

## Unusual Echocardiographic Presentations of Pulmonary Embolism in Transit

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The clinical spectrum of pulmonary embolism varies from asymptomatic cases to fatal outcome and does not correlate with anatomic findings; massive pulmonary embolism may be only mildly symptomatic or asymptomatic. The gold standard for the diagnosis of pulmonary embolism is pulmonary angiography. Echocardiography has been used only as an accessory diagnostic method. We present four unusual cases of pulmonary embolism, diagnosed or followed by echocardiography.

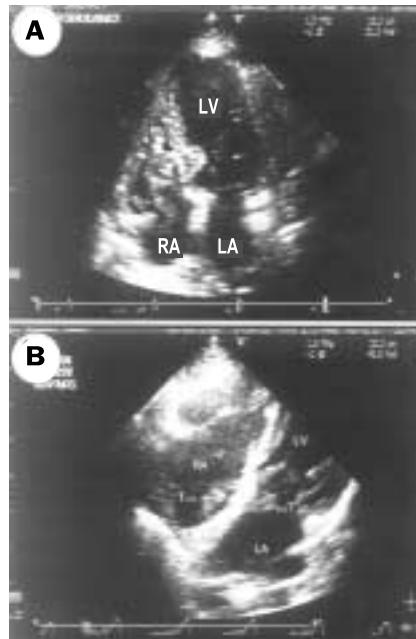
### Patient Descriptions

#### Patient 1: Asymptomatic major pulmonary embolism

A 71 year old woman had been bedridden for 2 weeks due to congestive heart failure. She had undergone angioplasty to the left circumflex artery and was sent for routine echocardiographic follow-up for the evaluation of the severity of mitral regurgitation. Apical four-chamber view showed a large thrombus in the right atrium. The next image showed the thrombus crossing over the tricuspid valve [Figure 1A]. Shortly after that, thrombi could not be seen in the cardiac chambers. The patient remained completely asymptomatic, had a normally functioning right ventricle, and her pulmonary artery was not enlarged. Subsequent evaluation confirmed deep vein thrombosis. The patient's hospital course was uncomplicated and she was discharged with recommendation for prolonged anticoagulation.

#### Patient 2: Paradoxical embolism detected on trans-thoracic echo

A 76 year old man with a history of congestive heart failure was evaluated by echocardiography due to chronic dyspnea. Transthoracic echocardiography detected severe left ventricular dysfunction and



**Figure 1.** Pulmonary embolism in transit.

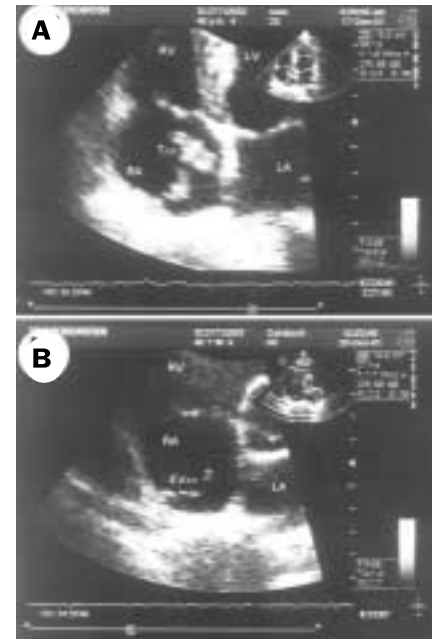
**[A]** Thrombus crossing the tricuspid valve (patient 1). T = the thrombus crossing the valve, LV = left ventricle, RV = right ventricle, LA = left atrium, RA = right atrium.

**[B]** Thrombi crossing the interatrial septum (patient 2). T = thrombi.

significant aortic stenosis. During the echocardiographic study the patient's condition suddenly deteriorated; he developed respiratory distress with desaturation and hemodynamic compromise. The image during the event detected a large thrombus in the right atrium, crossing into the right ventricle and also across a patent foramen ovale into the left atrium [Figure 1B]. The patient was resuscitated and treated with thrombolysis; however, despite the treatment he died.

#### Patient 3: A thrombus entrapped on the eustachian valve

A 47 year old man was admitted into the intensive cardiac care unit due to chest



**Figure 2.** Pulmonary embolism in transit entrapped on the eustachian valve (patient 3).

**[A]** Thrombus attached to the eustachian valve. RA = right atrium, LA = left atrium, RV = right ventricle, LV = left ventricle, T = thrombus. **[B]** Echo of the same patient as in **[A]** obtained 1 week later: normal eustachian valve. EV = eustachian valve.

pain and dyspnea. His electrocardiograph showed sinus tachycardia and right axis deviation. Transthoracic and transesophageal echocardiography on admission detected a prominent, deformed eustachian valve with a thrombus attached on it [Figure 2A]. A pulmonary scan on the same day detected a large left-sided perfusion defect compatible with massive pulmonary embolism. The patient's general condition improved under treatment with heparin. One week later a second echocardiography showed an apparently normal eustachian valve [Figure 2B]. A repeat pulmonary perfusion scan showed almost complete resolution of thromboembolism.

