CLINICAL NUCLEAR MEDICINE
*Volume 20, Number 10, pp 869–875*


# *Whole-Body Scintigraphy With Radioiodine-131*
## *A Comprehensive List of False-Positives With Some Examples*

I. ROSS McDOUGALL, M.D., PH.D.

**Whole-body scintigraphy with radioiodine-131 is an important diagnostic test in the management of patients with differentiated thyroid cancer who have undergone surgical treatment. The scan can demonstrate the presence of residual thyroid or functioning metastases in lymph nodes or distant sites. However, there are a number of potential pitfalls in the interpretation of this scan that could lead to a false-positive diagnosis of cancer. The scintiscans are presented for five patients in whom uptake outside of the thyroid was not due to functioning metastases. Some of these abnormalities are physiologic, such as uptake of iodine in the gastrointestinal tract. A comprehensive list of false-positive results are tabulated.**

*From the Division of Nuclear Medicine, Stanford Health Services, Stanford, California*

WHOLE-BODY SCINTIGRAPHY with I-131 is recognized as a valuable test to determine whether there is functioning thyroid tissue. It is generally used after surgery in patients with proven differentiated thyroid cancer and the results are used to determine if it is appropriate to treat the patient with a therapeutic dose of I-131. It is also frequently used to scan the therapy dose anywhere from 2 to 10 days after its administration. Whole-body scintigraphy is then repeated after 6 to 12 months to determine whether that therapy successfully ablated the functioning tissue. The test has good sensitivity, usually in the region of 60 to 80% (1,2). Its specificity is generally reported to be greater than 90% with several reports of 98 to 100% (1,3). The test requires that the patient be off l thyroxine for at least 4 weeks and a reduced iodine diet is recommended (4,5). There is debate about the best dose of I-131 for scintigraphy. The author has always used 2 mCi, and the patient is scanned after a delay of at least 48 hours. Therapy is given either on the same day as the diagnostic scan, or the next day depending on the result of scintigraphy and the logistics of arranging outpatient versus inpatient therapy. Larger diagnostic doses might reduce or inhibit uptake of subsequent therapeutic I-131 (6).

Despite the remarkably high specificity, there is a significant number of case reports and short series (7) of false-positive uptake, which can be misdiagnosed as metastatic cancer. This report shows five examples and provides a comprehensive review of the literature. Nuclear physicians should be alert when the scintigraphic findings do not seem appropriate.

### Case Reports

*Case 1*

A 68-year-old man was found to have a 1.5-cm, hard, thyroid nodule on a routine physical examination. Papillary carcinoma was diagnosed on fine needle aspiration. The patient had a total thyroidectomy. Because of his age, gender, and the fact that the lesion was close to the inked margin of the excised specimen, the patient was advised to have I-131 scintigraphy. The scan showed a single focus of uptake in the region of the thyroid bed, which contained 3% of the administered dose (Fig. 1A). The patient received 100 mCi I-131 and the therapy dose was scanned 5 days later (Fig. 1B). The patient was started on l thyroxine for 10 months, which was then stopped for 4 weeks. A repeat scan at that time shows faint uptake in the thyroid area <0.1% and no evidence of recurrent or metastatic disease (Fig. 1C). This example shows diffuse hepatic uptake in the post-treatment scan due to radioiodinated thyroid hormones being metabolized in the liver (8,9), plus salivary and gut activity; all of which are physiologic.

Received for publication February 28, 1995; accepted April 17, 1995.

Reprint requests: I. Ross McDougall, M.D., PH.D., Division of Nuclear Medicine, Stanford Health Services, Stanford, CA 94305.

