

Use of Venovenous Extra-Corporeal Membrane Oxygenation for Resection of a Large Paratracheal Mass Causing Critical Tracheal Stenosis: A Case Report

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Abstract

Abstract: Critical airway stenosis presents a challenge for surgeons and anesthesiologists alike in securing a reliable airway for adequate ventilation. The use of venovenous (VV) extra-corporeal membrane oxygenation (ECMO) has been described as a strategy to provide adequate gas exchange in such instances. We present a case of a young female with a complex paratracheal mass significantly compressing the trachea in whom a planned intra-operative VV ECMO was instituted to allow safe oro-tracheal intubation of a double lumen endotracheal tube for lung isolation and tumor resection.

Introduction:

The indications for extracorporeal membrane oxygenation (ECMO) have expanded as the technology has become an integral component of extracorporeal life support (ECLS). Drs. Gibbon, Rashkind, and Dorson described the use of ECMO in the 1950s and 1960s for cardio-pulmonary failure in neonates and subsequently expanded to the adult population¹.

In addition to standard indications in patients with parenchymal lung failure, ECMO has been used to achieve stable oxygenation/ventilation in the peri- and intra-operative period prior to re-establishment of airway patency in patients with critical tracheal stenosis secondary to tracheal tumors or mediastinal mass/neoplasms causing extrinsic airway compression². Critical tracheal stenosis defined as greater than 75% narrowing of the airway lumen that is often associated with extreme respiratory distress and difficult intubation³. Although not novel, the use of intra-operative ECMO in cases of critical tracheal stenosis has not frequently been described. We present a case of a large right paratracheal mass that significantly compressed the intrathoracic trachea; VV ECMO was instituted to allow safe endotracheal intubation and lung isolation to resect the lesion and relieve the tracheal stenosis. Institutional Review Board and informed consent waiver are included in our supplementary files.

Case Presentation:

A 29-year-old female presented to the thoracic surgery clinic for surgical evaluation of an incidental finding of cystic mediastinal mass in April 2017. She was scheduled for an elective mass resection in August 2017; however she was lost to follow-up. She re-presented in March 2020 with significant dyspnea at rest with occasional stridor, dysphagia, and chest pain that began a few days prior to presentation. Computed

tomography (CT) scan demonstrated complex, heterogeneous 8 cm x 10 cm x 7.4 cm mass on right middle mediastinum, abutting the medial right lung apex, causing significant extrinsic compression the distal trachea (Figure 1a and 1b). Interventional radiology was consulted to drain the mass to reduce the tracheal narrowing to allow for safer intubation. This was not possible as most of the mass was filled with hyperdense material representing blood clots and little free fluid to be drained. Given the critical extrinsic compression of the intrathoracic trachea, there was a significant risk of losing airway control by standard endotracheal intubation. Therefore, the ECMO team was requested to electively place the patient on VV ECMO intra-operatively prior to intubation and thoracotomy. Bilateral femoral veins were cannulated with the Seldinger technique with local anesthesia and ketamine infusion and veno-venous ECMO flow was instituted at 4 L/minute. The patient then underwent general anesthesia and was successfully intubated with a 38F double-lumen endotracheal tube under bronchoscopic guidance. She subsequently was placed in left lateral decubitus and the flow was decreased to 2 L/minute. The paratracheal mass was successfully resected via a right muscle-sparing thoracotomy and standard single left lung ventilation with right lung deflation. Large amount of clots were evacuated from the mass to decompress it for safe resection. The VV ECMO canulae were removed at the end of the operation. Her postoperative course was uneventful. The final pathology report revealed the paratracheal mass to be a benign mediastinal hemangioma (Figures 2) with intracavitary hemorrhage as indicated by the intraoperative large amount of clot discovered.

