

Bronchoscopic cryosurgery for metastatic tumor causing central airway obstruction

A case report

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Abstract

Rationale: Bronchoscopic cryotherapy has been considered as one of the optional interventions for unresectable malignant central airway obstruction (CAO). And it provides high safety and effectiveness in airway patency re-establishment. This report describes the interventional bronchoscopic cryotherapy for a patient with CAO caused by squamous cell carcinoma of the esophagus. We display a series of dramatic change of chest radiographs before and after the intervention.

Patient concerns: A 70-year-old man with squamous cell carcinoma of the middle third of the esophagus (initial staging, pT2N0M0; stage IIB; in January 2017) underwent Video-assisted esophagectomy and reconstruction with a gastric conduit via a substernal route. Following Chest computed tomography and positron emission tomography revealed disease progression with paratracheal metastases. Progressive dyspnea and chest pain lasted for a month, and he was admitted to the ER.

Diagnoses: Blood gas analysis revealed type I respiratory failure (pH, 7.445; PaO₂, 69.4 mmHg; PaCO₂, 40.6 mmHg). Other laboratory data were grossly normal. Chest radiography revealed a total left lung collapse. Chest CT identified a tumor blocking the left mainstem bronchus with the consolidation of the left lung.

Interventions: Dexamethasone and epinephrine inhalation were administered for initial symptom relief. Bronchoscopy performed 4 days after admission revealed a huge tumor completely occluding the left mainstem bronchus orifice. The occlusion was completely resolved following cryotherapy. Then, the first course of palliative chemotherapy with cisplatin plus fluorouracil, followed by the second course a month later, was administered.

Outcomes: The latest chest radiograph showed a patent airway. The patient's condition remained stable for at least the following 2 months.

Lessons: Malignant CAO is a rare but potentially life-threatening condition. Several acceptable bronchoscopy techniques exist for treatment. Cryotherapy has high safety and effectiveness in airway patency re-establishment.

Abbreviations: APC = argon plasma coagulation, CAO = central airway obstruction, CT = computed tomography, Nd:YAG = neodymium:yttrium aluminum garnet.

Keywords: airway obstruction, bronchoscopy, cryotherapy

1. Introduction

Although central airway obstruction (CAO) caused by a malignant tumor is rare, it can cause respiratory failure, which

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renders treatment difficult, leading to a poor prognosis.^[5,6] Bronchoscopic cryotherapy has been considered as one of the optional interventions for unresectable malignant CAO. And it provides high safety and effectiveness in airway patency re-establishment.^[1–4] But the application of cryotherapy in total mainstem bronchus obstruction is rarely found. We report a case of metastatic paratracheal squamous carcinoma in a patient to whom chemotherapy could not be prescribed owing to his life-threatening CAO. And the chest radiograph showed left hemithorax white-out due to mainstem bronchus obstruction. Interventional bronchoscopic cryotherapy alleviated the airway obstruction and allowed us to administer further chemotherapy and obtain a good response to date.

2. Case presentation

In February 2017, a 70-year-old man with squamous cell carcinoma of the middle third of the esophagus (initial staging, pT2N0M0; stage IIB; in January 2017) underwent Video-assisted esophagectomy and reconstruction with a gastric conduit via a substernal route. He was regularly followed up at our clinic for postoperative radiotherapy. In August 2017, chest computed tomography (CT) and positron emission tomography (PET) revealed disease progression with paratracheal metastases

