

False positive ^{131}I whole body scans in thyroid cancer

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Abstract. Well differentiated thyroid cancer is a rare disease in the UK. It is the only cancer which, having metastasized, remains curable by radioisotope therapy with ^{131}I . The main indication for administering repeat doses of ^{131}I is the appearance of abnormal uptake in a whole body scan following diagnostic or therapeutic ^{131}I administration. False positive scans, showing the presence of ^{131}I uptake in the absence of residual thyroid tissue or metastases can occur, although they are uncommon. Unless recognized as a false positive, ^{131}I uptake may result in diagnostic error and lead to administration of an unnecessary therapy dose. We describe a series of nine patients in whom the scans showed false positive uptake of ^{131}I , including cases where the cause of the uptake is still uncertain. We demonstrate the common sites of false positive uptake, discuss the underlying mechanisms and suggest a systematic approach to the interpretation of whole body scans in order to prevent unnecessary treatment with ^{131}I .

Whole body scanning with ^{131}I plays an important role in the management of patients with well differentiated thyroid cancer [1]. Areas of uptake demonstrated following diagnostic or therapeutic ^{131}I administration may indicate the need for further therapy with ^{131}I . A variety of reports of false positive whole body scans has demonstrated a diversity of causes such as effusions, second primary tumours and delayed excretion by the usual physiological routes [2–8]. False positive images usually do not create diagnostic confusion, particularly when they are considered together with serum thyroglobulin (Tg) estimation [9] and interpreted by an experienced practitioner. The clinical features also help to distinguish uptake caused by disease from that which is an artefact. Unfortunately, false positive scans can still lead to some patients undergoing invasive procedures or further ^{131}I treatment. We consider this an important reason to review the different types of false positive scans, particularly in view of the limited clinical experience of some practitioners overseeing ^{131}I therapy owing to the rarity of the disease.

To minimize the diagnostic errors which may be caused by false positive scans, it is first necessary to prepare the patient prior to scanning. This includes restricting intake of iodine-containing foods and ensuring an adequately raised level

of thyroid stimulating hormone (TSH) by withdrawing replacement thyroid hormone prior to ^{131}I administration. Secondly, it is necessary to consider the possibility that a scan may be false positive for it to be recognized.

The true frequency of false positive whole body scans is unknown, although it is likely to be uncommon. The following clinical cases illustrate a number of apparently false positive scans; some have been difficult to diagnose and may yet turn out to be the result of recurrent thyroid carcinoma.

Methods

The management of patients at the Royal Marsden Hospital with well differentiated thyroid carcinoma following total thyroidectomy with or without a modified block dissection usually includes ablation with 3 GBq ^{131}I 4 weeks post-operatively, before commencing replacement thyroid hormone. If already on replacement hormone, the patient is asked to discontinue thyroxine (T4) for 3 weeks, or tri-iodothyronine (T3) for 10 days prior to ^{131}I administration. The patient is also placed on a restricted iodine diet. TSH and Tg are measured on the day of ^{131}I administration. Neck and whole body scanning is performed approximately 3 days after isotope administration using a double-headed gamma camera with high energy collimators. In recent years, anterior and posterior whole body views have been taken using a scanning time of 12 cm m^{-1} , without skin markers. Anterior and posterior static views are taken of the neck, without skin markers, using a scanning time of 5 min.

Received 9 June 1999 and in final form 15 November 1999, accepted 20 December 1999.

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Restricted views, with skin markers, were used before whole body images became the standard for our department. The level of serum protein-bound ^{131}I (PBI) is measured 6 days following iodine administration. This measurement is an indicator of the amount of functioning thyroid tissue remaining, as iodine can be bound to protein only by thyroid tissue, which may be either normal thyroid remnant or malignant [10, 11]. In the athyroid patient with no tumour, the ^{131}I PBI should be below a significance level of $<0.01\%$ dose. The patient then starts hormone replacement therapy with T3. A diagnostic ^{131}I scan (370 MBq) is performed 4 months later and if further uptake of ^{131}I is shown, the patient receives a therapeutic dose of 5.5 GBq followed by neck plus whole body scans and PBI estimation at 6 days. Further investigations are performed as indicated by the scan and the final diagnosis of the presence of thyroid carcinoma depends on the results of these investigations as well as on the PBI and Tg results.

Case reports

Details of the patients studied are summarized in Table 1, demonstrating a wide age range (17–77 years) and initial pathological staging (pT1–T4, N0–N1b, M0–M1). All patients underwent initial near total thyroidectomy followed by ablation with 3 GBq ^{131}I . All Tg levels were measured while the patients were taking thyroid hormone replacement (unless otherwise stated).

