Thallium-201 SPECT Depicts Radiologically Occult Lung Cancer

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A case of radiologically occult lung cancer is presented in which ^{201}Tl SPECT of the chest clearly delineated the involved area. A 66-yr-old man underwent chest screening examinations for asymptomatic smokers and presented a positive sputum cytology for lung cancer. Conventional chest x-ray, tomography of computed radiography, and a CT scan failed to locate the lesion in the lung. Thallium-201 SPECT, however, was successful in depicting the area of the involvement.

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In patients with positive sputum cytology for lung cancer, it is crucial to locate the involved areas of lung. Thallium-201-chloride has been found to accumulate in lung neoplasms on planar images (*1–3*). The development of SPECT has encouraged the evaluation of patients with suspected or confirmed lung cancer by intravenous administration of ^{201}Tl-chloride. We have previously experienced promising results with this ^{201}Tl SPECT technique for the differential diagnosis of pulmonary nodular shadows found on the chest radiograph and for the detection of mediastinal lymph node metastases from lung cancer (*4*). While these studies were ongoing, we encountered a case with positive sputum cytology for lung cancer in which no abnormal mass was seen on chest radiographs or x-ray computed tomographs while ^{201}Tl SPECT clearly delineated the involved area of lung cancer.

METHODS FOR ^{201}Tl SPECT

A dose of 6 mCi (222 MBq) ^{201}Tl-chloride was injected intravenously. Tomographic scans were obtained at 15 min and 3 hr postinjection using a dual-headed rotating gamma camera (ZLC-7500, Siemens-Shimazu Co.) with low-energy, high-resolution collimators, interfaced to a minicomputer (Scintipac-700, Shimazu, Kyoto). Sixty projection data with an acquisition time of 40 sec were stored on magnetic disk. After processing the data by nine-point weighted smoothing, a filtered backprojection method using the Shepp-Logan filter was used for image reconstruction (*5*). Transverse, coronal, and sagittal sections were reconstructed without attenuation correction. The slice thickness was measured at 6 mm. The full width at half maximum of the system was 15 mm at the center of rotation when the rotation radius was set to 22 cm. Regions of interest (ROIs) were set in the area with abnormal ^{201}Tl radioactivity and in the contralateral normal lung on the transverse sections of both early and delayed scans. The mean voxel counts in the ROIs were measured and uptake ratios of the lesion to the contralateral normal lung were calculated on both scans (early ratio and delayed ratio). We then obtained the retention index to evaluate quantitatively the degree of ^{201}Tl retention in the lesion as follows; the difference of delayed and early ratios was divided by early ratio and expressed as a percentage.

CASE REPORT

In July 1989, a 66-yr-old man who underwent chest screening examination for asymptomatic cigarette smokers presented a positive sputum cytology (class IV) for lung cancer. His conventional chest radiograph did not show any abnormal findings suggesting lung cancer. Thereafter, transbronchial fiberscopy performed in a municipal hospital revealed a tumor-like lesion at the right bronchus 3 and transbronchial biopsy of the lesion suggested squamous-cell carcinoma.

The patient was referred to Kanazawa University Hospital for further evaluation and for treatment in October 1989. Chest radiograph and tomographs of computed radiography did not show any abnormalities. Computed tomograms revealed no abnormal mass other than the irregularity of the right main bronchus (Fig. 1). Repeated transbronchial fiberscopy revealed an irregular mucosal surface at the right bronchus 3 and transbronchial biopsy and bronchial lavage cytology confirmed the well-differentiated squamous-cell carcinoma and class IV respectively. Thallium SPECT of the chest was performed to locate the primary lesion and to assess mediastinal lymph node involvement. Both early and delayed scans (Fig. 2) demonstrated an abnormal tracer accumulation near the right hilum. No abnormal accumulation was noted in the mediastinum. Delayed ratio and retention index of this abnormal accumulation area was 1.5 and 25, respectively. Although the delayed ratio was not high, the retention index was high suggesting a malignant lesion. Right upper lobectomy and mediastinal lymph node dissection was performed. At surgery, a lesion with an irregular mucosal surface involved about 15 mm of the right bronchus (Fig. 3). Microscopic examination confirmed that the lesion was a well-differentiated squamous-cell

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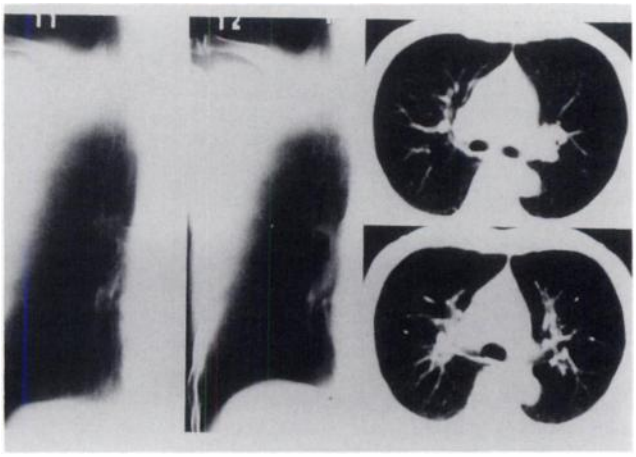

FIGURE 1. Tomograms of computed radiography of the right chest showing no abnormal findings. Computed tomograms reveal no abnormal mass other than the irregularity of the right main bronchus.

FIGURE 3. Surgical specimen of the right bronchus showing the area of irregularly-surfaced mucosa for about 15 mm in the length of longitudinal extension circularly in the right bronchus 3b (arrrows), cross to the bifurcation of the right bronchus 3a.

carcinoma with longitudinal growth along the bronchial lumen without extension into the bronchial cartilage, indicating early lung cancer. The mediastinal lymph node metastasis was not found. The patient has been free from recurrence for 16 mo since the operation.

DISCUSSION

It is difficult to detect small lung cancers radiologically, especially for those of less than 10 mm in diameter (*6,7*). In cases with positive sputum cytology, transbronchial fiberscopy, transbronchial biopsy, and transbronchial aspiration cytology are used primarily to locate and to determine the primary lung cancer. However, these modalities are not always successful, especially in cases with carcinoma in situ, hilar early lung cancer, and radiologically occult lung cancer.

It might be natural to think that SPECT has little advantage over other modalities for assessing small lesions, due to the limited spatial resolution of the SPECT instruments which are currently employed. In a previous paper, however, we presented a case with 15 × 10 × 15 mm adenocarcinoma, which was clearly delinated on ^{201}Tl SPECT (*4*). In the present case, the lesion had enough tumor volume and ^{201}Tl radioactivity to be visualized although the mass lesion was not evident on radiologic examination.

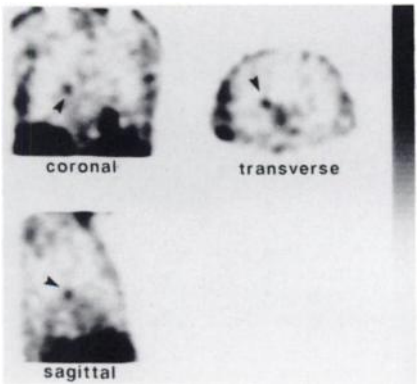

FIGURE 2. Thallium-201 delayed scans clearly demonstrate abnormal accumulation near the right hilum (arrowhead).

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