Robotic harvest of intercostal muscle flap

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Video clip is available online.

The intercostal muscle flap (ICMF) harvest has been used as a buttressing technique for the bronchial stump after pneumonectomy or lobectomy, and to reinforce suture lines after bronchoplastic resections, esophageal repairs, and esophagogastric anastomoses.^{1,2}

Harvesting of the ICMF has been described using the videoassisted thoracoscopic (VATS) technique,^{3,4} yet this technique still involved a minithoracotomy referred to as utility incision. As of this date, no reports have been published describing completely thoracoscopic harvest of the ICMF. Robotic harvest allows for better visualization of the interior chest and, thus, an easier method for mobilizing the flap, without a need for a thoracotomy. We hereby present the first reported cases of robotic harvest of the ICMF after a lobectomy.

CASE 1

A 68-year-old woman with a medical history of chronic obstructive pulmonary disease (COPD) presented with a squamous cell carcinoma of the superior segmental bronchus invading the distal left main bronchus. Pulmonary function tests revealed a forced expiratory volume in 1 second of 1.15 L. The mediastinal evaluation by endobronchial ultrasonography was negative for pathologic lymphadenopathy, as was the computed tomographic–positron emission tomographic scan. The patient was believed not to be a candidate for a pneumonectomy secondary to limited pulmonary reserve. Therefore, the patient was advised to undergo a sleeve left lower lobectomy with ICMF.

Endoscopic ports were introduced in the left chest wall (Figure 1), and dissection was performed through four 1.0- to 1.5-cm incisions. A camera port was introduced in the seventh intercostal space (ICS). Robotic arms 2 and 3 were placed in the eighth ICS posteriorly and the sixth ICS anteriorly. An access port was introduced in the ninth ICS. CO₂ insufflation was initiated at a pressure of 8 mm Hg to flatten the diaphragm. After completion of the

FIGURE 1. Diagram demonstrating standardized placement of robotic arms 2 and 3, camera (C) and access (A) ports, using the 3-arm approach and following the “rule of 10s.” This port placement allows for safe performance of lobectomy, intercostal muscle harvest, and paratracheal dissection for complete lymphadenectomy. Placement of the initial camera port 10 cm below the tip of the scapula correlates with the inframammary fold in the xiphisternal junction. This positions the camera below the level of the inferior pulmonary vein, which represents the inferior extent of the surgical dissection. Placing the anterior and posterior robotic dissecting ports on a straight line positioned at this level allows for the inferior pulmonary ligament to be divided and the remaining aspect of the dissection to be conducted in a cephalad direction toward the hilum.

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FIGURE 2. Intraoperative image demonstrating intercostal muscle (ICM) flap after mobilization, being secured in place with a silk stitch over the bronchoplasty stump.

lobectomy with bronchoplastic reconstruction, the intercostal space adjacent to the hilum was identified and then traced anteriorly. By using a 30° up scope, the intercostal neurovascular pedicle was dissected free anteriorly and divided between hemoclips (Video 1). Next, the ICMF was dissected free from the adjacent ribs, using electrocautery, taking care to preserve the vascular supply. After adequate mobilization of the ICMF, it was secured to the hilum using a silk suture (Figure 2). The patient was discharged on postoperative day (POD) 5.

CASE 2

A 67-year-old man with a history of COPD presented with a prior diagnosis of a left lower lobe carcinoma. The patient underwent definitive chemotherapy and radiation therapy (6500 cGy). After completion of therapy, the patient was recommended to undergo left lower lobectomy due to persistent radiographic and pathologic evidence of residual non-small cell carcinoma with neuroendocrine features.

After induction of general anesthesia, bronchoscopy was performed. There was no evidence of endobronchial tumor. The chest was entered in the usual manner, as previously described. Lymphadenectomy and lobectomy were performed. Given the history of radiotherapy (6500 cGy), it was believed that the patient was at a higher risk of stump breakdown; thus, it was decided to protect the stump with an ICMF that was harvested in a similar manner as in case 1. The patient was discharged on POD 5.

COMMENT

To our knowledge, our report is the first of its kind describing the use of a surgical robot in the harvest of an ICMF after lobectomy. The traditional approach to lobectomy is associated with significant morbidity. With advancements in operative techniques and a trend toward minimally invasive procedures, the use of VATS has grown during the past 2 decades. Completely port-based, robotic-assisted thoracoscopic lobectomy has been demonstrated to be a safe procedure comparable to the short-term outcomes of VATS lobectomies.⁵ Use of robotic technology as an enhanced surgical instrument may allow for improved VATS lymph node evaluation and extension of the VATS approach to more locally advanced resections and complex cases. This is demonstrated in the second case in which, despite high doses of radiation therapy, precise surgical dissection with an R0 resection was achieved. In our opinion, the surgical robot allows for easier harvest of the ICMF without the need for thoracotomy, rib resection, or associated complications. The ability to visualize the intercostal space adjacent to the bronchus, and trace this space anteriorly, allowed us to perform harvesting of the ICMF, based posteriorly, so that the bronchial stump could be covered by vascularized tissue, mitigating the risk of bronchopleural fistula without requirement for thoracotomy and rib resection. This technique potentially provides an improved risk to benefit ratio in patients with risk factors for stump breakdown and postoperative bronchopleural fistula.

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