Bronchoscopic Electrocautery for Palliation of Post-anastomotic Tracheal Stricture in a Patient with Complete Tracheal Transection Following Blunt Chest Trauma

Yu-Hsiu Chung, MD; Hung-I Lu[1], MD; An-Shen Lin, MD; Meng-Chih Lin, MD

There are many strategies available to treat palliation of airway obstruction due to benign or malignant conditions. The initial choice depends on the urgency of the situation, the extent of the disease process as assessed bronchoscopically, as well as the individual experience and preference of the physician. We present a rare case of complete tracheal transection following a traffic accident. Respiratory distress, which resulted from post-anastomotic tracheal stricture, developed progressively about 2 months after surgical repair. Symptomatic relief and improved ventilatory function were achieved in this patient once patency of the trachea was restored successfully using bronchoscopic electrocautery. The technique is a straightforward, safe, and quick method to palliate airway obstruction. *(Chang Gung Med J 2005;28:724-9)*

Key words: airway obstruction, complete tracheal transection, bronchoscopic electrocautery.

Tracheobronchial obstruction from benign or malignant lesions can cause significant morbidity in affected patients. Acute respiratory distress, post-obstruction pneumonia, atelectasis, asphyxia, or even death can result from airway obstruction.

Advances in flexible bronchoscopy have allowed for the development of techniques directed at alleviating airway obstruction, including mechanical removal, electrocautery, laser therapy, cryotherapy, brachytherapy, and photodynamic therapy with subsequent tracheobronchial stent insertion.[(1)] The use of electrocautery through a bronchoscope was first tried in the early 1980s with varying degrees of success.[(2)] Electrocautery (heat produced by an electrical current) to treat tumor tissue involved the use of a probe or snare.[(3)] The small probe functions as an active electrode, where heat is focused and transferred to a tiny spot on the surface area of contact, which leads to tissue coagulation or vaporization. The degree of tissue destruction depends on the magnitude of power used, duration of contact, surface area of contact, and density and moisture of the tissue.[(4)]

We present a case of post-anastomotic tracheal stricture after surgical repair of a complete tracheal transection that was subsequently relieved by bronchoscopic electrocautery (BE). The successful restoration of airway patency in this case demonstrates the potential value of this therapeutic technique.

CASE REPORT

A 33-year-old man was involved in a traffic accident which resulted in blunt chest trauma. He was sent to our Emergency Department (ED) for first aid. The patient's consciousness was drowsy, and some lacerative wounds were found on his left thigh

From the Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine; [1]Division of Thoracic Surgery, Department of Surgery, Chang Gung Memorial Hospital, Kaohsiung.
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Correspondence to: Dr. An-Shen Lin, Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, Chang Gung Memorial Hospital. 123, Dabi Road, Niaosung Shiang, Kaohsiung, Taiwan 833, R.O.C. Tel.: 886-7-7317123 ext. 8199; Fax: 886-7-7322402; E-mail: anshen@adm.cgmh.org.tw

and scalp. Initial vital signs were blood pressure of 80/50 mmHg, heart rate of 105, and temperature of 36.5°C orally. Shallow respiratory pattern was noted. Translaryngeal intubation was performed immediately and then the patient was connected to a mechanical ventilator. The development of severe subcutaneous emphysema was noted over the chest wall. Chest roentgenograph and computed tomography revealed bilateral lung contusion, bilateral pneumothorax, pneumomediastinum, and air over the upper thoracic spinal canal region. Bilateral chest tubes were inserted. During bronchoscopic examination, we found a complete tracheal transection 2 cm above the carina and a 2 x 5 cm posterior tracheal defect was observed. Under general anesthesia, right posterolateral thoracotomy was performed. The tracheal cartilage ring was repaired using a 4-0 polydioxanone interrupted suture. Then, the defect of the posterior membranous trachea was reconstructed using a pericardial patch (Fig. 1). The anastomosis site was reinforced using a parietal pleural flap. This patient recovered dramatically under careful and aggressive treatment. He was discharged after about a 1 month of hospital stay.