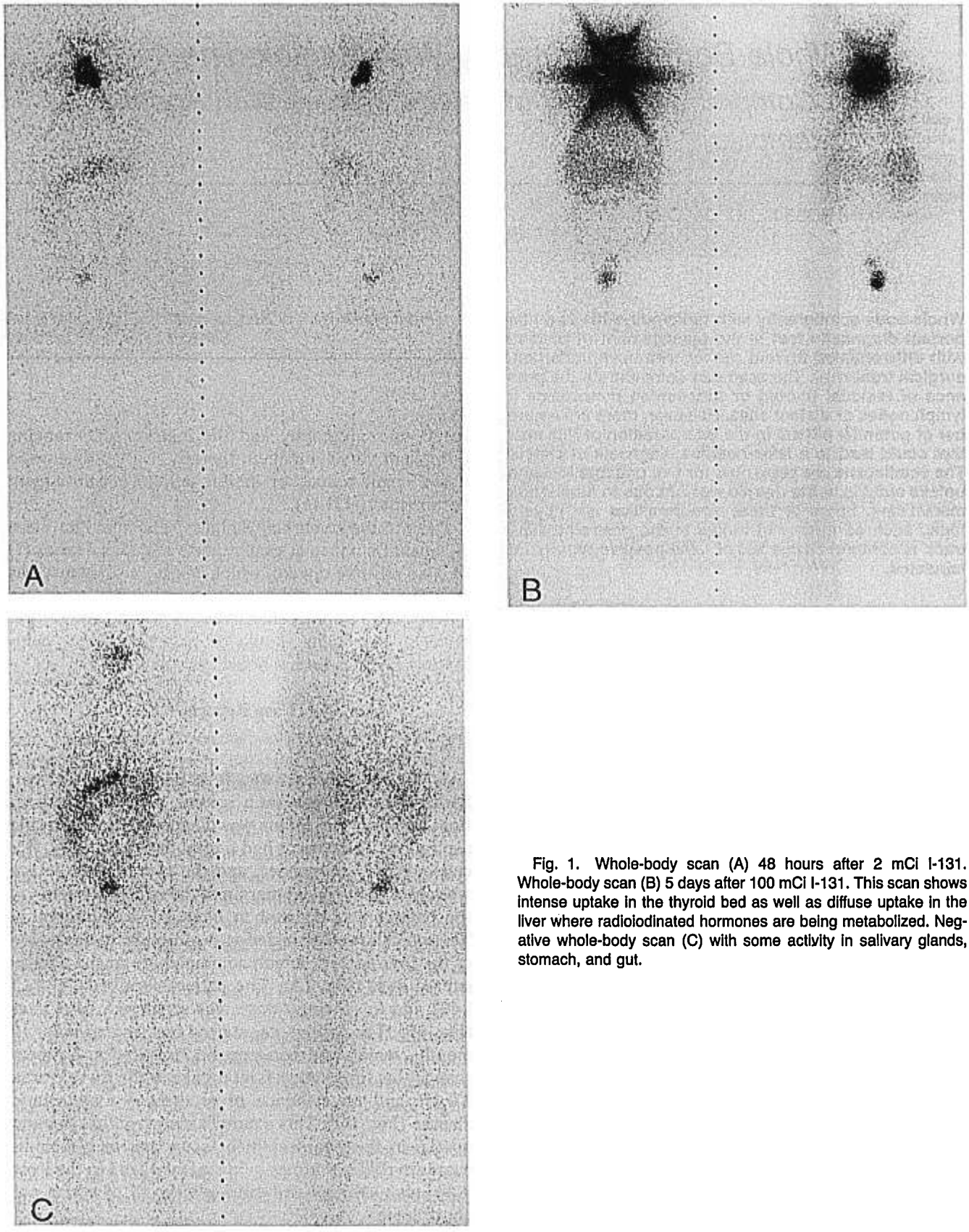



Fig. 1. Whole-body scan (A) 48 hours after 2 mCi I-131. Whole-body scan (B) 5 days after 100 mCi I-131. This scan shows intense uptake in the thyroid bed as well as diffuse uptake in the liver where radioiodinated hormones are being metabolized. Negative whole-body scan (C) with some activity in salivary glands, stomach, and gut.

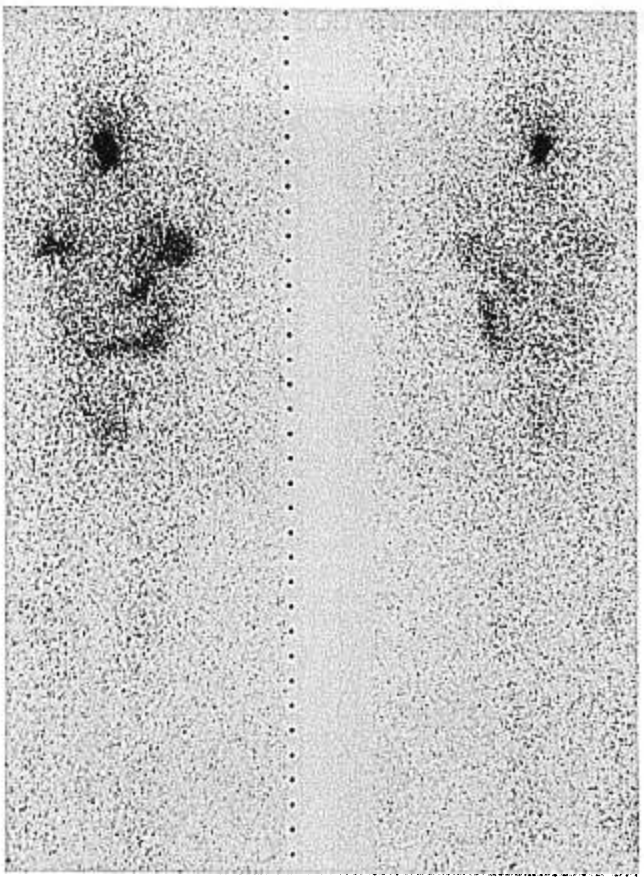


Fig. 2. Whole-body scan 48 hours after 2 mCi I-131 showing diffuse bilateral breast uptake of I-131. Patient had just stopped breast feeding. It should be noted that breast uptake has been noted in nonlactating breasts.

