

Successful Treatment of Complicated Tracheobronchial Rupture Using Primary Surgical Repair

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Traumatic tracheobronchial disruption is a life threatening injury in the pediatric population. The clinical presentations are variable depending on whether the peribronchial tissues remain intact. A high index of clinical suggestion and accurate interpretation of radiological findings are necessary to diagnose the injury. Delays in treatment increase the risk of death and complications. We report a 9-year-old boy who presented with subcutaneous emphysema, bilateral pneumothorax, pneumomediastinum, and respiratory failure. Bronchoscopy revealed a complex rupture of the airway over the junction of the right main upper lobar and intermediate bronchus. Emergent surgical intervention was performed via a right posterolateral thoracotomy after bilateral chest tube insertion. End-to-end anastomosis of the disrupted bronchus was completed with interrupted absorbable 4-0 vicryl without additional covering of the anastomosis with pleural or muscle flap and intra-operative bronchoscopy showed a normal anastomotic relationship after the procedure was completed. The patient was discharged in good condition 10 days after the operation. At 6 months of follow up, he had good health status and bronchoscopy showed good patency over the anastomotic region. (*Chang Gung Med J* 2005;28:662-7)

Key words: traumatic tracheobronchial disruption.

Thoracic injuries include rib fractures, sternal fractures, pulmonary contusions, cardiac contusions, aortic injuries, hemopneumothorax, hemopneumomediastinum, hemopneumopericardium, diaphragm injuries, and tracheal-bronchial disruption.⁽¹⁾ Among these injuries, tracheobronchial disruption is less common but it is a life threatening injury associated with blunt thoracic trauma.^(1,2) However, the injury has been associated with the increased use of high-speed transportation.^(3,4) Herein, we present a case with major airway disruption that was managed with primary repair.

CASE REPORT

The 9-year-old male patient was the pedestrian involved in a truck-pedestrian collision. He felt persistent chest pain and dyspnea after the accident. In addition, he had ecchymosis along the neck and the anterior chest wall. Because of these symptoms, he was sent to a hospital to seek medical help (vital signs: HR: 76/min, RR: 20/min, BP: 110/80 mmHg, BT: 36.5°C). After a series of surveys, he was found to have multiple rib fractures and bilateral pneumothorax. He received bilateral tube thoracotomy

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but still complained of dyspnea. In addition, poor right lung expansion, progressive neck subcutaneous emphysema, and persistent air leaks from chest tube were found.

Endotracheal intubation was performed because of impending respiratory failure. With possible of tracheobronchial disruption, the patient was transferred to our hospital for further management (2 hours after the accident).

Physical examination at our emergency department showed decreased breathing on the right side. Laboratory test results showed respiratory acidosis with carbon dioxide retention and desaturation (pH: 7.177, PCO₂: 74.4, PO₂: 74.7, HCO₃⁻: 26.9, ABE: -1.5, Sat.: 90.6 %). The chest X-ray films revealed subcutaneous emphysema over the neck and upper chest as well as pneumo-mediastinum, bilateral multiple rib fracture over upper chest, bilateral pneumothorax, and total collapse of the right lung (Fig. 1). The CT scan showed total collapse of the right lung and pneumothorax. With possible major tra-

cheobronchial disruption, the flexible bronchoscope was used to examine the airway via the endotracheal tube under local anesthesia. The results showed complete disruption of the right main, right upper, and intermediate bronchus. Under general anesthesia, single lumen endotracheal tube was introduced to the left main bronchus for left lung ventilation and to promote airway reconstruction of the right lung field. With adequate ventilation, the operation was performed via a right posterolateral thoracotomy. A blunt-tipped suction tube was used to dissect and manipulate the carinal region. The disrupted airway was identified after opening the mediastinal pleura. It was noted that three segments of the airway (right upper lobe bronchus, right main bronchus, right intermediate bronchus) were totally separated from each other (Fig. 2). Primary repair with interrupted 4-0 polyglactin (Vicryl) was performed after mobilizing the transected airway without disruption of the blood supply. No pleural patch was placed over the anastomotic site (Fig. 3).

