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Duration of Breastfeeding Interruption in Nuclear Medicine Procedures

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The recommendation for the duration of breastfeeding interruption after radiopharmaceutical administration has not been standardized and varies among the guidance documents and publications in the literature. **Methods:** A working group consisting of 3 staff physicians, 2 fellows, and 2 technologists was designated to update the institutional recommendations on breastfeeding interruption based on the review of the guidance documents and the literature. **Results:** Our institutional recommendations on the duration of breastfeeding interruption for 54 radiopharmaceuticals are presented in 4 summary tables. For completeness, we also include other radiopharmaceuticals with available information. **Conclusion:** The detailed recommendation summary on breastfeeding might be helpful to other centers.

Key Words: breastfeeding interruption; radiopharmaceutical; radiation to nursing infants

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It is often necessary to administer diagnostic or therapeutic radiopharmaceuticals to the nursing mother despite the risk of radioactivity excreted to breast milk. The lactating breast may accumulate radionuclides (through the tracer itself, metabolites, or impurities), which may result in radiation exposure to the infant through the ingestion of radioactive milk. In addition, the infant also receives external exposure from radioactivity in the mother when the infant is held close.

Although there have been several studies assessing radioactivity in breast milk and risk of radiation exposure to infants (*1–6*), they are limited by assumptions such as estimation of residence time, dosimetry model, breast size during lactation, and the amount and interval of feeding. In particular, it is often assumed that the ingested radionuclide from breast milk becomes systemic instantaneously and follows adult biodistribution behavior, whereas in practice some radionuclides are poorly absorbed from the gastrointestinal tract. The recommendation for the duration of breastfeeding interruption after radiopharmaceutical administration has not been standardized or consistent among guidance documents and publications in the literature.

As a part of quality control of our clinical service from the Patient Safety and Quality Control Committee, we have reviewed the guidance documents and literature on the requirement of breastfeeding interruption for radiopharmaceuticals. The final decision was based on the consensus from a panel of physicians. In this article, we summarize our institutional recommendations on breastfeeding interruption for routinely performed nuclear medicine procedures as well as recommendations from other professional body guidelines and references.

MATERIALS AND METHODS

A working group consisting of 3 staff physicians, 2 fellows, and 2 technologists was designated to work on the project, with the goal of reviewing the institutional recommendations on breastfeeding interruption and updating study protocols and patient information pamphlets on breastfeeding. The Society of Nuclear Medicine and Molecular Imaging (SNMMI) procedure guidelines (*7*), International Commission on Radiological Protection (ICRP) publication 106 (*8*), the Advisory Committee on the Medical Uses of Isotopes (ACMUI) Subcommittee on Nursing Mother Guidelines for the Medical Administration of Radioactive Materials (*9*), and peer-reviewed publications by Stabin and Breitz (*2*) and by Leide-Svegborn et al. (*1*) were reviewed and referenced. When the guidance documents were inconsistent or had unavailable or incomplete data, the studies were further reviewed and discussed by a physician panel consisting of 3 staff physicians and 1 fellow before the final decision was made.

The recommendations for our institution sought to balance radiation protection with convenience and practicality to the nursing mother and infant. For completeness, we also tabulated procedures and radiopharmaceuticals that are not used in our clinic but may be in common use elsewhere and have available data from the guidance documents and the literature, but we did not make recommendations for these procedures and radiopharmaceuticals.

As there was no patient information involved, institutional review board approval was not required for this review.

RESULTS

Recommendations for breastfeeding interruption are tabulated in Tables 1–4 by procedure type. For procedures conducted at our institution, recommendations on the duration of breastfeeding interruption are presented in the tables under

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TABLE 1
Duration of Breastfeeding Interruption (Studies Listed Alphabetically from A to I)