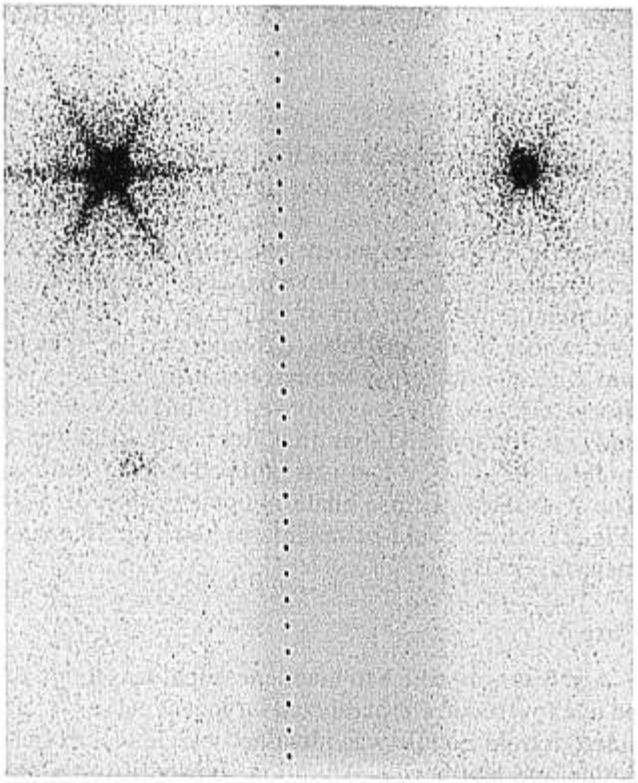
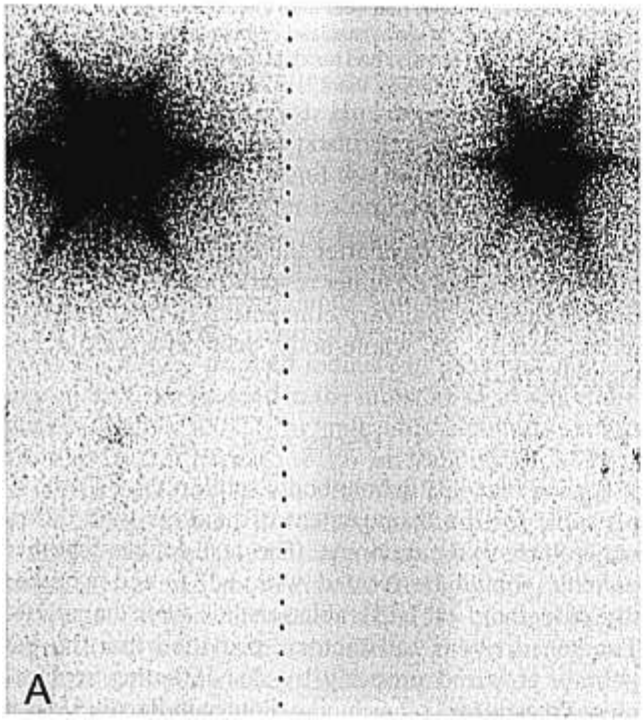


Fig. 3. Whole-body scan 72 hours after 2 mC: I-131 shows uptake in region of thyroid bed.



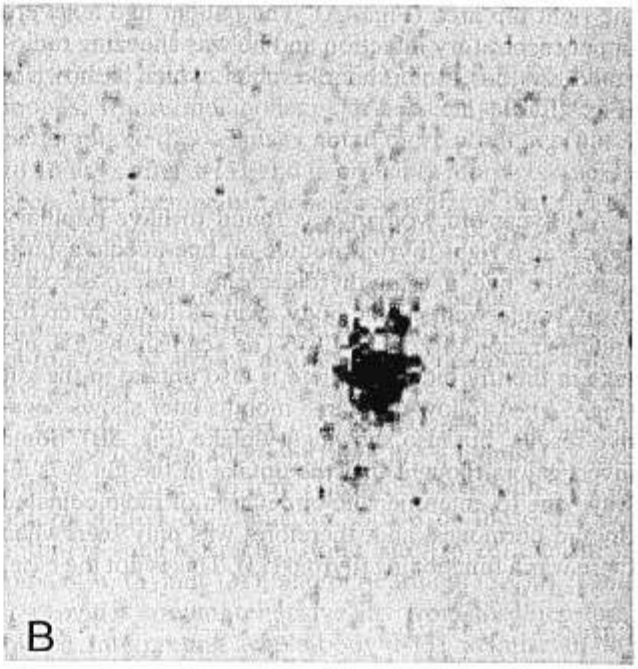




Fig. 4. Whole-body scan 7 days after 30 mCi I-131 showing intense uptake in the thyroid bed (A), which had been noted on diagnostic scan (7%) (3). Irregular uptake is noted in the region of the right hip. This was due to radioactive nasal secretions on a handkerchief, which is imaged in (B).

