The Journal of NUCLEAR MEDICINE

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J Nucl Med. 2010;51:1813-1820.
Doi: 10.2967/jnumed.110.082263

The Journal of Nuclear Medicine is published monthly.
SNMMI | Society of Nuclear Medicine and Molecular Imaging
1850 Samuel Morse Drive, Reston, VA 20190.
(Print ISSN: 0161-5505, Online ISSN: 2159-662X)

SNMMI SOCIETY OF NUCLEAR MEDICINE AND MOLECULAR IMAGING

SNM Practice Guideline for Sodium ^{18}F-Fluoride PET/CT Bone Scans 1.0*

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PREAMBLE

The Society of Nuclear Medicine (SNM) is an international scientific and professional organization founded in 1954 to promote the science, technology, and practical application of nuclear medicine. Its 16,000 members are physicians, technologists, and scientists specializing in the research and practice of nuclear medicine. In addition to publishing journals, newsletters, and books, the SNM also sponsors international meetings and workshops designed to increase the competencies of nuclear medicine practitioners and to promote new advances in the science of nuclear medicine.

The SNM will periodically define new Practice Guidelines for nuclear medicine practice to help advance the science of nuclear medicine and to improve the quality of service to patients throughout the United States. Existing Practice Guidelines will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each Practice Guideline, representing a policy statement by the SNM, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Committee on SNM Guidelines, Health Policy and Practice Commission, and SNM Board of Directors. The Practice Guidelines recognize that the safe and effective use of diagnostic nuclear medicine imaging requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published Practice Guidelines by those entities not providing these services is not authorized.

These Practice Guidelines are an educational tool designed to assist practitioners in providing appropriate care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the SNM cautions against the use of these Practice Guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the Practice Guidelines, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the Practice Guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of the Practice Guidelines.

The practice of medicine involves not only the science, but also the art, of preventing, diagnosing, alleviating, and treating disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to these Practice Guidelines will not ensure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these Practice Guidelines is to assist practitioners in achieving this objective.

I. INTRODUCTION

^{18}F-fluoride is a highly sensitive bone-seeking PET tracer used for detection of skeletal abnormalities (*1*). The uptake mechanism of ^{18}F-fluoride resembles that of ^{99m}Tc-methylene diphosphonate (MDP), with better pharmacokinetic characteristics including faster blood clearance and 2-fold higher uptake in bone. Uptake of ^{18}F-fluoride reflects blood flow and bone remodeling. The use of novel hybrid PET/CT

Received Aug. 13, 2010; revision accepted Aug. 20, 2010.
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DOI: 10.2967/jnumed.110.082263

systems has significantly improved the specificity of ^{18}F-fluoride imaging, because the CT component of the study allows morphologic characterization of the functional lesion and more accurate differentiation between benign lesions and metastases.

II. GOALS

The purpose of this information is to assist health care professionals in performing, interpreting, and reporting the results of PET/CT bone scans performed with ^{18}F-fluoride. Variable institutional factors and individual patient considerations make it impossible to create procedures applicable to all situations or to all patients.

III. DEFINITIONS

^{18}F is a diagnostic molecular imaging agent used for identification of new bone formation. ^{18}F, administered as intravenous Na^{18}F, was approved by the U.S. Food and Drug Administration in 1972 but has been listed as a discontinued drug since 1984. In 2000, the Food and Drug Administration listed it in the Orange Book for discontinued drug products, indicating that the original approval in 1972 is valid for companies wishing to reapply for an investigational new drug. However, to date no such application has been filed, and ^{18}F is manufactured and distributed by authorized user prescription under state laws of pharmacy.

PET/CT is a molecular imaging technology that combines cross-sectional functional and anatomic imaging for diagnosis.

PET/CT may be limited to a single anatomic region such as head and neck, thorax, or abdomen and pelvis; may include the body between the skull base and middle of the thighs; or image the entire body from the top of the head to the toes.

IV. COMMON CLINICAL INDICATIONS

A. No appropriateness criteria have been developed to date for this procedure.

B. PET/CT ^{18}F bone scans may be used to identify skeletal metastases, including localization and determination of the extent of disease (*2–18*).

C. Insufficient information exists to recommend the following indications in all patients, but these indications may be appropriate in certain individuals:

1. Back pain (*19,20*) and otherwise unexplained bone pain (*21*)
2. Child abuse (*22,23*)
3. Abnormal radiographic or laboratory findings
4. Osteomyelitis
5. Trauma
6. Inflammatory and degenerative arthritis
7. Avascular necrosis (*24,25*)
8. Osteonecrosis of the mandible (*26,27*)
9. Condylar hyperplasia (*28,29*)
10. Metabolic bone disease (*30*)
11. Paget disease (*31*)
12. Bone graft viability (*32*)
13. Complications of prosthetic joints (*33,34*)
14. Reflex sympathetic dystrophy
15. Distribution of osteoblastic activity before administration of therapeutic radiopharmaceuticals for bone pain

V. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

See Section V of the SNM Procedure Guideline for General Imaging and the SNM Procedure Guideline for Tumor Imaging with ^{18}F-FDG PET/CT.

