Right atrial embolus *Echocardiographic features*

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SUMMARY Although the value of echocardiography in detecting left heart thrombus is well recognised, right atrial thromboembolism has rarely been identified in life. In two patients with pulmonary embolism of varying severity cross sectional echocardiography identified a thrombus moving freely within the right atrium and clearly showed its string-like or even tubular structure. An embolectomy, based on the echocardiographic diagnosis, was undertaken successfully in one patient. The value of routine echocardiography in patients with suspected pulmonary embolism is yet to be confirmed.

Intracardiac thrombus, a well recognised and important necropsy finding,¹ can now be identified in life by echocardiography.^{2,3} The ability of this technique to detect intracardiac thrombus in the left ventricle and left atrium is well described.^{2,3} Only two isolated case reports of the echocardiographic features of right atrial thromboembolism have, however, been reported.^{4,5} We report the echocardiographic findings in two patients with a mobile right atrial thrombus, in whom pulmonary embolism occurred. The M mode and cross sectional echocardiographic appearances in both cases were similar and form important and specific diagnostic criteria for the detection of right atrial embolus.

Patients and methods

CASE 1

A 59 year old West Indian man was admitted with sudden onset of breathlessness while climbing stairs at home. On examination he was afebrile (temperature 36°C) and dyspnoeic at rest (respiratory rate 40/min) with a non-productive cough. His heart rate was 120 beats/min and his blood pressure 150/90 mm Hg, and the central venous pressure was not raised. The heart sounds were normal, but a soft and variable mid diastolic murmur was audible.

Chest radiographs showed a cardiothoracic ratio of 16:29 but no specific chamber enlargement, and the lung fields were clear. An electrocardiogram confirmed sinus tachycardia, a QRS axis of +90°, and poor R wave progression. The arterial pH was 7.4, PCO₂ 32 mm Hg, and PO₂ 62 mm Hg when the patient was breathing room air.

ECHOCARDIOGRAPHIC FINDINGS

Cross sectional and M mode echocardiograms were recorded using a Smith Kline Mechanical Echosector II. During routine M mode echocardiography of the right heart a normal tricuspid valve was clearly seen.

Fig. 1 M mode echocardiogram (case 1) showing a normal tricuspid valve (TV) and a randomly moving mass within the right atrium (RA).

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Fig. 2 Right atrial angiogram (a) (case 1) with explanatory diagram (b) during systole showing a massive space occupying lesion within the right atrium. TV, tricuspid valve.

Nevertheless, below this a randomly moving, echo reflecting mass approximately 1.0 cm in thickness was evident in the right atrium (Fig. 1). A cross sectional echocardiogram showed this same structure as a long coiled, string-like mass moving freely within the right atrium. The mass did not reflect the echoes strongly, so a high gain setting and low reject were necessary to visualise it clearly. Although well visualised in the short axis (at the aortic valve level), subcostal, and apical four chamber views, no clear point of attachment was apparent.

Additional findings

A lung perfusion scintigram showed filling defects in the left mid zone and right upper zone but a ventilation scan was normal. Right atrial angiography showed multiple large mobile filling defects that prolapsed across the tricuspid valve during diastole (Fig. 2). Subsequently, during preparation for surgery the patient collapsed and died. Postmortem examination confirmed a slightly enlarged heart (432 g) with mild left ventricular hypertrophy; the right ventricle was dilated but there were no intracardiac thrombi. Three major emboli were, however, removed from the pulmonary arterial tree, the most recent (22 cm in length) lay coiled astride the main pulmonary bifurcation (Fig. 3). Both lungs showed areas of peripheral infarction. Antemortem thrombosis was present in the veins of both calves and in the femoral vein on the left side only.

CASE 2

A 74 year old white woman had been unwell for several days with no specific symptoms. Two days before admission she had had an episode of acute breathlessness and had fainted. She also had a two year history of angina pectoris and palpitation. On the day of admission she had a two hour episode of severe central chest pain and breathlessness. On examination she was mildly breathless and not distressed. She was in atrial

Fig. 3 Morphological appearance of a massive embolus (Em) impacted in the pulmonary bifurcation (case 1). When uncoiled this (probable) venous cast was 22 cm in length. MPA, main pulmonary arteries.

Fig. 4 *M mode echocardiogram (case 2) showing a normal tricuspid valve and a randomly moving thrombus posterior to it and within the right atrium.*

fibrillation with an apex rate of 130 beats/min; her blood pressure was 110/70 mm Hg and the heart sounds were normal. Her chest was clear, but she did have slight ankle oedema. An electrocardiogram confirmed uncontrolled atrial fibrillation and right bundle branch block. A chest radiograph showed upper lobe blood diversion.

