CASE REPORT

Left ventricular free-wall rupture that occurred during a cardiopulmonary exercise test

Masaki Kodaira,¹ Takahito Itoh,² Kiyoshi Koizumi,² Yohei Numasawa¹¹Department of Cardiology, Japanese Red Cross Ashikaga Hospital, Ashikaga, Japan²Department of Cardiovascular Surgery, Japanese Red Cross Ashikaga Hospital, Ashikaga, JapanCorrespondence to
Dr Masaki Kodaira,
mskodaira@gmail.com

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SUMMARY

Although exercise testing has become a standard procedure before discharge for patients with acute coronary syndrome, a fatal accident during the test is extremely rare. A 60-year-old man was admitted for a non-ST-segment elevation myocardial infarction. A coronary angiogram showed stenosis at the distal lesion of the circumflex, and a balloon angioplasty was performed. His recovery was smooth, and a cardiopulmonary exercise test was performed 5 days after admission. At 2.5 metabolic equivalents, he suddenly went into cardiac arrest, and percutaneous cardiopulmonary support was initiated. Echocardiography revealed the presence of a large amount of pericardial effusion, and emergency cardiac surgery was performed to repair the free-wall rupture. This highlights the importance of careful monitoring of patients with percutaneous coronary intervention during cardiopulmonary exercise testing.

BACKGROUND

Patients who undergo percutaneous coronary intervention (PCI) for acute coronary syndrome (ACS) are usually subjected to cardiopulmonary exercise testing (CPX).¹ In fact, submaximal exercise testing, including CPX, is recommended before discharge as part of phase 1 cardiac rehabilitation, according to the guidelines of the American College of Cardiology/American Heart Association.² Herein, we report the case of a patient who developed a left ventricular free-wall rupture during CPX prior to discharge.

CASE PRESENTATION

A 60-year-old man was admitted to our hospital because he had been experiencing continuous chest

pain. He had a history of dyslipidaemia and hypertension. His vital signs were stable, and there were no signs of heart failure.

INVESTIGATIONS

Laboratory tests showed that his troponin levels were elevated (0.696 ng/mL). No signs of ST-segment elevation were noted on the ECG (figure 1A). Non-ST-segment elevation myocardial infarction (NSTEMI) was diagnosed, and coronary angiography revealed a distal 99% stenotic lesion at the distal circumflex artery with thrombolysis in myocardial infarction (TIMI) 1 flow (figure 1B).

TREATMENT

Balloon angioplasty was performed on the circumflex lesion to obtain TIMI 3 flow, which helped relieve his chest pain.

In addition to the dual antiplatelet therapy initiated at the emergency department, bisoprolol and telmisartan were administered after admission.

OUTCOME AND FOLLOW-UP

A subsequent transthoracic echocardiogram showed a slightly reduced left ventricular ejection fraction of 51% and lateral hypokinesis without pericardial effusion (figure 1C). Since no complications were noted after PCI, he was referred for cardiac rehabilitation and was integrated into our rehabilitation programme. After confirming consistent findings with those at admission on the bedside transthoracic echocardiogram (ie, no signs of pericardial effusion or acute mitral valve regurgitation) on day 4, the patient took a 240-metre walk along the ward corridor with the attending physiotherapist.

Figure 1 (A) ECG at admission. (B) Coronary angiography showing tight stenosis at the distal circumflex; white arrow. (C) Transthoracic echocardiography performed on the day after admission. (D) VCO_2 as a function of VO_2 during the exercise test; the yellow arrow indicates the timing of the event. VCO_2 , carbon dioxide production; VO_2 , oxygen consumption.

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Figure 2 Intraoperative findings. (A) Transesophageal echocardiography showing pericardial effusion (white arrow). (B) A myocardial tear on the lateral wall (white arrow). (C) Repair of the free-wall rupture with a patch.