Study	Radiopharmaceutical	Administered dose	Institution guidelines, 2022	SNMMI/EANM procedure guideline (*7*)*	Stabin and Breitz (*2*)	ICRP 106 (*8*)	Leide-Svegborn (*1*)†	ACMUI (*9*)‡
Adrenal medulla	^{131}I-MIBG	37 MBq	Stop	Stop	NA	>3 wk	NA	NA
Adrenal medulla	^{123}I-MIBG	370 MBq	48 h	48 h	48 h	>3 wk	NA	NA
Bone scan	^{99m}Tc-MDP	11 MBq/kg	4 h	4–24 h	0	0	0	24 h
Bone scan PET	^{18}F-fluoride	185–370 MBq	—	NA	NA	NA	NA	4 h
Bone marrow	^{99m}Tc-SC	555 MBq	4 h	NA	0	0	NA	24 h
Brain perfusion	^{99m}Tc-ECD	555–1,110 MBq	4 h	NA	NA	0	NA	24 h
Brain perfusion	^{99m}Tc-HMPAO	555–1,110 MBq	4 h	NA	NA	0	NA	24 h
Brain amyloid	^{18}F-florbetapir	370 MBq	—	24 h	NA	NA	NA	NA
Brain amyloid	^{18}F-flutemetamol	185 MBq	—	24 h	NA	NA	NA	NA
Brain amyloid	^{18}F-florbetaben	300 MBq	—	24 h	NA	NA	NA	NA
Breast imaging	^{99m}Tc-sestamibi	300–600 MBq	—	0	0	0	NA	24 h
Breast imaging	^{99m}Tc-testrofosmin	300–600 MBq	—	0	NA	0	NA	24 h
Cardiac necrosis	^{99m}Tc-PYP	740 MBq	4 h	NA	0	0	NA	24 h
Cisternography	^{111}In-DTPA	18–27.8 MBq	0	NA	NA	NA	NA	NA
Cerebrospinal fluid shuntogram	^{111}In-DTPA	28 MBq	0	NA	NA	NA	NA	NA
DaTScan	^{123}I-ioflupane	111–185 MBq	3 d	1–6 d	NA	NA	NA	NA
Brain scan	^{18}F-FDG	4.9 MBq/kg	12 h	24 h	NA	0	0	4 h
Esophageal transit	^{99m}Tc-SC	40 MBq	4 h	NA	0	0	NA	24 h
^{18}F-FDG PET (oncology)	^{18}F-FDG	4.9 MBq/kg	12 h	12 h	NA	0	0	4 h
^{67}Ga scan	^{67}Ga-citrate	148–333 MBq	Stop	2–4 wk	Stop	>3 wk	NA	28 d
Gastric emptying/transit (liquid)	^{99m}Tc-DTPA	37 MBq	4 h	NA	0	0	NA	24 h
Gastric emptying (solid)	^{99m}Tc-SC	18.5 MBq	4 h	NA	0	0	NA	24 h
Gastrointestinal bleed	^{99m}Tc-RBC in vitro	555–1,110 MBq	4 h	0	0	0	NA	24 h
Heat-damaged RBC scan	^{99m}Tc-RBC in vitro	370 MBq	4 h	NA	0	0	NA	24 h
Hepatic hemangioma	^{99m}Tc-RBC in vitro	750–925 MBq	4 h	NA	0	0	NA	24 h
Hepatobiliary scan	^{99m}Tc-DISIDA	185 MBq	4 h	0	0	0	NA	24 h
Hepatobiliary scan	^{99m}Tc-mebrofenin	185 MBq	4 h	0	NA	NA	NA	24 h
Iodine whole-body imaging	^{131}I-NaI	185 MBq	Stop	NA	Stop	>3 wk	Stop	Stop
Iodine whole-body imaging	^{123}I-NaI	74–185 MBq	4 d	NA	Stop	>3 wk	NA	3 d

*Or publicly available guidance documents.
†Recommendation was based on both internal and external radiation exposure.
‡Single 24-h interruption period is recommended for ^{99m}Tc-labeled radiopharmaceuticals to simplify guidance.
MIBG = metaiodobenzylguanidine; NA = data not available; MDP = methyl diphosphonate; 0 = no breastfeeding cessation is necessary; — = not institutional procedure; SC = sulfur colloid; ECD = ethyl cysteinate dimer; HMPAO = hexamethylpropyleneamine oxime; PYP = pyrophosphate; DTPA = diethylenetriaminepentaacetic acid; RBC = red blood cell; DISIDA = diisopropyl iminodiacetic acid.

