Case Report

Regression of lung bullae after pulmonary infection: Two case reports and the aspect of radiologic and pathologic findings in one case

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Abstract

A sharply demarcated area of emphysema, bleb or bulla, is usually asymptomatic. Some could lead to pneumothorax or superimposed infection, the common complications, while some could be spontaneously resolved, of which mechanism remains unclear.

We present two male patients who had asymptomatic bullae at their right upper lungs. The first patient presented with a low-grade fever for a month. His chest radiograph showed a new patchy opacity in right upper lung, which corresponds to an enhancing mass with central necrosis on the chest computed tomography. His tissue pathology from two specimens of pleura had proven as inflammation and fibrosis. After antibiotics treatment, the follow-up images showed partial regression of the bullae. Another patient presented with right pleuritic chest pain for 16 days and was diagnosed as pneumonia with an infected lung bulla. His chest

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radiograph showed a newly seen patchy opacity at the right middle lung zone and a new air-fluid level in the lung bulla in the right upper lobe. After he had been given antibiotics treatment, partial regression of the bulla was observed. He later underwent right upper lobectomy and successful smoking cessation. The follow-up chest images showed no new bleb or bulla.

Keywords: Bulla, Bleb, Spontaneous regression, Infection.

Case summary

A 68-year-old Thai male, former smoker of 150 packs a year with underlying chronic obstructive pulmonary disease, has been treated with the inhaled beta-agonist and corticosteroid therapy. He was clinically well-controlled and rarely had an acute exacerbation. The patient has also had asymptomatic right apical lung bullae since 2013 (Figure 1A).

In February 2018, the patient presented with a dry cough with a low-grade fever for a month. His chest radiograph revealed a new patchy opacity at the right upper lobe (RUL) with a cavitary-like lesion (Figure 1B). The physical examination showed expiratory wheezing in both lungs. Three sputum smears for acid-fast bacillus were all negative. He was suspected for having lung cancer; therefore, chest computed tomography (CT) was scheduled and later showed the centrally necrotic enhancing mass surrounding by reticulofibrosis and multiple bullae, suspected of apical lung bronchogenic carcinoma or scar carcinoma (Figure 2). Tissue biopsy was performed and revealed areas of lymphocyte infiltration and fibrous bands representing acute and chronic inflammation and fibrosis (Figure 3). In the meantime, he was treated with antibiotics as amoxicillin/clavulanate potassium for seven days.

In April 2018, his symptoms were improved and the follow-up chest radiograph revealed only the right apical pleural thickening (Figure 1C, 1D).

