Expanding the Differential Diagnosis of Hemoptysis: Mycotic Aortic Aneurysms

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The differential diagnosis of hemoptysis includes a wide spectrum of infectious, autoimmune, and neoplastic diseases as well as chest trauma. The clinical presentation of a mycotic aortic aneurysm is often nonspecific, but mortality is high, especially after aneurysmal rupture. A high index of suspicion is warranted in any patient presenting with hemoptysis and a recent past history of subacute bacterial endocarditis, intravascular interventions, known aortic aneurysm, and/or immunocompromised state. A case report is presented of a patient with an ascending aortic mycotic aneurysm eroding into the adjacent lung, leading to chest pain, dyspnea, and hemoptysis. This case report provides an important lesson of the need to expand the differential diagnosis of hemoptysis beyond the common bronchopulmonary diseases.

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Since 1885, when Sir William Osler first described mushroom-shaped, infected aneurysms in a patient with subacute bacterial endocarditis (SBE),[1] the etiology, incidence, diagnosis, and treatment of mycotic aneurysms have greatly evolved. Whereas SBE was the major cause in early reports, vascular injury with hematogenous seeding of organisms is the current leading culprit. The normal arterial intima is resistant to infection; disruption by atherosclerotic plaques or direct injury facilitates colonization by circulating organisms.[2] The growing number of invasive diagnostic and therapeutic modal-

ities, coupled with a rise in intravascular illicit drug use, aging of the population, and immunocompromised states, has led to an increased prevalence of mycotic aneurysms.[3] With this alteration in patient substrate and the advent of antibiotics, the causative organisms have also changed. *Streptococcus pyogenes* and *Streptococcus pneumoniae* have given way to *Staphylococcus aureus, Salmonella* species, *Aspergillus, Listeria,* and *Campylobacter fetus.*[1,2]

