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Unrecognized laceration of main bronchus caused by fracture of the T6 vertebra

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Abstract We report on an extremely rare case of a 58-year-old male poly-traumatized patient who sustained a bursting fracture of the T₆ vertebral body associated with laceration of the posterior wall of the right main bronchus from the spiculae of the vertebral body fragments. The patient was on admission asymptomatic until he underwent an endotracheal anesthesia for stabilization of associated fractures of the extremities, when he developed acute respiratory disturbances. The opening of the bronchus was repaired via a thoracotomy, while

the spine was successfully supported with a custom-made brace for 3 months. In the 3-year follow-up evaluation, the patient did well and suffered no complaints of the spine or lungs. Spine surgeons should be aware of this rare complication, which may accompany bursting fractures in the midthoracic spine. Laceration of the bronchus should be suspected when fragments of the vertebral body are dislocated far anteriorly.

Key words Thoracic vertebral fracture · Bronchus laceration

Introduction

Spinal trauma frequently results from high-energy vehicular accidents, which may produce multisystem trauma [2–5, 7]. Because of the priorities of resuscitation, other injuries may escape early diagnosis. This study reports on an extremely rare case of laceration of the bronchus by fragments of a bursting vertebral fracture that was not diagnosed on admission.

Case report

A 58-year-old man riding a motorcycle was hit by a car. On admission, the patient was in an excellent general condition, without cardiovascular or respiratory complaints. Physical examination revealed displaced ankle fractures bilaterally and a displaced olecranon fracture on the left. Lateral roentgenograms of the spine revealed a fracture of the T6 vertebra, while the CT scan revealed a bursting of its vertebral body (Fig. 1). Lung sounds and respiratory airway pressures were normal and the roentgenograms of the thorax in supine position were within normal limits; in particular, no hemothorax or pneumothorax was found. Ultrasound scanning of the abdomen (to examine the liver and spleen parenchyma and

check for bleeding) [1] revealed no pathological findings in the abdominal cavity or retroperitoneal space. The neurologic examination showed regular intrinsic muscle reflexes, both motor and sensory, in the upper and lower extremities. Two days after admission it was planned to stabilize the ankle and olecranon fractures under general anesthesia. The patient was placed in supine position for introduction of the general anesthesia. Immediately after introduction of the endotracheal tube and application of positive pressure by the anesthetist, a curious sound was observed inside the chest, which was followed by an increasing distention of the abdomen, without reverse filling of the ventilation balloon during the passive expiration. In other words, the volume of air passively inspired through the tube was not followed by the passive expiration of an equal air volume. There appeared to be a significant concentration of the mechanically inspired air somewhere inside the body. Initially it was supposed that the tube was not correctly positioned in the trachea. Thus, although the anesthetist performed repeated intubations in order to secure absolutely correct intubation (avoiding the esophagus, ensuring good contact of the tube on the inner surface of the trachea, etc.), the result was always the same. An increasing distention of the abdomen was observed during ventilation of the lungs with positive pressure, whereas when the tube was removed the distention decreased in a few seconds. Repeated blood gas analyses showed normal saturation and base levels, and the PO₂, PCO₂, and PH values were within normal limits for the age, height, and sex of the patient. Further anteroposterior and lateral chest roentgenograms in supine position on the operation table

Fig.1 Preoperative CT scan at the level of the fractured T6 vertebra. Note the proximity of the displaced fragment to the right main bronchus (arrow). No hemothorax or pneumothorax are visible

Fig.2 Transverse section at the level of the T6 vertebra (f). Artist's conception of the mechanism of laceration of the right main bronchus (b). (h heart, p pulmonary artery)

Fig.3 Sagittal section of the body. Artist's conception of the "escape" of the inspired air into the retroperitoneal space. The arrows show the route of "escape" of the air from the right bronchus, into the posterior mediastinum, underneath the parietal pleura into the retroperitoneal space, producing distention of the abdomen. (f, fragment of the T6 vertebral body, lu lung parenchyma, li liver, s stomach, p pancreas, lcp lesser cavity of peritoneum)

