October 2017 Imaging Case of the Month

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Clinical History: An 18-year-old man with no known previous medical history presented with complaints of intermittent cough persisting several months. No hemoptysis was noted.

Physical examination was largely unremarkable and the patient's oxygen saturation was 99% on room air. The patient's vital signs were within normal limits.

Laboratory evaluation was unremarkable. Quantiferon testing for *Mycobacterium tuberculosis* was negative, and testing for coccidioidomycosis was unrevealing. Frontal and lateral chest radiography (Figure 1) was performed.

Figure 1. Figure 1. Frontal (A) and lateral (B) chest radiography.

Which of the following statements regarding the chest radiograph is **most accurate**?

1. The chest radiograph shows asymmetric reticulation and interlobular septal thickening
2. The chest radiograph shows bilateral reticulation associated with decreased lung volumes
3. The chest radiograph shows focal consolidation
4. The chest radiograph shows large lung volumes
5. The chest radiograph shows small cavitary pulmonary nodules

Correct!

3. The chest radiograph shows focal consolidation

The chest radiograph shows focal consolidation at the right base, within the right lower lobe, obscuring the right diaphragmatic contour. Several somewhat tubular lucencies are evident within the focal right lower lobe opacity, and some mild volume loss is present. No lymphadenopathy is present, and left lung volume is normal. No evidence of interlobular septal thickening or significant reticulation is seen. No pleural abnormality is present, and no evidence of nodule formation, cavitary or otherwise, is present.

Which of the following represents the **most appropriate differential diagnostic consideration** for the chest radiographic pattern present?

1. Bronchogenic malignancy
2. Bronchopneumonia
3. Eosinophilic granulomatosis with polyangiitis (Churg-Strauss disease)
4. Langerhans cell histiocytosis
5. Pulmonary alveolar proteinosis

Correct!
2. Bronchopneumonia

The focal right lower lobe consolidation and mild volume loss are consistent with, although not specific for, bronchopneumonia. Bronchogenic malignancy is a consideration because occasionally this neoplasm may present with focal lobar consolidation, or the primary malignancy may obstruct a bronchus and produce post-obstructive consolidation. However, bronchogenic malignancy would be extremely uncommon in an 18-year-old patient (note, however, other pulmonary malignancies, particularly carcinoid tumor, may present in young patients). Pulmonary alveolar proteinosis typically presents as a bilateral process, manifesting as diffuse lung disease, not an area of focal consolidation. Langerhans cell histiocytosis commonly presents as an upper lobe predominant cystic / cavitary and nodular process, not as lower lobe focal consolidation. Eosinophilic granulomatosis with polyangiitis (formerly referred to as Churg-Strauss syndrome), has a number of non-specific presentations, commonly manifesting as areas of multifocal opacity, often peripheral in distribution, representing areas of pulmonary hemorrhage. Focal opacities that may cavitate are also possible, but the process is typically not focal or lobar in distribution.

Which of the following represents **the most appropriate next step for the management** of this patient?

1. ^{133}Xe -Ventilation – $^{99\text{m}}\text{Tc}$ -perfusion scintigraphy
2. ^{18}F FDG-PET scan
3. Bronchoscopy
4. Contrast-enhanced thoracic MRI
5. Thoracic CT

Correct!
5. Thoracic CT

Bronchoscopy is a reasonable consideration, but useful information may be gained through non-invasive evaluation with thoracic CT. ^{18}F FDG-PET scanning is premature at this point; typically, this procedure is performed to stage malignancies or assess solitary pulmonary nodules, and is generally most rewarding in the latter context after thoracic CT has been performed and returned indeterminate results. Contrast-enhanced MRI is most commonly used for musculoskeletal applications or for assessment of mediastinal or vascular disorders and is generally less efficacious than thoracic CT for evaluation of lung abnormalities. ^{133}Xe -Ventilation – $^{99\text{m}}$ Tc-perfusion scintigraphy could demonstrate the presence of either airway or vascular abnormalities contributing to the chest radiographic abnormalities, but often the findings at ventilation / perfusion scintigraphy are relatively non-specific and require interpretation in light of information from anatomic studies. The chest radiographic findings are not suggestive of thromboembolic disease, so ^{133}Xe -Ventilation – $^{99\text{m}}$ Tc-perfusion scintigraphy's role in the evaluation of that disorder is not relevant for this patient.

