

Bronchus Rupture in Multiply Injured Patients with Blunt Chest Trauma

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Abstract

Background: Tracheobronchial injuries due to blunt chest trauma are rare and occur in about 0.2–5% of patients. In this study, the pattern of injury is analyzed and the importance of careful clinical examination outlined. Diagnosis is confirmed by means of bronchoscopy.

Patients and Methods: Between 1993–2000, 1,243 patients with an ISS \geq 17 were admitted to the Trauma Division of the University Hospital Zurich, Switzerland. In only six of them (0.5%), a ruptured bronchus following blunt chest trauma was identified. All patients had sustained severe associated injuries with a mean ISS of 47.2 points (range, 34–56 points). In five patients presenting with an extended subcutaneous emphysema at the time of admission, an air leakage persisted after immediate tube thoracostomy, one patient showed continuous tracheal bleeding. Diagnosis was confirmed bronchoscopically and an emergency thoracotomy performed in all six patients.

Results: In four patients the main bronchus on the right side was sutured, in one patient a wedge resection became necessary, and in one patient with additional lung laceration a pneumonectomy was performed which resulted in intraoperative death due to acute pulmonary failure. Three of six patients have survived and show no sequelae 3, 36, and 48 months after trauma, respectively.

Conclusions: Multiply injured patients with blunt chest trauma presenting with an extended subcutaneous emphysema and persistent air leakage after tube thoracostomy are at high risk of lesions of the tracheobronchial tree. Bronchoscopy will confirm the diagnosis. Therapy consists in repair of the ruptured bronchus as “day 1 surgery”.

Key Words

Bronchus rupture · Chest trauma · Management

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Introduction

Lesions of the tracheobronchial tree due to blunt chest trauma are rare and occur in about 0.2–5% of patients. Severe thoracic trauma associated with life-threatening injuries results in a poor outcome [1–5]. Due to these patterns of injury, in our series only three of six injured patients (50%) with bronchial disruption have survived.

In 25–50% of all patients, a remarkable delay varying from 1 day to 1 year is encountered until the diagnosis of bronchus rupture is established [1, 6]. In six patients of our series, the correct diagnosis was confirmed bronchoscopically within 3 h after admission.

In this study of multiply injured patients with bronchus rupture after severe blunt thoracic trauma, the focus is on clinical signs, diagnostic and therapeutic measures.

Patients and Methods

In only six out of 1,243 polytraumatized patients with an ISS \geq 17 admitted to the Trauma Division at the Department of Surgery, University Hospital Zurich, between 1993–2000, a bronchus rupture following blunt thoracic trauma was identified. In this retrospective study, special attention was paid to the mechanism of injury, the clinical signs at the time of admission, the diagnostic measures, and the surgical treatment. The overall incidence of a bronchus rupture in our series was 0.5%.

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Four patients were male and two female, with a mean age of 34.5 years (range, 22–49 years).

The time between accident and admission to the shock room was 84 min (range, 30–220 min). Initial management was performed according to the ATLS, protocol [7]. Five out of six patients presented with a history of deceleration as the mechanism of injury which was caused by a car crash ($n = 3$) and by a fall from 10–15 m height ($n = 2$). In one patient the main impact was a compression mechanism. On arrival in the reanimation room, all patients were in severe hemorrhagic shock, with a systolic blood pressure < 90 mm Hg and continuous administration of catecholamines besides volume loading.

Results

The initial clinical examination revealed an extensive subcutaneous emphysema in five patients. The diagnosis was suspected in one patient on account of a tracheal bleeding seen after intubation (Table 1). Immediately after admission, open chest tube thoracostomy was performed in all six patients. In five, a second chest tube was inserted due to persistent pneumothorax and air leakage (Figure 1).

All patients had severe, life-threatening associated injuries with a mean ISS of 47.2 points (range, 34–56 points; Table 2).

