Echocardiographic evaluation of extracardiac masses

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SUMMARY Echocardiography was performed on 5 patients with extracardiac masses. Four patients had solid tumours and the fifth had a cystic intrapericardial haematoma. Case 1 showed dense echoes anterior to the aortic root and over the right ventricle. Thoracotomy disclosed malignant infiltration of the anterior heart wall. The echocardiogram of case 2 showed a dense mass behind the anterior mitral leaflet, left ventricle, and the left atrium. Bronchoscopy disclosed a carcinoma of the left bronchus. An x-ray film of case 3 was suggestive of a pericardial effusion; no echoes were recordable from the left sternal border, and echocardiography from the right sternal border showed no evidence of pericardial effusion. Necropsy showed a sarcoma which displaced the heart to the right. The ultrasound recording on case 4 in the supine position showed a dilated right ventricle and right ventricular outflow tract, and no evidence of pericardial effusion. In the left lateral position a large space in front of the right ventricle and a paradoxical decrease in right ventricular size were noted. Surgery showed an intrapericardial cystic haematoma anterior to the right ventricle. Echocardiography on case 5 showed a pericardial effusion and thickening (1.5 cm) of the anterior wall of the right ventricle. At operation a lymphoma infiltrating anterior wall of the right ventricle and a pericardial effusion were found.

Careful gain control, examination of the patient in different positions, and placement of the transducer at the right sternal border in addition to the standard position helped in the delineation of these masses. Echocardiography may prove to be a useful method of diagnosing extracardiac space-occupying lesions.

The echocardiographic features of intracardiac tumours have been extensively described (Popp and Harrison, 1969; Wolfe *et al.*, 1969; Schwarz *et al.*, 1972). On the other hand, little is known about the use of M-mode echocardiography in the diagnosis of extracardiac masses. In this report we describe the echocardiographic characteristics of 5 patients with extracardiac masses. Four of the subjects had solid extracardiac tumours, and the fifth patient had a large cystic intrapericardial haematoma which produced cardiac tamponade.

Methods and case reports

Echocardiography was performed with the subject in the supine and/or left lateral decubitus position. An Ekoline 20 Ultrasonoscope; a 0.5 in, 2.25 MHz, 10 cm focus transducer with a repetition rate of 1000/second; and a Honeywell 1856 recorder or an

Electronics for Medicine DR-8 recorder were used. An M-mode scan from the aortic root to the left ventricle was performed in each patient. The near gain was carefully controlled to obtain optimal visualisation of the anterior structures.

CASE 1

A 54-year-old black man was admitted with a complaint of persistent left praecordial chest pain of several days duration. The physical examination was unremarkable. A chest x-ray film disclosed cardiomegaly and an infiltrate in the lingular section of the upper lobe. The electrocardiogram showed diffuse ST segment elevation. Serum enzymes failed to disclose evidence of a recent myocardial infarct.

The echocardiogram showed a dense mass anterior to the aortic root and right ventricle (Fig. 1 and 2). The band of echoes anterior to the aortic root has a sharply defined posterior margin which was in contact with the aorta (Fig. 1). The dimensions of the right ventricle, left ventricle, and left atrium were normal and there was no evidence of

Fig. 1 Aortic root echocardiogram of case 1. Note the dense mass of echoes (*M*) anterior to the aortic root. The posterior border of this mass is sharply defined. *AWAo*, anterior wall of aortic root; *PWAo*, posterior wall of aortic root; *RC*, right coronary; *NC* non coronary cusp.

Fig. 2 Ultrasound recording of aortic root and mitral valve in case 1. There is a dense band of echoes (*M*) anterior to the aortic root and in the region of the anterior aspect of the heart. *CW*, chest wall; *LA*, left atrium; *AMV*, anterior mitral leaflet.

pericardial effusion. A Gallium-67 scan showed abnormal activity overlying the heart.

Thoracotomy disclosed a firm mass measuring 15×7 cm which was adherent to the pericardium overlying the right ventricle and aortic root, lingula, and sternum. Biopsy of the mass showed squamous cell carcinoma. The patient was treated with radiotherapy and died two months later.

CASE 2

A 63-year-old white man was admitted with a complaint of praecordial pain radiating to the interscapular region. On examination he had atrial fibrillation with a rapid ventricular response of 140/minute. There were no abnormal physical signs on auscultation of the heart. A chest x-ray film disclosed a left lower lobe infiltrate, and a lung scan showed a focal defect of the left upper lobe and decreased perfusion of the left lower lobe. These findings were thought to be consistent with pulmonary embolism.

The echocardiogram showed a dense band of echoes behind the left ventricle which extended posterior to the mitral valve, left ventricle, and the left atrium (Fig. 3 and 4). The left atrial cavity was much reduced in size (1.2 cm). These echoes were thought to represent a large retrocardiac mass. Cardiac fluoroscopy with barium swallow showed a mass behind the heart which displaced the oesophagus posteriorly. Tomograms showed a lobulated mass in the retrocardiac space. A Gallium scan

showed a doughnut shaped area of abnormal activity in the region of the heart. Bronchofibero-scopy revealed a large left-sided endobronchial mass, the histology of which was anaplastic small cell carcinoma. He continued to have left-sided chest pain despite radiotherapy and chemotherapy.

