Work in progress report - Pulmonary

Combined mediastinal node assessment by lymphadenectomy and intraoperative mediastinoscopy

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Abstract

The purpose of this study was to determine the importance of combined mediastinal node assessment by lymphadenectomy and intraoperative mediastinoscopy to patients with left lung cancer. Forty-one patients with left lung cancer were divided into a group of 13 and a group of 28: in the first group, the aortic arch was mobilized, while in the second group the aortic arch was not mobilized. The mediastinal nodes of both groups were then dissected and mediastinoscopes were inserted into the operation field with an approach through thoracotomy to biopsy each mediastinal node. We compared nodal pathological assessment in these two groups. In the group with mobilized aortic arches, pathological assessment of lymphadenectomy at Naruke’s station 3 was 11/13 (85%) and combined with intraoperative mediastinoscopy was 12/13 (92%). In the group without mobilized aortic arches, pathological assessment of lymphadenectomy of station 3 was 14/28 (50%) and combined use of intraoperative mediastinoscopy significantly improved the diagnoses to 24/28 (86%) (P = 0.004). Combined use of lymphadenectomy and intraoperative mediastinoscopy could improve the assessment of station 3 in left lung cancer without mobilizing aortic arch.

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Keywords: Lung cancer; Lymphadenectomy; Mediastinoscopy; Thoracotomy; Staging

1. Introduction

The presence of metastasis to mediastinal nodes is generally identified by pathological examination of preoperative cervical mediastinoscopy. However, cervical mediastinoscopy is an invasive procedure that requires another general anesthesia.

Superior mediastinal lymph nodes, including pretracheal nodes in left lung cancer patients, are not readily accessible during operation [1,2]. The complete staging for these nodes is difficult during the operation because the mediastinal nodal dissection is obstructed by the aortic arch. Older patients in particular often have calcifications in their aorta, so their aortic arches could not be mobilized well enough to dissect their mediastinal nodes.

To overcome these limitations, we have developed an intraoperative mediastinoscopy with thoracotomy approach. This procedure is carried out during the left lung cancer operation, obviating the cervical mediastinoscopy. We reported our early experience with 28 patients in a previous study [3].

The purpose of this study was to determine the importance of combined assessment for mediastinal nodes by lymphadenectomy and intraoperative mediastinoscopy to the left lung cancer patients with or without mobilizing aortic arch.

2. Patients and methods

Forty-one patients with left lung cancer agreed to receive intraoperative mediastinoscopy. Preoperative mediastinal assessment for all patients was done by CT. These patients were selected for this procedure without reference to their lymph node swelling in CT findings.

In thirteen cases, if they were under the age of seventy, had no calcifications in their aorta in the CT findings, and agreed to receive aortic arch mobilization, the aortic arch was mobilized anteriorly to facilitate nodal dissection of station 3.

We retrospectively evaluated if we could assess the mediastinal nodes, Naruke’s station 3 (pretracheal) [4], 4 (left tracheobronchial) and 7 (subcarinal) with or without mobilizing aortic arch by using this procedure.

The cases consisted of 26 adenocarcinomas, 13 squamous cell carcinomas, one adeno-squamous carcinoma, and one small cell carcinoma. Thirty-six lobectomies and five pneumonectomies were performed. There were 13 N2 findings in CT before surgery, five of which were revealed to be N2 disease after pathological assessment, as well as two cases not found with CT. There was no significant difference in patient characteristics between the group with mobilized aortic arches and the group without (Table 1).

Cervical mediastinoscopy was not performed in all cases for preoperative mediastinal assessment. Lung resection, consisting of a lobectomy and pneumonectomy, was com-
combined with mediastinal lymphadenectomy, as described by Martini [1] and Naruke [5]. The aortic arch was mobilized anteriorly in thirteen cases. Thereafter, intraoperative mediastinoscopy was performed [3] (Fig. 1).

The biopsy technique of the intraoperative mediastinoscopy was essentially the same as that of the cervical mediastinoscopy. A 20 cm-long mediastinoscope (Machida Co., Tokyo, Japan) was used for the first 28 patients, and a video-assisted mediastinoscope (type 10970-BR, 18 cm-long, and type 10970-MV, 19 cm-long, Karl-Storz, Tuttlingen, Germany) was used to examine the last 13 patients. A mediastinoscope was guided to the operation field, inserted vertically into the sagittal plane, and accessed the subcarinal space.

Intraoperative mediastinoscopy explored whether or not residual nodes were left behind. When station 7 nodes were not completely excised, the accessible residual nodes were biopsied using forceps, in order to dissect all residual nodes as far as possible when video-assisted mediastinoscope was used.

