Mobile Thrombi of the Right Heart in Pulmonary Embolism*

Delayed Disappearance After Thrombolytic Treatment

Emile Ferrari, MD; Mustapha Benhamou, MD; Frederic Berthier, MD; and Marcel Baudouy, MD

Background and objectives: In patients presenting with pulmonary embolism (PE), echocardiography, in some cases, reveals mobile clots in right heart (RH) cavities. How these clots evolve after treatment, in particular after thrombolytic treatment (TT), is unknown. We sought to determine the outcome of these mobile clots in the RH during TT.

Methods and results: Of a series of 343 patients who had been hospitalized for PE in our department, echocardiography performed on hospital admittance showed a mobile clot in the RH in 18 patients (mobile clot incidence, 5.2%). This subgroup of 18 patients presented with a more severe form of PE than the 325 patients without mobile clots in the RH. In our series, 16 patients were treated with thrombolytic agents. Close echocardiography monitoring showed the outcomes of these mobile clots during and after TT. In 50% of cases, the clot disappeared rapidly in < 2 h after the end of TT. In 50% of the remaining cases, the clot disappeared later, half within 12 h following the completion of TT, and the other half within 24 h. All patients were alive on day 30 without any clinical sequellae.

Conclusion: In these particular forms of PE with mobile clots in the RH, the short time lag required to disperse the clot after TT makes it imperative to delay any decision about new aggressive therapy.

(CHEST 2005; 127:1051–1053)

Key words: echocardiography; pulmonary embolism; thrombolysis

Abbreviations: PE = pulmonary embolism; RH = right heart; TT = thrombolytic treatment; TTE = transthoracic echocardiography

The presence of a mobile clot in the right heart (RH) distinguishes a particularly severe form of pulmonary embolism (PE). The incidence of such mobile clots in patients with PE has been reported to be between 3.6% and 18%.1–3 This incidence depends on the severity of the cases considered and on the systematic use, or not, of echocardiography. The mortality rate from these PEs is very high, up to 27% in a 2002 metaanalysis.4 The outcome of these mobile clots during and after thrombolytic treatment (TT) is not known.

Aim of the Study

The aim of our study was to describe the evolution of RH mobile clots during and after treatment, mainly TT. In particular, we tried to answer the two following questions: (1) What happens to these RH clots during TT?; and (2) Does the disappearance of the RH clots affect the patient’s prognosis?

Materials and Methods

Transthoracic echocardiography (TTE) was systematically performed on hospital admission in all patients being hospitalized for PE. In patients with an observed and echocardiographically confirmed RH clot, TTE was repeated at the end of TT, if it had been administered. Subsequently, echocardiography monitoring was done twice a day for 48 h, then once a day until the clot disappeared or whenever a clinical event occurred. The following parameters were gathered: right ventricular size; right ventricle/ left ventricle end-diastolic diameter ratio; and systolic pulmonary pressure estimated by means of tricuspid regurgitation.

TTE was performed (Sonos 5000; Hewlett Packard; Palo Alto, CA) by experienced operators. In order to confirm the diagnosis of these mobile clots in the RH, all TTE procedures were taped and reviewed by one of us (E.F.) in a blind manner. The clot was thus characterized by its appearance, size, and mobility. All patients had office follow-up at 1 month.

Statistical Analysis

Data were expressed as the mean ± SD. Differences for continuous variables between patients with and without RH clots were assessed by Student t test. Values of p < 0.05 were considered to be statistically significant.

Results

From January 1998 to May 2002, 343 patients were hospitalized for a confirmed PE in our cardiology department. PE was confirmed in 32% of cases using a high-probability lung scan combined with high clinical pretest probability, in 32% of cases by CT scan, and in 5% of cases by angiography. In 31% of cases, PE was diagnosed by the coexistence of confirmed deep venous thrombosis in patients.

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with high clinical pretest probability and nonnegative d-dimer levels. Of these 343 patients, the initial TTE showed a mobile clot in the RH in 18 patients. This represents an incidence of 5.2%. A comparison between PE patients with a mobile clot in the RH (n = 18) and PE patients without (n = 325) showed that age, comorbidity, and the clinical circumstances of PE occurrence were not different.