TABLE 2
Duration of Breastfeeding Interruption (Studies Beginning with L)

Study	Radiopharmaceutical	Administered dose (MBq)	Institution guidelines, 2022	SNMMI/EANM procedure guideline (*7*)*	Stabin and Breitz (*2*)	ICRP 106 (*8*)	Leide-Svegborn (*1*)†	ACMUI (*9*)‡
Lacrimal gland	^{99m}Tc-pertechnetate	7.4	0	NA	NA	NA	NA	NA
Liver, spleen	^{99m}Tc-SC	200	4 h	NA	0	0	NA	24 h
Lung perfusion	^{99m}Tc-MAA	74–185	12 h	NA	12 h	12 h	12 h	24 h
Lung ventilation	^{99m}Tc-Technegas	18–37	0	NA	NA	0	NA	24 h
Lung ventilation	^{99m}Tc-DTPA aerosol	20–40	—	NA	0	NA	NA	24 h
Lung ventilation	^{99m}Tc-SC aerosol	20–40	—	0	NA	NA	NA	24 h
Lung ventilation	^{81m}Kr gas	40–400	—	0	NA	0	NA	NA
Lung ventilation	^{133}Xe gas	200–750	—	0	NA	0	NA	NA
Lymphoscintigraphy	^{99m}Tc-filtered SC	37	4 h	24 h	0	0	NA	24 h
Lymphoscintigraphy	^{99m}Tc-unfiltered SC	185	4 h	24 h	0	0	NA	24 h
Lymphoscintigraphy	^{99m}Tc-sulphide nanocolloid	3.7−370	—	24 h	NA	NA	NA	24 h
Lymphoscintigraphy	^{99m}Tc-nanocolloidal albumin	3.7–370	—	24 h	NA	NA	NA	24 h
Lymphoscintigraphy	^{99m}Tc-antimony trisulfide	3.7−370	—	24 h	NA	NA	NA	24 h
Lymphoscintigraphy	^{99m}Tc-tilmanocept	3.7−370	—	24 h	NA	NA	NA	24 h
^{177}Lu-DOTATATE	^{177}Lu-oxodotreotide	3,700	Stop	2.5 mo	NA	NA	NA	Stop

*Or publicly available guidance documents.
†Recommendation was based on both internal and external radiation exposure.
‡Single 24-h interruption period is recommended for ^{99m}Tc-labeled radiopharmaceuticals to simplify guidance.
NA = data not available; 0 = no breastfeeding cessation is necessary; SC = sulfur colloid; DTPA = diethylenetriaminepentaacetic acid; — = not institutional procedure.

TABLE 3
Duration of Breastfeeding Interruption (Studies Listed Alphabetically from M to S)

Study	Radiopharmaceutical	Administered dose	Institution guidelines, 2022	SNMMI/EANM procedure guideline (*7*)*	Stabin and Breitz (*2*)	ICRP 106 (*8*)	Leide-Svegborn (*1*)†	ACMUI (*9*)‡
Meckel diverticulum	^{99m}Tc-pertechnetate	555 MBq	12 h	12 h	4 h	12 h	12 h	24 h
Multigated acquisition	^{99m}Tc-RBC modified in vivo	925 MBq	12 h	24 h	12 h	12 h	0	24 h
Myocardial perfusion (rest + stress)	^{99m}Tc-tetrofosmin	1,184 MBq	4 h	4 h	NA	0	NA	24 h
Myocardial perfusion (rest + stress)	^{99m}Tc-sestamibi	1,184 MBq	4 h	4 h	0	0	0	24 h
Myocardial perfusion	^{201}Tl-chloride	111 MBq	4 d	48 h	96 h	48 h	NA	4 d
Myocardial perfusion	^{82}Rb	1,100–1,850 MBq	—	NA	NA	NA	NA	0
Myocardial perfusion	^{13}N-ammonia	370–740 MBq	—	NA	NA	0	NA	1 h
Sodium fluoride PET	^{18}F-NaF	2.22 MBq/kg	0	NA	NA	NA	NA	4 h
Octreotide scan	^{111}In-octreotide	111 MBq	0	0	NA	0	NA	6 d
Parathyroid scan	^{99m}Tc-sestamibi	740 MBq	4 h	0	0	0	NA	24 h
Parathyroid scan	^{99m}Tc-tetrofosmin	185–925 MBq	—	0	NA	0	NA	24 h
Parathyroid scan (for dual phase)	^{99m}Tc-pertechnetate	75–150 MBq	—	12 h	4 h	12 h	NA	24 h
Parathyroid scan (for dual tracer)	^{123}I-NaI and ^{99m}Tc-sestamibi	7.5–20 and 740 MBq	4 d	3 wk	Stop	>3 wk	NA	3 d
R to L shunt	^{99m}Tc-MAA	37 MBq	12 h	NA	NA	NA	NA	24 h
Renal cortical	^{99m}Tc-gluceptate	296 MBq	4 h	NA	0	0	NA	24 h
Renal cortical	^{99m}Tc-DMSA	111 MBq	4 h	NA	NA	0	NA	24 h
Renal function	^{99m}Tc-MAG-3	260 MBq	4 h	4 h	0	0	0	24 h
Renal function	^{99m}Tc-DTPA	370 MBq	4 h	12 h	0	0	0	24 h
Renal GFR	^{99m}Tc-DTPA	37 MBq	4 h	NA	0	0	0	24 h
Salivary gland scan	^{99m}Tc-pertechnetate	555 MBq	12 h	NA	4 h	12 h	12 h	24 h
SeHCAT scan	^{75}Se-tauroselcholic acid	0.37 MBq	>3 wk	NA	NA	>3 wk	NA	NA
Small-bowel and colon transit	^{99m}Tc-SC	18.5–37 MBq	—	NA	0	0	NA	24 h

