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CASE REPORT

Anesthetic Management of Upper Tracheal Cancer Resection and Reconstruction: A Case Report

So Ron Choi, Deuk Won Eom, Tae Young Lee, Ji Wook Jung, Gang Hyun Lee, Seung Cheol Lee, Sang Yoong Park, Tae Hyung Kim

Department of Anesthesiology and Pain Medicine, University of Dong-A College of Medicine, Busan, Republic of Korea

Correspondence: Sang Yoong Park, Department of Anesthesiology and Pain Medicine, University of Dong-A College of Medicine, 26 Daeshingongwon-ro, Seo-gu, Busan, 49201, Republic of Korea, Tel +82-51-240-5390, Fax +82-51-247-7819, Email parksy@dau.ac.kr

Abstract: Tracheal tumor resection and reconstruction is the primary treatment for tracheal tumors. The trachea is the surgical site as well as an important channel to ensure ventilation and maintain oxygenation during surgery. In this report, we describe the successful management of an upper tracheal tumor in a 50-year-old patient. The tumor was situated approximately 2–3 cm below the vocal cords, occluding the tracheal lumen by 80%. Conventional orotracheal intubation was expected to be impossible, and the patient was managed with an I-Gel supraglottic airway for mechanical ventilation with the assistance of venovenous extracorporeal membrane oxygenation (VV ECMO). After securing tracheal intubation via the tracheostomy site, VV ECMO was weaned off, and mechanical ventilation was changed to tracheal intubation. Eventually, tracheal tumor resection and reconstruction were successfully performed under general anesthesia. No specific events occurred during anesthetic management. Careful preoperative planning and good teamwork made the procedure possible without complications.

Keywords: anesthesia, extracorporeal membrane oxygenation, tracheal resection and reconstruction

Introduction

Tracheal cancer are rare tumors of the upper respiratory system, leading to severe tracheal constriction that can be life-threatening during perioperative anesthetic management.[1] Patients usually present with airway irritation and obstruction symptoms including cough, sore throat, dyspnea, and shortness of breath. The diagnosis of this disease is confirmed by fiberoptic bronchoscope (FOB) or computed tomography (CT). Currently, surgical resection and tracheal reconstruction is the main treatment for tracheal tumors. Anesthesia for tracheal resection and reconstruction (TRR) is challenging because of the compromised airway and the need to share the airway with the surgeon while maintaining respiratory function. Variable strategies for airway management during tracheal tumor surgery vary depending on the nature, growth pattern, and tumor location, as well as the degree of airway obstruction and surgical approach.[2–5] First conventional airway management for TRR is endotracheal intubation after induction of general anesthesia and crossfield positive-pressure ventilation after insertion of a sterile endotracheal tube for mechanical ventilation during the resection phase. Second is using supraglottic airway devices, especially for the initial phase of the surgery. Preemptive extracorporeal membrane oxygenation (ECMO) can be other option. Third, Huang et al[4] proposed that non-intubated spontaneous respiration anesthesia for tracheal tumor could be a feasible and safe method. There are no controlled studies comparing various methods of anesthetic management and airway control for TRR operations. Thus, induction of anesthesia and endotracheal intubation need to be thoroughly planned. We report our experience with the successful management of upper tracheal malignancy in which I-Gel ventilation with preemptive venovenous (VV) ECMO was instituted because of impending airway obstruction prior to TRR.

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The patient was a 50-year-old man weighing 82 kg with the American Society of Anesthesiology grade II. He presented to the preoperative anesthesia clinic for an outpatient consult from the thoracic surgery department due to coughing, throat discomfort, and continuous sputum for the previous 3 months. FOB showed a lobulated hemorrhagic mass obstructing the airway, with contact bleeding and sputum (Figure 1). The chest magnetic resonance imaging showed a 2.7 × 2.5 cm-sized well-enhancing lobulated neoplasm in the upper posterior trachea, 2–3 cm below the vocal cords causing 80% obstruction (Figure 2). The narrowest intraluminal distance was approximately 0.5 cm. Physical examination revealed no other remarkable clinical findings. Arterial blood gas analysis results were as follows: partial pressure of oxygen, 82.3 mmHg; partial pressure of carbon dioxide, 39.5 mmHg; and O_2 saturation, 95.7% on room air at rest. All preoperative laboratory test results were within normal limits.