Discussion:

Critical tracheal stenosis caused by endotracheal tumors or extrinsic compression by mediastinal masses, if not recognized preoperatively and inadequately managed intraoperatively, may lead to loss of airway control; in the absence of alternative means of ventilation/oxygenation such as ECMO, this is often associated with significant morbidity/mortality. A high index of suspicion based on the preoperative imaging coupled with clinical presentation of respiratory stridor and significant dyspnea at rest should alert treating physicians of a potential airway emergency and the need for appropriate preoperative planning. This includes discussion with anesthesiology colleagues and consultation with members of the ECMO team, either for standby in the operating room at the time of endotracheal intubation or elective placement of a VV ECMO circuit and institution of flow to achieve total ventilatory/oxygenation support, prior to safe endotracheal intubation, as we presented in this case. Heparin-coated VV ECMO circuits may mitigate the need for systemic heparinization, which can facilitate surgery with minimal blood loss⁴. The indications for VV ECMO have expanded and currently include ARDS, lung rest (e.g. airway obstruction or pulmonary contusion), lung transplantation, lung hyperinflation (i.e. status asthmatics), pulmonary hemorrhage and congenital diaphragmatic hernia¹. The expanding use of ECMO as life support for patients with acute respiratory failure was popularized after the 2009 randomized controlled CESAR trial demonstrating patients with acute respiratory distress syndrome (ARDS) who were allocated to the VV ECMO group (n = 90 patients) had higher 6 month survival rates without disability versus conventional ventilator-based strategies (n = 90 patients; 63% vs. 47%, p = 0.03, respectively)⁵. A case report and systemic review by Malpas and colleagues demonstrated the essential role of ECMO or cardiopulmonary bypass (CPB) as the a priori method of oxygenation during difficult airway management⁶. They identified 45 cases of critical airway obstruction caused by a wide range of airway pathologies including tracheal tumors, tracheal stenosis, head-neck cancers and mediastinal masses being the most common. All patients underwent ECMO or CPB prior to induction of anesthesia and the extracorporeal support was either used only for establishment of tracheal intubation and ventilation or the entire operative case.

In summary, appropriate coordination with an ECMO team at a tertiary referral center allows for careful preoperative planning to resect tumors causing critical airway stenosis. The planned use of VV ECMO, not as a rescue option, but as part of an algorithm for difficult airways provides security in the surgical resection of mediastinal tumors.

Figures:

