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CASE REPORT

The preoperative assessment of subpleural lung cancer movement to distinguish thoracic wall adhesion or invasion using four-dimensional computed-tomography

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Abstract
Four-dimensional computed tomography (4DCT) is a relatively new technology. A review of the relevant medical literature reveals only very limited previous investigations of the utility of this technique. We report two cases of lung cancer located adjacent to the pleura in which 4DCT was used to assess parietal pleural invasion or adhesion based on the differential movements of tumors. We performed 4DCT to determine the surgical approach after obtaining appropriate informed consent from the patient. Based on 4DCT, Patient 1 showed there was no adhesion and we could perform thoracoscopic right lower lobectomy and the final pathological diagnosis was pT1bN0M0. Patient 2 Based on 4DCT, showed suspicious of invasion or adhesion. we performed chest wall resection because of tumor invasion in the eighth and ninth costal bones; a final pathological diagnosis of pT3N0M0 was made.

Keywords 4DCT · Lung cancer · Pleural invasion

Introduction

Since accurate evaluation of chest wall invasion by lung cancer is essential for precise staging and operative strategy planning. We report two cases of lung cancer located adjacent to the pleura in which 4DCT was used to assess parietal pleural invasion or adhesion based on the differential movements of tumors.

Case

Patient 1

A symptom-free 82-year-old man who was diagnosed with lung adenocarcinoma was admitted to our hospital. CT scan demonstrated a solid mass 35 mm in diameter located at the right dorsal basal segment adjacent to the pleura (Fig. 1). There were no distant metastases and we planned to conduct right lower lobectomy via the thoracoscopic approach considering his age. In view of the close apposition and the difficulty in determining the surgical approach, a wide field of view 4DCT using 320-slice multidetector CT scan (Aquilion ONE, Toshiba Medical Systems, Japan) was performed after obtaining appropriate informed consent from the patient. While the patient demonstrated full inspiration to full expiration, CT acquisition was activated. We postulated that the presence of differential motion confirms the absence of tethering of the mass to the adjacent structure with likely adherence to the visceral pleura and without involvement of the parietal pleura. Differential motion would, therefore, suggest that thoracoscopic resection is possible without the need to plan for extensive surgery, such as chest wall resection. Based on 4DCT and the likely absence of chest wall

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Fig. 1 A solid mass (diameter: 35 mm) located at the dorsal basal segment adjacent to the pleura

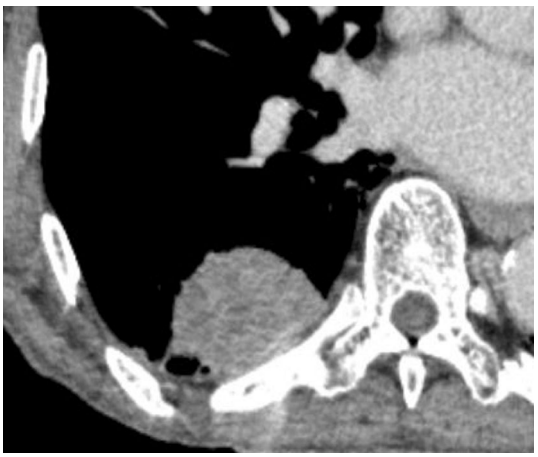

Fig. 2 A solid mass (diameter: 50 mm) located at the right superius segment adjacent to the pleura

invasion (Video file 1), the presurgical stage was changed to T2aN0M0. Finally, we could perform thoracoscopic right lower lobectomy and the final pathological diagnosis was pT1bN0M0.

Patient 2

A 82-year-old man with chronic hepatitis associated with hepatitis B virus was found to have a solid mass 50 mm in diameter located at the right superius segment adjacent to the pleura on chest CT (Fig. 2). CT-guided percutaneous needle biopsy revealed squamous cell carcinoma and there were no distant metastases. We performed 4DCT to determine the surgical approach after obtaining appropriate informed consent from the patient. In this case, 4DCT revealed close contact between the tumor and pleura with a lack of differential motion, suggesting tight tethering (Video file 2). The presurgical stage was changed to T3N0M0. During surgery, thick adhesion and invasion were observed and we performed chest wall resection because of tumor invasion in the eighth and ninth costal bones; a final pathological diagnosis of pT3N0M0 was made.

Discussion

4DCT is a relatively new technology, which has been used in the planning of stereotactic radiotherapy of lung cancer [1], simulation of transcatheter aortic valve implantation, and so on. However, only few studies have investigated the utility of this technique. Cine-MR [dynamic respiratory magnetic resonance (MR) or dynamic-ventilation MR] has been investigated for the assessment of lung cancer invasion of the parietal pleura, chest wall, and thoracic aorta [2]. Although the accuracy and usefulness of cine-MR for identifying tumor invasion of these adjacent structures have been clearly demonstrated in published reports, the indications of cine-MR for lung cancer remain very limited, since preoperative chest MR for lung cancer is generally unusual and increases medical costs. In addition, patients with metallic medical devices, including conventional cardiac pacemakers or a cochlear implant, cannot undergo MR imaging. Since CT is routinely performed as a standard preoperative assessment of patients with lung cancer to evaluate tumor size and metastases, few reports have mentioned that the addition of 4DCT to conventional CT for patients with peripheral lung cancer is reasonable for obtaining an accurate diagnosis of cancer invasion of the parietal pleura and additional adjacent structures [3]. In addition, we could take CT and 4DCT at the same time and Patient's does not need another 4DCT cost and reservation. We currently believe that, like these two cases, there is a good indication for adding 4DCT to conventional CT. 4DCT has been used for the assessment of thoracic tumor invasion toward adjacent structures. We tried to assess the parietal pleural invasion or adhesion by lung cancers located in the adjacent chest wall and easily recognized invasion or adhesion.

However, there are several limitation in this technology, First, relatively high radiation exposure was needed. In our hospital, there are two measures so far. There is equipment for reducing doses in the CT machine itself, and we adjust the range of the 4DCT imaging which leads to reduce radiation exposure. Second, we have not yet determined which quantitative parameter is the best for diagnosing pleural invasion or adhesion. Kotaro et al. performed a quantitative assessment of parietal pleural invasion and adhesion by peripheral (subpleural) lung cancers. they reported about investigations of quantitative indices of the movements of tumor and adjacent structures, as determined by 4DCT [4]. But the number was small (16) and qualitative analysis

performed by specialized software or workstations. And also, they have not yet determined what kinds of quantitative parameter is the best for diagnosing. The next step is investigating the quantitative parameter.

Conclusion

We report two cases of lung cancer located adjacent to the pleura in which 4DCT was used to assess parietal pleural invasion or adhesion based on the differential movements of tumors.

4DCT can be utilized as a novel imaging approach for the preoperative assessment of parietal pleural invasion or adhesion. Further studies with a larger cohort of patients are required to further validate this new investigation for preoperative assessment of lung cancer invasion into adjacent structures.

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