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NUCLEAR IMAGING OF PULMONARY METASTASES IN THYROID CARCINOMA

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Well differentiated thyroid carcinomas (papillary, follicular and mixed types) usually have a prolonged course, though the incidence of metastases is high. Metastases to the cervical lymph nodes occur in 35 to 80 per cent and distant metastases, usually to the lung, in 10 to 40 per cent of the patients (WOOLNER et coll. 1961, CRILE 1971, LINDAHL 1975, RASMUSSON 1978). The distribution of metastases differs in the follicular and the papillary carcinomas, lymph node metastases being most common in the papillary carcinomas, whereas distant metastases occur most frequently in the follicular carcinomas.

It has been repeatedly documented that chest radiography does not detect all pulmonary metastases, but that scintigraphy with ^{131}I may demonstrate some that are not radiographically detectable (CATZ & STARR 1956, ERNST & HEINE 1961, BARRETT & STENBERG 1965, BONTE & MCCONNELL 1973). Therefore, ^{131}I whole body scintigraphy was compared with chest films in a series of patients with well differentiated thyroid carcinoma in order to obtain an increased knowledge of the value of these methods.

Material and Methods

The patients were referred for evaluation and treatment at this oncologic centre. ^{131}I treatment was given to patients with supposed or confirmed tumor tissue outside the thyroid gland.

During a 3-year period (1976 to 1979), 161 whole body scans were performed in 52 patients (17 males and 35 females, mean age 50 years, range 14–84 years) with well differentiated thyroid carcinoma, diagnosed between 1960 and 1978, but without evidence of co-existing malignant disease.

All whole body scans from these 52 patients were reviewed with special reference to abnormal pulmonary ^{131}I accumulation and compared with routine chest films.

Due to varying surgical practice or degree of operability in 20 patients total thyroidectomy was not carried out.

The ^{131}I whole body scintigraphy was performed 2 days after oral Na-^{131}I intake, using a gamma camera with a whole body imaging accessory (Nuclear Chicago, Pho/Gamma III, HP, IV, and a 410 keV parallel collimator). The ^{131}I doses varied from 0.74 to 4.625 GBq (20 to 125 mCi).

Thyroid hormone and dietary iodine intake was avoided for 1 to 2 weeks before the ^{131}I administration. A hypothyroid state was confirmed by laboratory tests including thyroid stimulating hormone (TSH) determination before scanning.

Results

Pulmonary metastases were evident in 14 of the 52 patients diagnosed at the same time as the primary thyroid carcinoma in 7 patients. In 7 patients, the

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lung metastases were detected 5 to 15 years (mean 10 years) after the diagnosis of the thyroid carcinoma.

The lung metastases were demonstrated at scintigraphy as well as at radiography in 7 patients. Four patients had lung metastases demonstrated only at radiography, all with subtotal thyroidectomy.

At whole body scintigraphy 3 patients had abnormal pulmonary ^{131}I uptake, though no abnormality was found at repeat chest radiography within the same period.

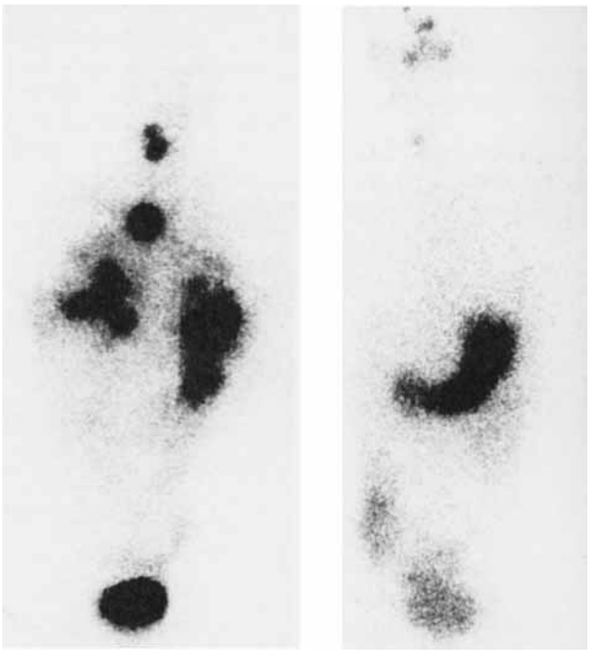
Discussion

Some of the decisive factors for the survival of patients with well differentiated thyroid carcinoma are age, histology and the presence of distant metastases (FRANSSILA 1975, MAZZAFERRI et coll. 1977, BEIERWALTES 1978). Surgery followed by ^{131}I treatment has reduced the mortality rate (VARMA et coll. 1970, HARNESS et coll. 1974, LINDAHL, BEIERWALTES).