Subsequent to clinical examination and chest X-ray, a diagnostic bronchoscopy using a flexible fiberoptic bronchoscope was performed in five patients and after recognition of tracheal bleeding in another. The clinically suspected bronchus rupture could be confirmed in all six patients (Figure 2).

In five of six patients, the rupture was located on the right side of the bronchial tree. The right main bronchus was affected four times and the intermediate bronchus once. The rupture on the left was located at the lobar bronchus of the upper lobe.

The diagnosis was established after a mean of 105 min (range, 20–270 min). However, a bronchus rupture



Figure 1. Chest X-ray of a patient with a rupture of the main bronchus and an extensive subcutaneous emphysema.

was already suspected in five patients after approximately 60 min. Only in one patient was the diagnosis made due to a sudden tracheal bleeding during surgical treatment of the associated injuries. In two patients with circulatory arrest, an “emergency-department thoracotomy” (EDT) was performed. The remaining four patients could be brought to the operating room for surgery (anterolateral thoracotomy). In four patients, repair was possible with direct suture. In consciousness of its unfavorable outcome, a pneumonec-tomy was performed in one patient. Due to extensive lacerations of the right lung and massive hemorrhage, lung preservation proved impossible. In one patient, an atypical lobar resection (wedge resection) was performed (Table 3).

Three of six patients, including the two with EDT, died during the early postoperative follow-up. Irreversible hemorrhagic shock with coagulopathy due to associated pelvic or femoral fractures, injury to the right heart, splenic and liver ruptures were causes of death.

Table 1. Clinical signs of bronchus rupture ($n = 6$).

Subcutaneous emphysema	5
Pneumothorax	6
Persistent fistula after chest tube insertion	5
Hemothorax	5
Tracheal bleeding	1
Flail chest	5

Table 2. Associated injuries ($n = 6$).

Pelvic/spine fractures	3
Splenic injury	1
Liver injury	3
Heart/great vessel injury	1
Severe head injury	3
Femoral/tibial fractures	4

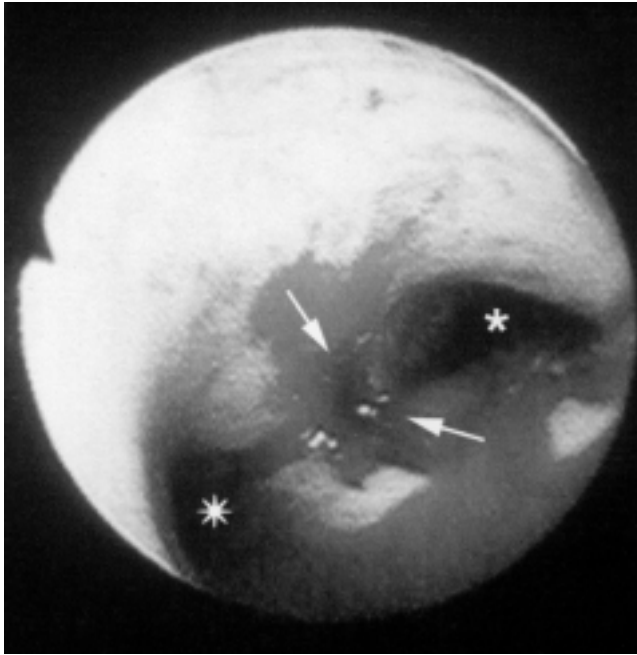


Figure 2. Bronchoscopic confirmation of ruptured bronchus (arrows) on the right side (main bronchus right * and left *).

The three survivors show no pulmonary restrictions 3, 36, and 48 months after trauma.