The patient underwent unenhanced and enhanced thoracic CT for further investigation of the chest radiographic findings (Figure 2).

Figure 2. Representative images of axial contrast-enhanced thoracic CT displayed in lung windows (A-I) and soft tissue windows (J-O).

Which of the following statements regarding this imaging study is **most accurate**?

1. The thoracic CT shows evidence of pulmonary hypertension
2. The thoracic CT shows mediastinal lymphadenopathy
3. The thoracic CT shows pulmonary arterial aneurysms
4. The thoracic CT shows pulmonary emboli
5. The thoracic CT shows right lower lobe bronchiectasis

Correct!

5. The thoracic CT shows right lower lobe bronchiectasis

The unenhanced and enhanced thoracic CT shows patchy areas of ground-glass opacity and reticulation, likely inflammatory and potentially infectious in nature. These opacities are far too inconspicuous to be visible at chest radiography. Right lower lobe bronchiectasis is present and accounts for the findings seen at chest radiography (arrows). Right lower lobe bronchial impaction is seen at the cranial / central aspect of the right lower lobe bronchiectasis (curved arrow, Panel O). Mediastinal lymph nodes measuring near the upper limits of normal for size are present, but no frank mediastinal lymph node enlargement is seen, although right peribronchial lymph nodes are mildly enlarged. Enlarged mediastinal bronchial arteries extending into the peribronchial region are seen. The unenhanced thoracic CT shows that a focus of high attenuation focus is located at the cranial / central aspect of the right lower lobe bronchiectasis, in the right basal bronchial trunk, just distal to the origin of the medial basal segmental right lower lobe bronchus. No pulmonary emboli are present and there is no evidence of pulmonary arterial aneurysms. The pulmonary arteries are normal in size, which argues against the presence of pulmonary hypertension. No prior imaging was available for the patient.

In addition, closer inspection of the CT scan shows the presence of a bronchial opacity (Figure 3).

Figure 3. Axial unenhanced thoracic CT displayed in soft tissue windows shows at the cranial / central aspect of the right lower lobe bronchiectasis, a high attenuation focus (A, block white arrow) is present. Also visualized is focal basal segmental and subsegmental bronchial impaction (B & C, curved arrows) in the area of bronchiectasis.

Which of the following represents **the most appropriate next step for the management** of this patient?

1. ^{18}F FDG-PET scan
2. Bronchoscopy
3. Dynamic contrast-enhanced MRI
4. Pleuroscopy
5. Video-assisted thoracoscopic lung biopsy

Correct!
2. Bronchoscopy

Given that an abnormal focus has been shown in the right basal bronchial trunk, direct examination of the airway to evaluate this endobronchial abnormality is warranted. ¹⁸FDG-PET scanning is not particularly useful here because the absence of tracer utilization would not allow bronchoscopy to be deferred, whereas the presence of increased tracer utilization would not distinguish between inflammatory and neoplastic etiologies for the endobronchial lesion. Video-assisted thoracoscopic lung biopsy is not an appropriate procedure for evaluating central airway lesions, nor is pleuroscopy. Similarly, dynamic contrast-enhanced MRI would not be useful for evaluation of an endobronchial lesion contributing to focal bronchiectasis; this seldom used procedure has been employed for solitary pulmonary nodule characterization.

The patient underwent bronchoscopy and an endobronchial lesion was identified (Figure 4).

Figure 4. Bronchoscopic image showing an endobronchial lesion lodged in the right basal bronchial trunk.

The endobronchial lesion seen at this study could not be readily grasped. Probing the lesion did not reveal bleeding, but the lesion was not readily moveable, and there was concern that, given the wedged nature of the focus, attempts at retrieval may drive the lesion more distally or result in airway injury.

Which of the following represents the **next most appropriate** step for the evaluation of this patient?