Because the tumor had highly developed vasculature, the risk of suffocation may increase if bleeding occurred through the tracheal intubation. Another limitation was that the tumor was located on the right side of the tracheostomy

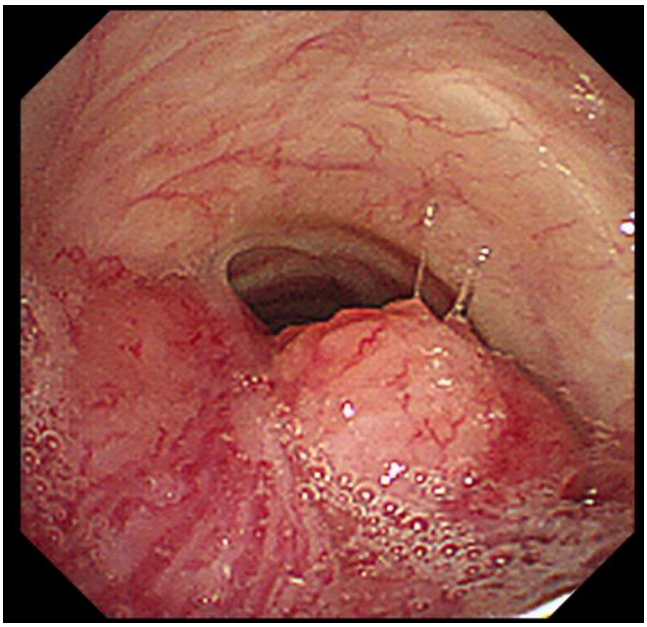

Figure 1 Preoperative examination revealed the intra-tracheal tumor by fiberoptic bronchoscopy.

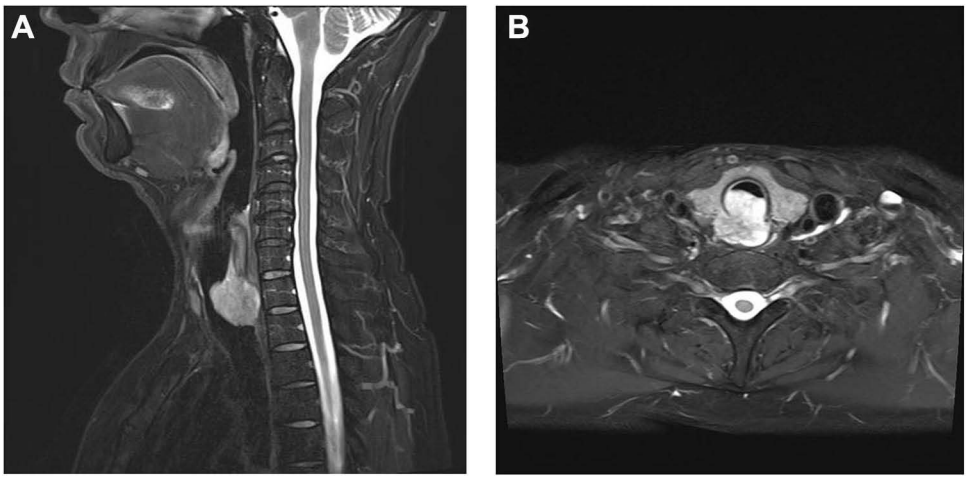

Figure 2 T2 weighted magnetic resonance imaging of upper tracheal tumor. (**A**) Sagittal view and (**B**) transverse view.

site. Considering the risk of sudden suffocation during anesthesia, we decided to do TRR under the assistance of VV ECMO. An ECMO intensivist was consulted regarding the possibility of instituting ECMO in the awake state to allow for oxygenation before securing a definitive airway under total intravenous anesthesia.

