

This department provides a forum for *JNMT* readers to ask technical questions and receive answers from an expert in nuclear medicine technology. Send your questions and comments for future *Ask the Expert* columns to: Frank J. Papatheofanis, MD, PhD, UCSD Medical Center Hillcrest, 200 West Arbor Dr., San Diego, CA 92103-8758 or fax 619-543-1975.

Question: Does radioiodine administration interfere with breast feeding?

It has been well-documented that radioiodine administered to lactating women will be excreted in the breast milk. With the ever-increasing popularity of breast feeding, a thorough understanding of the potential radiation risks to the infant represents an important aspect of nuclear imaging. The kinetics of radioiodine excretion in the setting of active milk production may also have important implications in the accurate diagnosis of thyroid disease and may even alter the bioavailability of therapeutic radioiodine doses. In addition to the routine pregnancy test, a history of breast feeding should routinely be elicited from women of child-bearing age prior to the administration of most radiopharmaceuticals, particularly long-lived radioisotopes such as ^{131}I . In this regard, common reasons for administering radioiodine to women of child-bearing age include the frequent occurrence of differentiated thyroid cancers and the evaluation of suspected thyroiditis or Graves' disease.

After oral ingestion, radioiodine is almost completely absorbed through the stomach and small intestine; radioiodine serum levels peak within 6 hr of ingestion (1,2). The circulating radioiodine concentration declines exponentially for 48–72 hr following ingestion as iodide is rapidly removed from the plasma by the kidneys and lactating breast (3,4) (Fig. 1) with an effective half-life of 11.1 hr for ^{131}I (1,5). Thyroidal iodine is converted to thyroid hormone, stored as thyroglobulin, and slowly released into the plasma where it is degraded to iodide in the peripheral tissues and liver. Plasma iodide concentrates in the salivary glands, choroid plexus, gastric mucosa, ciliary body and sweat glands.

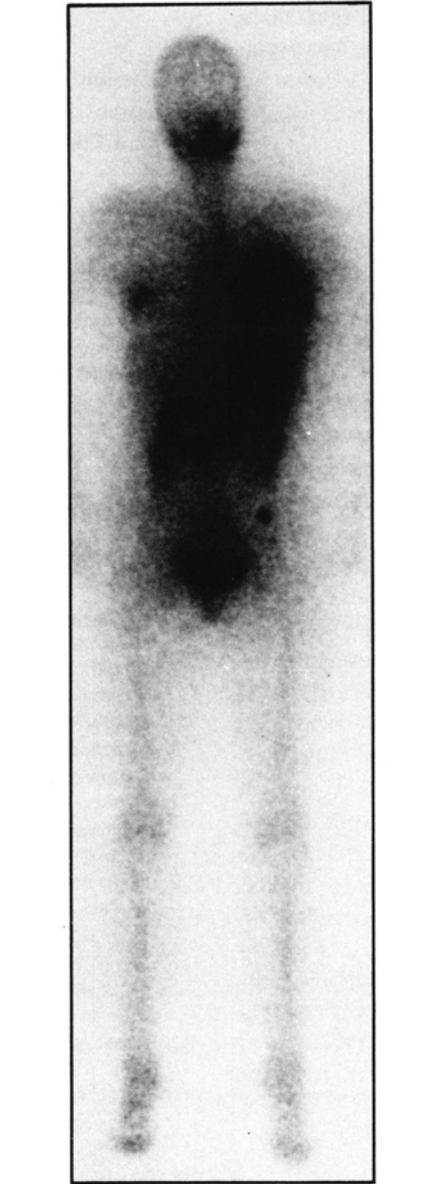


FIGURE 1. Anterior whole-body scintigram in hypothyroid 42-yr-old woman 2 days following 3.7 GBq ^{131}I -sodium iodide for a second treatment of papillary thyroid carcinoma. There is significant uptake within the left breast and mild uptake within the right breast. She had been nursing her son with only the left breast for several months. Reprinted by permission of the Society of Nuclear Medicine from: Grunwald F, Palmedo H, Biersack HJ. Unilateral ^{131}I uptake in the lactating breast. *J Nucl Med* 1995;36:1724–1725; figure 1.

A second, much slower decline then occurs with an effective half-life of approximately 5.9 days owing to the recircu-

lation of mostly protein-bound organic iodine released from the thyroid gland. During lactation the mammary glands concentrate iodide at about 30 times the free inorganic plasma iodide concentrations, which is approximately 1/30th the protein-bound iodine concentration. The slow decline in breast milk ^{131}I concentration then roughly parallels the decline in total plasma ^{131}I concentration (4,6). The decrease during this second phase is dominated by physical decay (1).

