Intraoperative minimally invasive left bronchial reconstruction using a pericardial flap during robot-assisted esophagectomy

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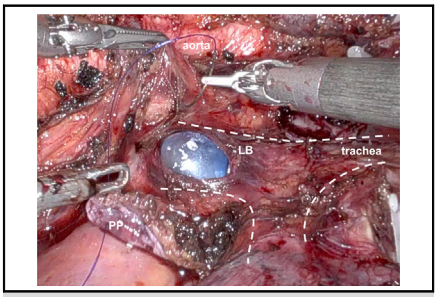


The cuff perforates the left main bronchus. A pericardial patch is prepared.

CENTRAL MESSAGE

The report demonstrates a minimally invasive repair of a left mainstem bronchus injury during robot-assisted minimally invasive esophagectomy using a pericardial flap and an uneventful course.

Video clip is available online.

Robot-assisted minimally invasive esophagectomy (RAMIE) is currently evolving as the new standard treatment for abdominothoracic resection of esophageal cancer at many centers.[1-3] Benefits of the total minimally invasive robotic approach seem to be decreased postoperative morbidity, shorter hospital stay, and earlier recovery.[3,4] Here, we report the successful minimally invasive management of an intraoperative injury of the left main bronchus (LMB) caused by the double-lumen endotracheal tube during a RAMIE procedure.

METHODS

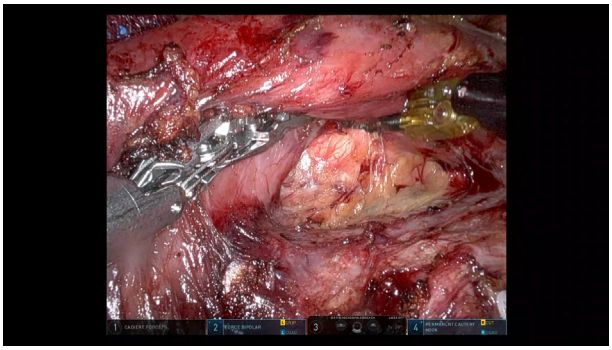
The complete RAMIE procedure with an intrathoracic end-to-side stapled esophagogastrostomy (28-mm diameter) was performed with the DaVinci Xi system (Intuitive Surgical) using 4 trocars for the thoracic part. Written informed consent for the case report was obtained from the patient after full recovery. Ethical approval was obtained from our institutional review board on April 18, 2023 (approval No: F-2023-028).

RESULTS

An 81-year-old male patient (height, 176 cm and weight, 72 kg) underwent RAMIE for stenosing adenocarcinoma of the esophagogastric junction (AEG I) 5 weeks after neoadjuvant chemoradiation (carboplatin/paclitaxel [ie, CROSS protocol]). During chemoradiation, enteral feeding was supplemented using a percutaneous gastrostomy tube.

A 41Fr left-sided double-lumen endotracheal tube (DLT) was placed after induction of general anesthesia according to previously described principles.[5] Pressures of the proximal and distal DLT cuffs were adjusted within commonly used limits.

After uneventful completion of the abdominal part, the patient was positioned in a left-lateral semiprone position. The right lung was deflated and surgery was continued in single (left) lung ventilation. The thoracic part started with careful mobilization of the upper esophagus from the



VIDEO 1. The video sequences demonstrate the intrathoracic repair of a left mainstem bronchus leak during robot-assisted minimally invasive esophagectomy using a pericardial flap. Soon after the start of careful mobilization of the esophagus from the trachea, the laceration of the membranous portion of the left mainstem bronchus at the site of the double lumen tube (DLT) ballon was noted (*arrows*). During further dissection, the laceration gradually increased under the pressure of the ballon. Before suture repair, the DLT was advanced some millimeters to sustain respiration during suturing. The video ends with the esophagogastrostomy and the omental patch to cover the bronchial repair. Video available at: https://www.jtcvs.org/article/S2666-2507(23)00199-2/fulltext.

