Three-field Dissection for Squamous Cell Carcinoma in the Thoracic Esophagus

Hiromasa Fujita, MD, Susumu Sueyoshi, MD, Toshiaki Tanaka, MD and Kazuo Shirouzu, MD

An esophageal cancer has frequent metastasis in the cervical and upper mediastinal lymph nodes, in particular along the recurrent nerves. Cervicothoracoabdominal three-field dissection is the most radical and rational lymphadenectomy procedure based on this evidence. During three-field dissection, the nodes along the recurrent nerves from the neck to the mediastinum are more meticulously resected than during any other procedure of radical lymphadenectomy. A consensus has been obtained that complete resection of the recurrent nerve nodes improves the survival rates of patients with cancer in each of the various locations of the thoracic esophagus, and that resection of the supraclavicular and internal jugular nodes improves the survival rates of patients with cancer in the upper thoracic esophagus. There is, however, still some controversies over whether or not resection of the supraclavicular and internal jugular nodes improves the survival rates of patients with cancer in the middle or lower thoracic esophagus. Moreover, there remains many controversies over the indication for three-field dissection regarding metastasis-positivity in the lymph nodes, the numbers of the metastasis-positive nodes, the stage, surgical risks and other aspects. Large randomized prospective studies are needed to accumulate conclusive evidence for the benefits of three-field dissection. (Ann Thorac Cardiovasc Surg 2002; 8: 328–35)

Key words: esophageal cancer, radical lymphadenectomy, three-field dissection, two-field dissection

Introduction

The history of cervicothoracoabdominal three-field dissection started from the reports by Kinoshita et al. in 1976 and Sannohe et al. in 1981. They emphasized that esophageal cancer had frequent metastasis in the recurrent nerve nodes and in the supraclavicular nodes. Based on these two reports, many surgeons adopted three-field dissection for cancer in the thoracic esophagus. The inquiring research of the Japanese Society for Esophageal Diseases (JSED) by Isono et al. showed that three-field dissection was performed in 35 of 96 major Japanese hospitals from 1983 to 1986. During the past two decades, three-field dissection has become recognized by many surgeons, not only in Japan but also worldwide, as an option in radical surgery for cancer in the thoracic esophagus.

In the Consensus Conference of the International Society for Diseases of the Esophagus (ISDE) in Munich in 1994, the experts determined three-field dissection to be the most radical lymphadenectomy and they agreed that there was increasing evidence that radical lymphadenectomy for esophageal cancer might have a beneficial effect for the patient through:

(1) staging information, treatment planning
(2) prevention of local recurrence, and
(3) better long-term survival in undefined subgroups.

In the Consensus Conference at the 6th World Congress of the ISDE in Milan in 1995, panelists agreed
cervical lymphadenectomy should be performed in patients with supracardinal cancers. However, no consensus could be obtained for subcardinal cancers, where cervical lymphadenectomy for cancers in the middle third was considered by panelists optional.

There are, even now, controversies over the survival benefit and the indication of three-field dissection for esophageal cancer. The main reason is that there have been few randomized control trials to evaluate the efficacy of this procedure.15-17) Here, we have reviewed the terminology, the incidence of metastasis to the cervical nodes, the survival benefit, the indication, and the mortality and morbidity in three-field dissection for esophageal cancer.