*Case 2*

A 33-year-old woman had bilateral thyroid nodules. Fine needle aspiration of the right nodule was suspicious for papillary thyroid cancer, and the left nodule appeared benign. The patient had a near total thyroidectomy and was found to have papillary cancer on the right nodule with two foci of follicular variant of thyroid cancer in the left lobe, although the left nodule was clinically obviously benign. Because she had multifocal disease, she was advised to undergo whole-body scintigraphy. At that time, her fourth child was 3 months old and she had just stopped breast feeding. The scan shows diffuse bilateral uptake in the breasts (Fig. 2), which could be misinterpreted as pulmonary metastases (10).

*Case 3*

A 59-year-old man had hoarseness that was found to be due to a recurrent paralyzed laryngeal nerve. A left sided thyroid nodule was identified by clinical examination and fine needle aspiration showed it to be benign. A repeat biopsy specimen was diagnosed as papillary cancer and he underwent subtotal thyroidectomy. Postoperatively, he had a total-body scan that showed a single area of uptake (7%) in the region of the thyroid bed (Fig. 3). He was given 30 mCi I-131 and the therapy dose was scanned 7 days later. In addition to uptake in the neck, there were two faint lesions in the right hip area (Fig. 4A). The patient had a severe upper respiratory infection and he was sneezing radioactive sputum into his handkerchief, which is shown in (Fig. 4B) (11,12).

*Case 4*

A 30-year-old woman was found to have papillary cancer in a right thyroid nodule on fine needle aspiration. She had a total thyroidectomy and, postoperatively, underwent whole-body scan 48 hours after the administration of 2 mCi I-131. The scan shows 1% uptake in the thyroid bed. There is also uptake in the gut (Fig. 5A). A follow-up scan 8 months later shows negative results, but also shows gut uptake (Fig. 5B). Some investigators thought that the uptake in the gut was always due to enterohepatic circulation of radioiodinated thyroid hormones, and, therefore, was only seen when there was a functioning thyroid (13). This is not the case.

*Case 5*

A 49-year-old woman had papillary carcinoma of the thyroid. Whole-body scan 48 hours after the administration of 2 mCi I-131 shows intense uptake in the neck (4%), as well as uptake in the nose and mouth (Fig. 6A). Scintiscan 7 days after the therapy dose shows a hot nose. She had no upper respiratory infection at the time of imaging. Salivary concentration of iodine plus nasal activity on whole-body scan are well documented (14–17).

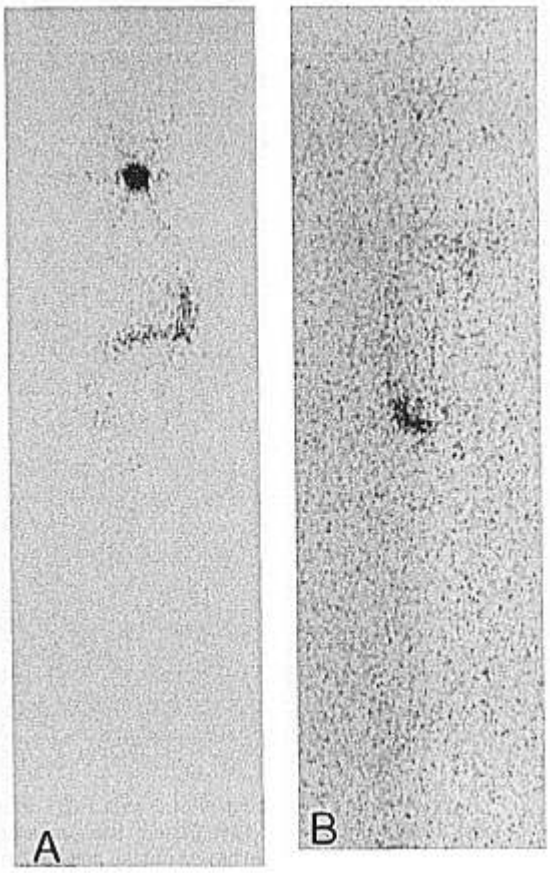



Fig. 5. Whole-body scan (A) 48 hours after 2 mCi I-131 in a patient who had recently had near total thyroidectomy. The bowel, in particular the colon, is well visualized. Whole-body diagnostic scan (B) in the same patient who had residual thyroid ablated immediately after the first scan. Although there is no uptake in the thyroid, there is still activity in the bowel.