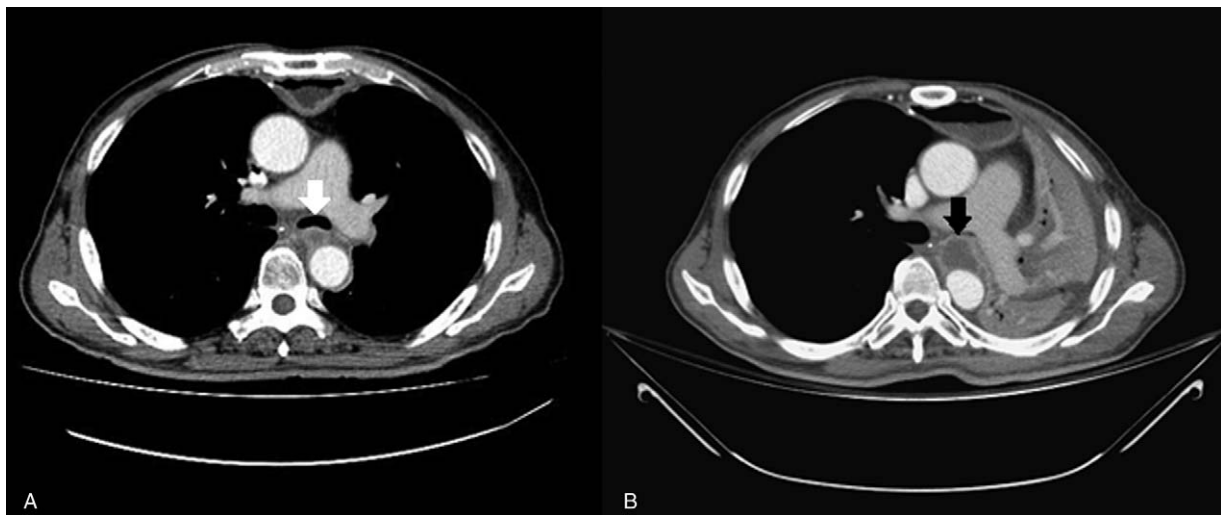


Figure 1. Chest CT before cryotherapy. (A) At 2 months before admission, the left mainstem bronchus (white arrow) was compressed by a tumor mass. (B) After admission, the left mainstem bronchus (black arrow) was obstructed by a paratracheal tumor. CT=computed tomography.

(Fig. 1a). Progressive dyspnea and chest pain lasted for a month, and he was admitted to the ER. His consciousness was clear and vital signs were normal (body temperature, 36.9°C; respiration rate, 16 bpm; pulse, 105 bpm; blood pressure, 145/95 mmHg) but oximetry was 75%. Blood gas analysis revealed type I respiratory failure (pH, 7.445; PaO₂, 69.4 mmHg; PaCO₂, 40.6 mmHg). Other laboratory data were grossly normal. Chest radiography revealed a total left lung collapse (Fig. 2a). Chest CT identified a tumor blocking the left mainstem bronchus with the consolidation of the left lung (Fig. 1b). Dexamethasone and epinephrine inhalation were administered for initial symptom

relief. Bronchoscopy performed 4 days after admission revealed a huge tumor completely occluding the left mainstem bronchus orifice (Fig. 3). The occlusion was completely resolved following cryotherapy. Pathological examination demonstrated squamous cell carcinoma metastasized from the esophagus. Postoperatively, the symptoms improved, and the follow-up chest radiography revealed much better-left lung expansion (Fig. 2b). With the improving physical condition, the first course of palliative chemotherapy with cisplatin plus fluorouracil, followed by the second course a month later, were administered. The latest chest radiograph showed a patent airway (Fig. 4). The patient's

