

Venovenous extracorporeal membrane oxygenation supported intervention therapy for metastatic cancer of the central airway

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Abstract

Background: Endobronchial-invasive lung cancer is rare but often leads to upper airway obstruction and acute respiratory distress. However, difficulties with tracheal intubation resulting from the tumor in the central airways can lead to total tracheal obstruction and massive hemorrhage during surgery, which may necessitate the use of extracorporeal membrane oxygenation (ECMO) to ensure oxygen supplementation and carbon dioxide removal.

Case Summary: We present the case of a 52-year-old man undergoing veno-venous ECMO who had an obstructive tracheal tumor removed through bronchoscopy.

Conclusion: When conventional methods cannot guarantee the patient's airway's patency, such support should be considered.

Keywords: Acute Care Surgery, Emergency Room, Emergency Department, Interventional Radiology

Core Tip

ECMO has emerged as a highly versatile treatment modality for refractory respiratory and/or cardiac failure not only in the intensive care setting, but also as procedural support for anesthesia and surgery. ECMO and adjunctive apneic oxygenation should be considered as part of the algorithm for airway management and the maintenance of adequate gas exchange in patients requiring surgery for subtotal lower airway obstruction.

Introduction

The incidence and prevalence of central airway obstruction, the most common cause of which is direct occlusion by an adjacent bronchogenic carcinoma, are increasing [1]. After a critical narrowing of the airway, treatment should then focus on reopening the airway and restoring normal ventilation. Appropriate ventilation and oxygenation must be maintained in patients with central airway obstruction, and endotracheal intubation and rigid bronchoscopy are the preferred methods [2]. However, if they result in complete airway obstruction, these procedures may be risky and impossible in extremely severe cases. Interventional bronchoscopic procedures, including CO₂ cryosurgery, electrocautery, high-frequency electrical entrapment ablation, and airway stent implantation, are the main strategies to relieve airway obstruction and reconstruct the trachea and main bronchus. However, certain subsets of patients cannot receive

adequate treatment without respiratory support [3]. In such cases, all diagnostic and therapeutic modalities are risky [2].

Extracorporeal membrane oxygenation (ECMO) is a useful means of short-term support for patients with refractory hypoxemia. Venovenous (VV) ECMO allows for safe and effective interventional operations in patients with upper airway obstruction by maintaining normal ventilatory function (CO₂ removal and oxygenation) [4]. Here, we report a case of airway-obstructing small cell lung cancer that was successfully managed with the support of ECMO.

Case Presentation

Chief Complaints

The patient was a 52-year-old man who went to his local hospital 16 days before being admitted because his chest tightness, shortness of breath, and cough were getting worse.

History of Present Illness

He developed severe hypoxemia and hypercapnia three days before admission.

History of Past Illness

Bronchoscopy and thoracic computed tomography (CT) at his local hospital were carried out (Figure 1) disclosed that a tumor

had nearly blocked his trachea and completely blocked the left main bronchus, resulting in atelectasis of the left lung.

Personal and Family History

The patient was intubated and transferred to our hospital.

Physical Examination

At admission, he had paradoxical respiratory movement with a respiratory rate of 40 cycles per minute and a peripheral capillary oxygen saturation (SpO₂) of 80% with the support of invasive ventilation.

Laboratory Examinations

Breath sounds were absent in the left thorax, and wet rales were auscultated on the right.

Imaging Examinations

The lower portions of the trachea were found to have slit-like stenosis, and the left main bronchus was completely blocked, according to an emergency bronchoscopy.

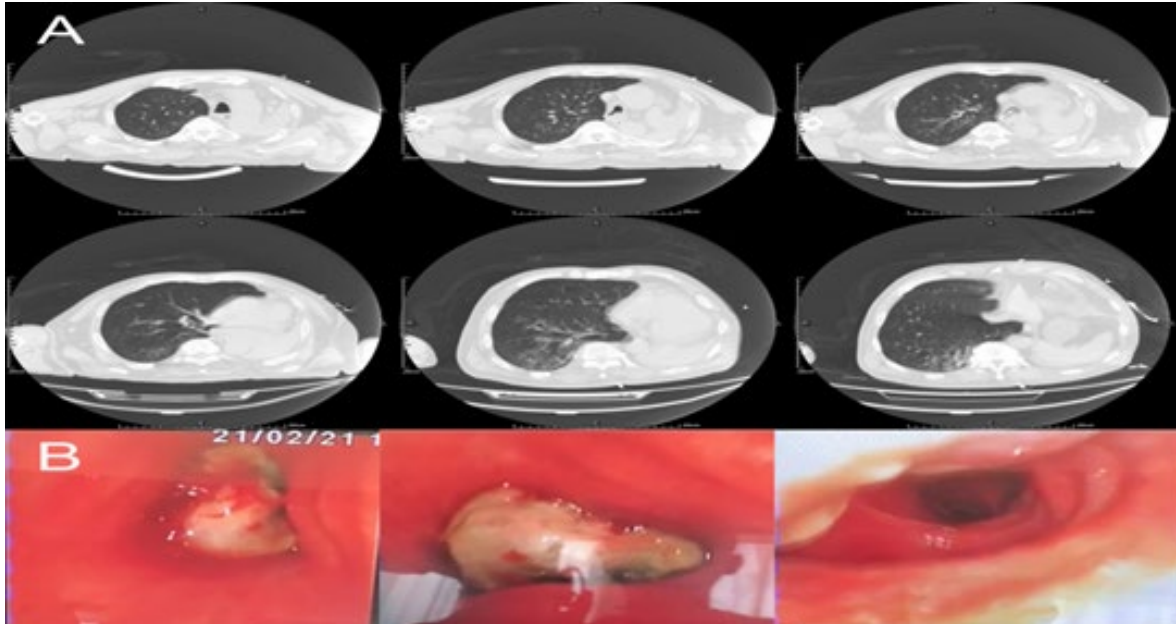


Figure 1: Thoracic computed tomography and bronchoscopy images prior to surgery. A: Computed tomography revealed a tumor on the tracheal wall causing left bronchial obstruction; B: Bronchoscopy revealed complete occlusion of the left main bronchus.

