Air-fluid level in the right lung

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A 52-year-old smoker male with 30 pack years smoking history and history of chronic obstructive pulmonary disease (COPD) and bullous emphysema presented to our hospital with complaints of worsening dyspnea, fever, and productive cough for past 3–4 days. Physical examination revealed a well-built African-American male in moderate respiratory distress requiring supplemental oxygen through nasal cannula to maintain adequate oxygen saturation. Significant findings on respiratory system examination included tachypnea and bronchial breath sounds in the upper-right chest area. An upright PA and lateral view of chest radiograph [Figure 1, panel A and B] and computed tomographic scan (without contrast) of the chest [Figure 2] are shown.

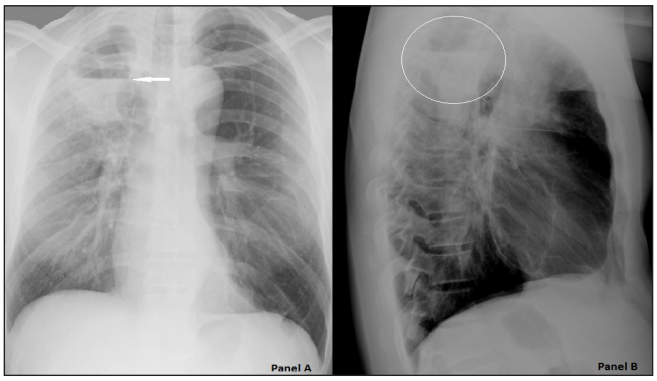

Figure 1: (Panel A and B) Posterior–anterior and lateral chest radiograph showing air–fluid level in the right lung. (arrows and circle)

QUESTIONS

Q1. What is the classic radiological finding demonstrated in the plain chest radiograph?

Q2. What is the most likely diagnoses in this patient given his underlying severe bullous emphysema?

Q3. What are the other important differential clinical diagnoses for the given radiological findings on chest radiograph and computed tomographic scan of the chest?

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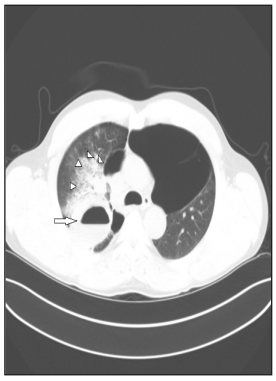

Figure 2: Computed tomogram chest (without contrast), axial view with lung window, showing air fluid level (arrows) with surrounding parenchymal infiltrates (arrowheads). Extensive bullous emphysema of bilateral lungs is visible

ANSWERS

Answer 1

The given chest radiograph shows the presence of classic air–fluid level in the lung parenchyma demonstrated in Figure 1 by an arrow. Corresponding computed tomographic (CT) scan of the chest shows the similar findings [Figure 2, arrow]. Also, there are visible lung parenchymal infiltrates on the CT-chest [Figure 2 arrow-heads].

Answer 2

In this particular patient, the most likely diagnoses is 'infected emphysematous bulla'. The presence of severe underlying bullous emphysema and prior radiological demonstration of a bulla at the site of air–fluid level is a *condicio sine qua non* for the definitive diagnoses of this condition.

Answer 3

Besides 'infected emphysematous bulla', other important differential diagnoses for the lung conditions involving 'air–fluid' levels include lung abscess, pulmonary fungal infections such aspergillosis, pulmonary tuberculosis, cavitary lung cancer – most commonly squamous cell lung cancer and emphysema with congestive heart failure.[1]

DISCUSSION

Bullous emphysema is characterized by the presence of air-filled lung parenchymal spaces termed 'emphysematous bullae' which result from the destruction of the alveolar spaces. Rarely, they may be present as isolated spaces in otherwise normal lungs.[2] Drouet *et al*. first described the air–fluid level in emphysematous bullae in 1947 as a separate disease entity from lung abscess.[3] Overall, this condition remains highly underreported in the medical literature and in a recent largest retrospective review done by Chandra *et al*., total of 52 cases reported in medical literature since 1947 were described.[4]

The pathogenesis behind the accumulation of fluid in a pre-existing emphysematous bulla is still controversial and two major possible underlying mechanisms have been proposed. Maher *et al*. described the role of peribullous pneumonitis and the reactive buildup of the fluid in the bulla due to surrounding lung parenchymal inflammation as underlying cause of this phenomenon.[5] The presence of surrounding lung parenchymal infiltrates in our patient [Figure 2 arrowheads] does support this hypothesis. The second mechanism is thought to be the loss of airway communication between the bulla and larger airways due to inflammatory mucus plugging leading to the inadequate drainage of the sterile fluid within the bulla and thus subsequent development of enough fluid to cause characteristic radiological appearance [Figures 1 and 2].

Clinical presentation of the patients with fluid containing emphysematous bulla has a wide spectrum ranging from being completely asymptomatic incidental finding on chest radiograph to severe lower respiratory tract infection presenting with high fevers, dyspnea, productive cough, and sometimes respiratory failure needing mechanical ventilation support. Most of the patients, however, present with mild symptomatic disease with symptoms such as cough, low grade fever, and rarely mild pleuritic chest pain.[6] Diagnosis relies upon the presence of characteristic air–fluid level on chest radiograph and CT scan with prior radiological evidence of bullous emphysema in the patient [Figures 1 and 2]. In the absence of prior radiological studies, some of the characteristic differentiating features include: sharper inner margins of the cavity wall, rapid changes in the amount of intrabullous fluid on serial follow up chest radiographs, the absence of purulent productive cough, and the presence of clinically milder disease.[1]Most important differential diagnosis to rule out is the lung abscess and other possible differentials as described earlier include pulmonary fungal infections, pulmonary tuberculosis, and cavitary lung cancer.

Management of this clinical condition is controversial due to the wide spectrum of clinical presentation and low reported incidence in the medical literature. Most of the reports in the literature recommend against the use of any type of invasive procedures including percutaneous drainage of the intrabullous fluid and bronchoscopy in the management.[2] Medical management for this disease entity has also been confusing regarding the need, choice as well as duration of antibiotic therapy for the treatment. Routine use of antibiotics in asymptomatic patients has been discouraged.[4] This group of patients should be followed up with expectant observation and serial chest imaging to confirm the resolution of the fluid in the bullae that can take up to weeks to months to resolve completely. Based on current clinical data, no recommendations for the use of specific antibiotics can be given for the symptomatic patients due to varied nature of causative microbiological agents.[4] Empiric choices of antibiotics used in different reports include the use of oral penicillins like amoxicillin/clavulanic acid and respiratory fluoroquinolones such as moxifloxacin or levofloxacin for varying durations. Overall, the treatment should be tailored for each patient based on the severity of

initial clinical presentation and presence of other underlying medical conditions. Following the resolution of the acute symptomatic disease, patient should also be evaluated for surgical resection of the bulla (bullectomy). Although an infected bulla in itself is not considered as an indication for bullectomy but some symptomatic patients of bullous emphysema are known to benefit from surgical resection of the bullae. The most common indications for bullectomy are symptomatic dyspnea due to a giant bulla (involving more than one-third of the hemi-thorax) and development of the secondary pneumothorax.[7]

In conclusion, this radiological quiz illustrates findings of a relatively rare disease entity seen as complication in one of the commonly encountered chronic lung diseases. Recognition and differentiation of this disease from other cavitary lung disease like lung abscess is very important as invasive diagnostic and therapeutic interventions can be avoided due to relatively benign disease course and good response to oral antibiotics in general.

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