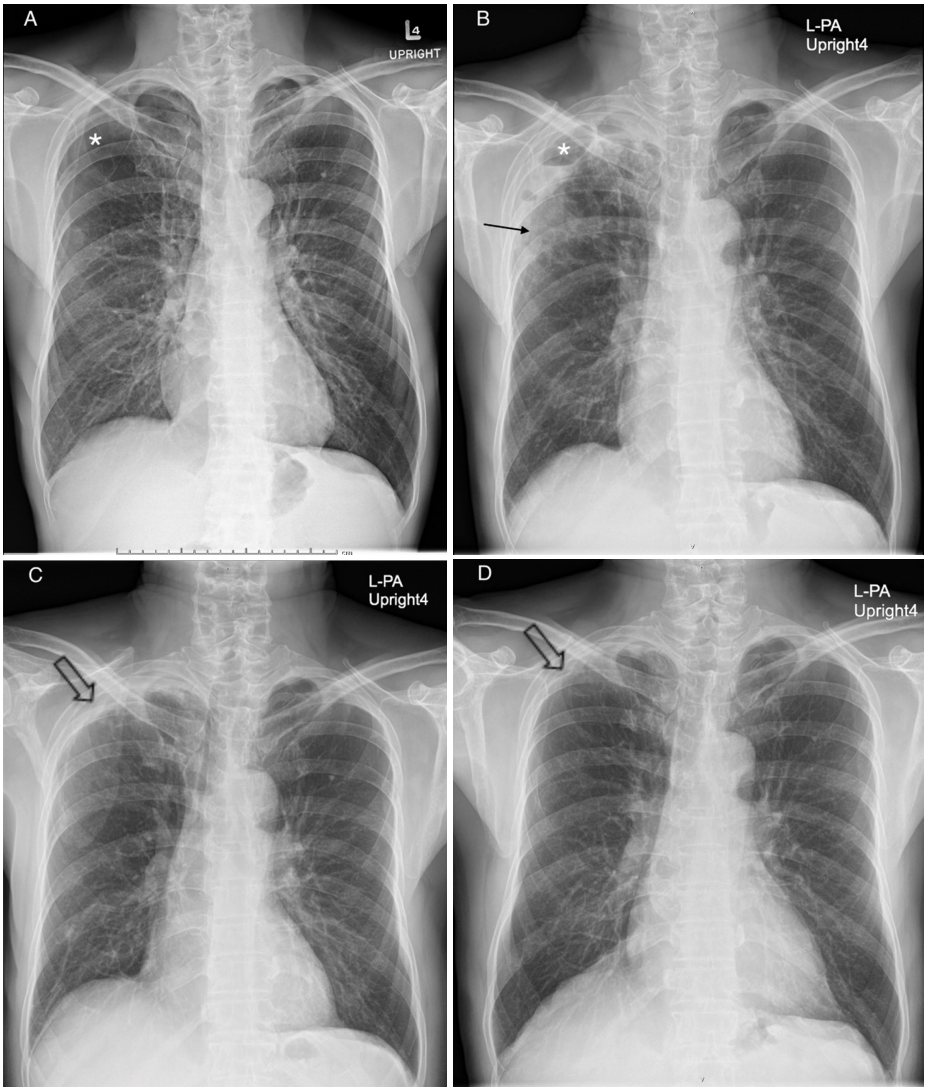

Figure 1. *Chest radiograph PA upright in 2013 (A) shows a thin-wall air-filled cavity compatible with a bulla in the RUL (asterisk). In February 2018, chest radiograph (B) shows the previously seen bulla (asterisk) with a new surrounding patchy opacity (black arrow). The follow-up chest images after treatment in March 2018 (C) and in December 2020 (D) show smaller size of the cavitary lesion with gradually improved right apical pleural thickening (open arrows), compatible with partial regression of the lung bullae.*