*Or publicly available guidance documents.
†Recommendation was based on both internal and external radiation exposure.
‡Single 24-h interruption period is recommended for ^{99m}Tc-labeled radiopharmaceuticals to simplify guidance.
RBC = red blood cell; 0 = no breastfeeding cessation is necessary; NA = data not available; — = not institutional procedure; DMSA = dimercaptosuccinic acid; MAG = mercaptoacetyltriglycine; DTPA = diethylenetriaminepentaacetic acid; SC = sulfur colloid.

TABLE 4
Duration of Breastfeeding Interruption (Studies Listed Alphabetically from T to Z)

Study	Radiopharmaceutical	Administered dose	Institution guidelines, 2022	SNMMI/EANM procedure guideline (7)*	Stabin and Breitz (2)	ICRP 106 (8)	Leide-Svegborn (1)†	ACMUI (9)‡
Thyroid scan	^{123}I-NaI	18.5 MBq	4 d	NA	0	>3 wk	NA	3 d
Thyroid scan	^{99m}Tc-pertechnetate	370 MBq	12 h	NA	4 h	12 h	12 h	24 h
Thyroid uptake	^{131}I-NaI	0.37 MBq	Stop	NA	Stop	>3 wk	Stop	Stop
Thyroid ablation (hyperthyroidism)	^{131}I-NaI	185–1,110 MBq	Stop	Stop	Stop	>3 wk	Stop	Stop
Thyroid cancer ablation§	^{131}I-NaI	1,100–7,400 MBq	Stop 3 mo prior	Stop	Stop	>3 wk	Stop	Stop
Urea breath test	^{14}C-urea	0.037 MBq	0	NA	NA	0	NA	NA
WBC scan	^{111}In-oxine WBC	10–40 MBq	0	NA	0	0	NA	6 d
WBC scan	^{99m}Tc-HMPAO WBC	370–740 MBq	24 h	NA	48 h	12 h	0	24 h
^{90}Y-radiolabeled therapy	^{90}Y-ibritumomab tiuxetan	15 MBq/kg	—	Stop	NA	NA	NA	NA

*Or publicly available guidance documents.
†Recommendation was based on both internal and external radiation exposure.
‡Single 24-h interruption period is recommended for ^{99m}Tc-labeled radiopharmaceuticals to simplify guidance.
§For radioiodine ablation for thyroid cancer, discontinuation of breastfeeding of 3 mo is recommended before therapy to reduce radiation exposure to lactating breast.
NA = data not available; 0 = no breastfeeding cessation is necessary; WBC = white blood cell; HMPAO = hexamethylpropyleneamine oxime; — = not institutional procedure.

the header "institution guidelines, 2022." For completeness, we included procedures and radiopharmaceuticals with available recommendations from the literature that are not performed at our institution, but we do not make recommendations for these.

For simplicity of implementing in a clinical setting, the recommendations were categorized into the following sets.

