Excretion of Radioactivity in Breast Milk After an Indium-111 Leukocyte Scan

TO THE EDITOR: When a radiopharmaceutical is administered to a lactating mother, breast feeding must be interrupted until the potential radiation dose to the infant has diminished to an acceptable level (*1,2*). Indium-111-labeled leukocyte scanning (ILLS) is a widely used technique for localizing infection, but there is no data describing the excretion of indium-111 (^{111}In) in breast milk. The recent referral of a lactating mother for an ILLS has enabled some measurements to be made of the resultant release of ^{111}In activity in breast milk.

A 26-yr-old woman delivered a full-term infant complicated by a retained placenta requiring manual removal. Subsequently, she developed a fluctuating temperature and leukocytosis. Antibiotic treatment failed to control these symptoms, blood cultures were negative, and her general condition deteriorated. Her white cell count was $24 \times 10^9/1$, and an abscess in the Pouch of Douglas was suspected. Ten days after delivery, a sample of the patient's leukocytes was labeled with 0.7 mCi (24 MBq) of ^{111}In oxine (*3*). Images taken 4 and 24 hr after reinjection of the labeled cells showed a large area of abnormal uptake in the lower abdomen and pelvis. At laparotomy on the third day after reinjection, 150 ml of pus was drained from the patient's pelvis.

The volumes and measured ^{111}In concentrations in 10 milk samples expressed with a pump over three days after reinjection are given in Table 1. The concentration of ^{111}In at 2.2 hr after reinjection was 0.09 nCi/ml, rising to a maximum value of 0.2 nCi/ml at 12.7 hr. Beyond this time, the concentration of activity decreased at about the same rate as the physical half-life (67.2 hr). The delay in reaching a maximum concentration must have been caused in part by the slow intravascular disappearance of labeled leukocytes ($T_{1/2}$ = 5 hr) (*4*). Using 10% trichloroacetic acetic acid precipitation, the proportion of protein-bound ^{111}In was found to decrease with time (Table 1). The initial activity contained a greater proportion of protein-bound ^{111}In, which was probably caused by the small amount of residual free ^{111}In unavoidably reinjected in a labeled cell suspension (*3*). Cell bound activity was considered absent because centrifugation of the third sample failed to concentrate activity, and microscopic examination of a stained smear revealed just cellular debris, with the occasional epithelial cell and macrophage.

There are many uncertainties and assumptions associated with the calculation of the potential radiation dose to a breast-fed infant (*2*). In this case, the chemical form and its likely anatomical distribution in the infant were unknown. The whole-body dose equivalents per feed were estimated by assuming 100 ml per feed, total absorption and retention by the 4 kg infant, and a factor of 12.1 mrem/μCi (3.3 mSv/MBq) derived from adult data for i.v. administration of In^{3+} and corrected for body weight (Table 1) (*5*). On the further assumptions of uninterrupted breast feeding, a 4-hr interval between feeds, and an excretion rate the same as the physical half-life, the total-body dose equivalent would have been 6 mrem and the infant would have ingested less than 2% (0.52 μCi) of the annual limit of intake of ^{111}In (for a member of the public and corrected for body weight) (*6*). An interruption of 24 hr in breast feeding would have decreased these values by only 25%.

TABLE 1
Measured Concentration of ^{111}In in Breast Milk, Percentage of Protein-Bound Activity, and Total Body Dose Equivalents to a New-born Infant

Time after reinjection (hr)	Volume of milk sample (ml)	Activity concentration (nCi/ml)	Protein -bound (%)	Total body dose equivalent (per 100 ml) (mrem)
2.2	11	0.089	60	0.108
7.2	5	0.174	—	0.211
12.7	34	0.204	27	0.247
18.2	12	0.165	—	0.200
22.2	29	0.171	—	0.207
28.0	32	0.147	27	0.178
32.2	20	0.149	—	0.180
45.2	10	0.137	—	0.165
47.4	19	0.148	10	0.179

These assumptions should result in an overestimate of the total dose equivalent and ingested activity. In our experience, infection can be localized with an ILLS using an injected activity as low as 0.2 mCi (7.4 MBq), and thus the potential dose and ingested activity could be reduced by 70%. An ILLS has many advantages over a gallium-67 citrate scan for the detection of pelvic infection. In addition, this study has shown that in a lactating mother, it has the additional benefit of releasing a concentration of radioactivity in breast milk which is about 0.1% of that released by gallium-67 (*7,8*).

The measurements show that following an ILLS only a small quantity of ^{111}In appears in breast milk. Because of biologic variation between patients and differences in labeling techniques, further studies are needed before it can be recommended that it is unnecessary to interrupt breast feeding after an ILLS.