The patient entered the operating room and was placed in a supine position with the arms tucked and the neck extended. An inflatable bag was placed under the shoulders to extend the neck. The head was placed on a gel head rest and was not suspended. Respiration was supported with a high-flow oxygen mask at 5 liters/minute and deep breaths for 5 minutes. Standard noninvasive monitoring (electrocardiography, noninvasive arterial blood pressure measurement, and pulse oximetry) was initiated through anesthesia monitoring. The patient's initial vital signs were as follows: blood pressure, 120/70 mmHg; regular sinus rhythm with a heart rate of 62 beats/minute; and peripheral oxygen saturation level, 100%. Invasive arterial pressure was monitored in the left radial artery, and an invasive central venous catheter was inserted into the left subclavian vein under local anesthesia. The airway strategy was communicated to the operating team. The strategy consisted of inserting the ECMO cannulas under local anesthesia and establishing ECMO flow. Once established, anesthesia induction was initiated. The patient was sedated intravenously with propofol (Fresofol MCT 2%, Fresenius Kabi AG, Bad Homburg, Germany) via a target-controlled infusion (TCI) pump using the modified Marsh model with a target concentration of 4.0 μg/mL and midazolam 0.05 to 0.1 mg/kg. Remifentanil (Remiva, Hana Pharm Co., Ltd., Seoul, Korea) was subsequently administered via a TCI pump using the Minto model with a target concentration of 4.0 ng/mL for the induction of anesthesia. Propofol and remifentanil were infused using a TCI pump (Injectomat TIVA Agilia, Fresenius Kabi AG, Bad Homburg, Germany). The bispectral index (BIS; Medtronic, Minneapolis, MN, USA) was used to monitor the depth of anesthesia. The goal of propofol administration was to maintain the BIS level between 40 and 60. After sedation, the peripheral oxygen saturation suddenly decreased to 80%. Immediate manual positive pressure ventilation was applied, and VV-ECMO was also performed. Peripheral oxygen saturation recovered to 99%. After securing manual ventilation, 100 mg of succinylcholine chloride was administered for insertion of a supraglottic airway. An I-Gel 5.0 (Intersurgical, Wokingham, UK) was smoothly inserted. After confirming I-Gel position and airway patency, mechanical ventilation was initiated. Anesthesia was maintained using propofol at a target concentration of 1.5 to 2.5 μg/mL and remifentanil at a target concentration of 1.5–2.5 ng/mL. In addition, 50% oxygen was delivered using the I-Gel.

The proximal tracheal lesions were approached via a small transverse cervical incision. The trachea was dissected in a circular manner directly below the site of cancer invasion to the tracheal membrane. Next, an intraoperative tracheostomy was performed at the exact site, and a sterile tube was inserted into the tracheostomy to replace the I-Gel. Following tube insertion via the tracheostomy site, anesthesia was transitioned to inhalational anesthesia using sevoflurane. The ECMO was then weaned off, and the femoral cannulas were removed. The tracheal tumor specimen was removed and sent for pathological examination. Tissue pathology confirmed an adenoid cystic carcinoma with a clear margin at the edge of the tracheal resection. Enlarged lymph nodes were not observed. After resection of the tumor and first to fourth tracheal ring, orotracheal intubation with a reinforced 7.0-mm inner diameter endotracheal tube was inserted under direct vision to replace the tracheal tube at the tracheostomy site. After completion of anastomosis, a small amount of saline was dripped onto the surface of the anastomosis to test sealing integrity. To achieve low anastomotic tension, the neck was flexed, and the chin was fixed to the chest wall using silk thread to maintain head flexion. Total operation time was 695 minutes. The patient could not be extubated right after surgery. He was transferred to ICU remaining endotracheal tube. The patient received vent care for 14 days. Written informed consent was obtained from the patient for the publication of this case. Institutional approval was not required to publish the case details.