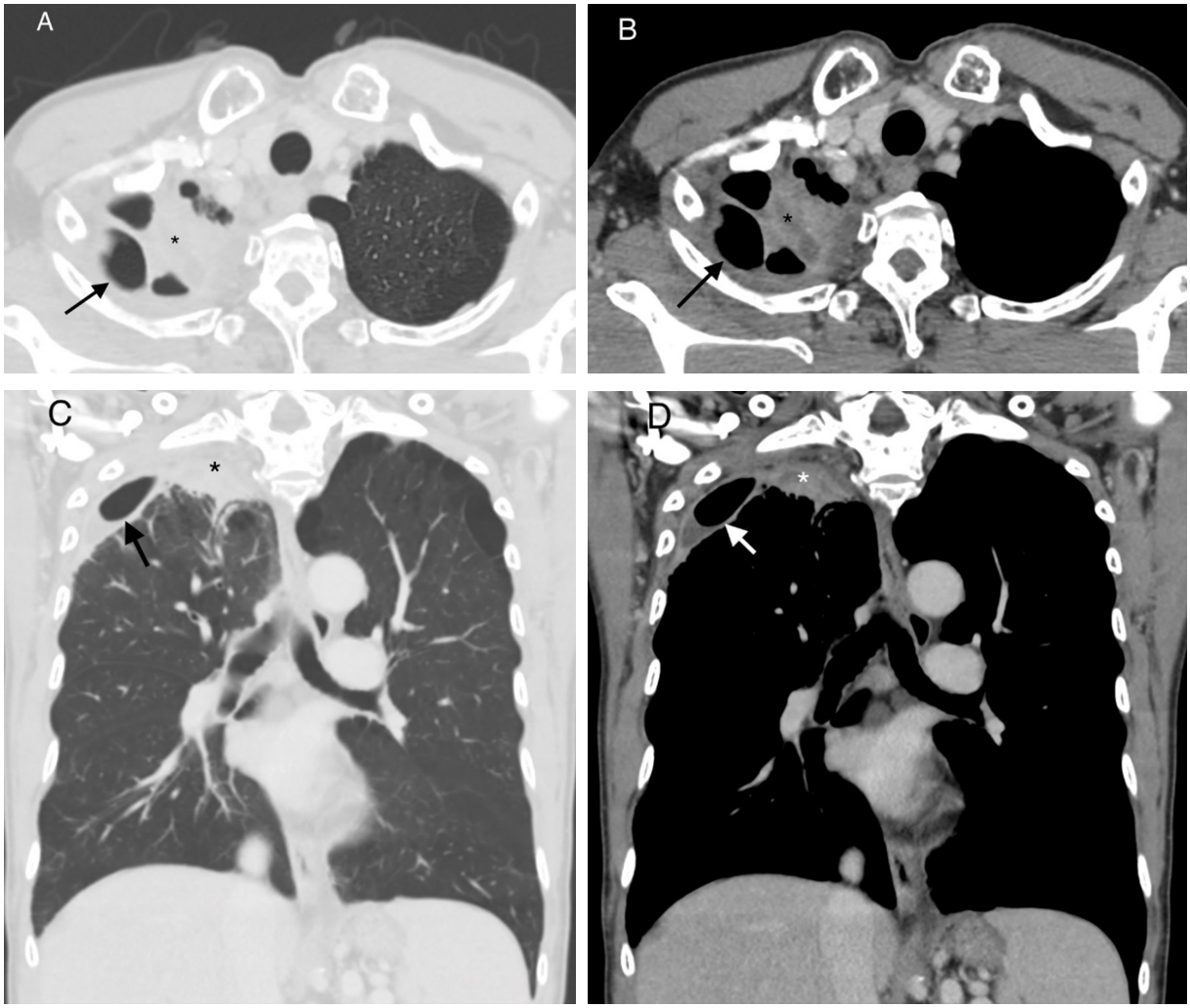

Figure 2. *Conventional CT of the chest in axial (A, B) and coronal views (C, D) in lung window (A, C) and mediastinum window (B, D) shows an enhancing mass with central necrosis in the right apical lung (asterisks) and multifocal cavity (arrows).*

