**CLINICAL VIGNETTE**

# Caught with Clot: A Massive Complication of Eisenmenger Syndrome

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## *Introduction*

Eisenmenger syndrome (ES) is the long-term process by which chronic left-to-right central cardiac shunt, caused by congenital disease such as ventricular septal defect (VSD) or patent ductus arteriosus (PDA), leads to pulmonary hypertension through increasing pulmonary vascular resistance and subsequent shunt reversal, resulting in a cyanotic bidirectional or right-to-left shunt.[1] Pulmonary artery thrombosis is a common sequela of Eisenmenger physiology, with a prevalence of almost 20%.[2,3] We present a case of ES complicated by massive pulmonary artery thrombus.

## *Case Presentation*

A 57-year-old male with recently diagnosed heart failure with preserved ejection fraction (HFpEF) (EF 55-60%) presents with four days of progressively worsening shortness of breath. He also reports a non-productive cough, worsening dyspnea on exertion, and increased lower extremity swelling. He denies fevers, chills, orthopnea, syncope, chest pain, palpitations, or recent sick contacts.

On exam, initial oxygen saturation was 83% on room air which improved to 90-93% on bilevel positive airway pressure (BiPap). His other vitals were notable for a respiratory rate in the 20s, normal temperature, heart rate in the 60s, and blood pressure 140s/80s. His physical exam was notable for mild respiratory distress with labored breathing but speaking in full sentences. On lung auscultation, inspiratory crackles were present in the bilateral posterior lung fields. Extremities were warm and well perfused with 2+ pitting edema to the shins in the bilateral lower extremities. There was clubbing and central and peripheral cyanosis.

Electrocardiogram (ECG) showed sinus rhythm, left atrial enlargement and right bundle branch block. Chest x-ray revealed enlargement of pulmonary arteries. Computed tomography angiography of the pulmonary arteries (CTPA) revealed ground glass opacities bilaterally and no evidence of pulmonary embolism. There was a 14cm mass communicating with the right pulmonary artery extending to the right hilum with mass effect upon adjacent airway and left atrium (Figures 1, 2). Transthoracic echocardiography (TTE) showed a large non-restrictive VSD with bidirectional shunt, right ventricular hypertrophy, dilation, and mildly reduced systolic function. The left ventricle appeared normal, but the left atrium had external, non-hemodynamically significant, compression from the mediastinal mass.

The patient was diagnosed with severe COVID pneumonia requiring high flow nasal cannula for one week. He was discharged and followed in the Adult Congenital Heart Disease Clinic.

Further evaluation with cardiac magnetic resonance (CMR) revealed a 34mm nonrestrictive perimembranous VSD, a 12x16mm PDA, and a dilated right pulmonary artery (RPA) at 75x81mm compressing the superior aspect of the left atrium. Imaging also showed a significant intraluminal thrombus burden (up to 60% in the mid portion of the RPA). Right heart catheterization (RHC) showed elevated left and right sided filling pressures. Chronic hypoxemia and secondary erythrocytosis were noted, secondary to right-to-left reversal shunting due to the unrepaired unrestricted VSD. Pulmonary hypertension was demonstrated by RHC with a pulmonary vascular resistance of 17.9WU. The differential diagnosis for the intraluminal thrombus included atypical malignancy (sarcoma or lymphoma), but due to high biopsy risk, a positron emission tomography (PET) scan was performed instead which lessened the suspicion for malignancy.

Given the diagnosis of large PA thrombus, the patient was started on warfarin with close monitoring due to risk for hemorrhage and continued thrombosis. He was also started on sildenafil and ambrisentan given his worsening dyspnea and declining functional status. Around one year after his initial presentation, the patient presented to the emergency department with massive hemoptysis and fatal cardiac arrest.

## *Discussion*

Various pathophysiological mechanisms have been proposed regarding thrombus formation in individuals with ES. Local vascular injury and endothelial damage with procoagulant activation resulting from progressive pulmonary hypertension, stasis and reduced flow through the pulmonary artery circuit is one proposed etiology. Another potential contributor to clot formation involves arterial dilation with aneurysmal changes and mural thrombus formation.[2,3] In-situ thrombosis of the PA

of patients with ES also has reported association with older age, biventricular dysfunction, dilation of the pulmonary arteries, and concomitantly decreased pulmonary flow velocity.[2]

Clinically, patients may present with worsening exertional dyspnea, exercise intolerance, syncope, fatigue, congestive right heart failure, arrythmias, cerebrovascular accidents due to hyperviscosity, and hemoptysis due to pulmonary infarction.[4] Studies report from 20%[5] to 57%[6] of Eisenmenger patients present with hemoptysis, with one study documenting 36% of presentations as massive hemoptysis.[6] Many patients with ES also develop secondary erythrocytosis as an adaptation to reduced oxygen carrying capacity secondary to right-to-left shunting.

