



The major thoracic vascular invasion of lung cancer



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HIGHLIGHTS

- We actually investigated tumor invasion of the major thoracic vessels.
- We analyzed 30 patients in whom pulmonary artery (PA) invasion was suspected.
- We analyzed 11 patients in whom pulmonary vein (PV) or left atrium (LA) invasion was suspected.
- The positive predictive value of CT findings was low.

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ABSTRACT

Background: We actually investigated the surgical and pathological findings in cases which tumor invasion of the major thoracic vessels was suspected based on the preoperative Computed tomography (CT) findings.

Materials and methods: We retrospectively reviewed our prospective database of all patients, who underwent lung resection for lung cancer from 2012 to 2014. 387 patients underwent lung cancer surgery. Among these patients, we analyzed 30 patients in whom pulmonary artery (PA) invasion was suspected and 11 patients in whom pulmonary vein (PV) or left atrium (LA) invasion was suspected based on the preoperative CT findings.

Results: Among the 30 patients with suspected PA invasion, there were 9 patients in whom the tumor could be peeled off the PA in actual thoracotomy. Pathological invasion of the PA was observed in 6 of these patients. The positive predictive value of the preoperative CT findings was 20%. Among the 11 patients with suspected PV or LA invasion, there were 2 patients in whom the tumor could be peeled off the PV or LA in actual thoracotomy. Pathological tumor invasion of the PV or LA was observed in 4 of these patients. The positive predictive value of the preoperative CT findings was 36%.

Conclusion: The positive predictive value of the preoperative CT findings for tumor invasion of the thoracic vessels was low. Therefore, surgical opportunities that offer the chance of a cure shouldn't be missed in advanced lung cancer patients because the tumor is located near the major thoracic vessels on preoperative CT.

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1. Introduction

Lung cancer is a leading cause of death worldwide; it is the primary cause of cancer death in men and the secondary cause in women [1].

Computed tomography (CT) scans have been considered the reference standard for the preoperative evaluation of the intrathoracic spread and invasion of lung cancer [2]. However, the

Abbreviations: NSCLC, non-small cell lung cancer; CT, computed tomography; MRI, magnetic resonance imaging; PET, positron emission tomography; PA, pulmonary artery; PV, pulmonary vein; LA, left atrium.

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assessment of the preoperative T stage in lung cancer on CT is not always satisfactory, due to the limited ability to evaluate tumor invasion in the adjacent structures [3]. We therefore considered the possibility that the assessment major thoracic vessel invasion based on the preoperative CT findings might not be accurate.

The vascular wall is constructed from three membranes (the outer, media, and inner membranes). The media membrane structure of an artery, which includes elastic fiber and smooth muscle, is thicker and stronger than the media membrane structure of a vein (Fig. 1). Thus, the artery is able to withstand blood pressure. The thickness of the vascular wall also affects tumor invasion. In other words, the tumor can invade a vein wall more easily than an artery wall. In general, it is more difficult for a tumor to penetrate an artery wall than a vein wall.

Surgeons, radiologists, and physicians classify vascular invasion differently. For a surgeon, vascular invasion is defined by the inability to peel the tumor off the vascular wall. Thus, vascular invasion is defined based on the presence of adhesion due to inflammation—a condition which is difficult to detect before surgery.

Harman et al. reported three criteria for diagnosing vascular invasion on CT: 1) the disappearance of the fat layer; 2) the angle of tumor contact $>90^\circ$; and 3) stenosis and deformation of the vascular lumen [4]. Thus, Munden et al. reported that the CT-based diagnosis of vascular and mediastinal tumor invasion was of limited use [5].

In the present study, we investigated the surgical and pathological findings of cases in which major thoracic vessel invasion was suspected based on the preoperative CT findings.