No Interruption Needed

Breastfeeding interruption is unnecessary for cerebrospinal fluid cisternography and shuntography, lacrimal gland studies, lung ventilation studies with Technegas (Cyclomedica Australia Pty. Ltd.), sodium fluoride PET, urea breath testing, ^{111}In-octreotide scanning, and white blood cell scanning with ^{111}In-oxine.

4-h Interruption

A 4-h interruption period is recommended for most ^{99m}Tc-labeled studies. Although most radiopharmaceuticals have very low radioactivity in the breast, the recommendation is based mainly on the concern of ^{99m}Tc-pertechnetate impurity, as ^{99m}Tc-pertechnetate is widely recognized to be avidly concentrated in the lactating breast (*1,6*).

12-h Interruption

A 12-h interruption period is recommended for lung perfusion scanning and right-to-left shunt scanning with ^{99m}Tc-macroaggregated albumin (MAA), thyroid scanning, Meckel diverticulum scanning and salivary gland scanning with ^{99m}Tc-pertechnetate, oncology and epilepsy ^{18}F-FDG PET, and multigated acquisition scanning with modified in vivo labeled red blood cells

Cessation

Breastfeeding should be stopped or interrupted for at least 3 wk for all scanning with ^{131}I-labeled radiopharmaceuticals, ^{67}Ga-citrate scanning, SeHCAT (GE Healthcare) scanning with ^{75}Se-tauroselcholic acid, and ^{177}Lu-DOTATATE therapy with ^{177}Lu-oxodotreotide.

Others

Breastfeeding should be interrupted for 24 h for white blood cell scanning with ^{99m}Tc-hexamethylpropyleneamine oxime, 48 h for adrenal medulla studies with ^{123}I-metaiodobenzylguanidine, 3 d for a DaTscan (GE Healthcare) with ^{123}I-ioflupane, and 4 d for whole-body thyroid scanning with ^{123}I-sodium iodine, partly because of concerns about possible ^{131}I contamination.

DISCUSSION

Although a nursing mother who has received unsealed radioactive material can be released by a licensee if the total effective dose to any other individual exceeds 0.5 rem (5 mSv) in the United States, federal regulations (title 10 of *Code of Federal Regulations,* section 35.75) (*10*) require that the licensee must give guidance on the interruption or cessation of breastfeeding and information on the consequences of failure to follow the guidance if the dose to a breastfeeding infant or

child could exceed 0.1 rem (1 mSv). Consequently, the recommendation on breastfeeding interruption from most guidance documents is based on the 1-mSv radiation exposure limit to the infant or child. However, infants and children are known to be about 3 times more sensitive to radiation than adults (*11*), and their vulnerability to radiation was considered when formulating the recommendations, usually with a conservative approach assuming a worst-case scenario (*1,5,9*).

Radiation exposure to a nursing child from a radiopharmaceutical administered to the child's mother comes from both ingestion of radioactive maternal milk and external exposure from radioactivity in the mother. Generally, less than 10% of an administered radiopharmaceutical's activity is excreted into breast milk; typical estimates range from 0.3% to 5% of the initial administered activity (*2*), depending on the radiopharmaceutical and physiologic factors. If breastfeeding were not discontinued, the doses from ingestion of radioactive milk to the newborn tissues (whole body or thyroid) could be calculated by summing the exposure from each feeding.

At our institution we follow the clinical procedure guidelines from the SNMMI and European Association of Nuclear Medicine (EANM); their recommendations on breastfeeding interruption are presented in the 4 tables. In general, SNMMI guidance documents are based on the consensus of experts from various fields, with consideration of scientific data from the ICRP, feasibility and convenience for patients, and the flexibility of the study. Consequently, the cutoff for breastfeeding interruption for some radiopharmaceuticals is loosely defined in their recommendations.

Stabin is well known for his work on dosimetry of radiopharmaceuticals, including studies on breast milk excretion. In the classic study of Stabin and Breitz on breast milk excretion (*2*), they provided not only the recommendations for 25 radiopharmaceuticals but also an understanding of radiation dosimetry, including breast anatomy, the physiology of lactation, a possible mechanism for breast milk excretion of radiopharmaceuticals, breast radiation exposure, and exposure to infants. Their recommendations are presented in the 4 tables.

