

# Airway management in a patient with an intratracheal tumor near the carina by a two-stage operation

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## Abstract

In patients with intratracheal tumors, airway management while maintaining oxygenation and providing surgical access to the airway can be challenging. Here, we present a case of a two-stage operation to remove an intratracheal tumor causing partial obstruction near the carina. In the otorhinolaryngology department, a biopsy was performed during apnea under high-flow nasal oxygenation support. A few days later, a thoracic surgeon performed tracheal resection after sternotomy under general anesthesia. Mechanical ventilation was performed by inserting a sterile endotracheal tube in the resected distal part of the trachea in the surgical field for tracheal end-to-end anastomosis. Airway was successfully secured through close communication between teams of anesthesiologists and surgeons.

## Keywords

Apneic oxygenation, difficult airway, high-flow nasal oxygenation, tracheal tumors, laryngeal microsurgery, oxygen reserve index

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## Introduction

In patients with intratracheal tumors, securing an airway requires careful management.<sup>1</sup> During treatment, the location, size, and rigidity of tumor along with the residual tracheal space must be considered.<sup>2</sup> If located in the upper part, tracheostomy under local anesthesia or placement of a small-sized endotracheal tube or laryngeal mask airway can be considered with caution in order to avoid contact with the tumor.<sup>3,4</sup> However, if the tumor is close to the carina, there is a risk of placing the tip of the tube in the main bronchus, inducing one-lung ventilation, and creating difficulties in performing tracheostomy because of the need for sternotomy under general anesthesia (GA).<sup>2</sup> Therefore, tubeless technique with apneic oxygenation performed by a well-communicated team with a concrete strategy can be considered.<sup>5</sup> Here, we introduce a method of securing airway by performing a two-stage operation for intratracheal tumors causing partial obstruction near the carina.

## Case

A 36-year-old man weighing 59 kg with a height of 174 cm was admitted to the Department of Otorhinolaryngology and evaluated for the presence of an intratracheal mass. His medical

history was clear apart from two surgeries for pneumothorax performed 17 years ago. An otorhinolaryngologist planned a biopsy with laryngeal microsurgery to confirm the pathology of the mass, followed by tracheal resection and end-to-end anastomosis if required, along with thoracic surgery if the biopsy result was malignant.

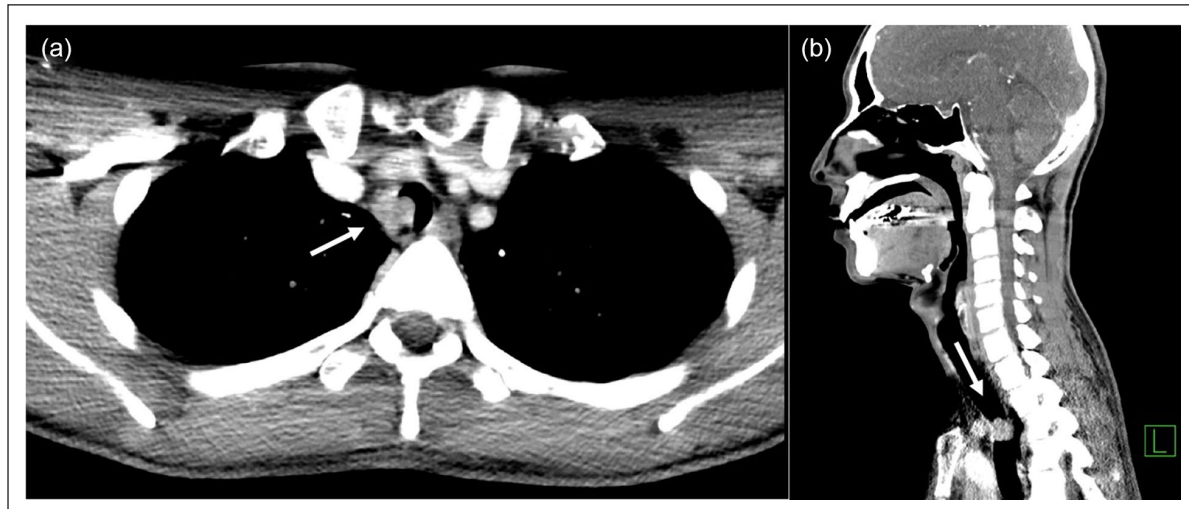
The mass partially obstructed the patient's airway, resulting in dyspnea on exertion. The patient's functional capacity was 4 METs (metabolic equivalents); he showed mild dyspnea on climbing two flights of stairs. Preoperative assessment showed no loose teeth and Class I of Mallampati classification. The thyromental distance was 8 cm and mouth opening was 5 cm, along with normal head and neck movement. Magnetic resonance imaging and computed tomography of the neck showed an enhancing polypoid mass of approximately 1.4 cm, causing partial obstruction in the right lateral wall of the trachea

