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August 2023 Imaging Case of the Month: Chew Your Food Carefully

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History of Present Illness

A 50-year-old woman presents with a history of chronic dyspnea and cough, becoming particularly problematic following COVID-19 infection 4 months prior to presentation. While she did experience significant periodic oxygen desaturations during her COVID-19 infection, she was not hospitalized for this illness. The patient also reported wheezing in the previous few weeks.

Past Medical History, Family History and Social History

The patient's past medical history was also notable for gastroesophageal reflux disease as well as both Coombs positive and iron deficiency anemia. She reports a history of asthma, well controlled with inhaler use. The patient's past surgical history included adenoidectomy, cholecystectomy, and gastric laparoscopic band placement. Her medications included prednisone (20 mg daily), dextroamphetamine-amphetamine, furosemide, omeprazole, fluoxetine, zolpidem (Ambien), daily Bactrim, occasional Loratadine (Claritin). She also utilized an albuterol inhaler and Fluticasone-based (both Flonase and Breo Ellipta) inhalers.

The patient is a former smoker, ½ pack-per day for 26 years, having quit 11 years prior to presentation. She also reported a history of

vaping (agent inhaled unclear) for 8 years, quitting 3 years earlier. She has no known allergies. She drinks alcohol socially and denied illicit drug use.

Physical Examination

The patient's physical examination showed her temperature to be 99°F with normal pulse and respiratory rate but her blood pressure elevated at 160/90 mmHg. She was obese (263 lbs., BMI= 41). Bilateral basal rales were noted at her examination, but no other abnormal physical examination findings were detected.

Laboratory Evaluation

The patient's room air pulse oximetry was 85%. A complete blood count showed an upper normal white blood cell count at $1.9 \times 10^9/L$ (normal, $4.5 - 11 \times 10^9/L$). Her hemoglobin and hematocrit values were 10.7 gm/dL (normal, 12 - 16 gm/dL) and 37.1% (normal, 36 - 46%). The patient's serum chemistries and liver function studies were entirely normal. The patient had an elevated anti-nuclear antibody titer at 1:320. An echocardiogram noted diastolic dysfunction but normal left ventricular contractility. Frontal chest radiography (Figure 1) was performed.



Figure 1. Frontal chest radiography. To view Figure 1 in a separate, enlarged window click [here](#).

Which of the following statements regarding this chest radiograph *is accurate*? Frontal chest radiography shows normal findings

1. Frontal chest radiography shows normal findings
2. Frontal chest radiography shows marked cardiomegaly
3. Frontal chest radiography shows mediastinal lymphadenopathy
4. Frontal chest radiography shows pleural effusion
5. Frontal chest radiography shows multifocal peribronchial consolidation

Correct!

5. Frontal chest radiography shows multifocal peribronchial consolidation

Frontal chest radiography shows multifocal, bilateral, somewhat mid and upper lung predominant peribronchovascular thickening and peribronchial consolidation. No pleural effusion is seen. The heart size is not markedly abnormal, and mediastinal lymphadenopathy is not readily apparent. The patient underwent CT pulmonary angiography (Figure 2).

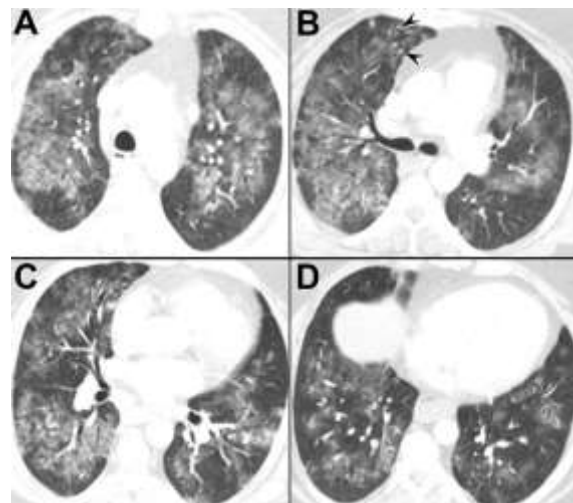


Figure 2. Representative images from axial enhanced CT pulmonary angiography in lung windows. To view Figure 2 in a separate, enlarged window click [here](#). For a video of the CT angiography click [here](#).

Which of the following represents *an appropriate* interpretation for this examination?

1. Enhanced chest CT shows extensive mosaic perfusion
2. Enhanced chest CT shows acute pulmonary embolism
3. Enhanced chest CT shows multifocal ground-glass opacity
4. Enhanced chest CT shows loculated pleural effusion
5. Enhanced chest CT features of fibrotic lung disease

Correct!

