

Incidental Finding of a Left Atrial Thrombus during Surgical Management of a Massive Pulmonary Embolism

Abstract

A 58-year-old male presented with a hemodynamically significant pulmonary embolism. Computed tomography angiogram revealed a saddle embolus in the main pulmonary artery with extensive clot burden affecting all lobes and right heart strain. Transthoracic echocardiogram displayed a dilated right ventricle with reduced systolic function. The patient was scheduled for pulmonary embolectomy. The intraoperative transesophageal echocardiogram (TEE) demonstrated a mobile left atrial thrombus that was missed on previous imaging. After removal of the thrombi, TEE showed a patent foramen ovale (PFO). The left atrial thrombus passed across the PFO secondary to increased right heart and pulmonary pressures.

Keywords: *Left atrial thrombus, patent foramen ovale, pulmonary embolism, right ventricular failure, right-to-left shunt*

**Sarah Dunn,
Nisha Dave,
Yilium F
Rodriguez-Blanco,
Oscar Aljure**

*Department of Anesthesiology,
Jackson Memorial Hospital,
Miami, FL, USA*

Introduction

A patent foramen ovale (PFO) is the most common congenital anomaly, occurring in 25%–35% of the population.^[1] A PFO can serve as a conduit for passage of thrombi across the interatrial septum. Pulmonary embolism (PE) is a widespread disease encountered with an incidence of about 60 cases/100,000 people in the general population.^[2] PE is an important disease process to be ruled out when evaluating patients with suggestive symptoms because it is the third leading cause of death for cardiovascular patients.^[2] When considering how frequent both PE and PFO are in the United States, it is vital for clinicians to understand the implications of these two disease processes occurring together.

A patient with a PE and a PFO is at risk for paradoxical emboli due to right-to-left shunting across the PFO.^[1] Paradoxical emboli traversing across a PFO is a rare diagnosis with no established treatment guidelines.^[3] Recognizing patients with a significant PE and PFO is critical for correct management as these patients are at risk for cerebral and coronary paradoxical emboli.

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Case Report

This case is of a 58-year-old male with a past medical history of hypertension and paranoid schizophrenia who presented to the emergency room with hypoxemia and right ventricle (RV) failure. The patient's vital signs are as follows: blood pressure 89/60 mmHg, pulse 120 beats/min, respiratory rate of 22, and saturation of 88% on 2 L/min nasal cannula. Computed tomography angiogram revealed a saddle embolus in the main pulmonary artery with extensive clot burden affecting all lobes and right heart strain with reverse curvature of the interventricular septum. Transthoracic echocardiogram (TTE) displayed a severely dilated RV with severely reduced systolic function. Figure 1 exhibits a dilated RV with a flattened interventricular septum. A mobile thrombus was seen in the right atrium that measured 2.7×1.2 cm.

This patient had a preinduction arterial line placed, and the patient had a standard induction with etomidate, fentanyl, lidocaine, midazolam, and rocuronium. Once the airway was secured with an 8.0 standard endotracheal tube through direct laryngoscopy, a 9 French MAC Introducer was placed through the right internal jugular vein. The surgical team, as well as the perfusionist, was on standby during

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Address for correspondence:

*Dr. Sarah Dunn,
7728 Abbott Ave. Unit 301,
Miami Beach, FL 33141, USA.
E-mail: sarah.dunn@jhsiami.org*

