**Off-label use of Cor-Knot automated fastener for a manual bronchial closure through a video-assisted thoracoscopic surgery approach.**

**Abstract**

Manual closure of the bronchial stump can be challenging during minimally­-invasive thoracic surgery. Automated fastener has been used for over a decade in minimally invasive heart valve surgery in order to eliminate the need for manual knot tying during the suturing of prosthetic valves. Herein, we describe the use of the Cor-Knot automated fastener in a case of video-assisted left upper lobectomy with open section of the bronchus and manual closure with interrupted resorbable sutures for a malignant bronchial tumor located on the proximal part of the left upper lobe bronchus. This case represents, to our knowledge, the first case of using the Cor-Knot device for minimally invasive pulmonary surgery.

Keywords: bronchial disease – lung cancer – lobectomy – minimally invasive surgery – thoracoscopy/VATS

**Introduction**

Resections of centrally located lung tumors represent technically challenging procedures, especially via minimally invasive surgery. When the distance between the origin of the lobar bronchus and the tumor is short, it may be preferable to perform an open section of the bronchus with manual closure rather than mechanical suturing with staplers to ensure complete removal of the tumor with microscopically clear margins. If single interrupted stiches are used, manual knot tying can be tedious during minimally invasive procedures. We describe below the use of an automated fastener device that greatly facilitates the execution of knot tying during video-assisted thoracic surgery (VATS) lobectomy with manual closure of the bronchial stump.

**Case**

A 66-year-old man underwent pulmonology work-up for a cough evolving for several months. His past medical history was notable for passive smoking and alcohol use disorder in remission for five years but complicated by cirrhosis and esophageal varices (Child-Pugh score of 5). Thoracic computed tomography (CT) scan (Figure 1) demonstrated the presence of a sub-obstructive mass of 12 X 8 mm locating in the origin of the left upper lobe (LUL) bronchus and associated with impaired LUL ventilation. Bronchoscopy (Figure 2) confirmed the sub-obstruction of the LUL bronchus by a budding lesion extending 5 mm from the secondary carina. Microscopic examination of the bronchoscopic biopsy revealed the presence of a low grade mucoepidermoid carcinoma of the lung. The extent of the disease was assessed by PET-CT and there was no other lesion showing hypermetabolic activity apart from the main bronchial tumor. Cerebral CT-scan did not detect brain metastases. Patient was scheduled for a VATS upper left lobectomy with mediastinal lymphadenectomy.

**Technique**

Under general anesthesia with single lung ventilation, we performed a 4 cm utility incision in the left fourth intercostal space, centered on the mid-axillary line and we inserted two 10 mm ports, one posteriorly in the eighth intercostal space and the other anteriorly in the seventh intercostal space. A soft tissue retractor (Alexis®) was used in the utility incision without rib retraction. Left superior pulmonary vein, LUL arteries and the fissure were divided in a conventional way using surgical powered stapler. The distance between the secondary carina and the tumor was deemed too short to ensure an oncologically satisfactory resection using a surgical stapler and we decided to perform an open section of the origin of the LUL bronchus flush with the secondary carina (figure 3). The short bronchial stump was closed manually by 12 interrupted simple stitches using 3-0 absorbable braided polyglactin suture and the knots were tied using the Cor-Knot automated fasteners (Cor-Knot Mini ® device) (Figure 4a and 4b). The rotational knob’s indicator fin of the device was oriented outward from the bronchus so that the fasteners remained angled towards the longitudinal axis of the bronchus and away from the pulmonary artery. An extended mediastinal lymph node dissection (stations 5, 6, 7, 9, 10 and 11) was performed during the surgery. The water submersion test was satisfactory, and one chest tube was place posteriorly and superiorly. The postoperative course was uneventful. The chest drain was removed by Day 3 and patient was discharged from the hospital by Day 4. Pathology confirmed the presence of a low grade mucoepidermoid carcinoma measuring 15 mm in its greatest diameter with clear surgical margins. All the lymph nodes were free of tumor spread. A satisfactory closure of the bronchial stump with no residual pneumothorax or pleural effusion was observed on the CT scans obtained 3 and 9 months after surgery (Figure 5).

**Discussion**

 The Cor-Knot (LSI Solutions, NY) is by far the most common employed automated fastener in heart valve surgery 1. This device acts by securing a suture with a titanium fastener whilst simultaneously cutting excess length of the suture. The device was developed to facilitate minimally invasive heart valve surgery and is intended to be used with the company’s own 2–0 polyester, 2–0 polypropylene and 3–0 polypropylene sutures. To our knowledge, this device has never been used for minimally invasive pulmonary surgery.

In case of manual bronchial stump closure, the quality of the sutures but also the quality of the knot tying, particularly for interrupted sutures, are crucial to ensure a satisfactory closure of the stump and to reduce the risk of bronchopleural fistula. During VATS, it is possible but very challenging to tie the knots intracorporeally using needle drivers designed for minimally invasive surgery. For this reason, the technique adopted in the majority of the VATS procedures is to tie the knot extracorporeally and then to push it intracorporeally to the desired site using a knot pusher 2. The use of this knot pusher is nevertheless more time consuming and at higher risk to produce loose knots, compared to conventional knot tying by hands. In this context, Cor-knot appears to be superior to the knot-pusher in terms of strength, consistency and time saving 1 .

The postulated advantages of using the Cor-knot fastener in the setting of the minimally invasive lung surgery are to ensure the quality of the tying of the knots and to reduce the operation time. The disadvantages of the use of this device are the financial burden of its use and the presence of titanium fasteners that will persist on the outer aspect of the bronchial stump. But in our case, the presence of titanium outside the bronchial stump was not associated with any complications at one-year follow-up.

References

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

ETHICS STATEMENT

Approval for publication was obtained from the patient and from our Institutional Review Board.

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Figures Legends

Figure 1

Thoracic computed tomography scan revealing the tumor (white arrow) locating in the origin of the left upper lobe bronchus. LMB, left main bronchus.

Figure 2

Bronchoscopy showing the tumor (asterisk) in the left upper lobe bronchus, close to the secondary carina. LUB, left upper lobe bronchus; LLB, left lower lobe bronchus

Figure 3

Thoracoscopic view. Opening of the left upper lobe bronchus close to the secondary carina and view of the budding tumor in its origin (asterisk). PA, pulmonary artery; LUB, left upper lobe bronchus

Figure 4

Cor Knot MINI device. (a) Picture of the device and the titanium fastener (insert). (b) Intraoperative view of the sutures secured by the titanium fasteners (white arrows). PA, pulmonary artery

Figure 5

Three-month follow-up computed tomography scan showing hyperdense titanium fasteners (withe arrow) in contact with the bronchial stum without any signs of complications.

Video Legend

Use of the Cor-Knot automated fastener in a case of video-assisted left upper lobectomy with open section of the bronchus and manual closure with interrupted resorbable sutures for a malignant bronchial tumor located on the proximal part of the left upper lobe bronchus.