The ICRP is a nongovernment organization that provides recommendations and guidance on protection against the risk associated with ionizing radiation. Societies such as the SNMMI depend on the ICRP for guidance. Because of its influence and impact on radiation safety protection, we present its recommendations in the 4 tables.

There are limited studies on breast milk excretion of radiopharmaceuticals. A recent study of activity concentration in breast milk from 53 breastfeeding patients after administration of 16 different radiopharmaceuticals has added new data to the field (*1*). The study provided estimates of absorbed doses to various organs and tissues and the effective dose to the infant. Consequently, the recommendations of this study are also presented in the 4 tables.

The ACMUI advises the U.S. Nuclear Regulatory Commission on policy and technical issues that arise in the regulation of the medical uses of radioactive material in diagnosis and therapy. A subcommittee on nursing mother guidelines for the medical administration of radioactive materials, led by experts in the field, provided updated recommendations for the nursing mother (*10*). For ^{99m}Tc-labeled radiopharmaceuticals, rather than a radiopharmaceutical-specific interruption period, a single 24-h interruption period is recommended by the ACMUI. It argued that although this interval may be longer than necessary for some ^{99m}Tc-labeled radiopharmaceuticals, the recommendation is compliant with the 0.1-rad dose limit and simplifies the guidance, thereby avoiding confusion and reducing the likelihood of error. Consequently, the ACMUI recommendations for most ^{99m}Tc-labeled radiopharmaceuticals are different from other references and generally more conservative in terms of radiation risk.

There are differences in recommendations between our institution and other references shown in the tables for some radiopharmaceuticals. For ^{99m}Tc-methyl diphosphonate, the SNMMI guidance document (*7*) is not definitive on the duration of breastfeeding interruption, with 2018 guidelines stating: "Per the International Commission on Radiological Protection, ^{99m}Tc-labeled radiopharmaceuticals do not require any change in breastfeeding (unless ^{99m}Tc-NaO_4 is present). Nevertheless, it may be recommended that the patient delay breastfeeding for a minimum of 4 h after receiving a ^{99m}Tc-labeled radiopharmaceutical, and many institutions have the patient delay breastfeeding for 24 h."

According to the EANM guidelines, whereas interruption of breastfeeding is not essential according to the ICRP, this is based on there being no free pertechnetate in the radiopharmaceutical. Therefore, an interruption of at least 4 h during which 1 meal is discarded is advised to be on the safe side. The ACMUI recommends 12 h for most ^{99m}Tc-labeled radiopharmaceuticals for simplicity. On the basis of the available studies in the literature, and considering the possibility of free pertechnetate, which has been shown to be excreted in breast milk, we recommend a 4-h interruption of breastfeeding for ^{99m}Tc-methyl diphosphonate, consistent with the guidance documents from the SNMMI and EANM.

It has been shown that ^{99m}Tc-MAA and ^{99m}Tc-pertechnetate have a higher breast excretion than other ^{99m}Tc-labeled radiopharmaceuticals (*1,2*). For ^{99m}Tc-MAA, it is speculated that "The individual variations in the initial ^{99m}Tc concentrations and, likewise, in the total activities excreted in the breast milk were presumably caused by various amounts of ^{99m}Tc-pertechnetate in the initial ^{99m}Tc-MAA preparation, and by varied rates of breakdown of macroaggregate in the lungs." (*1*). Consequently, for both ^{99m}Tc-MAA and ^{99m}Tc-pertechnetate we recommend a 12-h interruption whereas for other ^{99m}Tc-labeled radiopharmaceuticals we recommend a 4-h interruption, consistent with most of the references in the tables.

For ^{123}I in the form of NaI (^{123}I-NaI), a shorter discontinuation period of 3 or 4 d is recommended by our institution and by the ACMUI than the earlier recommendation, which

was based on the contamination (≤2.5% of the total activity) with long-lived ^{125}I (physical half-life, 60 d) that occurred with older methods of ^{123}I production (such contamination of ^{123}I with ^{125}I no longer occurs). Our recommendation of a 4-d interruption is similar to that of the ACMUI (3-d interruption) but much shorter than the recommendations of more than 3 wk from the ICRP (*8*) and the cessation recommended by Stabin and Breitz (*2*), thus significantly improving the prospect of resuming breastfeeding.

