considered small, and the patient agreed to the study. Breast milk samples were obtained two times after injection to estimate the radiation dose to the child.

Five hundred microcuries of ^{111}In-DTPA were injected intrathecally. Breast milk was pumped and a sample counted at 3 and 20.5 hr postinjection. The gamma well counter had a system sensitivity of 1.38×10^6 cpm/μCi using a 0.5-μCi ^{111}In standard and an energy window with a lower level discriminator set at 140 keV with the upper level discriminator wide open. Count rates were 60 cpm/ml at 3 hr and 35 cpm/ml at 20.5 hr. Therefore, the breast milk had an approximate specific activity of 4.3×10^{-5} μCi/ml at 3 hr and 2.6×10^{-5} μCi/ml at 20.5 hr.

We assumed that all of the radioactivity appearing in the breast milk was conjugated to DTPA and was absorbed instantaneously from the child's gastrointestinal tract into the blood pool. The child's dose per unit ingested activity was calculated using the DTPA pharmacokinetic model of McAfee et al. (*6*). The newborn phantom of Cristy and Eckerman (*7*) was also used. Assuming a 2-hr urinary bladder voiding interval, estimated radiation dose to the bladder wall was 6.4 rads/mCi (i.e., rads per millicurie ingested by the infant). All other organs received between 0.2 and 0.6 rads/mCi. Using Cristy and Eckerman's 1-yr-old model (*8*) and a 2-hr bladder void, the estimated bladder wall dose was 2.7 rads/mCi. All other organs received between 0.1 and 0.25 rads/mCi.

To estimate the total dose from the episode, the ingested activity was calculated. Assuming the amount of radioactivity follows a monoexponential pattern for decrease, the two data points yielded an effective half-life for ^{111}In-DTPA in the breast milk from cisternography of approximately 24 hr. Assuming 8 oz of milk per feeding, a 4-hr interval between feeds and an uninterrupted feeding schedule, the ingested activity would be approximately 1 μCi. Thus, the highest target dose estimate organ—to the bladder wall using the newborn model—would be less than 1 mrad. This is comparable to the whole-body dose arising from naturally occurring isotopes ^{14}C and ^{40}K ingested from organic foodstuffs.

REFERENCES

1. Chilton HM, Thrall JH. Radiopharmaceuticals for central nervous system imaging: blood-brain barrier, function, receptor-binding, cerebral spinal fluid kinetics. In: Swanson DP, Chilton HM, Thrall JH, eds. *Pharmaceuticals in medical imaging: radiopaque contrast media, radiopharmaceuticals, enhancement agents for magnetic resonance imaging and ultrasound*. New York: Macmillan Publishing Co.;1990:332.
2. Coakley AJ, Mountford PJ. Nuclear medicine and the nursing mother. *Br Med J* 1985;291:159–160.
3. Mountford PJ, Coakley AJ, Hall FM. Excretion of radioactivity in breast milk following injection of ^{99m}Tc-DTPA. *Nucl Med Commun* 1985;6:341–345.
4. Mountford PJ, Coakley AJ. Excretion of radioactivity in breast milk after an ^{111}In leukocyte scan. *J Nucl Med* 1985;26:1096–1097.
5. Pullar M, Hartkamp A. Excretion of radioactivity in breast milk following administration of an ^{113m}In-labeled chelate complex. *Br J Radiol* 1977;50:846.
6. McAfee JG, Gagne G, Atkins HL, Kirchner PT, Reba RC, Blaufox MD, Smith EM. Biological distribution and excretion of DTPA labeled with Tc-99m and In-111. *J Nucl Med* 1979;20:1273–1278.
7. Cristy M, Eckerman KF. Specific absorbed fractions of energy at various ages from internal photon sources. VI. Newborn. *Oak Ridge National Laboratory Rep. ORNL/TM-8381*, vol. 6, Oak Ridge: Oak Ridge National Laboratory; 1987.
8. Cristy M, Eckerman KF. Specific absorbed fractions of energy at various ages from internal photon sources. II. One-year-old. *Oak Ridge National Laboratory Rep. ORNL/TM-8381*, vol. 2. Oak Ridge: Oak Ridge National Laboratory; 1987.