Table 1. Terminology of the regional lymph nodes in esophageal cancer

<table>
<thead>
<tr>
<th>ISDE</th>
<th>JSED</th>
<th>Numbering</th>
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<tbody>
<tr>
<td>Cervical nodes</td>
<td>Cervical paraesophageal (R, L)</td>
<td>Superficial cervical (R, L)</td>
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<tr>
<td></td>
<td>Cervical paraesophageal (R, L)</td>
<td>Cervical paraesophageal (R, L)</td>
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<td></td>
<td>Internal jugular (R, L)</td>
<td>Deep cervical (R, L)</td>
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<td>Peripharyngeal (R, L)</td>
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<tr>
<td></td>
<td>Supraclavicular</td>
<td>Supraclavicular</td>
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<tr>
<td>Thoracic nodes</td>
<td>Supraclavicular</td>
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</tr>
<tr>
<td>Periesophageal</td>
<td>Upper thoracic paraesophageal</td>
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</tr>
<tr>
<td></td>
<td>Middle thoracic paraesophageal</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td>Lower thoracic paraesophageal</td>
<td>110</td>
</tr>
<tr>
<td>Right recurrent nerve</td>
<td>Recurrent nerve (R)</td>
<td>106 recR</td>
</tr>
<tr>
<td>Left paratracheal</td>
<td>Recurrent nerve (L)</td>
<td>106 recL</td>
</tr>
<tr>
<td>Right paratracheal</td>
<td>Pretracheal</td>
<td>106 pre</td>
</tr>
<tr>
<td>Infraaortic arch</td>
<td>Tracheobronchial (L)</td>
<td>106 tbL</td>
</tr>
<tr>
<td>Infraaortic arch</td>
<td>Bifurcational</td>
<td>107</td>
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<tr>
<td></td>
<td>Main bronchus (R, L)</td>
<td>109</td>
</tr>
<tr>
<td>Lower posterior mediastinal</td>
<td>Supradiaphragmatic</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>Posterior mediastinal</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>Ligamentum arteriosum (Botallo’s node)</td>
<td>113</td>
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<tr>
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<td>Anterior mediastinal</td>
<td>114</td>
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<td>Esophageal hiatus</td>
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<td>Abdominal nodes</td>
<td>Cardiac (R, L)</td>
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<tr>
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<td>Lesser curvature</td>
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<tr>
<td></td>
<td>Left gastric</td>
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<td></td>
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<td></td>
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<td></td>
<td>Coeliac</td>
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<td></td>
<td>Abdominal paraaortic</td>
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<td></td>
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<td>Infradiaphragmatic</td>
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recR: right recurrent nerve, recL: left recurrent nerve, pre: pretracheal, tbL: left tracheobronchial

### Terminology

#### a) Terminology of the regional lymph nodes of the esophagus

In order to discuss scientifically the incidence and pattern of lymph node metastasis, and the extent of lymphadenectomy, the terminology of the regional lymph nodes of esophageal cancer was defined by the ISDE19) and by the JSED (Table 1).20)

The cervical paraesophageal and paratracheal nodes belong to the recurrent nerve chain nodes. In the right side, the nodes—the cervical paraesophageal nodes—are frequently situated posterior to the recurrent nerve, while in the left side, the nodes—the cervical paratracheal nodes—
are frequently situated anterior to the recurrent nerve. Therefore, the right cervical paravesophageal nodes can be completely resected through a thoracic approach, while the left paratracheal nodes cannot be completely resected through a thoracic approach. However, the left cervical paratracheal nodes can be resected through a cervical approach during cervical anastomosis. Therefore, the difference between modern two-field dissection and total mediastinal dissection and three-field dissection is only in the procedure resecting the internal jugular nodes and the supraclavicular nodes.

b) Lymph node grading and compartment classification
The lymph node (N) grading was authorized by the JSED (Table 2) based on the incidence of metastasis in each cluster of the regional lymph nodes of the esophagus revealed by three-field dissection. The theoretical framework of the lymph node grading is based on the compartment classification, which was defined considering the clinical value of each cluster of the lymph nodes assessed according to the incidence of metastasis in those nodes and the survival rates after resection of those nodes when metastasis was positive.

c) Extent of lymphadenectomy
The extent of lymphadenectomy was defined by the ISDE based on the historical background and by the JSED based on the lymph node grading.

Figure 1 illustrates the extent of radical lymphadenectomy agreed by the experts in the Consensus Conference of the ISDE in Munich in 1994. The extent of lymphadenectomy was classified into four groups; dissection 0 (D0), D1, D2, and D3. D0 means no lymph node dissection or incomplete dissection of the N1. D1, D2, and D3 mean complete dissection of the N1, 2, and 3, respectively. The extent of lymphadenectomy was defined in each cancer location. For cancer in the upper or middle thoracic esophagus, three-field dissection is defined as D3 lymphadenectomy, and total mediastinal lymphadenectomy and modern two-field dissection is defined as D2 lymphadenectomy, while for cancer in the lower thoracic esophagus, both three-field dissection and modern two-field dissection are defined as D3 lymphadenectomy.

