Assessment of Aortic Invasion by Lung Cancer With the Use of Transesophageal Echocardiography

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Abstract

Background. An exact determination of aortic invasion by lung cancer is necessary for planning surgical intervention. We assessed whether or not the aortic wall is invaded by the tumor by transesophageal echocardiography (TEE).

Methods. We studied 6 patients (mean age, 68.5 years) who had lung tumors located in the left upper lobe, and invasion to the aorta was strongly suspected but inconclusive. With the use of TEE, aortic invasion is represented by the disappearance of the outer hyperechoic layer of the aorta and the lack of synchronous movement of consolidation during respiration.

Results. By TEE, 5 patients showed signs of invasion to the aorta. One of the patients underwent left upper lobectomy as well as replacement of the descending aorta, and aortic invasion was histologically proven.

Conclusions. In lung cancer, the diagnostic procedure should be complemented by TEE if therapeutic management depends on whether or not the aortic wall is invaded by the tumor.

Key words: lung cancer, aorta, transesophageal echocardiography

Introduction

An exact clinical staging of lung cancer is necessary for planning surgical intervention. Lung cancer invasion into the aortic wall (T4/stage IIIb) often means local unresectability or at least gives reasons for a modification of the surgical approach. T-staging of lung cancer is mostly based on computed tomography (CT) [1-4] or magnetic resonance imaging (MRI) [5, 6]. However, the results of CT and MRI are unsatisfactory in determining aortic invasion.

Transesophageal echocardiography (TEE) in lung cancer staging has been demonstrated in a few reports [7, 8]. Pulsating movement of the aorta and respiratory movement of the lung, while disturbing the CT images, are very helpful in the ultrasound study. Visible motion between the two structures also demonstrates that there is no adhesion. We assessed whether the aortic wall was invaded by the tumor or not by TEE in patients whose CT and MRI were judged inconclusive for aortic invasion.

Methods

Patients.

We studied 6 patients (mean age, 68.5 years; 47-78 years old; 1 woman and 5 men) who had lung tumors located in the left upper lobe, and the invasion to the aorta was strongly suspected by CT and MRI but inconclusive. Informed consent was obtained before the study from all patients.

TEE

Before TEE study, tumor invasion to the esophagus was excluded by CT and/or MRI in all patients. Esophageal endoscopy was performed if necessary.
Aortic Invasion by Lung Cancer

TEE study was performed by using commercially available ultrasonography systems (SONOS 5500 or HDI 5000, Philips), and the studies were recorded on a Super VHS videotape for storage and playback analysis. A 4-7 MHz multiplane probe was used for the TEE studies in all patients. For pharyngeal anesthesia, 10% lidocaine was applied topically. The TEE study included a complete two-dimensional and color flow mapping examination of the horizontal (arch) and descending thoracic aorta, with particular attention to visualizing the contact between the lung tumor and the aorta. No complications were observed during the study.

Passing the aortic lumen, the ultrasound generates a well defined borderline representing the aortic wall and the covering pleura. Invasion of the aortic wall is represented by the disappearance of the outer hyperechoic layer of the aorta and lack of synchronous movement of the consolidation during respiration.

### Results

By TEE, 5 of 6 patients showed signs of invasion to the aorta (Fig. 1). TEE study was repeated in 2 patients after chemotherapy, and the invasion to the aorta still existed. One of the 2 patients underwent left upper lobectomy as well as replacement of the descending aorta, and aortic invasion was histologically proven. The patient who had no sign of invasion to the aorta by TEE (Fig. 2) was successfully treated with chemotherapy. The remaining 4 patients did not undergo surgery. The reasons for this included age, comorbidities, patient preference or the risk of surgery.

### Discussion

T4 tumors that invade structures in theory are not amenable to excision. With regard to the invasion of mediastinal structures, especially the thoracic aorta, the predominantly used imaging procedures (CT, MRI) have not met expectations (1-6). In addition, localized invasion is not necessarily a contraindication to surgical resection. Thus, an accurate diagnosis of aortic invasion by lung cancer is very important. TEE

<table>
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<th>Patient</th>
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<th>Therapy</th>
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<td>Invasion (+)</td>
<td>Chemotherapy + Radiation</td>
</tr>
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</table>

Figure 1. Transesophageal echocardiograms demonstrating abolishment of the borderline (arrows) between tumor and the descending aortic wall (a: transverse view, b: longitudinal view). Ao, thoracic aorta.
is unique as it is the technique directly used by attending cardiologists familiar with a patient’s medical history or condition to make clinical decisions at the bedside [9].

Previous authors showed that the accuracy of even mono-plane or bi-plane TEE in detecting or excluding malignant invasion of the aorta was 92% [8]. The advantage of ultrasound is its detection of borderlines on the basis of a different sound conduction. With the use of intra-aortic endovascular sonography, the diagnostic criterion for aortic invasion was obliteration of the hyperechoic layer of the aorta [10]. However, by TEE, if the sound beam hits the border obliquely, the borderline can disappear, and invasion may be suspected. This disadvantage is corrected by the multi-plane real-time mode. Pulsating movement of the aorta and respiratory movement of the lung are very helpful, and visible motion between the two structures by using a multi-plane transducer can be diagnosed as no invasion.

**Conclusion**

In lung cancer contacting the aorta, the diagnostic procedure should be complemented by TEE if the therapeutic management depends on whether or not the aortic wall is invaded by the tumor.

**References**