Echocardiographic Detection of Right-sided Cardiac Thrombi in Pulmonary Embolism*

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Echocardiography has proved useful in detecting right-sided heart thrombi in cases of pulmonary embolization. We found echocardiographic evidence of right-sided cardiac thrombi in six of seven patients affected by pulmonary embolism referred to our hospital within the past five months. In one patient with clinical evidence of pulmonary and paradoxical embolization, echocardiography revealed, besides thrombi within the inferior vena cava and right atrium, a transient, wide, systolic movement of the valvula foraminis ovalis toward the left atrium, suggesting an interatrial communication that was confirmed by contrast echocardiography. Five patients had a good outcome, with disappearance of the thrombi following IV heparin therapy, and one patient died.

This report deals with six cases of pulmonary embolism (PE) with echocardiographic evidence of thrombi within the right-sided heart cavities or the inferior vena cava. All of the patients but one survived, and the thrombi disappeared following IV heparin therapy. Echocardiography also revealed a transient interatrial defect in one patient with clinical data consistent with paradoxical embolism.

**Materials and Methods**

The diagnosis of pulmonary embolism was supported by typical

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Table 1—Clinical Features and Course of Six Patients with Right-sided Thrombi

<table>
<thead>
<tr>
<th>Case</th>
<th>Age, yrs</th>
<th>Sex</th>
<th>Underlying Problem</th>
<th>Presenting Symptoms</th>
<th>ECG</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>66</td>
<td>M</td>
<td>Chronic lymphocytic leukemia</td>
<td>Chest pain, dyspnea</td>
<td>Inversion of T waves in V₁-V₂ leads</td>
<td>Heparin</td>
<td>Clinical improvement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>discharged on coumadin</td>
</tr>
<tr>
<td>2</td>
<td>46</td>
<td>M</td>
<td>Previous anterior and inferoposterior infarction</td>
<td>Chest pain, dyspnea, hemoptysis</td>
<td>Inversion of T waves in V₁-V₂ leads</td>
<td>Heparin</td>
<td>*</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>F</td>
<td>Recent operation (fracture of tibia)</td>
<td>Chest pain, dyspnea, clinical features consistent with paradoxical embolization</td>
<td>Inversion of T waves in precordial leads</td>
<td>Heparin</td>
<td>*</td>
</tr>
<tr>
<td>4</td>
<td>38</td>
<td>F</td>
<td>Recent operation cholecystectomy</td>
<td>Dyspnea, syncope</td>
<td>Inversion of T waves in V₁-V₂ leads</td>
<td>Heparin</td>
<td>*</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>F</td>
<td>Recent operation (hysterectomy)</td>
<td>Chest pain, dyspnea</td>
<td>S₁, Q₃ pattern</td>
<td>Heparin</td>
<td>*</td>
</tr>
<tr>
<td>6</td>
<td>61</td>
<td>M</td>
<td>Diabetes</td>
<td>Dyspnea, chest pain, syncope</td>
<td>S₁, Q₃ pattern</td>
<td>Heparin Urokinase</td>
<td>Death, during urokinase infusion</td>
</tr>
</tbody>
</table>

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revealed the presence of right-sided cardiac thrombi. They were found within the right atrium in all patients (Fig 1-4). In addition, in one case (case 2) ultrasound examination also revealed the presence of a big, immobile thrombus adherent to the moderator band and right ventricular free wall (Fig 5), and in two cases (cases 3 and 4) it showed thrombi within the terminal tract of the inferior vena cava (Fig 6).

The thrombi were immobile in all cases but the last (case 6). In this case (Fig 4) two-dimensional echocardiography showed a long, serpentine-like right atrial thrombus with chaotic movements within right atrium. Such a thrombus was irregularly protruding into the right ventricle (Fig 7).

One patient (case 3) also had symptoms and signs consistent with paradoxical embolism (sudden acute pain to the right foot, with pallor and disappearance of pedal pulsation). In this patient two-dimensional echocardiography showed, besides two thrombi within the...

