Blunt traumatic rupture of a mainstem bronchus: spiral CT demonstration of the “fallen lung” sign

Abstract Tracheo-bronchial injuries occur in less than 1% of blunt chest trauma patients. Indirect signs, such as pneumomediastinum, pneumothorax, and/or subcutaneous emphysema, are revealed on admission plain films and chest CT survey. In most instances, however, tracheo-bronchoscopy is mandatory in assessing the definite diagnosis of tracheo-bronchial lesion. Occasionally, an abnormal course of a mainstem bronchus or a “fallen lung” sign, featuring a collapsed lung in a dependent position, hanging on the hilum only by its vascular attachments, may allow for CT diagnosis of a blunt traumatic bronchial injury.

Key words Wounds and injuries · Thorax · Thoracic injuries · Bronchi · X-Ray CT

Introduction Tracheo-bronchial injuries occur in less than 1% of blunt chest trauma patients [1]. Their detection in the emergency room is difficult and frequently delayed. It relies on a clinical suspicion, relating to the accident biomechanics [1], and on clinical or radiological indirect signs, such as pneumothorax, pneumomediastinum, and/or subcutaneous emphysema [1, 2, 3]. Diagnosis of blunt tracheo-bronchial lesions is definitely assessed by tracheo-bronchoscopy [1]; however, the admission radiological survey may provide direct signs of blunt tracheo-bronchial lesions, among which, the “fallen lung” sign, initially reported by Oh et al. [4] and Kumpe et al. [5], is seen on plain films. Our purpose is to depict a case of blunt traumatic complete rupture of the left mainstem bronchus, in which a fallen lung is displayed by spiral CT.

Case report An unbelted 39-year-old male driver involved in a high-speed head-on motor vehicle accident was admitted to our institution. In the emergency room, the patient was conscious, with a 13 Glasgow score. He was tachycardic and tachypneic. Blood gas analysis demonstrated an acid pH of 6.9 and an elevated pCO₂ of 14.6 kPa. Unstable vital signs justified endotracheal intubation and aggressive volume replacement. Examination of his chest revealed a thoracic asymmetry, with a left paradoxical motion, as well as subcutaneous emphysema and decreased breath sounds in the left chest. Extensive facial lesions were also present.

The supine front chest radiograph (Fig.1a) obtained on admission demonstrated a pneumomediastinum, featuring an air collection in the aorto-pulmonic window and a Nacilio’s “V” sign, and a left pneumothorax, which led to immediate chest tube insertion. Left muscular emphysema casting pectoral muscles could also be noticed. Radiological survey revealed a concomitant unstable fracture of the pelvis.

Sudden worsening of the respiratory conditions 10 min later justified obtaining of a second plain film (Fig.1b). A left flail chest had then become obvious, as well as a leftward displacement of the heart, with a tensed inferior vena cava. Bilateral upper rib fractures, reported as a risk factor for bronchial injuries, could be clearly identified on both chest roentgenograms (Fig.1a, b).

Contrast-enhanced spiral CT of the chest (3-mm thickness) was obtained to rule out an aortic lesion. The CT sections (Fig.1c) demonstrated a left pneumothorax and a left “fallen lung,” the latter lying in the most dependent position of the chest. The left mainstem bronchus rupture featured an abnormal vertical course and an interruption of its lumen on five consecutive images, whereas the right mainstem bronchus could be identified on each image of the whole series. This luminal interruption of the left mainstem bronchus related to an interposition of mediastinal fat...
Fig. 1a-c A 39-year-old male patient involved, as an unbelted driver, in a high-speed head-on motor vehicle accident. a Admission front chest radiograph discloses a pneumomediastinum, featuring an air collection in the aortopulmonic window (arrow) and a Naderio’s “V” sign (arrowheads), as well as a left pneumothorax and left muscular emphysema casting pectoral muscles. b On a plain film obtained 10 min later for worsening of the respiratory conditions, a left flail chest has become evident. Moreover, a major leftward displacement of the heart in the left hemithorax, with a tensed inferior vena cava, is seen. A chest tube had been inserted to relieve the left pneumothorax. a,b Bilateral upper rib fractures are clearly identified; such fractures have been reported as a risk factor for bronchial injuries and always justify further investigations. c Spiral CT survey (3 mm) reveals a left lung in the most dependent position, with pulmonary vessels displaying an abnormal backward course, thus featuring a left fallen lung. The heart (arrow) bulges into the left pleural space, anteriorly to the collapsed left fallen lung. The left mainstem bronchus has an abnormal vertical course, related to the bronchial tear. The left bronchial laceration itself is identified as a segmental interruption of its lumen (open arrow), whereas the right mainstem bronchus is identified uninterruptedly on each image of the whole series. This luminal interruption relates to an interposition of mediastinal fat and blood. (From [3])

and blood. The heart bulged into the left pleural space, anteriorly to the collapsed left fallen lung. The bronchial lesion was confirmed at tracheo-bronchoscopy and thoracotomy. The patient died in the operating room from irretrievable hemorrhagic shock, relating to multiple abdominal lesions.

Discussion
Admission chest X-ray is a reliable screening test for the identification of tracheo-bronchial injuries, even if it remains unremarkable in up to 20% of blunt trauma