

April 2016 Imaging Case of the Month

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Clinical History: A 19 year-old man with no previous medical history was vacationing when he was found down, intoxicated, surrounded by vomit. He went into cardiac arrest, and, after several minutes, cardiopulmonary resuscitation was initiated. He was intubated in the field, and epinephrine was administered.

Once at the hospital, frontal chest radiography (Figure 1) was performed.

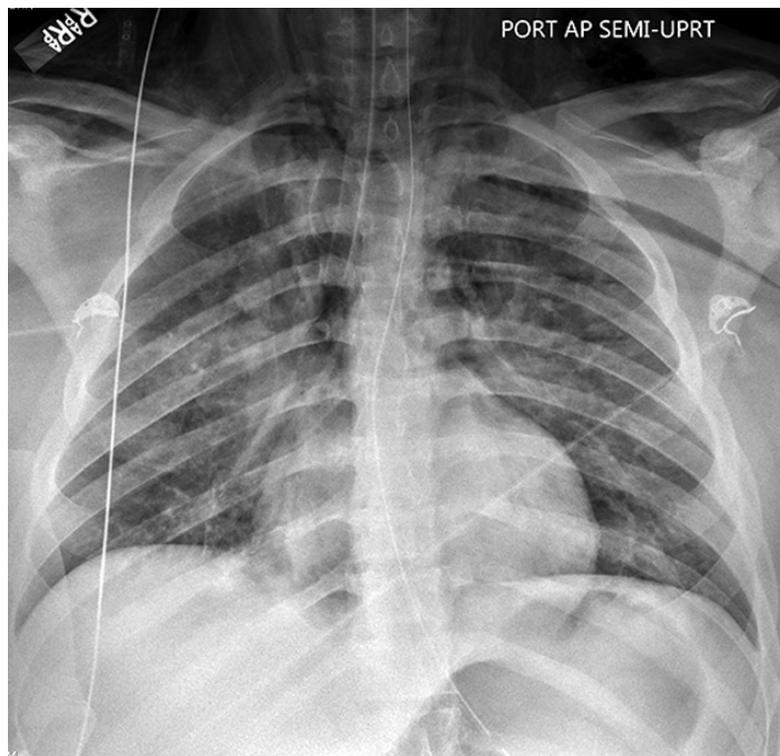


Figure 1. Frontal chest radiograph.

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

1. The frontal chest radiograph shows central venous catheter malposition
2. The frontal chest radiograph shows focal consolidation
3. The frontal chest radiograph shows pleural fluid loculated within the major fissures
4. The frontal chest radiograph shows pneumomediastinum
5. The frontal chest radiograph shows pneumothorax

Correct!

4. The frontal chest radiograph shows pneumomediastinum

Frontal chest radiography shows bilateral perihilar ground-glass opacity, extensive subcutaneous emphysema, and pneumomediastinum- the latter is evidenced by the lucency around the heart due to “lifting” of the mediastinal pleura. This appearance should not be confused with pneumopericardium. An oval lucency involving the mid-thoracic trachea, surrounding the endotracheal tube, which is approaching the right mainstem bronchus is present. No focal consolidation or pneumothorax is seen. An endotracheal tube is present, approaching the right mainstem bronchial orifice, but no central venous catheter is present. No pleural effusion, either freely layering or loculated, is present.

Which of the following differential diagnostic considerations is **not appropriate** for the imaging findings in this patient?

1. Abdominal-pelvic organ perforation
2. Penetrating thoracic injury
3. Ruptured aortic aneurysm
4. Ruptured esophagus
5. Tracheobronchial injury

Correct!

3. Ruptured aortic aneurysm

Ruptured esophagus, tracheobronchial injury, penetrating thoracic injury and abdominal-pelvic organ perforation [small bowel, or even large bowel, as may occur with diverticulitis] may all result in pneumomediastinum. A ruptured thoracic aortic aneurysm, however, would not be associated with the development of pneumomediastinum.