In contrast, when examining PE severity criteria, a comparison between the two groups pinpointed a more severe form of PE when RH clot was present (Table 1). Indeed, heart rate, systolic pulmonary pressure assessed by echocardiography, and right ventricle/left ventricle diameter ratio were higher, while BP was lower in the group of patients presenting with RH clot (p < 0.05 for all four criteria).

The RH clots found in our study were always located in the right atrium; all were very mobile, prolapsing into the RH ventricle during diastole in 50% of cases (8 of 16 cases). The mean dimensions were 4.2 ± 0.6 cm in length by 0.4 ± 0.1 cm in width. No patient had more than one clot. In one case, the clot was trapped astride the foramen ovale prolapsing into both atria.

Treatments Performed

For the patient with the clot trapped in the foramen ovale, surgical removal was chosen. This patient had been hospitalized 3 days previously for a stroke. A systematic echocardiography performed at day 3 showed enlarged RH cavities and the clot trapped in the foramen ovale. Given the threatening nature of the clot, the patient was operated on. The surgical procedure involved removing the clot and closing the foramen ovale. Despite the recent stroke, the outcome was favorable. In particular, there was no worsening of the patient’s neurologic condition.

One patient received treatment with IV heparin alone. For this patient, the clot was still present on day 5 and had disappeared by day 6, while echocardiography showed a decrease in systolic pulmonary pressure (from 54 to 42 mm Hg) and a decrease in right ventricle diastolic size (from 38 to 31 mm) with a concomitant improvement in right ventricle hemodynamics.

The remaining 16 patients received TT (alteplase, 10 mg as a bolus then 90 mg during a 2-h infusion). For these 16 patients who had been treated with thrombolytic agents, the first control echocardiogram, which was performed on average 2 h after the end of TT, showed the disappearance of the RH clot in 8 patients (50%). For four other patients (25%), the clot was still present with no modification of echocardiographic features but had disappeared at the second control echocardiogram within 12 h. It could not be determined exactly when the RH clots disappeared between hour 4 and hour 12.

For the remaining four patients (25%), the clot was still present at hour 4 and hour 12 but had disappeared by the time of hour 24 control echocardiogram. It should be noted that, in all cases, the control echocardiogram that had been performed before the disappearance of the clot showed a marked improvement in RH hemodynamic status with a decrease in the right ventricle/left ventricle diastolic diameter ratio (from 0.86 ± 0.11 to 0.65 ± 0.12, respectively) and a decrease in systolic pulmonary pressure (from 69 ± 12 to 48 ± 11 mm Hg, respectively).

On day 30, all patients were alive with no sequellae from their PE. None of these patients presented clinical signs of PE recurrence.

Table 1—Comparison of Different Parameters in PE Patients With RH Clots vs Those Without RH Clots

<table>
<thead>
<tr>
<th>Parameters</th>
<th>With RH Clots (n = 18)</th>
<th>Without RH Clots (n = 325)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV/LV ratio</td>
<td>0.86 ± 0.18</td>
<td>0.58 ± 0.11</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Systolic PAP, mm Hg</td>
<td>68 ± 17</td>
<td>48 ± 13</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Systolic BP, mm Hg</td>
<td>112</td>
<td>142</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>HR, beats/min</td>
<td>112</td>
<td>92</td>
<td>&lt; 0.05</td>
</tr>
</tbody>
</table>

*Values given as mean ± SD, unless otherwise indicated. RV = right ventricle; LV = left ventricle; PAP = pulmonary artery pressure; HR = heart rate.

Discussion

Mobile clots of the RH in patients with PE are now detectable using echocardiography. The incidence of these in-transit mobile clots in the RH is variable, as has been reported in the literature.3,4 We ourselves reported an incidence of 4% in a French multicenter survey including > 550 patients.5

In an ancillary study using data from the International Cooperative Pulmonary Embolism Registry,6 Torbicki et al7 reported an incidence of 4%, which would decrease to 3.6% if we did not take into account those patients with central lines and pacemakers who obviously fall into a different category. Other studies,3 including those with patients experiencing more severe forms of PE (eg, patients who have been admitted to critical care units), have reported a higher incidence of these mobile clots in the RH.