Intraoperative mediastinoscopy was also assessed at station 4 between the aortic arch and the left pulmonary artery, and at lower station 3 nodes between the aorta and the trachea from the stump of the aortopulmonary ligament of Botalli (Fig. 2).

![Fig. 1. Intraoperative mediastinoscopy with thoracotomy approach accesses for nodal biopsy in left lung cancer patient.](https://academic.oup.com/icvts/article-abstract/4/4/374/895734/fig2.png)

**Table 1.** Patient’s characteristics in two groups with aortic arch mobilized or without aortic arch mobilized

<table>
<thead>
<tr>
<th></th>
<th>A group with mobilizing Ao. arch (n=13)</th>
<th>A group without mobilizing Ao. arch (n=28)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/female</td>
<td>8/5</td>
<td>22/6</td>
<td>0.25</td>
</tr>
<tr>
<td>Age</td>
<td>60.2 ± 10.0</td>
<td>64.4 ± 9.9</td>
<td>0.23</td>
</tr>
<tr>
<td>ad/sq/ad-sq/scc</td>
<td>10/3/0/0</td>
<td>16/10/1/1</td>
<td>0.59</td>
</tr>
<tr>
<td>Clinical N2/others</td>
<td>5/8</td>
<td>8/20</td>
<td>0.53</td>
</tr>
<tr>
<td>Pathological N2/others</td>
<td>2/11</td>
<td>5/23</td>
<td>0.84</td>
</tr>
<tr>
<td>Lobectomy/pneumonectomy</td>
<td>11/2</td>
<td>25/3</td>
<td>0.67</td>
</tr>
</tbody>
</table>

_values are number of patients; ca = carcinoma; ad = adenocarcinoma; sq = squamous cell carcinoma; ad-sq = adenocarcinoma-squamous cell carcinoma; scc = small cell carcinoma; others = N0, N1 and N3._

Any mediastinal lymph nodes, removed or biopsied, were submitted for histological assessment to compare nodal assessment in the group with mobilized aortic arches to the group without mobilized aortic arches.

**Table 2.** Mediastinal node pathological assessment in two groups, with and without aortic arch mobilization, in each group comparing lymphadenectomy and combined use of lymphadenectomy and intraoperative mediastinoscopy

<table>
<thead>
<tr>
<th>Assessment of L</th>
<th>Combined assessment of L and IM</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A group with mobilizing aortic arch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Station 7</td>
<td>13/13 (100)</td>
<td>13/13 (100)</td>
</tr>
<tr>
<td>Station 4</td>
<td>12/13 (92)</td>
<td>13/13 (100)</td>
</tr>
<tr>
<td>Station 3</td>
<td>11/13 (85)</td>
<td>12/13 (92)</td>
</tr>
<tr>
<td>A group without mobilizing aortic arch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Station 7</td>
<td>28/28 (100)</td>
<td>28/28 (100)</td>
</tr>
<tr>
<td>Station 4</td>
<td>22/28 (79)</td>
<td>23/28 (82)</td>
</tr>
<tr>
<td>Station 3</td>
<td>14/28 (50)</td>
<td>24/28 (86)</td>
</tr>
</tbody>
</table>

_L = lymphadenectomy; IM = intraoperative mediastinoscopy; Station = Naruke’s station; Values are number (%) of mediastinal nodes._

Fig. 2. Schematic view of intraoperative mediastinoscopy, location and biopsy of the pretracheal lymph node, Naruke’s station 3, in left lung cancer.

3. Results

In the group with mobilized aortic arches, pathological assessment of mediastinal lymph node dissection and that compared to its combination with intraoperative mediastinoscopy revealed 13/13 (100%) and 13/13 (100%) at station 7, 12/13 (92%) and 13/13 (100%) at station 4, and 11/13 (85%) and 12/13 (92%) at station 3, respectively (Table 2). One at station 3 (8%) and one at station 4 (8%) were not removed by lymphadenectomy, and were assessed by intraoperative mediastinoscopy.

In the group without mobilized aortic arches, pathological assessment of lymphadenectomy and compared to its combination with intraoperative mediastinoscopy were 28/28 (100%) and 28/28 (100%) at station 7, 22/28 (79%) and 23/28 (82%) at station 4, and 14/28 (50%) and 24/28 (86%) at station 3, respectively. Ten at station 3 (Naruke) (36%) and one at station 4 (4%) were not removed by lymphadenec-
operative mediastinoscopy at station 3 (P = 0.004).

The intraoperative mediastinoscopy procedure took approximately 10 to 20 min at each node. Eleven station 3 (27%) and two station 4 (5%) nodes of eleven patients were biopsied by intraoperative mediastinoscopy only. Pre-operative CT findings of these nodes were two N2 and nine N1 and their pathological diagnoses were negative for metastases.