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

1. ¹⁸F₁₈FDG-PET scanning
2. Cervical mediastinoscopy
3. Thoracic CT
4. Thoracostomy tube insertion
5. Video – assisted thoracoscopic surgical examination of the left pleural space

Correct!
3. Thoracic CT

Thoracostomy tube insertion would be indicated for pneumothorax or pleural effusion evacuation, but neither are present in this case. Cervical mediastinoscopy is typically used for sampling enlarged mediastinal lymph nodes, as may occur with lung cancer staging, or sampling indeterminate mediastinal masses, but neither are considerations for this patient. Video-assisted thoracoscopic investigation of the left pleural space would be employed for diagnosis or management of pleural effusions, sampling left-sided mediastinal lesions or lymph nodes in contact with the pleura (as may occur with lung cancer staging), resection of indeterminate lung nodules or small, localized primary lung malignancies, bullectomy in cases of spontaneous pneumothorax, etc., but these considerations are not relevant to this patient. ¹⁸F-DG-PET scanning would not provide useful information for this patient.

The patient underwent enhanced thoracic CT (Figure 2) to further characterize the lesion found at chest radiography.

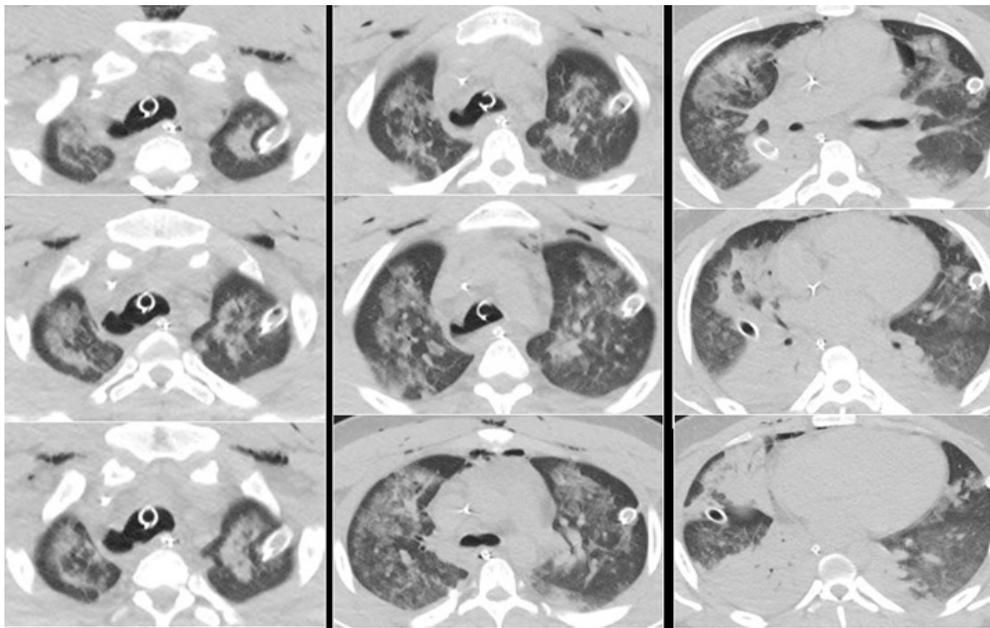


Figure 2. Axial thoracic CT in lung windows.

Which of the following is **correct** regarding the description of the thoracic CT findings?

1. Thoracic CT shows a large left pneumothorax and pleural effusion
2. Thoracic CT shows multifocal bronchiectasis and interstitial emphysema
3. Thoracic CT shows multifocal cystic lung disease
4. Thoracic CT shows multifocal small nodules with cavities
5. Thoracic CT shows pneumomediastinum and extensive subcutaneous emphysema

Correct!

5. Thoracic CT shows pneumomediastinum and extensive subcutaneous emphysema

Thoracic CT shows extensive subcutaneous emphysema and pneumomediastinum. Small bilateral pneumothoraces are present, but a large left pneumothorax is not seen, nor is there a significant left pleural fluid collection. No evidence of nodular, cavitary, or cystic lung disease is seen. Extensive symmetric basal consolidation is noted bilaterally. The pneumomediastinum is predominantly seen anteriorly. No bronchiectasis is present and no definite interstitial emphysema is seen.

One day later the patient underwent repeat chest radiography (Figure 3) for worsening respiratory status.