CASE 3

A 62-year-old white man who was being treated for a sarcoma of the left chest wall presented with dyspnoea, increased jugular venous pressure and an enlarged cardiac silhouette (Fig. 5). Since these features were suggestive of a pericardial effusion an echocardiogram was performed. No cardiac echoes could be recorded from the left sternal border. All the cardiac structures could be identified by placing the transducer on the right sternal border. There was no pericardial effusion. These findings were suggestive of displacement of the heart to the right by a mass on the left side. The patient died one month later. At necropsy a large sarcoma of the left chest wall which displaced the heart to the right was found. The heart was normal in size and less than 50 ml pericardial fluid was found.

CASE 4

A 70-year-old white man was admitted complaining of shortness of breath. Three weeks before this he had been admitted to another hospital with an acute inferior myocardial infarction. During that admission he was started on anticoagulants.

Fig. 3 M-mode sweep from left ventricle to mitral valve of case 2. A dense mass of echoes (T) is seen behind the anterior mitral leaflet (AMV) and the posterior wall of the left ventricle (LVPW).

Fig. 4 Echocardiogram of aortic root (Ao) and mitral valve of case 2. A thick mass of echoes is seen behind the anterior mitral leaflet (AMV) and the posterior wall of the left atrium. The pronounced reduction of left atrial cavity size (especially near the base of the mitral valve) is probably the result of anterior displacement of the posterior left atrial wall by tumour behind the atrium. LA, left atrium.

On examination he was orthopnoeic. His pulse was 130/minute and regular, and his blood pressure was 90/60 mmHg. The neck veins were distended to the angle of the jaw. A distinct left parasternal lift was present. There was a grade 2/6 holosystolic murmur at the apex. The electrocardiogram showed evidence of old inferior myocardial infarction and ST segment depression from V2 to V6. The chest x-ray film showed an unusual configura-

Fig. 5 Chest x-ray film of case 3. This shows a much enlarged cardiac silhouette.

tion of the cardiac silhouette (Fig. 6), which was very different from that seen three weeks previously. His echocardiogram taken in the supine position showed a dilated right ventricle (right ventricular internal dimension = 3.2 cm) and right ventricular outflow tract (Fig. 7). There was no evidence of pericardial effusion. The ultrasound tracing done in the left lateral decubitus position was strikingly different. A large anterior echo-free space was seen and the dimensions of the right ventricle (1.2 cm) and the right ventricular outflow tract were considerably less than those obtained in the supine position (Fig. 8). Cardiac catheterisation disclosed a right atrial mean pressure of 16 mmHg; a pulmonary wedge pressure of 22 mmHg and a left ventricular end-diastolic pressure of 22 mmHg. The left ventriculogram showed grade 2/4 mitral regurgitation and good contractions of the left ventricle. The right coronary artery was totally occluded near its origin. A large space was present between the outer border of the left ventricular cavity and the lateral border of the cardiac silhouette. Operation was performed shortly after cardiac catheterisation. On entering the chest, the innominate vein was grossly dilated (6 cm) because of cardiac tamponade. The pericardium was tightly distended and discoloured due to old and new blood beneath it. On opening the pericardium a large,

Fig. 6 Chest x-ray films of case 4. The film on the left was taken on the first hospital admission; the film on the right was taken 3 weeks later when he was admitted in a low output state. Note the unusual bulge on the upper left cardiac border, which was not present on the earlier film.

Fig. 7 Echocardiogram of case 4 recorded in the supine position. Note the dilated right ventricle (RV) and the right ventricular outflow tract (RVOT). AWRV, anterior wall of right ventricle; AW inf, anterior wall of infundibulum of the right ventricle; LV, left ventricle; IVS, interventricular septum.

Fig. 8 Echocardiogram of case 4 recorded in the left lateral decubitus position. In contrast to the recording done in the supine position, an echo-free space (x) is seen anterior to the anterior right ventricular wall (AWRV) and the right ventricular outflow tract (RVOT). The dimension of the right ventricle and RVOT is much smaller than that observed in the supine view. AV, aortic valve.

Fig. 9 A diagrammatic sketch of the surgical findings in case 4. A large cystic mass (which has been opened by the surgeon) is seen anterior to the right ventricle (RV) and covering the right ventricular outflow tract.

Fig. 10 Ultrasound recording of Case 5. A large posterior (x), and a small anterior (x) pericardial effusion is present. The anterior wall of the right ventricle (ARV) is obviously thickened (1.5 cm). CW, chest wall; LVPW, posterior wall of left ventricle.

localised, cystic haematoma containing liquefied black blood was noted on the anterior surface of the right ventricle and right ventricular outflow tract (Fig. 9). When the haematoma was evacuated, the innominate vein became entirely flat, indicating relief of tamponade. The diaphragmatic surface of the heart was plum coloured and did not contract well. There was no identifiable myocardial rupture. Palpation of the mitral valve through the left atrium did not show a regurgitant jet. A left atrial catheter showed a mean pressure of 20 mmHg and there were no prominent 'V' waves. It was felt that the mitral regurgitation seen at cardiac catheterisation was probably caused by extrinsic compression and deformity of the mitral valve apparatus. The patient died shortly after operation.