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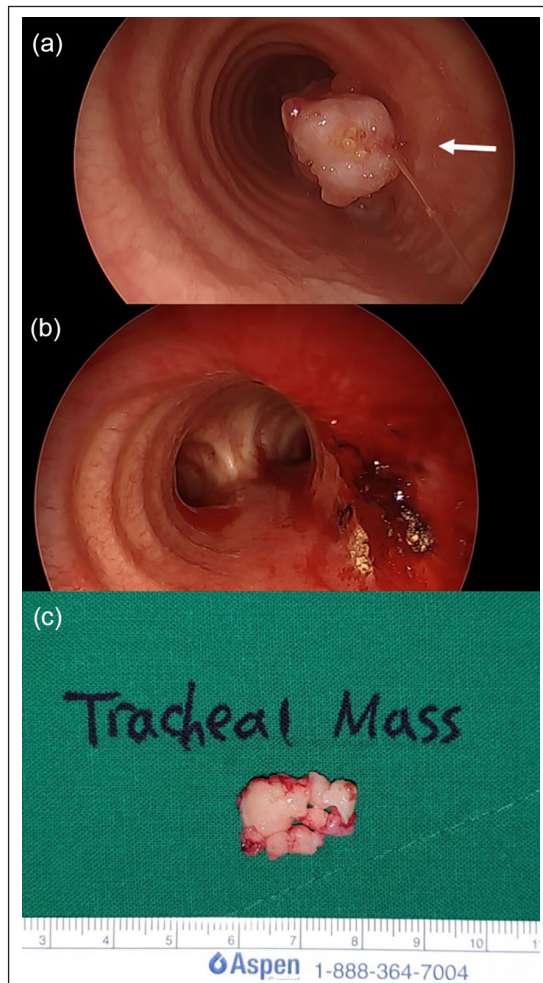
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**Figure 1.** Neck computed tomography image showing the intratracheal mass of 1.4 cm causing partial obstruction: (a) intratracheal mass (white arrow) is shown in the axial image and (b) intratracheal mass (white arrow) is shown in the sagittal image.



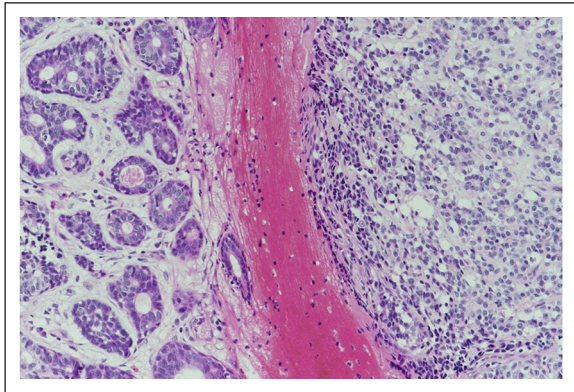
**Figure 2.** Tracheal mass biopsy with laryngeal microsurgery: (a) endoscopic view showing intratracheal mass, (b) endoscopic view showing the trachea after the biopsy of mass close to carina, and (c) the specimen of intratracheal mass.

(Figure 1). The mass was located at an approximate distance of 4 cm from the carina and 8 cm from the vocal cords.

