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## Commentary: Clot in transit: Catch it when you can

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Large pulmonary emboli can have devastating physiologic consequences that result in mortality as high as 18% to 33%, but can be reduced significantly if appropriately diagnosed and treated.<sup>1,2</sup> The case report by Medina and colleagues<sup>3</sup> from Universidad del Rosario presents a unique situation where the presence of a patent foramen ovale (PFO) makes not only the right heart and pulmonary vasculature vulnerable to thromboembolic effects, but also makes the systemic arterial vasculature vulnerable to thromboembolic phenomena. In the setting of increased right heart pressures from a large pulmonary arterial embolic load and a PFO, paradoxical emboli can occur and present as acute systemic arterial obstruction. The authors describe a case in which a 49-year-old man with known deep venous thrombosis receiving anticoagulation therapy presented with symptomatic pulmonary emboli and a left subclavian arterial thrombus with a paradoxical embolism in transit across the PFO. In patients who can tolerate an operation, open embolectomy with bicaval cannulation to facilitate removal of any clot in transit in the right atrium is indicated because it represents the most controlled circumstances to obtain the most complete embolic clearance. It is critical to distinguish an operation for chronic thromboembolic pulmonary hypertension and an acute embolus as in the case scenario. An operation for chronic thromboembolic pulmonary hypertension is much more extensive and includes a period of circulatory arrest to perform endarterectomy of as much of the pulmonary arterial tree as possible.<sup>4</sup> A less-extensive saddle embolus largely involving only the pulmonary trunk and left



Derek Serna-Gallegos, MD (left), and Ibrahim Sultan, MD (right)

### CENTRAL MESSAGE

Large pulmonary embolism in the setting of a patent foramen ovale is a potentially catastrophic situation and can be treated with open surgery and possibly other, less-invasive techniques.

and right pulmonary arteries can be approached with a beating heart technique if the bronchial blood returning to the heart can be controlled with cardiotomy suckers adequately to remove all the thrombus. In the case of a clot in transit across a PFO, the aorta must be crossclamped and heart function arrested to ensure that a paradoxical embolus is not ejected into the systemic arterial vasculature. One important technical consideration when approaching the thrombus within the PFO is not to simply pull on the thrombus from the right atrial side because it can break, leaving thrombus in the left atrium. Instead, carefully extend the opening of the PFO with a knife with the thrombus in place so that there is adequate room for the thrombus to be easily pulled into the right atrium in its entirety and to allow for exposure to the left atrium to explore for any other thrombus left behind. After removal of the thrombus, the atrial septum can be closed with a patch or primarily depending on the size of the defect. A PFO is an important consideration to always address in the setting of acute pulmonary embolic disease because patients with pulmonary embolism with a PFO >4 mm have a 10-fold increased risk of death and a 5-fold increased risk of systemic embolism when compared with patients without a PFO.<sup>5</sup>

In patients who cannot tolerate an open operation, several options exist. In the case of massive pulmonary embolus with circulatory collapse, peripheral venoarterial extracorporeal membrane oxygenation can be initiated as a bridge to catheter-based thrombolysis or to an aspiration

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thrombectomy using a device such as an Angiovac (Angio-Dynamics, Latham, NY). It is important to note that the nonsurgical management options have little to no ability to address a thrombus in transit across a PFO as in this case.

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