### Incidence of Metastasis to the Regional Lymph Nodes from Cancer in the Thoracic Esophagus

Three-field dissection revealed that lymph node metastasis from esophageal cancer widely spread from the neck to the abdomen. Table 3 shows the incidence of metastasis...
sis in the regional lymph nodes in 715 patients with cancer in the thoracic esophagus who underwent three-field dissection in 10 major centers in Japan from 1985 to 1989.\(^{23}\)

Table 4 summarizes the incidence of metastasis to the cervical nodes at surgery. Metastasis in the cervical nodes were found in around 30% of patients who underwent three-field dissection, in around 45% of patients with cancer in the upper thoracic esophagus, in around 30% of those with cancer in the middle thoracic esophagus, and in around 20% of those with cancer in the lower thoracic esophagus. In most reports, the cervical paraesophageal and paratracheal nodes, and the supraclavicular and internal jugular nodes were not separately distinguished within the cervical lymph nodes.\(^{4,7,11,25}\) Fujita et al. pointed out that the incidence of metastasis to the supraclavicular and internal jugular nodes—excluding the cervical paraesophageal and paratracheal nodes—from cancer in the lower thoracic esophagus was only 5%.\(^{24}\)

**Survival Benefit**

In the historical studies,\(^{6}\) it was reported that the five-year-survival rates after three-field dissection were better than those after two-field dissection. On the other hand,
in the contemporary studies both in the single institute studies and in the multi-institute studies, there has been a controversy over whether or not three-field dissection improved the long-term survival rates compared to two-field dissection (Table 5). Kato et al. reported based on their randomized control trial that three-field dissection was superior to two-field dissection. However, Watanabe et al. asserted that the five-year-survival rates after modern two-field dissection—total mediastinal lymphadenectomy—in which the recurrent nerve nodes were completely resected similar to three-field dissection were the same as those after three-field dissection.

**Indications**

**a) Cancer location**

In the Consensus Conference at the 6th World Congress of the ISDE in Milan in 1995, the panelists agreed that cervical lymphadenectomy should be performed in patients with cancer in the upper thoracic esophagus. However, a consensus was not obtained for its indication for cancer in the middle or lower thoracic esophagus. Baba et al. concluded that three-field dissection should be indicated for cancer in the upper or middle thoracic esophagus.

**b) Lymph node metastasis (N)**

Isono et al. reported that three-field dissection improved the survival rates of patients both with and without lymph node metastasis. Tabira et al. concluded that three-field dissection should be indicated for patients with metastasis in one to four lymph nodes. Shiozaki et al. reported that cervical lymphadenectomy could be omitted for pa-
Patients with cancer in the middle or lower thoracic esophagus when no metastasis in the recurrent nerve nodes was found.\textsuperscript{31)}

c) T category
Isono et al. concluded that three-field dissection should be indicated for cancer with a depth of invasion from T1b to T3.\textsuperscript{3)}

d) Stage (UICC)
Lerut et al.\textsuperscript{11)} reported that this procedure should be indicated for patients at stage IIB to stage IV in the UICC\textsuperscript{32)} stage classification.

In short, there is a consensus over the indication of three-field dissection for cancer in the upper thoracic esophagus. Its indication for cancer in the middle thoracic esophagus is accepted by most Japanese surgeons, but not by Western surgeons. The indication for cancer in the lower thoracic esophagus is controversial also in Japan. Cancers with a depth from T1b to T3 are indicated for three-field dissection. The indications for three-field dissection regarding metastasis-positivity in the lymph nodes or the numbers of the metastatic lymph nodes are controversial.

Operative Results

a) Mortality rates
The hospital mortality rate was 0 to 10% after three-field dissection with no difference from that after two-field dissection (Table 6).\textsuperscript{3,8,9,11,12,18,33)} There has been few reports to indicate that the overall morbidity rates after three-field dissection were higher than those after two-field dissection,\textsuperscript{18)} although the higher incidence of particular complications after three-field dissection has been frequently described.

b) Postoperative complications
Isono et al.\textsuperscript{3)} and Udagawa et al.\textsuperscript{33)} reported that recurrent nerve paralysis increased after three-field dissection. Baba et al.\textsuperscript{8)} reported that permanent recurrent nerve paralysis increased after three-field dissection, and it caused deterioration of the quality of life (QOL) after surgery. Fujita et al.\textsuperscript{9)} reported that although the incidence of temporary recurrent nerve paralysis increased after three-field dissection, the QOL after surgery was not different from that after two-field dissection. They also reported that anastomotic leakage and tracheobronchial ischemic lesions were more common after three-field dissection than after two-field dissection. Udagawa et al.\textsuperscript{33)} reported that pulmonary edema/adult respiratory distress syndrome (ARDS) and pulmonary embolism increased after three-field dissection.

In short, the morbidity including recurrent nerve paralysis and other pulmonary complications increased after three-field dissection, while the mortality rates did not increase.