In the operating room, the patient was monitored with electrocardiogram electrodes; pulse oximetry and noninvasive blood pressure measurements were recorded. A SEDLine<sup>®</sup> sedation sensor (Masimo, CA, USA), Rainbow<sup>®</sup> Pulse Co-Oximeter Adhesive sensor (Masimo), and TCM TOSCA transcutaneous carbon dioxide (PtcCO<sub>2</sub>) monitor (Radiometer<sup>™</sup>, Copenhagen, Denmark) were attached to the patient's forehead, fingers, and arms, respectively. Apneic oxygenation during the operation was maintained with Optiflow<sup>™</sup> (Fisher & Paykel Healthcare, Auckland, New Zealand). Preoxygenation was performed using a tightly fitted facemask supplied with 10 L/min of 100% oxygen for 3 min. After preoxygenation, propofol (150 mg) and rocuronium (25 mg) were injected for anesthetic induction. High-flow nasal oxygenation (HFNO) at 50 L/min was initiated after confirming adequate mask ventilation. Biopsy was performed by insertion of a suspension laryngoscope into the patient's mouth (Figure 2). Intravenous anesthesia was performed using propofol and remifentanyl to induce unconsciousness during apnea. During the first apnea time of 26 min, PtcCO<sub>2</sub> was increased up to 80 mmHg, and oxygen reserve index was maintained at 0.22, with a peripheral oxygen saturation of 100%. Transient mechanical ventilation was started by insertion of a plain tube (ID 6.0) through the suspension laryngoscope. When the PtcCO<sub>2</sub> reached 50 mmHg, the biopsy of the mass was continued with a second apnea time of 25 min. PtcCO<sub>2</sub> was then increased to 103 mmHg with an oxygen reserve index of 0.22. After removal of the mass, bleeding was controlled using an electrosurgical suction coagulator at the bottom of the tumor. Epinephrine-soaked gauze was also used to ensure hemostasis. After the surgery, the tube was reinserted, and mechanical ventilation was performed to facilitate CO<sub>2</sub> washout. The patient was

extubated and transferred to the post-anesthetic care unit. The anesthesia and surgery durations were 105 and 64 min, respectively. The frozen biopsy result indicated an adenoid cystic carcinoma (Figure 3).

The patient was re-admitted after 6 days. Tracheal resection and end-to-end anastomosis were performed via inverted T-sternotomy under GA. Tracheal intubation was performed by inserting a plain tube (ID 6.0) into the mouth after anesthetic induction followed by tracheal resection of 3 cm. To maintain oxygenation, a reinforced sterile tube (ID 6.0) was inserted into the distal part of the trachea in the surgical field

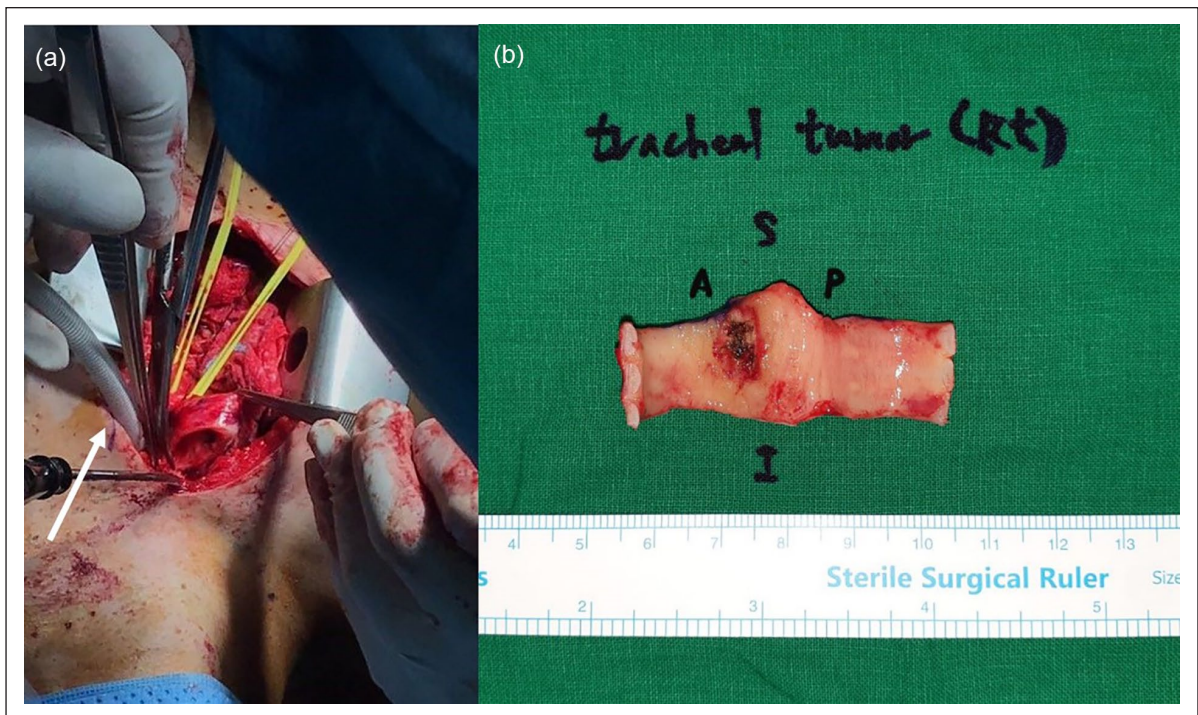


**Figure 3.** The tumor showed multilobular growth pattern with various histologic patterns, including cribriform (left side of the picture) and tubular (right side of the picture) pattern of adenoid cystic carcinoma ( $\times 200$ ).

by a thoracic surgeon (Figure 4). The oral plain tube (ID 6.0) was withdrawn proximally about 2 cm to facilitate tracheal end-to-end anastomosis. After completion of the tracheal anastomosis and removal of the reinforced tube in the surgical field, the patient kept mechanically ventilated with the oral plain tube. Anesthesia and surgery durations were 210 and 138 min, respectively. The patient was extubated and sent to the intensive care unit for 1 day. After 12 days, the patient was discharged without any major events.