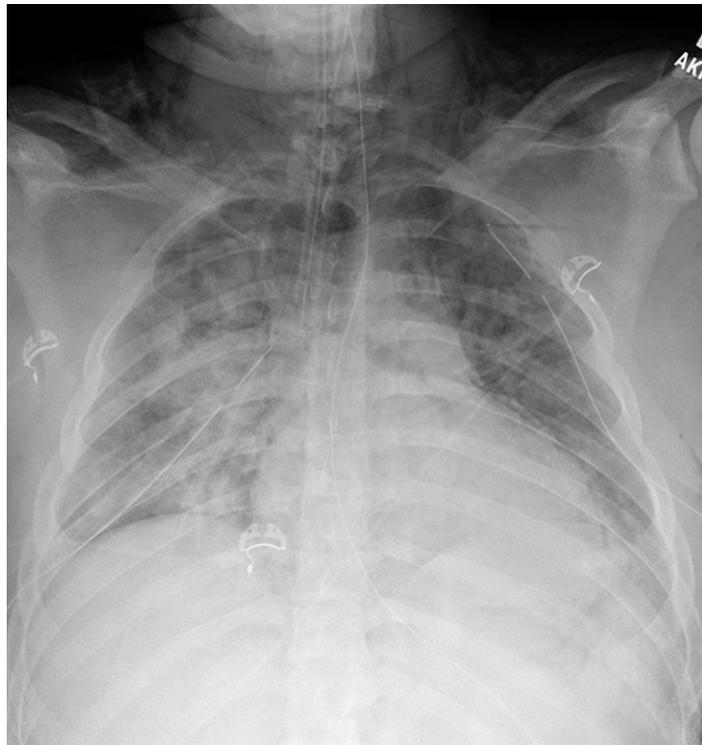


Figure 3. Repeat frontal chest radiograph.

Which of the following **best describes** the chest radiographic findings for this patient?

1. The frontal chest radiograph shows developing cavitation in the lung parenchyma
2. The frontal chest radiograph shows interval worsening of bilateral consolidation and ground-glass opacity
3. The frontal chest radiograph shows intrathoracic herniation of the stomach
4. The frontal chest radiograph shows the “fallen lung” sign
5. The frontal chest radiograph shows worsening subcutaneous emphysema and pneumomediastinum

Correct!

5. The frontal chest radiograph shows worsening subcutaneous emphysema and pneumomediastinum

The frontal chest radiograph shows interval worsening of bilateral lung opacity. Given that the patient was found unresponsive, in cardiac arrest, surrounded by vomit, there was strong concern for aspiration pneumonia now with developing widespread lung injury. The subcutaneous emphysema and pneumomediastinum are actually improving. While lung opacity is clearly worsening, there is no evidence of cavitation with the pulmonary abnormalities. The “fallen lung” sign is not present. This chest radiographic finding may be encountered when bronchial injury is present, and the lung collapses away from the mediastinum in the presence of a pneumothorax, rather than in towards the hilum, as is the more usual case with pneumothorax. This particular radiographic findings is thought to occur as a result of loss of the normal anchoring capacity of the central bronchi. No evidence of intrathoracic herniation of the stomach is seen- this would appear as a gas lucency projected over the left lower lobe, and would raise the possibility of left diaphragmatic injury.

There was no history or evidence of thoracic trauma at physical examination. The patient’s respiratory status continued to deteriorate, however.

Repeat thoracic CT (Figure 4) was performed.