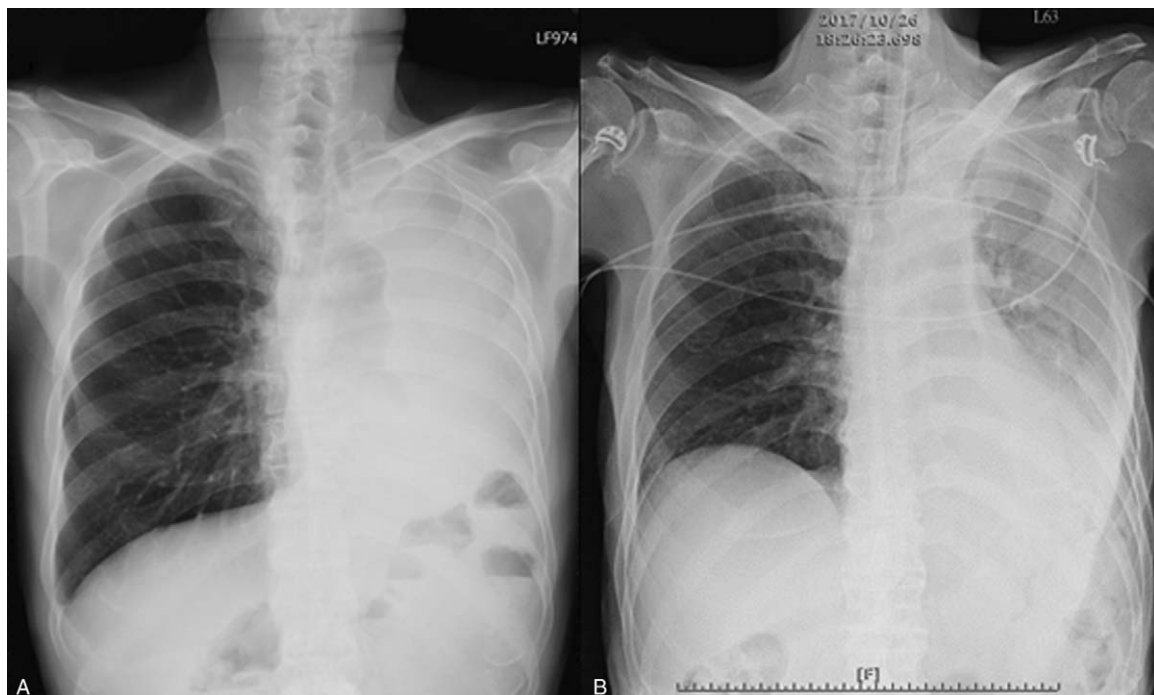


Figure 2. Chest radiographs (A) before cryotherapy (left lung total collapse) and (B) 1 day after cryotherapy (much clearer left lung marking).

