Robotic-assisted tracheal resection for adenoid cystic carcinoma with extracorporeal membrane oxygenation support

Lorenzo Spaggiari, MD, PhD,[a,b] Domenico Galetta, MD,[a,b] Giorgio Lo Iacono, MD,[a] Andrea Cara, MD,[a] Luca Bertolaccini, MD,[a] Monica Casiraghi, MD,[a,b] and Shehab Mohamed, MD,[a] Milan, Italy

From the [a]Division of Thoracic Surgery, European Institute of Oncology, IRCCS, Milan, Italy; and [b]Department of Oncology and Hemato-Oncology, University of Milan, Milan, Italy.

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Address for reprints: Domenico Galetta, MD, Division of Thoracic Surgery, European Institute of Oncology, Via Ripamonti, 435, Milan, Italy (E-mail: mimgaletta@yahoo.com).

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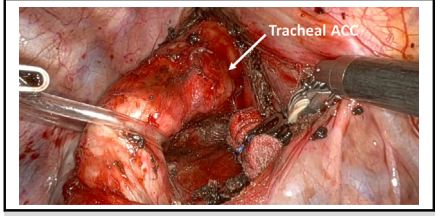


Tracheal isolation for robotic-assisted tracheal resection/reconstruction for ACC.

CENTRAL MESSAGE

Robotic-assisted resection/reconstruction of tracheal ACC under ECMO appears feasible and safe surgical procedure.

Video clip is available online.

Adenoid cystic carcinoma (ACC) is a rare malignant tumor originating from secretory glands and is the second most common primary tracheal tumor, accounting for approximately 10% to 15% of cases.[1]

Surgical resection with tumor-free margins is the current standard treatment for tracheal ACC but may be technically difficult and hazardous to the patient given the frequently extensive airway involvement. Sometimes the extension of the resection may be less than optimal due to the high risk of surgical procedure complications (eg, necrosis, dehiscence, granuloma formation, and stenosis). In these cases, the presence of microscopic tumor in the specimen margins that is effectively treated by adjuvant radiotherapy is generally accepted.[2]

Tracheal resection/reconstruction is typically performed via thoracotomy, but nowadays, less invasive techniques have been adopted.[3,4] In particular, a robotic approach for tracheal surgery has gained popularity in highly selected cases and has been found to be safe, feasible, and effective.[4,5]

Tracheal resections/reconstructions can be very challenging even with the use of cross-field ventilation techniques due to impaired surgical access and visibility. Also, the lack of hemodynamic stability can become a problem in cases of extended retraction when mediastinal maneuvers are needed. In this situation, the use of extracorporeal membrane oxygenation (ECMO) helps to perform a complex surgical procedure in a technically easier way.

We describe the case of robotic-assisted tracheal resection for ACC with ECMO support. We believe this is the first report with this approach.

CASE REPORT

An institutional review board exemption was obtained for this retrospective review and the patient provided informed consent for publication of study data.

A 33-year-old woman was diagnosed with an endotracheal lesion on a chest contrast-enhanced computed-tomography (CT) scan performed for persistent dyspnea and confirmed by positron-emission tomography scan. On CT scan, the lesion was 18 mm in length and located at 85 mm from the glottic plane with extension anteriorly into the mediastinum (Figure 1, *A*). Initially, the endotracheal neoplasm was removed by rigid bronchoscopy confirming a primary ACC. The patient was then referred to our department for radical resection of the remaining lesion (Figure 1, *B*).

The patient submitted to venovenous ECMO. Percutaneous cannulas were inserted into the right femoral vein

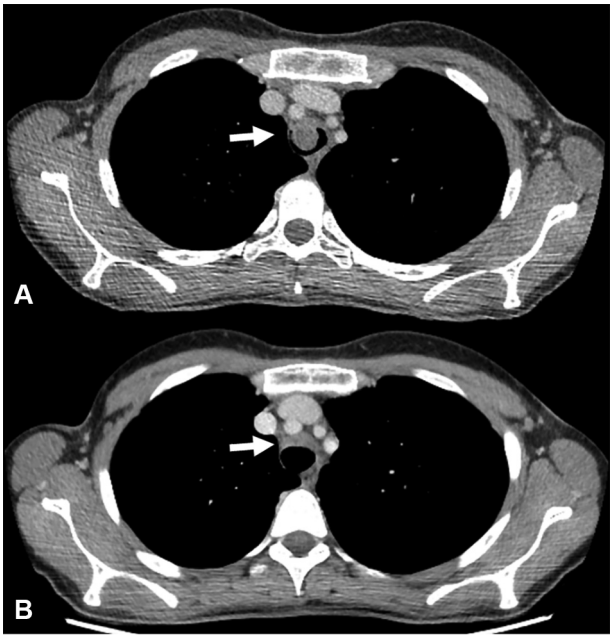
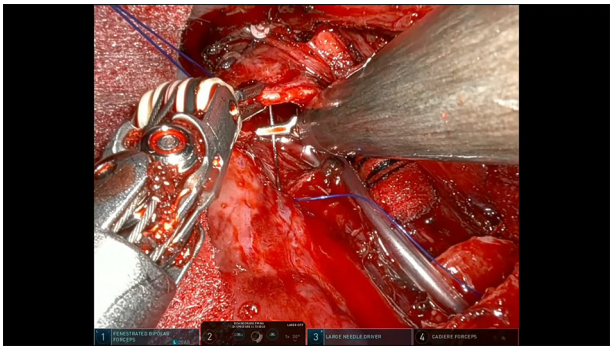


