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CASE REPORT

BEGINNER

CLINICAL CASE

A Thrombus in Transit Complicating Acute Pulmonary Embolism

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ABSTRACT

A 51-year-old man presented with acute pulmonary embolism. He was found to have a large intracardiac thrombus in transit across a patent foramen ovale. He underwent anticoagulation and urgent surgical thrombectomy with good outcome. **(Level of Difficulty: Beginner.)** (J Am Coll Cardiol Case Rep 2019;1:652-6) © 2019 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

A 51-year-old male patient presented for shortness of breath. He described 1 week of worsening dyspnea and recurrent dizzy spells while performing his usual daily activities, which limited his function.

Physical examination revealed an obese man who appeared at his stated age. He was tachycardic and hypoxic with an oxygen saturation of 94% on room air. His blood pressure was 123/93 mm Hg. He had an estimated jugular venous pressure of 15 cm of water, prominent P2, right ventricular lift with S3, symmetrical breath sounds without rales or wheezing, and warm extremities with intact pulses.

LEARNING OBJECTIVES

- Assessment for intracardiac thrombi in PE should be considered, as this may substantially modify the treatment strategy.
- Three-dimensional echocardiography offers an additive value in the evaluation of intracardiac thrombi, especially if surgical thrombectomy is needed, as knowing the exact thrombus shape can help in achieving complete excision with confidence.

PAST MEDICAL HISTORY

The patient's history was significant for obesity.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included pulmonary embolism (PE) (Wells score = 4.5, calculated from the summation of alternate explanation is less likely [3 points], and tachycardia [1.5 points]) and acute coronary syndrome versus heart failure.

INVESTIGATIONS

Laboratory results were as follows: troponin I, 0.16 ng/ml (reference <0.03 ng/ml); and N-terminal pro-B-type natriuretic peptide, 300 pg/ml (reference <125 pg/ml); platelets 160,000 (reference >150,000 platelets/μl); prothrombin time, 9.5 s (control 9.5 s), activated partial thromboplastin time, 30 s (reference 30 to 40 s). The electrocardiogram showed sinus tachycardia, incomplete right bundle branch block, and right heart strain (Figure 1). The chest x-ray showed normal findings. A PE protocol computed tomography angiography revealed multiple filling defects in the right and left main pulmonary arteries with involvement of subsegmental

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Informed consent was obtained for this case.

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branches and right atrial and inferior vena cava thrombi (**Figure 2**). Venous ultrasound Duplex showed no deep vein thrombus.

MANAGEMENT

Intravenous heparin was initiated. Cardiology consultation was requested for localized catheter-directed thrombolytic therapy. Urgent bedside transthoracic echocardiography demonstrated systolic septal flattening, normal left ventricular systolic function with an estimated left ventricular ejection fraction of 55%, dilated right ventricle, reduced right ventricular systolic function with akinesis of the free wall, and normal motion at the apex (McConnell's sign). Right and left atrial thrombi were visualized and suspicious for thrombus in transit (**Figure 3**, Video 1). Urgent transesophageal echocardiography confirmed the diagnosis of thrombus in transit across patent foramen ovale (PFO) (**Figure 4**, Video 2). The 3-dimensional images demonstrated one long thrombus (**Figure 4**, Videos 3 and 4).

The patient developed increasing oxygen requirements; therefore, an urgent heart team approach was undertaken. Catheter-directed thrombolytic therapy was abandoned due to thrombus dislodgement concerns. The patient underwent urgent surgical thrombectomy with removal of a large thrombus in transit in one piece that matched the thrombus visualized by 3-dimensional echocardiography (**Figure 5**).