Timothy K. Johnson
University of Colorado Health Sciences Center
Denver, Colorado

Michael Stabin
Oak Ridge Associated Universities
Oak Ridge, Tennessee No. 8

Unilateral Iodine-131 Uptake in the Lactating Breast

TO THE EDITOR: We read with interest the article by Robinson et al. (*1*) on ^{131}I content in breast milk following therapy for thyroid carcinoma. Up to nearly 30% of the administered amount of ^{131}I can appear in breast milk (*2*). There are various aspects which should be considered before administration of a diagnostic or therapeutic amount of ^{131}I:

1. As described by Robinson et al. (*1*), the infant effective dose and infant thyroid dose is extremely high and would require discontinuation of breast feeding for about 2 mo. In a study on the excretion of various radiopharmaceuticals in human breast milk, Robow et al. (*3*) stated that breast feeding is contraindicated after ^{131}I administration, even when the activity is given for diagnostic purposes (40 MBq).
2. The radiation exposure to the breast itself is high, resulting in an increase of the effective dose of the treated women in addition.
3. Iodine-131 uptake in the breast can cause difficulties in the evaluation of whole-body scintigraphy in patients suffering from thyroid carcinomas, particularly if the uptake pattern is irregular (*4*) and mimicks lung metastases. Bakheet and Hammami (*4*) described asymmetries in the majority of their patients. Unilateral uptake was observed in a patient with mastitis (*4*).

Under normal circumstances, breast feeding is not a major problem in women being treated for thyroid carcinoma, since they have normally discontinued feeding before admission to the hospital for surgery. We present an uncommon finding of excessive ^{131}I uptake in the left breast with nearly no visible activity on the contralateral side (Fig. 1). This 41-yr-old woman underwent a second treatment with 3.7 GBq ^{131}I for papillary thyroid carcinoma (pT2). The treatment was interrupted after the first therapy because the patient became pregnant about 2 mo after the first treatment. For 4 yr, further therapy with ^{131}I was refused by the patient. At admission, she did not mention that she was breast feeding her now 4-yr-old son. Whole-body scintigraphy was performed 2 and 7 days after ^{131}I administration. Both scans showed intense uptake of ^{131}I in the whole left breast and only a small amount of activity in the right breast. When questioned about breast feeding, she said that she has been feeding her son with only the left breast since about 3 yr. After comparison of the early and delayed scans, no shifting from the breast to the thyroid remnant, as described by Bakheet and Hammami (*4*), was observed in this patient. The patient was advised to discontinue breast feeding, to increase fluid intake and to use a milk pump to reduce radiation exposure.

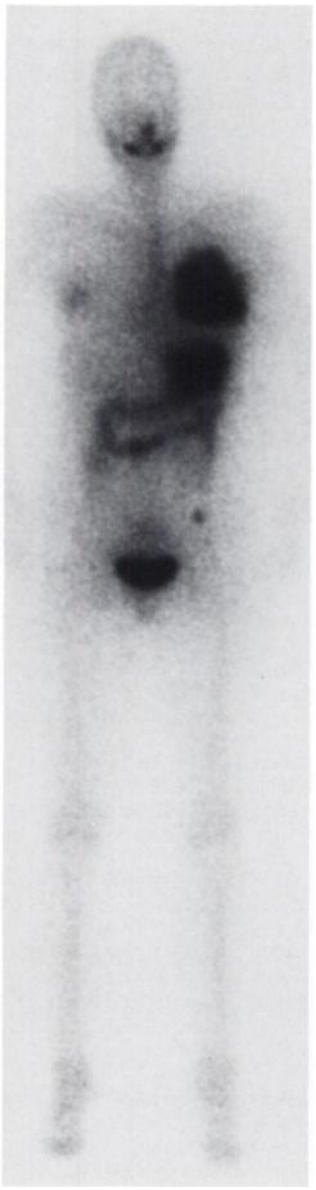

FIGURE 1. Whole-body scintigram (anterior view) in a 42-yr-old woman breastfeeding with the left breast 2 days after the second ^{131}I treatment for thyroid carcinoma. There is intensive uptake in the left breast with nearly no visible radioactivity on the contralateral side or in the thyroid bed.