As for lung metastases a recent Danish survey of thyroid carcinoma reported a frequency of radiographically demonstrated lung metastases in the well differentiated carcinomas of less than 10 per cent; at autopsy of 50 cases pulmonary metastases were revealed in 18, 8 of these with no abnormality detected on chest films during life (RASMUSSON).

In the present series lung metastases were evident in a total of 14 of 52 patients at ^{131}I whole body scintigraphy or on chest films. The patient material is selected insofar as the ^{131}I whole body scintigraphy was carried out only in patients with extrathyroidal tumor tissue. Therefore, the number of patients with lung metastases in this series does not reflect the all-over frequency of lung metastases in well differentiated thyroid carcinoma. Seven of the 14 patients had lung metastases demonstrated both at radiography and at scintigraphy.

The value of ^{131}I whole body scintigraphy in addition to radiography is demonstrated in the 3 patients with an abnormal scan but negative radiography. These cases are in accord with those of other reports both with respect to the combination of abnormal ^{131}I scintigraphy and normal chest films and to the efficacy of treatment as indicated by the loss of capability of the metastases to accumulate ^{131}I (CATZ & STARR, ERNST & HEINE, BARRETT & STENBERG, TURNER & WEIR 1972, BONTE & MCCONNELL).



a b

Follicular thyroid carcinoma in a 24-year-old woman. After surgery, treated with ^{131}I. a) Whole body scintigraphy after first dose. Diffuse and nodular uptake in the lungs. b) After last dose (total dose 13 875 GBq; 375 mCi within 6 months), normal scintigraphy. No abnormality detected on repeat chest films.

Four patients had metastases demonstrated only at chest radiography. Failure of the tumor to concentrate iodine due to low TSH stimulation could be ruled out as the cause of negative scintigraphy, since these patients had laboratory values indicating a hypothyroid state with a high endogenic serum concentration of TSH. Subtotal thyroidectomy was performed in these patients, and the initial ^{131}I uptake in the thyroid remnant was of such a degree as to account for the lack of a demonstrable amount of iodine outside the neck (BEIERWALTES). Two of these patients died before further treatment could be instituted.

In the third patient it was not possible to ablate the thyroid remnant despite treatment with ^{131}I to a total of 27.75 GBq (750 mCi). This patient died with widespread metastatic disease.

Although the thyroid remnant was ablated after several ^{131}I treatment doses in the fourth patient, the radiologically evident metastases remained nondemonstrable by nuclear imaging up to the death of the patient 1 1/2 years after the diagnosis was established. Autopsy confirmed the diagnosis of

thyroid carcinoma with pulmonary metastases. The reason why the pulmonary metastases remained non-demonstrable at scintigraphy in this patient can only be speculated upon.

Failure to accumulate ^{131}I in distant metastases, although the thyroid gland is totally ablated, has been described by HARNESS et coll. and CHARBORD et coll. (1977). Furthermore, PREISMAN & HALPERN (1978) reported that low tumor versus background count ratio may camouflage ^{131}I uptake in small pulmonary metastases.

The figure of 14 patients with lung metastases in the present series can only be considered as a minimum incidence. The result clearly demonstrates that neither ^{131}I whole body scintigraphy nor chest radiography alone will reveal all cases of lung metastases in this type of tumor.

SUMMARY

Pulmonary metastases were diagnosed in 14 of 52 patients with well differentiated thyroid carcinoma by ^{131}I whole body scintigraphy or radiography. Three patients had metastases only demonstrable on scintigraphy, whereas chest radiography was diagnostic in 4 patients with normal scintigraphic findings. Thus, in this type of thyroid carcinoma, neither ^{131}I scintigraphy nor routine chest films alone will reveal all cases of pulmonary metastases.

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