TTE is the first-line imaging modality in the diagnosis of ES. CMR is one method of longitudinal follow-up that allows for more precise evaluation of size, systolic function of the right ventricle, assessment of main and branch pulmonary arteries, and for further evaluation of additional congenital cardiac defects that may been missed on TTE.[4] CTPA has excellent spatial resolution and sensitivity in the diagnosis of pulmonary embolism and is the primary modality for diagnosis of in situ pulmonary thrombosis in patients with ES.[4] Because of the potential for serious long-term adverse effects of pulmonary thromboembolic disease, some institutions have incorporated routine CTPA as a component of follow-up.[3] Finally, cardiac catheterization is used to elucidate vascular physiology and to measure patient's pulmonary vascular reactivity to vasoactive substances to dictate therapeutic decisions and treatment modalities.[4]

Treatment is generally supportive and includes diuretics and vasodilating agents. Supplemental oxygen therapy and phlebotomy with isovolumic replacement in individuals with symptoms of hyperviscosity are other supportive modalities. A predicament arises in the patients with PA thrombosis and hemoptysis, where the treatment of one runs the risk of exacerbating the other. Paradoxically, anticoagulation is the treatment of choice for both the thrombosis and the hemoptysis, as the etiology of the hemoptysis is likely secondary to pulmonary infarction from the arterial thrombosis. Unfortunately, anticoagulation increases the risk of massive hemoptysis and fatal bleeding. This risk has been documented in the literature, with one study reporting 29%[1] and another, 11.4%[7] of Eisenmenger patient fatalities attributed to massive hemoptysis.

Compared to the general population, individuals with ES have a decreased life-expectancy of around ~20 years, with a close to four- fold increased risk of mortality.[5]

***Conclusion***

Pulmonary artery dilation with subsequent mural thrombus formation may be seen in patients with ES. The benefits of anticoagulation must be carefully balanced with the risk of hemoptysis in these patients.

***Figures***

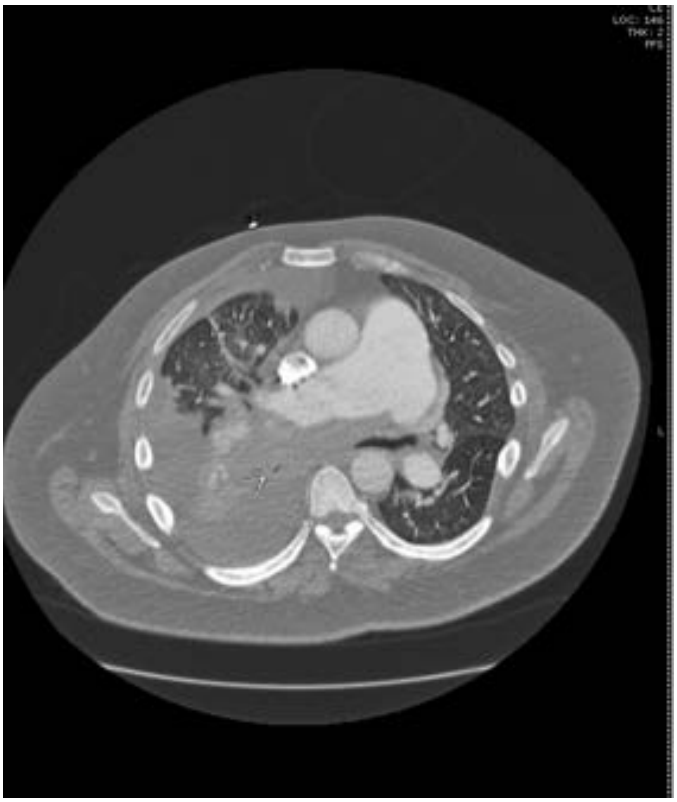

Figure 1: Pulmonary Artery Thrombus (CTPA, axial view)

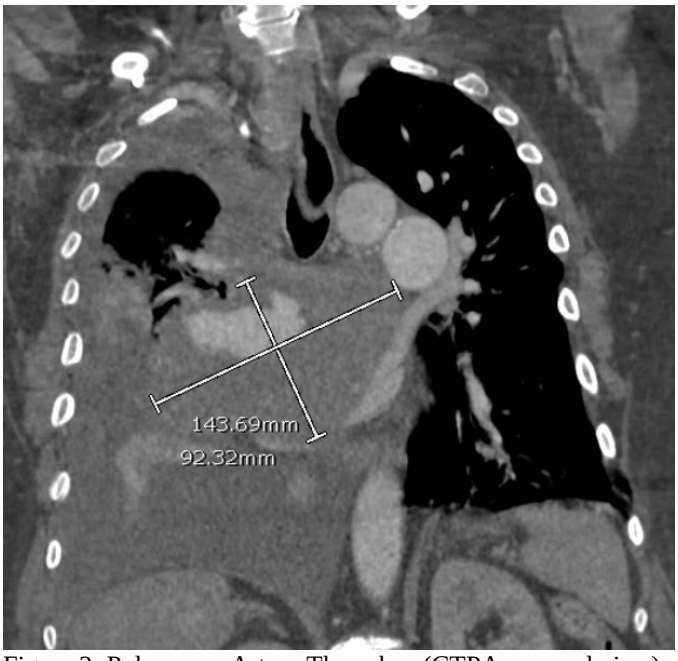


Figure 2: Pulmonary Artery Thrombus (CTPA, coronal view).

*The authors have no Conflicts of Interest or Disclosures to report.*

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