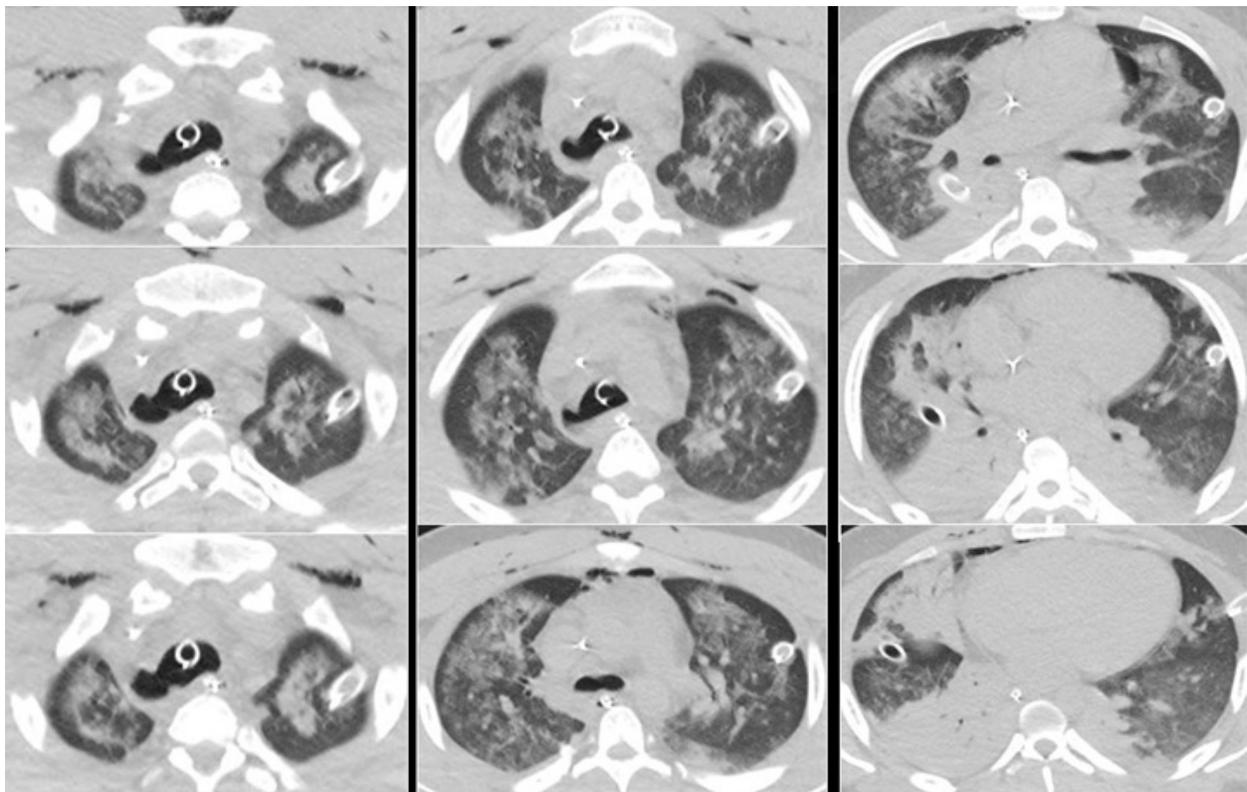


Figure 4. Repeat axial thoracic CT in lung windows performed 2 days after presentation.

Regarding this examination, which of the following is **correct**?

1. The repeat thoracic CT shows worsening multifocal lung consolidation
2. The repeat thoracic CT shows an irregular appearance of the intrathoracic trachea
3. 1 and 2
4. The repeat thoracic CT shows new mediastinal gas and fluid collections
5. None of the above

Correct!
3. 1 and 2

Both 1 and 2 are correct. The repeat thoracic CT shows fairly symmetric bilateral lung consolidation presumably reflecting aspiration-related acute lung injury. The pneumomediastinum and subcutaneous emphysema have improved significantly. However, there is gross irregularity of the right lateral mid-thoracic trachea, appearing as an outpouching, at the 8 o'clock position, raising the possibility of trachea injury resulting in the pneumomediastinum and subcutaneous emphysema at presentation (Figure 5).



Figure 5. Left: coronal minimum intensity projected image shows the tracheal disruption (arrow) to advantage.

No new or increasing mediastinal gas and / or fluid collections- which may suggest esophageal rupture- are evident.

Based on the data thus far, which of the following represents the **next most appropriate step** for the evaluation of this patient?

1. Anterior mediastinotomy
2. Cervical mediastinoscopy
3. Continue current treatment plan and monitor for response
4. Flexible fiberoptic bronchoscopy
5. Upper endoscopy

Correct!

4. Flexible fiberoptic bronchoscopy

Flexible fiberoptic bronchoscopy is indicated to evaluate for tracheal injury. Cervical mediastinoscopy would be more invasive and less capable of evaluating a potential airway injury. Anterior mediastinomy is typically used to sample anterior mediastinal or subaortic / aortopulmonary lymph nodes in patients for lung cancer staging or for mediastinal masses in these areas and would not be well-suited for the evaluation of trachea injuries. Upper endoscopy would be appropriate for suspected esophageal perforation, which is a consideration given the pneumomediastinum, subcutaneous gas, and presentation of unresponsive patient found in vomit. However, in this patient the pneumomediastinum was found predominantly anteriorly- not in close relation to the esophagus- was unaccompanied by the left pleural effusion typical of esophageal rupture, and the subcutaneous gas is decreasing. Furthermore, a potential candidate for the pneumomediastinum and subcutaneous gas- trachea injury- is now found.

Flexible fiberoptic bronchoscopy confirmed a trachea tear involving the mid-thoracic trachea at the 8 o'clock position (Figure 6).

