Thallium-201-Chloride Lung Imaging for Bronchogenic Carcinoma

Wei-Jen Shih, Sylvia Magoun, Vickie Stipp, Kelly Gross, Sara Brandenburg, Becky Wierzbinski, U. Yun Ryo, and Marcus Dillon

Veterans Administration and University of Kentucky Medical Centers, Lexington, Kentucky

To evaluate the clinical utility of thallium-201-(201TI) chloride lung imaging for patients with suspected lung tumor or recurrent tumor before and/or after thoracic surgery, 33 men (aged 50 to 79; mean 62) with recurrent or suspected carcinoma of the lung underwent 201 TI-chloride planar lung imaging. Planar lung images (anterior, posterior, and lateral views) were obtained 15 min after i.v. injection of 2–4 mCi of 201 TI-chloride. Thallium-201 lung images were compared with concurrent computed tomography of the chest and correlated to the pathologic results from bronchial washing, bronchoscopic biopsy, computed tomography of the chest and correlated to the conditions and areas demonstrated diffuse lung disease.

Sixty patients included one in chronic inflammation, one in pneumonia, one in granulomatous inflammation, one in squamous metaplasia, and two in nonmalignancy. Three of the six patients' lung images interfered with interpretation. Four of these six patients had diffuse or focal uptake of the lung in a nonmalignant condition which interfered with interpretation. Six benign lesions included one in chronic inflammation, one in pneumonia, one in granulomatous inflammation, one in squamous metaplasia, and two in nonmalignancy. Three of the six patients' lung images showed focal areas of uptake and lung images of three others demonstrated diffuse lung uptake. Diffuse lung uptake in malignant lesions(s) of four patients interfered with scan interpretation. Four of these six patients with nonmalignant conditions and two of four patients with diffuse uptake in malignant lesion(s) had a history of smoking and/or obstructive lung disease, two had undergone recent thoracotomy and one postirradiation. These results suggest 201 TI-chloride localized in the benign lesions of the lung and/or diffuse lung uptake may interfere with the interpretation of 201 TI-chloride lung images.

Thallous ion is a biochemical analog of potassium and has the same pathway as potassium across cell membranes into myocardial cells (/). The exact mechanism of thallium-201 (201 TI) uptake in tumors is still unclear. Experimental results suggest that 201 TI avidity in neoplasms depends on increased vascularity, cellularity, and changes in the cell membrane (1,2). Since 201 TI is taken up by viable tumor cells and infectious foci usually do not show high avidity for thallium (1,2), 201 TI-chloride has been used in the detection of tumor and tumor recurrence in brain tumors, lymphomas, thyroid tumors, and hepatomas (3,6). To evaluate the clinical utility of 201 TI-chloride lung imaging for patients with suspected lung tumor before and/or after thoracic surgery, we performed 201 TI lung imaging in 33 consecutive patients with suspected or known cancer.

MATERIALS AND METHODS

Thirty-three men aged 50 to 79 (mean 62) with suspected or recurrent carcinoma of the lung were included in the study. Malignancy had been diagnosed by cytology of bronchial washing and/or histopathology of bronchoscopic biopsy, lobectomy, or pneumonectomy. Thallium-201 planar lung images, including anterior, posterior, and lateral views, were obtained 10–15 min after i.v. injection of 2–4 mCi of 201 TI-chloride. Each image contained 500,000 counts. Thallium-201 lung images were compared with concurrent computed tomography (CT) of the chest and correlated with surgical pathologic findings. Surgical-specimen images were also obtained if pneumonectomy or lobectomy had been performed within 48 hr of the lung imaging.

Single-photon emission computed tomography (SPECT) imaging was obtained when planar images were negative. A gamma camera (Orbiter, Siemens, Des Plaines, IL) equipped with a high-resolution collimator was interfaced with a computer (PDP-11/34, Digital Equipment Corp., Marlboro, MA). The patient was placed in a supine position. The detector focusing on the chest was rotated every 3° for a total of 360°, and image data were collected for 20 sec at each stop. A 64 × 64 matrix was used for data acquisition, and the transaxial images were reconstructed by the use of Shepp and Logan filters. Coronal and sagittal images were assembled from the transaxial images.

