A NEW MINIMALLY INVASIVE TECHNIQUE OF COMBINED CHEST WALL RESECTION FOR LUNG CANCER: ADVANCED DATA OF IMPLICATION OF ADVANCED BIPOLAR DEVICE IN VIDEO-ASSISTED CHEST WALL RESECTION FOR LUNG CANCER

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Abstract: We describe a novel method for resecting lung cancer that has invaded the chest wall using an advanced bipolar device during video-assisted thoracoscopic surgery. The method is convenient for both tumor and chest wall resection because it is easy to handle and less invasive than the currently used technique.

Key words: chest wall resection, advanced bipolar device, thoracoscopy, lung cancer surgery, chest wall invasion

Introduction

When resecting lung cancer with chest wall invasion, it is crucial to take special care with the surgical incisions of the chest wall to accomplish lobectomy with hilar and mediastinal lymph node dissection. This resection (especially of the chest wall under thoracoscopy) has not been performed routinely, because surgery for lung cancer with chest wall invasion is often carried out under open thoracotomy. We describe a novel technique using an advanced bipolar device during video-assisted thoracoscopic surgery (VATS) for resection of lung cancer with chest wall invasion.

Technique

The operation starts with the usual three incisions for video-assisted thoracic lobectomy: a 3-cm thoracic incision in the seventh or eighth intercostal space (ICS) (on the midaxillary line); a 5-cm thoracic incision in the fourth or fifth ICS (on the posterior axillary line); and a 2-cm thoracic incision in the fourth or fifth ICS (on the front of the anterior axillary line) (Fig. 1A-C). The approach to the surgery depends on whether only the chest wall is resected or there is en bloc resection of the affected lobe plus the chest wall. To illustrate these approaches, we describe three representative cases.

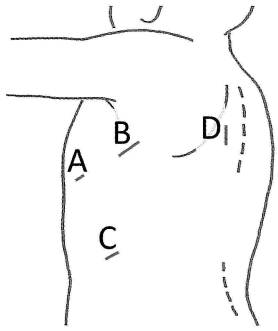

Fig. 1. Placement of the thoracic incisions for the usual three ports for video-assisted thoracic lobectomy (A–C) and an additional port (D) placed over the dorsal edge (in this case, the vertebral side) of the targeted chest wall.

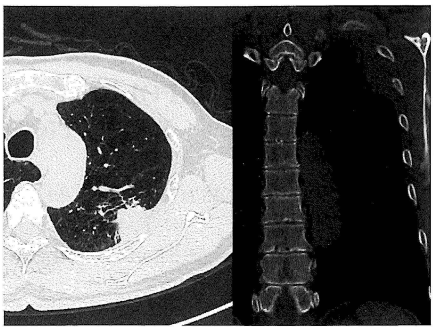

Fig. 2. Case 2. Computed tomography shows a tumor in the left upper lung lobe that has invaded the chest wall.

Table 1. Tumor, resection detail and post-operative events.

	Location	Ribs	Tumor size (mm)	Surgical time (min)	Blood loss (mL)
Case 1[(1)]	left, upper	4,5th	45x40x40	213	54
Case 2[(1)]	left, upper	4,5th	25x22x15	210	10
Case 3	left, upper	3,4th	34x22x26	208	50
				mean 210	mean 38

	Histology	Stage	Postoperative therapy	Clinical course
Case 1[(1)]	Sq	pT3aN0M0	adjuvant CX*	POM 44, alive without cancer
Case 2[(1)]	Sq	pT3cN0M0	adjuvant CX*	POM 43, alive without cancer
Case 3	Ad	pT3aN0M0	undergoing CX	POM 8, alive with cancer**

*CDDP + VNR x 4 course **adrenal metastasis

Chest wall resection alone with the advanced bipolar device using VATS

In cases 1 and 3, with no pleural adhesion diagnosed prior to surgery, the lobe containing lung cancer was initially released from the chest wall at the extrapleural space (Table 1). When the surgically removed, tumor-free margin on the wall side was judged inadequate, some of the chest wall was resected as well. The intercostal muscles and vessels were divided along the ICS using the LigaSure™ vessel sealing system (Medtronic, Minneapolis, MN, USA), and the ribs were removed using a rib cutter that was inserted through one of the thoracic incisions. The LigaSure™ technique for intercostal muscle dissection included running the blade along the upper edge of the rib. If it was difficult to handle the rib cutter through the existing incisions, we added a thoracic incision at the dissection point. Lobectomy was then performed along with hilar and mediastinal lymph node dissection using VATS.