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References

1. Anderson PO: Drugs and breast feeding—A review. *Drug Intel Clin Pharmacol* 11:208-223, 1977
2. Coakley AJ, Mountford PJ: Nuclear medicine and the nursing mother. *Br Med J* 291:159-160, 1985
3. Mountford PJ. Allsopp MJ, Baird AC, et al: A study of leukocyte labeling efficiencies obtained with In-111 oxine. *Nucl Med Commun* 6:109-114, 1985

4. Weiblen BJ, Forstrom L, McCullough J: Studies of the kinetics of Indium-111-labeled granulocytes. *J Lab Clin Med* 94:246–255, 1979
5. DHSS Health Notice HN(84)5: Notes for the guidance on the administration of radioactive substances. Appendix 1, Parts A and B, DHSS, London, 1984, p 22–26
6. ICRP Publication 30. Limits for intakes of radionuclides by workers. Supplement to part 2. Oxford, Pergamon Press, 1980, p 333
7. Larson SM, Schall GL: Gallium-67 concentration in human breast milk. *JAMA* 218:257, 1971
8. Tobin RE, Schneider PB: Uptake of Ga-67 in the lactating breast and its persistence in milk: Case report. *J Nucl Med* 17:1055–1056, 1976

Thyroid Carcinoma Metastatic to Pituitary

TO THE EDITOR: We have treated a patient with metastatic carcinoma of the thyroid who developed panhypopituitarism from a pituitary metastasis while undergoing iodine-131 (^{131}I) therapy. The diagnosis of pituitary deficiency was not established until after thyroxine therapy was reinstituted.

A 44-yr-old male had papillary thyroid carcinoma for at least 25 yr. Multiple surgical procedures, including mediastinal exploration and a tracheostomy for regional recurrence of the disease, were performed. Eight years ago, we saw him for a radioiodine (^{131}I sodium iodide) metastatic survey. That examination did not reveal any abnormal activity. A repeat study 1 yr later showed right mediastinal uptake. He was treated with 180 mCi of ^{131}I. Follow-up images, 6 mo later, showed improvement but persistence of activity in the right mediastinum. Exploration of the chest, 1 yr after this, demonstrated a large mass of metastatic thyroid carcinoma which was surgically removed. He was again treated with ^{131}I (205 mCi). Imaging with the therapeutic dose of ^{131}I revealed abnormal activity in both right and left mediastinal areas, skull, chest wall and left epigastrium.

Sixteen months later, exogenous thyroid medication was discontinued for 6 wk. A therapeutic dose of ^{131}I sodium iodide (250 mCi) was again administered. Prior to the radioiodide therapy, the serum TSH level was 55 mU/ml (normal 0–6.5). Imaging, following ^{131}I treatment, demonstrated multiple small foci in the mediastinum, pelvis, rib cage, and skull (Fig. 1). There was a midline skull lesion. A technetium-99m-diphosphonate bone scan also showed multifocal abnormality involving the skull, ribs, spine, and pelvis. Following this ^{131}I therapy, the patient began to lose weight, feel weak, and become hypotensive and hyponatremic. Thyroxine therapy was reinstituted, but he did not improve. He was admitted to the hospital for further endocrine evaluation. At 30 days after radioiodine therapy, serum cortisol was undetectable (normal = 4–24 μg/dl). Serum LH was 2.7 IU/l (normal for males = 3–20 IU/l). The serum FSH was 2 IU/l (normal for males = 2.5–15 IU/l), and serum testosterone was below 15 ng/dl (normal for males = over 300 ng/dl). Skull radiographs showed an abnormal (demineralized) sella, and a subsequent CT scan revealed a large intrasellar pituitary tumor. The patient was treated medically for secondary adrenal insufficiency and hypogonadism and improved dramatically. Transsphenoidal excision of a pituitary tumor was performed, and the tissue diagnosis was metastatic papillary thyroid carcinoma of the pituitary. About 13 mo later, the patient was given 250 mCi of ^{131}I. However, the mediastinal metastases continued to grow. He succumbed to massive intrathoracic hemorrhage. This case illustrates that papillary carcinoma of the thyroid can metastasize to the pituitary resulting in panhypopituitarism. Symptoms of hypopituitarism may be difficult to separate from those of hypothyroidism, which may be induced in these patients for purposes of ^{131}I therapy.

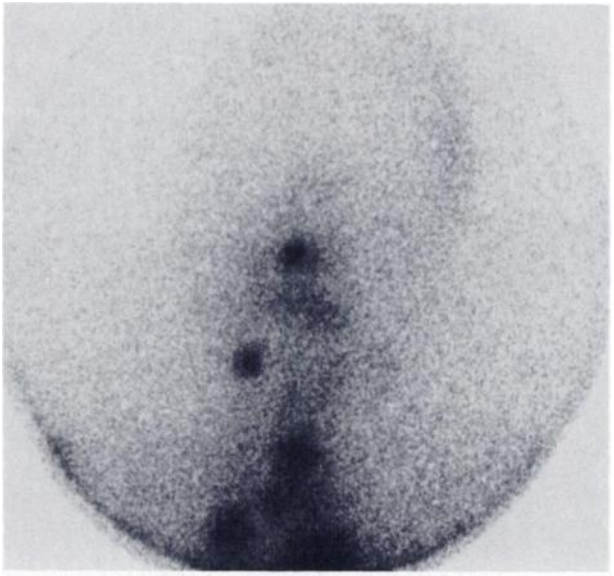

FIGURE 1
Anterior view of head, neck and upper thorax obtained 7 days after administration of therapeutic dose of radiodiodide. Multiple lesions, including one in midline of skull, can be noted

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Use of a Cardiac Phantom for Intersystem Survey

TO THE EDITOR: We were interested to read the paper by Makler et al. (*1*) in which they report their use of the Vanderbilt phantom to establish the variability of ejection fractions measured by a number of hospitals in an interhospital survey.