⁷⁵Se-sodium selenite as a diagnostic aid in the assessment of peripheral pulmonary opacities

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ABSTRACT To establish or exclude the diagnosis of bronchial carcinoma a series of 43 patients with peripheral pulmonary opacities was studied by lung scanning after intravenous injection of ⁷⁵Se-sodium selenite. A diagnosis was ultimately obtained in all patients. The incidence of both false-positive and false-negative results was high. Selenite was taken up by a range of non-neoplastic processes including inflammatory lesions. The value of the procedure in distinguishing bronchial carcinoma from non-neoplastic conditions of the lung that radiographically mimic carcinoma was not confirmed.

A patient with a peripheral pulmonary opacity may be needlessly subjected to an exploratory thoracotomy on the valid grounds that the lesion might be a malignant neoplasm. Great value would therefore be derived from an investigation that is both non-invasive and diagnostically conclusive. The inadequacy of the radionuclide Gallium-67 as a diagnostic tool in this respect has been reported by le Roux and Houlder (1974).

Esteban *et al* (1972), Von Jammers and Ramos (1972), Jereb *et al* (1972), Pokorna *et al* (1973), and Cheiretova and Orechkov (1974) using the radionuclide ⁷⁵Se-sodium selenite (Na₂⁷⁵SeO₃) have reported encouraging results and indicate that lung scintigraphy using ⁷⁵Se-sodium selenite is an investigation worthy of more widespread use.

The purpose of this study was to assess the use of ⁷⁵Se-sodium selenite clinically where peripheral pulmonary opacities are often caused by non-neoplastic processes which, on chest radiography, closely mimic bronchial carcinoma.

Materials and methods

⁷⁵Se-sodium selenite was obtained as a sterile solution made isotonic with sodium chloride. The specific activity ranged from 5-20 μ Ci/mg. Each patient was given an intravenous injection of 250 μ Ci 48 hours before imaging on the gamma camera. The 270 and 280 KeV peaks were used for imaging purposes.

Count rates were low because of the small dose injected and the decreased sensitivity of the de-

tector with the medium energy collimator used. To obtain 50 000 counts a single image would take 15 to 20 minutes. Only one view, the anterior projection, was usually studied, with particular care to include the area of interest seen on the chest radiograph. A computer image was taken simultaneously as this helped to interpret the polaroid scintigrams from the gamma camera.

The scintigrams were interpreted by an experienced examiner without prior knowledge of other clinical data and termed positive or negative in the region of interest as seen on the chest radiograph.

Patients

Forty-three patients (seven Caucasian, 33 African, two Asiatic of Indian extraction, and one Mulatto) were studied. The youngest was 30 years of age and the oldest 75. This ratio corresponds approximately to the ratio of the various racial groups in the population from which the patients were drawn. There were only two women in the series, one Caucasian and the other African. Every patient gave informed consent. Each had a peripheral pulmonary opacity indistinguishable on chest radiography from bronchial carcinoma. In all but two the lesion was outside the range of bronchoscopic vision. A histological diagnosis was obtained in 24 cases. In the remaining 19 the diagnosis was established beyond all reasonable doubt on clinical, radiographic, or bacteriological grounds.

Results

Of the 43 patients studied, 31 exhibited a positive scan, only 23 of whom were subsequently shown to have a carcinoma. There were therefore eight false-positive results, an incidence of 18.6% of the total number of cases studied and 47% of the non-neoplastic conditions (tables 1 and 2).

Twelve patients did not exhibit uptake of the radionuclide. Nine of them had non-neoplastic lesions while three had bronchial carcinomas proved histologically. The incidence of false-negative results was thus 6.8% of the total number of cases studied and 11.5% of the neoplastic conditions (tables 1 and 2).

Discussion

In this study the incidence of both false-negative and false-positive results was high, which is contrary to the findings of others. Esteban *et al* (1972) found nine false-negative results (6.9%), five "questionable cases" (3.8%), and only one false-positive result (0.7%) in a series of 130 patients with pulmonary lesions—peripheral (not bronchoscopically visible) and central (bronchoscopically visible). Cheiretova and Orechkov (1974) studied 29 patients without either a single false-positive or false-negative result.

Of the three false-negative results obtained in this study one patient had a malignant neoplasm which at operation was found to be less than 2 cm in diameter. It has been reported that lesions less than 2 cm in diameter are difficult to interpret scintigraphically. The other two patients had large neoplasms occupying about one-third of the lobe in which they were situated. The chest radiograph and scintigraph of one of these patients is shown (fig 1). In each of these three cases the negative result would not have influenced the management of the lesion were the result taken into account. It must, however, be emphasised that false-negative results preclude the test from use as

a screening procedure for referral of patients to a thoracic surgical unit. This failing detracts greatly from its usefulness and would limit its use to units that specialise in the investigation and management of peripheral pulmonary opacities.