2. Materials and methods

We retrospectively reviewed our prospective database of all patients who underwent lung resection for lung cancer between January 2012 and December 2014 at the University of Occupational and Environmental Health Hospital (a single institution). Informed consent was obtained from all of the patients with written. Three

hundred eighty-seven patients underwent lung cancer surgery during this period. Among these patients, we analyzed 30 patients in whom pulmonary artery (PA) invasion was suspected and 11 patients in whom pulmonary vein (PV) or left atrium (LA) invasion was suspected based on the preoperative CT examination. The presence of vascular invasion on the preoperative CT scans was independently evaluated by a thoracic surgeon and radiologist. Furthermore, vascular invasion was pathologically evaluated by a thoracic surgeon and two pathologists. The degree of vascular invasion is classified as follows: 1) invasion outside the outer membrane; 2) invasion of inflammatory cells; 3) invasion of the outer membrane; 4) invasion of the media membrane; 5) invasion of the inner space (Fig. 2).

2.1. Image acquisition

Whole lung CT scans were obtained with a 32-detector row CT scanner (Aquilion 32, Toshiba Medical Systems) or a 64-detector row CT scanner (Aquilion 64, Toshiba Medical Systems) using the following technique: collimation, 1 mm; rotation time, 0.5 s; reconstruction thickness, 2 mm; and pitch (ratio of table travel per rotation to total beam width), 27 or 53, 120 kV. Automatic tube current modulation (z-axis modulation with the Real E.C. technique, Toshiba Medical Solutions) was used with the noise level set at 10 SD. Each CT image was displayed and evaluated using a standard lung window (window width, 1600 HU; window level, -600 HU) and a mediastinal window (window width, 350 HU; window level, 50 HU) on a high-resolution monitor.

3. Results

We encountered 30 patients in whom pulmonary artery (PA) invasion was suspected and 11 patients in whom pulmonary vein (PV) or left atrium (LA) invasion was suspected based on the preoperative CT findings. Among the 30 patients with suspected PA invasion, there were 9 patients in whom the tumor could be peeled off the PA in actual thoracotomy. Thus, there were 21 patients in

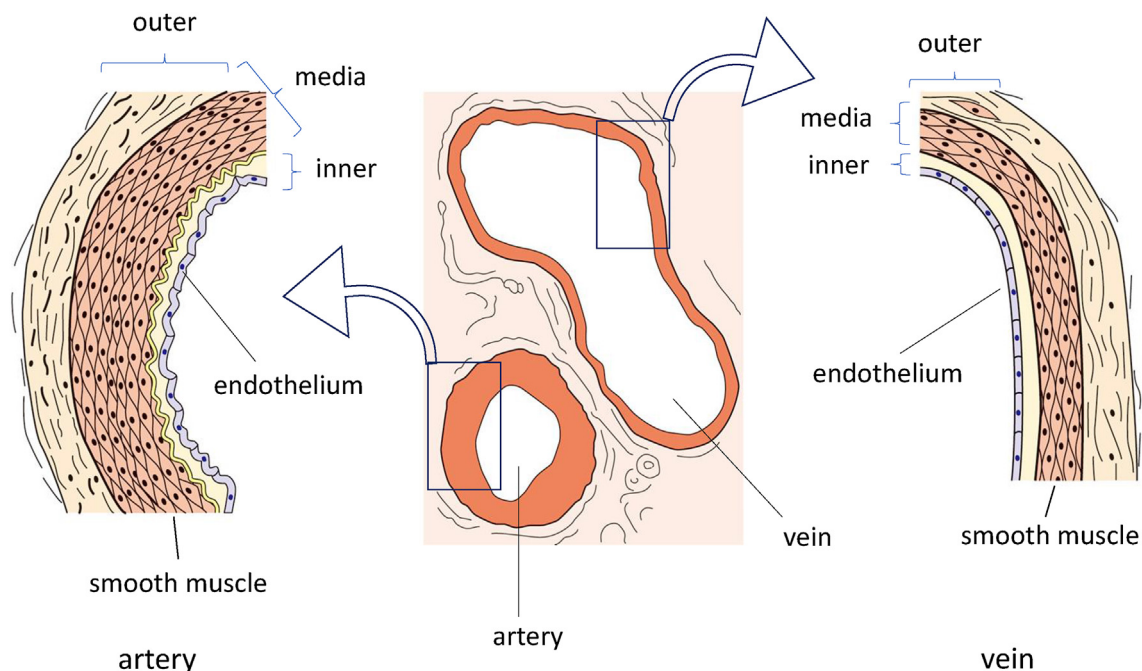


Fig. 1. This figure shows the structures of artery and vein.

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