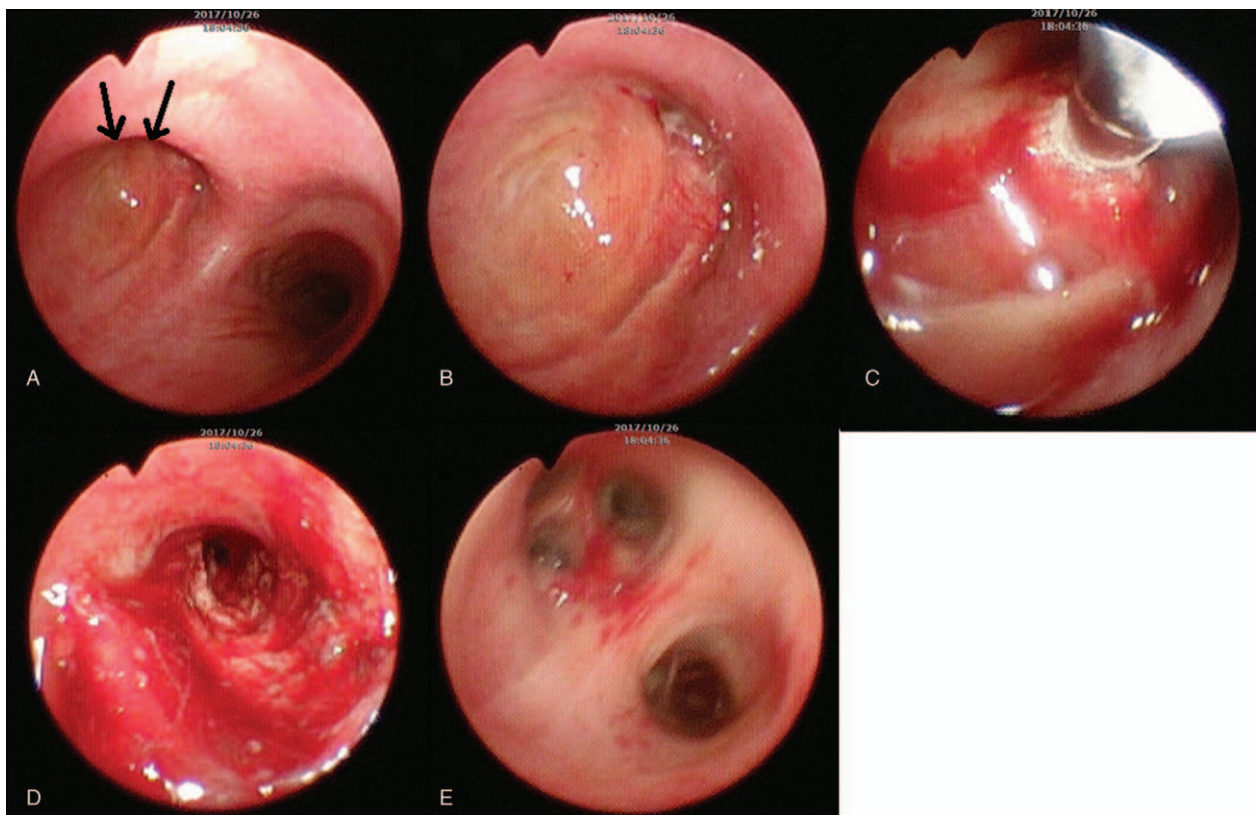


Figure 3. Bronchoscopic cryotherapy. (A,B) Left mainstem bronchus (black arrow) was completely obstructed. (C) Cryotherapy via rigid bronchoscope. (D) After cryoablation, an opening was made. (E) Branches of left main bronchus could finally be visualized.

condition remained stable for at least the following 2 months. Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

3. Discussion

CAO is defined as a >50% occlusion of the trachea, mainstem bronchi, bronchus intermedius, or a lobar bronchus. Etiologies are variable, including malignant and nonmalignant

causes.^[5-7] The most common causes of nonmalignant CAO are post-intubation and post-tracheostomy tracheal stenoses. Other causes include foreign body aspiration, benign endobronchial tumors, tracheobronchomalacia, and idiopathic causes.^[6,7] Malignant CAO most commonly occurs in patients with locally advanced lung or esophageal cancer. Otherwise, CAO due to airway metastases may be seen, mostly from thyroid, breast, or colon cancers; melanoma; or renal carcinomas.^[6]



Figure 4. Chest radiographs. (A) Four days after cryotherapy, there was a dramatic change in the left lung. Only left pleural effusion was noted. (B,C) At 17 days 1 month after cryotherapy, there was bilateral full-lung expansion.

CAO may clinically present with varying degrees of dyspnea, cough, stridor, or wheezing, depending on the lesion site, the severity of narrowing, and underlying states.^[6,7] It is a potentially life-threatening condition. Lung function tests, chest CT, and bronchoscopy are most commonly performed for diagnosis. Several classification systems aimed to provide an objective tool for clinical physicians have been developed; however, there is no consensus on the ideal model. Parameters of functional class, location, distribution; stenotic airway segment length; and severity of stenosis are described in most of the classification systems.^[6]

CAO Treatment is based on its etiology. In malignant CAO, surgical resection is considered in patients with lung cancer suitable for a curative operation. For others, the aim of treatment is better airway patency, symptom relief, and the prevention of secondary infection.^[8] Many interventional bronchoscopic options exist, such as laser, electrocautery, cryotherapy, argon plasma coagulator, photodynamic therapy, among many others.^[1–4,8,10]

Laser has been well-reported for treating tumors obstructing the central airway and benign airway stenosis.^[1,3,4,8–10] A noncontact light energy is delivered via a catheter, providing a better control of bleeding in the airway. Of several different types of lasers, the neodymium:yttrium aluminum garnet (Nd:YAG) laser is the best described for either rigid or flexible bronchoscopy. Reportedly, the Nd:YAG laser shows a 90% success rate in re-establishing airway patency for central, intrinsic, and short (<4 cm), lesions with a visible distal endobronchial lumen.^[11] Furthermore, the Nd:YAG laser shows the deepest penetration (up to 10 mm), with other methods reported at 2 to 5 mm. Complications include a very low incidence of bleeding, airway perforation, and death.