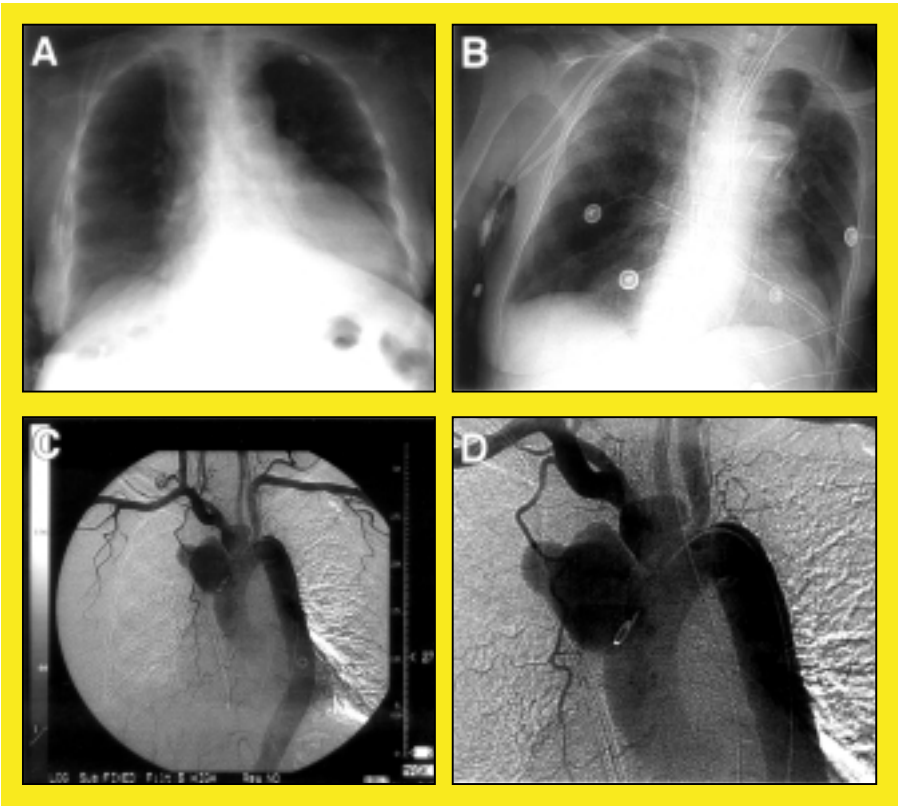

Figure 1. *Results of diagnostic procedures on a patient presenting with chest pain, dyspnea, cough, and hemoptysis.* **(A)** *Radiography depicting mild left ventricular enlargement with an unfolded aorta causing mediastinal widening; no pulmonary abnormalities are noted.* **(B)** *Right upper lobe infiltrate consistent with hemorrhage.* **(C, D)** *Aortography revealing a large lobulated pseudoaneurysm of the ascending aortic together with a smaller aneurysm of the transverse arch.*

Case Report

Our patient's story follows this model. Her underlying immunocompromised state (end-stage renal disease), numerous invasive procedures (arteriovenous grafts, central lines), atherosclerotic aorta, and recent *Staphylococcus aureus* bacteremia predisposed her to mycotic aneurysm formation.

O.P. is a 73-year-old, African-American female with end-stage hypertensive renal disease who is on chronic hemodialysis and has had a recent arteriovenous graft infection by methicillin-sensitive *Staphylococcus aureus* (MSSA). She presented to the University of Chicago Hospital with a chief complaint of substernal chest pain and cough. The physical findings included stable vital signs, an irregular heart rhythm with a 4/6 pan-systolic murmur at the cardiac apex audible throughout the precordium and back, diffuse expiratory wheezes, and a pulsatile, tender liver. Admission labs revealed the following: normal electrolytes, blood urea nitrogen (BUN), 27 mg/dL; creatinine, 4.2 mg/dL; creatinine kinase, 39 U/L; white blood cell count, 13.2 K/mL, with normal differential; hematocrit, 33.2%; normal prothrombin time/partial thromboplastin time/platelets, and heme-positive stool. A chest radiograph (CXR) depicted mild left ventricular enlargement with an unfolded aorta causing mediastinal widening; no pulmonary abnormalities were noted (Figure 1, A). An electrocardiogram showed atrial fibrillation without evidence of acute ischemia.

The growing number of invasive diagnostic and therapeutic modalities, coupled with a rise in intravascular illicit drug use, aging of the population, and immunocompromised states, has led to an increased prevalence of mycotic aneurysms.

On the second day at the hospital the patient's chest pain resolved, but she developed dyspnea, hypoxia, a worsening cough, and a low-grade fever that responded to steroids and bronchodilators. Blood cultures were sent out and subsequently grew MSSA. On the third day she expectorated one-half cup of bright red blood, followed by a respiratory arrest requiring emergent intubation. A repeat CXR revealed a right upper lobe (RUL) infiltrate consistent with hemorrhage (Figure 1, B). A bronchoscopy demonstrated bleeding from the RUL, too brisk to identify the source. Shortly thereafter the

patient underwent bronchial angiography with the intent of performing embolization. Aortogram revealed a large lobulated pseudoaneurysm of the ascending aorta together with a smaller aneurysm of the transverse arch (Figure 1, C and D). These were diagnosed as probable mycotic aneurysms because of their mushroom-like appearance in the setting of positive blood cultures. The hemoptysis was attributed to a rupture of the mycotic aneurysm into the pulmonary parenchyma. Cardiac and thoracic surgery consultants estimated over 90% surgical mortality for the patient, given her comorbid diseases. The patient refused surgery and received supportive care until she exsanguinated and died 2 days after the diagnosis was made.