VI. THE PROCEDURE/SPECIFICATION OF THE EXAMINATION

A. Nuclear medicine request

The request for the examination should include sufficient medical information to demonstrate medical necessity and should include the diagnosis, pertinent history, and questions to be answered.

The medical record should be reviewed. A history of trauma, orthopedic surgery, cancer, osteomyelitis, arthritis, radiation therapy, or other localized conditions affecting the bony skeleton may affect the distribution of ^{18}F.

Relevant laboratory tests, such as prostate-specific antigen in patients with prostate cancer, and alkaline phosphatase, should be considered.

The results of prior imaging studies should be reviewed, including plain-film radiography, CT, MRI, bone scanning, and ^{18}F-FDG PET/CT. Relevant prior studies should be directly compared with current imaging findings when possible.

B. Patient preparation and precautions

1. Regarding pregnant or breastfeeding patients, see Section VI of the SNM Procedure Guideline for General Imaging.

   Examinations involving ionizing radiation should be avoided in pregnant women, unless the potential benefits outweigh the radiation risk to the mother and fetus.
2. Patients should be well hydrated to promote rapid excretion of the radiopharmaceutical to decrease radiation dose and to improve image quality. Unless contraindicated, patients should drink 2 or more 224-mL (8-oz) glasses of water within 1 h before the examination, and another 2 or more 224-mL glasses of water after administration of ^{18}F. Patients should be instructed to empty their bladder immediately before imaging. Appropriate precautions for proper disposal of radioactive urine should be taken in patients who are incontinent.
3. Patients do not need to fast and may take all their usual medications.

The impact of treatment such as bisphosphonates, antihormonal therapy, chemotherapy, and radiotherapy on the uptake of ^{18}F and the role of ^{18}F PET/CT in monitoring response to therapy is yet to be determined.

C. Radiopharmaceutical

^{18}F-fluoride is injected intravenously by direct venipuncture or intravenous catheter. The activity for adults is 185–370 MBq (5–10 mCi). A higher activity (370 MBq [10 mCi]) may be used in obese patients. Pediatric activity should be weight-based (2.22 MBq/kg [0.06 mCi/kg]), using a range of 18.5–185 MBq (0.5–5 mCi).

D. Protocol/image acquisition

See also the SNM Procedure Guideline for Tumor Imaging with ^{18}F-FDG PET/CT.

1. Patient positioning

   See the SNM Procedure Guideline for Tumor Imaging with ^{18}F-FDG PET/CT.

   Arm position during scanning depends on the indications for the study. The arms may be by the sides for whole-body imaging or elevated when only the axial skeleton is scanned.

2. Protocol for CT imaging

   See the SNM Procedure Guideline for Tumor Imaging with ^{18}F-FDG PET/CT.

   CT may be performed for attenuation correction of emission images and localization of scintigraphic findings. Optimized CT may also be performed for radiographic characterization of skeletal abnormalities. The CT protocol depends on the indications for the study and the likelihood that radiographic findings will add diagnostic information. The need for additional diagnostic information should always be weighed against the increased radiation exposure from CT. Dose parameters should be consistent with the principles of ALARA (as low as reasonably achievable).

   Several reports (*4*–*9*) have shown an improvement in sensitivity of NaF PET over planar ^{99m}Tc bone scintigraphy in patients with metastatic osteoblastic metastases. The addition of CT also appears to improve the specificity of NaF PET (*4*,*5*).

   Because of the high bone–to–soft-tissue activity ratio of ^{18}F bone scans, high-quality images may be obtained without CT for attenuation correction. It is possible to survey the whole body with emission-only images and then acquire additional images, as needed, using PET/CT of a limited area. The diagnostic accuracy of this approach has not been studied.

3. Protocol for PET emission imaging

   a. Emission images of the axial skeleton may begin as soon as 30–45 min after administration of the radiopharmaceutical in patients with normal renal function, because of the rapid localization of ^{18}F in the skeleton and rapid clearance from the circulation. There have not been any studies looking at image quality or accuracy with a longer delay. It is necessary to wait longer to obtain high-quality images of the extremities, with a start time of 90–120 min for whole-body imaging or imaging limited to the arms or legs.

   b. Images may be acquired in 2- or 3-dimensional mode. Three-dimensional mode is recommended for whole-body imaging because the higher count rates compensate for the shorter acquisition times required for imaging a large area.

   c. Acquisition time per bed position will vary depending on the amount of injected radioactivity, decay time, body mass index, and camera factors. Typical acquisition times are 2–5 min per bed position.