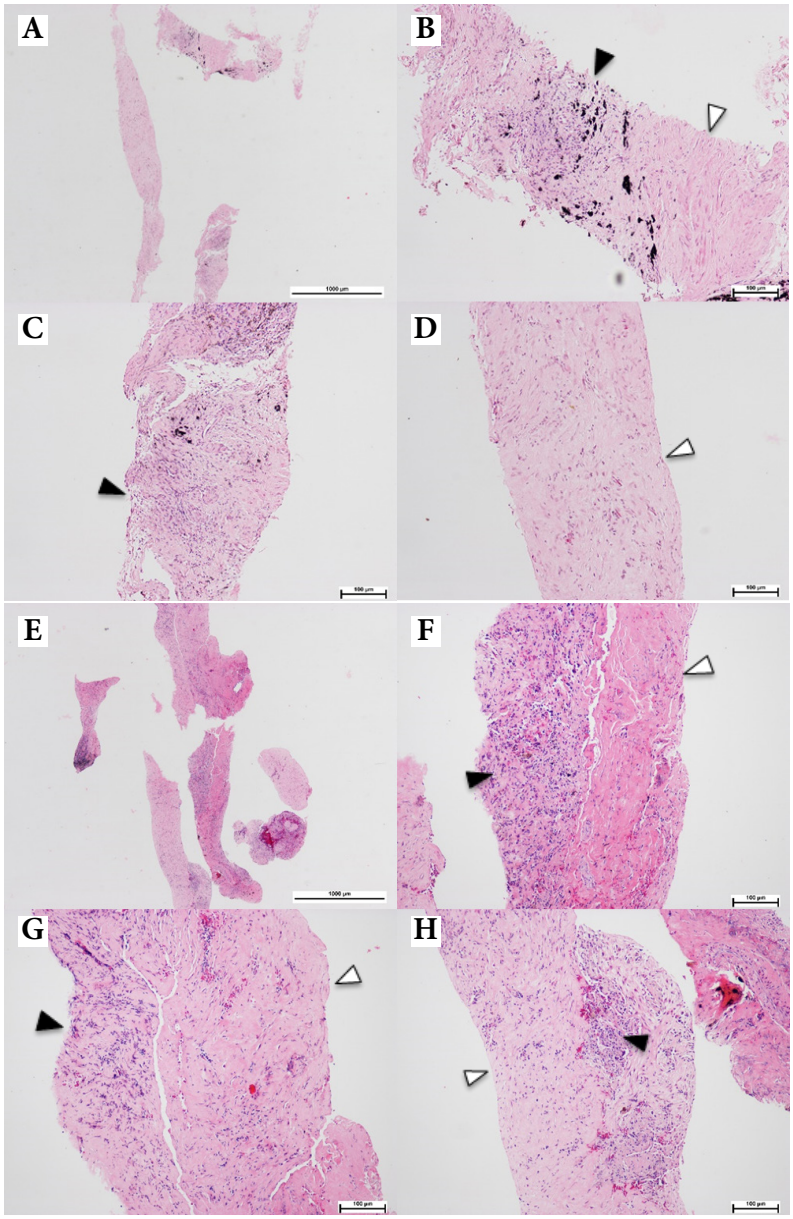

Figure 3. *Core biopsy from pleura number 1(A-D): (A) 40x magnification, (B) 100x magnification shows area of lymphocyte infiltration (black arrow head) representing chronic inflammation, and an area of the fibrous band (white arrow head), (C) 100x magnification shows an area of lymphocyte infiltration (black arrow head), and (D) 100x magnification shows the fibrous band (white arrow head). No malignant cell is demonstrated. Core biopsy from pleura number 2 (E-H): (E) 40x magnification and (F-H) 100x magnification show an area of lymphocyte infiltration, representing chronic inflammation(black arrow head), and an area of fibrous band without a malignant cell (white arrow head). All specimens are stained in hematoxylin-eosin.*

In August 2021, the patient developed worsening oxygenation. The high-resolution computed tomography (HRCT) of the chest was scheduled in order to evaluate the possible causes, such as interstitial lung disease. The study confirmed the regression of the RUL bullae (Figure 4).

