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Fallen lung sign: radiographic findings

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ABSTRACT
The term "fallen lung sign" refers to the collapsed lung in a dependent position, hanging on the hilum only by its vascular attachments. This is usually the result of the complete rupture of a bronchus. On chest radiograph, the diagnosis of bronchial tear is usually suspected with the persistence of a pneumothorax after chest tube insertion. An 8-year-old male patient had radiographic findings of persistence of right pneumothorax which was due to complete rupture of the right main bronchus, resulting in fallen lung.

Key words: • *thoracic injury* • *chest radiographs*

Bronchial rupture should be considered in cases of rapidly progressive pneumothorax refractory to closed underwater seal drainage. Bronchial rupture may be complete or partial. In our case, we observed on follow-up radiographs that pneumothorax secondary to trauma persisted after the insertion of the thorax tube, and that the lung was displaced to the dependent side (fallen lung sign). The fallen lung sign, which is indicative of complete bronchial rupture, is rarely seen on radiographs.

Case report

The initial chest radiograph of an 8 year-old boy presenting with acute dyspnea following a tractor crash suggested right pneumothorax (Fig. 1). Six hours after the initial film, the child's dyspnea had worsened. At this time, a second radiograph demonstrated that the pneumothorax was more marked on the right, and that a pneumothorax had developed on the left (Fig. 2). A closed underwater seal drainage was performed. The second radiograph also showed pneumomediastinum, soft tissue emphysema, and an unexpected location of the collapsed lung, which was displaced peripherally at the dependent portion of the pleural cavity, rather than centrally, adjacent to the mediastinum. Because the pneumothorax had not improved and symptoms had worsened, a second closed underwater seal drainage was performed on the right, and a first closed drainage was performed on the left (Fig. 3). Despite all efforts, the pneumothorax did not resolve, and symptoms did not diminish. At this point, a radiological consultation was obtained, and it was revealed that the right pneumothorax was due to complete rupture of the right main bronchus, resulting in fallen lung. Bronchial rupture was corrected surgically.

Discussion

The term "fallen lung" refers to the peripheral displacement rather than the usual central displacement of the collapsed lung. This is usually the result of complete rupture of a bronchus (1–4). Since the hilar vascular structures remain in their normal locations, the fallen lung is displaced towards the dependent portion of the lung rather than centrally. With bronchial rupture, lung displacement is posterior and lateral in a supine position, and inferior in a standing position. The positive intrapleural pressure probably keeps the lung at the center. Symptoms that progress within hours raise the index of suspicion; a pneumothorax that persists or progresses despite a correctly placed chest tube is a valuable sign in the diagnosis of bronchial rupture. X-ray findings of the fallen lung sign (Figs. 2, 3) are specific for bronchial rupture.

The fallen lung sign was first described by Oh et al. in 1969 and by Kumpe et al. in 1970, indicating complete rupture or transection of the main bronchi (1, 2). However, later it was reported that incomplete rupture also may produce this sign on computed tomography (CT), and that

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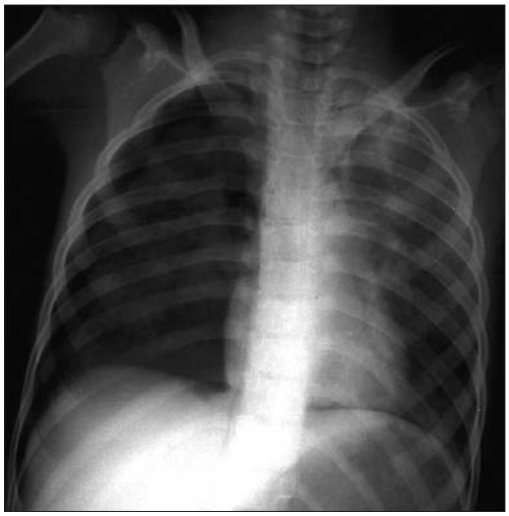

Figure 1. Chest radiograph obtained at presentation. Diaphragm contour is clearly seen on the right. Deep right costophrenic sulcus and visceral pleura seen in the right peripheral space suggest pneumothorax. Additionally, pneumomediastinum is visible in the upper mediastinum.

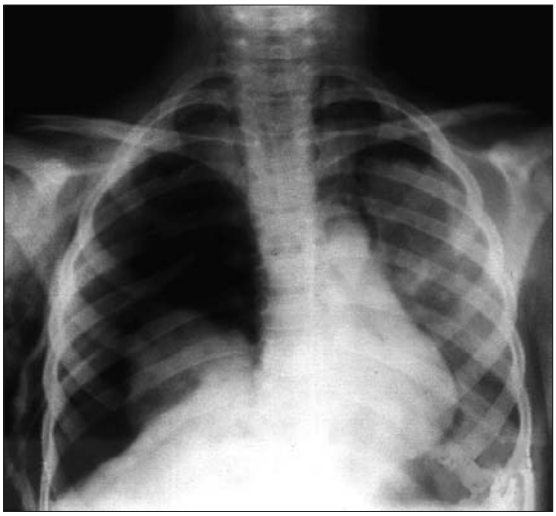

Figure 2. Chest radiograph obtained six hours after the initial presentation. Bilateral pneumothorax, more prominent on the right, is seen. Pneumomediastinum and soft tissue emphysema are observed. Right lung is seen to be collapsed below the hilus (fallen lung sign). A thorax tube has been inserted on the right.

Figure 3. Chest radiograph showing a second closed underwater seal drainage performed on the right, and a first closed drainage performed on the left due to aggravation of symptoms and persistence of pneumothorax.

the collapsed lung is displaced towards the dependent portions, or posteriorly in a supine patient (3–5). Although pneumothorax, pneumomediastinum, and soft tissue emphysema may indicate a bronchial rupture, these signs may not be observed in early examination of most patients presenting with pnemothorax and pneumomediastinum following blunt trauma. Tracheobronchial rupture is reported in less than 1% of patients with blunt trauma (4). Such ruptures are difficult to diagnose in the emergency ward, and the diagnosis is often delayed. Although the fallen lung sign is seen rarely, it is highly specific for bronchial rupture.

Most tracheobronchial ruptures occur within 2.5 cm of the carina, and are more likely to involve the proximal right main bronchus. Eighty percent of patients who have sustained sufficient trauma to have had a trachiobronchial rupture die within two hours of the injury. Esophageal rupture also may complicate the clinical picture. The most common symptom in airway injuries is dyspnea; the most common clinical findings are soft tissue emphysema and hemoptysis. In complete bronchial rupture, chest radiograph shows pneumomediastinum, pneumothorax, and extensive swelling of the endotracheal tube cuff or mislocation of the endotracheal tube, in addition to the fallen lung sign. A pneumothorax refractory to evacuation by a correctly placed thorax tube, together with a wide air leakage should also suggest bronchial rupture (6).

In cases of bronchial rupture, the localization of the rupture, surrounding air leakage, and accompanying pathology may be demonstrated with CT. Irregularity in the bronchial wall and air leakage around the ruptured bronchus may be seen in partial ruptures. Bronchoscopy may be indicated for diagnosis in such cases (6).

Bronchial wall irregularity and surrounding air leakage may be seen in partial ruptures. The diagnosis in the rarely seen tracheobronchial rupture is generally established with CT or bronchoscopy; however, when the typical fallen lung sign is present, the diagnosis of bronchial rupture may be established on radiograph and without performing any additional examinations.

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