A 65-year-old woman presented to her primary care physician with a 3-month history of worsening cough, now productive of copious blood-tinged secretions. She also reported a recent onset of fever and dyspnea. She denied any chest pain, chills, night sweats, and weight loss.

Posteroanterior (PA) and lateral chest radiographs were obtained. The PA radiograph is shown below (Figure 1).

Making the diagnosis
The PA chest radiograph demonstrated consolidation in the right upper lobe, with bulging of the adjacent fissure. Cardiac and mediastinal contours were normal, with no lymphadenopathy. The patient was treated with antibiotics for a presumptive diagnosis of community-acquired pneumonia. On her follow-up visit, she reported mild improvement of her symptoms, but a chest radiograph did not show any improvement.

A CT scan of the chest obtained after intravenous administration of contrast material demonstrated consolidation in the right upper lobe (Figure 2). A CT angiogram sign was present. This sign, which refers to the presence of enhancing vessels simulating an angiogram in an area of low-attenuation consolidation, was originally described in association with bronchoalveolar cell carcinoma. In this setting, the high-attenuation, enhancing pulmonary vessels contrast with the low attenuation of mucinous tumor in the lung parenchyma. There was no evidence of obstructing endobronchial lesions or significant mediastinal lymphadenopathy. The patient subsequently underwent fiberoptic bronchoscopy with bronchoalveolar lavage (BAL), which demonstrated no evidence of infection or malignancy.

Because of the chronicity of the right upper lobe consolidation, the absence of response to antibiotics, and the presence of a CT angiogram sign, bronchoalveolar carcinoma was the leading diagnosis. A whole-body positron emission tomography (PET) scan was obtained for further characterization of the lesion and for evaluation of distant spread of disease. On PET imaging, low-level fluorodeoxyglucose (FDG) activity was seen in the periphery of the lesion, with no significant uptake elsewhere in the body. The negative findings on the PET scan suggested that there was no active infection, which would typically avidly accumulate FDG. Although a definitive diagnosis had not yet been made, the low-level activity on PET correlated with the presumptive diagnosis of bronchoalveolar carcinoma, given that this non-small-cell lung cancer often demonstrates low-level metabolic activity on PET.

A transthoracic CT-guided needle biopsy of the right upper lobe lesion was subsequently performed. Specimens obtained by fine-needle aspiration were used for cytologic examination; core specimens were used for histologic analysis. The pathology was consistent with bronchoalveolar carcinoma of a mucinous subtype.

Discussion
Bronchoalveolar carcinoma is a subtype of non-small-cell lung cancer with unique clinical, imaging, and pathologic features. Historically, it has been considered the least common form of bronchogenic carcinoma. However, the incidence of bronchoalveolar carcinoma has dramatically increased in the past few decades, with a reported increase from 5% to 24% between 1955 and 1990. This rise has contributed to the overall increase in the incidence of adenocarcinoma, of which bronchoalveolar carcinoma is a subtype.

A substantial proportion of the increase in bronchoalveolar carcinoma has occurred in women. The term “bronchoalveolar carcinoma" was originally coined by Liebow in 1960 to describe a peripheral, well-differentiated adenocarcinoma that did not distort the pulmonary interstitium. In 1999, the World Health Organization formulated strict diagnostic criteria for bronchoalveolar carcinoma. These criteria include the absence of primary adenocarcinoma elsewhere; the absence of a central bronchogenic source; a peripheral location; an intact pulmonary interstitium; and the presence of malignant cells growing along the alveolar septae.

The most characteristic histopathologic pattern of bronchoalveolar carcinoma is the spread of tumor along the walls of airspaces without destruction or distortion of the pulmonary interstitium. This is also referred to as a "lepidic" growth pattern. There are 3 cell variants of bronchoalveolar carcinoma: Clara cell, alveolar type II epithelial cell, and mucin-producing carcinomas. The mucinous subtype frequently presents with a pneumonic pattern of disease and has been associated with a worse prognosis than have other subtypes.