3. Enhanced chest CT shows multifocal ground-glass opacity

The CT pulmonary angiogram shows no evidence of acute or chronic thromboembolic disease, nor is pleural effusion present. No mosaic perfusion is present. Features of fibrotic lung disease are absent- there is no evidence of traction bronchiectasis or honeycombing. Multifocal bilateral ground-glass opacity is present, in some areas somewhat lobular appearing. A

few centrilobular nodules are present. Mild mediastinal lymph node enlargement is visualized. Empiric outpatient therapy with cefdinir (Omnicef) was initiated.

Based on available information this far, which of the following is the *best working diagnosis*?

1. Community-acquired pneumonia
2. Post-acute COVID-19
3. Multifocal adenocarcinoma
4. Pulmonary lymphoma
5. None of the above

Correct!

1. Community-acquired pneumonia

While the imaging findings are relatively non-specific, community-acquired pneumonia is the most likely diagnosis, if for no other reason than community-acquired pneumonia is probably the most common etiology for new onset multifocal pulmonary opacities. Primary pulmonary malignancies, including adenocarcinoma and lymphoproliferative disease, may present with multifocal pulmonary opacities, but multifocal lung disease is a rare manifestation of primary malignancy and does not typically present with a relatively acute onset, and is most commonly diagnosed when multifocal pulmonary opacities persist on follow up imaging after presumptive treatment for pneumonia fails to result in resolution of pulmonary opacities at chest imaging. The imaging features of post-acute COVID-19 infection are protean, ranging from nearly normal-appearing CT scans to multifocal areas of reticulation and ground-glass opacity [typically band-like in morphology], and even features that suggest overt fibrosis. The pulmonary opacities on this patient's CT have an appearance more suggestive of relatively acute infection or exudative acute lung injury, rather than the residua of a previous inflammatory or infectious disorder.

The patient was diagnosed with suspected pneumonia, presumably community-acquired, with bacterial or viral etiologies considered most likely. Testing with a viral respiratory panel was negative, including testing for COVID-19. Other supportive respiratory therapies were instituted as well. The patient remained afebrile. Her shortness of breath and cough subjectively improved, but did not completely resolve. Repeat frontal chest radiography (Figure 3) was performed 1 week following presentation.



Figure 3. Repeat frontal chest radiography performed one week following presentation after empiric antibiotic therapy for presumed bacterial community-acquired pneumonia.

To view Figure 3 in a separate, enlarged window click [here](#).

Which of the following represents *an appropriate interpretation* for this examination?

1. Repeat frontal chest radiography shows *improvement in* the pulmonary opacities
2. Repeat frontal chest radiography shows *no change in* the pulmonary opacities
3. Repeat frontal chest radiography shows *worsening of* the pulmonary opacities
4. Repeat frontal chest radiography is technically suboptimal, limiting assessment
5. Repeat frontal chest radiography shows gas trapping

Correct!

1. Repeat frontal chest radiography shows improvement in the pulmonary opacities

Repeat frontal chest radiography performed one week following presentation after empiric antibiotic therapy for presumed bacterial community-acquired pneumonia shows improvement in the bilateral pulmonary opacities. No pleural effusion is present. The lung volumes do not appear abnormally increased, and hence clear evidence of gas trapping is not seen. The chest radiograph is of adequate quality.

The patient continued to subjectively improve, with decreasing cough and shortness of breath and was scheduled for outpatient follow up in 3 months with home oxygen therapy prescribed. About 1 week prior to her outpatient follow up, the patient experienced an exacerbation of her dyspnea and cough, with home oxygen saturation monitoring suggesting values ranging from 85-90%.

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

1. ⁶⁸Ga-PET Dotatate scan
2. ¹⁸FDG-PET scan
3. Pulmonary function testing
4. Repeat thoracic CT
5. More than one of the above

Correct!

5. More than one of the above

Repeat chest CT and pulmonary function testing are both reasonable tests to perform. ¹⁸FDG-PET scanning is not typically employed for multifocal lung opacity, and is generally reserved for the assessment of the indeterminate solitary pulmonary nodule and cancer staging. ⁶⁸Ga-PET Dotatate is most

commonly performed for staging of neuroendocrine malignancies. Repeat unenhanced chest CT (Figure 4) was ordered at her outpatient follow up visit.

