

## Case Report

# Perioperative Airway Management of a Mediastinal Mass through Early Intervention with Extracorporeal Membrane Oxygenation [ECMO]

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- Difficult airway

**Abstract**

Venous-venous extracorporeal membrane oxygenation [ECMO] can be life saving in clinical situations where awake, fiberoptic intubation or tracheostomy were indicated but were not feasible because of critical airway obstruction in the lower airways. We present a case of unusual airway obstruction by a neck mass extending in the mediastinum in a young adult. A flexible fiberoptic bronchoscope was used to confirm the extent of external compression and airway obstruction. The nature of invasion was concerning for bleeding and obstruction of the airway if we attempted to manipulate the airway by fiberoptic intubation. The extension of the mass into the chest prevented other methods for securing the airway such as retrograde intubation or awake tracheostomy. There was also a concern that the use of standard induction and neuromuscular blocking drugs would cause irreversible tracheal compression or cardiovascular compromise. ECMO was utilized to provide safe oxygenation while establishing a definitive airway.

**INTRODUCTION**

Mediastinal masses that compress or invade the airway may create difficulties in endotracheal intubation, tracheostomy and ventilation: the level of the obstruction as well as the extension within the trachea can pose clinical challenges to secure a patent airway and guarantee optimal oxygenation. The difficult airway algorithm from ASA recommends actively pursuing opportunities to supplement oxygen while managing the difficult airway [1].

In this article we advocate the initiation of Extracorporeal Membrane Oxygenation [ECMO] prior to securing the airway. ECMO has been utilized to maintain oxygenation during procedures where standard airway management was not possible or prior to securing an endotracheal tube or tracheostomy [2], because of the critical nature of the airway obstruction or

because of complications [bleeding, disruption, trauma]. In this case, ECMO was initiated prior to inducing the patient to provide successful oxygenation while securing the airway. Rigid bronchoscopy and progressive dilation of the trachea were utilized in securing an endotracheal tube.

**CASE REPORT**

A 35- year old woman presented to the outpatient otorhinolaryngology clinic with a two month history of dry cough with intermittent blood, progressively increasing respiratory distress, biphasic stridor, "hoarseness", dysphagia to solids and fullness in the left lower neck. She denied any history of thyroid dysfunction, her father had non-Hodgkin's lymphoma and she denied using tobacco or alcohol. Physical examination revealed a left lower neck firm mass at the level of the thoracic inlet.

Superior extent of the mass was at the lower pole of left thyroid lobe and the lower limit was not palpable. She exhibited increased work of breathing with suprasternal retractions. Fiberoptic nasal endoscopy showed paralyzed left true vocal fold in an abducted position. No lesion was visualized in the subglottis.

Contrast-enhanced CT scan of the neck and chest revealed a 4.5 x 3.9 x 4.3 cm homogeneously enhancing mass displacing the left inferior pole of thyroid gland, compressing the extrathoracic trachea to a slit like appearance with possible erosion in the trachea. There was significant mass effect on the esophagus with compression at the C7-T1 level.

The patient was immediately transferred from the clinic, which was connected to the hospital, to the intensive care unit due to progressive dyspnea. The patient was treated with intravenous dexamethasone and nebulized racemic epinephrine to optimize her ventilation. The patient was started on a mixture of helium 79% and oxygen 21 % [Heliox]. Heliox, having a lower density than room air reduces resistance of turbulent/orifice flow, and indeed subjective fatigue of ventilation immediately improved based on patient's experience.

However the relief was temporary and due to the patient's deteriorating respiratory status she was taken to the operating room [general OR] to assess the airway in a protected environment and possibly secure it by mean of endotracheal intubation.

We attempted an awake flexible fiberoptic bronchoscopy [FFB] with the intent of proceeding to an oral endotracheal intubation. After topicalization of the oropharynx and trachea with lidocaine 4%, mild sedation by midazolam 2 mg and 50 mcg of fentanyl, the bronchoscope was placed through the glottic opening. FFB revealed that the tumor was eroding through the left tracheal wall 5 cm below the level of the vocal cords with about 90% occlusion of the trachea. Most of the concern [that was also raised initially at the CT scan images review], was the extension of the airway invasion, up to 3-5 cm below the initial visualization. We decided not to proceed with immediate intubation and consider a tracheostomy surgically impossible [as per assessment of ORL surgeon]. Even though placement of an endotracheal tube into the larynx would likely be uneventful, there was concern that ventilation may be difficult due to subglottic compression or significant bleeding may occur as result of shaving and scraping the irregular mucosal surface of the trachea, surely could have ended up in hypoxia/asphyxia. A consult was made for cardiothoracic surgery to initiate ECMO.

