CASE REPORT

Robotic circumferential tracheal resection and reconstruction via a completely portal approach

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Abstract

Robotic surgery for circumferential tracheal resection and reconstruction has not previously been reported. Herein we describe the case of a 48-year-old man with primary extra-luminal tracheal leiomyosarcoma. A preoperative bronchoscopy exam and chest computed tomography revealed a tracheal neoplasm, which derived from lower membranous trachea and nearly obstructed the orifice of the left main bronchus. The patient underwent circumferential tracheal resection and reconstruction via a completely portal robotic approach with four arms. Benefiting from flexible instruments and a three-dimensional magnified view, telescope anastomosis was performed and modulated. No postoperative complications presented. Follow-up showed the reconstructed trachea without stenosis or recurrence.

Introduction

Surgical management of primary tracheal tumors remains a challenge for thoracic surgeons. The majority of these procedures are performed by thoracotomy or median sternotomy. Recently, video-assisted thoracoscopic surgery has been gradually applied in high-volume centers.¹,² However, whether a robotic approach is competent for tracheal surgery has not been well defined. Herein we describe a patient with primary leiomyosarcoma in the lower trachea who underwent circumferential tracheal resection and telescope anastomosis via a completely portal robotic approach with four arms (Video S1).

Case Report

A 48-year-old man presenting with a progressive cough was admitted to our department. A flexible bronchoscopy exam showed the terminal trachea and carina before and after surgery.

Figure 1. Bronchoscope exam shows the terminal trachea and carina (a) before and (b) after surgery.
Figure 2 (a) Tumor derived from the lower membranous trachea. *: Transected arch of the azygos vein. Anastomosis of (b) cartilaginous trachea with a transthoracic endotracheal tube and (c) membranous trachea with an oral approach endotracheal tube. (d) Knots on the midpoint of the membranous trachea.
revealed a tracheal neoplasm in the lower membranous trachea, which was approximately 1 cm in length and nearly obstructed the orifice of the left main bronchus (Fig 1a). The pathologic biopsy revealed that the tumor originated from smooth muscle. Chest computed tomography revealed a 4 × 3 cm extra-luminal mass above the carina.

We performed a completely portal robotic approach using the da Vinci Surgical System (Intuitive Surgical, Sunnyvale, CA, USA). The patient was induced by general anesthesia with single-lumen endotracheal intubation. An artificial pneumothorax was applied to allow sufficient access for surgery before transecting the trachea. The surgical steps taken were as follows (Fig 2). The robotic surgical system docked to the patient with four arms. Appropriate and circumferential tracheal rings with the tumor were resected, and the assistant inserted an endobronchial tube into the left main bronchus to keep single lung ventilation by creating an additional port in the third intercostal space at the midaxillary line. With single lung ventilation by transthoracic tube, the anastomosis began from the mid-point of cartilaginous trachea, using one 2-0 polypropylene suture in a continuous fashion. Because of the dilated terminal trachea, the mismatched calibers were anastomosed and modulated by pulling the proximal smaller lumen into the distal larger lumen like a telescope. After changing back to an oral approach endotracheal tube, the membranous trachea was anastomosed.

Pericardial fat pad was harvested to cover the anastomosis. The final pathologic examination was leiomyosarcoma with sufficient and negative resection margins. The patient recovered uneventfully. The postoperative bronchoscopy exam taken the first month after discharge showed the reconstructed trachea without stenosis or recurrence (Fig 1b).

Discussion

Surgical resection is one of the essential treatments for primary tracheal tumor. This procedure using a video-assisted thoracoscopic approach has been reported by several studies. Furthermore, our team was the first to report the use of robotic-assisted non-circumferential tracheal resection and reconstruction for leiomyoma. Compared to video-assisted thoracoscopic surgery, tracheal anastomosis using a robotic surgical system may involve less suturing adjustment and shorten surgeons’ learning curve.

Because the caliber dilates at the terminal trachea to transform into the carina, the telescope should not be inserted too far that it increases the tension of anastomosis, or too short to result in marked caliber mismatch. Therefore, robotic surgery has several advantages to meet these requests. First, with instruments that bend and rotate far greater than the human hand, the operator is able to finish each stitch precisely without repeated suturing for correction. Second, the three-dimensional magnified view displays more structures in greater detail, including the tiny branches of blood supply to the tracheal wall. Third, after retraction by the robotic arm, the surgical field is more exposed and is stable. Finally, tangled sutures seldom appear during robotic suturing, as the whole process is completely performed in the thoracic cavity instead of moving the needle through the incision back and forth.

In conclusion, we consider that circumferential tracheal resection and reconstruction via a completely portal robotic approach with four arms is a feasible and safe option for selected patients.

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Disclosure

No authors report any conflict of interest.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher’s website:

**Video S1.** Video-tracheal resection