A 40-Year-Old Woman With Cough and Dyspnea 2 Months After a Motorcycle Accident

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A 40-year-old woman presented with 6 weeks of dyspnea and nonproductive cough. Two months earlier, she had been hospitalized for 15 days following a high-speed motorcycle accident in which she sustained multiple traumatic injuries. These included facial, cervical vertebral, rib (left first and second, right second and third), pelvic, and tibial fractures as well as pneumomediastinum and a right pneumothorax. That stay was complicated by a prolonged air leak after chest tube thoracostomy with eventual chest tube removal on hospital day nine. Her past medical history included type 2 diabetes mellitus and chronic pain syndrome. Her family history was unremarkable. She was a mother of two with a history of alcohol abuse and tobacco dependence.

Physical Examination Findings

The patient's vital signs were as follows: temperature, 36.8°C; BP, 126/81 mm Hg; heart rate, 118 beats/min; respiratory rate, 22 breaths/min; and oxygen saturation, 92% on 2 L/min supplemental oxygen by nasal cannula. Neck examination was notable for rightward deviation of the trachea. Chest examination revealed absent breath sounds over the right hemithorax with increased dullness to percussion and diminished tac-

tile fremitus without egophony. Heart sounds were best appreciated in the midline.

Diagnostic Studies

Laboratory findings included the following: WBC count, 7,400/ μ L with a normal differential; hemoglobin level, 13.6 g/dL; and platelets, 225,000/ μ L. Serum electrolytes, coagulation studies, and liver and renal function tests were all within normal limits. Chest radiograph revealed total opacification of the right hemithorax with ipsilateral tracheal and mediastinal shift (Fig 1). A CT scan of the chest was then obtained, with comparative imaging available from her earlier hospitalization (Figs 2A, 2B).

FIGURE 1. Chest radiograph at the time of presentation demonstrating opacification of the right hemithorax with ipsilateral tracheal and mediastinal shift.

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FIGURE 2. A, CT scan of the chest, coronal view, obtained after a high-speed motorcycle accident 2 months earlier. B, CT scan of the chest, coronal view, from the current presentation.

What is the diagnosis?

DISCUSSION

To determine the diagnosis, flexible fiber-optic bronchoscopy was performed, with view of the right and left main bronchi from the level of the distal trachea shown in Figure 3. Blunt thoracic trauma rarely results in interruption of the large airways. When present, the prehospital mortality of blunt tracheobronchial injury (TBI) is high, and most of these patients die at the scene of the accident. In a review of autopsy reports from approximately 1,200 trauma patients, 2.8% were found to have tracheobronchial rupture, and 81% of these patients died before reaching the hospital. Other studies have reported a similar overall incidence and prehospital mortality rate. Most cases of blunt TBI result from motor vehicle accidents and crush injury, constituting 59% and 27% of injuries, respectively.

Blunt trauma is hypothesized to cause airway injury by multiple mechanisms. Compression of the chest reduces the anterior-posterior diameter of the thorax, with a resultant increase in transverse diameter. This displacement is theorized to place lateral forces on the lungs that exceed the elasticity of the tracheobronchial tree and cause tearing or rupture of the airways. Forced exhalation against a closed glottis (bracing for

impact) may also lead to an abrupt increase in intraluminal airway pressure, causing a “blowout” rupture. Finally, rapid deceleration may cause a shearing force on the fixed proximal airways (trachea and main bronchi) as they decelerate more rapidly than the lung parenchyma, which moves freely within the thorax.

The most common site of injury is the right mainstem bronchus. This predilection is probably due to increased traction on the shorter more vulnerable right bronchus during deceleration, whereas the trachea and left bronchus are afforded relative protection by the aorta and mediastinal tissue, respectively. Most TBI (60%) occurs within 1 cm of the carina, with 80% occurring within 2 cm of the carina.

Symptoms of acute TBI usually include tachypnea, dyspnea, and, occasionally, hemoptysis. Subcutaneous emphysema, pneumothorax, and/or pneumomediastinum are common, and these will frequently be seen on chest radiograph or CT scan. Rib fractures are also common, and, historically, those involving any of the first three ribs are present in up to 90% of patients with TBI. Although the chest radiograph may be unremarkable in up to 20% of patients, rarely a “fallen lung” sign is observed. This refers to a peripheral displacement of the collapsed lung after a complete bronchial rupture results in an inability of the still-attached vascular structures to support the lung in its usual position. Occasionally, the diagnosis of TBI is suggested by a persistent and massive air leak after chest tube thoracostomy for pneumothorax. Early complications of TBI include pneumothorax, pneumomediastinum, respiratory failure, lung torsion, mediastinitis, empyema, and death.