## Discussion

Radioiodine-131 whole-body scintigraphy is indispensable for the management of patients with differentiated thyroid carcinoma. The test defines whether patients should be treated with I-131, and whether thyroidectomy or I-131 ablation has been complete. The sensitivity is satisfactory, provided that the patient is prepared properly by discontinuing replacement therapy and by reducing dietary iodine (4,5). The thyrotropin measurement after 4 weeks without l thyroxine is usually elevated unless there is a significant

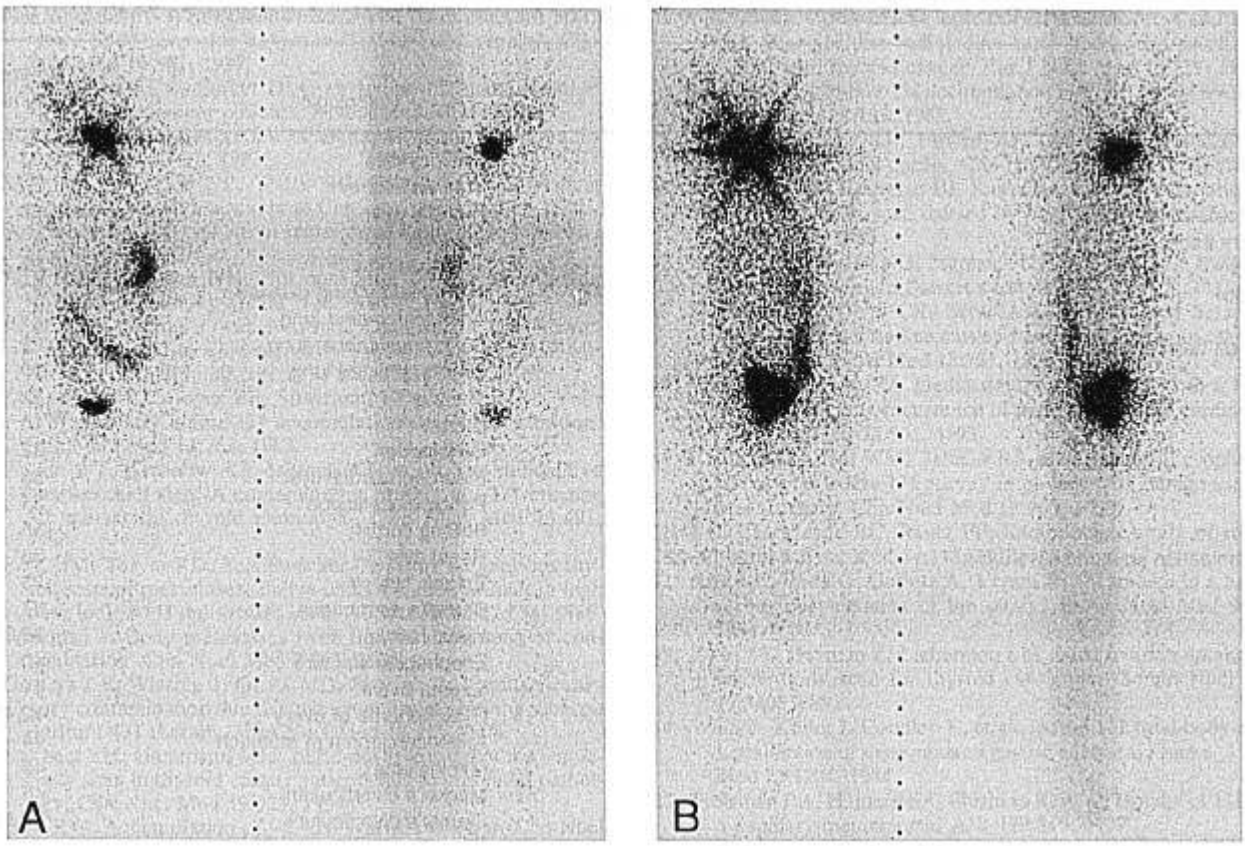



Fig. 6. Diagnostic (A) and therapeutic (B) scans in a woman who was somewhat claustrophobic when imaged with a dual-head camera. She had to keep her head turned to the right. A hot nose and nasopharynx is noted on both scintiscans.

amount of thyroid left after surgery. The specificity is excellent (95–100%) (2,3). However, there are many potential causes of false-positive results (Table 1). Clinicians have to understand the normal distribution of iodine, 48–72 hours after its oral administration. Several organs are capable of trapping iodine, including the salivary glands (14), gastric mucosa, choroid plexus, and mammary glands (10). Iodine trapped by these organs is not retained because it is not organified. Therefore, trapped iodine can pass out of these organs and can be seen in the intestine or in secretions such as saliva (20,22) or milk (10). Similarly, reflux from an hiatal hernia (38,39) or trapping of I-131 in ectopic gastric mucosa in a Meckel's diverticulum (46) are possible causes of a false-positive result.