Two months postoperatively, the patient complained of progressively worsening paroxysms of productive cough and dyspnea. Hemoptysis, fever, and sweat were absent. The only abnormal breathing sound was rales and there was no evidence of upper airway stridor. Arterial blood gas values on fraction of inspired oxygen (FiO_2) 35% showed a pH of 7.47, pO_2 of 101, and pCO_2 of 38.9. Ventilatory function was 1.56 liters (42.6% of the predicted value) for a forced expiratory volume in 1 second (FEV1) and 1.79 liters (42.9% of the predicted value) for forced vital capacity (FVC). His symptoms did not respond to therapy with antibiotics, bronchodilators, or corticosteroids, but they did respond to supplementary oxygen administered via a facemask. Bronchoscopic examination revealed post-anastomotic tracheal stricture caused by granulation tissue with exposed blue stitches (Fig. 2A). Three-dimensional computed tomography showed narrowing of the lower trachea with protrusion of radiopaque stitches at the repair site (Fig. 3). Progressive symptoms necessitated immediate treatment. The electrocautery used in the contact mode had an insulated flexible bronchovideoscope (P-240F, Olympus) and a flexible monopolar electrocautery probe (CD-6C-1, Olympus). An average power setting of 30 watts (blend mode) was employed with a generator (UES-30, Olympus). After coagulation and vaporization, the carbonized tissue and stitches were removed mechanically (Fig. 2B). Both restoration of airway patency and alleviation of symptoms were achieved without any adverse effects. Post-procedure ventilatory function improved with FEV1 of 2.27 liters (62.9% of the predicted value) and FVC of 2.46 liters (59.6% of the predicted value). The patient was followed at our chest outpatient department monthly. There were no specific complaints except for phlegmatiz expectoration. Fiberoptic bronchoscopy was

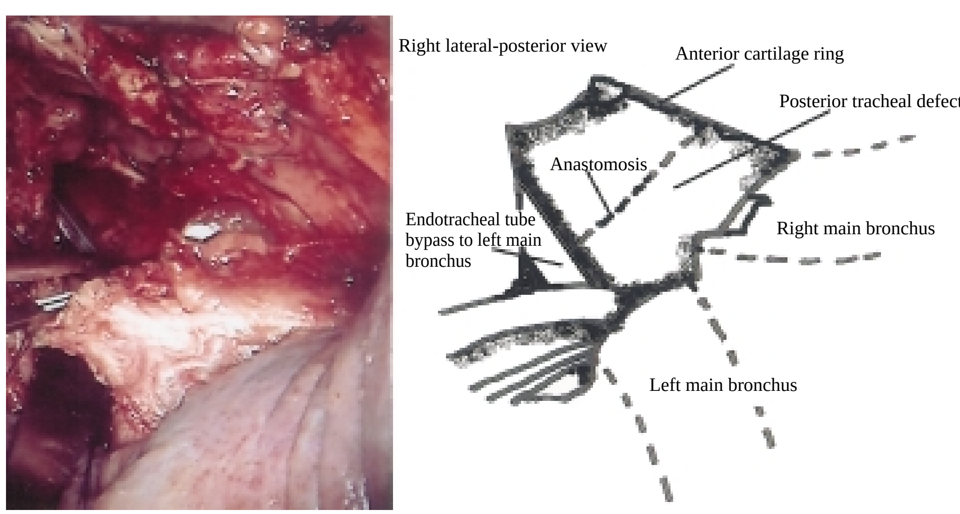

Fig. 1 Posterior tracheal defect was visualized during the operation.

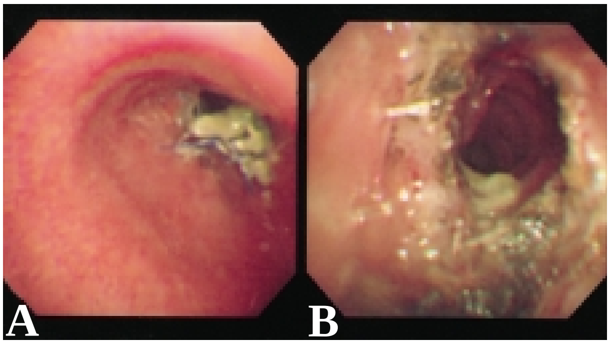

Fig. 2 (A) Post-anastomotic tracheal stricture caused by granulation tissue with exposed blue stitches at bronchoscopy. (B) Successful restoration of airway patency using BE.