trachea and carina. At this early point, it became evident that the distal cuff of the double-lumen endotracheal tube had perforated the membranous portion of the LMB (Video 1). The size of the laceration increased the more the esophageal attachments to the LMB were released. Because ventilation remained sufficient with only minimal leakage, the surgical and anesthesiology team agreed to continue and attempted minimally invasive robotic reconstruction. Thus, the oncological resection of the esophagus was continued and the esophagus was divided with a linear stapler above the tumor. Next, a pedicled pericardial flap was created using the permanent cautery hook and sutures (polydioxanone 4-0) were prepared for the bronchial sutures and flap coverage. The endotracheal tube was deflated, carefully advanced some millimeters by the anesthesiological team, and reinflated to enable immediate robot-assisted suturing and patch closure of the bronchial defect (Figure 1 and Video 1). The patch was further reinforced using a fibrin sealant. The surgical reconstruction was then accomplished using an intrathoracic esophagogastrostomy (Ivor-Lewis) as reported recently.[1] Finally, the LMB was covered using the omentum of the gastric conduit as an additional patch.

In contrast to routine postoperative extubation, the left-sided DLT was replaced with a right-sided DLT immediately after surgery for protective single right lung ventilation. Continuous positive end-expiratory pressure of 5 mbar was applied to the left lung to prevent atelectasis. On the first postoperative day, extubation was uneventful. The further postoperative course showed no complications, especially no signs of emphysema or significant air leakage from the intraoperatively placed chest tube. In accordance, a planned computed tomography chest scan on postoperative day 7 confirmed the absence of pneumomediastinum or anastomotic leakage (Figure 2, *A*). There was no surgical site infection (Figure 2, *B* and *C*). The histopathological stage was ypT3 ypN0 (0 out of 26), L0, V0 R0. The patient

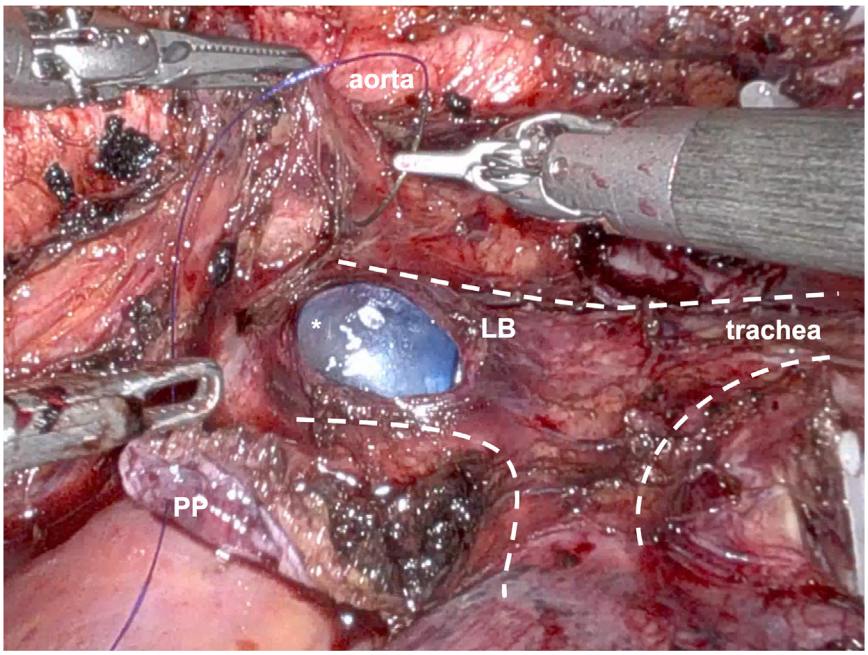


FIGURE 1. Intraoperative view after intrathoracic division of the esophagus during robot-assisted minimally invasive esophagectomy (*RAMIE*). The double-lumen cuff perforates the left main bronchus (*LB*). A pericardial patch (*PP*) is prepared for augmentation of the bronchial reconstruction with robot-assisted suturing.