Any iodine that is not trapped by the thyroid, or the organs described above, is excreted in kidneys. Thus, if the postsurgical remnant traps 5% of an administered dose, 95% is excreted into the urine. As a result, disorders of the kidney, such as an urine containing cysts, will appear as an abnormality (36). Contamination with radioactive urine can be misinterpreted as metastatic cancer. When there is a significant functioning thyroid, it can secrete radioiodinated thyroid hormones, whose metabolism can be seen as diffuse hepatic uptake (8,9). This is noted more often in scans 4 to 10 days after I-131 and is probably more commonly seen after therapeutic doses, recognizing that the diagnostic scan is usually completed at 48 to 72 hours. Any nonanatomical pattern of uptake on a scan should suggest contamination with saliva, sputum, milk, or urine. Thyroidal tissue in ectopic sites such as struma cordis (35) or struma ovarii (41) will be imaged. However, these are very rare.

Each of these causes of uptake on scintiscan is understandable. In addition, there are a number of conditions described to trap I-131 and cause difficulty on interpretation of scintiscan. Some of these are not intuitive such as tracheostomy site (25,26), neurilemoma (49), thymus (31), and pericardium (33,34). Table 1 provides a comprehensive list from the literature. When interpreting whole-body I-131 scintiscan, the nuclear physician should consider the expected distribution of I-131 and ask the following questions:

1. Does the distribution correspond with uptake in the region of the thyroid bed, or where metasta-

TABLE 1. *Normal and Abnormal Distribution of Radioiodine That Can Be Misinterpreted as Metastatic Cancer on Whole-Body Scan*

| Physiologic | Reference Number | Pathologic | Reference Number |
|---|---|---|---|
| Salivary glands | 14 | Dacrocystitis | 23 |
| Nasopharynx | 15–17 | Warthin's tumor | 24 |
| Gastrointestinal tract | | Artificial eye | 23 |
| Urinary tract | | Sinusitis | |
| Sweat | 18 | Tracheostomy | 25,26 |
| Breast | 10 | Inflammatory lung disease | 27 |
| | | Adenocarcinoma lung | 28 |
| Liver on delayed scan | 8,9 | Squamous cancer lung | 29 |
| | | Undifferentiated lung | 30 |
| | | Thymus | 31 |
| | | Breast | 10 |
| | | Gallbladder | 32 |
| | | Pleuropericardial cyst | 33 |
| | | Pericardial effusion | 34 |
| | | Struma cordis | 35 |
| Contamination sputum/saliva/urine | 11,12, 19–22 | Renal cyst | 36 |
| | | Ectopic kidney | 23 |
| | | Barrett's esophagus | 37 |
| | | Hiatal hernia | 38,39 |
| | | Esophageal stricture | 40 |
| | | Struma ovarii | 41 |
| | | Cystadenoma of ovary | 42,43 |
| | | Adenocarcinoma of stomach | 44 |
| | | Meningioma | 45 |
| | | Meckel's diverticulum | 46 |
| | | Zenker's diverticulum | 47,48 |
| | | Neurelimoma | 49 |
| | | Colon graft | 50 |
| | | Dental disease | 51 |
| | | Wig | 52 |
| | | Thyroglossal tract | 53 |
| | | Ectopic thyroid | 55 |

ses are expected: the cervical lymph nodes, lungs, or skeleton?

2. When the distribution suggests functioning metastases, do other features such as size of primary cancer, local invasion, clinical findings, and serum thyroglobulin make this reasonable?
3. Does distribution outside of thyroid correspond with physiologic uptake in salivary glands, stomach, or gastrointestinal tract?
4. Can I-131 outside of these sites be explained by contamination by saliva, sputum, milk, or urine?