Table 2—Echocardiographic Findings of Six Patients with Right-sided, Thrombi

<table>
<thead>
<tr>
<th>Case</th>
<th>Location of the Masses</th>
<th>Mobility of the Masses</th>
<th>Disappearance of the mass, wk</th>
<th>Other Echographic Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Right atrium</td>
<td>No</td>
<td>3</td>
<td>Enlargement of right heart cavities; paradoxic septal motion</td>
</tr>
<tr>
<td>2</td>
<td>Right atrium, right ventricle (attached to moderator band)</td>
<td>No</td>
<td>3</td>
<td>Four chamber dilation</td>
</tr>
<tr>
<td>3</td>
<td>Right atrium, terminal tract of inferior vena cava</td>
<td>No</td>
<td>4</td>
<td>Enlargement of right heart cavities; systolic movement of the valvula foraminis ovals toward the left atrium</td>
</tr>
<tr>
<td>4</td>
<td>Right atrium, terminal tract of inferior vena cava</td>
<td>No</td>
<td>2</td>
<td>Enlargement of right atrium</td>
</tr>
<tr>
<td>5</td>
<td>Right atrium</td>
<td>No</td>
<td>2</td>
<td>Enlargement of right atrium</td>
</tr>
<tr>
<td>6</td>
<td>Right atrium</td>
<td>Yes</td>
<td>—</td>
<td>Enlargement of right heart cavities; paradoxic septal motion</td>
</tr>
</tbody>
</table>

Within right atrium, irregularly protruding into right ventricle

**Figure 1.** Case 1: Two-dimensional echocardiogram in the parasternal short-axis view. Echo-dense mass (arrow) within the right atrium. RA = right atrium; RV = right ventricle.

**Figure 2.** Case 3: Two-dimensional echocardiogram in the parasternal short-axis view. Evidence of an echo-dense mass (arrow) within the right atrium. RA = right atrium; LA = left atrium.

**Figure 3.** Case 4: Two-dimensional echocardiogram in the parasternal short-axis view. Echo-dense mass (arrow) within the right atrium. RA = right atrium; RV = right ventricle.
right atrium and the inferior vena cava, a wide systolic movement of the valvula foraminis ovalis toward the left atrium, causing a systolic interatrial communication (Fig 5); moreover, contrast echocardiography revealed slight right-to-left intracardiac shunt. These echocardiographic findings were no longer appreciable one month later.

All of the patients were treated with heparin therapy. Gradual clinical improvement with disappearance of the masses within the second to the fourth week was obtained in five patients. The sixth, treated with heparin followed by IV urokinase, died suddenly during the infusion of urokinase.

**DISCUSSION**

Recently echocardiography has proved useful in detecting right-sided heart thrombi in cases of pulmonary embolism.$^{1,10}$ It is possible that early echocardiographic detection of right-sided cardiac thrombi in pulmonary embolism would not be unusual if such thrombi were actively sought. In fact, we recognized them in six of seven patients affected by pulmonary embolism by performing echocardiography on the same day of an episode of embolization or within 24 hours.

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**FIGURE 4.** Case 6: Two-dimensional echocardiogram in the parasternal short-axis view. Thromboembolus (arrow) is appreciable within the right atrium just beneath the tricuspid valve.

**FIGURE 5.** Case 2: Two-dimensional echocardiogram in the four-chamber apical view. Immobile echo-dense mass (arrow) attached to the moderator band and right ventricular free wall of the right ventricle. RA = right atrium; LA = left atrium.

**FIGURE 6.** Case 3: Two-dimensional echocardiogram in the subcostal four-chamber view. Echo-dense mass (arrow) within the terminal tract of the inferior vena cava. RA = right atrium.

**FIGURE 7.** Case 6: Two-dimensional echocardiogram in a modified apical four-chamber position demonstrating right atrial thromboembolus (arrow) protruding into the right ventricle. RV = right ventricle; LV = left ventricle.
Concerning therapy, following early reports, it was thought that in the presence of such echocardiographic findings, surgical removal of the thrombus was mandatory, even if a relevant surgical mortality was reported. The good outcome of five of our patients who were not treated with surgery is similar to that reported in other recent articles. This result seems to lend support to the view of Cameron et al., who suggested selecting the approach on the basis of the echographic features (ie, the mobility of thrombi). However, the lack of agreement on such a crucial point emphasizes the need of investigating wider series, possibly in controlled trials.

The possible merit of echocardiography in the diagnosis of paradoxical embolization is further highlighted by our case 3 in whom a transient interatrial communication was shown and confirmed by the demonstration of right-to-left shunt by means of contrast echocardiography. Since this finding was not present one month later, it is possible that it was related to the high pressure levels within the right heart and to the transient tricuspid insufficiency. It may be questioned whether such a mechanism might be responsible for paradoxical embolization in other, similar cases, where no evidence of a true atrial septal defect was reported.

Our cases suggest the following: (1) in pulmonary embolization, thrombi must be looked for in right atrium as well as in inferior vena cava and in the right ventricle; sometimes thrombi may be detected in more than one side; (2) the outcome of the patients treated with heparin therapy appears good if there is echocardiographic evidence of immobile right-sided heart thrombi; (3) echocardiography may be useful in the follow-up of pulmonary embolization, showing the possible disappearance of the thrombi; and (4) echocardiography may be useful in diagnosing paradoxical embolism.

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