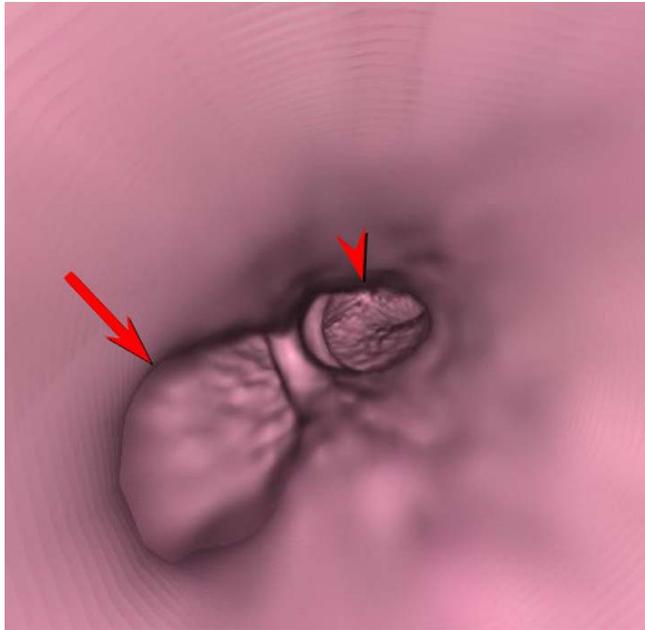


Figure 6. Virtual bronchoscopy shows the tracheal defect, visible as a circular area at the 8 o'clock position (arrow), just before the carina comes into view. The trachea lumen (arrowhead) is visible just to the right of the tracheal defect.

The patient was managed non-operatively and continued to improve, with resolution of the lung opacities, pneumomediastinum, and subcutaneous gas. He was discharged 11 days following admission.

Diagnosis: Tracheal rupture from traumatic endotracheal intubation

References

1. Mussi A, Ambrogi MC, Ribechini A, Lucchi M, Menoni F, Angeletti CA. Acute major airway injuries: clinical features and management. *Eur J Cardiothorac Surg*. 2001 Jul;20(1):46-51. [\[CrossRef\]](#) [\[PubMed\]](#)
2. Sahin M, Anglade D, Buchberger M, Jankowski A, Albaladejo P, Ferretti GR. Case reports: iatrogenic bronchial rupture following the use of endotracheal tube introducers. *Can J Anaesth*. 2012 Oct;59(10):963-7. [\[CrossRef\]](#) [\[PubMed\]](#)
3. Baumgartner FJ, Ayres B, Theuer C. Danger of false intubation after traumatic tracheal transection. *Ann Thorac Surg*. 1997 Jan;63(1):227-8. [\[CrossRef\]](#) [\[PubMed\]](#)
4. Pourmand A, Shokoohi H. False passage to the trachea after emergency intubation in a victim of near hanging. *Case Rep Emerg Med*. 2013;2013:281307. [\[CrossRef\]](#) [\[PubMed\]](#)
5. Gabor S, Renner H, Pinter H, Sankin O, Maier A, Tomaselli F, Smolle Jüttner FM. Indications for surgery in tracheobronchial ruptures. *Eur J Cardiothorac Surg*. 2001 Aug;20(2):399-404. [\[CrossRef\]](#) [\[PubMed\]](#)
6. Koletsis E, Prokakis C, Baltayiannis N, Apostolakis E, Chatzimichalis A, Dougenis D. Surgical decision making in tracheobronchial injuries on the basis of clinical evidences and the injury's anatomical setting: a retrospective analysis. *Injury*. 2012 Sep;43(9):1437-41. [\[CrossRef\]](#) [\[PubMed\]](#)
7. Tcherveniakov A, Tchalakov P, Tcherveniakov P. Traumatic and iatrogenic lesions of the trachea and bronchi. *Eur J Cardiothorac Surg*. 2001 Jan;19(1):19-24. [\[CrossRef\]](#) [\[PubMed\]](#)
8. Loh KS, Irish JC. Traumatic complications of intubation and other airway management procedures. *Anesthesiol Clin North America*. 2002 Dec;20(4):953-69. [\[CrossRef\]](#) [\[PubMed\]](#)
9. Tack D, Defrance P, Delcour C, Gevenois PA. The CT fallen-lung sign. *Eur Radiol*. 2000;10(5):719-21. [\[CrossRef\]](#) [\[PubMed\]](#)