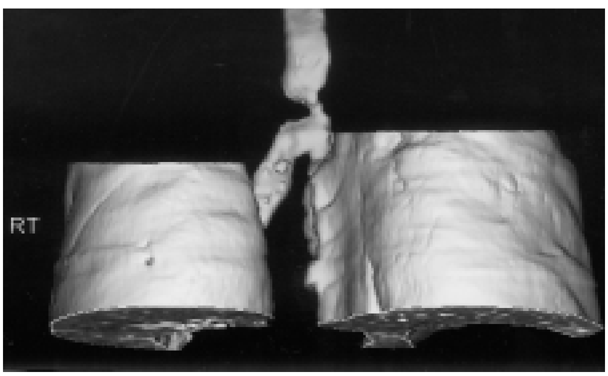

Fig. 3 Three-dimensional computed tomography shows narrowing of the lower trachea.

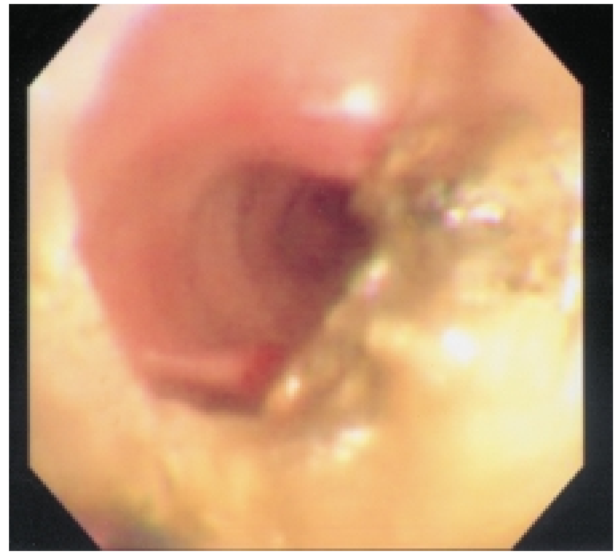
Fig. 4 Some granulation tissue is coated with dark-colored secretion during bronchoscopy.

performed 3 months after electrocautery. The restored patency of the lower trachea was maintained, but some granulation tissue coated with a dark-colored secretion was discovered (Fig. 4).

DISCUSSION

Tracheal injuries secondary to blunt chest trauma are not common, and complete tracheal transection is even more unusual especially when the injury is to the lower trachea just above the carina. One autopsy study estimated that the incidence of blunt tracheobronchial injury associated with blunt chest trauma is 2.8%.[5] Another report of 10 patients with blunt tracheobronchial injuries identified only one complete tracheal transection.[6] Not surprisingly, the number of tracheobronchial injuries has increased with the increasing use of motorized vehicles, including the recent proliferation of all-terrain recreational vehicles.[7] A high index of suspicion is essential, especially in cases of head, neck, or chest trauma. The key to successful management is early injury recognition, emergency airway management, and expedient surgical referral.

It is still unclear how three-dimensional reconstruction can replace findings of direct bronchoscopic visualization. However, virtual reconstruction will eventually allow pre-procedure planning, as well as provide an opportunity to perform a practice run through of the procedure itself before taking the patient to the interventional suite.[8] The bronchoscopic examination is probably the most important component of the pre-interventional bronchoscopy workup. During this assessment, the location and extent of the obstruction are noted.

Various palliative therapeutic modalities include the mechanical removal, electrocautery, laser therapy, cryotherapy, and subsequent tracheobronchial stent implantation in the management of airway obstruction stemming from a benign lesion. Each technique has its own merits and limitations. The treatment choice is usually based upon various factors including clinical presentation, expertise of the bronchoscopist, anesthetic care, and technical facilities of the hospital. Immediate tumor debulking may be achieved by mechanical removal, electrocautery, laser therapy, and a stent which can be inserted for extraluminal stenosis. The effects of cryotherapy are not immediate and there are risks of secondary necrosis. Coulter et al. showed that a high success rate was achieved using electrocautery under local anesthesia.[9] Sutedja et al. showed a successful response in 88% of cases.[10] Endobronchial electrocautery eliminated the need for laser therapy in 36% of such procedures and had a potential for significant time and cost savings.[11] Thus, we chose the simple, cheap, and safe electrocautery procedure to treat this patient.