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induction of anesthesia in the event of hemodynamic collapse to initiate cardiopulmonary bypass. The patient underwent emergency pulmonary embolectomy for massive pulmonary embolus with hemodynamic compromise. Intraoperative transesophageal echocardiogram (TEE) demonstrated the mobile thrombus in the right atrium that was seen on TTE. Figure 2 demonstrates the right atrial thrombi in the mid-esophageal five-chamber view. In addition to the right atrial thrombi, TEE revealed a new finding of large thrombi in the left atrium. Figure 3 reveals a thrombus in the left atrium in the mid-esophageal aortic valve in long-axis view with an arrow highlighting the left atrial thrombus. The patient underwent sternotomy with cardiopulmonary bypass for embolectomy. Massive pulmonary emboli and clots were removed from both the left and right pulmonary arteries as well as the right and left atria. After removal of the thrombi, TEE demonstrated a PFO with left-to-right shunt and no residual intracardiac or pulmonary artery thrombi. Figure 4 shows the PFO with the left-to-right shunt after the removal of right and left atrial thrombi as well as pulmonary artery embolectomy. The patient was subsequently weaned off cardiopulmonary bypass and remained hemodynamically stable. At the end

of the procedure, an inferior vena cava filter was placed to prevent further PE. The patient recovered with aggressive medical management without neurologic consequences.

Discussion

A PFO is such a common congenital anomaly that it is important that clinicians are vigilant in diagnosing it, especially in a patient with a PE. Thrombi may travel across the right atria to the left atria and may affect cerebral or coronary circulations. When left atrial pressures are greater than right atrial pressures, there is a functional closure of the foramen ovale. Conditions that cause right atrial pressures to exceed left atrial pressures will lead to a right-to-left shunt.^[4] In this case, left atrial thrombi were seen on TEE which likely traversed across the PFO. This demonstrated the right-to-left shunting from increased right atrial pressures secondary to increased pulmonary pressures. This is a particularly rare case because the PFO placed this patient at risk for paradoxical emboli. There are few case reports of PE with thrombi that migrated across a PFO; as such, there is no formally established treatment for this pathology.^[3] However, surgical embolectomy does have superior outcomes compared to medical treatment with thrombolysis or anticoagulation based on expert opinion and case reports.^[3]

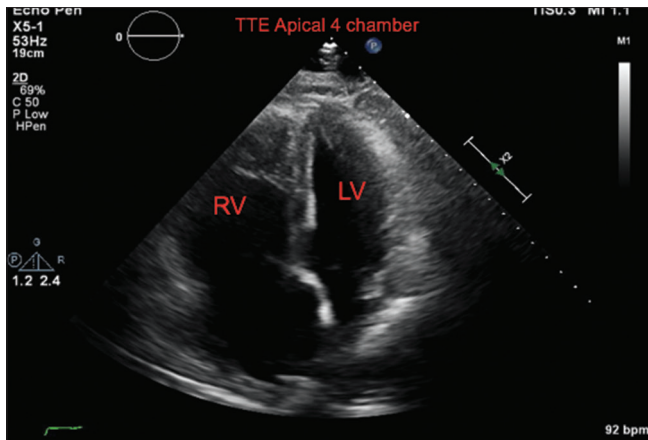


Figure 1: Flattened interventricular septum in apical four-chamber transthoracic echocardiogram view with enlarged right ventricle suggesting right ventricle failure

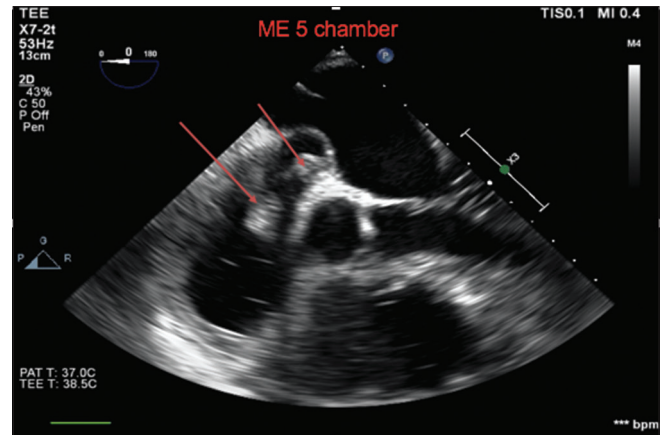


Figure 2: Arrow highlighting the right atrial thrombi in the mid-esophageal five-chamber view