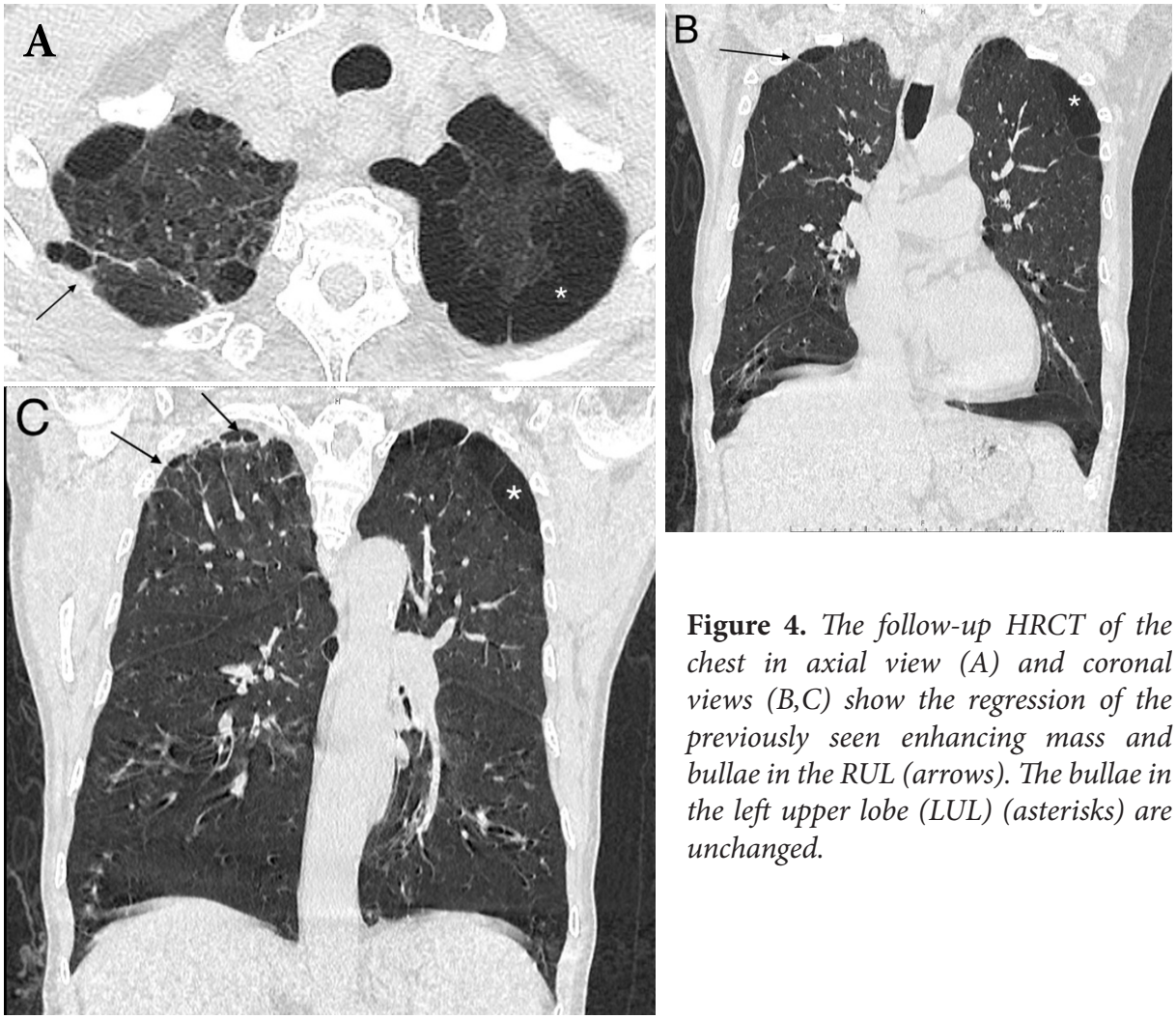

Figure 4. *The follow-up HRCT of the chest in axial view (A) and coronal views (B,C) show the regression of the previously seen enhancing mass and bullae in the RUL (arrows). The bullae in the left upper lobe (LUL) (asterisks) are unchanged.*

Our second patient, a 64-year-old male smoker of 40 packs a year with underlying gouty arthritis presented with right pleuritic chest pain for 16 days in September 2012. He also had fever and productive cough for 10 days. The physical examination revealed bilateral coarse crepitation at both lower lungs. His chest radiograph (Figure 5B) showed a newly seen patchy opacity at RUL and a new air-fluid level in the previously seen RUL bulla since 2011 (Figure 5A), which preoccupied almost one third of the right hemithorax. He was diagnosed with pneumonia with an infected lung bulla, and was given a 1-gram tablet of amoxicillin /clavulanate potassium twice daily with other supportive medication. The chest CT was scheduled for full evaluation. At the time, the patient denied undergoing bullectomy.

A week later, the chest CT (Figure 6) revealed a thin-walled cavity at the apical segment of RUL with a smooth internal margin with an internal air-fluid level (corresponding with the previous chest radiograph), minimal residual reticulonodular infiltration at the posterior segment of RUL, and minimal cylindrical bronchiectasis with ground-glass opacity at the superior segment of the right lower lobe (RLL). Resolving pneumonia and infected RUL bulla were confirmed.