Final Diagnosis

We decided to use microcoils and gelatin sponge particles (350-560 μ m; Hangzhou Alekang) for bronchial artery chemoembolization with the support of right lung ventilation to reduce the risk of major airway bleeding and suffocation during bronchoscopy.

Treatment

The patient was then transferred to the operating room. Utilizing a heparin-coated membrane lung, we were able to perform bronchoscopy-guided interventional therapy with the help of a VV ECMO machine.

The patient's right femoral vein and right internal jugular vein were each punctured percutaneously with an F21 and F19 venous cannula, respectively. The pipe connection ran in the following order: right internal jugular vein, centrifugal pump, membrane lung, and left femoral vein. Human albumin (1000 mL) was used to preload the circulatory system, and no anticoagulation was used

during ECMO. During transfusion, the following parameters were tracked: mean arterial pressure (MAP), SpO₂, hematocrit, and activated clotting time (ACT). The ECMO rate was set at 3000 rpm, the blood flow rate was 3 L/min, average arterial oxygen pressure was kept at 90 \pm 10 mmHg, and the ACT and activated partial thromboplastin time (APTT) were kept at 30 and 150 seconds, respectively. Hemostasis was accomplished with argon plasma coagulation, and the tumor cells were killed with cryotherapy and then ablation with high frequency electrical entrapment.

Outcome and Follow-Up

After treatment, the trachea, left main bronchi, and right main bronchi were recanalized (Figure 2). About 30 mL of blood was lost during surgery, but the SpO₂ was kept between 90% and 95% and the other vitals were steady. We discontinued ECMO support gradually postoperatively while administering mechanical ventilation.



Figure 2: The trachea was recanalized after therapy.

On the second day, we eliminated the last of the airway tumor tissue under mechanical ventilation with minimal intraoperative bleeding. On the third day, the patient was able to be extubated and safely released from the hospital. The tumor was histologically diagnosed as a poorly differentiated small cell lung tumor.

Discussion

Clinical management of malignant tumors with advanced central airway metastases is very challenging. Dyspnea and hemoptysis significantly lower the patients' quality of life. The life expectancy of patients will be drastically decreased if respiratory distress and obstructive pneumonia are not treated. Many patients are resistant to conventional treatments such as surgical resection, radiotherapy and chemotherapy, or molecular targeting. When a patient's airway is completely or significantly obstructed, a combination of bronchoscopic interventional techniques and adjuvant therapy becomes a timely and effective treatment. Currently available interventional procedures include laser therapy, cryotherapy, electrocautery, photodynamic therapy, brachytherapy, argon plasma coagulation, and stent placement. Bleeding, granulation tissue formation following stent placement, sputum retention, and stent displacement are the most common complications of interventional techniques.

Based on the results of this study, it seems that VV ECMO could be helpful for keeping patients who are at high risk of central airway obstruction breathing during emergency procedures.

Most interventions, which are efficient methods to relieve central airway obstructions, are often not performed conventionally because of the high risk of complete airway obstruction. Selective, preventative VV ECMO ensured that the patient received sufficient oxygen and ventilation during airway surgery, preventing the need for invasive emergency rescue procedures that carry a higher risk of complications and additional morbidity. In this case, endotracheal intubation was used after the tumor was removed to secure the airway during the removal of the venous cannulas and make it easier to come out of anesthesia.

Patients with central airway obstruction may benefit from pre-bronchoscopic bronchial arterial embolization to lessen the risk of severe bleeding during bronchoscopic procedures. DEE particles are a novel drug-delivery embolization system that uses drug-loaded microspheres to provide a slow and sustained release of drugs, with the goal of promoting tumor necrosis while minimizing adverse effects [5]. Treatment of advanced, unresectable lung cancer with chemoembolization and transarterial chemoembolization using DEE particles has been described as effective in previous studies [6].

Conclusion

ECMO has become a multi-functional treatment modality, used not only as a rescue therapy for refractory respiratory and/or cardiac failure in the intensive care unit, but also as procedural support in anesthesia and surgery. Surgery for subtotal lower airway obstruction should include consideration of ECMO and adjunctive apneic oxygenation for airway management and maintenance of adequate gas exchange.

Conflict-of-Interest Statement

Written informed consent was obtained for publication of this case report and accompanying images.

Disclosure Statement

The authors declare that they have no conflict of interest regarding the publication of this case report.

Author Contribution

We thank Leonie McKinlay, DVM, from Liwen Bianji (Edanz) (www.liwenbianji.cn/) for editing the English text of a draft of this manuscript.

Li-Cheng Song and Bo Wang contributed to manuscript writing and editing, and data collection; Kun Xiao contributed to data analysis; Yu-Hong Liu contributed to conceptualization and supervision; all authors have read and approved the final manuscript.

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