There were eight false-positive results. One patient had tuberculosis, although four other cases of tuberculosis did not exhibit uptake of ⁷⁵Se-sodium selenite. This single case had an opacity in the right upper lobe indistinguishable on chest radiography from bronchogenic carcinoma (fig 2). At operation also the lesion was indistinguishable from a carcinoma. After lobectomy, histology of the lesion showed it to be proliferative tuberculosis.

Four of the false-positive results were in patients with chronic destructive pneumonia, which in the African patient is almost as common as bronchial carcinoma. Le Roux and Dodds (1968) and Cameron (1977) have reported on this condition, the clinical manifestations and chest radiography of which are not infrequently indistinguishable from those of bronchial carcinoma (fig 3). The virulent nature of chronic destructive pneumonia and the high incidence of postoperative morbidity and mortality has been reported by le Roux (1971) and Cameron (1977). Great value would therefore be derived from a non-invasive technique that would differentiate chronic destructive pneumonia from bronchial carcinoma. In this respect scintigraphy using ⁷⁵Se-sodium selenite has been a disappointment as only two negative scans were obtained in patients with proved chronic destructive pneumonia. Two cases of pulmonary infarction, one of which was

Table 2 Incidence of positive and negative results

Total number of cases with carcinoma	26
True positive	23 (88.5%)
False negative	3 (11.5%)
Total number of non-neoplastic lesions	17
True negative	9 (53%)
False positive	8 (47%)

Table 1 Summary of results

Positive uptake (31)			Negative uptake (12)		
Bronchogenic carcinoma (23)	Non-neoplastic (8)		Bronchogenic carcinoma (3)	Non-neoplastic (9)	
Squamous	6	Tuberculosis	1	Hydatid cyst	1
Adenocarcinoma	4	Chronic destructive pneumonia	4	Chronic destructive pneumonia	2
Small cell	1	Lung infarction	2	Chronic lung abscess	1
Undifferentiated	1	Organising pneumonia	1	Fissural effusion	1
Mesothelioma	1			Tuberculosis	4
Metastatic (kidney/colon)	2				
Diagnosed on other grounds	8

Fig 1 Chest radiograph with corresponding negative scintigram. Histology of lesion in right upper lobe was squamous carcinoma.¹

Fig 2 Chest radiograph showing lesion in right midzone with corresponding positive scintigram. Histology of lesion was proliferative tuberculosis.¹

histologically proved from tissue taken at thoracotomy also exhibited ⁷⁵Se-sodium selenite uptake. Management in either case would not, however, have been influenced if the result had been negative.

¹Scintigrams are reproduced from computerised colour originals which may render their interpretation difficult, as different colours are represented as the same shade in the black and white reproductions. In fig 2 uptake is highest in liver and spleen, moderate in heart pool, lesion, and thyroid gland, and poor in lung fields. In fig 3 uptake is highest in liver, spleen, and lesion and moderate in heart pool and remainder of lung zones.

The remaining patient with a false-positive result was found at operation to have a solid subpleural lesion not having the appearance of carcinoma. Histology showed the lesion to be an organising pneumonia. Had cognisance of the positive scan been taken, an unnecessary pneumonectomy would have been performed.

Previous workers (Esteban *et al* 1972) have made the observation that uptake bears no relation to tumour histology. This study has shown that, certainly in our clinical context, uptake bears

Fig 3 Chest radiograph showing cavitating lesion in left lung with corresponding positive scintigram. Resolution of this lesion was achieved with antibiotic treatment.¹

little relation to the pathological process. This is especially true of chronic destructive pneumonia where lesions exhibited uptake more often than not in a ratio of 2:1. The finding of Pokorna (1973) that all the sarcoid lesions in his study exhibited a positive uptake of the radionuclide is also relevant. The conclusion must be that whatever determines ⁷⁵Se-sodium selenite uptake, it is not solely neoplastic activity.

While agreeing with Jereb *et al* (1972) that ⁷⁵Se-sodium selenite uptake studies may be of value in determining the presence of mediastinal metastases in proved bronchial carcinoma, with a view to modifying management, we believe that the procedure has no place in determining whether the primary lesion is a malignant tumour or not, and has therefore only a limited place as an investigative aid in thoracic surgery.

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