Discussion

TRR is the best therapeutic method for the treatment of primary tracheal tumors. However, after the induction of general anesthesia for TRR, tracheal tumors can lead to severe tracheal obstruction because of the mass effect of the tumor itself, operative position, loss of muscle and diaphragm tone, altered lung compliance, and chest wall structure. Hypoxia can easily occur and affect multiple organ functions. Therefore, it is important to consider possible problems and prepare airway management options based on specific individual conditions and tumor characteristics. Tracheal intubation is difficult to perform because of the risk of suffocation owing to bleeding during intubation. When effective ventilation is

not established, the condition can be life threatening. A comprehensive and well-organized plan for preoperative airway management is essential for successful therapy. In order to reduce the risk and simplify the surgical procedure, some previous studies reported the use of ECMO and performed TRR without obstruction of tracheal intubation.[6–8] We considered several anesthetic techniques that have been used in patients requiring TRR.[3,9,10] Our main purpose was to emphasize the issues that we faced at every step of treatment.

Menna et al[11] mentioned that LMA could help reduce airway manipulation during surgery and prevent the risk of complications such as intubation failure or mucosal trauma, bleeding, or perforation, avoiding mechanical stress on the newly sutured airway and decreasing postoperative complications such as restenosis, anastomotic dehiscence, or dysphonia. It had the advantage of increasing the patient's postoperative comfort by reducing the risk of airway irritation and coughing when the patient emerged from anesthesia. Krecmerova et al[12] and Schweiger et al[13] said LMA could be an effective alternative to tracheal intubation and primary airway option for tracheal surgery with high-grade tracheal stenosis if the patient had no upper airway anatomic abnormality. However, most patients in these cases had a certain secured airway in advance, such as a pre-existing tracheostomy, as an alternative when the LMA did not properly secure the airway. However, in our case, there was a risk to proceed with the operation by trusting only the LMA, and through a meeting with the intensivist, we came to the conclusion that it would be unsafe to use the LMA alone. So, we tried to find other ways.

Gao et al[14] proposed that extracorporeal circulation should be used for the surgical treatment of tracheal tumors. The study by Kim et al[15] recommends elective initiation of ECMO in cases where the observed tracheal stenosis was less than 5 mm using bronchoscopic or chest CT measurements. Although ECMO provides adequate cardiopulmonary support, it is also associated with complications such as hemorrhage, hemolysis, embolism, infection, and edema.[16] Hong et al[17] reported a patient who experienced major airway bleeding after tumor resection with ECMO support. Fortunately, in our case, the patient did not experience any complications due to ECMO, the ECMO time during surgery was also short, and there were no delayed complications such as bleeding. For surgery in patients who are expected to have many challenges in securing the airway, the most important consideration is clear preoperative plans through discussions among various medical teams.

In our case, there was sufficient prior discussion with cardiothoracic surgeons and the ECMO intensivist about securing the airway before surgery. If conventional orotracheal intubation is instituted, tumor debris may be sprayed throughout the lower respiratory tract, and the risk of suffocation due to tumor bleeding increases. Distal tracheostomy under local anesthesia may be a method to secure the airway; however, in our case, the tumor location was not accurately secured, and another method was needed. Thus, we decided to insert the I-Gel under total intravenous anesthesia, and ECMO was established in advance under the supervision of the intensivist. In addition, we decided to administer a neuromuscular blocker after mechanical ventilation even though the I-Gel was completely secured because we were concerned that the patient's oxygenation would be insufficient with ECMO assistance. In the worst case, we planned to treat the patient without performing surgery. Fortunately, in our patient, securing the airway using the I-Gel with the help of ECMO was sufficient for the surgeon to directly inspect the tumor and perform distal tracheostomy. After tracheostomy, anesthesia was changed using volatile anesthetic agents and TRR was completed safely.

Conclusion

In conclusion, our findings suggest that the induction of general anesthesia is a risk factor for patients with severe tracheal obstruction. Using I-Gel ventilation with the assistance of ECMO before the induction of general anesthesia may support the usage and effective strategy to maintain oxygenation in such patients.

Abbreviations

BIS, bispectral index; CT, computed tomography; FOB, fiberoptic bronchoscope; TCI, target-controlled infusion; TRR, tracheal resection and reconstruction; VV ECMO, venovenous extracorporeal membrane oxygenation.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically

reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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