REFERENCES

1. Robinson PS, Barker P, Campbell A, Henson P, Surveyor I, Young PR. Iodine-131 in breast milk following therapy for thyroid carcinoma. *J Nucl Med* 1994;35:1797–1801.
2. Weaver JC, Kamm ML, Dobson RL. Excretion of radioiodine in human milk. *JAMA* 1960;173:872–875.
3. Robow S, Klopper J, Wassermann H, Baard B, van Niekerk M. The excretion of radiopharmaceuticals in human breast milk: additional data and dosimetry. *Eur J Nucl Med* 1994;21:144–153.
4. Bakheet SM, Hammami MM. Patterns of radioiodine uptake by the lactating breast. *Eur J Nucl Med* 1994;21:604–608.

F. Grünwald
H. Palmedo
H. J. Biersack
University of Bonn
Bonn, Germany

REPLY: We read the comments of Grunwald et al. with interest. In our study (*1*), we were initially uncertain whether prolonged discontinuation of breast feeding would be required after total thyroidectomy since the magnitude of the second exponential component of the ^{131}I breast milk activity concentration curve (incorporation of ^{131}I into thyroid iodoproteins and subsequent recycling) might be expected to be greatly reduced. This proved optimistic and we agree that breast feeding is contraindicated following ^{131}I administration (*2*).

The absorbed dose to the lactating breast is high, although the validity of our model is uncertain. Mammary epithelial cell loss associated with involution may affect the consequences of this exposure. Confusion of breast ^{131}I uptake with functioning metastases of thyroid carcinoma should not occur if the physician remains aware of this possibility.

A further issue is the period for discontinuation of breast feeding prior to ^{131}I administration to minimize competition for ^{131}I uptake and the absorbed dose to the breast. Bakheet and Hammami reported ^{123}I or ^{131}I administration within 1 wk of cessation of breast feeding and showed significant breast uptake in all patients (*3*). It is possible that the various patterns of breast uptake described may be related to the stage of involution. Repeat ^{123}I administration in two patients demonstrated faint uptake at 5 wk and no uptake at 11 wk following cessation of breast feeding.

Studies of the composition of mammary secretion of women following abrupt termination of breast feeding show rapid alterations. Secretion involving transcellular transport (lactose, potassium) declines while leakage through intercellular junctions (immunoglobulins) increases. Most of the change occurs within 7–10 days, although secretory activity may still be present up to 42 days (*4*).

It would be sensible to discontinue breast feeding for as long as is practicable prior to administration of ^{131}I but further information is required.

REFERENCES

1. Robinson PS, Barker P, Campbell A, Henson P, Surveyor I, Young PR. Iodine-131 in breast milk following therapy for thyroid carcinoma. *J Nucl Med* 1994;35:1797–1801.
2. Robow S, Klopper J, Wassermann H, Baard B, van Niekerk M. The excretion of radiopharmaceuticals in human breast milk: additional data and dosimetry. *Eur J Nucl Med* 1994;21:144–153.
3. Bakheet SM, Hammami MM. Patterns of radioiodine uptake by the lactating breast. *Eur J Nucl Med* 1994;21:604–608.
4. Hartmann PE, Kulski JK. Changes in the composition of the mammary secretion of women after abrupt termination of breast feeding. *J Physiol* 1978;275:1–11.

P.S. Robinson
I. Surveyor
Royal Perth Hospital
Perth, Australia

Diagnosis of Scaphoid Fractures: The Role of Nuclear Medicine

TO THE EDITOR: In a recent editorial in the *Journal*, Holder et al. (*1*) criticized our study published in the same issue entitled "Choosing a Strategy for the Diagnostic Management of Suspected Scaphoid Fracture: A Cost-Effectiveness Analysis" (*2*). They do not agree that the most efficient approach in the diagnosis of scaphoid fracture is a combination of first-day scaphoid radiography followed by bone scintigraphy.

Holder et al. state that the inclusion of a consecutive series of patients is not representative for long-term outcome or cost-effec-