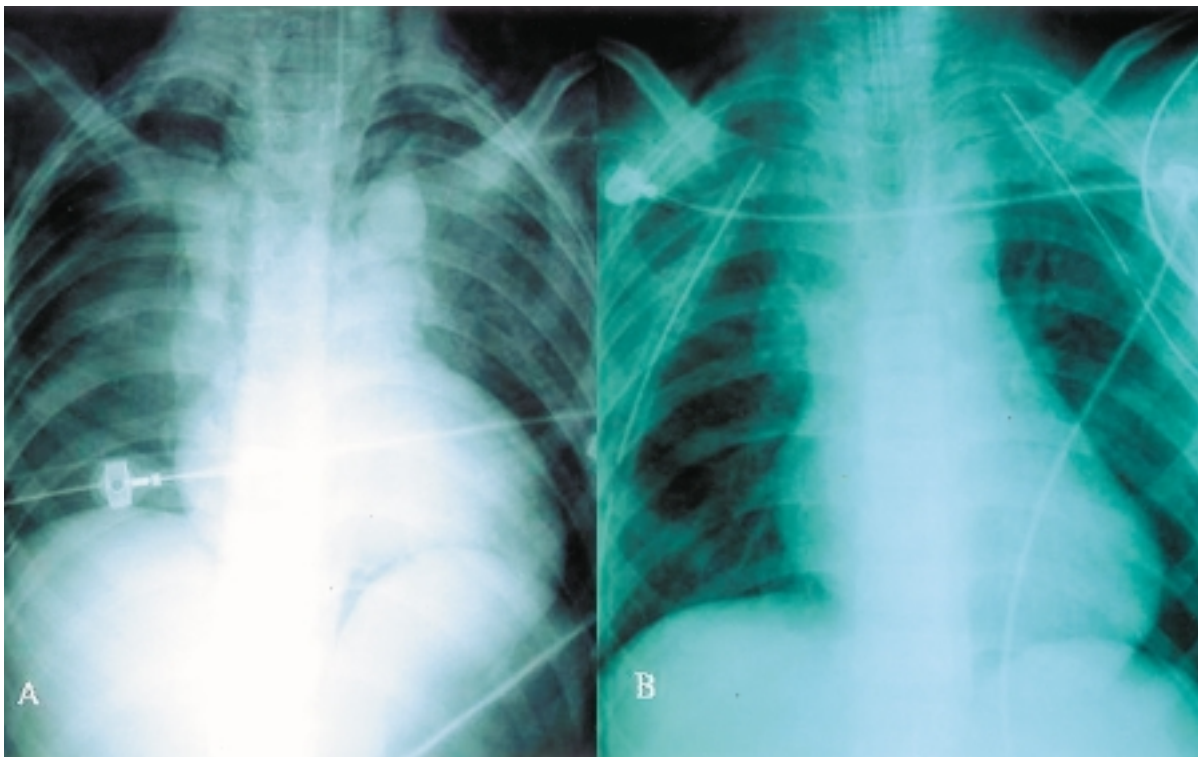


Fig. 1 (A) Pre-op chest X-ray revealed cervical subcutaneous emphysema, bilateral pneumothorax and total collapse of the right lung. (B) Chest X-ray 1 day after operation revealed full expansion of the lungs bilaterally.