All histological diagnoses of the lymph nodes assessed by intraoperative mediastinoscopy were the same as those removed at the mediastinal lymph node dissection, and there was no change of the staging before and after the intraoperative mediastinoscopy.

No fatal complications related to intraoperative mediastinoscopy were observed. There was only one complication (2.5%), a hoarseness caused by left recurrent nerve damage due to the intraoperative mediastinoscopy.

4. Discussion

Wu et al. [6] reported from their randomized trial that lobectomy (pneumonectomy) combined with systematic nodal dissection could improve survival in respect to non-small cell lung cancer. However, Keller et al. [7] showed that mediastinal lymph node dissection could improve survival when compared with sampling, this advantage was limited to patients with right non-small cell lung cancer. In our investigation of the pathological assessment of cervical mediastinoscopy and lymphadenectomy, we reported that station 3 in left lung cancer without aortic arch mobilization was insufficiently dissected when compared with those whose aorta had been mobilized (22.2% vs. 100%, P = 0.05) [2]. These data suggest that mediastinal lymph node dissection and assessment might be incomplete for left lung cancer without aortic arch mobilization.

Use of video-assisted thoracoscopy can allow access to the aortopulmonary window (stations 5 and 6), inferior mediastinal (stations 8 and 9), and hilar nodes (station 10) in the left hemithorax [8,9]. In this video-assisted thoracoscopy, the stations at which the remnants of larger lymph nodes were found were pretracheal (station 3), subcarinal (station 7) and para-aortic lymph nodes (station 6) [10].

We developed intraoperative mediastinoscopy for locating and sampling nodes, to be carried out simultaneously with left lung cancer operation without mobilizing the aortic arch. Intraoperative mediastinoscopy aims to dissect all residual nodes as thoroughly as possible, especially when video-assisted mediastinoscopy was used, for example radical video-assisted mediastinoscopic lymphadenectomy (VAMLA) technique [11]. This technique would be easier for surgeons who perform mediastinoscopy routinely.

The frequency of involvement of the lower station 3 nodes increased to 37% of patients with multiple N2 stations in left lung cancer, and this involvement in station 3 is a good predictor of N2 lung cancer in the left upper lobe [12]. Even though the staging-assessments by intraoperative mediastinoscopy were the same as those removed at the mediastinal lymph node dissection, the final pathological diagnosis combined with intraoperative mediastinoscopy could be obtained for up to 86% or 92% of station 3, without or with aortic arch mobilized, respectively. Intraoperative mediastinoscopy often could not biopsy the nodes of station 4 and 3, because the nodes were already thoroughly resected by the mediastinal lymph node dissection.

Choi et al. [13] reported that routine mediastinoscopy is necessary in clinical stage I non-small cell lung cancer. Recently, however, surgeons have chosen not to use mediastinoscopy on patients with clinical I or II NSCLC [14]. Our small study suggests that metastasis to station 3 might not be properly diagnosed by lymphadenectomy without mobilization of the aortic arch.

In conclusion, intraoperative mediastinoscopy was useful for the assessment of the inaccessible mediastinal lymph nodes, especially station 3, when the aortic arch was not mobilized.

References

Appendix A. ICVTS on-line discussion

Authors: Biruta Witte and Martin Huertgen (Katholisches Klinikum Koblenz, Germany)

eComment: We are delighted to hear about a new application for videomediastinoscopy. If we got it right, you used it at thoracotomy to assess the accuracy of dissection of the stations 4L, 7 and 3 in left-sided bronchial carcinoma. Without mobilisation of the aortic arch, you detected more remnants of lymphatic tissue, especially at station 3. Was this observation associated with any false negative findings concerning N2 involvement? 13 of 41 of patients had N2 involvement, in your clinical setting detected at open surgery. We assume that neoadjuvant therapy for stage III disease is of minor significance in your strategy, and we are interested to learn about the current adjuvant treatment in your institution and in Japan in general. We might have overlooked some specifications concerning the involved mediastinal nodes. Were these nodes at station 5 or 6, or more centrally located as 4L, 7 or 3? How do you assess contralateral nodes in left-sided carcinoma, where N3 involvement is not uncommon, especially for tumors originating from the lobe? As you mentioned, a complete preoperative dissection of 2R, 4R, 7, 3 and 4L can be achieved videomediastinoscopically (video-assisted mediastinoscopic lymphadenectomy, VAMLA), and we would like to encourage everybody interested in accurate pretherapeutical mediastinal staging to do so. However, for VAMLA you should have a bivalved spreadable videomediastinoscope at your disposal.