It seems that the presence of RH clots has prognostic significance, predicting a mortality rate that is higher than the average. In a metaanalysis including all major reported cases in the literature up to 2002, Rose et al5 reported a 27% mortality rate.

In our study, we confirmed the correlation between the presence of an RH clot and the severity of the PE described in prior studies.2,3 This correlation probably explains the worse prognosis of these forms of PE. It is possible that the migration of these clots to the lung is temporarily slowed by high pulmonary pressure, low cardiac output, and considerable tricuspid regurgitation, which may result in the clot remaining in the right atrium.

Obviously, the echocardiographic features of the clots we described, in particular their appearance and dimensions, represent a real model of a peripheral vein and argue in favor of in-transit clots rather than in situ clots, which may sometimes occur under conditions of low cardiac output.7

At the present time, there is no consensus on how to treat patients with PE and associated RH clots.8 The metaanalysis published in 1989 by Kinney and Wright8 showed no advantage for any treatment option used, namely, heparin, TT, or surgery. However, the more recent metaanalysis published...
by Rose et al, pointed to a better outcome with TT. It should be mentioned that in the data from the study by Torbicki et al, the delay between the presumed onset of symptoms and hospitalization was shorter in patients with those forms of PE with mobile clots in the RH (2.2 vs 4.5 days, respectively). This may account, in part, for the favorable result when TT is used. In our study, although we did not perform hemodynamic measurements, the 50% rate of RH clot disappearance after 2 h seems a quite favorable response compared to the expected TT efficacy.10,11

In our series, in addition to the very good results obtained with TT, we showed that mobile clots may persist in half of the patients treated in the hours following the end of TT without the result being prejudicial. This information is clinically relevant. It suggests that the persistence of the clot during the hours following TT should not result in a hasty decision to embark on a new strategy (eg, TT or a surgical option).

Our study did not allow us to assess whether disappearance of the clot was due to dissolution by TT or to migration to the pulmonary arteries. In the literature, some data favor dissolution of these clots by TT in the RH. However, some particular cases documented the migration of these clots to the lung. The findings of our study argue in favor of the latter result. The improvement of cardiac output and the decrease in RH afterload and pulmonary pressure caused by TT may have finally induced migration of the clot. Dissolution of the clot in the RH, which probably formed prior to the latter result. The improvement of cardiac output and the decrease in RH afterload and pulmonary pressure caused by TT may have finally induced migration of the clot. Dissolution of the clot in the RH, which probably formed prior to the latter result. The improvement of cardiac output and the decrease in RH afterload and pulmonary pressure caused by TT may have finally induced migration of the clot. 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CONCLUSION

The choice of the optimal treatment for patients with PE presenting with mobile clots in RH is still open to debate. Although this was not the purpose of our study, our series demonstrated favorable results with TT. The short time lag required in 50% of cases to disperse the clot after TT is a new and highly relevant finding. In particular, it suggests that, when a RH clot is still present shortly after TT, we should delay the echocardiogram before deciding on a new aggressive strategy.

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Does Continuous Positive Airway Pressure by Face Mask Improve Patients With Acute Cardiogenic Pulmonary Edema Due to Left Ventricular Diastolic Dysfunction?*

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Objective: Continuous positive airway pressure (CPAP) by face mask is an effective method of treating severe cardiogenic pulmonary edema (CPE). However, to our knowledge, no study has provided a precise evaluation of the effects of CPAP on cardiac function in patients presenting with CPE and preserved left ventricular (LV) function.

Design: Prospective observational clinical study.

Setting: A 14-bed, medical ICU at a university hospital.

Patients: Nine consecutive patients presenting with hypoxemic acute CPE.

Interventions: All patients were selected for 30 min of...