



Minimally invasive esophagectomy with three fields (2.5-field and cervical-field) lymph node dissection with esophageal suspension method

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Introduction

Esophagectomy, including complete primary tumor removal and radical lymphadenectomy with or without cervical lymphadenectomy, has been accepted as a radical esophagectomy that remains a standard treatment choice for esophageal squamous cell carcinoma (ESCC) (1,2). Studies have reported low incidences of pneumonia and mortality, similar medium-term, stage-specific survival in minimally invasive esophagectomy (MIE), compared with those reports from open esophagectomy (1,3).

For radical esophagectomy, lymphadenectomy along recurrent laryngeal nerves (RLNs) is an essential step of the operation, because of the high incidence of lymphatic metastasis in this area (4,5). However, the procedure has remained a challenge, because the meticulous dissection in a limited space frequently induces RLN palsy, followed by a higher incidence of postoperative pneumonia and laryngopharyngeal dysfunction (6,7).

We have reported the feasibility and safety of esophageal suspension method in thoracoscopic lymphadenectomy along the RLN in the semi-prone position in 2014 (8). In our institution, we routinely perform thoracoscopic and laparoscopic esophagectomies with programmed extensive lymphadenectomy along RLNs in the semi-prone position (2.5-field). Here we describe a MIE with three fields (2.5- and cervical-field) lymph node dissection using esophageal suspension method.

Clinical vignette

The endoscopic biopsy was performed preoperatively for

the patient to confirm the pathological diagnosis of ESCC. The preoperative examinations and staging procedures included thorough history review, physical examination, electrocardiogram, echocardiography, pulmonary function tests, esophagogastric radiography, esophagogastroscope, endoscopic ultrasonography, thoracic computed tomography scan, cervical and abdominal ultrasonic examinations. Patients were examined with integrated positron emission tomography/computed tomography scan with informed consent, or they will have emission computed tomography whole-body-bone imaging combined with brain magnetic resonance imaging instead.

The multidisciplinary treatment group determined the treatment strategy. We routinely did thoracoscopic programmed extensive lymphadenectomy along the left and right RLNs. And we sent the lymph nodes along the right RLNs for intraoperative frozen pathological examination. If the results of intraoperative frozen resection were negative, patients were randomly divided into three-field lymph node dissection group and two-field lymph node dissection group. When metastasis to the right RLN chains was confirmed, bilateral cervical lymphadenectomy was also performed. And informed consent was obtained from the patient.

Surgical technique

The patients were intubated with conventional single lumen tubes and were set in the semi-prone position.

We commonly set a 12 mm trocar at the 7th intercostal space at the middle axillary line for thoracoscope, a 12 mm trocar at the 4th intercostal space at middle axillary line,

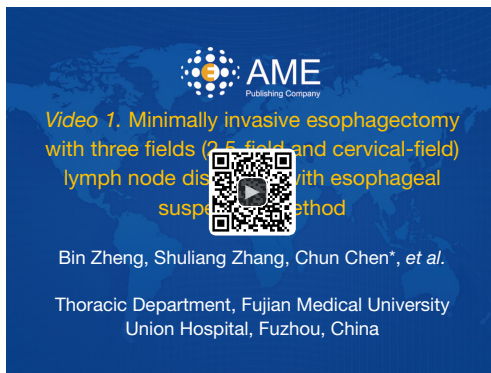


Figure 1 Minimally invasive esophagectomy with three fields (2.5-field and cervical-field) lymph node dissection with esophageal suspension method (9).

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two 5 mm trocars at 7th and 9th intercostal spaces at the infrascapular line (insufflation of carbon dioxide 8–10 mmHg).

Firstly, we free the middle and lower segment of the esophagus. Then we do the programmed extensive lymphadenectomy along RLNs.