There is a significant difference in the recommendation for ^{111}In-oxine white blood cell scanning. Both Stabin et al. (*2*) and the ICRP recommended no cessation, whereas the ACMUI (*10*) recommends a 6-d interruption. Although the recommendation from the ACMUI was based on the data from Stabin and Breitz (*2*), the reported administered activity is quite different (185 MBq from Table 4 from the ACMUI and 18.5 MBq from Stabin and Breitz), probably because of a typographic error. On the basis of the original data from Stabin and Breitz, we have recommended no cessation. For ^{111}In-octreotide scanning, the SNMMI and ICRP recommend no cessation whereas the ACMUI recommends a 6-d interruption, based on the kinetic data from Castronovo et al. (*5*). In the study by Castronova et al., they measured the concentration of ^{111}In in breast milk in a 10-wk-postpartum woman at daily intervals up to 72 h after injection of 196.1 MBq (5.3 mCi) of ^{111}In-octreotide, with a conservative approach. They showed that if a newborn is nursed for the first 10 d, the internal and external dose equivalents would be 0.23 and 0.28 mSv, respectively, for a total of 0.51 mSv. The difference in recommendation was discussed with our working group, and until more data are available, we have decided to keep our recommendation of no cessation for the ^{111}In-octreotide scan. This test will soon be replaced with PET.

The external exposure from radioactivity in the mother to the infant could be significant, especially with high-energy photon radiopharmaceuticals (e.g., positron emitters). Despite common observations of increased breast ^{18}F-FDG uptake in the lactating breast, ^{18}F activity measured in breast milk was low (*3*), suggesting that the main source of potential radiation hazard to a breastfeeding infant is likely to be from the infant's close proximity to the breast (external) rather than from ingestion of milk (internal). Consequently, patients should also be advised to avoid close contact with their children to reduce external radiation exposure. Our recommendation of breastfeeding interruption and avoiding close contact with the infant for 12 h is consistent with the SNMMI/EANM guidelines. The ACMUI recommended a 4-h interruption, possibly based only on the biokinetics of ^{18}F-FDG and the absorbed-dose estimates for the lactating breast.

The mother should be advised to breastfeed the baby right before administration of the radiopharmaceutical and the interruption period. During this interruption, breast milk may be expressed at the usual feeding times and discarded or frozen for later use, depending on the circumstances. Afterward, breastfeeding can resume without concern. For an interruption period of longer than 3 wk, it may be difficult to resume breastfeeding. However, if the mother wishes to continue to breastfeed, she is advised to continue to express breast milk at the usual feeding times and discard it each time during these 3 wk.

There is a 2- to 5-fold increase in breast mass during lactation, and it is known that the lactating breast is sensitive to radiation. Except for ^{67}Ga-citrate and ^{131}I-NaI, the highest absorbed dose estimates to the lactating breast for typical diagnostic administered activities are usually well under 0.01 Gy (1 rad). The absorbed dose to the lactating breast with a therapeutic administered activity of 4,000 MBq (108 mCi) of ^{131}I-NaI was estimated to be 1.6 Gy (160 rad) (*12*). For lactating patients undergoing radioiodine therapy, we have followed the American Thyroid Association guidelines (*13*) and recommend discontinuing breastfeeding 3 mo before radioiodine ablation therapy to minimize the radioiodine concentration in the maternal breast and, thus, the absorbed maternal breast dose.

CONCLUSION

The use of radiopharmaceuticals in breastfeeding patients can elevate the risk of radiation exposure to the feeding infant and the lactating breast. Other centers might find helpful the detailed recommendations on breastfeeding for radiopharmaceuticals used in our center and the summary recommendations from leading professional bodies and the academic literature presented in this study.

DISCLOSURE

Ran Klein receives revenue shares from the sale of rubidium generators from Jubilant-DraxImage and from the sale of myocardial flow quantification software from Invia Medical Solutions. No other potential conflict of interest relevant to this article was reported.

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KEY POINTS

QUESTION: Is the summary of breastfeeding interruption for nuclear medicine procedures helpful to nuclear medicine professionals?

PERTINENT FINDINGS: We present detailed summary tables on breastfeeding interruption from institutional recommendations and the literature.

IMPLICATIONS FOR PATIENT CARE: The summary tables may be helpful to busy practicing nuclear medicine technologists and physicians.

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