Pseudoaneurysm of the Left Ventricle Progressing From a Subepicardial Aneurysm

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A 56-year-old man presented with an inferior myocardial infarction and a huge pseudoaneurysm below the inferior surface of the left ventricle, which had progressed from a small subepicardial aneurysm over a 6-month period. Transthoracic echocardiography, Doppler color flow images, radionuclide angiography, magnetic resonance imaging and contrast ventriculography all revealed an abrupt disruption of the myocardium at the neck of the pseudoaneurysm, where the diameter of the orifice was smaller than the aneurysm itself, and abnormal blood flows from the left ventricle to the cavity through the orifice with an expansion of the cavity in systole and from the cavity to the left ventricle with the deflation of the cavity in diastole. Coronary angiography revealed 99% stenosis at the atroventricular nodal branch of the right coronary artery. At surgery the pericardium was adherent to the aneurysmal wall and a 1.5-cm orifice between the aneurysm and the left ventricle was seen. Pathological examination revealed no myocardial elements in the aneurysmal wall. The orifice was closed and the postoperative course was uneventful. Over-intense physical activity as a construction worker was considered to be the cause of the large pseudoaneurysm developing from the subepicardial aneurysm. These findings indicate that a subepicardial aneurysm may progress to a larger pseudoaneurysm, which has a propensity to rupture, however, it can be surgically repaired. (Jpn Circ J 1999; 63: 559–563)

Key Words: Echocardiography; Magnetic resonance imaging; Pseudoaneurysm; Subepicardial aneurysm

A pseudoaneurysm of the left ventricle is a rare complication of a myocardial infarction (MI), cardiac surgery, trauma, infection or inflammation, and like a true aneurysm of the left ventricle after MI it may cause left ventricular failure, embolization or ventricular arrhythmia. In contrast to a true aneurysm, in which a left ventricular rupture may occur early in the clinical course but is extremely rare in the late phase, a pseudoaneurysm has a propensity to rupture and cause sudden death even in the chronic stage and when it is small. As a result, early diagnosis and surgical exploration of a left ventricular pseudoaneurysm is vital. The features of a subepicardial aneurysm of the left ventricle consist of an abrupt interruption of the myocardium, a narrow neck and a propensity to rupture spontaneously, regardless of its wall’s components. We describe a patient with a huge left ventricular pseudoaneurysm that had progressed from a small subepicardial aneurysm.

Case Report

A 56-year-old man had been admitted 6 months previously to the hepatology department of Kansai Medical University Hospital due to an acute hepatitis caused by type B hepatitis virus. The presence of pericardial effusion was suspected based on the abdominal ultrasonography performed just before his discharge, and echocardiography incidentally revealed an inferior wall MI with a subepicardial aneurysm of the left ventricle (Fig 1a, b). As he had no cardiac symptoms he refused any further examinations or consultations regarding this abnormality and was discharged from the hospital to continue his work as a construction worker there. One month before the current presentation he caught a cold, and although his body temperature recovered to the normal range, both coughing and dyspnea continued and so he re-presented at hospital. The patient’s heart rate was 80 beats/min with a regular rhythm. Blood pressure was 118/80 mmHg. The third heart sound was heard at the apex, but no heart murmur was present on auscultation. Laboratory studies were normal. Chest roentgenography revealed a cardiothoracic ratio of 52%, slight pulmonary congestion and an abnormal protrusion at the lower left margin of the cardiac shadow (Fig 2). An electrocardiogram showed a normal sinus rhythm, a left atrial abnormality, Q waves and inverted T waves in leads II, III and aVF (Fig 3). Two-dimensional echocardiography disclosed a huge echo-free space behind the inferior myocardial wall and an abnormal cavity that communicated with the left ventricle through a small hole at the inferior myocardial wall (Fig 1c, d). The blood flows across the hole from the left ventricle to the cavity in systole and from the cavity to the left ventricle in diastole were observed by Doppler color flow imaging (Fig 4). These findings were compatible with a pseudoaneurysm of the left ventricle. Thallium-201 myocardial scintigraphy showed a complete defect of the inferoposterior wall. On radionuclide angiography, a huge abnormal cavity below the inferior myocardial wall was opacified through a narrow orifice shortly after the opacification of the left ventricle, and the tracer was stagnant in the cavity for a short while. Magnetic resonance imaging using spin-echo (Fig 5a, b) and gradient-
echo (Fig 6a–d) techniques showed the left ventricular pseudoaneurysm as a whole entity; that is, the myocardium discontinued abruptly at the neck of the cavity, the diameter of the neck was much smaller than that of the aneurysm, the blood flows were from the left ventricle to the cavity with expansion of the cavity in systole and from the cavity to the left ventricle with cavity deflation in diastole, thrombus formation was seen in the cavity, and no subepicardial fat was present around the wall of the aneurysm. Digital subtraction angiography of the contrast ventriculography showed an abnormal cavity below the left ventricle, with an hour-glass appearance (Fig 7). His hemodynamic data were

