Hemoptysis and Dyspnea in a 67-Year-Old Man With a Normal Chest Radiograph*

Estrellita T. Velez Jo MD; and Richard Scott Morehead, MD, FCCP

A 67-year-old man with a history of hypertension was referred for evaluation of hemoptysis and dyspnea. He had been in good health until 3 weeks prior to presentation when he developed sore throat, dry cough, and mild dyspnea on exertion. He was treated for acute bronchitis without improvement. Subsequently, hemoptysis developed, at a rate of 5 to 10 mL, several times per day, accompanied by progressive, severe dyspnea on minimal activity. There was no reported fever, chills, chest pain, or weight loss. Before the onset of symptoms the patient had been very active, walking 6 to 7 miles daily. There was a smoking history of 60 pack-years, but no history of cardiac disease, venous thromboembolism, or occupational lung disorder.

Physical Examination

Vital signs were normal except for an increased respiratory rate of 20 breaths per minute. The chest revealed diffuse bilateral rhonchi without rales or consolidation. The findings from the cardiac examination were normal. There was no peripheral edema or clubbing; the findings from the rest of the examination were unremarkable.

Laboratory Findings

The initial workup included normal results of CBC and blood chemistry tests. Arterial blood gas levels, checked while the patient was in the emergency department breathing high-flow oxygen by mask (estimated fraction of inspired oxygen, 80%) were the following: pH, 7.36; PaCO₂, 38 mm Hg; and PaO₂, 67 mm Hg. Chest radiography was interpreted as normal (Fig 1).

Hospital Course

The patient was treated with inhaled bronchodilators, corticosteroids, and IV azithromycin with improvement in symptoms and gas exchange. Further evaluation included echocardiography, which revealed mild concentric hypertrophy and normal systolic function; the right heart was normal, and there was no significant valvular disease or pericardial effusion. Duplex ultrasound examination of the lower extremities was negative for thrombosis. Several days later, while receiving 2 L/min oxygen by nasal cannula, the patient’s pulse oximetry saturation was 97%; however, severe dyspnea occurred immediately when the patient was ambulatory, with tachycardia and desaturation to 83%. A spirogram was obtained showing the following: FEV₁, 0.99 L (29% of predicted); FVC, 3.12 (73% of predicted); and FEV₁/FVC ratio, 0.32 (Fig 2). A diagnostic test was performed.

What is the cause of the patient’s hypoxemia and dyspnea?

What would be the diagnostic test of choice?
FIGURE 1. Posteroanterior chest radiograph at presentation.

FIGURE 2. Flow-volume loop from spirogram obtained on presentation.
Diagnosis: Squamous cell carcinoma arising from the carina and occluding both mainstem bronchial orifices; diagnosed by bronchoscopy

Tracheal tumors are rare and may frequently mimic other pulmonary diseases. Although 60 to 88% of all tracheal tumors are malignant, the incidence of primary tracheal carcinoma is <0.2 per 100,000 cases per year, and primary tracheal carcinoma accounts for <1% of all cancer deaths. Case series from major referral centers entail remarkably few patients: 53 cases over a 30-year period reported from the Mayo Clinic, 41 cases during a 33-year period from a major center in New York, and the largest recent published experience from a single institution, 198 cases treated during a 26-year period at the Massachusetts General Hospital.

Squamous cell carcinoma is the most frequent cell type among primary tracheal neoplasms and most commonly occurs during the sixth decade of life, with a male/female ratio of 4:1. As with other cancer involving respiratory epithelium, there is a strong association with cigarette smoking. In fact, other respiratory tract malignancies often coexist with tracheal carcinoma; two large studies documented that 33 to 37% of patients with tracheal squamous cell carcinoma had another concurrent respiratory tract malignancy or subsequently developed one. The portion of the trachea usually involved varied among the published series. One paper noted that over half occurred within 4 cm of the carina, while others have reported that 40 to 45% arose from the upper third of the trachea, with only 30 to 35% involving the lower third of the trachea and the carina.

Presenting symptoms and signs of tracheal carcinoma usually reflect airway involvement. In one series of 329 patients with primary tracheal malignancies, dyspnea was found to be the most frequent symptom (71%), followed by cough (40%), hemoptysis (34%), asthma (19.5%), and stridor (17.5%). Symptoms related to involvement of adjacent structures, such as hoarseness and dysphagia, were less frequent. Because of the nonspecificity of symptoms and the rarity of the disease, early diagnosis is unusual. Patients are often misdiagnosed with asthma or bronchitis, and the tumor may elude detection for months to years. In the patient presented, the findings of hypoxemia, dyspnea, and hemoptysis in the setting of a “normal” chest radiograph led initially to the consideration of obstructive airways disease with exacerbation, pulmonary embolization, and “flash” pulmonary edema (resolved by the time chest radiographs are obtained).