En bloc resection (lobe plus chest wall) with the advanced bipolar device

The tumor in case 2 (Table 1, Fig. 2) adhered to the chest wall, so the chest wall and lobe were resected en bloc. The distal edge (especially when outside the thoracic incisions—in this case, on the vertebral side) was blocked by the fixed lobe, making it difficult to dissect the distal side of the chest wall through the thoracic incisions. Therefore, an additional, 4-cm thoracic

incision was made on the distal side (on the paravertebral line) (Fig. 1D) to divide the distal edge (vertebral side) of the chest wall. At the start of the resection, the intercostal muscles and vessels were divided using LigaSure™, and the ribs were cut using the rib cutter as described for cases 1 and 3. The chest wall side of the target lesion was then released from the thorax. Lobectomy was performed along with hilar and mediastinal lymph node dissection through the thoracic incisions.

Discussion

We successfully applied a minimally invasive approach for resecting lung cancer with chest wall invasion using an advanced bipolar device (LigaSure™ vessel-sealing system) under VATS with partitioned incisions. This procedure was based on our previous experience of discovering the usefulness of the advanced bipolar device to divide intercostal muscles and vessels. The device was easy to handle through the incisions made for VATS and easily achieved hemostasis [1].

We focused here on using the advanced bipolar device for chest wall resection. The main concern during that resection was to maintain the visual field and the myotome at the correct layer. In recent years, less-invasive surgical techniques (e.g., thoracoscopic and robotic surgery) have been used to overcome this problem. Although electrocautery is frequently used for chest wall resection, the procedure sometimes provides insufficient hemostasis when it is necessary to seal the intercostal artery. Also, heat is dissipated to the surrounding tissue. In contrast, the advanced bipolar device we used provided reliable hemostasis without damaging the surrounding tissues. The average intraoperative blood loss volume for our three patients was only 38 ml (Table 1).

With respect to operability, the system applied in our cases had a strong-boned jaw that was suitable for dividing the muscle without disturbing the muscle layer. Because the blade was advanced along the upper edge of the rib, the tip could grasp the intercostal muscle both stably and reliably. As only the gripped target was sealed, the other tissue was hardly damaged. These benefits allowed us to dissect only the intercostal muscle while keeping the other chest muscles intact. In addition, excessive surgical time was not required. When dividing intercostal muscles, the LigaSure™ system causes less intraoperative blood loss and has a shorter operative time than electrocautery [2], contributing to the good results we obtained in our three patients.

Although a prospective randomized study is necessary to verify the effectiveness of this method, some reports have already shown the benefits of LigaSure™ regarding intraoperative blood loss and operative time in other surgical fields [3-6]. Regarding these two parameters (blood loss and operative time), our results compared favorably with those of other recently reported methods for chest wall resection [7].

The present method had several limitations. First, it is not generally recommended that the tumor be removed separately. Second, other approaches, such as another or larger incision, may be necessary depending on the tumor's location or size. We have also used this technique to remove a posteriorly invading superior sulcus tumor [8].

The approach described here is easy to perform by modifying the conventional procedure to make it less invasive—that is, without damaging the uninvolved extra-thoracic musculature—because of the stable performance of LigaSure™ and the superior thoracoscopic visibility. Using the advanced bipolar device during VATS for chest wall resection ensured reliable hemostasis with a reasonable operative duration. We believe that our method is a less-invasive option for patients with lung cancer that is invading the chest wall.

Disclosure statement

There are no conflicts of interest.

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