Non-invasive diagnosis of pseudoaneurysm of left ventricle

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SUMMARY A patient free of symptoms, with a pseudoaneurysm of the left ventricle after infero-posterolateral myocardial infarction, is reported. The diagnosis was established by nuclear cardiography and echocardiography of the left ventricle.

Pseudoaneurysms of the left ventricle are extremely rare. The diagnosis is usually made after death. The genesis of a pseudoaneurysm is a ventricular wall rupture, rapidly causing death by cardiac tamponade (Hurst *et al.*, 1963; Vlodayer *et al.*, 1975). In the rare instances of survival after myocardial rupture, pre-existing pericardial adhesions confine the bleeding to a limited space (Gueron *et al.*, 1975). The wall of a pseudoaneurysm lacks elements of infarcted myocardium, in contrast to the wall of a true ventricular aneurysm, but is comprised of extracardiac tissue or pericardium (Van Tassel and Edwards, 1972; Gueron *et al.*,

1975). In this report we describe two noninvasive methods to establish the diagnosis of pseudoaneurysm of the left ventricle, which was successfully resected.

Case report

A 56-year-old man, with a history of an inferolateral myocardial infarction in November 1973 and a recurring infarction inferoposterolateral in November 1974, visited our outpatient department in September 1975. A routine chest x-ray film showed a large mass, adjacent to the border of the left

Fig. 1 Chest x-rays showing in posteroanterior view (a) a large mass adjacent to the border of the left ventricle. The lateral projection (b) shows a dorsal displacement of the barium-filled oesophagus.

ventricle, which had not been present on the x-ray film in 1974.

Ten days later the patient was admitted to our hospital for further cardiac investigation. On admission he was free of symptoms since his last infarction in November 1974. He had an administrative job, and was without cardiac complaints. Physical examination revealed a patient in good health. Blood pressure 120/70 mmHg, pulse 80 beats/min regular. There were neither signs of congestive heart failure, nor abnormal heart sounds or murmurs.

The chest x-ray film showed an enlarged heart shadow and a localised paracardial mass. Cardiothoracic ratio: 0.62. The lateral projection demonstrated a dorsal displacement of the barium-filled oesophagus (Fig. 1a, b).

The electrocardiogram showed regular 80 beats/min, biphasic P wave in lead V1, normal conduction times; Q waves were present in leads II, III, aVF, V5, V6, with a tall R in V1. Flat T waves were seen in leads I, II, III, aVL, and aVF. This electrocardiogram was interpreted as showing an old

inferoposterolateral myocardial infarction and questionable left atrial hypertrophy.

An echocardiographic study was performed, showing an echo-free extracardiac space behind the left ventricular posterior wall (Fig. 2a). This extracardiac space could represent a pseudoaneurysm. Theoretically it also could be a pericardial cyst or extensive loculated pericardial effusion, though the latter possibilities are very unlikely.

Nuclear cardiography was performed using the high phase resolution construction technique (de Graaf and van Rijk, 1976). The patient was injected with 10 mCi ^{99m}Tc -albumin intravenously. After equilibrium in the circulation the spatial distribution of the radioactivity was measured with a gamma-camera (Searle, LFOV), in the RAO-15° position. All data (4.10^6 counts) including the electrocardiogram were collected on-line by a digital acquisition system (Hewlett-Packard RTE-II) to construct a film display of the beating heart according to the high phase resolution technique (de Graaf and van Rijk, 1976). At visual examination of this film a generalised hypokinesia and extra-

Fig. 2 (a) Preoperative study. M-mode sector from aorta (Ao) towards the apex of the left ventricle (LV). There is an echo-free space posterior to the left ventricle, which is separated from it by the left ventricular posterior wall. LA, left atrium; MV, mitral valves; FA, false or pseudoaneurysm. (b) Postoperative study. The echo-free space posterior to the left ventricle is no longer present. The dimensions of the left ventricle are scarcely enlarged, with normal movements of septum and posterior wall. An intensive echo of the pericardium of the posterior wall exists, probably a postoperative effect. Ao, aorta; MV, mitral valves; LV, left ventricle; LA, left atrium.

Fig. 3 Preoperative nuclear cardiographic study with ^{99m}Tc -albumin, position RAO-15°. (a) End-diastolic image (DC, double contour; LV, left ventricle). (b) End-systolic image. (c) Time-activity curves of LV (top) and DC (middle), together with the electrocardiogram (bottom). Activity is proportional to volume.

cardiac contribution of radioactivity was observed. The latter could be recognised as a blood pool adjacent to the left ventricular wall (Fig. 3a, b).

Time activity curves of the blood contents of the left ventricle and the extracardiac pool were generated in order to determine whether or not a connection existed. A paradoxical filling pattern of the extracardiac space was found (Fig. 3c), which corresponded with an open connection to the ventricle.