Fig.4 CT scan of the chest at the level of the T6 vertebra, demonstrating the obstruction of the right main bronchus by displaced fragments of the vertebral body (arrow). There is a little hemothorax visible in the posterior thoracic cavity. A displacement of the thoracic aorta (a) and its segmental vessel produced by the dislocated vertebral fragments is shown

still did not disclose any concrete pathological findings. Because of this unexplained phenomenon of “escape” of the inspired air, associated with distention of the abdomen, a thoracic surgeon was called to the operation theater. On the basis of the clinical findings, the thoracic surgeon localized the problem at the right hemithorax and bronchus, and he performed a right thoracotomy under the same anesthesia. During preparation of the bronchotracheal tree in the posterior mediastinum, he found a little (0.5-cm) transverse laceration of the right main bronchus, produced by the spiculae of the fractured T6 vertebra, approximately 3 cm below the bifurcation of the trachea (Fig. 2). The laceration of the bronchus was repaired after removal of the penetrating bone spicula and the pleural cavity was drained. The exploration of the posterior mediastinum also revealed laceration by a bone spicula of the segmental vessels derived from the thoracic aorta and hemiazygos vein. These were ligated. A detachment of the pariental pleura (found intact, not lacerated by the bone spicula) with simultaneous communication of the space underneath the pariental pleura with the retroperitoneal space through the posterior edge of the diaphragm was found. While the thorax was open a small dissection through the muscle fibers of the posterior origin of the diaphragm allowed for investigation of the retroperitoneal space up to the level of the L2 vertebra. Posteriorly to the diaphragm a detachment of the pariental peritoneum was found with significant retroperitoneal emphysema and blood concentration. This had obviously derived from the fracture site, since there was no lesion in the retroperitoneal space. Thus, it appeared that during the application of positive pressure mechanically into the trachea, an amount of the inspired air escaped from the right bronchus under the pleura downwards into the retroperitoneal space, where it became concentrated under tension (Fig. 3). The concentration of a significant amount of air in the retroperitoneal space resulted in distention of the abdomen. After repair of the laceration of the bronchus and drainage of the pleural cavity, the patient did well. A new CT scan of the thorax showed (1) the site of the previous pressure onto the right main bronchus associated with (2) damage of the segmental vessels derived from the aorta, and (3) a mild hemothorax bilaterally from the thoracotomy (Fig. 4). Two weeks later, the ankle fractures were operated on under spinal anesthesia. The patient was fitted with a custom-made body cast for 3 months for the T6 fracture. At the follow-up evaluations of 3, 6, 12, and 36 months the patient did well, and suffered no respiratory deficiency or spine complaints.

Discussion

Bursting of the vertebral body usually results in retropulsion of the fragments towards the spinal canal, with or without neurologic impairment. Ryan et al. [7] reported on missed thoracic injuries that may associate with spinal cord trauma: hemopneumothorax, pneumothorax, paralyzed hemidiaphragm. Several reports of fracture-dislocations in the thoracic spine without associated spinal cord injury have been published [4, 5]. Two recent papers reported on the presence of air in the spinal canal in conjunction with thoracic trauma [2, 3]. Laceration of bronchus

with clinical significance resulting from anterior displacement of the spiculae of a thoracic vertebral body fracture, to our knowledge, has not been previously reported. In the case just reported, the laceration of the right main bronchus occurred at the level of the sixth thoracic vertebra probably because of the proximity of the right bronchus to the anterior surface of the fractured T6 vertebral body and because the fragments of the burst vertebra had been retro-pulsed so far anterolaterally. Laceration of the bronchus was not suspected on admission because until the introduction of general anesthesia the patient remained without clinical signs, since there was no pneumo- or hemothorax following this rare injury.

In a conscious individual an active inspiration phase is followed by a passive expiration phase. In contrast, immediately after intubation of the trachea the mechanics of respiration in the patient changed due to the positive pressure applied into the lungs by the mechanic ventilation: both inspiration and expiration were passive. Thus a significant amount of the passively inspired air “escaped” from the opening of the lacerated right bronchus into the posterior mediastinum underneath the pariental pleura and thereafter into the retroperitoneum through the posterior loose insertion of the diaphragm (Fig. 3). This led to a large concentration of gas in the retroperitoneal space, which resulted in the observed distention of the abdomen.

The mechanics is explained by the anatomy [6] of the posterior mediastinum. The posterior mediastinum is an irregular triangular space running parallel with the vertebral column. The pleura below covers the upper surface of the diaphragm and may sometimes extend below the level of the last rib. The right bronchus lies close to the anterior surface of the vertebral bodies behind the pulmonary artery, while on the left side the left bronchus is anterior to the aorta and oesophagus. Thus the unusual right antero-lateral bursting of the fragments of the vertebral body of T6 resulted in laceration of the bronchus. Since the spiculae of the vertebra did not lacerate the pleura or great vessels, there were no clinical symptoms prior to the introduction of anesthesia.

Such an extremely unusual complication of a thoracic fracture should be suspected by spine surgeons when pre-operative CT scans show significant anterior displacement of fragments.

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