Gallium-67 scintigraphy in lung diseases

J. B. Van der Schoot, A. S. Groen, and J. de Jong

Laboratory of Nuclear Medicine and Division of Pulmonary Diseases of the
Department of Internal Medicine, University of Amsterdam, Netherlands

There is some disagreement in the literature about the tumour affinity and tumour specificity of gallium-67 (67Ga). The present investigation showed good uptake of 67Ga in most cases of bronchial carcinoma, but some uptake of 67Ga was also found in 30% of those with non-malignant lung lesions. There was no relationship between the uptake of 67Ga and the histological type of bronchial carcinoma. After radiotherapy, a transient uptake of 67Ga in the irradiated field was seen. In five patients who were studied again two months after the end of radiation treatment, uptake of 67Ga was no longer demonstrable at the original site of the tumour. 67Ga appears to be an isotope with a high affinity for bronchial carcinoma but it is not tumour specific. However, our experience indicates that a negative 67Ga scintigram of the lung in a case of suspected malignancy calls for reconsideration of the clinical diagnosis.

Edwards and Hayes (1971) reported that gallium-67 (67Ga) was taken up by bronchial carcinoma but that this uptake was much more striking in cases of squamous-cell carcinoma than in other histological types. We have studied the tumour specificity of 67Ga citrate in lung lesions, the influence of radiotherapy, and the uptake of 67Ga in relation to the histological type of carcinoma.

METHODS

Our scans were taken two to three days after the intravenous administration of 2 mCi 67Ga (as carrier-free gallium citrate) when normally a high activity was found over the liver. We used a Picker Magna-scanner V with a spectrometer window setting of 160 to 320 KeV and an 85-hole collimator. The maximum count rate was 4,000–6,000 counts/min, the ratemeter range 6 K, the count range differential 40%, and the scanning speed about 40 cm/min. We graded the uptake in the lung lesions by comparing the 67Ga count rate over the lesion with that over the liver and with the corresponding area of supposedly normal contralateral lung. We graded ++ when the count rate over the lung lesion was as high as or higher than that over the liver (Figs. 1 and 2), + when the count rate over the lesion was lower than that over the liver, and — when there was no uptake seen in the lesion.

MATERIAL

67Ga scintigraphy was performed in 79 patients with lung diseases. In 53 cases the clinical diagnosis was bronchial carcinoma, confirmed by either histological or cytological methods in 41 cases (Table I).

RESULTS

No less than 40 of the 41 proved cases of bronchial carcinoma showed a positive 67Ga scan; in 11 of these cases the diagnosis was only confirmed after operation or necropsy. The only proved case with a negative 67Ga scan was that of a woman, 60 years old, with an excavated anaplastic large-cell carcinoma in the right lower lobe. Microscopical examination after lobectomy showed that only a shallow shell of living tumour tissue remained. In the 12 unproved cases of bronchial carcinoma, 10 showed a positive scan; 26 cases of non-malignant lung disease were also studied. The diagnoses in these patients and grades of 67Ga uptake can be seen in Table II.

Of the 26 cases of non-malignant lung diseases two patients with pulmonary tuberculosis are interesting. The first patient, a man aged 27 years, had primary tuberculosis of the left lung confirmed by a positive culture of the

TABLE I

<table>
<thead>
<tr>
<th>No. of Patients</th>
<th>Microscopic Confirmation</th>
<th>67Ga Uptake</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>With</td>
<td>Without</td>
</tr>
<tr>
<td>53</td>
<td>41</td>
<td>12</td>
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<tr>
<td></td>
<td>++</td>
<td>16</td>
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<td>20</td>
<td>30</td>
</tr>
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Thorax (1972), 27, 543.
FIG. 1. Chest radiograph of a 66-year-old man showing a bronchial carcinoma in the apicoposterior segment of the left upper lobe.

FIG. 2. Same patient as in Fig. 1. Frontal scan made three days after injection of 2 mCi gallium-67 citrate. The $^{67}$Ga-accumulation in the tumour is graded ++.
sputum. The enlarged hilar lymph nodes showed a high uptake of $^{67}$Ga, which diminished and disappeared under treatment with tuberculostatics (Figs. 3 and 4). The radioactivity registered in the left lower lobe was probably due to an accumulation of $^{67}$Ga in tomographically visualized enlarged intrapulmonary lymph nodes. The second patient, a man aged 45 years, had suffered from pulmonary tuberculosis in his youth but this had been quiescent for several years. A routine radiograph one month before admission showed a shadow in the apex of the lung in the area of the old tuberculous foci. This patient had been smoking 30 cigarettes a day for 30 years. The $^{67}$Ga scan was negative and, although the clinical diagnosis was more inclined to tuberculosis than to bronchial carcinoma, a lobectomy was performed. Microscopy showed a tuberculoma. The four other cases with post primary lung tuberculosis also showed no uptake of $^{67}$Ga at the site of the lesion.

In eight patients receiving telecobalt therapy for lung cancer we studied $^{67}$Ga uptake directly...
after the conclusion of therapy and again between 6 and 12 weeks later (Table III). In five of six patients examined directly after the radiation treatment we found in the irradiation field a diffuse, but small uptake of $^{67}$Ga, not found before radiation therapy. This uptake in the irradiation field was not seen on scans made between 6 and 12 weeks later.

We also studied the relation between the histological type of tumour and the uptake of $^{67}$Ga (Table IV) and found an uptake of $^{67}$Ga in all our cases of small-cell anaplastic carcinoma (5), adenocarcinoma (7), and in a case of alveolar-cell carcinoma. We did not find a relationship between the intensity of the uptake in the tumour and the histological cell type.

**Discussion**

The differential diagnosis of isolated shadows in the lungs, especially when found in patients without symptoms, remains difficult. Our results with $^{67}$Ga scintigraphy in proved cases of bronchial carcinoma suggested that diagnostic errors can be diminished by the addition of this isotope investigation to our routine diagnostic methods.

Unfortunately, mediastinal localizations of tumour cannot always be recognized owing to the normal uptake of $^{67}$Ga in the spine. The importance of such a possibility was illustrated by a patient with a proved bronchial carcinoma and a positive $^{67}$Ga scan. Tomography did not demonstrate enlargement of mediastinal lymph nodes but on the $^{67}$Ga scan a small uptake was noted next to the spinal activity. During surgery a lymph node in the carina of the upper lobe was found to contain carcinoma and pneumonectomy was performed instead of a lobectomy. We are investigating the possibilities of a subtraction technique for recognizing abnormal $^{67}$Ga accumulation in the mediastinum. The uptake of $^{67}$Ga in the irradiation field, seen shortly after the end of radiation treatment, was unexpected. A possible explanation may be the uptake of $^{67}$Ga in the fast proliferating connective tissue cells, known to be present after radiation treatment.

Unlike Edwards and Hayes (1971), we found no relationship between the $^{67}$Ga uptake in a tumour and its histological cell type. An accumulation of $^{67}$Ga was found in 30% of non-malignant lung lesions. The uptake was small, except in one case of primary lung tuberculosis where the activity was localized in enlarged lymph nodes. With respect to this it is of interest that a high uptake of $^{67}$Ga has been found in the hilar nodes of active sarcoidosis (Langhammer et al., 1972). In a case of tuberculosis (confirmed after operation) no uptake of $^{67}$Ga in the lesion was found.

Although $^{67}$Ga evidently has no tumour specificity, our experience indicates that a negative $^{67}$Ga scintigram of the lung in a case of suspected malignancy calls for reconsideration of the clinical diagnosis.

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**References**


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