Case 1

^{131}I whole body scanning following ablation revealed uptake in the thyroid bed and left chest wall. The patient was asymptomatic and chest radiography (CXR) showed no abnormality. Tg was $<1 \mu\text{g l}^{-1}$. There was doubt about the nature of the chest wall uptake as the position and distribution of ^{131}I made skin contamination unlikely. This uncertainty, together with the

presence of lymph node metastases at presentation, resulted in the decision to give a therapeutic dose. The subsequent scan showed minor uptake in the thyroid bed only and Tg and 6-day PBI had returned to normal. The chest wall uptake was considered to be a false positive as a bony metastasis was unlikely to have resolved following a single ablative dose. The patient remains free of disease at follow-up 2 years later.

Case 2

^{131}I whole body scanning following ablation revealed uptake within the thyroid bed only. Because of extrathyroid spread of the patient's primary tumour, she received a therapeutic dose of ^{131}I after which scanning demonstrated ^{131}I uptake in the thorax close to the midline (Figure 1). Tg was $1.1 \mu\text{g l}^{-1}$ and the 6-day PBI was 0.01%. CT scanning revealed no abnormality. This was considered to be a false positive iodine scan as there was no confirmatory evidence of metastatic disease. No further therapy was given and she remains free of disease 3.5 years after presentation.

Case 3

This patient presented with a mass in the sternum from which a biopsy showed metastatic follicular carcinoma. Whole body scanning after near total thyroidectomy and ablation with ^{131}I showed uptake within the thyroid bed and sternum. Tg was raised at $8462 \mu\text{g l}^{-1}$. A scan following a therapeutic dose of ^{131}I continued to show uptake in the sternum but also in two areas in the pelvis (Figure 2). He had no pain and a normal serum alkaline phosphatase. Tg and PBI had fallen to $5.4 \mu\text{g l}^{-1}$ and 0.084%, respectively. It was therefore considered unlikely that he was developing new sites of metastatic disease and this was deemed to be a false positive scan. This assumption was confirmed following a second ^{131}I therapeutic dose, when scanning showed no

Table 1. Presenting characteristics of patients with false positive ^{131}I whole body scans

| Patient | Sex | Age at diagnosis (years) | Stage at diagnosis | Surgery | Histology |
|---------|-----|--------------------------|--------------------|-----------------------------|-----------|
| 1 | F | 65 | T1 N1 M0 | NTT + excision of neck node | Pap |
| 2 | F | 72 | T4 N0 M0 | NTT | Pap |
| 3 | M | 77 | T3 N0 M1 | NTT + sternal mass excision | Fol |
| 4 | F | 32 | T3 N1 M0 | NTT | Pap |
| 5 | F | 33 | T3 N1 M0 | NTT | Pap |
| 6 | F | 27 | T2 N1a M0 | NTT | Pap |
| 7 | F | 60 | T3 N0 M1 | NTT | Fol |
| 8 | F | 17 | T2 N1 M0 | NTT (incomplete excision) | Pap |
| 9 | M | 27 | T4 N0 M0 | NTT | Pap |

M, male; F, female; NTT, near total thyroidectomy; Pap, papillary thyroid cancer; Fol, follicular thyroid cancer.

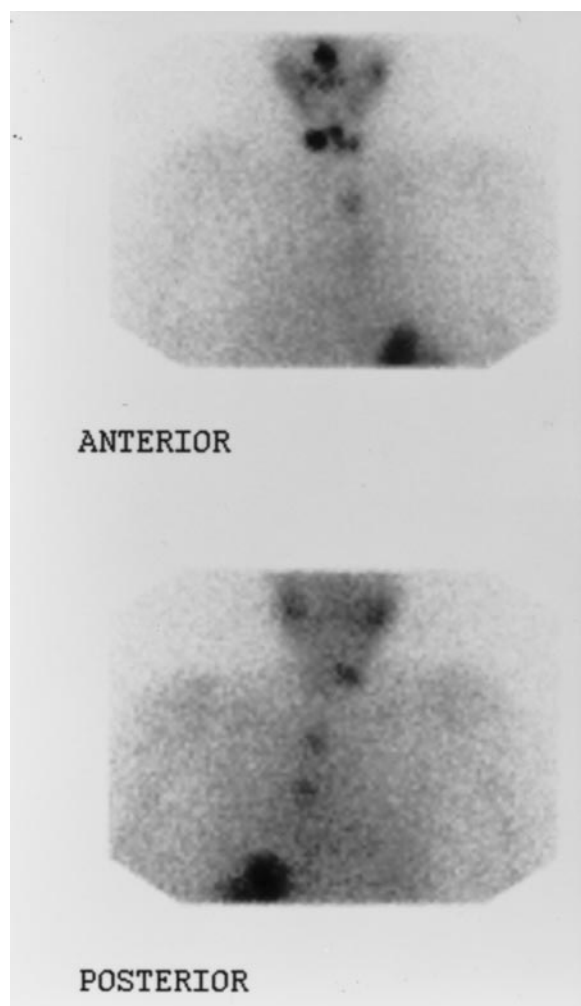


Figure 1. ^{131}I whole body scan demonstrating likely oesophageal ^{131}I localization.

uptake in the pelvis and reduced uptake in the sternum. The patient died at home 4 months later of a cardiac event.