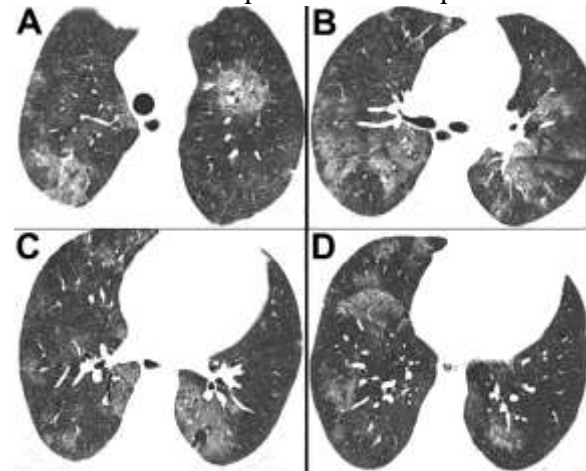


Figure 4. Representative images in lung windows from the unenhanced chest CT performed 3 months following initial presentation. To view Figure 4 in a separate, enlarged window click [here](#). For a video of the chest CT click [here](#).

Which of the following represents **an appropriate interpretation** for this examination?

1. Unenhanced chest CT shows new areas of dense consolidation
2. Unenhanced chest CT shows development of features of fibrotic lung disease
3. Unenhanced chest CT shows multifocal bronchiectasis
4. Unenhanced chest CT shows new areas of multifocal areas of ground-glass opacity
5. Unenhanced chest CT shows new bilateral pleural disease

Correct!

4. Unenhanced chest CT shows new areas of multifocal areas of ground-glass opacity

Unenhanced chest CT, performed 3 months following initial presentation and at the patient's first outpatient follow up visit, shows patchy, multifocal ground-glass opacity

associated with some mild reticulation. No pleural abnormality is present, nor are there features to suggest pulmonary fibrosis. The pulmonary opacities represent *ground-glass opacity*- increased lung attenuation that *does not* obscure the margins of pulmonary vessels and bronchial walls. *Consolidation*- increased lung attenuation that *does* obscure the margins of pulmonary vessels and bronchial walls- is lacking.

Which of the following represents *an appropriate differential diagnostic consideration* for the appearance at CT?

1. Organizing pneumonia
2. Vaping / e-cigarette associated lung injury
3. Pulmonary vasculitis
4. Hypersensitivity pneumonitis
5. All of the above

Correct!

5. All of the above

The differential diagnosis of multifocal, bilateral ground-glass opacity is extensive, and includes all of the entities listed and more. The persistent or recurrent nature of the pulmonary opacities can be seen with all the listed diagnoses as well.

The patient underwent iron infusion, which improved her anemia, followed by pulmonary function testing, which showed a total lung capacity of 3.62L (66% predicted), forced vital capacity of 2.37L (63% predicted), forced expiratory volume in 1 second of 2.09L (70% predicted), and a diffusion capacity of 14.06 mL/min/mmHg (69% predicted). No evidence of bronchospasm was detected.

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

1. Rheumatologic consultation
2. Paxlovid (Nirmatrelvir & Ritonavir) therapy

3. Bronchoscopy
4. Gastrointestinal medicine consultation
5. More than one of the above

Correct!

5. More than one of the above

Given the persistent lung opacity and elevated antinuclear antibody level, rheumatologic consultation is appropriate. Similarly, bronchoscopy with lavage and tissue sampling could be performed to evaluate the persistent lung opacities, given that viral testing has been unrevealing and broad-spectrum antibiotic therapy has been instituted without improvement in the pulmonary opacities. Consultation with gastrointestinal medicine is appropriate given the history of reflux disease and the apparent exacerbation of her respiratory condition recently.

Repeat COVID-19 testing was negative, but Paxlovid (Nirmatrelvir & Ritonavir) therapy was instituted anyway given some concern for post-acute COVID-19 syndrome.

Rheumatology evaluated the patient and found no clinical or other serological evidence of an autoimmune condition. Gastrointestinal medicine evaluated the patient and felt that she was stable on her Omeprazole therapy. The patient underwent repeat chest CT (Figure 5), 6 weeks following Figure 4 (first outpatient follow up) and 18 weeks following her initial presentation CT (Figure 2).