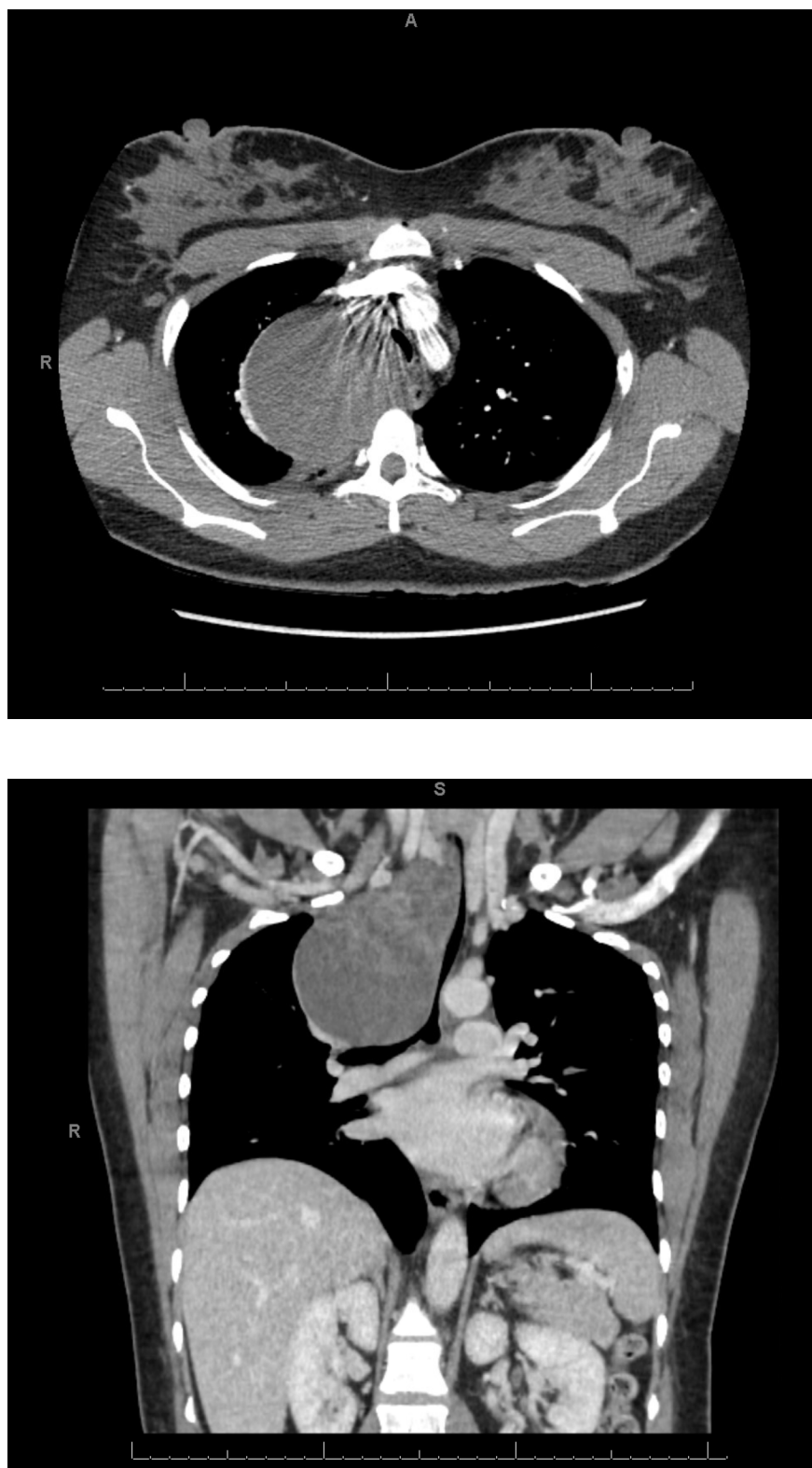


Figure 1: Axial (a) and coronal (b) CT images with 8 cm x 10 cm x 7.4 cm, non-enhancing, low-attenuation

mass of right middle mediastinum, abutting the medial right lung apex and causing significant extrinsic compression of the distal trachea. Blue arrows highlight narrowing of trachea. Orange arrows demonstrate paratracheal mass.

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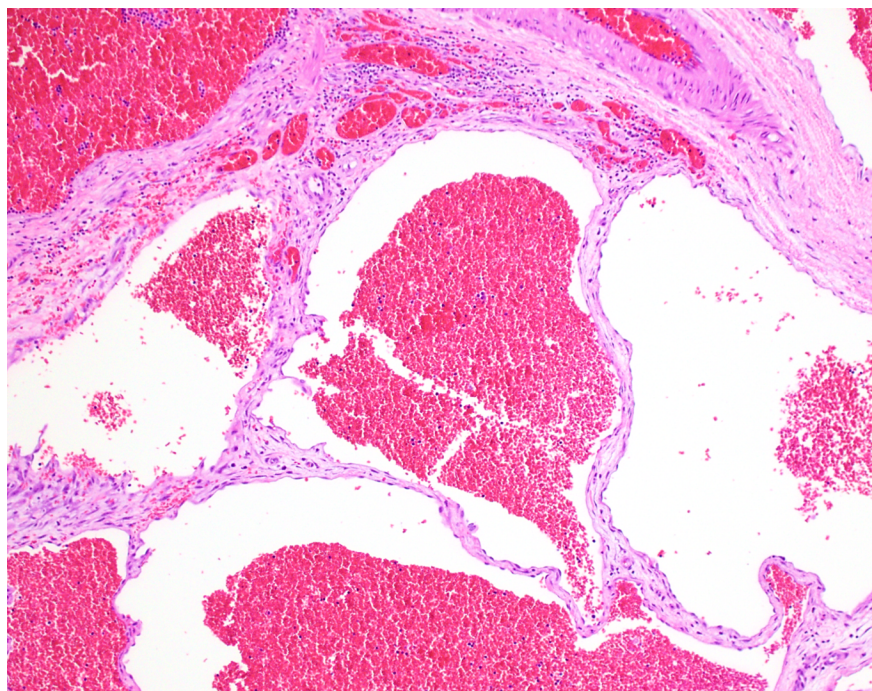


Figure 2: Medium-power microscopic view with (hematoxylin and eosin stain; 100X magnification) highlighting endothelial cells lining blood-filled spaces, confirming the diagnosis of a benign hemangioma.

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