Our patient was then transferred to the cardiothoracic operating room. While awake, but comfortably sedated [midazolam 2 mg] she was placed in a semi-recumbent position and local anesthetic infiltration was used prior to placement of a left subclavian vein which was verified by fluoroscopy [that was decided by the CV surgeon, a skilled clinician expert and director of the ECMO adult and pediatric program at our institution]. The time span from placing local anesthetic to initiating ECMO was approximately 15 minutes. Venous-venous flow was initiated at approximately 2.4 L/min/meter<sup>2</sup> and the perfusionist titrated flows to maintain normal blood pressure. The patient was anesthetized smoothly titrating 100 mcg of fentanyl, propofol

150 mg and Rocuronium 50 mg. Continuous general anesthesia was provided by propofol and fentanyl. After obtaining adequate oxygen saturation and hemodynamic stability [20 minutes were necessary], a rigid bronchoscopy was performed by a thoracic surgeon.

The surgeon sequentially dilated the trachea and tumor to 11mm with an esophageal dilator [Savory, Cook Medical, IN, USA]. Bleeding was controlled by irrigation of the tumor with saline and 1:10,000 epinephrine. Orotracheal intubation was successfully performed after several dilations, over an exchange catheter [Soft tipped exchange catheter, Cook Medical, IN, USA]. The patient was intubated with a 7mm internal diameter, wire reinforced, cuffed endotracheal tube [about 25 minutes from the start of the procedure]. Flexible bronchoscopy and a chest x-ray were utilized to confirm the placement of the endotracheal tube 3.5 cm above the carina.

ECMO was discontinued after mechanical ventilation was commenced and there was confirmation of adequate oxygenation [about 1 hour from the beginning of the artificial oxygenation]. At the end of the case an ultrasound guided core needle biopsy of the mass was performed through the left lower neck. Biopsy results were inconclusive for undifferentiated epidermal carcinoma. The patient returned to the OR 3 days later for left subtotal thyroidectomy, mediastinal mass resection and prophylactic tracheostomy which were performed under general anesthesia. The patient did not experience any complications with this procedure. The patient was discharged from the hospital within a few weeks of the initial surgery. She survived approximately four months post resection. The histology confirmed the mass not being thyroid tissue, but a highly undifferentiated epidermal carcinoma.

## DISCUSSION

ECMO was established prior to airway manipulation in a patient requiring urgent tracheal intubation due to critical subglottic tracheal compression from an anterior mediastinal mass. If the clinical situation allows time for thorough investigation, patients should be evaluated for extension of the tumor to determine whether the tumor affects structures that can lead to respiratory and hemodynamic instability [3,4].

Hemodynamic compromise may occur during induction in a patient with a mediastinal mass due to vascular or cardiac compression. A thorough evaluation for a mediastinal mass may include a chest x-ray, CT scan, EKG, echocardiogram and upright/supine flow volume loop. In a patient with an intra thoracic tumor [such as this one] we would expect to find a normal inspiratory flow rate, a plateau in the expiratory flow rate, a decrease in the vital capacity in the supine position and a decreased expiratory flow rate in the supine position [5]. The large negative intrapleural pressure produced on inspiration serves to maximally dilate the trachea and minimize the obstructive effects of an intra thoracic tumor. The airway obstruction of an intra thoracic mass is best visualized on the expiratory limb of a flow volume loop. Fiberoptic bronchoscopy may be beneficial in specific cases for evaluation of tracheal invasion.

Due to the size and location of the mass, there was a significant risk of airway obstruction secondary to dynamic airway collapse

caused by general anesthesia [6]. This effect is thought to be produced in part by loss of muscle tone produced by anesthetics and by ablation of spontaneous ventilation, resulting in the loss of negative intrapleural and the production of airway obstruction. There is also a concern that inflammation and bleeding may occur during attempted intubation.

Under optimal settings with a cooperative patient, fifteen minutes were needed to initiate ECMO.

ECMO was required for sixty minutes while the multidisciplinary team established a definitive airway. The location of the mass prohibited using a tracheostomy as a means for establishing the airway. If ECMO was not initiated prior to attempting to establish an airway the patient may have experienced prolonged periods of hypoxia resulting in organ damage, brain damage or possible death.

## CONCLUSION

Anterior mediastinal masses may present situations where intubation and performance of a tracheostomy are not immediately possible. Anesthesiologists have been taking a systematic approach to these patients with a focus on establishing a definitive airway as well as the maintenance of oxygenation. Due to the high possibility of difficult and impossible ventilation, and other complications associated with a mediastinal tumor, the initiation of ECMO prior to intubation should be considered as part of the airway plan in patients with high risk mediastinal tumors. This is determined by location, size, nature, age of the patient and severity of obstruction, as well as risks of losing ventilation/oxygenation while manipulating the airway [for instance because of bleeding]. In the presented case, attempting to establish the airway without supporting oxygenation would have resulted in a "cannot intubate-cannot ventilate" situation without a suitable way to rescue the airway, particularly because no tracheostomy could not be performed. Initiation of ECMO preemptively is critical in high pressure situations, where time to successful cannulation would definitely result in hypoxic organ injury.

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## IRB

The case presented is an educational medical report that our IRB [UTH] does not consider human research. The subject did provide verbal consent to have information related to her specific anesthetic management being used for medical educational purposes. No written consent was obtained considering the delicate and sensitive nature of the clinical situation.

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