Case 4

After ablation, ^{131}I whole body scanning revealed uptake in the thyroid bed and also in the liver and a solitary focus in a lower right rib (Figure 3). The patient was asymptomatic. Scanning following a therapeutic dose of ^{131}I revealed uptake within the thyroid bed and right neck only. Tg and 6-day PBI levels fell from $610 \mu\text{g l}^{-1}$ to $448 \mu\text{g l}^{-1}$ and 1.023% to 0.045%, respectively. It was unlikely that bone or liver metastases would have been cured by a single ablative dose of ^{131}I ; therefore the rib and liver uptake on the scan was deemed false positive. The patient received four further therapeutic doses of ^{131}I over the following 2 years with persisting uptake in the right neck but no further liver or rib uptake. 10 years after presentation she remains clinically free of disease but has a persistently slightly raised Tg at $4.9 \mu\text{g l}^{-1}$.

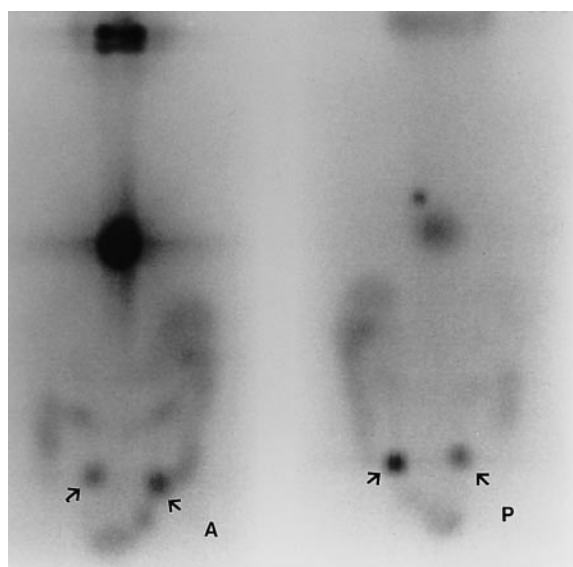


Figure 2. ^{131}I whole body scan demonstrating false pelvic ^{131}I localization (arrows). A, anterior; P, posterior.

Case 5

Following thyroidectomy in 1976 the thyroid bed was treated with external beam radiotherapy (5000 R using 6 MV photons in 33 daily fractions with parallel opposed fields treated on alternate days). An ^{131}I scan 4 months after ablation was negative. In 1997 the patient presented with a left pleural effusion but a normal Tg level. Diagnostic ^{131}I scanning showed uptake in the effusion. After a therapeutic dose of ^{131}I , the scan showed additional uptake at the left apex and in the region of the left clavicle, although she had no symptoms at these sites (Figure 4). The 6-day PBI was well below the normal range at 0.005% dose. A bone scan was normal and CT showed only lung collapse associated with the effusion. Pleural biopsy revealed poorly differentiated carcinoma with negative Tg staining, thought to result from a new primary mesothelioma. The cause of uptake in the region of the clavicle and apex is unknown but ^{131}I localization in the pleural effusion and/or pleural tumour was not the result of lung involvement by thyroid carcinoma, *i.e.* this was a false positive scan. The patient has since died from progressive tumour involving the left lung but with a normal Tg level.

Case 6

^{131}I whole body scanning after an ablative dose showed uptake in the thyroid bed only, as did a therapy scan 3 months later. The patient had no cardiac symptoms but was manic depressive and had intermittently refused to take adequate thyroxine replacement. The manic depressive illness was managed with benzodiazepines and