**Patient 4: Follow-up of treatment**

A 55 year old woman had been bedridden for 3 months following a road accident. She was not treated with anticoagulation therapy due to recurrent episodes of coffee-ground vomiting. She developed acute respiratory failure, shock and cardiac arrest and was resuscitated. Transthoracic echocardiography revealed right ventricular dilatation and dysfunction with signs of pressure overload. A subsequent TEE detected a large thrombus in the dilated right pulmonary artery. After thrombolysis with tissue plasminogen activator her condition improved significantly. Follow-up TEE still showed a thrombus in the right pulmonary artery, which was much smaller and more organized. The patient's condition improved further. An inferior vena cava filter was implanted and the patient was rehabilitated.

**Comment**

Contrast pulmonary angiography remains the gold standard for the diagnosis of pulmonary embolism. Perfusion/ventilation lung scanning is the most useful screening test to rule out clinically important acute pulmonary embolism. An alternative to lung scanning or conventional pulmonary angiography is spiral computed tomography angiography of the pulmonary artery. Echocardiography is useful for the evaluation of right ventricular function and for differential diagnosis of acute dyspnea or chest pain, but it is not a definitive diagnostic test. In all four cases presented here, pulmonary embolism was diagnosed during echocardiographic evaluation.

Asymptomatic pulmonary embolism is frequent. Among 101 asymptomatic outpatients with proven deep vein thrombosis, 51% had a high probability lung scan at the initiation of treatment. In 44 patients without DVT the prevalence of a high probability scan for pulmonary embolus was only 5% [1]. However, overall mortality for pulmonary embolus associated with thrombus in transit is 33%. The outcome in these patients is determined by the clinical presentation rather than by the identifica-

tion of thrombus [2]. The first patient described here is a rare example of "silent" pulmonary embolism in transit detected as an incidental echocardiographic finding.

Paradoxical embolism crossing through a patent foramen ovale requires a "triad" of patent foramen ovale, raised right atrial pressure, and a venous source of embolism. Visualization of trans-septal thrombus by transthoracic echocardiography is extremely unusual [3]. In our second case, both trans-septal thrombus in transit through a patent foramen ovale and pulmonary embolism in transit were demonstrated. The clinical picture confirmed the echocardiographic diagnosis.

Our third patient had a rare localization of thrombus, attached to the eustachian valve. We found only one report in the literature of thrombus over the eustachian valve [4], lysed with streptokinase. In the absence of echocardiographic follow-up, such a finding over the eustachian valve must be differentiated from myxoma and vegetation. In our case the disappearance of the thrombus at a follow echocardiography correlated well with a completely normal repeat lung scan 1 week later. This is also an example of mildly symptomatic massive pulmonary embolism without any signs of right ventricle compromise and with normal pulmonary artery pressure. For the last 40 years most fatal embolisms have been unexpected postmortem findings, and 10% of patients who survive for more than an hour beyond the occurrence of acute massive pulmonary embolism are a self-selected population with a relatively benign prognosis. This was the case in our patient, who did not receive any specific therapy except for standard anticoagulation.

Transesophageal echocardiography is not a convenient test for the diagnosis of pulmonary embolism, but the finding of a thrombus in a large branch of the pulmonary artery may be diagnostic and particularly useful in critically ill patients, such as our fourth patient. Massive pulmonary embolism presenting with shock and cardiac arrest is an indication for thrombolytic therapy. As was shown recently in massive pulmonary embolism, the morphology of thromboemboli is an independent predictor of 30 day mortality. Mobile thrombi, which originate from acute DVT, can be an

earlier phase of organization, are more susceptible to the thrombolysis and are associated with better short-term outcome than immobile partially organized thrombi [5]. Our case is an unusual example of evolution of the treatment effect of thrombolysis on a large clot in a major pulmonary artery.

We conclude the following: a) echocardiography may be a definitive diagnostic procedure in patients with pulmonary embolism; b) prominent eustachian valve is a potential though rare location for entrapment of pulmonary embolism in transit; c) occasionally even a massive pulmonary embolism may be clinically silent or mildly symptomatic and can resolve completely or partially with and also without thrombolytic therapy; d) if a thrombus in a major branch of pulmonary artery is observed during initial echocardiography, further evolution on a subsequent echocardiographic examination can provide information regarding treatment success.

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TEE = transesophageal echocardiography  
DVT = deep vein thrombosis