In a study of 36 patients undergoing BE for benign and malignant etiologies, there was an average improvement in FEV1 and FVC of 53.1% and 20.6%, respectively.[12] Not surprisingly, ventilatory function improved in this patient once patency of the central airway had been restored. Our patient demonstrated an increase of 710 ml (45.5%) for FEV1 and 670 ml (37.4%) for FVC.

Endobronchial electrocautery can be applied either using a rigid or flexible bronchoscope. The choice of techniques depends on the expertise of the bronchoscopist and risk assessment. Patients presenting with imminent respiratory failure, hemorrhage, and life-threatening airway obstruction are obviously at risk for any kind of intervention. Electrocautery using a rigid bronchoscopy under general anesthesia (to have optimal control of the situation) is safer than flexible bronchoscopy.

The drawbacks of BE include repeated covering of the probe with carbonized tissue, respiratory failure, bleeding, and fire outbreaks. To decrease the risk of fire in our case, the oxygen concentration was maintained at FiO_2 of less than 30%. Pulse oximetry was used to guide the oxygen therapy. An insulated bronchoscope is theoretically safer in preventing current leaks, allowing for control of the process of coagulation, thus avoiding burns or electrical shock to both the patient and the bronchoscopist.[13]

The most common cause for BE failure is the misleading endoscopic appearance of some lesions. While these lesions may appear to be polypoid initially, on attempted removal they can sometimes be seen to extend down the lumen. Other difficult lesions are vascular, and hence, very hemorrhagic. Blood in the field of work provides a wet surface that diffuses the contact point and limits the effectiveness of electrocautery. Therefore, if a lesion is suspected to be extensive or vascular, it would be prudent to utilize laser therapy rather than BE. BE has been utilized in place of costly photodynamic therapy or brachytherapy on patients with radiologically occult carcinoma. In a pilot study, complete response to BE in 10 of 13 patients with endobronchial lesions that were < 1 cm^2 was demonstrated. In that study, the authors suggested that BE may be an effective alternative in the treatment of carcinoma in situ.[14]

BE has been used to reduce benign intraluminal neoplastic or inflammatory lesions. However, significant intramural or extraluminal disease is likely to be present and lead to a rapid recurrence of the symptoms. BE may also cause formation of granulation tissue or superficially damage mucosa, leading to fibrosis. In addition, longer treatment intervention may damage the underlying cartilage.[15] This is remedied by the insertion of a tracheobronchial stent. In our case, we thought that positioning a Dumon Y-stent through a rigid bronchoscope under general anesthesia so that it sits on the carina was the best available option. Because the lesion was near the wide space above the carina, the distal end of a straight cylindrical stent (whether silicone or metal) would not have been tightly anchored to the mucosa, hence risking its migration. On the other hand, three-dimensional computed tomography showed that narrowing of the lower trachea was short in length. Resection and reconstruction of the airway was also available.

The mission of an interventional bronchoscopist is first to restore airway patency and to assess the potential for curative bronchoscopic or open surgical treatment. Emergency interventional procedures in this setting are usually life saving and allow patients to participate in subsequent decision-making regarding further treatment options.

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以支氣管鏡電燒改善胸腔鈍傷致氣管完全截斷病人於接受氣管吻合術後的氣管狹窄

鍾聿修 呂宏益[1] 林安伸 林孟志

針對因良性或惡性病變導致的氣道阻塞，有許多的治療方式。必需依據—情況的危急性、支氣管鏡下阻塞的性質與程度、和醫師個人的經驗與偏好等，做出適當的選擇。我們報告一個因車禍導致氣管完全截斷的罕見病例。緊急手術後，在吻合處由於肉芽組織贅生造成氣管狹窄，因此病人呼吸日益困難。於是我們選擇了支氣管鏡電燒來打通氣管；在此同時，也改善了病人的症狀和呼吸功能。在緩解氣道阻塞上，支氣管鏡電燒是一個安全又迅速的治療方式。(長庚醫誌 2005;28:724-9)

關鍵字：氣道阻塞，氣管完全截斷，支氣管鏡電燒。

長庚紀念醫院　高雄院區　胸腔內科，[1]胸腔外科
受文日期：民國93年8月12日；接受刊載：民國93年12月28日
通訊作者：林安伸醫師，長庚紀念醫院　胸腔內科。高雄縣833鳥松鄉大埤路123號。Tel.: (07)7317123轉8199; Fax: (07)7322402; E-mail: anshen@adm.cgmh.org.tw