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Successful Management of Delayed Left Main Bronchus Rupture with End-to-End Anastomosis

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ABSTRACT

Background: Central airway injuries resulting from blunt trauma are infrequent but potentially fatal. Main bronchial ruptures, if not promptly diagnosed, can lead to complete airway obstructions and functional pneumonectomies due to fibrosis and granulation. Regardless of the timing of the rupture, successful bronchial reconstruction and end-to-end anastomosis can restore lung function in these cases.

Case Report: We present the case of a 23-year-old patient involved in a high-energy traffic accident 45 days prior, who was also eight weeks pregnant at the time. The patient underwent a functional left pneumonectomy due to a delayed left main bronchus rupture. On the 45th day post-accident, the patient's lung functionality was successfully restored through surgical intervention, utilizing left main bronchus reconstruction and end-to-end anastomosis.

Conclusion: Patients with delayed bronchial ruptures can achieve a curative and complete treatment through end-to-end anastomosis. Thus, it is imperative for experienced surgical teams in large medical centers to perform such treatments.

Keywords: Blunt trauma, bronchial rupture, end-to-end anastomosis, surgery, tracheobronchial injury.

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INTRODUCTION

Tracheobronchial injuries (TBIs) represent a well-recognized, yet perilous, complication arising from blunt thoracic trauma.[1] Despite advancements in patient transportation systems, mortality rates remain alarmingly high, with up to 80% of patients succumbing before reaching the hospital. Notably, delays in diagnosis—ranging from 25% to 70%—persist in cases that do make it to the hospital, often attributable to concomitant injuries and the clinical presentations' resemblance to ordinary thoracic trauma.[1,2] In instances where complete obstructions of the main bronchus lead to diagnosis delays, the resultant functional pneumonectomy poses a considerable challenge for surgical intervention. However, irrespective of the time elapsed since the rupture, lung functionality can be restored through the meticulous execution of main bronchus reconstruction and end-to-end anastomosis.

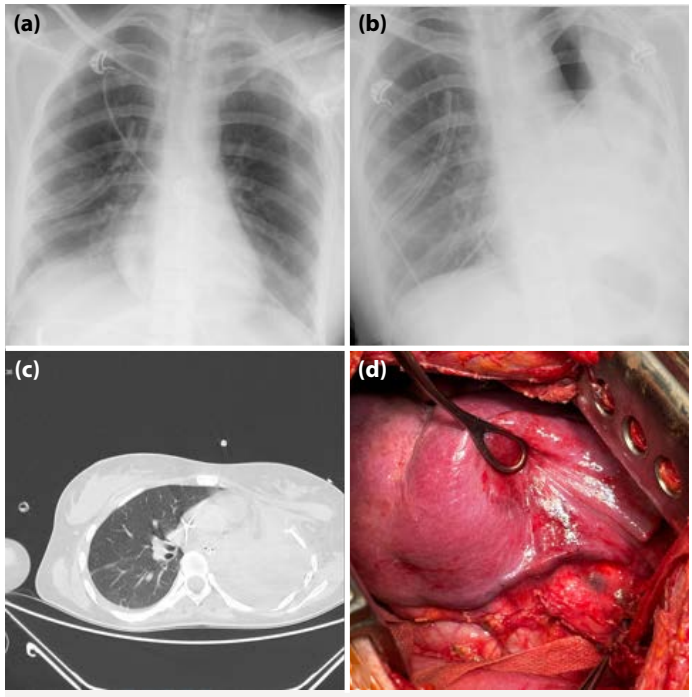

Figure 1. (a) Chest radiograph showing expanded lungs after bilateral chest tube insertion. **(b)** Atelectasis and pneumothorax visible after removal of the left chest tube on the 8th day post-accident. **(c)** Chest CT scan illustrating the interruption of the left main bronchus and total left atelectasis. **(d)** Intraoperative view showing the left main bronchus suspended with vascular tape.

