A Patient With Acute Exacerbation of COPD Who Did Not Respond to Conventional Treatment*

A. E. L. Stebbings, MD; and Tow K. Lim, MBBS

(CHEST 1998; 114:1759–1761)

An 81-year-old man with COPD was admitted to the hospital with a 2-week history of breathlessness and cough productive of purulent sputum. He was an ex-smoker with a history of adenocarcinoma of the lung 3 years previously for which a right upper and middle lobectomy was performed. He also had a history of left ventricular failure.

Physical Examination

He was alert and able to speak in short sentences. Vital signs: pulse rate, 88 beats/min; BP, 100/70 mm Hg; temperature, 37°C; respiratory rate, 30 breaths/min. Lungs: coarse inspiratory crackles in the left lung base with diminished breath sounds bilaterally. Cardiac, abdominal and neurological examinations: normal.

Laboratory Investigations

Values included hemoglobin, 15.1 g/dL; WBC count, 7,170/μL; platelets, 266,000/μL. With the patient breathing room air, arterial blood gas values: pH, 7.43; $PaCO_2$, 38 mm Hg; PaO_2, 43 mm Hg. Calcium, renal test results, and electrolytes: normal. Chest radiograph: hyperlucent lungs with a small left pleural effusion (Fig 1). ECG: right ventricular hypertrophy. Sputum culture: no pathogens isolated.

Clinical Course

The patient was treated with antibiotics, oral prednisolone, and bronchodilators. He improved only with regard to his purulent cough. After 1 week of treatment, he continued to experience episodic nocturnal breathlessness. Clinical examination showed a respiratory rate of 28 breaths per minute, a pulse rate of 88 beats per minute, BP of 90/60 mm Hg, and temperature, 36.8°C. Examination of the lungs showed decreased breath sounds bilaterally without crepitations. The chest radiograph showed no new abnormalities. Arterial blood gas analysis with the patient breathing room air showed pH 7.43; $PaCO_2$, 36 mm Hg; and PaO_2, 51 mm Hg.

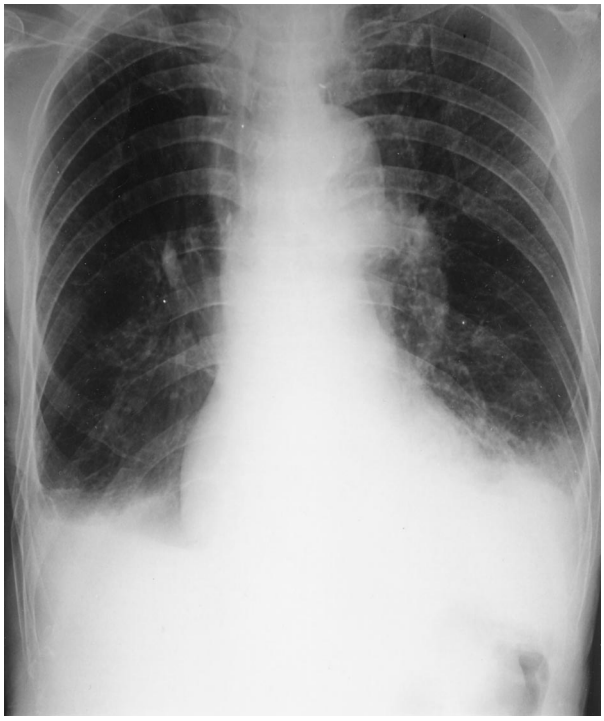

FIGURE 1. Chest radiograph showing hyperlucent lungs, a left pleural effusion, and signs of a previous right upper lobectomy.

What is the cause of this patient's persistent hypoxemia and breathlessness?

What is the diagnostic investigation of choice?

*From the Department of Medicine, National University Hospital, Singapore.
Manuscript received July 10, 1997; accepted September 10, 1997.

Diagnosis: A pulmonary embolus involving the right main pulmonary artery detected by contrast-enhanced spiral CT scan of the thorax (Fig 2).

Pulmonary embolism (PE) may precipitate acute exacerbations of COPD. The risk factors for PE in patients with COPD include (1) immobility, (2) congestive heart failure, (3) cigarette smoking, (4) underlying lung malignancy, and (5) advanced age. The frequency of PE in patients admitted to the hospital with acute exacerbation of COPD is unknown. Postmortem studies indicate that the prevalence of PE in patients with COPD may range from 28 to 51%. Clinical studies, however, indicate that the incidence of PE may be as high as 19% in patients with COPD who have symptoms suggestive of PE (the PIOPED study) or as low as 1.4% in patients who were admitted with an acute severe COPD exacerbation accompanied by hypercapnia ($PaCO_2$, ≥50 mm Hg in the SUPPORT [Study to Understand Prognosis and Preferences for Outcomes and Risks of Treatments] study).

It is extremely difficult to differentiate the clinical features of PE from those of the underlying lung disease in patients with acute exacerbation of COPD. Among the patients with COPD who were investigated for PE in the PIOPED study, it was not possible to distinguish between patients with PE and without PE on the basis of any of the following: symptoms, physical signs, abnormalities on chest radiographs, alveolar-arterial oxygen pressure gradient differences [$P(A\text{-}a)O_2$], or $PaCO_2$. In patients with COPD who had documented PE, there were also no significant differences in $P(A\text{-}a)O_2$ and $PaCO_2$ between measurements prior to and at the time of the PE. The increased $P(A\text{-}a)O_2$ in this patient could have been ascribed to his underlying pulmonary disease. Even in patients without prior cardiorespiratory disease, a normal $P(A\text{-}a)O_2$ does not exclude the diagnosis of PE. It had been suggested that a reduction in the $PaCO_2$ in a previously hypercapnic patient may support the diagnosis of acute PE. The $PaCO_2$ may not fall, however, and may even increase in some patients with COPD due to the inability to increase minute ventilation in response to the increased dead space caused by acute PE.