CASE 5

A 63-year-old white man was admitted with a complaint of cough, fever, and shortness of breath. The chest x-ray film showed a mediastinal mass, and mediastinoscopy and biopsy showed a lymphocytic lymphoma. He was treated with chemotherapy and radiotherapy with consequent improvement of his symptoms. He was discharged to be followed as an outpatient, and was readmitted two weeks later with symptoms and signs suggestive of a pericardial effusion. The electrocardiogram showed diffuse ST elevation.

The echocardiogram showed a large posterior

and a small anterior pericardial effusion (Fig. 10). The anterior wall of the right ventricle was thickened (1.5 cm). Pericardiocentesis was attempted, but only a small amount of fluid was obtained. Because of increasing dyspnoea, a thoracotomy was performed. A large pericardial effusion and extensive tumour deposits on the anterior and other surfaces of the heart were found at operation.

Discussion

Several reports have stressed the usefulness of echocardiography in the diagnosis of intracardiac tumours (Popp and Harrison, 1969; Wolfe *et al.*, 1969; Schwarz *et al.*, 1972). Though A-mode ultrasound has been used to evaluate mediastinal masses, the use of M-mode echocardiography in the diagnosis of extracardiac masses has received little attention (Ostrum *et al.*, 1967; Child *et al.*, 1975). Our study shows that echocardiography is a useful method of evaluating patients with extracardiac masses.

Cases 1 and 2 illustrate the importance of gain control in the detection of extracardiac tumours. If the anterior gain had not been carefully adjusted in case 1, the mass in front of the aortic root and right ventricle could have been missed. Similarly in case 2, the tumour mass behind the heart might have been overlooked if the gain had not been appro-

priately adjusted. The left atrial cavity in this patient was much reduced in size. The retrocardiac mass probably pushed the posterior left atrial wall anteriorly, thus reducing the anteroposterior dimension of the left atrium.

The value of different transducer positions and the importance of examining the patient in different positions during echocardiography are illustrated in cases 3 and 4. Cardiac structures could only be recorded from the right sternal border in case 3. This suggested that the heart was displaced to the right. Since the patient was known to have a sarcoma of the left chest wall, intrathoracic extension of the tumour with displacement of the heart seemed a logical explanation. This was confirmed at necropsy.

The echocardiogram of case 4 in the supine position showed a dilated right ventricle and right ventricular outflow tract. A strikingly different picture was seen in the left lateral decubitus posi-

Fig. 11 A diagrammatic cross-section of the thorax and heart of case 4, with the patient supine (left panel) and the corresponding echocardiogram (right panel). The dark area behind the sternum represents a cystic haematoma which has compressed a part of the right ventricle, resulting in a bulge of another part of the right ventricular chamber. The ultrasound beam (dotted line) traverses the area that is bulging, giving rise to the impression of right ventricular enlargement on the echocardiogram.

Fig. 12 Diagram of heart and thorax of case 4, with the patient in the left lateral position (left panel) and the corresponding echocardiogram (right panel). The cystic haematoma is now in the path of the ultrasound beam (dotted line) giving rise to an echo-free space (X) anterior to the right ventricle. The ultrasound beam traverses the compressed part of the right ventricle (RV) and hence the RV dimension on the echocardiogram is less than that observed in the supine position. T, transducer.

tion. A large echo-free space was present anterior to the right ventricle and the right ventricular outflow tract, and the dimensions of the right ventricle and right ventricular outflow tract were much smaller. A possible explanation for the remarkable difference between the supine and left lateral echocardiogram is given in Fig. 11 and 12. At operation, a cystic haematoma was present between the anterior wall of the right ventricle and the sternum. The mass squashed an area of the right ventricle, thereby producing a bulge in another area. In the supine position (Fig. 11), the echo beam passed through the bulging area of the right ventricle, but not through the haematoma which was situated behind the sternum. In the left lateral position (Fig. 12), the mass came into the path of the ultrasound beam and the squashed area of the right ventricle was seen, so that a paradoxical (in the normal subject the right ventricular dimension is greater in the left lateral position) reduction of right ventricular size was noted.

A pericardial effusion and considerable thickening of the anterior wall of the right ventricle (1.5 cm) was noted in case 5. In the absence of clinical or electrocardiographic evidence of right ventricular hypertrophy, this gross anterior heart wall thickening was construed as possible evidence of tumour deposition on the myocardium. Our hypothesis was confirmed by thoracotomy.

In summary, the echocardiographic features of 5 patients with extracardiac masses are presented. Four patients were found to have solid tumours and the fifth had a cystic haematoma. Careful gain control; examination of the patient in different positions (supine and left lateral); and placement of the transducer at the right sternal border in addition to the standard position, helped in the delineation of these masses. It should be noted that the chest x-ray film failed to point to the precise diagnosis of our patients. Echocardiography may prove to be a useful method of diagnosing extracardiac space-occupying lesions and in differentiating between solid and cystic masses.

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