Diagnosing Hemoptysis

The differential diagnosis of hemoptysis includes a wide spectrum of infectious, autoimmune, and neoplastic diseases as well as chest trauma. Bronchogenic carcinoma, bronchitis, bronchiectasis, pneumonia, and idiopathic hemoptysis account for the majority of causes in series in developed nations, whereas the incidence of hemoptysis from tuberculosis has declined.[4,5] However, aorto-bronchopulmonary fistulas are the sixth most common cause of massive hemoptysis[6,7]; an aortic aneurysm is the predisposing factor in 50%–60% of these cases.[8]

Although older reports implicated endocarditis, syphilitic aortitis, and tuberculosis in the pathogenesis of mycotic aortic aneurysms, our patient's case is more typical of the cases described in the recent literature.[9,10] Elderly and atherosclerotic vessels that have undergone invasive diagnostic or therapeutic procedures or contain implanted devices provide a locale for bacterial seeding.[11–13] In more rare instances, colonization of otherwise healthy arterial walls occurs via the vasa vasorum or lymphatic embolization or by direct extension from adjacent extravascular structures.[14] Histologic examination typically reveals medial necrosis, abscess, and elastic-tissue destruction from mediators released by polymorphonuclear cells attacking the causative organisms.[15]

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Clinical Presentation of Mycotic Aortic Aneurysms

The clinical presentation of a mycotic aortic aneurysm is often nonspecific.[3] A high index of suspicion is thus warranted in any patient presenting with hemoptysis and a recent past history of SBE, intravascular procedures, known aortic aneurysm, and/or immunocompromised state. Ruptured mycotic thoracic aortic aneurysms usually present with chest pain. Other presentations include cardiac ischemia, cerebrovascular accident, hoarseness, wheezing, cough, dyspnea, and recurrent hemoptysis. Hemoptysis is the most common presentation of aorto-bronchopulmonary fistulas[8] and results from erosion of the aneurysm into either the pulmonary parenchyma or bronchial wall. The first episode of hemoptysis can be fatal, but occasionally a thrombus will temporarily seal the fistulous connection, as probably occurred in our patient prior to her terminal event.

Diagnosis and Treatment of Mycotic Aortic Aneurysms

The origin of the bleeding can often be found by bronchoscopy; however this carries a risk of procedure-induced rebleeding if a thrombus is

Main Points

- A case report is presented of a patient with end-stage renal disease on hemodialysis and a recent arteriovenous graft infection by methicillin-sensitive *Staphylococcus aureus*, complaining of chest pain and cough.
- The patient subsequently developed dyspnea, hypoxia, and a worsening cough, and expectorated blood. Aortogram revealed a large mycotic aneurysm of the ascending aorta together with a smaller mycotic aneurysm of the transverse arch.
- The hemoptysis—the most common presentation of aorto-bronchopulmonary fistulas—was attributed to a rupture of the mycotic aneurysm into the pulmonary parenchyma. Given her comorbid diseases, the surgeons estimated 90% surgical mortality for the patient, who refused surgery, and died 2 days after the diagnosis.
- This case provides an important lesson of the need to expand the differential diagnosis of hemoptysis beyond the common bronchopulmonary diseases.

dislodged from the fistulous tract. Angiography is the gold standard for making the diagnosis of aneurysmal rupture, but it is an invasive procedure and less readily available. Computed tomography (CT) is gaining support as the preferred initial diagnostic modality in stable patients with suspected aneurysms.[16] Infused CT provides information regarding the great vessels, pulmonary parenchyma, and mediastinum, and has a high sensitivity for aneurysm detection.

The treatment of mycotic aneurysms consists of surgical resection and debridement of the infected tissue and placement of an allograft or prosthetic graft, followed by at least 6 to 8 weeks of antibiotics.[17–19] But new endovascular stent-grafting techniques, followed by lifelong antibiotics, have shown some promise in the descending thoracic aorta.[20,21] Without surgical intervention, a mycotic aortic aneurysm inevitably results in death from rupture and exsanguination or uncontrolled sepsis; the overall reported survival rate after surgical intervention is 76% for aortobronchial fistulas and 82% and 50% at 1 and 5 years for mycotic aortic aneurysms, with lower survival rates in aneurysmal ruptures.[22,23]

Our patient provides an example of an ascending aorta mycotic aneurysm eroding into the adjacent lung, leading to chest pain, dyspnea, cough, and hemoptysis. She delivers an important lesson of the need to expand the differential diagnosis of hemoptysis beyond the common bronchopulmonary diseases. ■

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