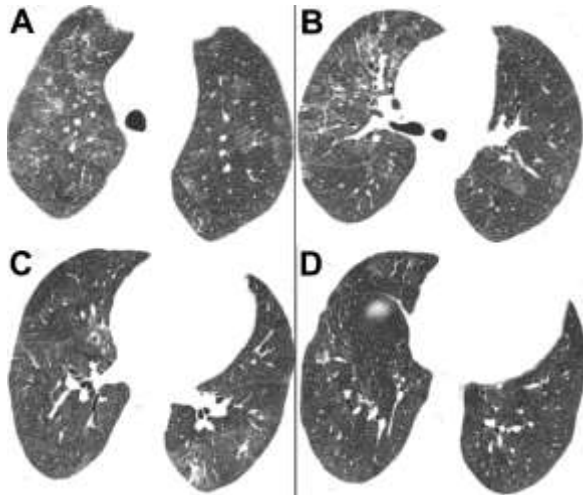


Figure 5. Representative images in lung windows from the unenhanced chest CT performed 18 weeks following initial presentation. To view Figure 5 in a separate, enlarged window click [here](#). For a video of the CT scan click [here](#).

Which of the following represents an appropriate interpretation for this examination?

1. Repeat unenhanced chest CT shows new areas of dense consolidation
2. Repeat unenhanced chest CT shows development of features of fibrotic lung disease
3. Repeat unenhanced chest CT shows multifocal bronchiectasis
4. Repeat unenhanced chest CT shows multifocal ground-glass opacity in a somewhat different distribution than the prior two chest CTs
5. Repeat unenhanced chest CT shows new nodular lung disease

Correct!

4. Repeat unenhanced chest CT shows multifocal ground-glass opacity in a somewhat different distribution than the prior two chest CTs

Unenhanced chest CT performed 18 weeks following initial presentation shows areas of bilateral, right-greater-than-left upper lobe

predominant mild ground-glass opacity in a somewhat different distribution than either of the two previous chest CTs (Figures 2 and 4), but again without clear fibrotic features. There is mild architectural distortion best seen in the right upper lobe, but no clear bronchiolectasis is evident. No new pleural abnormality is seen. No new pulmonary nodules are evident, and no substantial new consolidation is seen.

Given all the information presented thus far, which of the following represents the most appropriate next step for the patient's management?

1. Expectant management with follow up in 3 months
2. Bronchoscopy with bronchoalveolar lavage and transbronchial biopsy
3. Thoracoscopic lung biopsy
4. Increase her corticosteroid therapy dose
5. More than one of the above

Correct!

5. More than one of the above

A tissue sampling procedure is appropriate at this point as a clear etiology for the chronic, recurrent, and migratory opacities has not been identified. Furthermore, these pulmonary opacities have not resolved on chronic corticosteroid therapy (20 mg/day). Bronchoscopy with bronchoalveolar lavage and transbronchial biopsy may be able to establish a diagnosis and would be the least invasive method for such. Although not mentioned among the choices listed and more invasive than a bronchoscopic approach, cryobiopsy would be a potentially useful procedure. Thoracoscopic surgical lung biopsy should be able to establish the diagnosis with a high degree of certainty. Increasing the dose of immunosuppression could, depending on the diagnosis, result in regression in the pulmonary opacities, but such therapy can be associated with significant complications and should the

opacities recur, the impairment in wound healing may result in an increased risk with tissue sampling procedures.

The patient underwent thoroscopic lung biopsy of the right upper, middle, and lower lobes, and bronchioloalveolar lavage of the left lower lobe, which showed areas of patchy aspiration pneumonia and bronchiolectasis with numerous food particles (Figure 6) discretely visualized.

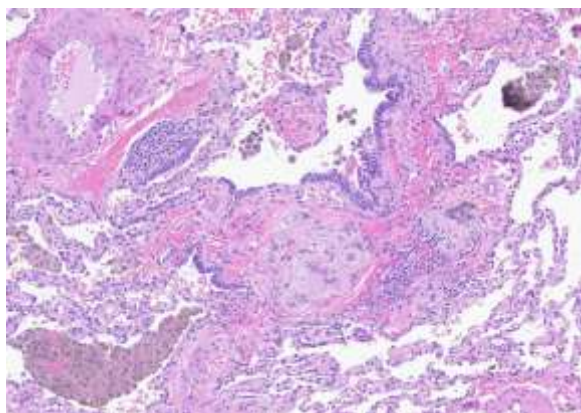


Figure 6. Histopathologic image (Hematoxylin-Eosin, 40X) shows aspirated food particles. To view Figure 6 in a separate, enlarged window click [here](#).

Areas of granulomatous inflammation, organizing lung injury, and airway-centered scarring and patchy areas of alveolar siderosis related to previous hemorrhage were seen. No evidence of vasculitis or capillaritis was noted. No evidence of hypersensitivity pneumonitis or tissue eosinophilia was seen.

Diagnosis: Aspiration pneumonia manifesting as chronic, recurrent, and migratory pulmonary opacity at chest imaging.

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