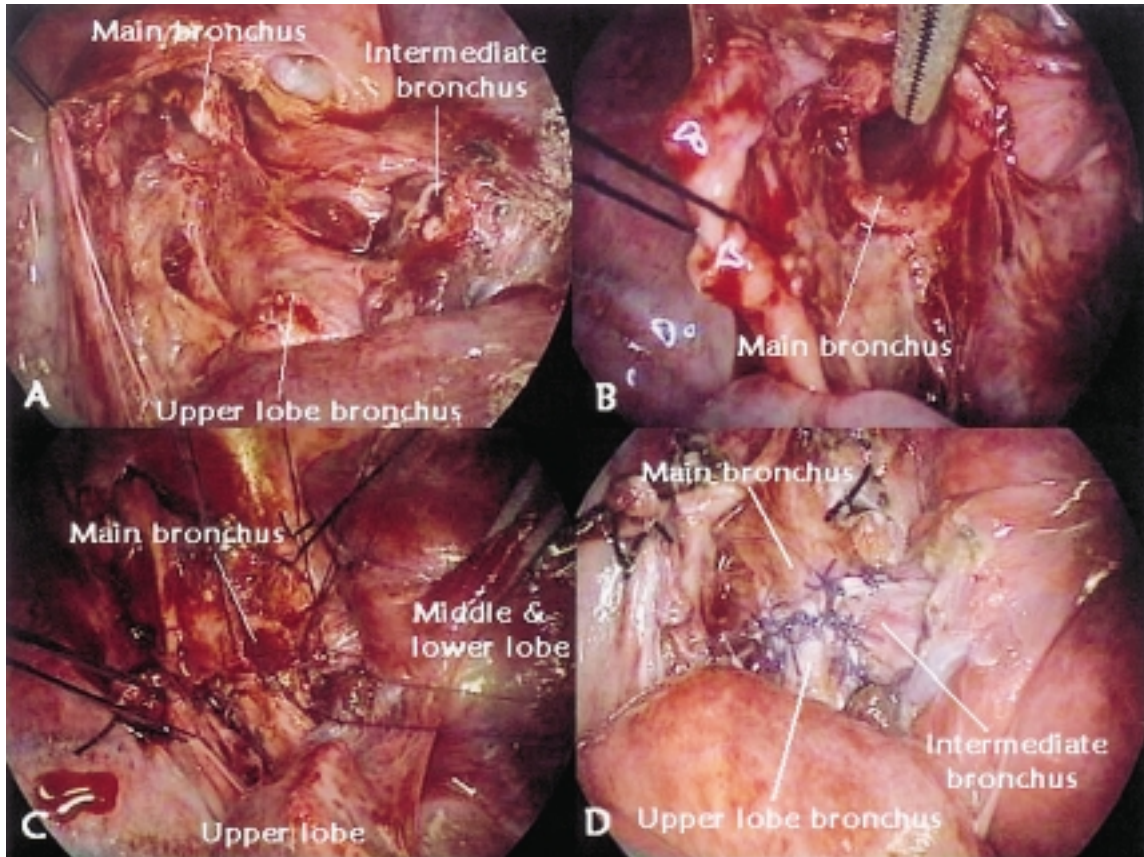


Fig. 2 (A-C) Intraoperative findings revealed airway disruption over the right main and intermediate bronchus. (D) Intraoperative findings immediately after the operation revealed good anastomosis over the disruption region.

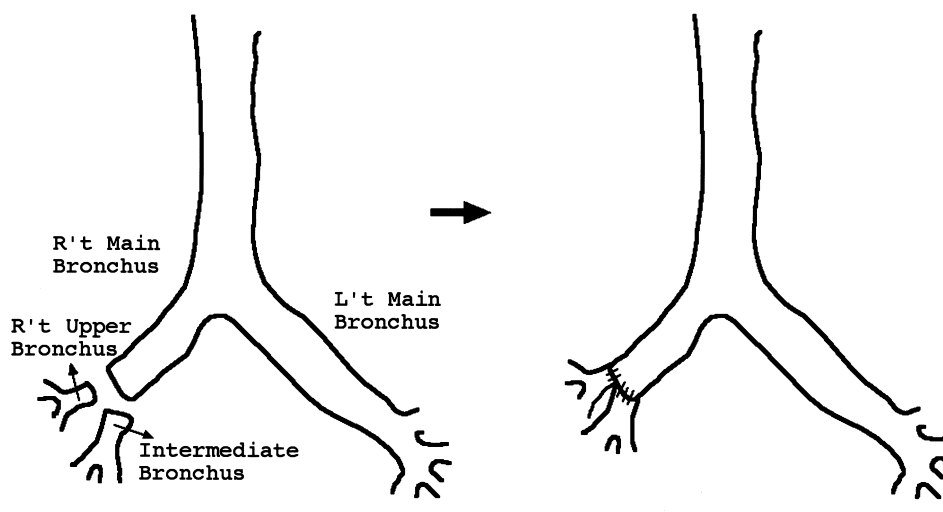


Fig. 3 Schematic representation before and after the operation.

To prevent airway dehiscence and fistula, every procedure was meticulously performed. A watertight seal of the anastomotic region was confirmed after the operation. There were no air leaks after the operation. The X-ray immediately after operation revealed full expansion of bilateral lung without pneumo or hemothorax. The endotracheal tube was removed the day after the operation. The patient regained all daily activity immediately after operation and was discharged 7 days after the operation uneventfully.

Two weeks after surgery, the patient returned for a check up and displayed good respiratory function. He received flexible bronchoscopy 3 weeks after the surgery and displayed good patency of the airway without any granulation over the anastomotic region. The patient remained stable 6 months after our surgery.

DISCUSSION

Tracheobronchial disruption is an uncommon but life threatening injury associated with blunt thoracic trauma. The estimated incidence of tracheobronchial disruption obtained from clinical series was 2.9 ~ 5.8 %^(5,6) and the incidence in pediatric group is 0.7 ~ 2.8 %.⁽⁷⁾ Though the incidence is low, tracheobronchial disruption has a high potential for rapid progression to death. The mortality rate may be up to 30 %. Half of the children with tracheobronchial disruption died within 1 hr of the traumatic event.⁽¹⁾

The pathogenesis of tracheobronchial disruption may be divided to three mechanisms and these forces may act alone or in concert.⁽³⁾ The first is the decrease in the antero-posterior diameter of the thorax which may cause traction of carina and disrupted the tracheobronchial tree. The second is when the trachea and major bronchi are crushed between the sternum and vertebral column with glottis closed may lead to bronchi rupture, especially in the membrane part.⁽⁷⁾ The third is the rapid deceleration which leads to shearing force at the areas of fixation, namely the carina and cricoid cartilage. In this patient, the mishaps occurred after a truck hit the boy while he was a pedestrian. We believe that the first and second mechanisms were the main etiologies of this case.