## Discussion

In case of complete tracheal blockage and severe breathing problems, extracorporeal membrane oxygenation should be considered.<sup>6-8</sup> Here, because the mass induced partial obstruction of the tracheal lumen and preoperative images showed its confinement within the endoluminal cavity of the trachea with no visible extra tracheal extension, anesthetic induction and placement of the endotracheal tube could be considered. There are two potential ways to insert the tube tip above or below the mass during anesthetic induction.<sup>2</sup> One method is to insert a long tube with a small diameter, such as a microlaryngeal tube ID 4.0, beyond the mass.<sup>2,9</sup> The tube can be advanced without trauma with a fiberoptic bronchoscope while observing the tube tip thoroughly during the procedure.<sup>4</sup> However, there is a risk of mass dislodgment resulting in bleeding as the tube advances beyond the mass.<sup>1,6</sup> Another method is to place the tip of the plain tube ID 6.0 above the mass. In this regard, the laryngeal mask airway can also be used.<sup>10,11</sup> However, ventilation can be



**Figure 4.** Resection of tracheal tumor after sternotomy: (a) the reinforced tube was inserted through the open trachea in the surgical field, and the tracheal segment was being resected and (b) the specimen of resected tracheal segment of about 3 cm.

impaired by the displacement of airway equipment, hemorrhage, or disruption of the friable and vascular mass below the tube, causing unanticipated catastrophic conditions.<sup>3</sup>

Tracheal intubation by both methods may require removal of the microlaryngeal tube and induction of apnea during mass biopsy as insertion of the biopsy device and endoscope into the patient's narrowed tracheal lumen may be difficult with the microlaryngeal tube already placed in the trachea.<sup>12</sup> Using HFNO, apnea time can be safely extended in various airway surgeries.<sup>5</sup> In this case, preoperative airway examination did not present any problems in upper airway, thereby suggesting that HFNO could be used safely in this patient with the maneuver of maintaining upper airway patency, such as jaw thrust.<sup>13</sup> Therefore, trachea was not intubated, and HFNO was used to maintain saturation during mass biopsy. Hypercapnia occurred up to 103 mmHg of PtcCO<sub>2</sub> during the apneic oxygenation period, which is consistent with the report of CO<sub>2</sub> retention (highest end-tidal CO<sub>2</sub> of 65–120 mmHg) in the cases of maintaining apnea using HFNO in airway surgery.<sup>14</sup> It has been reported that respiratory acidosis caused by hypercapnia during apneic oxygenation did not lead to major complications; however, it is better to utilize transcutaneous CO<sub>2</sub> monitoring so that the medical staff can immediately perform ventilation when the predetermined CO<sub>2</sub> level is reached.<sup>5</sup>

Tracheostomy under local anesthesia is another option for securing the airway in such patients. Here, the mass was below the suprasternal notch, and sternotomy under GA was needed to access it.<sup>3</sup> During operation, the tracheal mass was found to be much closer to the carina than shown on the neck computed tomography image. This proximity would have caused the ballooning cuff of the tube to press against the mass, causing inadequate sealing and ventilation, even if the tube tip was successfully placed below the mass. Therefore, tube placement was considered in the second-stage operation after removal of the mass in the first-stage; a cuffed endotracheal tube was placed in the upper part of the trachea, and a sterile reinforced tube was placed in the distal airway of the surgical field.<sup>1</sup>

## Conclusion

In patients with tracheal tumors, airway management should be performed with care. The location and size of the tumor should be considered. Under HFNO support and PtcCO<sub>2</sub> monitoring, the mass removal can be facilitated with extended safe apnea time.

## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Ethical approval

Ethical approval to report this case series was obtained from institutional review board (IRB) of Severance Hospital and Yonsei University Health System (no. 4-2020-1165).

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## Informed consent

Written informed consent was obtained from the patient for their anonymized information to be published in this article.

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