She was initially thought to have had acute myocardial infarction, but early the next morning she complained of further breathlessness and chest discomfort. She became hypotensive (90/50 mm Hg), her venous pressure was raised, and there were signs of consolidation at the base of the left lung. A chest radiograph showed an effusion and collapse of the left lower lobe.

Echocardiographic findings

Cross sectional and M mode examinations were performed with a Hewlett Packard phased array ultrasound system. The M mode echo (Fig. 4) showed two parallel randomly moving echoes within the right atrium, which were separated by approximately 1 cm. As in the previous case, the cross sectional echocardiogram was more impressive, clearly showing a tubular structure approximately 1 cm in diameter and 4 or 5 cm in length moving freely within

the right atrium but apparently attached at one end to the interatrial septum. Figure 5 shows an apical four chamber view in which the thrombus can be clearly visualised within the right atrium. In a parasternal modified short axis plane at aortic valve level the thrombus was visualised, in its own short axis, as a

Fig. 5 *Cross sectional echocardiogram (case 2) in the apical four chamber view showing a tubular mass (TM) within the right atrium (RA). TV, tricuspid valve; RV, right ventricle; LV, left ventricle.*

ring-like object. These echocardiographic findings suggested the diagnosis of an embolised venous cast.

Additional findings

Based upon previous experience urgent surgery was advised. At operation an extensive thrombus was found in the right atrium and inferior vena cava. Pulmonary artery pressures were moderately raised (47/15 mm Hg), but no definite areas of pulmonary infarction were noted. The postoperative recovery was initially uncomplicated, but on the fourth post-operative day she had haemoptysis with further signs in the chest. A chest radiograph confirmed a new effusion and pulmonary collapse. Venography showed extensive left iliofemoral venous thrombosis. She was treated with urokinase and subsequently with warfarin. Recovery was uneventful thereafter.

Discussion

Although the clinical presentations of these two cases were slightly different, the echocardiographic features were strikingly similar. The characteristic appearance on M mode echocardiography was of an echo reflecting mass within the right atrium which moved randomly and was quite separate from a normal tricuspid valve. Although an early report related a massive pulmonary embolus to "dense shaggy echoes closely applied to the tricuspid valve",⁵ the masses here were much less dense, clearly separated from the tricuspid valve, and much more like the recognised features of left atrial thrombus.³ Important further detail was apparent on cross sectional echocardiograms which, in both cases, showed the object to be string-like (coiled or even tubular in form) and freely mobile; again it was not strongly echo reflective and therefore necessitated instrument settings of high gain or transmit and low reject or compression. Nevertheless, cross sectional echocardiography did not show a definite point of attachment. Importantly, there was no inferior vena caval extension.

There is little doubt that the echocardiographic masses were major emboli moving towards the lungs. In one patient (case 1) angiography confirmed a mobile right atrial mass that could only have been the massive thrombus found impacted in the pulmonary bifurcation at necropsy. Similarly, in the second case a thrombus was again clearly identified as the source of the characteristic echocardiographic appearance. Thus the characteristic features of a right atrial thrombus appeared to be those of a poorly echo reflective mass, usually with a string-like appearance moving randomly within the right atrium but with clear separation from the tricuspid valve and inferior vena cava. The mass should be visible in several cross sectional echocardiographic views to exclude the possibility of artefact.

The clear separation from the tricuspid valve excludes the possibility of vegetation or redundant valve apparatus. The acoustic properties, absence of stalk and point of attachment, and absence of paradoxical septal motion differentiate this mass from a myxoma.⁶ The absence of pericardial effusion, involvement of the right atrial wall or one or other vena cava, and the low echo reflectance also exclude the possibility of primary or secondary tumour.⁶ No previously reported features of congenital heart disease could account for these findings, although the vestiges of an inferior vena caval valve could be misinterpreted as a right atrial mass. Nevertheless, the characteristic features of the inferior vena caval valve, both the site and orientation of the echoes, and their "bright rotatory features"⁷ are quite different from the structure described here and should alert the echocardiographer to this diagnosis.

Although the second patient appeared to have had several small pulmonary emboli, a major episode was probably prevented. Thus when massive pulmonary embolism is suspected such echocardiographic features might permit more urgent surgery and obviate the risks of pulmonary angiography.

While the overall incidence of two cases among approximately 4000 examined by routine echocardiography in a two and a half year period is low, the incidence among patients with suspected pulmonary embolism may be higher, and thus the potential value of routine echocardiography in such patients remains open to discussion.

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