The clinical presentation of bronchoalveolar carcinoma is variable. About 50% of patients are asymptomatic at the time of diagnosis. As the disease progresses, patients may report cough, bronchorrhea, dyspnea, chest pain, hemoptysis, fever, and weight loss. Bronchoalveolar carcinoma has a wide spectrum of radiographic findings, ranging from an isolated, ground-glass nodule or localized area of consolidation to diffuse, multifocal disease. A consolidative pattern is frequently seen with the mucinous subtype. As demonstrated in this case, it is often mistaken clinically and radiographically for infectious pneumonia. Excessive mucin production by the tumor often leads to a characteristic bulging of the interlobar fissures, as seen in our patient. The CT angiogram sign was initially described as a characteristic sign of bronchoalveolar carcinoma. However, this sign is not specific for bronchoalveolar carcinoma; it may be observed in many other conditions, including lymphoma, lipoid pneumonia, alveolar hemorrhage, hydrocarbon inhalation, alveolar proteinosis, and obstructing pneumonia.

In addition to bronchoalveolar carcinoma, the differential diagnosis for pulmonary consolidation without response to conventional antibiotics includes lymphoma, tuberculosis, fungal infections, and lipoid pneumonia. In the setting of diffuse consolidation, a diagnosis of alveolar proteinosis and the alveolar form of sarcoidosis should also be considered. Although radiologic and clinical features can help narrow the differential for chronic consolidation, it is important to make a definitive diagnosis to guide appropriate treatment. Depending on the location and extent of disease, a variety of diagnostic techniques may be used, including sputum cytology, BAL, CT-guided biopsy, and video-assisted thoracoscopic surgery.

In this case, BAL results were initially negative, and CT-guided biopsy was required for definitive diagnosis; this emphasizes the need to pursue additional diagnostic procedures when initial tests are inconclusive. It should be noted that a definitive diagnosis of bronchoalveolar carcinoma requires a histologic specimen.

Treatment depends on the presentation and extent of disease. There is consensus that patients with bronchoalveolar carcinoma presenting as a solitary pulmonary nodule should be treated with surgical resection and that these patients typically have a very good prognosis. However, the management of multiple nodules or the pneumonic form of disease is more controversial. Laskin reported that recent case series support the general principle that in the absence of mediastinal lymph node disease or distant metastases, multifocal bronchoalveolar carcinoma should be treated surgically as separate primary tumors. There is no consensus on whether patients with the pneumonic form benefit from surgical resection. Recently, there have been promising results in the treatment of lung cancer using targeted chemotherapy agents, such as gefitinib and erlotinib, which interfere with the epidermal growth factor receptor. A subgroup of patients has been shown to respond favorably to such targeted chemotherapy, including women, nonsmokers, and those with adenocarcinoma and/or bronchoalveolar carcinoma. Further studies are needed to determine whether such therapy should become a first-line treatment option for these patients. The outcome in this case
The patient's case was discussed by the thoracic surgeons, pulmonologists, oncologists, and radiologists at the Multidisciplinary Thoracic Oncology Conference. It was decided that a right upper lobectomy was the best available therapeutic option, although the long-term prognosis was expected to be poor. The patient was educated about the nature of her disease, the prognosis, and the lack of data and consensus regarding the appropriate treatment of the pneumonic type of bronchoalveolar carcinoma. She was also encouraged to seek a second opinion at another institution.

The patient opted for surgical resection and subsequently underwent right upper lobectomy and mediastinal lymph node dissection. Pathologic analysis of the surgical specimen confirmed a low-grade bronchoalveolar cell carcinoma of mucinous subtype (Figure 3). She had an unremarkable postoperative course and was discharged a few days later. At initial postoperative follow-up, she was asymptomatic and feeling well.

**References:** REFERENCES

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