Fig 1. Apical long axis (a,c) and short axis (b,d) views of transthoracic 2-dimensional echocardiography 6 months before the current presentation (a, b) and at the time of presentation (c, d). Six months before presentation, the inferior myocardium showed thinning and an aneurysm with a maximal diameter of 3.5×3.5 cm and that of the neck of 2.5×1.5 cm are seen. The myocardium at the neck is abruptly discontinued, although the aneurysmal wall looks not to exceed the epicardial margin (a,b), which is compatible with a subepicardial aneurysm. At the time of presentation, a large echo-free space behind the inferior wall, which communicates with the left ventricle through a narrow orifice, and an abrupt interruption of the myocardium at the neck are shown. The maximal diameter of the cavity is 11×9.5 cm and that of the orifice is 1.5×1.5 cm. A thrombus is observed inside the cavity (c). These findings are compatible with a pseudoaneurysm of the left ventricle. LA, left atrium; LV, left ventricle; P-AN, pseudoaneurysm; RV, right ventricle; (arrow) orifice of the subepicardial aneurysm.

Fig 2. Chest roentgenography in the anteroposterior projection showing a cardiothoracic ratio of 52%, slight pulmonary congestion and an abnormal protrusion at the lower left margin of the cardiac shadow.

Fig 3. 12-lead electrocardiography showing a left atrial abnormality, and Q waves and inverted T waves in leads II, III and aVf.
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as follows: pulmonary arterial pressure was 44/24 mmHg, the mean capillary wedge pressure was 21 mmHg, the right ventricular pressure was 45/8 mmHg, the mean right atrial pressure was 5 mmHg, and the cardiac index was 3.3 L min⁻¹ m⁻². Coronary arteriography revealed 99% stenosis at the atrioventricular nodal branch of the peripheral right coronary artery. At surgery, a huge pseudoaneurysm was seen on the inferior surface of the left ventricle. The pericardium had adhered to the wall of the aneurysm and a thrombus had formed in the cavity. The diameter of the orifice was 1.5 cm, and connected the pseudoaneurysm and the left ventricle (Fig 8a). Pathological examination revealed that there was no myocardial element in the aneurysmal wall and a mixed thrombus inside the aneurysm (Fig 8b). The orifice was closed with a teflon patch and the postoperative course was uneventful.

Discussion

Rupture of the left ventricular free wall is a catastrophic complication after an acute MI, although mortality rates have decreased due to recent progress in the management and treatment of MI. The pathogenesis of a rupture following MI is sophisticated. It begins with a small endocardial tear at the site of infarction, which may cause a sudden rupture within 1 day after the onset of MI or become associated with an intramural hemorrhage dissecting the myocardium and finally rupturing several days later. When this process is completed, a left ventricular free wall rupture with a hemopericardium or ventricular septal perforation can occur. When the pericardium is adherent at the site of the rupture, a pseudoaneurysm of the left ventricle is formed. If the development of a spreading intramural

Fig 4. Short axis views of color flow imaging in diastole (a) and systole (b) showing the blood flows across the orifice from the cavity to the left ventricle in diastole and from the left ventricle to the cavity in systole.