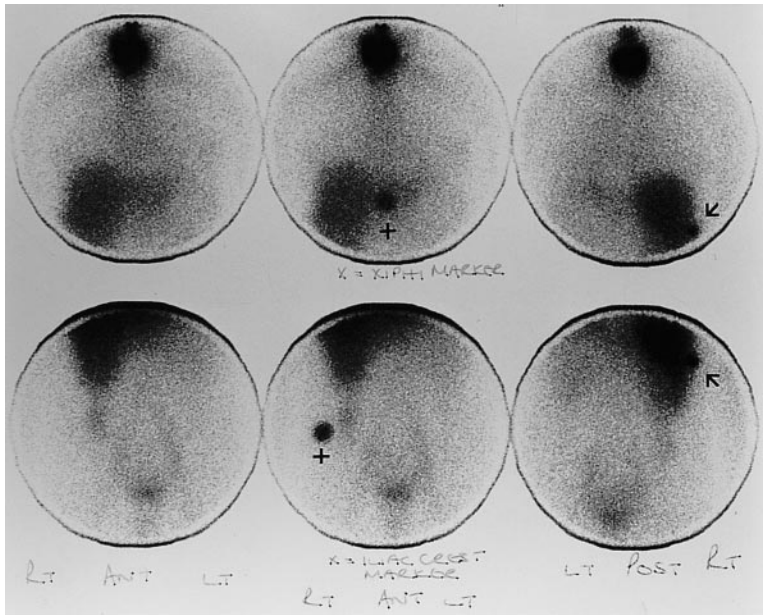


Figure 3. ^{131}I whole body scan demonstrating uptake in the thyroid bed, but also in the liver and a solitary focus in a right lower rib (arrow). +, xiphisternal and iliac crest markers.

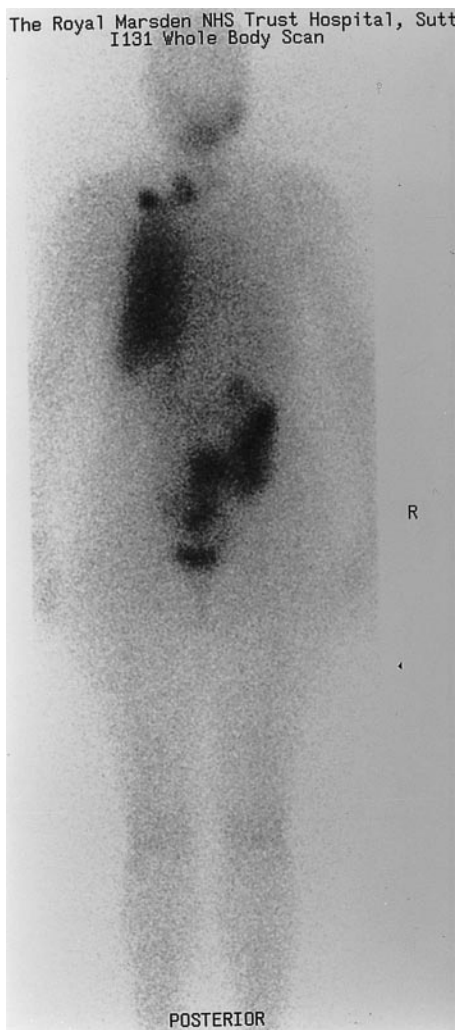


Figure 4. ^{131}I whole body scan demonstrating uptake within a pleural effusion and left lung apex.

haloperidol and she did not receive lithium. A subsequent diagnostic ^{131}I scan showed uptake in the neck with additional uptake around the heart (Figure 5). The latter was considered to be a myxoedematous pericardial effusion in view of her raised TSH at $>50 \text{ mU l}^{-1}$. The neck recurrence was excised and a subsequent ^{131}I therapy whole body scan showed no further evidence of pericardial or neck uptake, but on this occasion demonstrated asymmetric ^{131}I uptake within the breasts (Figure 6). She had completed lactation a few months before and the breast uptake did not persist on a subsequent diagnostic scan. This patient is considered to have had false positive uptake within a pericardial effusion and the breasts and remains free of disease 18 years later.

Case 7

^{131}I whole body scanning after ablation showed uptake in the thyroid bed and lung metastases. Tg was raised at $149 \mu\text{g l}^{-1}$. The lung metastases were managed by repeated therapeutic doses of ^{131}I . A gradual fall in Tg and 6-day PBI indicated a response to treatment. Scanning after a therapy dose 18 months later again showed uptake in the lungs but also revealed ^{131}I uptake the liver. As the Tg and PBI continued to fall, this was considered to be a false positive scan, which was confirmed by the next therapy ^{131}I scan when the liver uptake was not seen. Persisting lung metastases continue to be treated with ^{131}I .