From 1.4% to 26.8% (2,5,7) of the ingested activity can be found in the breast milk during the first 48 hr after ingestion. Variability between patients may be secondary to differences in thyroid function and the differences in volumes of milk secreted (1,2,5,7). Further investigation on the effects of hyperthyroidism and hypothyroidism on breast milk radioiodine concentration would be of interest. A patient with hypothyroidism and low uptakes will have more free iodide immediately available for renal extraction and breast milk secretion, while there will be little incorporation into thyroid hormones. In this case, a higher percentage of the initial dose may be found in the breast milk. Conversely, a patient with Graves' disease and high thyroid uptake values may have a lower percentage of the initial activity found in breast milk owing to the avid clearance and subsequent incorporation of iodine into thyroid hormones, resulting in a prolonged second exponential phase. This relationship exists for diagnostic and therapeutic doses (1).

Consensus has not been achieved in determining an acceptable radiation dose to infants following consumption of radioiodinated breast milk. The most recent reports use the criteria of effective dose derived from the recommendations of the International Commission of Radiological Protection (8). Two criteria have been proposed: the infant estimated effective dose of <1.0 mSv and the infant thyroid dose of <10.0 mSv (1.0 rem) (3). Notwithstanding the variability of acceptable infant doses reported in the literature, the majority of calculations result in an exceedingly long delay to safe resumption of nursing, assuming similar volumes of milk consumed (Table 1).

TABLE 1
Required Nursing Delay Following Radioiodine

Isotope	Dose	Volume of milk ingested per day (ml)	Delay in days (Reference)
¹³¹ I	108 mCi	1500	52 (3)*
	108 mCi	840	48 (3)*
	9.6 mCi	1500	106 (1)†
	9.6 mCi	850	99 (9)
	8.6 μCi	1500	46 (1)
	8.6 μCi	850	40 (9)
	0.1 μCi	1500	8 (1)
	0.1 μCi	850	5 (9)
¹²³ I (p,2n) 4.8% ¹²⁴ I	100 μCi	1500	26 (1)†
	100 μCi	850	23 (9)
	30 μCi	1500	20 (1)
	30 μCi	850	17 (9)
¹²³ I (p,5n) 1.9% ¹²⁵ I	100 μCi	1500	126 (1)†
	100 μCi	850	106 (9)
	30 μCi	1500	96 (1)
	30 μCi	850	79 (9)

*Infant thyroid dose <1.0 rem; dosimetry calculations of Robinson, et al. (3).

†Based on Dydek's model (1) and Hendrick's radiation dosimetry (2).

Due to the long physical half-life of ¹³¹I and long circulation time of the iodoproteins, nursing would have to be halted for approximately 46 days after a 8.6 μCi dose and 106 days following a 9.6 mCi dose (1) before acceptable levels of radioiodine in the breast milk are achieved. It is impractical to consider resuming breast feedings after such a long period. Similar results are reported in the presence or absence of functioning thyroid tissue (5).

Unfortunately, the prospects for breast feeding following a dose of ¹²³I are not better. Recently published reports state that "clean" ¹²³I (p,5n) may contain up to 1.9% ¹²⁵I contaminant. After a 100-μCi dose an effective half-life of 16.1 days results in a exceedingly impractical delay of 106 to 112 days before breast feeding could be resumed (1,9). A dose of 100 μCi of ¹²³I (p,2n) with 4.8% ¹²⁴I contaminant would result in a 23-day delay. Possibly, an even longer delay may occur since ¹²³I preparations may contain up to 12.9% ¹²⁴I at the time of expiration. At our institution the "clean" ¹²³I (p,5n) available is allowed up to 2.9% ¹²⁵I contaminant at the time of calibration and may have up to 12.4% approximately 24 hr later at the time of expiration (10).

This significantly increases the already prohibitively-long nursing delay, since the ¹²³I contaminants are the most important factors in determining the dosimetry.

Consequently, whenever possible, radioiodine should be avoided in the breast-feeding mother. Careful thought should be given to the urgency and necessity of performing the study and acceptable alternatives should be considered where indicated. Pertechnetate scanning and uptakes can reliably assist in differentiating between thyroiditis and Graves' Disease. Anticipated radioiodine therapy should be preceded by gradual suppression of lactation as soon as possible, allowing for a less abrupt weaning process for the infant, as well as, involution of mammary tissue and subsequent decrease in the milk concentration of radioiodine. This would have the advantage of addressing concerns over the diversion of therapeutic radioiodine doses, which may lower the intended radiation dose to the target tissues (5,11). It also seems prudent to minimize the absorbed dose to breast tissue therein diminishing the chance of imaging clinically irrelevant breast uptake which may confound scan interpretation during metastatic surveys (5,12,13).

When ¹²³I or ¹³¹I must be used, breast feeding is ultimately contraindicated (5). Milk should be mechanically pumped and discarded at regular intervals to reduce the absorbed breast dose and minimize discomfort due to engorgement. The radiation risks to the infant from breast milk should be thoroughly explained to the mother and written acknowledgment that such a discussion took place obtained for medical-legal reasons. Although unlikely to succeed, mothers determined to resume breast feeding can bring in milk samples for periodic measurements of activity and breast feeding may be resumed when concentrations fall to safe levels (5).

Guy A. Ravad, MD
Division of Nuclear Medicine
Department of Radiology
UCSD Medical Center
San Diego, California

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