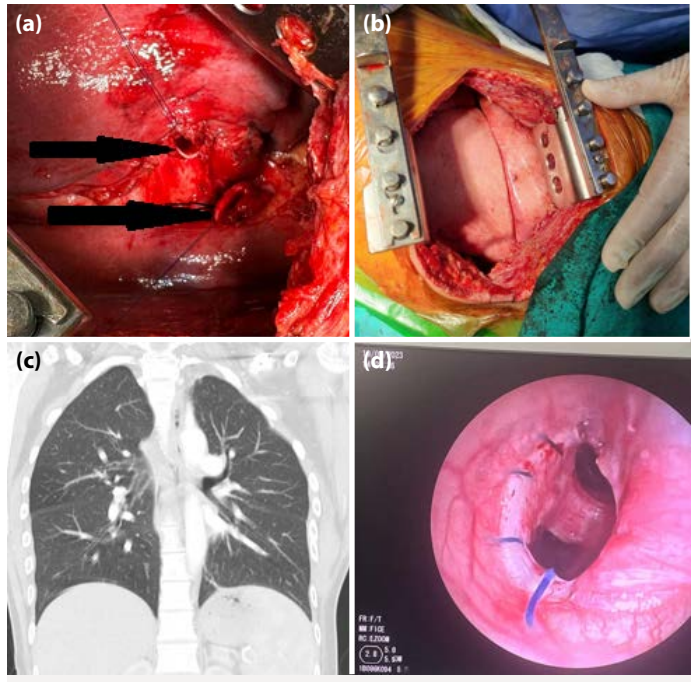

Figure 2. (a) Intraoperative view of the suspended proximal and distal ends of the left main bronchus. **(b)** Intraoperatively expanded upper and lower lobes of the left lung. **(c)** Follow-up chest CT scan confirming lung expansion on the 60th postoperative day. **(d)** View of the anastomosis line on day 60, visualized with fiber-optic bronchoscopy.

CASE REPORT

A 24-year-old woman, eight weeks pregnant and previously healthy, was brought to the emergency room following a high-energy traffic accident 45 days earlier. The patient presented with multiple left rib fractures, bilateral pneumothorax, a left clavicle fracture, a right forearm double-shaft fracture, and a spleen laceration. Bilateral tube thoracostomy was promptly performed to achieve lung expansion (Fig. 1a). Subsequently, the patient was transferred to a higher-level medical center, where she underwent consecutive surgeries for curettage, laparotomy, and treatment of extremity fractures. During the postoperative follow-up, the left chest tube was removed on the eighth day post-trauma. However, a new chest tube had to be inserted due to the development of total atelectasis and pneumothorax (Fig. 1b). On day 20, the right thoracostomy tube was removed, but on day 26, a left thoracotomy was conducted due to persistent total atelectasis and pleural effusion in the left lung. Fiberoptic bronchoscopy in the patient with persistent postoperative atelectasis revealed a complete obstruction of the left main bronchus. The patient was subsequently referred to our institution for further diagnosis and treatment. Upon conducting a chest computed tomography (CT), we identified the disruption of the left main bronchus's continuity under the aortic arch, confirming the obstruction at the distal end through bronchoscopy (Fig. 1c). The patient underwent surgery with a preliminary diagnosis of delayed left main bronchial rupture. A left thoracotomy was performed along the previous incision line, and the left main bronchus was mobilized from the presumed rupture area under the aortic arch (Fig. 1d). Intraoperative fiber-optic bronchoscopy (FOB) aided in precisely determining the rupture site. The bronchus was then fully transected at the rupture site. Both proximal and distal ends were closed. After clearing the lung's mucus with an aspirator, both proximal and distal ends were reopened and mobilized (Fig. 2a). The anastomosis was executed using simple interrupted 3/0 polypropylene sutures (Prolene), rather than employing a continuous suture technique. This approach allowed the left lung to fully expand while being ventilated intraoperatively (Fig. 2b). Postoperative checks for air leakage were conducted, followed by the placement of a chest tube into the thorax to finalize the surgery. The patient was then transferred to the postoperative intensive care unit. No air leaks were observed during the follow-up, and the patient was transferred to a regular ward on the second day post-

surgery. FOB on postoperative days 4 and 7 confirmed clear secretions and an intact anastomosis line. The patient was discharged following the removal of the thoracostomy tube on postoperative day 9. Subsequent follow-ups with FOB and chest radiography on the 60th postoperative day showed a fully expanded lung and an intact anastomosis line, after which the patient was excluded from further follow-up (Fig. 2c, d).