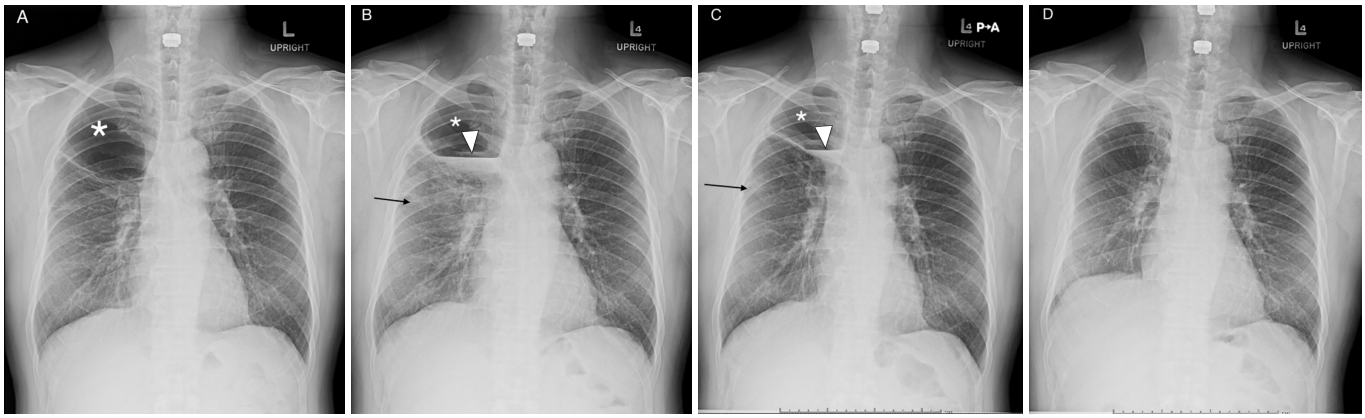

Figure 5. *Baseline chest radiograph (A) in 2011 indicated to work up the secondary cause of his arthralgia, an asymptomatic lung bulla (asterisk) is seen as an air-filled cavity, about 10.2x8.9 centimeters in size, at the RUL. The workup chest radiograph for the right pleuritic chest pain in September 2012 (B) shows a newly seen patchy opacity at RUL (arrow) and a new air-fluid level in the previous bulla in the RUL (arrow head). The diagnosis of pneumonia with an infected bulla at RUL is made. The follow-up chest radiograph after two weeks of antibiotic treatment (C) shows the decreased RUL bulla's size from the baseline (asterisk) that was about 8.4x8.3 centimeters in dimension, and a decreased amount of internal fluid (arrow head), suggestive of spontaneous partial regression of the bulla. Also, a noted disappearance of patchy opacity at RUL, likely resolved pneumonia (arrow). Finally, after discussion with cardiothoracic surgeon about the residual bulla, this patient underwent RUL lobectomy three months later without a serious post-operative complication. The post operative follow-up chest radiograph in January 2013 (D) reveals the right apical pleural thickening of surgical change and no residual bullae with mild decreased right lung volume.*