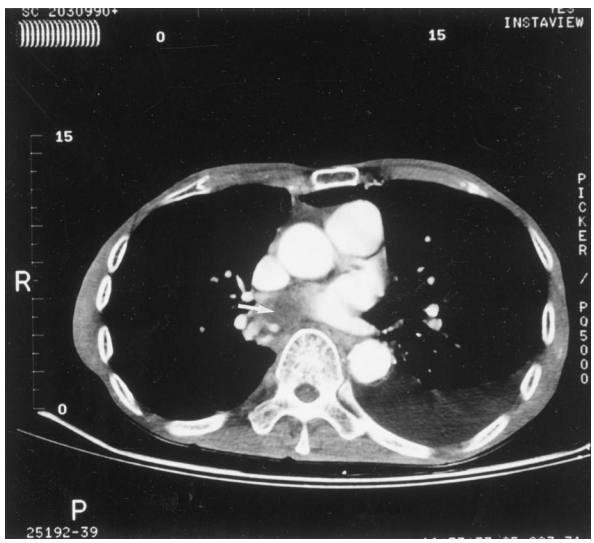

FIGURE 2. Spiral CT scan of the thorax which shows a filling defect consistent with PE in the right pulmonary artery (white arrow).

The first diagnostic study in the investigation of patients suspected of PE is usually ventilation-perfusion ($\dot{V}/\dot{Q}$) lung scanning. If the clinical assessment and the $\dot{V}/\dot{Q}$ scan suggest a high probability of PE, the diagnosis is confirmed by a pulmonary angiogram in over 95% of patients. Conversely, a normal $\dot{V}/\dot{Q}$ scan excludes clinically significant PE. However, in patients with COPD, the clinical assessment is unreliable and less than 10% of $\dot{V}/\dot{Q}$ scans are normal or in the high probability category. This low incidence of normal or high probability $\dot{V}/\dot{Q}$ scans (large perfusion defects with normal ventilation) is the result of widespread abnormalities of ventilation in nearly all patients with COPD. Thus, the diagnosis of PE in patients with COPD is a dilemma which, in the majority of cases, can only be resolved definitively by pulmonary angiography. Pulmonary angiography, however, is underutilized by most physicians because it is an invasive procedure that is expensive, potentially risky in patients with acute respiratory failure and cor pulmonale, and may not be available in all centers at short notice.

Other diagnostic techniques have been evaluated as alternatives to pulmonary angiography. The detection of deep venous thrombosis, which is treated in the same way as PE, may obviate the need for further testing. A single negative study of leg veins does not, however, exclude the presence of clinically significant PE. Another approach is the use of noninvasive tests for the diagnosis of PE. Contrast-enhanced spiral CT scanning had been the most extensively studied in recent years. It is a rapid imaging process which may be used safely in critically ill patients. It requires a bolus of contrast medium for vascular imaging. Spiral CT scanning detects emboli in the proximal (main, lobar, and segmental) pulmonary arteries with a sensitivity of 73 to 97% and a specificity of 86 to 98%. It also may detect nonvascular abnormalities such as lymph nodes, tumors, and lung parenchymal disease. The spiral CT, though a useful advance, has not replaced pulmonary angiography as the gold standard. Up to 25% of proximal emboli and an even larger propor-

tion of peripheral clots may be missed on a spiral CT scan. In particular, none of the studies on the accuracy of spiral CT scanning in the diagnosis of PE has included large number of patients with COPD. It may be expedient, however, as in this patient, to perform a spiral CT scan in acutely ill patients with COPD when the diagnosis of PE needs to be confirmed promptly. Further experience is needed with this technique. In addition, its role in the diagnosis of PE in patients with an acute exacerbation of COPD needs to be better defined in controlled, prospective studies.

The present patient with COPD had respiratory failure which did not improve satisfactorily with conventional treatment. Only with close attention to the patient's clinical progress and a high index of suspicion was the diagnosis of PE suspected and subsequently confirmed by a spiral CT scan of the thorax. He received treatment with intravenous heparin with improvement in breathlessness. Two days later, however, he developed gross hematuria following urinary catheterization, and the heparin administration was discontinued for 12 h. He subsequently relapsed with acute breathlessness despite restarting the heparin and died, presumably from recurrent PE.

Clinical Pearls

1. *A normal $P(A\text{-}a)O_2$ does not exclude the possibility of PE.*
2. *There may be no change or even a further increase in $PaCO_2$ during PE in some patients with COPD who are unable to increase minute ventilation in response to an increase in dead space.*
3. *$\dot{V}/\dot{Q}$ lung scans may be nondiagnostic (intermediate or low probability for PE) in up to 90% of patients with COPD.*
4. *Spiral CT scan of the thorax is a safe, relatively sensitive, and highly specific test for proximal PE in acutely ill patients.*

Suggested Readings

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