Programmed extensive lymphadenectomy along right RLN included three steps: (I) location of the right vagus nerve. Mediastinal pleura was opened along the right vagus nerve and posterior margin of the right subclavian artery, to the apex of the thoracic cavity. The right vagus nerve could be observed. (II) Location of the root of the right RLN. The root of the right RLN could always be found at the junction of the vagus nerve and the subclavian artery. It was better to do the blunt separation carefully, to avoid accidental injuries. Once the root had been found, we bluntly freed the RLN as long as possible. (III) Extensive lymphadenectomy. Ultrasound knife and scissors were used to do the skeletonization of RLN. With clear exposure of nerves, *en bloc* resection of the para-nerve lymph nodes and soft tissues was done. The upper margin of the extent of lymphadenectomy was at the level of the inferior artery of the thyroid.

Lymphadenectomy along left RLN was carried out subsequently, including four steps. (I) Esophageal suspension. We separated the anterior wall of the esophagus and the membranous portion of the trachea, till the left margin of the trachea. We divided the posterior wall of esophagus and the spine, and carefully exposed the upper segment of the thoracic duct to avoid injury. Number 7 surgical suture was introduced into the thoracic cavity through a trocar, suspended the esophagus at the level of

carina and pulled out by a perforator with a barb at the head end at the fifth intercostal space on the inner edge of the scapula. (II) Lymph node rolling. We separated and fully exposed the left margin of the trachea and the left main bronchus. The lower part of the trachea was pushed forward and downward to expose the posterior space of trachea fully. The para-nerve lymph nodes and soft tissues were separated and rolled from the very bottom of the posterior space of trachea. We carried out the lymph node rolling from the left margin of left bronchus to the level of cervical-thoracic junction. (III) Location and identification of left RLN. After separation of soft tissue at the level of the inferior segment of the trachea, the sympathetic cardiac branch and left RLN could always be found and should be distinguished carefully. Once the RLN had been confirmed, we bluntly freed the RLN as long as possible, and several branches of the nerve should be cut off during separation. (IV) Extensive lymphadenectomy. After the three steps above, most of the para-nerve lymph nodes and soft tissues are above the RLN, an ultrasound knife and scissors were used to do the skeletonization of RLN. The *en bloc* resection of the para-nerve lymph nodes and soft tissues was done. The upper margin of the extent of lymphadenectomy was higher than the level of cervical-thoracic junction (*Figure 1*).

During the operation, we paid more attention to the protection of the nerves. Commonly, in the zones near the RLN, we preferred blunt separation. We believed that the electrical knife had specific side effects, and we preferred to use the harmonic scalpel and scissors.

If the result of intraoperative frozen resection was negative, and the patient was randomly divided into three-field lymph node dissection group, or when metastasis to the right RLN chains was confirmed, bilateral cervical lymphadenectomy was performed.

After 2.5-field lymphadenectomy, we found lymph nodes in station 101 had almost already been dissected when we did the cervical lymphadenectomy, and we could hardly find positive lymph nodes in station 101.

Postoperative anatomy of the specimens is also critical, especially the location of the lymph nodes. We do the location of the lymph nodes according to the Japan Esophageal Society methods.

Comments

Based on the previous experiences, we modified lymphadenectomy procedures.

We modified the procedures as programmed

lymphadenectomy, which included several steps. The programmed lymphadenectomy will be helpful for new-hands to shorten their learning curves, and also useful for experienced surgeons to do the quality control. It may result in more radical lymph node clearance, reduce injuries of the nerves.

Thoracoscopic programmed extensive lymphadenectomy along the RLNs (2.5-field lymphadenectomy) was feasible and safe. According to our current data, it yields sufficient regional lymph nodes, with acceptable postoperative complications. Further research was needed to confirm the efficacy of programmed extensive lymphadenectomy (2.5-field lymphadenectomy).

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Footnote

Conflicts of Interest: This video was granted the Award of Great Potential in the 2017 AME-Medtronic Minimally Invasive Esophageal Surgery Video Contest.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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