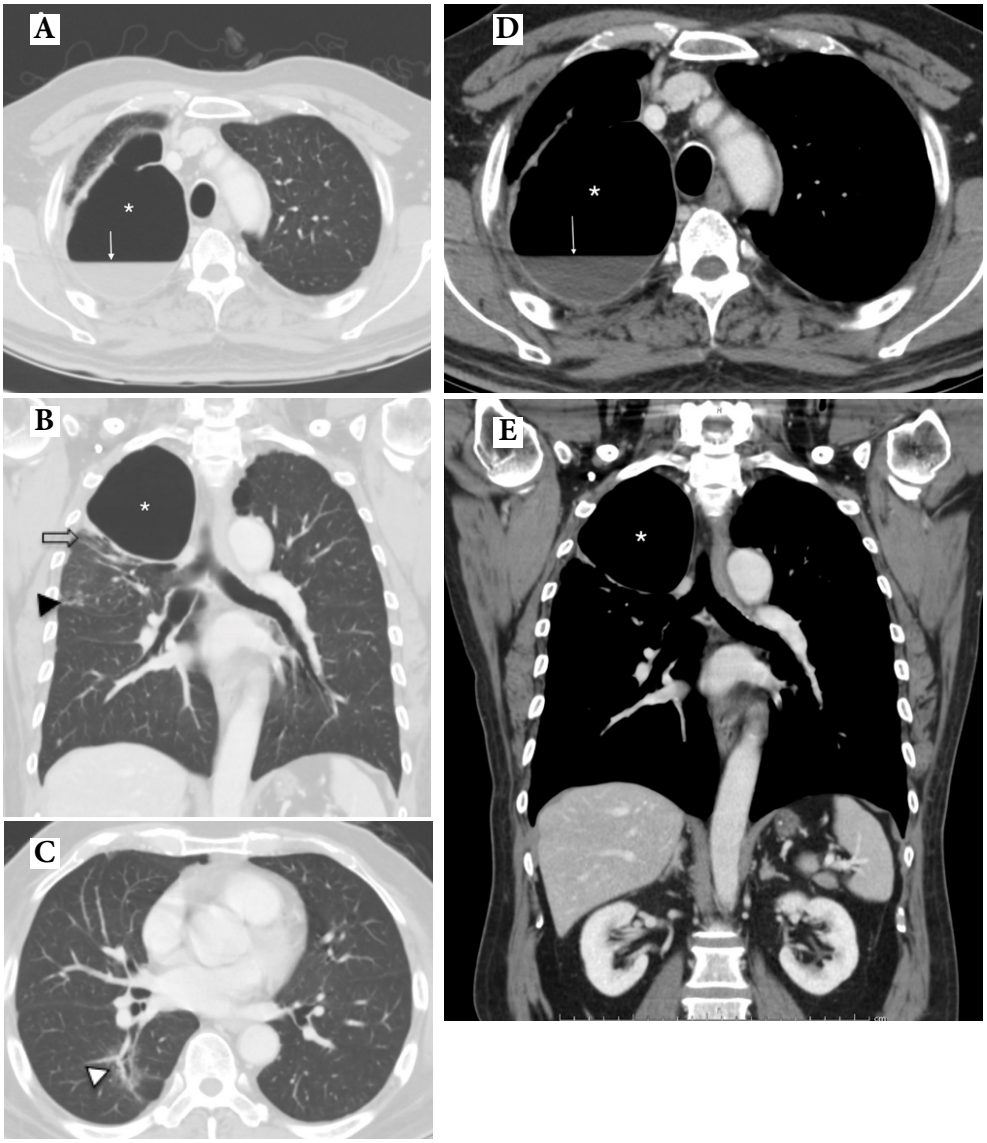

Figure 6. *The contrast enhanced CT of the chest for full evaluation of infected lung bulla in axial (A,C,D) and coronal views (B,E) of the lung window (A,B,C) and the mediastinal window (D,E) eight days after the treatment shows a thin-walled cavitary lesion at the apical segment of the RUL (asterisks) with a smooth internal margin and an internal air-fluid level (arrows in A,D), corresponding with the air-fluid level in the bulla on figure 4B. A small area of the centrilobular nodules in RUL (black arrow head in B) corresponding with the patchy opacity in figure 5B and 5C, and minimal residual reticulonodular infiltration at the posterior segment of RUL (open arrow in B), and minimal cylindrical bronchiectasis with ground-glass opacity at the superior segment of RLL (white arrow head in C) confirmed the resolving pneumonia.*

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At 2-week follow-up after the first visit, his symptoms subsided including afebrile and less dyspnea. The chest image (Figure 5C) showed disappearing patchy opacity at RML, likely resolved pneumonia. The RUL bulla had a decreased amount of internal fluid and a smaller size than on the baseline chest radiograph in 2011. The patient agreed to visit the cardiothoracic surgeon, and the antibiotic treatment was discontinued.

In December 2012, the patient underwent RUL lobectomy at a new hospital. He came to the outpatient department of the cardiothoracic surgery for post-operative follow-up in January 2013 without a serious complication. The follow-up chest radiograph showed no residual cavitary-like lesion (Figure 5D). In addition, he reported successful smoking cessation.