FIGURE 1. A, Contrast-enhanced chest computed tomography (*CT*) scans showing the endotracheal tumor (*arrow*) before bronchoscopic resection. B, Contrast-enhanced chest CT scans performed before tracheal surgery showing the remaining tumor located in the anterior aspect of the trachea (*arrow*).

for drainage and into the internal right jugular vein for return (Video 1). A single-lumen endotracheal tube combined with a bronchial blocker was used. Surgical procedure was a right chest, 4-arm approach (3 ports and 1 3-cm utility incision) by Xi DaVinci (Intuitive Surgical Inc) with the patient in lateral decubitus. The pulmonary ligament was divided and the mediastinal pleura was opened to obtain good exposure of the tracheal wall. After paratracheal lymph node dissection, the trachea was isolated from mediastinal structures, the lesion was identified, and ECMO was started before tracheal resection. The involved tracheal segment was removed (Figure 2, *A*) (resection was performed 1 cm from the tumor; the length of the tracheal segment resected was 28 mm) with the help of bronchoscopy performed before resection, and tracheal anastomosis was performed by a single 3-0 Polypropylene stitch (Figure 2, *B*), and reinforced by a single Stratafix Symmetric PDS Plus 3-0 suture (Ethicon). Two chin stitches were placed at the end of the procedure. Protamine was administered, lung ventilation was restored, and cannulas were removed before the patient awakened. Operative time was 420 minutes. The patient was discharged the 10th postoperative day without complications. Histology confirmed a 15-mm ACC with microscopic tumor remnants at the upper margin that were treated with adjuvant proton therapy. A bronchoscopy was performed 45 days after discharge showing a regular tracheal anastomosis (Figure 2, *C*).



VIDEO 1. Resection and reconstruction of tracheal ACC with ECMO support. Video available at: https://www.jtcvs.org/article/S2666-2507(23)00264-X/fulltext.

DISCUSSION

Primary tracheal tumors are rare and usually treated in referral centers. Although tracheal surgery has been studied for long time, several questions remain open regarding the surgical approach, the intraoperative ventilation, and the extent of tracheal resection in case of ACC. Localized tracheal ACC should be treated by surgical resection after a preoperative correct identification of macroscopic limits of the tumor by bronchoscopy and CT scan. This is crucial because it improves safety in surgical resection, notably in less-invasive approaches.

We did not perform intraoperative frozen section because submucosal spread and perineural invasion commonly extend beyond the visible gross tumor for many centimeters, resulting in a high rate of positive resection margins despite aggressive surgery. Attempting to have negative margins can be dangerous for anastomotic tension. In the case of positive margins, we follow-up with radiation therapy, as in the present case.

In regard to surgical approach, we have demonstrated that a robotic approach is feasible and effective. This is the first case describing a robotic tracheal resection for primary tumor using ECMO to avoid intrafield intubation. During the operation, by using a robotic platform, the tracheal resection and anastomosis can be completed easily in a manner similar to the traditional open approach with skills and experience obtained from our previous large robotic experience. Although ECMO-assisted surgery may be associated with complications (eg, renal failure, bacterial pneumonia, bleeding, and hemolysis), it ensures adequate respiratory support and a clean operating field, which allows good

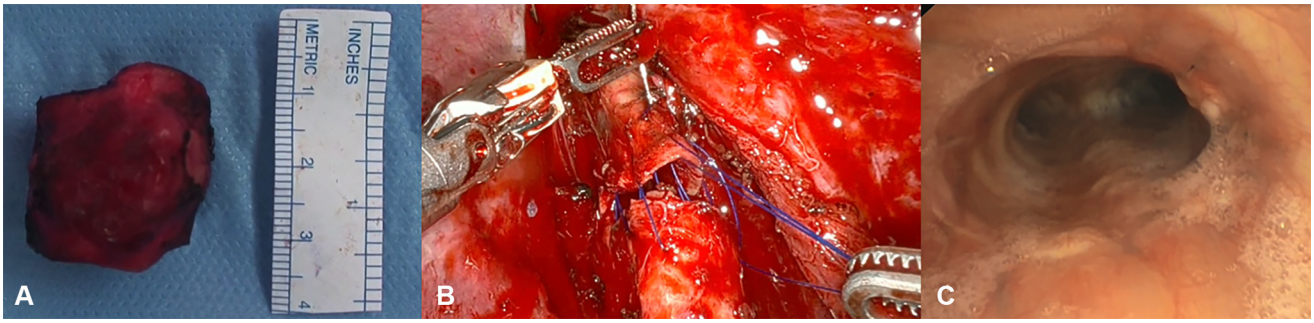


FIGURE 2. A, Removed tracheal specimen. B, Intraoperative view of the tracheal robotic-assisted anastomosis under extracorporeal membrane oxygenation. C, Postoperative endotracheal view of the tracheal anastomosis.

surgical exposure. Based on 1 case report, it appears safe and feasible.

CONCLUSIONS

Our experience suggests that robotic technology associated with use of ECMO allows surgeons to safely maintain oxygenation during the procedure and perform a minimally invasive, complete, and safe tracheal resection/reconstruction ensuring all benefits of robotic-assisted surgery, such as less postoperative pain and fewer postoperative complications.

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