Case 8

Whole body scanning following ablation with ^{131}I showed uptake in the thyroid bed only, when

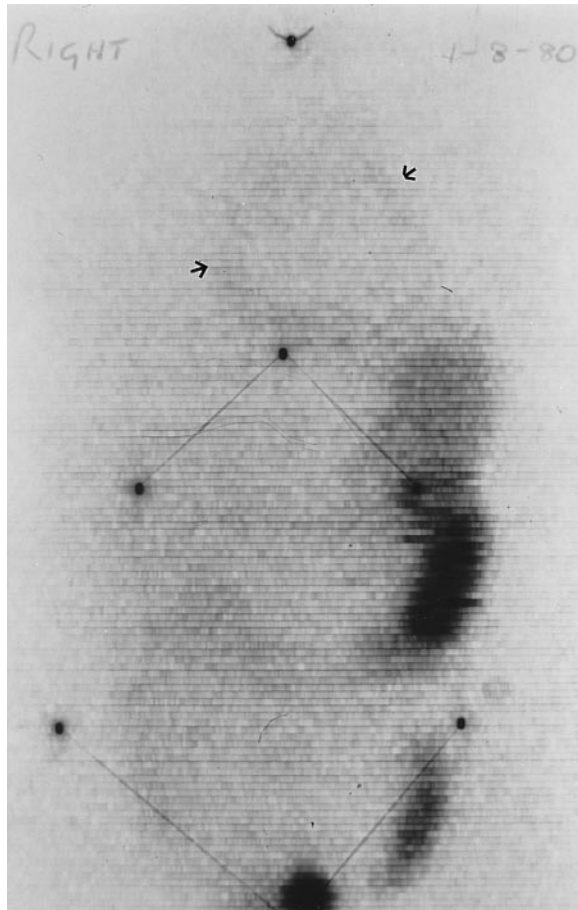


Figure 5. ^{131}I whole body scan demonstrating pericardial ^{131}I localization (arrow). Anatomical markers present.

the Tg was $1826 \mu\text{g l}^{-1}$ (off thyroid replacement). ^{131}I therapy 6 months later demonstrated uptake in both lung fields (Figure 7). Spiral CT of the thorax was normal, as was the 6-day PBI, and Tg had fallen to $30 \mu\text{g l}^{-1}$ (off thyroid replacement). A final ^{131}I therapy scan was negative and the Tg fell to $19 \mu\text{g l}^{-1}$ (off thyroid replacement). There are two possible explanations. The first is that the uptake within the lungs is an example of a false positive scan as it was not present in the initial ablation scan and appeared despite a rapid fall in Tg and PBI. The alternative explanation is that the uptake in the neck in the initial scan was residual normal thyroid tissue. This is more avid for iodine than lung metastases, and the latter only became visible after the thyroid tissue had been ablated. The patient remains free of disease 2 years after her final therapy dose, with an unrecordable Tg (on replacement hormone).

Case 9

^{131}I scanning after ablation revealed uptake in the thyroid bed and throughout both lung fields, although the Tg was below $1 \mu\text{g l}^{-1}$. CXR revealed small pulmonary nodules suggestive of

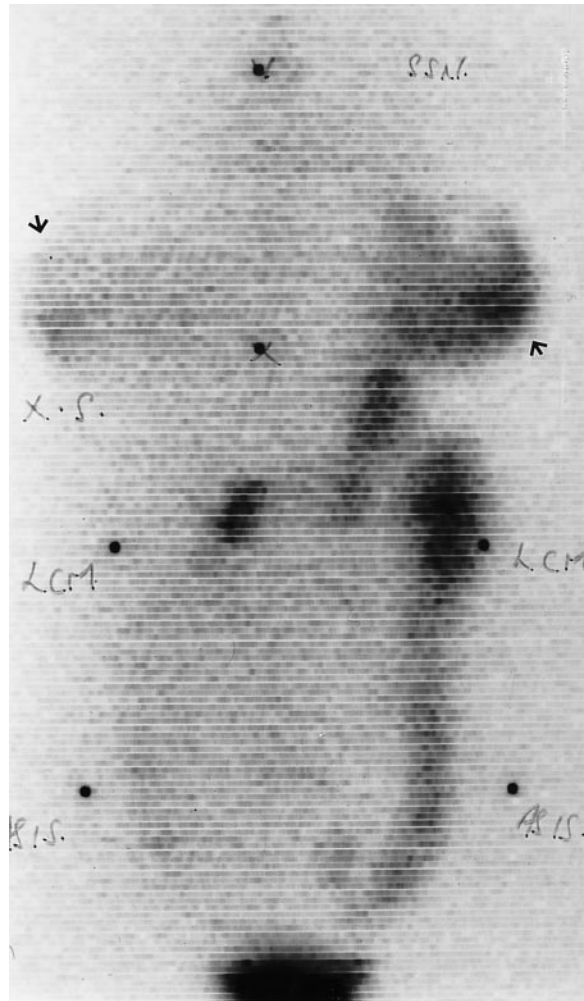


Figure 6. ^{131}I whole body scan demonstrating bilateral breast ^{131}I localization (arrows). Anatomical markers present.