RESULTS

Of the 33 patients, 3 underwent pneumonectomy, 11 lobectomy, 9 lung biopsy, and 10 bronchial washing. The results of final diagnosis consisted of 27 with malignant tumors and 6 with nonmalignant conditions. Twenty-five of the patients had bronchogenic carcinoma (Fig. 1), two patients had met-

For reprints contact: Wei-Jen Shih, MD, Dept. of Veterans Affairs, University of Kentucky Medical Centers, Lexington, KY 40511.
astatic lung carcinoma (Fig. 2). The six patients with nonmalignant conditions had one squamous cell metaplasia, one pneumonia, one granulomatous inflammation (Fig. 3), one chronic inflammation, and two were negative for malignancy (Fig. 4). Among the six nonmalignant patients were four having a smoking history and one having recent lobectomy (Table 1). Three patients with a smoking history showed diffuse lung uptake. Two patients with carcinoma of the esophagus who had negative findings by planar imaging were found to be positive by SPECT imaging (Fig. 2).

Diffuse lung uptake in 4 of the 27 patients with carcinoma of the lung masked 201TI uptake related to the malignant lesions or interfered with image interpretation (Table 2). Two patients had a history of smoking and/or obstructive lung disease. One had undergone recent thoracotomy and one patient’s irradiation treatment was complicated with pleural effusions and pulmonary edema (Fig. 5). The planar image showed diffuse pulmonary uptake in the lung masking the tumor mass which was demonstrated by SPECT images. Another patient with negative planar images gave positive SPECT images.

FIG. 2. (A) Planar images in a 50-yr-old man with cancer of the esophagus show no abnormal area of radiotracer uptake, while (B) SPECT images show a small focal area of increase in uptake (arrowhead) in the mediastinal region.

FIG. 3. Thallium-201-chloride planar lung images of a 63-yr-old man with a long smoking history and complicated emphysema show diffuse lung uptake without a focal area of radiotracer localization. The patient underwent lung biopsy which was confirmed to be granulomatous inflammation and negative for malignancy.
DISCUSSION

Although some researchers have suggested the absence of thallium avidity in infection, Lee et al. (7) reported that three patients with Kaposi's sarcoma in the lung showed either diffuse increased uptake or patchy increased pulmonary uptake. They concluded that if pulmonary opportunistic infection were superimposed, pulmonary images might be misinterpreted. Recently, unexpected 201 Tl-chloride accumulation in cerebral candidiasis has been reported and this uptake disappeared after treatment (8). In our study, a focal area of increase in pulmonary uptake was seen in various benign conditions. The mechanism of the lung uptake in those nonmalignant conditions is unknown.

Smoking and associated obstructive lung disease may explain diffuse increase in 201 Tl uptake. Diffuse or focal lung uptake was also revealed in the images of one patient who had recently undergone thoracotomy. One patient who had undergone irradiation of lung tumor had diffuse uptake which was explained by pulmonary edema.

CONCLUSION

Thallium-201-chloride has been localized in benign lesions. Diffuse lung uptake of 201 Tl in patients with a history of smoking, recent thoracotomy, or postirradiation complicated by pulmonary edema may result in problems with image interpretation. SPECT may be useful in those patients with...
Anterior planar image of 79-yr-old man with squamous cell carcinoma who had undergone irradiation treatment 3 yr previously shows diffuse pulmonary activity of the right lung and the right upper lung shifting of the mediastinum to the left side. A clear zone is shown between the LV wall activity and the activity of the left medial border of the left lung and the activity of upper border of the left hepatic lobe resulting from known massive pericardial effusion. The pulmonary activity is thought to be the result of pulmonary congestion and/or edema.

diffuse lung uptake in planar images or in negative results in planar images.

REFERENCES

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