Application of ECMO to the Treatment of Benign Double Tracheoesophageal Fistula: Report of a Case

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This report presents the extracorporeal membrane oxygenation (ECMO)-assisted surgical as a treatment of benign double tracheoesophageal fistula. The patient was a 43-year-old woman who presented the airway obstruction for 3 weeks after the esophagus metal stent implantation for the tracheoesophageal fistula 1 year ago. The airway obstruction was due to the expansion and piercing of the metal stent through the upper part of the esophagus into the tracheal cavity. In view of the failure of endotracheal intubation, we finally used ECMO-assisted surgery to remove the stent. And at the same time, cervical esphagostomy externa, exclusion of the thoracic tracheoesophageal fistulas and gastrostomy were performed.

Keywords: adult, ECMO, benign, tracheoesophageal fistula

Background

Surgery is necessary for most patients who underwent benign tracheoesophageal fistula, regarding the poor prognosis of the conservative treatment. However, it is hard for patients who suffer the airway obstruction by stent piercing to undergo the operation due to the difficulty of endotracheal intubation. This article presents an extracorporeal membrane oxygenation (ECMO)-assisted surgery to remove the esophageal stent before the routine endotracheal intubation, which can help to perform the operation successfully.

Case Report

A 43-year-old woman patient was admitted to our hospital because of postprandial choking cough and shortness of breath for 3 weeks. Six years ago, she received chemotherapy and cervical radiotherapy for B cell lymphoma. Two years ago, a mediastinal lymph node metastasis was found by positron emission tomography (PET)-computed tomography (CT), for which she received mediastinal radiotherapy. After radiotherapy, the patient presented dysphagia, and chest CT scan revealed the presence of esophageal stenosis. The symptoms were relieved after esophageal expansion treatment. The patient presented 1 year ago with choking cough after drinking fluid, and an esophageal fistula, which had a diameter less than 1 cm and located 1.5 cm superior to the tracheal carina, was found by CT scan. To relieve the symptoms, a self-expanding metal stent was implanted. About 3 weeks ago, the patient complained of postprandial choking cough and shortness of breath again. Cervical CT scan in our hospital revealed tracheal obstruction caused by the expanding upper part of esophageal stent compression. Part of the stent pierced into the tracheal cavity in the thoracic entrance level forming a new tracheoesophageal fistula with a diameter of 3 cm. And no heal was found in the original fistula (Fig. 1). The bronchosbioscopic result verified the CT finding. Surgery, including the stent removing, cervical esphagostomy externa, exclusion of the thoracic tracheoesophageal fistulas and...
gastrostomy were planned to perform under general anesthesia. But the operation had not been performed smoothly owing to the difficulty of endotracheal intubation even with fibrobronchoscopic assistance on the fifth day of hospitalization.

On the eighth day after admission, the patient was sent to the operating room again. After anesthesia with Fentanyl and 50 mg heparin, right femoral arterial and venous catheterization was performed and connected to the ECMO circuit. The circuit was clamped temporarily. Oxygen saturation of the patient was about 97% at this moment. After that, surgeons were divided into the abdomen operation group and neck operation group. An oblique left side cervical incision was made to expose the cervical segment of esophagus, and the esophagus was incised longitudinally. Under the guidance of fibrobronchoscope, the upper edge of the stent was clamped by vascular forceps. During the process of removing the stent, oxygen saturation of the patient dropped sharply to 60%. The ECMO circuit was unclamped immediately at the flow rate of 2.2 L/min and the oxygen concentration of membrane oxygenation of 100%. After the stent was removed, endotracheal intubation was implemented successfully through the upper tracheoesophageal fistula under the guidance of the fibrobronchoscope and mechanical ventilation with a pressure control mode was performed. The cuff was between the two fistulas. After the removal of the stent, abdominal group of surgeons had freed and cut off the lower segment of the esophagus. To prevent the tension effect on the lower esophageal stump induced by the mechanical ventilation, stump was closed by the staple for twice with an interval of 1 cm and a figure-of-eight suture. Gas overflow was found during the upper thoracic esophageal stump closing, so the upper stump was also closed by the figure-of-eight suture and covered by the sternocleidomastoid muscle coverage. The ECMO flow rate was reduced gradually and discontinued finally according to the airway pressure and blood-gas parameters. Protamine was injected intravenously in time to antagonize heparin. The total duration of intra-operative ECMO assistance was about 10 min. A gastrostomy was placed by the abdominal team and a cervical esophagostomy externa was created by the cervical team. The patient was separated from the ventilator after recovering of the consciousness and spontaneous breathing and detached from endotracheal intubation 1 hour after surgery. Enteral nutrition was supported via the gastrostomy tube on the fifth day after surgery. On the 15th day after surgery, we reinspected the patient with a CT scan, which showed that the tracheal lumen was patent, the tracheoesophageal remained unclosed, and there was no evidence of effusion in the suspended tracheal cavity (Fig. 2). The patient was discharged 20 days after surgery. Fibrobronchoscopy showed the upper tracheoesophageal fistula became smaller and the lower one closed fairly well 6 months after surgery (Fig. 3).

Discussion

Esophageal metal stenting is responsible for many cases of acquired tracheoesophageal fistula.\(^1\) Post-radiotherapy patients have more probability to have this kind of fatal complications.\(^2\) However, there are few reports describing the surgical treatment of double-opening tracheoesophageal fistula with airway obstruction causing by the stent piercing. This kind of patients used to receive conservative treatment instead of operation due to the difficulty of endotracheal intubation and had a bad quality of life. But in this case, we used ECMO-assisted surgery...
we performed the cervical and abdominal operations simultaneously, dissected the lower segment of the esophagus as quickly as possible, used the pressure-control ventilation mode during and after operation, reduced the airway pressure, and separated the patient from mechanical ventilation as early as possible.

ECMO, a supportive technique of respiratory circulation, is frequently used in emergency treatment of neonatal critical conditions, severe myocarditis, ARDS and temporary cardiopulmonary function replacement before and after organ transplantation. In recent years, it is also used in some complex tracheal operations, the treatment of post-traumatic empyema, and some other general thoracic diseases. However, there are few reports about using ECMO in removing esophageal stents in patients with complex tracheoesophageal fistulas. It is generally accepted that the ECMO-assisted V-V mode is suitable for simple pulmonary function replacement. However, we found in our clinical practice that this mode may cause the repetitive circulation in some patients due to the catheter position. Part of the oxygenated blood flows back to the ECMO circuit instead of entering the systemic circulation, which causes the instability and insufficiency of the oxygen saturation. By contrast, the V-A mode can lead more stable oxygen saturation, and therefore this mode may be a better choose in short-term intra-operative respiratory function replacement.

Compared with conventional surgery, ECMO-assisted surgery may cause more hemorrhage on the surface of the trachea and the suspended esophagus, and therefore special attention should be paid to the prevention of aspiration during the perioperative period. The duration of ECMO assistance should be minimized, and protamine should be used in time to antagonize heparin. Postoperative...
management of the respiratory tract should be intensified, including removal of secretions from the respiratory tract timely.

Although ECMO-assisted surgery may lead to hemorrhage and other severe complications, it is still a better choice for patients who can undergo surgery after removing the difficulty of endotracheal intubation with the ECMO assistance. We hope our report can provide a new method to treat the benign tracheoesophageal fistula patients with removable airway obstruction.

Disclosure Statement

The authors declare that they have no competing interests.

References