Traumatic left main bronchial rupture: delayed but successful outcome of robotic-assisted reconstruction

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Abstract
Tracheobronchial injuries are rare but life-threatening conditions in patients with blunt thoracic trauma. The diagnosis and management of such injury may often be delayed due to other concomitant severe injuries. No reported case of a robotic-assisted bronchial reconstruction has ever been performed for a traumatic bronchial injury. A 23-year-old male suffered from traumatic left main bronchial (LMB) rupture with an initial presentation of pneumothorax and pneumomediastinum that eventually progressed to left main bronchus fibrosis and total obstruction, which led to left lung atelectasis and consolidation. Minimally invasive robotic-assisted sleeve surgery, 33 days after the initial trauma, successfully reconstructed the left main bronchus with satisfactory morphological and functional results. Recognition of a bronchial injury and precise localization of the lesion is mandated to ensure a prompt and adequate salvage surgical procedure in order to help patients recover from this critical condition.

Introduction
Tracheobronchial injuries (TBI) occur rarely but can be life-threatening. Little information was available concerning the accurate incidence of injury specifically to the bronchus as a result of blunt trauma because nearly 80% of patients with blunt traumatic injury to the trachea or bronchus die before arriving at a hospital [1,2]. The diagnosis and management of TBI may often be delayed due to masking by other debilitating injuries [3]. The robotic-assisted thoracoscopic surgery (RATS) has been introduced into clinical practice for years, but there is no literature reporting the utilization for traumatic bronchial injury repairs.

Case Report
A 23-year-old male was brought to the emergency after his motorcycle crashed into a bus. On arriving, physical examination of the patient revealed multiple laceration wounds and abrasion in the face, bilateral arms, and left shoulder with subcutaneous emphysema of the left chest, and open fracture of the right patella. There were decreased breath sounds in the left chest, and the initial chest roentgenogram (CXR) showed left sided pneumothorax, and thus one 28 Fr. chest tube was inserted. Focused assessment with sonography for trauma (FAST) was negative for intra-abdominal free fluid and pericardial effusion. After initial resuscitation, whole body computed tomography (CT) was obtained, which revealed a type 2 odontoid fracture and left clavicular, scapular, first and second rib fractures with bilateral lung contusion, pneumothorax, and pneumomediastinum.

Eight days after the initial trauma, atelectasis of the left lung was seen, which was transiently resolved with the use of low-pressure suction and frequent endotracheal suctioning. Bronchoscopy revealed a granulomatous lesion causing obstruction of the left main bronchus and left main bronchial (LMB) rupture was suspected.

Three-dimensional (3D) reconstruction view of the tracheobronchial tree showed total obstruction of the left main bronchus proximal to the second carina (Fig. 1). Ventilation/perfusion scans revealed no ventilation into the left lung; however, perfusion of the left lung remained intact.
Robotic-assisted left main bronchus segmental resection and reconstruction were performed using a three-arm system. The descending aorta was looped for better exposure of the left main bronchus. Segmental resection of the severe fibrosis of left main bronchus was done until spillage of bronchial secretions distally was found (Fig. 2A). The stenosis was about 3 cm in length with patent lumen distal to the stenosis and proximal to the second carina. The stumps of both the proximal and distal ends were then both trimmed, and end-to-end anastomosis was performed using interrupted 4-0 polydioxanone sutures (Fig. 2A, B).

Post-operative recovery was uneventful. Immediate post-operative CXR showed bilaterally equal lung expansion. Two weeks later post-operative bronchoscopy showed good healing of the anastomosis of the left main bronchus with luminal patency (Fig. 2C). Follow-up CXR at 2 months showed bilateral full lung expansion (Fig. 2D).

Discussion

Tracheobronchial injuries have been reported as early as 1873 with an estimated incidence about 0.5–2% including the 30–80% who died immediately [1]. Kummer et al. [2] reported an incidence of 0.4% and 4.5% for traumatic blunt and penetrating airway injuries, respectively. Up to 80% of traumatic airway injuries can be missed during the
first 24–48 h after the initial trauma because normal ventilation may be present despite airway injury and because of non-specific symptoms [1]. Thus, delayed diagnosis of airway injury may occur; airway stenosis or complete bronchial obstruction eventually results as the injured bronchus is gradually filled with fibro-granulation tissue and organized haematoma.

Subcutaneous emphysema is the most common finding occurring in up to 87% of these patients [4]. Pneumothorax may result from laceration of the mediastinal pleura and/or bronchial injury and occurs in 17–70% of patients. A massive air leak and the inability of the lung to re-expand despite drainage after tube thoracostomy are highly indicative of a TBI [5].

The CT scans may identify larger tracheobronchial disruptions. Flexible bronchoscopy is recommended for suspected TBI. Common findings of TBI include tearing of the wall, blood in the airway, and collapsed airway with inability to view and access the part of the tracheobronchial tree distally to the site of injury [5].

Any diagnosed TBI despite the timing of diagnosis should be treated surgically if possible [5]. The method of surgical approach is dependent on the location of the injury. Previous literature reported cervical approach or posterolateral thoracotomy [5]. Small tears and lacerations can be primary repaired, while complete or partial transections require debridement of the infected and devitalized tissue, trimming of the edges of the injured airway, and end-to-end anastomosis [1,5]. However, extensive bronchial damage or co-existing pulmonary vascular injury, and/or irreversible lung parenchyma injury may necessitate lung resection for effective control of the injury [4].

Owing to the limited cases, there is no literature to compare the difference of bronchial reconstruction via thoracotomy, video-assisted thoracoscopic surgery (VATS), or RATS. In general, VATS or RATS seem less invasive, with smaller incisions and rapid recovery. VATS is quite challenging due to narrow vision and limited manoeuvrability of the instrument. Owing to advantages in the robotic system, including the 3D camera with a magnified view, hand-tremor filtration, and more flexibility of articulated forceps, the bronchial fibrosis can be clearly identified and precisely dissected. This is also useful to perform the anastomosis precisely and to prevent vascular injury during the operation.

To date, this is the first case of traumatic bronchial rupture to receive RATS for bronchial reconstruction with satisfactory morphological and functional result, even though the treatment was done 33 days after the initial trauma. Recognition of a bronchial injury and precise localization of the lesion is mandated to ensure prompt and adequate salvage surgical procedure in order to help patients recover from this critical condition.

Disclosure Statements
Appropriate written informed consent was obtained for publication of this case report and accompanying images.

References
1. Kiser AC, O’Brien SM, and Detterbeck FC. 2001. Blunt tracheobronchial injuries: treatment and outcomes. Ann. Thorac. Surg. 71:2059–2065.
2. Kummer C, Netto FS, Rizoli S, et al. 2007. A review of traumatic airway injuries: potential implications for airway assessment and management. Injury 38:27–33.
3. Toker A, Tanju S, and Dilege S. 2008. Reimplantation of the left lung 17 years after a bronchial rupture. Ann. Thorac. Surg. 85:1436–1438.
4. Koletsis E, Prokakis C, Baltayiannis N, et al. 2012. Surgical decision making in tracheobronchial injuries on the basis of clinical evidences and the injury’s anatomical setting: a retrospective analysis. Injury 43:1437–1441.
5. Prokakis C, Koletsis EN, Dedelias P, et al. 2014. Airway trauma: a review on epidemiology, mechanisms of injury, diagnosis and treatment. J. Cardiothorac. Surg. 9:117.