The initial clinical presentations are subcutaneous emphysema (85 %) and dyspnea (77%).^(3,4,8) Other clinical manifestations include persistent large

air leaks, pneumothorax, massive atelectasis, and failure to expand the lung with thoracotomy tube drainage.⁽⁵⁾ According to X-ray findings, Mordehai et al. considered that pneumo-mediastinum and cervical emphysema were the highest sensitivity markers of airway rupture.⁽⁹⁾ In addition, decreased upper lung margin below the level of bifurcation (fallen lung sign) is regarded as a typical sign for a complete disruption of the main bronchus.^(6,8) All those presented in our patient and which was highly suggestive of major tracheobronchial injury.

Cay et al. considered that the presence of "deep neck emphysema" was the main indication for prompt bronchoscopy.⁽⁴⁾ It was the most reliable means of establishing the diagnosis, determining the site, nature, and the extent of tracheobronchial disruption.^(5,7,8,10) In our patient, the bronchial rupture over the junction of the right main, upper lobar, and intermediate bronchus was confirmed using a pediatric bronchoscope. The endotracheal tube was introduced to the left main bronchus over the flexible bronchoscope to decrease air-leaks and facilitate peri-operative management, and the surgical repair was engaged on an emergency basis.

Successful treatment of a tracheobronchial disruption includes prompt diagnosis, early airway repair under appropriate surgical approach, good anesthesia techniques, and the best operative techniques. Rupperecht et al. reported that reconstruction of the tracheobronchial tree within the first 24 h, showed no degree of later pulmonary dysfunction and late reconstruction was associated with a decrease between 30 ~ 50 % of vital and 80 % of diffuse capacity.⁽⁸⁾

The best surgical approach for tracheobronchial disruption is right postero-lateral thoracotomy.⁽¹¹⁾ Using this approach, the surgeon can access the carina and left main bronchus at its origin. Relating to anesthesia technique, intubation with a double-lumen tube is the most common and comfortable method to ventilate the contralateral lung without air leaks during bronchial reconstruction in adult patients according to patient's age and body weight.^(8,12) However, no appropriate size of the double lumen tube can be used for children. In our patient, a right postero-lateral thoracotomy was performed via the fifth intercostal space. The single lumen endotracheal tube was used as an alternative and was pushed down to the uninjured left main stem bronchus to perform left

lung ventilation.

The optimal surgical procedure for tracheobronchial disruption is debridement of injured tissue and end-to-end anastomosis.⁽⁵⁻⁷⁾ Grillo et al. recommended the importance of the preservation of tracheal and bronchial blood supply and the limitation of tension while repairing the tracheobronchial disruption.⁽¹³⁾ In this patient, we used monofilament absorbable interrupted sutures to repair the bronchus in order to avoid granuloma and airway stenosis.^(1,14) During a post-operation follow up, we found good airway pattern without stricture over the anastomotic region.

Missing and delaying the diagnosis and surgical intervention of tracheobronchial disruption may be complicated by partial or complete airway stenosis or even death. Given the good outcome of primary repair in our patient, we believe that close observation, prompt diagnosis, and correct surgical repair as described here is indispensable for both physician and surgeon in managing emergency patients.

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複雜性支氣管斷裂經外科修補之成功經驗

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外傷性支氣管斷裂在小孩是具有生命威脅的疾病。其臨床表現多變，主要與氣道周圍的組織是否完整有關。臨床症狀與影像診斷的正確判讀是診斷這類疾病所必須。若在診斷上有延遲，會使致死或是併發症的比率增加。我們紀錄一個九歲男性因車禍於右側支氣管發生斷裂的病例。其臨床表現為皮下氣腫，雙側氣胸，氣縱隔併呼吸衰竭。術前軟式支氣管鏡評估發現在右側支氣管有完全斷裂的情況。在雙側胸管置入後，我們經由右後側胸壁施行外科修補併氣管重建手術。術中施行支氣管鏡檢查發現所有斷裂處已備復原。術後六個月以支氣管鏡追蹤發現斷裂處癒合良好並無狹窄情形。(長庚醫誌 2005;28:662-7)

關鍵字：外傷性支氣管斷裂，軟式支氣管鏡，氣道修補。

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