Standard chest radiographs are insensitive in the detection of tracheal neoplasms, as evidenced by the fact that less than half of tracheal tumors are diagnosed by plain chest radiograph. The lack of appropriate clinical suspicion and suboptimal quality of radiographs may explain this poor performance; radiographs taken with a high-kilovoltage technique and proper mediastinal penetration can provide good tracheal visualization and may reveal lesions large enough to create symptoms. Spirometry may also play an important role in the diagnosis of symptomatic tracheal lesions, but characteristic abnormalities of the flow-volume loop may not appear until the airway is reduced to $\leq 8$ mm. Moreover, this may be masked in the setting of a small airways disease such as COPD. In the present case, the flow-volume loop was suggestive of variable intrathoracic obstruction of the upper airway. This was most likely due to the location of the tumor and to the fact that it was neither completely “fixed” nor attached to the tracheal wall as shown by tomographic studies (Figs 3 and 4).

Tracheal lesions may be diagnosed by bronchoscopy or radiographic imaging. CT is the current imaging technique of choice, but plain film tomography is also very sensitive in displaying tracheal tumors. Tracheal evaluation by CT is best performed using a spiral or helical scanner, allowing precise volumetric acquisition and multiplanar image display, because conventional CT protocols may miss small lesions or may underestimate the longitudinal dimension of the tumor. In addition, spiral CT may allow differentiation of mucosal from submucosal masses as well as demonstration of submucosal spread. MRI also holds promise in the evaluation of tracheal disease, but few studies have been published on this application. Bronchoscopy, the diagnostic procedure used in the present case, demon-

![Figure 3. CT scan at the level of the mainstem bronchial origins demonstrating the tumor arising from the carina (arrow).](https://journal.publications.chestnet.org/pdftools/35289741)
strated the tumor arising from the carina with subtotal occlusion of both main bronchi (Fig 5). Bronchoscopy has the advantage over radiographic techniques in that it affords both direct visualization of the lesion and the ability to obtain pathologic specimens, albeit at a higher cost. Moreover, relief of obstruction by laser or cryotherapy may be performed at the same time if this technology is available.

Treatment of tracheal tumors has focused on radiotherapy and surgical resection, the latter often with adjunctive irradiation. Though most patients with airway obstruction have incurable disease at the time of presentation, a highly select group may be amenable to potentially curative resection. Daddi and associates reviewed a series of 24 patients undergoing tracheobronchial resection after preliminary endoscopic laser treatment to relieve airway obstruction. The median period between endoscopic treatment and operation was 18 days, with clear resection margins obtained in 21 of the 24 patients. Fourteen patients had squamous cell carcinoma, and excluding one patient lost to follow-up, the mortality rate was 36% at a median time of 25 months postoperatively; one was alive with known disease at 5 months, and the remainder (57%) were disease free at a median of 26 months postoperatively (range, 1 to 59 months). Grillo and Mathisen reported a series of 198 patients with tracheal tumors, of which 70 (35%) were squamous cell carcinoma. Of these 70 cases, 44 (63%) were resected, with operative mortality of 5%. The overall survival rate was 27% at 3 years and 13% at 5 and 10 years.

Laser therapy for relief of airway obstruction may be given alone but is usually combined with radiotherapy. The risks of this approach include bronchopleural and tracheoesophageal fistula. Radiotherapy alone as a primary treatment modality for tracheal carcinoma is associated with a 5-year survival rate of 5 to 40%. In general, nonrandomized trials demonstrate better survival in patients given combined
radiation and surgical resection compared with those given radiotherapy alone; however, studies reporting this data are obviously subject to selection bias. In addition, chemotherapy with or without concomitant radiotherapy may play a role in the treatment of squamous cell carcinoma of the trachea, as with nonsmall cell carcinoma of the lung. However, the effectiveness of such an approach has not been defined in randomized clinical trials.

The present patient was treated with endoscopic Nd-YAG laser ablation followed by external beam radiotherapy to a total dose of 5,000 cGy. This yielded marked symptomatic and objective improvement (Fig 6). Repeat bronchoscopy 2 months later showed a small residual tumor at the right main bronchial orifice, approximately 2 cm from the carina. Surgical resection was contemplated, but the patient declined and instead received intraluminal brachytherapy. Two months later, a new cough accompanied by wheezing and dyspnea developed with the taking of liquids or solids. Evaluation revealed a large tracheoesophageal fistula. Esophageal stenting was performed, but the patient subsequently died as a result of recurrent infection and respiratory failure.

**Clinical Pearls**

1. Tracheal tumors often mimic other pulmonary disorders and may present as dyspnea in the setting of a “normal” chest radiograph.
2. Chest radiographs are insensitive for the identification of tracheal lesions. The flow-volume loop should suggest tracheal obstruction when the disease becomes symptomatic, but the presence of significant small airways disease may mask these findings.
3. The imaging technique of choice when tracheal disease is suspected is the spiral CT scan; plain tomography is the best modality when spiral CT is unavailable.
4. When tracheal tumor is suspected in symptomatic patients, bronchoscopy provides rapid diagnosis and airway assessment as well as the potential for introducing laser or cryotherapy to relieve obstruction.

**Suggested Readings**


McCafferty GJ, Parker LS, Suggit SC. Primary malignant disease of the trachea. J Laryngol Otol 1964; 78:441–479

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