metastatic disease. A therapy ^{131}I scan also demonstrated uptake in the thyroid bed and both lung fields, but the 6-day PBI was not elevated. CT demonstrated only one definite nodule of 5 mm diameter, hence the majority of the pulmonary abnormalities seen on CXR were considered to be of vascular or bronchial origin. Bronchoscopy with alveolar lavage cytology failed to show malignant cells. A repeat CT 2 years later showed no change in the size of this nodule, suggesting the diagnosis of a granuloma. It is possible that this patient did have pulmonary metastases from thyroid carcinoma, in view of an advanced T stage of disease at presentation, papillary histology, male sex and the known phenomenon of micrometastatic disease of the lung which is visible only on an ^{131}I scan and not on conventional diagnostic X-ray imaging. However, the patient has never had a raised Tg or PBI and the appearance on CXR remains unchanged. There is no clinical evidence of disease 3 years following the last therapy dose and we consider the ^{131}I uptake in the lung to be false positive.

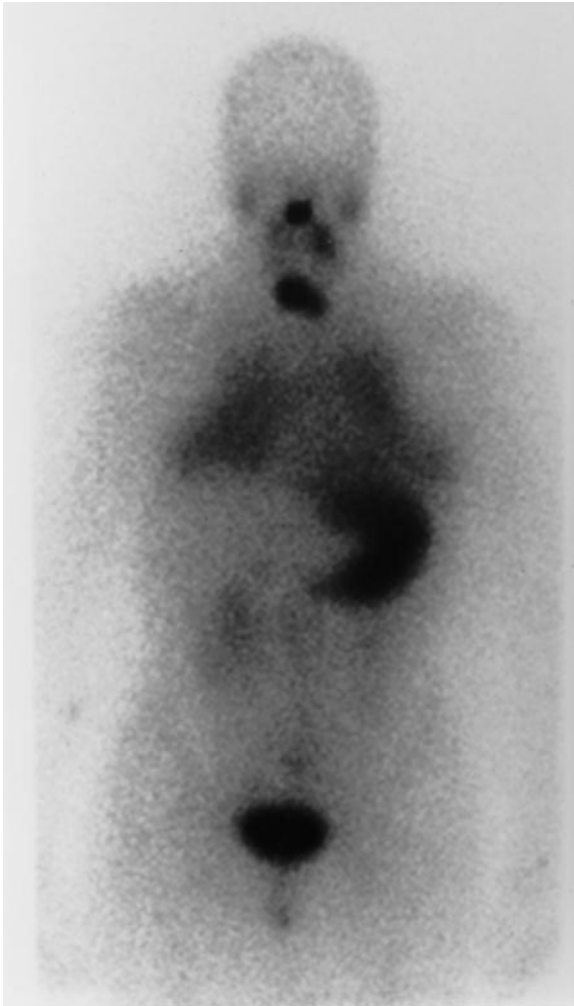


Figure 7. ^{131}I whole body scan demonstrating diffuse lung uptake.

Discussion

Thyroid cancer is a rare disease in the UK. Well differentiated papillary and follicular carcinoma account for approximately 80% of all cases [1]. These are the only cancers known which, having metastasized, can be cured by radioisotope therapy [12]. The challenge to the clinician is to tailor treatment to be vigorous enough to eradicate disease but not to cause unnecessary morbidity [1]. Surgery is the definitive treatment for localized disease. Ablation of the residual thyroid tissue with radioactive iodine usually follows as this will permit subsequent whole body ^{131}I scanning to exclude residual or metastatic disease. In addition, Tg monitoring for follow-up is easier to interpret after all thyroid tissue has been removed. Growth of differentiated thyroid cancer is hormone dependent, so exogenous thyroid hormone is given to suppress TSH secretion [13].

The decision to give a therapeutic dose of ^{131}I depends upon the likelihood of the presence of residual disease, determined by the Tg level and a

whole body scan, following either a diagnostic or therapeutic dose of ^{131}I [10, 11]. A detectable level of Tg, particularly when TSH is completely suppressed, is suggestive of residual thyroid tissue, either normal thyroid remnant or malignant disease [14]. Anti-Tg antibodies can result in either a false high or a false low Tg. The antibody titre should therefore always be measured and taken into account when interpreting the Tg result. A rising Tg antibody titre may itself be an indicator of recurrent carcinoma [15]. Following prior ablation, the whole body scan typically shows normal physiological uptake within the salivary glands, gastrointestinal tract and bladder. In a normal scan, the neck may be either completely free of radioiodine concentration or show a ghost-like remnant of normal residual thyroid tissue [1]. Any other areas of uptake are considered suspicious or positive. An indirect method for quantifying a positive scan is to measure the protein-bound ^{131}I . The percentage of the administered dose per litre which is organically bound in plasma at 6 days after the dose (in the absence of normal thyroid) is proportional to the amount of functioning tumour [16].