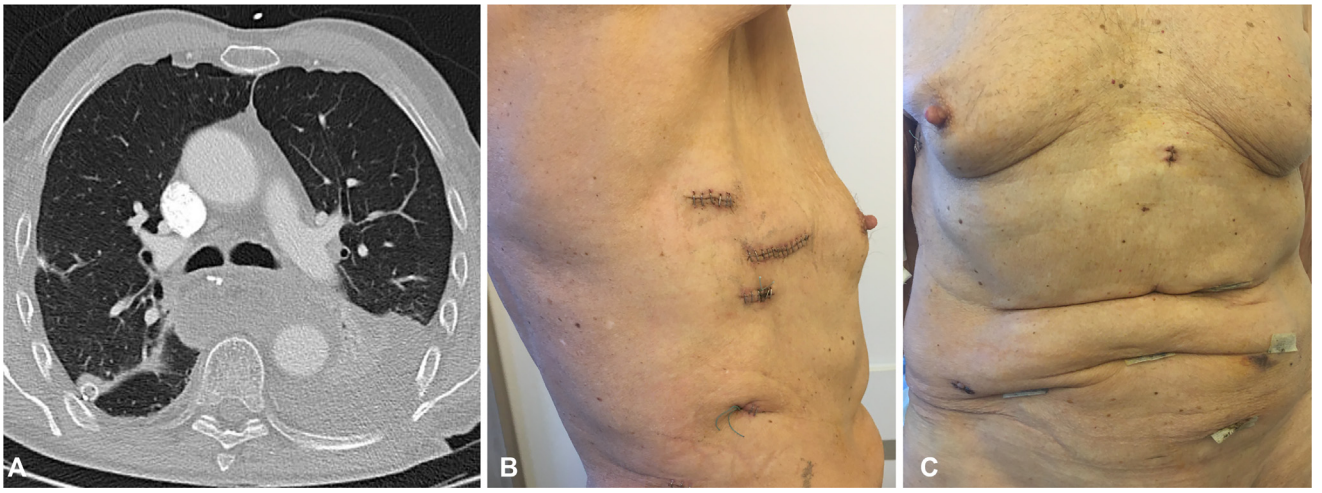


FIGURE 2. A, Elective postoperative computed tomography scan of the chest on postoperative day 7 without evidence of a bronchial or anastomotic leak. B and C, The patient was mobilized postoperatively and recovered well without further complication such as surgical site infection.

tolerated early mobilization and enteral nutrition. He was discharged after 14 days and recovered accordingly at home.

DISCUSSION

The present report demonstrates successful, fully robotic management of intraoperative bronchial rupture, which is a rare but potentially life-threatening complication.[6] Intraoperative laceration of the trachea or main bronchus can be caused extraluminally by radical resection of locally advanced cancers, radiation-induced adhesions, iatrogenic cautery damage, or endoluminally by the DLT or its inflated cuff. No injury was noticed during bronchoscopy after the initial intubation. However, it cannot definitely be excluded that a minor latent endoluminal laceration by the DLT tip gave rise to a subsequent perforation at the cuff site. Neoadjuvant chemoradiation may have also contributed to a more vulnerable tissue texture. A specific risk for bronchial laceration during RAMIE may also be the repositioning of the patient for the thoracic part with the DLT in place. Because ventilation is completely dependent on the left lung during this phase, LMB laceration is highly critical. Recommended intraoperative strategies are the immediate repair using sutures (if feasible) complemented with a pericardial or muscle flap coverage (eg, dorsal latissimus, intercostal, or major pectoral muscle[6]). However, repositioning of the patient with a large left bronchial defect during RAMIE to enable immediate right thoracotomy is critical because ventilation can rapidly deteriorate during this maneuver. Therefore, if ventilation of the left lung can be sustained and the minimally invasive exposure of the bronchial defect is stable, the presented robot approach can be a realistic and feasible strategy toward a further uneventful course. Transient protective right-sided single-lung ventilation is an additional option to optimize the outcome.

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