Cardiac catheterisation disclosed a raised left ventricular end-diastolic pressure of 24 mmHg. Cineangiography of the left ventricle was performed in right and left anterior oblique projections. In the right anterior oblique projection a severe generalised hypokinesia was observed. In the left anterior oblique projection a pseudoaneurysm, which arose

from the posterior wall, could be visualised. A communication between the left ventricle and the extracardiac space was evident.

Coronary arteriography disclosed a dominant right coronary artery, with multiple lesions of less than 35 per cent in the proximal one-third before the crux. The posterior descending artery was subtotally obstructed. The left main coronary artery was normal. The left anterior descending artery showed 60 per cent stenosis in the proximal one-third after the first septal and diagonal branches. The remaining vessel was normal. The circumflex artery showed 25 per cent stenosis in the proximal portion and 90 per cent stenosis in the middle segment, three posterolateral branches were visualised but not very sharply. A small first marginal branch appeared to be normal.

Fig. 4 Postoperative nuclear cardiographic study with ^{99m}Tc -albumin, position RAO-15°. (a) End-diastolic image (LV, left ventricle). (b) End-systolic image. (c) Time-activity curves of LV (top) and extracardiac space (EC) (middle) together with the electrocardiogram (bottom). Activity is proportional to volume.

Subsequently the patient was operated upon and a large pseudoaneurysm, originating from a small perforation to the posterolateral wall, was resected. In addition a saphenous vein bypass graft was performed to the left anterior descending artery. Histology of the resected aneurysm showed that the wall consisted of non-specific fibrous material, without any identifiable myocardial element. Two weeks after the operation, the patient was discharged from the hospital. A postoperative echocardiogram (Fig. 2b) and a nuclear cardiographic study were performed in 1976.

The nuclear cardiographic study showed no extraventricular activity and a less severe hypokinesia compared with the preoperative study (Fig. 4a, b). The paradoxical filling pattern of the

extracardiac space seen in the preoperative study could no longer be seen (Fig. 4c).

Discussion

Rupture of the myocardium after an acute myocardial infarction is occasionally compatible with survival. In such cases a pseudoaneurysm is formed (Gueron *et al.*, 1975).

A review of the available published reports reveals 9 cases of pseudoaneurysm, in which a correct diagnosis was made in life, and successful surgical resection was performed (Smith *et al.*, 1957; Fallah-nejad *et al.*, 1972; MacNeil *et al.*, 1974; Gueron *et al.*, 1975; Harper *et al.*, 1975; Roelandt *et al.*, 1975; Botvinick *et al.*, 1976). Though

symptoms of a pseudoaneurysm are similar to symptoms of a true aneurysm of the left ventricle, we emphasise the fact that symptoms can be absent. To our knowledge this is the first patient without symptoms. In this patient, the chest x-ray film, showing an enlarged heart shadow and a localised paracardial mass, suggested the necessity of additional cardiac investigation. Noninvasive methods can be important in establishing a correct diagnosis. Echocardiographic features of a post-infarction pseudoaneurysm were first described by Roelandt *et al.* (1975).

Echocardiography seems to be a safe, though non-specific, method for the diagnosis of left ventricular pseudoaneurysm. The extracardiac space, shown as an echo-free area behind the left ventricular posterior wall, cannot be differentiated from extensive loculated pericardial effusion or a pericardial cyst (Roelandt *et al.*, 1975).

This differentiation can be established by nuclear cardiography which is also a safe and non-invasive technique. The analogue scintigram of the heart and its surrounding tissues disclosed a blood pool adjacent to the left ventricle confirming the existence of an aneurysm, since no extraventricular activity can be shown—immediately after injection—in pericardial cyst or pericardial effusion. Furthermore, the typical halo of the latter will disappear within an hour because of mixing of radioactivity with pericardial fluid.

However, to differentiate between a pseudo aneurysm and a true aneurysm it is necessary to collect the data digitally in order to construct and analyse time-activity curves (volume curves) of the left ventricle and aneurysm. Curves obtained from a pseudo-aneurysm study will show volumes that alternate in opposite directions while in true aneurysms of the left ventricle no phase-shift will be detected.

Cineangiography of the left ventricle and selective coronary arteriography remain indispensable, primarily to determine the exact site of the ventricular wall perforation and secondly to delineate the underlying coronary artery disease.

In conclusion, the diagnosis of pseudoaneurysm

of the left ventricle should be suspected on the basis of a paracardial mass in patients with a previous myocardial infarction. The diagnosis can be established by noninvasive techniques such as echocardiography and nuclear cardiography.

Angiographic investigations, including coronary arteriography, remain mandatory.

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