Discussion

Lesions of the tracheobronchial tree are rare. About 70% of all bronchial or tracheal lesions are caused by penetrating trauma, whereas in 30% blunt trauma leads to bronchus ruptures [2, 8, 9]. In blunt trauma, lesions of the main bronchus are common; in our series, four of six injuries were located at the main bronchus. The mechanism is described as an extreme force on the tethered carina and a sudden deceleration that gives rise to shear forces disrupting the airway. Other possible mechanisms include a decrease of the anterior-posterior diameter with a consecutive widening and distraction of the carina followed by disruption, as well as a sudden onset and rise of the thoracic pressure with occlusion of the glottis. This results in an airway blowout at the point of the carina [3, 10–12]. In our series, a deceleration mechanism could be recorded in five patients, whereas in one case a thoracic compression led to the bronchus rupture.

In case of a communication with the pleural cavity, a bronchus rupture appears as pneumothorax, otherwise as pneumomediastinum. Despite the presence of a bronchus rupture, the chest X-ray may, in some instances, be normal due to intact peribronchial tissue.

Table 3. Operative treatment (n = 6).

Direct anastomosis of the bronchus	4
Pneumonectomy	1
Atypical stapler resection	1

These patients develop strictures or complete stenosis weeks or years after the injury [11, 13].

In patients with blunt thoracic trauma, there is a high index of suspicion of bronchus rupture, if a subcutaneous emphysema combined with an air leakage persists or even progresses after insertion of a chest tube (Figure 1). In these situations, bronchoscopy is mandatory to exclude or confirm the diagnosis of disruption of the tracheobronchial tree [2, 11, 12, 14–16]. Consistently, five of six patients in our series initially showed a pneumothorax and an extensive subcutaneous emphysema. Due to persistent air leakage after tube thoracostomy, a bronchoscopy was performed to confirm the diagnosis of a ruptured bronchus. Only in one patient a tracheal bleeding was the reason for bronchoscopy which led to the correct diagnosis.

Compared to the mortality of 8.5–25% reported in the literature, the outcome in our series with a mortality rate of 50% was poor [10, 15, 17]. One reason for this might be the short time period of 84 min between accident and admission to the hospital (range, 30–220 min), i.e., seriously injured patients, who would die at the scene of the accident or during transport, reached the hospital still alive. Another reason is the severity of the trauma with a higher ISS in our series in contrast to other groups [15].

In our patients the treatment of associated life-threatening injuries was given priority over bronchial rupture repair. This raises the question when to operate the bronchus rupture. In a stable pulmonary situation, bleeding control to maintain a sufficient circulation has higher priority. After stabilization of the vital functions, the bronchus should then be repaired as “day 1 surgery”. Delayed repair is associated with a less favorable outcome [18, 19].

There are several surgical options for the treatment of a ruptured bronchus. Small lesions can be treated with simple suture whereas in larger tears a lobar resection might be necessary. We do not advocate pneumonectomy in multiply injured patients, because it has a high mortality rate of 75–100% and should thus be avoided whenever possible [5, 20]. The patient in our series undergoing pneumonectomy died postoperative-

ly from pulmonary failure due to extensive lung contusions.

In seriously injured patients with severe thoracic trauma and additional lung contusions, a time-consuming reconstruction of the bronchus (bronchoplasty) is not indicated [14].

In cases of delayed diagnosis of partial rupture, endoluminal stenting seems to be an alternative treatment to surgical repair [21]. Huh et al [10], however, have advocated endobronchial stenting even in complex disruptions. Reported complications of stenting are granuloma formation, stent migration, or hypersecretion. In one case, a hypertrophic granuloma was successfully resected by endobronchial laser [21]. At our institution, we have no experience with endobronchial stenting in traumatic disruptions of a bronchus.

Conclusions

In multiply injured patients with clinical signs of extended subcutaneous emphysema, persistent air leakage and pneumothorax despite tube thoracostomy, a tracheobronchial injury must be suspected. In these cases the liberal use of bronchoscopy is important for the diagnosis of tracheobronchial injury. In polytrauma patients bleeding control is given priority over bronchial rupture repair. Pneumonectomy cannot be recommended and should be avoided whenever possible. Direct suture of the bronchus is the primary goal of treatment and can be achieved in most cases.

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