Unfortunately, the whole body scan can show areas of ^{131}I uptake not related to thyroid disease, *i.e.* a false positive scan. In most cases these scans do not cause diagnostic confusion as they are interpreted with the knowledge of Tg, 6-day PBI and clinical and radiographic examinations by an experienced practitioner. However, there are occasions when there is uncertainty about the cause of the uptake and further therapy doses of ^{131}I may be given. Fortunately, these clinical dilemmas are uncommon.

The cases described here illustrate part of the range of false positive whole body scans which may be observed following administration of ^{131}I in the management of thyroid carcinoma. False positive scans are usually the result of four general causes: body secretions, pathological transudates and exudates, infection or inflammation, and non-thyroid tumours [5].

Body secretions and exudates/transudates

Iodine is taken up by the salivary glands and these frequently show on scans as part of the normal physiological metabolism of ^{131}I which is then excreted in saliva and may cause diagnostic confusion owing to salivary retention and pooling in other organs. Oesophageal retention of saliva [17] may explain the midline uptake in Case 2 (Figure 1), although the oesophagus is usually best visualized on the anterior scan, and in this case the ^{131}I uptake is most obvious on the posterior scan. Iodine is also excreted by the

stomach and may later appear in the colon as another normal physiological route of excretion [18]. Gastrointestinal disorders causing abnormal gut motility or stasis of gut contents such as Meckel's diverticulum [19], or malformations of the urinary tract, which can delay renal excretion [5], may cause persistent intraabdominal/pelvic uptake and could be the explanation for the abnormality seen in Case 3 (Figure 2).

The normal iodine content of biological fluids probably explains the ^{131}I present in pathological transudates or exudates. This could have caused the uptake in the pericardial effusion in Case 6 and in the pleural effusion in Case 5. Case 5 may include two different mechanisms: uptake in the pleural effusion and by malignant cells of the pleural tumour, which has been reported previously [20].

Infection or inflammation

False positive scans secondary to ^{131}I uptake in inflammatory or infectious lesions include cholecystitis and sebaceous cysts [21], skin burns [5], fungal lesions of the lung [22] and inflammatory lung diseases [23], which may be the mechanism underlying Case 9. The uptake secondary to inflammation may be caused by the iodine content of the biological fluids in the resulting inflammatory exudate.

Non-thyroid tumours

Uptake of ^{131}I into non-thyroid neoplasms has been reported. These reports include tumours containing thyroid tissue, such as struma ovarii [24] and teratoma [25] but other tumour types may also take up ^{131}I such as lung carcinoma [26] and abdominal adenocarcinoma [27]. The mechanism of localization in these latter tumours is uncertain but may be secondary to the inflammatory response associated with the tumours.

Specific organ uptake

The categories outlined above cannot explain false positive ^{131}I scans with uptake in specific organs such as the breast, liver and thymus. Breast uptake does not normally cause diagnostic confusion as this is a most uncommon site for metastasis and is easily examined to exclude pathology, as illustrated by Case 6. Mammary ^{131}I uptake can be caused by lactation [28] but can also occur in the absence of lactation [7] although the mechanism for this is unknown.

^{131}I uptake by internal organs such as the liver can cause greater diagnostic confusion as they are less accessible to examination and may be sites of metastatic thyroid cancer. Liver uptake in the

absence of metastatic disease has been reported [6, 29] and appears to be a relatively common finding with rates of up to 80% reported following therapeutic ^{131}I administration [30]. The pattern of uptake seen in these "physiological" cases appears diffuse, in contrast to the focal uptake of metastatic disease [6]. The frequency of liver uptake is related to dose, with larger ^{131}I doses more likely to accumulate in the liver [6, 29]. The appearance of hepatic uptake is possibly the result of accumulation of iodoproteins secondary to the metabolism of thyroid hormones. Thyroid hormone metabolism is slowed in the presence of hypothyroidism, which is a necessary prerequisite for both ablative and therapy dose administration [6, 29], and hence will predispose to liver uptake.

Physiological thymic uptake has the potential to cause even greater diagnostic confusion because of its anatomical position. False positive uptake has been frequently reported, often in the setting of a diagnostic dilemma, in contrast to false positive breast and liver uptake [8, 31–33]. The mechanism is unknown but Hassall's bodies in the thymus have iodine trapping properties [8].