Electrocautery is less expensive (compared with laser therapy), with the ease of use and wide availability at most hospitals. Its safety and effectiveness appear not to be inferior to that of Nd:YAG laser.^[11] Complications include airway perforation, bronchial wall damage, and bleeding due to transmural perforation. Argon plasma coagulation (APC) uses gas discharges in argon with electrical discharge to provide a noncontact thermal coagulation effect. It exhibits high safety due to the limited penetration depth of the eschar produced (approximately 2–5 mm). However, it also has limited abilities of cauterization and destruction. The unique complication compared with other interventions is air embolism, such as pulmonary emboli, or stroke.^[11] All 3 techniques may possibly cause airway fire. Hence, intraluminal oxygen concentration should be lowered during surgery.^[1,3] In addition, balloon dilatation is another safe, rapid, and simple technique for CAO, providing an almost immediate improvement in the stenosis in nearly all cases. However, on the long-term follow-up, 30% to 50% of patients require other therapies, such as stenting, laser, APC, or cryotherapy.^[11] Although it is safe, the potential complications of tissue tear, perforation, and bleeding must be considered.

For malignant CAO, airway stent placement has resulted in a higher complication rate (approximately 23% to 34%), and its effectiveness is not much greater than that of other techniques.^[6] Avoiding stenting may be preferable if airway patency can be reestablished with laser, electrocautery, or other ablative techniques. In our case, we finally chose cryotherapy, which destroys tissue with low temperature using the application of the Joule–Thomson effect (extremely low temperature produced by the sudden expansion of gas). Repeated freeze and thaw cycles result in cytodestruction.^[11]

Cryotherapy applied to malignant CAO has been well documented.^[8] Regarding cryotherapy, Qianli et al^[2] have reported symptom-specific relief rates of 78% for dyspnea and 83% for cough. In their cohort, 2 of the 37 patents suffered

bronchial bleeding and 1 developed pulmonary infection. They used assisted APC for hemostasis.^[2] In an uncontrolled case study, 53 patients with unresectable endobronchial malignancy underwent bronchoscopic cryotherapy and showed significant improvement in performance status and lung function tests following cryotherapeutic tumor removal.^[3] The result of this study is compatible with that of our case, in which dramatic improvement in dyspnea and chest radiography were noted immediately post-operation and lasted for more than 2 months.

Cryotherapy, compared with other bronchoscopic tumor ablations, is much safer.^[10] Compared with cryotherapy, the heat energy with laser poses a higher risk for airway fire under a high fractional inspiration of oxygen (FiO₂). Moreover, cryotherapy causes limited tissue damage, which may indicate a lower risk of airway penetration.^[10] In our experience, because of the delayed effect of cryotherapy, tissue ablation using forceps is imperative, rendering bleeding inevitable. Additionally, although cryotherapy is a highly safe procedure, it still requires anesthesia, with its attendant risks.

In our case, cryotherapy achieved dramatic changes of chest radiography and the improvement of symptoms. There was no sign of recurrent obstruction or obvious complication at 2 months of follow-up.

4. Conclusion

Malignant CAO is a rare but potentially life-threatening condition. Several acceptable bronchoscopy techniques exist for treatment. Cryotherapy has high safety and effectiveness in airway patency re-establishment. Further studies with the long-term follow-up and head-to-head comparisons with other ablation therapies are warranted.

Author contributions

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Writing – review & editing: Yen-Chiang Tseng, Tun-Yi Chen.

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