Five days after admission, CPX with the output measured using an ergometer and respiratory gas analysis were performed for risk stratification after discharge. The test was progressing smoothly without any signs of ST-segment changes on the ECG or chest pain. However, when the test reached a workload of 48 Watts and 2.5 metabolic equivalents, he suddenly collapsed on the floor and let out a moan (figure 1D; the carbon dioxide production (VCO_2) vs oxygen consumption (VO_2) relationship during CPX). Chest compression was initiated after confirmation of cardiac arrest. Despite efforts to resuscitate him, he was unresponsive, and cannulation was performed for percutaneous cardiopulmonary intervention. Transthoracic echocardiography revealed the presence of a large amount of pericardial effusion, and we decided to perform emergency cardiac surgery. Transesophageal echocardiography performed at the start of the surgery showed that two ventricles were compressed by pericardial effusion (figure 2A). After making an incision in the pericardium, we could see blow-out-type bleeding and subsequently identified the rupture in the lateral wall (figure 2B; video 1). The rupture was successfully fixed by applying a felt strip with mattress sutures that was covered by a collagen patch with fibrin glue (figure 2C). The patient was weaned and decannulated from cardiopulmonary support 11 days after the operation; however, he died 24 days after the operation.

DISCUSSION

Cardiac rehabilitation programmes with early progressive exercise have been reported to improve functional capacity in patients with recently developed ACS, and it is considered an essential intervention in order to optimise patient recovery.³ In their meta-analysis, Lawler *et al*⁴ demonstrated the effect of exercise-based cardiac rehabilitation to significantly reduce

reinfarction and mortality. Moreover, the safety of CPX after ACS has been proven in numerous studies,^{5,6} and the associated cardiac event incidence rate is only 0.01%. Furthermore, the American College of Cardiology/American Heart Association referred to the performance of exercise testing for patients admitted for unstable angina or NSTEMI. It stated that exercise testing is beneficial to guide the initial exercise prescription and labelled it as class I.⁷ Notably, figure 1D shows that the VCO_2 versus VO_2 slope had not increased in steepness until the event, and that the patient had not reached the first ventilatory threshold, that is, the point at which blood lactate starts to increase. However, the rise in blood pressure during CPX, which had reached 186/132 mm Hg just before the event, could have triggered the rupture.

The devastating consequences of this case have several implications to specify how, when and for whom CPX should be performed after acute myocardial infarction. First, although current guidelines by the American Heart Association merely define within 2 days of acute myocardial as the absolute contraindication for performing exercise testing,⁸ the timing of CPX in the current case may have been too early. It is noteworthy that 3 to 5 days after admission has been reported as the late peak when left ventricular rupture frequently occurs because the damaged myocardium is still fragile.⁹ Second, our case suggests that certain patients should be exempted from CPX before discharge. Specifically, our patient was admitted 2 days after developing acute myocardial infarction, and this delayed hospital admission has been notified as a risk factor for the development of cardiac rupture in previous reports.¹⁰ Unfortunately, we considered the patient as low risk because he did not possess other risk factors considered to be associated with left ventricular rupture

Video 1 Blow-out-type bleeding due to the myocardial tear.

Learning points

- ▶ Our report describes a case in which left ventricular free-wall rupture occurred in a patient during cardiopulmonary exercise testing (CPX) after percutaneous coronary intervention (PCI).
- ▶ Although exercise testing has become a standard procedure before discharge for patients with acute coronary syndrome and considered safe, fatal accident could occur.
- ▶ Preliminary imaging control: transthoracic echocardiography is recommended before performing an exercise test to rule out pericardial effusion.
- ▶ Patients with delayed hospital admission (24 hours after onset of chest pain) should be exempted from exercise testing during admission after acute myocardial infarction because delayed admission has been proven to be high risk for cardiac rupture.
- ▶ Our case highlights the importance of careful monitoring of patients with PCI during CPX.

in previous reports: female sex or advanced age.^{11–14} Third, an increase in blood pressure could be a sign for early termination of exercise testing. Although existing guidelines only define systolic blood pressure >250 mm Hg and/or diastolic blood pressure >150 mm Hg as indications for termination of exercise testing,⁸ this case suggests that this limit should be lowered.

In conclusion, the occurrence of left ventricular free-wall rupture in a patient undergoing CPX after PCI for NSTEMI highlights the importance of careful monitoring of such patients during CPX.

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