Guidelines for the Management for Esophageal Cancer

The Guidelines for the Management for Esophageal Cancer, published by the JSED in 2002,\textsuperscript{35)} state that three-field dissection is recommended for esophageal cancer, in particular cancer in the upper thoracic esophagus, based on the incidence of metastasis spreading from the cervical nodes to the abdominal nodes. However, there remains controversy over which is better lymphadenectomy for cancer in the middle or lower thoracic esophagus, two-field or three-field dissection, because of the lower inci-

<table>
<thead>
<tr>
<th>Authors</th>
<th>Two-field Mortality rate (%)</th>
<th>Three-field Mortality rate (%)</th>
<th>Two-field Morbidity rate (%)</th>
<th>Three-field Morbidity rate (%)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isono (1991)\textsuperscript{3)}</td>
<td>5</td>
<td>3</td>
<td>75</td>
<td>62</td>
<td>1983-89</td>
</tr>
<tr>
<td>Kato (1991)\textsuperscript{4)}</td>
<td>12</td>
<td>3</td>
<td>65</td>
<td>3</td>
<td>1985-89</td>
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<tr>
<td>Baba (1994)\textsuperscript{8)}</td>
<td>–</td>
<td>10</td>
<td>–</td>
<td>65</td>
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<td>Fujita (1995)\textsuperscript{9)}</td>
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<td>2</td>
<td>–</td>
<td>46</td>
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<tr>
<td>Lerut (1999)\textsuperscript{11)}</td>
<td>–</td>
<td>0</td>
<td>–</td>
<td>–</td>
<td>1992-93</td>
</tr>
<tr>
<td>Udagawa (2001)\textsuperscript{33)}</td>
<td>3</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>historical</td>
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</table>

\textsuperscript{*}the mortality rate within 30 days
idence of metastasis in the supraclavicular nodes than in the cervical paraesophageal and paratracheal nodes which are considered to be resected through a thoracic approach. There is also controversy over survival benefits, as to whether there is any difference between two-field and three-field dissection, and whether there are more survival benefits from three-field dissection.

On the other hand, the Guidelines, published by the Association of Upper Gastrointestinal Surgeons of Great Britain and Ireland, the British Society of Gastroenterology, and the British Association of Surgical Oncology in 2002, state that the principle aims of lymphadenectomy should be to minimize staging error, reduce locoregional risks of recurrence and, by increasing the number of patients undergoing an R0 resection, increase the five-year survival rate. Although there is considerable enthusiasm for the performance of lymphadenectomy in three fields in Japan, this approach has not been adopted widely by Western surgeons. A number of studies have shown that two-field dissection can be carried out with no significant increase in operative morbidity and mortality. Conversely, although the three-field dissection is advocated in Japan for squamous cell carcinoma, its benefits may simply reflect the reduction in staging error, as nearly a quarter of all Japanese patients will have cervical lymph node metastasis. It must be recognized that the operation has been associated with a higher risk of postoperative morbidity.

Conclusion

Esophageal cancer has frequent metastasis in the cervical and upper mediastinal lymph nodes, in particular along the recurrent nerves. Cervicothoracoabdominal three-field dissection is the most radical and rational lymphadenectomy procedure based on this evidence. During three-field dissection, the nodes along the recurrent nerves from the neck to the mediastinum are more meticulously resected than during any other procedure of radical lymphadenectomy. A consensus is obtained that complete resection of the recurrent nerve nodes improves the survival rates of patients with cancer in any location of the thoracic esophagus, and that resection of the supraclavicular or internal jugular nodes improves the survival of patients with cancer in the upper thoracic esophagus. There is, however, a controversy over whether or not resection of the supraclavicular or internal jugular nodes improves the survival of patients with cancer in the middle or lower thoracic esophagus. Moreover, there are many controversies over the indication of three-field dissection regarding metastasis-positivity in the lymph nodes, the numbers of the metastasis-positive nodes, the stage, surgical risks and other aspects.

Three-field dissection does not always increase the mortality rate, while it increases the morbidity rates in particular complications such as recurrent nerve paralysis.

As cited by Lerut et al., there is a need for large randomized prospective studies to give conclusive evidence of the benefits of three-field dissection. Such studies are even more needed in view of the upcoming trend to treat esophageal carcinoma by minimally invasive surgery. Finally, the results from three-field dissection have to be compared with those obtained from combined chemotherapy and chemoradiotherapy followed by surgery.

References