ABBREVIATIONS AND ACRONYMS

PE = pulmonary embolism

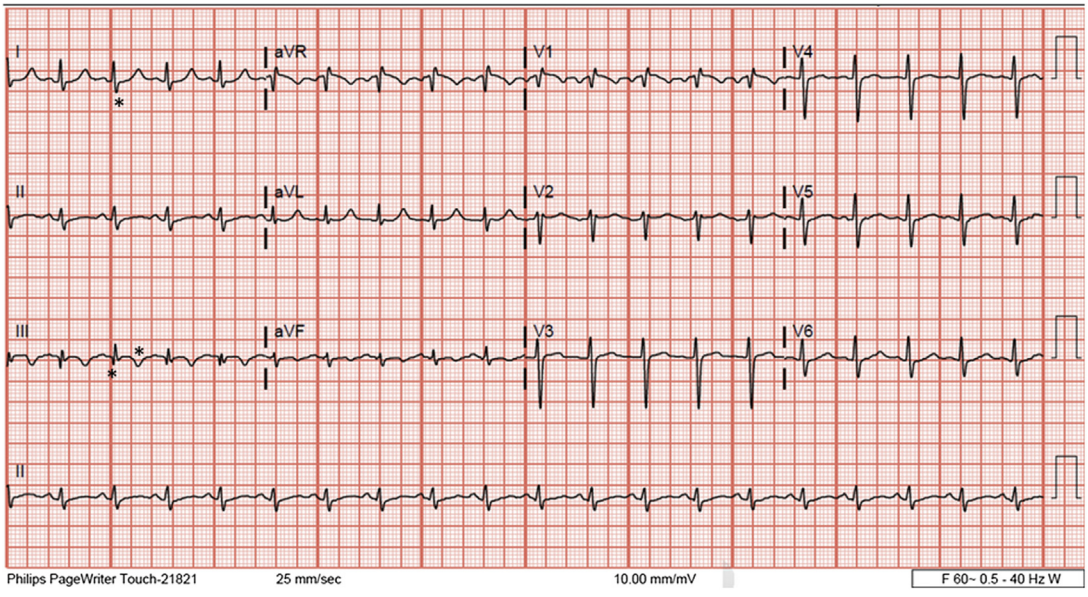
PFO = patent foramen ovale

DISCUSSION

PE is classified as massive when there is hypotension, submassive when patients are normotensive but with evidence of right ventricle dysfunction, and stable if neither is present (1). Thrombolytic therapy is indicated in massive PE (Grade 1B), while anticoagulation alone is recommended for stable PE (1). In submassive PE, thrombolytics mostly work to prevent hemodynamic deterioration at the expense of increased bleeding with lack of survival (2) or long-term pulmonary hypertension prevention benefits (3). Therefore, in submassive PE, anticoagulation is the initial preferred therapy, and if clinical deterioration occurs on anticoagulation despite stable blood pressure, thrombolytics are considered (Grade 2B) (1).

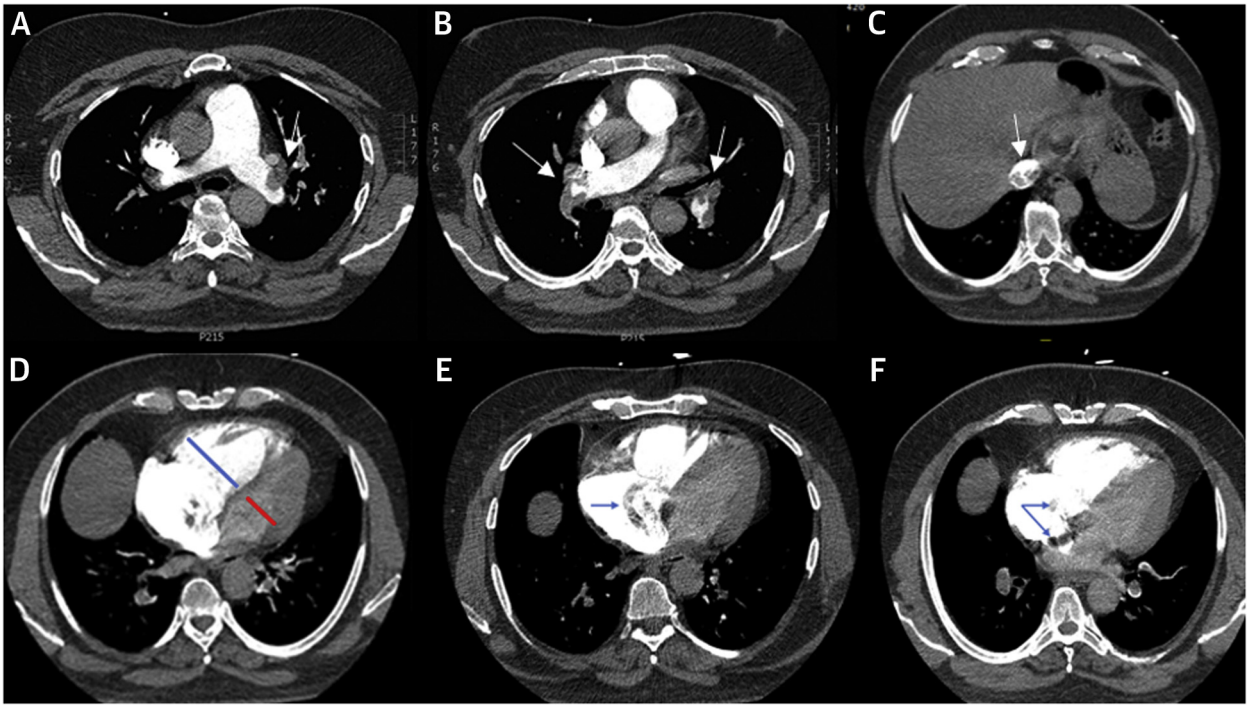
PFO is a hole in the heart between the right and left atria resulting from nonclosure of the foramen ovale after birth. PFO is common, with an estimated prevalence of 27.5% (4). Thrombus in transit across a PFO can develop when a thrombus is migrating from

FIGURE 1 Patient Electrocardiogram



The electrocardiogram shows sinus tachycardia, incomplete right bundle branch block, and right ventricular strain (**asterisk** indicates S1Q3T3 sign).