## References


1. Bayer MF, McDougall IR, Kriss JP: Retrospective study of serum thyroglobulin measurements performed in patients with differentiated thyroid carcinoma at the Stanford University thyroid clinic between 1979 and 1985. In Hufner M, Reiners C (eds): Thyroglobulin and Thyroglobulin Antibodies in the Follow-up of Thyroid Cancer and Endemic Goiter. Stuttgart, George Thieme Verlag, pp 104–111.
2. Sorge-Van Boxel RAJ, Van Eck-Smit BLF, Goslings BM: Comparison of serum thyriglobulin, $^{131}I$ and $^{201}Tl$ scintigraphy in the postoperative follow-up of differentiated thyroid cancer. Nucl Med Comm 14:365, 1993.
3. Lubin E, Mechlis S, Zatz S, et al: Serum thyroglobulin and iodine-131 whole-body scan in the diagnostic and assessment of treatment for metastatic differentiated thyroid carcinoma. J Nucl Med 35:257, 1994.
4. Maxon HR, Thomas SR, Boehringer A, et al: Low iodine diet in I-131 ablation of thyroid remnants. Clin Nucl Med 8:123, 1983.
5. Lakshamanan M, Schaffer A, Robbins J, et al: A simplified low iodine diet in I-131 scanning and therapy of thyroid cancer. Clin Nucl Med 13:866, 1988.
6. Park H-M, Perkins OW, Edmondson JW, Schnute RB, Manatunga A. Influence of diagnostic radioiodine on the uptake of ablative dose of iodine-131. Thyroid 4:49, 1994.
7. Greenler DP, Klein HA: The scope of false-positive iodine-131 images for thyroid cancer. Clin Nucl Med 14:111, 1989.
8. Rosenbaum RC, Johnston GS, Valente WA: Frequency of hepatic visualization during-131 imaging of metastatic thyroid carcinoma. Clin Nucl Med 13:657, 1988.
9. Zeissman HA, Bahar H, Fahey FH, Dubiansky V: Hepatic visualization on iodine-131 whole-body thyroid scan. J Nucl Med 28:1408, 1987.
10. Bakheet SM, Hammami M: Patterns of radioiodine uptake by the lactating breast. Eur J Nucl Med 21:604, 1994.