Fig 5. Long axis (a) and short axis (b) views of spin-echo magnetic resonance imaging (a, d). A huge aneurysm below the inferior surface of the left ventricle is present. The maximal diameter of the cavity is 12×9 cm and that of the orifice is 2.5×1.5 cm (open arrows). The myocardium is abruptly discontinued at the neck of the aneurysm. No subepicardial fat is seen on the wall of the cavity. A mixed thrombus, which has a high and relatively low signal intensity using the spin-echo technique (closed arrow) is seen inside the aneurysm on the long axis view. These findings are compatible with a pseudoaneurysm of the left ventricle. LV, left ventricle; P-AN, pseudoaneurysm.
hematoma, which dissected into the myocardial wall, is stopped, then a so-called pseudo-false aneurysm, a diverticulum of the left ventricle or a subepicardial aneurysm, will develop.1–6,8–12

The constellation of features of a subendocardial aneurysm consists of an abrupt interruption of the myocardium, a narrow neck and a propensity to rupture spontaneously regardless of its wall’s components.4 When transthoracic 2-dimensional echocardiography was performed for the first time in the present patient, all the criteria for a completed subepicardial aneurysm and inferior MI with a subepicardial aneurysm of the left ventricle were observed. Unfortunately, because the patient did not have any cardiac symptoms he refused any further examinations or consultations about this incidentally found lesion. The factors affecting the progression from an initial endocardial tear to rupture include hypertension, physical activity, mental status, infarct size, intensity of the polymorphonuclear inflammatory reaction and intraventricular pressure.8 The present patient worked as a construction worker after being discharged and thus it is considered that over-strenuous physical activity could have caused the formation of the huge pseudoaneurysm during the 6 months between presentations. In addition, the pathological findings indicated that no myocardial element was present in the wall of the aneurysm. The formation of a left ventricular pseudoaneurysm may have 2 mechanisms: one is the absorption of the hematoma located in the pericardial cavity after a sudden rupture of the left ventricular free wall and the other is the gradual development of a subepicardial aneurysm into a pseudoaneurysm. This case is a good example of the latter mechanism of pseudoaneurysm formation.

Pseudoaneurysms and subepicardial aneurysms are often asymptomatic and are incidentally found on imaging tests.12 Chest roentgenography often reveals a pseudoaneurysm as...
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and stagnation in the pseudoaneurysm.15 As magnetic resonance imaging has the advantages of a high spatial resolution, the ability to image the entire heart, tissue characterization, and dynamic flow information by cine mode images, it is the method of choice to detect the abrupt discontinuity of the myocardium at the neck of the pseudoaneurysm, the size of the aneurysm and the orifice, the components or presence of subepicardial fat of the aneurysmal wall, thrombus formation and the flow pattern through the orifice16,17 Although invasive examinations, such as left ventriculography or cardiac catheterization, are still useful, coronary arteriography is essential because the decision to include aortocoronary bypass surgery or not while closing the orifice of a pseudoaneurysm depends on these findings. Finally, the diagnosis of a subepicardial aneurysm is done in almost the same manner as for pseudoaneurysm.

The clinical significance of a pseudoaneurysm or a subepicardial aneurysm is the same, and both require early diagnosis and prophylactic surgical correction, because both have a propensity to rupture even in the chronic phase or regardless of their size, and the surgical management is relatively simple compared with that of a true aneurysm and the results are much better than in unoperated cases.6,11 In contrast, the potential of a true aneurysm to rupture in the chronic stage is a very low and prophylactic surgical repair is usually unnecessary.

It is important to recognize a subepicardial aneurysm because it may progress to a larger pseudoaneurysm and has a propensity to rupture regardless of its size and stage, and this potentially lethal lesion can be easily corrected by surgery.

References

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Fig 8. View inside the aneurysm after incising the wall of the aneurysm at surgery (a) and the microscopic findings of the aneurysmal wall by hematoxylin-eosin stain (b). (a) The orifice of the aneurysm (open arrow) measuring 1.5×1.5 cm in diameter, and the thrombus (closed arrow) are seen. (b) The wall of the aneurysm consists of fibrous tissue without any myocardial elements in the outer layer (bottom) and the mixed thrombus includes a fresh and organized thrombus in the inner layer (top).