Bronchoscopy remains the gold standard for establishing the diagnosis. Common bronchoscopic findings include obstruction of the airway with blood and failure to visualize distal lobar bronchi because of proximal bronchial collapse. The identification of a luminal tear is confirmatory.

Coexisting traumatic injuries can mask TBI and delay the diagnosis. A review of the six largest published case series on the topic found that diagnosis was delayed > 24 to 48 h in 50% of patients. For those in whom the diagnosis is not established until after discharge, the median time from injury to delayed diagnosis is 6 months. In these cases, two types of airway injury are observed: (1) small noncircumferential tears, or (2) complete transections in which the free bronchial ends remain in close enough proximity to permit normal ventilation in the early post-trauma period. Granulation tissue subsequently forms at the site of injury, with eventual fibrous tissue deposition. Dependent on whether the transection is complete, this results in either stricture or complete airway obstruction. These patients most commonly present with exertional dyspnea or postobstructive pneumonia.

FIGURE 3. Flexible fiber-optic bronchoscopy from the level of the lower trachea. A partial view of the patent left mainstem bronchus is seen at the 9 o'clock position. The right mainstem bronchus is seen at the 3 o'clock position.

Surgical repair is the treatment of choice for tracheobronchial injury, and airway sleeve resection is the preferred method of achieving this goal. This typically involves thoracotomy and resection of fibrotic or devitalized tissue followed by reanastomosis of the remaining bronchus. Patients in whom the diagnosis of TBI is delayed should still be considered for primary surgical repair. The length of delay between the inciting trauma and subsequent diagnosis of TBI is not associated with a lower chance of successful repair. Operative success rates in this patient population are reported to be as high as 95%. Unfortunately, the limited data available on minimally invasive repair have not demonstrated optimistic results. Relief of obstructive lesions with endobronchial laser ablation is associated with a high rate of restenosis. Similarly high failure rates have been seen in the few reported cases of endobronchial stent placement, predominantly related to stent migration and stent occlusion.

Clinical Course

On the current CT scan of the chest (Fig 2B), the right bronchi are not visualized beyond the main carina, and there is atelectasis of the right lung, elevation of the right hemidiaphragm, and ipsilateral mediastinal shift. Review of CT imaging from her previous trauma (Fig 2A) reveals pneumomediastinum, right pneumothorax, and subcutaneous emphysema. There is also apparent compromise of the right mainstem bronchus, a finding that led us to suspect the diagnosis. Bronchoscopy showed a blindly ending airway with normal mucosa and a band of white fibrotic tissue completely occluding the right mainstem bronchus. Thoracic surgery was consulted, and the patient was taken for operative repair. The pleural space was entered via a right posterolateral thoracotomy. A complete right mainstem transection at the level of the carina was confirmed. A carinoplasty was performed with excision of the obstruction and reanastomosis of the right mainstem bronchus. The anastomosis was reinforced using an intercostal muscle flap. Postrepair intraoperative bronchoscopy showed a widely patent right mainstem bronchus, and her postoperative chest radiograph demonstrated excellent re-expansion of the right lung. She was extubated in the postanesthesia care unit. The remainder of her hospital stay was unremarkable. Her cough and dyspnea resolved, and she has continued to do well in post-hospitalization follow-up.

1. *Blunt tracheobronchial injury is rare, associated with a prehospital mortality rate of approximately 80%, and delayed in its diagnosis in up to 50% of patients.*

2. *Bronchoscopy is the gold standard for diagnosis. Most injuries (80%) occur within 2 cm of the main carina and most frequently involve the right mainstem bronchus.*

3. *Missed tracheobronchial injury should be considered in patients with a prior history of blunt chest trauma and unexplained dyspnea or recurrent pneumonia.*

4. *Undiagnosed tracheobronchial injury may be complicated by airway stricture or complete bronchial obstruction.*

5. *Surgical repair is the treatment of choice for acute and delayed presentations of tracheobronchial injury.*

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