1. Rigid bronchoscopy
2. Catheter aortography with bronchial artery embolization
3. Surgical resection of the right lower lobe
4. 1 or 3
5. Any of the above

Correct!
4. 1 or 3

Rigid bronchoscopy may be considered as this procedure could provide the technical requirements needed to grasp the endobronchial lesion and resect it, as well as control procedural complications, such as hemorrhage. However, given that the right lower lobe has been essentially destroyed by bronchiectasis, undoubtedly post-obstructive in nature, there is an argument for resecting the right lower lobe and simultaneously removing the endobronchial lesion as well as the diseased right lower lobe. Catheter aortography with bronchial artery embolization is commonly employed to control hemorrhage from the airways and / or lung parenchyma resulting from bronchial artery hypertrophy, commonly in the setting of chronic inflammatory conditions of the lung. This patient does have bronchial artery hypertrophy, likely the result of the long-standing recurrent inflammation resulting from the bronchiectasis [itself the result of focal bronchial obstruction], but the patient is not actively bleeding and hence this procedure is not required at this point. Catheter aortography with bronchial artery embolization in this context could be considered as a pre-operative procedure to control hemorrhage prior to surgical resection, however. Endoscopic ultrasound is not a useful procedure here- the lesion is not resectable, and probably even visible, through an esophageal approach.

Rigid bronchoscopy was considered, but the patient ultimately underwent right lower lobe resection (Figure 5).

Figure 5. Intraoperative views of the right lower lobe resection (A and B) showing bronchiectasis.

Which of the following represents the **most likely diagnosis** for this patient?

1. Aspirated foreign body causing post-obstructive bronchiectasis
2. Bronchial stricture with broncholithiasis from previous *Mycobacterium tuberculosis* infection causing post-obstructive bronchiectasis
3. Carcinoid tumor causing post-obstructive bronchiectasis
4. Minor salivary gland neoplasm causing post-obstructive bronchiectasis
5. Plastic bronchitis with post-obstructive bronchiectasis

Correct!

1. Aspirated foreign body causing post-obstructive bronchiectasis

Carcinoid tumor is a leading consideration for an endobronchial neoplasm that may result in post-obstructive phenomena, including bronchiectasis. Carcinoid tumors may also undergo calcification, and therefore may appear hyperattenuating at CT. Similarly, minor salivary gland neoplasms, including adenoid cystic carcinoma and mucoepidermoid carcinoma, may present as endobronchial lesions at CT scanning and may also cause post-obstructive changes. Furthermore, mucoepidermoid carcinomas have been shown to calcify, and therefore could manifest as a hyperattenuating endobronchial lesions at CT. Broncholithiasis from previous *Mycobacterium tuberculosis* infection could also present as a focal, hyperattenuating endobronchial lesion at CT causing post-obstructive bronchiectasis. However, both endobronchial neoplasia and broncholithiasis are unlikely in this patient because the lesion resected at surgery is clearly has regular, squared edges, consistent with an aspirated foreign body rather than either a neoplasm or a broncholith. Plastic bronchitis is a rare process characterized by rubber-like, obstructive, fibrinous, tracheobronchial casts that has been reported most commonly in pediatric patients with surgically repaired cyanotic congenital heart disease, particularly following a Fontan procedure, but also in patients with cystic fibrosis, asthma, pulmonary infections, and sickle cell disease with acute chest syndrome. This process has most often been described as multifocal in distribution and occasionally associated with extensive lung infiltration and even respiratory failure, and is typically neither focal nor hyperattenuating, and not associated with post-obstructive bronchiectasis.

Dissection of the surgical specimen revealed a foreign body (Figure 6).

Figure 6. The resection specimen was dissected and an endobronchial lesion was removed (A). The lesion was identified as a cap to a tube of superglue (B- Elmer's Superglue).

The patient recovered uneventfully following surgery. He and his mother were then questioned regarding the etiology of the aspirated foreign body. The mother recalled at that when the patient was very young, approximately 5 years old, he had been playing with a cap to a superglue tube, but that this cap was subsequently “lost.” At this time the patient developed a cough that persisted for several months, which was attributed to a transient childhood illness, and subsequently resolved. The patient had been largely asymptomatic since that time, and it is likely that he presented now with a minor respiratory illness (recall the patchy areas of ground-glass opacity in the left lung at CT) which brought the aspirated foreign body to attention.

Diagnosis: Aspirated foreign body right lower lobe (glue cap), occurring in childhood, resulting in post-obstructive bronchiectasis

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