanged. The workload was begun with 25 watts and increased by 25 watts every 2 min on a bicycle ergometer under continuous monitoring with 12-lead electrocardiography. Thallium-201 of 111 MBq (3 mCi) was injected intravenously at the achievement of 85% of the age-predicted maximal heart rate (ie, 124 beats per minute) with a blood pressure of 167/87 mmHg. After having achieved the peak workload of 100 watts, a 1-min cool-down period at a grade of 30 watts was initially planned, but was discontinued immediately after injection of thallium-201 because practitioners noticed slight ST-segment elevation in the inferior leads. The increasing ST-segment elevation with subsequently developed chest pain was refractory to the administration of sublingual nitroglycerin, intravenous isosorbide dinitrate, and intravenous heparin sodium. Scintigraphic image acquisition was deferred and he was transferred to the catheter laboratory in this hospital. Emergency coronary angiography showed no significant stenosis in the left anterior descending coronary artery and the circumflex coronary artery, but revealed occlusion in the right coronary artery (Figure 1A). Subsequently, stent implantation (Figure 1B) after thrombus aspiration was successfully performed, with no residual stenosis (Figure 1C).

Scintigraphic images were acquired after angioplasty (approximately 4 h after the onset of ST-segment elevation). As shown in Figure 2A, thallium-201 uptake was severely reduced in the inferior wall of the left ventricle. The peak day (24 h after the onset of ST-segment elevation), images showed a partial redistribution of tracer in the inferior wall (Figure 2B). The peak
level of creatine kinase in the clinical course was 201 U/l (reference range in men, <240), but the MB fraction was elevated to 15.0% (reference range, <6.0%). T wave inversions in inferior leads and lateral leads normalized on the second postoperative day; no pathological Q waves developed. The patient was discharged in stable condition. Approximately 4 months later, he underwent re-evaluation of thallium-201 scintigraphy at rest, showing increased accumulation in the inferior wall (Figure 2C). He has been well for more than 1 year postoperatively with optimized medical therapy.

**Discussion**

The inferior myocardium in the present case was almost salvaged due to early reperfusion therapy, suggesting that myocardial viability was underestimated on 4-h delayed images of thallium-201. Although the underlying mechanism remains unclear, a possible explanation proposed by Weiss et al [6] is a high washout rate due to a higher blood flow in the infarct-related area after reperfusion therapy, accompanied by an initial decrease in thallium-201 uptake. A decrease in tracer activity on the delayed images of thallium-201, disproportionate to myocardial viability, is often observed in patients with acute myocardial infarction when thallium-201 is administered after reperfusion therapy [6-8]. It is unclear whether this unique phenomenon or reverse redistribution developed in our case, because an initial image immediately after exercise was not obtained.

**Conclusions**

We report a case of a patient who developed acute myocardial infarction during exercise scintigraphy, highlighting the kinetics of thallium-201 during acute myocardial infarction.

**Declaration of Figures’ Authenticity**

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

**References:**

9. Mochizuki T, Murase K, Sugawara Y, et al. Twenty-four-hour Tl-201 delayed redistribution on 24-h delayed images has been reported to have been observed in 3 of 37 patients (8%) with acute myocardial infarction when thallium-201 was administered at rest within 1 week after emergency angioplasty [9]. In general, thallium-201 uptake in the myocardium is determined by a combination of the influx (blood flow and the tracer content) and the efflux (myocardial ability to retain tracer based on cell metabolism and cell membrane integrity) [4,10]. Thus, we believe that our findings on 24-h delayed images indicate insufficient recovery of the inferior myocardium despite early successful reperfusion therapy.