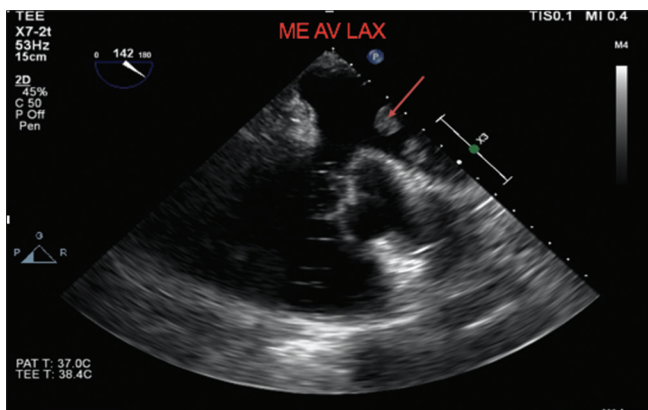


Figure 3: Left atrium in the mid-esophageal aortic valve in long-axis view with an arrow disclosing the left atrial thrombus

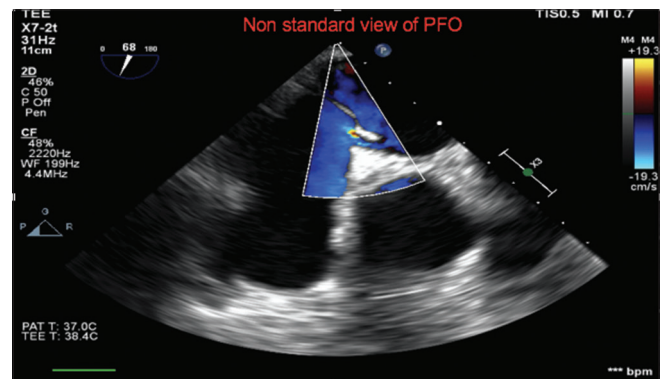


Figure 4: Patent foramen ovale with the left-to-right shunt after the removal of right and left atrial thrombi as well as pulmonary artery embolectomy

Managing patients with a PE first requires practitioners to assess whether a patient is hemodynamically stable or not. For patients who are hemodynamically stable, these patients are medically treated with anticoagulation. For patients who are hemodynamically unstable, these patients are traditionally considered for thrombolysis and possible surgical intervention. It is important to evaluate patients who are presenting with a hemodynamically significant PE for the presence of a PFO as these patients can also have atrial thrombi that can put them at risk for paradoxical emboli. It is not routine to evaluate these patients for a PFO and left atrial thrombi can be missed on TTE. Fortunately, this patient underwent intraoperative TEE which is more sensitive for left atrial thrombi as well as diagnosing a PFO.^[5] Although it is not standard management to evaluate patients with a PE for a PFO, patients who are hemodynamically unstable should be assessed for a PFO given the changes in the pulmonary vascular resistance (PVR) due to the PE. In addition, patients who have a PFO in the setting of a PE should be evaluated for surgical intervention instead of thrombolysis.^[3]

The anesthetic management for a patient with a PE and PFO should include avoiding hypoxemia, hypercarbia, acidosis, nitrous oxide, excessive positive end-expiratory pressure, sympathetic stimulation, and hypothermia as further increases in PVR will worsen the right-to-left shunt. In addition, increases in PVR can worsen RV function with ensuing hypotension from underfilling of the left ventricle. Before the induction of anesthesia, it is crucial to monitor arterial blood pressure with invasive monitoring and adequate intravenous access for preload optimization and the use of inotropes to support the right ventricular function. Inhaled nitric oxide should be considered for patients with elevated PVR who are at risk for RV failure. As these patients are at risk for RV failure

and cardiovascular collapse with induction of anesthesia, it is important to have the surgeons present in the operating room during anesthesia induction and the cardiopulmonary bypass machine immediately available to go on the pump if the patient becomes hemodynamically unstable.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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