Discussion

Bullae, the gas-containing spaces, usually are well-defined emphysematous areas larger than 1 cm in diameter with walls less than 1 millimeter thick [1]. These commonly found gas-containing spaces are usually accompanied by the emphysematous changes of the adjacent lung.

Patients with a lung bulla usually are asymptomatic, but some may develop complications, namely, pneumothorax, superimposed infection, hemorrhage, or bronchogenic carcinoma [2-4]. The treatment of the symptomatic bulla includes smoking cessation or surgical management in patients with refractory dyspnea due to a giant bulla, which is arbitrarily defined as one that occupies at least one third of the volume of a hemithorax [2]. A spontaneous decrease in size of the bullous lesions has been reported in only 4 of 49 patients during the x-ray follow-ups [4], of which the mechanism still remains unclear. According to the literature review by Chang [5], the spontaneous regression and resolution of giant bullae in most cases could occur after infection or smoking cessation. Although the pathophysiology of this resolution has not been well understood, the airway inflammation is believed to cause obliteration of the communication between the airway and the bullae. When the bullae become close spaces, the internal air might have been absorbed resulting in their regression.

Some authors have also reported about the spontaneous regression of giant bullae after smoking cessation and the intensive care with an inhaled bronchodilator and anti-inflammatory medication. To our knowledge, tobacco smoke could increase airway inflammation; therefore, smoking cessation could decrease airway inflammation and obstruction, as well as anti-inflammatory medication, which results in bulla regression.

Our patient, a former smoker of 150 packs a year, presented with a dry cough and a low-grade fever for a month. The chest CT showed focal reticulofibrosis near the prior RUL bulla could be related to the tissue pathology showing areas of fibrous bands, while patchy or ground glass opacities could be related to areas of lymphocyte infiltration from acute and chronic inflammation. After he was previously treated with the inhaled corticosteroid and recently treated with antibiotics, the disappearance of the bullae in his follow-up chest HRCT might be the result of the prior infection or inflammatory process.

Theoretically, emphysema is a condition characterized by permanent enlargement of the respiratory airspaces accompanied with destruction of their walls without obvious fibrosis [6-8], granulation tissue, or inflammation [9]. The presence of lymphocytes and collagen in the wall of the bulla in one of our cases is likely the result of chronic infection and could be responsible for its spontaneous regression. However, cystic lesions found in smokers other than emphysema such as airspace enlargement with fibrosis are pathologically defined with dense fibrous walls [10] and scanty inflammatory cells [9]. Paraseptal emphysema, which is less comprehensively studied comparing to other kinds of emphysema, was mentioned to associate with a dense fibrous wall in one study [11].

In the second patient, a 64-year-old male smoker of 40 packs a year, the period of the infection was more specific and evident on the series of chest images. Spontaneous partial regression was also observed during the antibiotic treatment. About seven months after the beginning of smoking cessation and one month after the right upper lobectomy was performed, there was no new bleb or bulla on the follow-up chest films. This could imply that the spontaneous partial regression

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may be associated with previous infection/inflammation or smoking cessation. The disadvantages of this case were that the pathological result was not available to explain the correlation with the radiographic findings; also, the details of the smoking cessation were not available on the medical records.

Furthermore, the bulla in this case, which occupied almost one third of right hemithorax, could be defined as a giant bulla. Eleven cases of complete resolution and six cases with partial regression of giant bullae are reported [12]. The bullectomy was offered to the patient despite the partial regression of the bulla in the follow-up chest radiograph. Otherwise, according to Mehran's study [13], if a patient has a smaller bulla, which is less than 30% of the volume of the hemithorax, the dyspnea is unlikely to be related to the bulla and its excision is probably not indicated.

This case report supports those factors such as prior infection or an inflammatory process, smoking cessation, and anti-inflammatory medication in some cases, relate to the spontaneous resolution of the bullae. As mentioned in Daewa et al [14], the pathophysiology of this mechanism has still not been completely understood. A further study or observation is still needed to ensure the relation between bulla regression and these factors.

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