These cases demonstrate part of the range of false positive ^{131}I scans. It is impossible to estimate the frequency of such scans but they are likely to be relatively uncommon. False positive scans may be kept to a minimum by careful patient preparation prior to ^{131}I administration, which includes rendering the patient sufficiently hypothyroid to ensure avid thyroid tissue uptake and speeding up physiological excretion of ^{131}I by maintaining a high fluid intake, sucking of bitter sweets and the routine use of a laxative during therapy. Reducing the exposure of normal tissue to ^{131}I is desirable to reduce the lifetime total radiation exposure of individual patients and the possible risk of a second malignancy. The use of lateral and/or oblique views to give a third dimension to the scan may also help to identify false positive uptake. Furthermore, as the likelihood of false positive scans rises with increasing doses of ^{131}I [29], the therapeutic dose of ^{131}I should be kept as low as possible without compromising cure. Fortunately, the phenomenon of "stunning", *i.e.* the prior administration of a diagnostic dose of ^{131}I resulting in trapping a lesser proportion of the subsequent therapeutic activity [34], will decrease the likelihood of a false positive scan, although it is theoretically possible that stunning may increase the risk of false negative scans. This is unlikely to be a major problem, however, since stunning appears to be related to the primary dose of ^{131}I used in the diagnostic scan prior to the delivery of a therapeutic dose of ^{131}I , as no case of stunning was identified with a dose of 74 MBq

^{131}I [30], although it was associated with doses above 370 MBq.

Despite these measures, false positive scans still occur and any suspicious uptake should be investigated to prove the presence of persistent thyroid tissue before further ^{131}I is administered. Careful patient evaluation by clinical examination and investigations should identify possible sites of false positive localization, such as effusions and other tumours. Cellular evaluation is considered the "gold standard" investigation, either a biopsy or cytology, from bronchopulmonary lavage for example. In situations where this is not possible and there is still doubt about the cause of ^{131}I localization, imaging techniques complementary to conventional CT and MRI, such as positron emission tomography (PET) and sestamibi scanning, may be helpful [35]. Fluorine-18-fluorodeoxyglucose (FDG) PET is a sensitive technique for the identification of malignant tissue as it concentrates in areas with a high glycolytic rate [36], a feature of many malignant tumours. PET scanning may therefore be of use in distinguishing a false positive from a true positive scan by virtue of increased FDG uptake. Limitations in the use of PET in thyroid cancer include poor discrimination of thyroid cancer in areas of high background signal, since the metabolic rate of the cancer must be higher than the surrounding tissue. This may not be the case in well differentiated thyroid cancer or in areas with a high metabolic activity or physiological routes of ^{131}I excretion, such as the mediastinum (high metabolic rate of the myocardium) and abdomen (high metabolic rate of the liver and excretion route in the kidneys, ureters and bladder). FDG PET is likely to be of most use in the identification of local recurrence in the neck and cervical lymph node metastases. Sestamibi (hexakis (2-methoxyisobutylisonitril) technetium-99m (I)) is a single photon emission computed tomography (SPECT) tracer. It has a sensitivity of about 80–90% and is particularly useful in the detection of Hürthle cell carcinomas [35] owing to their high mitochondrial content. Sestamibi uptake depends mainly on mitochondrial numbers as more than 90% of the tracer is accumulated in the inner mitochondrial matrix [37]. Tumours with a high metabolic rate are also likely to have a high mitochondrial content and therefore sestamibi scanning may be expected to detect a range of tumours similar to that detected by FDG PET. FDG PET and SPECT differ in their spatial resolution, which may determine their optimum role. A major advantage of SPECT is its ability to assess the pattern of uptake in cross-section, which will allow the identification of false positive scans owing to the summation of uptake in overlying tissues in the anteroposterior plane.

Finally, there is only a very limited role for measurement of uptake in suspicious areas. Providing that care has been taken to scan in a manner which provides adequate information about density to identify areas of uptake, measuring the actual quantity of tracer will rarely be able to distinguish between false positive or true positive scans as the tracer is physically present in false positive scans, just not located in thyroid tissue.

Conclusions

Whole body scanning has a well recognized role in the management of patients with well differentiated thyroid cancer. We have demonstrated that scans may sometimes show ^{131}I uptake that cannot be accounted for by the presence of residual thyroid tissue or metastases, *i.e.* false positive scans. We have encountered this problem only occasionally but the number of reports in the literature suggest that there is a significant number of false positive scans. The recognition of a scan as false positive is important in avoiding unnecessary ^{131}I treatment.

The presence of ^{131}I uptake will not lead to an incorrect conclusion when the scan is evaluated in conjunction with the Tg, 6-day PBI, and clinical and radiological findings by an experienced practitioner, recognizing the possibility that uptake does not indicate residual thyroid tissue. Every effort must be made to determine the cause of the uptake. There are rare occasions, however, when doubt remains, especially when uptake occurs in anatomical sites which are common for metastatic disease and there are no positive clinical or radiological findings. The difficult decision whether or not to continue treatment with ^{131}I in these patients should be based on the likelihood of recurrence and the serum Tg.

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