11. Chandramouly BS, Scagnelli T, Burgess CK: Artifact on I-131 whole body scan due to contaminated handkerchief. Clin Nucl Med 14:301, 1989.
12. Ibis E, Wilson CR, Collier D, et al: Iodine-131 contamination from thyroid cancer patients. J Nucl Med 33:2110, 1992.
13. Hays MT: Colonic excretion of iodide in normal human subjects. Thyroid 3:31, 1993.
14. Kolla IS, Alazaraki NP, Watts NB: Sialoadenitis mimicking metastatic thyroid carcinoma. Clin Nucl Med 14:564, 1989.
15. Boxen I, Mei Zhang Z: Nasal secretion of iodine-131. Clin Nucl Med 14:610, 1989.
16. Park H-M, Wellman HN: Hot nose after I-131 sodium iodide thyroablation therapy. Clin Nucl Med 17:130, 1992.
17. Norby EH, Neutze J, van Nostrand D, Burman KD, Warren RW: Nasal radioiodine activity: A prospective study of frequency, intensity and pattern. J Nucl Med 31:52, 1990.
18. Camponovo EJ, Goyer PF, Silverman ED, Kistler AM, Yudt WM: Axillary iodine-131 accumulation due to perspiration. Clin Nucl Med 14:762, 1989.
19. Pochis WT, Krasnow AZ, Isitman AT, et al: The radioactive handkerchief sign: A contamination artifact in I-131 imaging for metastatic thyroid carcinoma. Clin Nucl Med 15:491, 1990.
20. Park HM, Tarver RD, Schauwecker DS, Burt R: Spurious thyroid cancer metastases: Saliva contamination artifact in high dose iodine-131 metastases survey. J Nucl Med 27:634, 1986.
21. Wiseman J: Bony metastases from thyroid carcinoma or contamination. Clin Nucl Med 9:963, 1984.
22. Gritters LS, Wissing J, Gross MD, Shapiro B: Extensive salivary contamination due to concurrent use of chewing tobacco during I-131 therapy. Clin Nucl Med 18:115, 1993.
23. Bakheet SM, Hammami MM: False-positive radioiodine whole-body scan in thyroid cancer patients due to unrelated pathology. Clin Nucl Med 19:325, 1994.
24. Burt RW: Accumulation of $^{123}I$ in a Warthin's tumor. Clin Nucl Med 3:155, 1978.
25. Kirk GA, Schulz EE: Post-laryngectomy localization of I-131 at tracheostomy site on a total body scan. Clin Nucl Med 9:409, 1984.
26. Ain KB, Shih W-J: False-positive I-131 uptake at a tracheostomy site: Discernment with Tl-201 imaging. Clin Nucl Med 19:619, 1994.
27. Hoschl R, Choy DHL, Gandevia B: Iodine-131 uptake in inflammatory lung disease: A potential pitfall in treatment of thyroid carcinoma. J Nucl Med 29:701, 1988.
28. Fernandez-Ulloa M, Maxon HR, Mehta S, Sholiton LJ: Iodine-131 uptake by primary lung adenocarcinoma. JAMA 236:857, 1976.
29. Misaki T, Takeuchi R, Miyamoto S, et al: Radioiodine uptake by squamous-cell carcinoma of the lung. J Nucl Med 35:474, 1994.
30. Acosta J, Chitkara R, Khan F, Azueta V, Silver L: Radioactive iodine uptake by a large undifferentiated bronchogenic carcinoma. Clin Nucl Med 7:368, 1982.
31. Jackson GL, Graham UY: Thymus accumulation of radioactive iodine. Pa Med 82:37, 1979.
32. Achong DM, Oates E, Lee SL, Doherty FJ: Gallbladder visualization during post-therapy iodine-131 imaging of thyroid carcinoma. J Nucl Med 32:2275, 1991.
33. Francese C, Schlumberger M, Vera JP, Caillou B, Parmentier C: Iodine 131 uptake in a pleuropericardial cyst: Case report of a false-positive radioiodine total body scan result in a patient with thyroid cancer. Eur J Nucl Med 18:779, 1991.
34. Maslack MM: Iodine-131 accumulation in a pericardial effusion. J Nucl Med 28:133, 1987.
35. Rieser GD, Ober KP, Cowan RJ, Cordell AR: Radioiodine imaging of struma cordis. Clin Nucl Med 13:421, 1988.
36. Brachman MB, Rothman BJ, Ramanna L, et al: False-positive iodine-131 body scan caused by large renal cyst. Clin Nucl Med 13:416, 1988.
37. Berquist TA, Nolan NG, Stephens DM, Carlson HC: Radioisotope scintigraphy in Barrett's esophagus. AJR 123:401, 1975.
38. Schneider JA, Divgi CR, Scott AM, et al: Hiatal hernia on whole-body radioiodine survey mimicking metastatic thyroid cancer. Clin Nucl Med 18:751, 1993.
39. Willis LL, Cowan RJ: Mediastinal uptake of I-131 in a hiatal hernia mimicking recurrence of papillary thyroid carcinoma. Clin Nucl Med 18:961, 1993.
40. Kistler AM, Yudt WM, Bakalar RS, et al: Retained esophageal activity on iodine-131 survey in patient with benign esophageal stricture. Clin Nucl Med 18:908, 1993.
41. Yeh EL, Meade RC, Reutz PP: Radionuclide study of struma ovarii. J Nucl Med 14:118, 1973.
42. Kim EE, Pjura G, Gobutz A, Verani R: $^{131}I$ uptake in a benign serous cystadenoma of the ovary. Eur J Nucl Med 9:433, 1984.
43. Zwas ST, Heyman Z, Lieberman LM: I-131 ovarian uptake in a whole body scan for thyroid carcinoma. Semin Nucl Med 19:340, 1989.
44. Wu SY, Kollin J, Coodley E, et al: Iodine-131 total-body scan: Localization of disseminated gastric adenocarcinoma. J Nucl Med 25:1204, 1984.
45. Preisman RA, Halpern SA, Shishido R, et al: Uptake of 131-I by a papillary meningioma. AJR 129:349, 1977.
46. Caplan RH, Gundersen GA, Abellera RM, Kisken WA: Uptake of iodine-131 by a Meckel's diverticulum mimicking metastatic thyroid carcinoma. Clin Nucl Med 12:760, 1987.
47. Boulahdour H, Meignan M, Melliere D, et al: False-positive I-131 scan induced by Zenker's diverticulum. Clin Nucl Med 17:243, 1992.
48. Dhawan VM, Kaess KR, Spencer RP: False positive thyroid scan due to Zenker's diverticulum. J Nucl Med 19:1231, 1978.
49. Ceccarelli C, Pacini F, Lippi F, Pinchera A: An unusual case of a false-positive iodine-131 whole body scan in a patient with papillary thyroid cancer. Clin Nucl Med 13:192, 1988.
50. Wang P-W, Chen H-Y, Li C-H, Chen W-J: Uptake of I-131 by an abdominal neurilemoma mimicking metastatic thyroid carcinoma. Clin Nucl Med 18:964, 1993.
51. Herzog G, Kisling G, Bekerman C: Diagnostic significance of dental history in the clinical evaluation of patients with thyroid carcinoma. Clin Nucl Med 17:589, 1992.
52. Abdel-Dayem HM, Halker K, Sayed ME: The radioactive wig in iodine-131 whole body imaging. Clin Nucl Med 9:454, 1984.
53. Feuerstein IM, Harbert JC: Hypertrophied thyroid tissue in a thyroglossal duct remnant. Clin Nucl Med 11:135, 1986.
54. Wu S-Y, Brown T, Milne N, et al: Iodine131 total body scan: Extrathyroidal uptake of radioiodine. Semin Nucl Med 16:82, 1986.