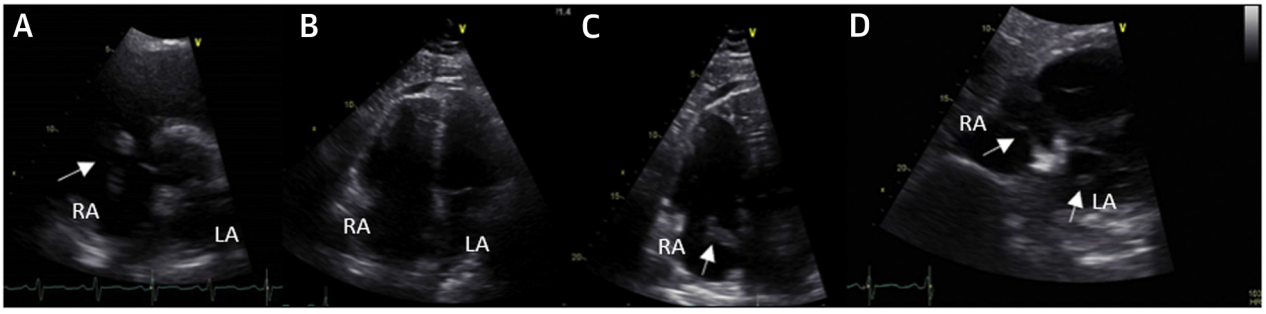
FIGURE 2 PE Protocol Chest Computed Tomography Angiography of this Patient Reveals PE With Right Heart Filling Defects and Strain



(A, B) Axial images through the pulmonary artery showing distal left and right main pulmonary, as well as subsegmental, emboli **(white arrows)**. **(C)** Axial image through the inferior vena cava showing filling defects **(white arrow)**. **(D to F)** Axial images through the heart revealing right heart strain (**blue-to-red line** ratio >0.9) and filling defects **(blue arrows)**. The left atrial thrombus visualization by this pulmonary embolism (PE) protocol computed tomography angiography was not possible; therefore, alternative imaging modality is required when left heart thrombi are suspected.

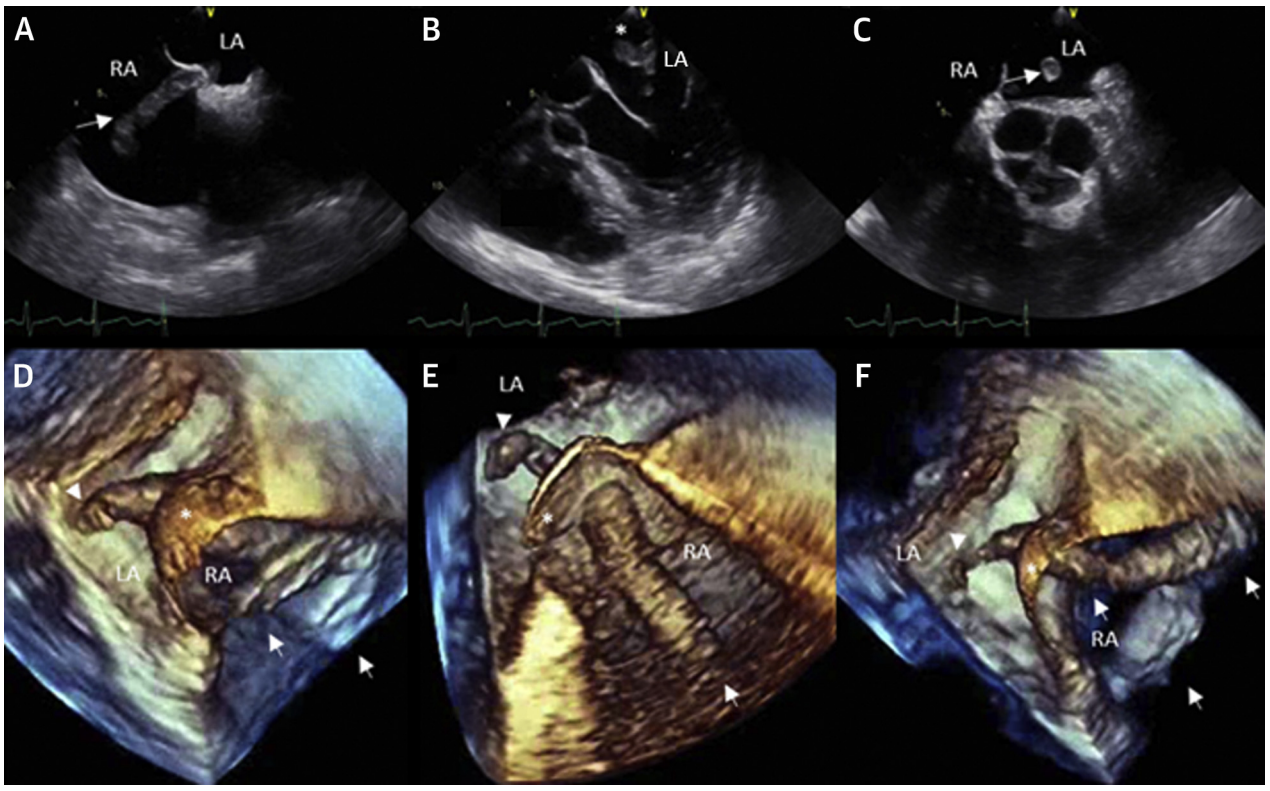
the right to the left atrium through the PFO. Although thrombus in transit is believed to be uncommon, its prevalence may be underestimated, especially if the window of time for capturing this event is missed. Occasionally, right heart thrombi are found in PE with variable prevalence, and data suggest that it is more common in massive compared with stable PE (5,6).