DISCUSSION

TBIs present a significant challenge with a notably high mortality rate, often resulting in fatalities at the accident scene. The estimated incidence of TBIs ranges between 0.5% and 2.5%, with these injuries typically occurring following high-energy trauma. These injuries affect the trachea and main bronchi, which are located in partially protected areas.[1,2] Notably, injuries often cluster around the carina, especially within approximately 2.5 cm of this region. In 75% of cases, injuries are observed in the distal trachea and right main bronchus. However, as in our patient's case, the left main bronchus—supported by the aorta and other anatomical structures—is less commonly affected, occurring in only 17% of cases.[3]

Upon arrival at the hospital, the traditional expectation for TBI patients includes massive pneumothorax or tension pneumothorax, often accompanied by significant air leakage following chest tube insertion. While a chest CT can aid in the early diagnosis of main bronchial ruptures, bronchoscopy remains the gold standard. It enables the early detection of the injury and facilitates more manageable treatment.[1,4,5]

However, clinical and radiological presentations occasionally deviate from these expectations. In cases where a bronchus rupture does not extend into the pleural space, air circulation can persist, leading to subcutaneous emphysema, mediastinal emphysema, and pneumothorax,[1] without massive air leaks observed after chest tube insertion. This subclinical course may divert clinicians' attention to other health issues, as observed in our patient, who faced additional health concerns due to a high-energy accident, pregnancy, and orthopedic problems.

The development of fibrosis and granulation within the ruptured airway, typically occurring between 6 and 21 days, underscores the importance of early detection to prevent partial (stenosis) or complete obstruction.[4] Patients with partial obstruction may develop complications such as recurrent pneumonia, bronchiectasis, and destroyed lung syndrome until the diagnosis is made. In contrast, those with complete obstruction may be spared from an infective process due to airway mucus filling, thereby facilitating lung preservation even if the diagnosis is delayed, as was evident in our case. A significant advantage of this scenario is the preservation of lung function, even when the diagnosis occurs years later, as demonstrated in our patient.[6] Remarkably, in our case, there were no complications related to pulmonary infections either during or after the surgery.

Surgical repair of the left main bronchus rupture poses unique challenges due to the proximity of the aorta and other anatomical structures.[6] A noteworthy observation from our experience in surgically addressing delayed bronchial ruptures is that exaggerated fibrosis and lymph node reactions can complicate bronchial dissection and identification. This was observed in our patient, who had undergone a prior thoracotomy without successful identification of the bronchial rupture. The most common surgical approach is resection and end-to-end anastomosis of the obstructed area, a task that is particularly challenging in the case of left main bronchus ruptures due to severe fibrosis and the constraining presence of the aorta.

Our postoperative experience with the patient was free of complications; however, it is essential to note that complications in cases of delayed bronchial ruptures can occur in approximately 20% of cases. Common complications include anastomotic separation, air leakage, bronchopleural fistulas, empyema, and late stenosis.[1,3] To avoid these, meticulous and careful bronchial dissection is crucial, along with minimizing the resected bronchial line by precisely identifying the rupture site. This approach helps reduce anastomotic tension.

CONCLUSION

In conclusion, maintaining a high index of suspicion for TBIs and utilizing bronchoscopy as the gold standard for diagnosis are crucial. Despite the complexities associated with surgeries for delayed bronchial ruptures, successful outcomes are achievable when performed by experienced surgical teams in large medical centers.

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