FIGURE 3 Transthoracic Echocardiography Images



(A) Short-axis, **(B)** apical 4-chamber, **(C)** right ventricular–focused, and **(D)** subcostal views showing left atrial (LA) and right atrial (RA) masses **(arrows)**. The mass was not clear in the apical 4-chamber view. This observation emphasizes that even large thrombi, as the one described in this case, may be missed if 2D echocardiography imaging is limited to one view. Therefore, the use of multiple acoustic windows is essential. See Video 1.

FIGURE 4 Midesophageal Transesophageal Echocardiography Images



(A) Two-dimensional 4-chamber view with clockwise rotation showing the RA thrombus in transit across the patent foramen ovale **(arrow)**. **(B)** Two-dimensional 5-chamber view showing thrombus in the LA **(asterisk)**. **(C)** Two-dimensional view at 45° showing LA thrombus **(arrow)**. **(D to F)** Three-dimensional zoom 4-chamber views showing 1 large thrombus in transit **(arrows)** across the patent foramen ovale **(asterisk)** extending into the LA **(arrowheads)**. Given the thrombus shape complexity, 2-dimensional planes fail to display the thrombus as one piece; thus, it is hard to determine the number and extension of thrombus. See Videos 2, 3, and 4. Abbreviations as in **Figure 3**.

This 51-year-old man had acute submassive PE with thrombus in transit across a PFO without residual deep vein thrombus. The large intracardiac thrombus burden complicated the decision-making process. With the limited benefits of systemic thrombolytics in submassive PE (1) and the safety concerns for thrombus dislodgement during catheter manipulation, both systemic and catheter-based thrombolytic options were less favored. Also, anticoagulation alone was less favored given the patient's worsening status on anticoagulation. Therefore, urgent surgical thrombectomy, anticoagulation, and supportive therapy seemed to be a more favorable approach.

This case highlights the importance of identifying thrombus in transit in PE. Both computed tomography and 2-dimensional echocardiography are useful for diagnosis. However, 3-dimensional echocardiography has an additive value, as it may allow thrombus size and number delineation more accurately. As the thrombus was large and moved in and out of the 2-dimentsional imaging plane, it may give the false impression of multiple thrombi (**Figures 1 and 2**). Understanding the thrombus burden may be useful for selecting the appropriate therapy. In addition, 3-dimensional echocardiography may facilitate operative approach planning to achieve successful complete thrombus excision. In this case, the pathology specimen matched the 3-dimensional echocardiography thrombus shape and the surgeon was more assured of a complete excision leaving no residual thromboembolic risk.

FOLLOW-UP

Postoperatively, the patient required extracorporeal membrane oxygenation and mechanical ventilation

FIGURE 5 Excised Thrombus and 3-Dimensional Echocardiography Image Focusing on Left Atrial Aspect of the Thrombus

(A) surgical specimen showing the thrombus along with its left atrial portion of loosely attached piece **(asterisk)**. **(B)** Three-dimensional echocardiography zoomed image showing the left atrial portion of the thrombus **(asterisk)** that was loosely attached to the main body.

support, which were successfully weaned gradually. The patient was discharged to rehabilitation facility, recovered, and returned to his baseline activity.

CONCLUSIONS

This case highlights the essential role of imaging in a patient with PE. Identifying intracardiac thrombi in PE may present an important piece of information for management.

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KEY WORDS 3-dimensional echocardiography, patent foramen ovale, pulmonary embolism, thrombus in transit

APPENDIX For supplemental videos, please see the online version of this paper.