      In a patient with a normal body mass index, good images of the axial skeleton may be obtained with an acquisition time of 3 min/bed position starting 45 min after injection of 185 MBq (5 mCi) of ^{18}F. Good whole-body images may be obtained with an acquisition time of 3 min/per bed position starting 2 h after injection of 370 MBq (10 mCi) of ^{18}F.

1. Intervention

   Intense tracer activity in the urinary bladder degrades image quality and can confound interpretation of findings in the pelvis. Hydration and a loop diuretic, without or with bladder catheterization, may be used to reduce accumulated urinary tracer activity in the bladder.

2. Processing

   See the SNM Procedure Guideline for Tumor Imaging with ^{18}F-FDG PET/CT and Boellaard et al. (*37*).

   Images are typically acquired in a 128 × 128 matrix, although a 256 × 256 matrix may be advantageous if processing times are reasonable. Commercially available software packages for iterative reconstruction are widely available. The optimal number of iterations and subsets, filters, and other reconstruction parameters will depend on patient and camera factors. In general, the same reconstruction protocols as are used for imaging ^{18}F-FDG PET may be used for ^{18}F. Maximum-intensity-projection images should be generated to help facilitate lesion detection.

   Combination imaging with simultaneous ^{18}F-FDG and ^{18}F injection has been reported (*38*–*40*), although there is not enough evidence to support its use in routine clinical practice, and there is some suggestion that it may lead to confusion in interpretation due to uncertainty in separating the

contribution of each radiopharmaceutical, such as in the posttherapy flare phenomenon, in patients on colony-stimulating-factor medications, and in patients with marrow metastases in which ^{18}F-FDG uptake may be obscured by adjacent cortical ^{18}F activity (*41*).

E. Interpretation criteria

See also the SNM Procedure Guideline for Bone Scintigraphy.

^{18}F is normally distributed throughout the entire skeleton. The major route of excretion is the urinary tract. Kidneys, ureters, and bladder should be visible in the absence of renal insufficiency. The degree of localization in the urinary tract depends on renal function, state of hydration, and interval between administration of ^{18}F and imaging. Renal insufficiency will decrease localization in the urinary tract. Urinary outflow obstruction will increase localization proximal to the site of obstruction. Chronic severe obstruction, however, may reduce localization. Soft-tissue activity reflects the amount of circulating ^{18}F in the blood pool at the time of imaging and should be minimal. Local or regional hyperemia may cause increased visualization of the soft tissues.

^{18}F localization in the skeleton is dependent on regional blood flow, as well as on new bone formation. ^{18}F is substituted for hydroxyl groups in hydroxyapatite and covalently bonds to the surface of new bone. Uptake is higher in new bone (osteoid) because of higher availability of binding sites. Local or regional hyperemia may also cause increased localization in the skeleton.

Physiologic ^{18}F uptake in the skeleton is generally uniform in adults. Normal growth causes increased localization in the metaphyses of children and adolescents. Symmetric uptake between the left and right sides is generally observed in individuals of all ages, except in periarticular sites, where ^{18}F uptake can be variable.

Nearly all causes of increased new-bone formation cause increased localization of ^{18}F. The degree of increased localization is dependent on many factors, including blood flow and the amount of new bone formation. Processes that result in minimal osteoblastic activity, or primarily osteolytic activity, may not be detected.

In general, the degree of ^{18}F uptake does not differentiate benign from malignant processes. The pattern of ^{18}F uptake, however, may be suggestive or even characteristic of a specific diagnosis. Correlation with skeletal radiographs and other anatomic imaging is essential for diagnosis. The CT component of PET/CT, even when performed primarily for attenuation correction and anatomic registration, also provides diagnostic information.

Any degree of ^{18}F uptake that is visibly higher or lower than uptake in adjacent bone, or uptake in the corresponding contralateral region, indicates an alteration in bone metabolism. Because of the higher resolution of PET/CT, compared with single-photon imaging, physiologic variability is more prominent.

Subclinical joint disease commonly causes increased periarticular ^{18}F uptake that may be asymmetric and occurs anywhere in the body, especially in the spine and small bones of the hands and feet. The addition of diagnostic CT can often help differentiate benign from malignant disease in these cases (*4*,*5*). Dental disease commonly causes increased periodontal ^{18}F uptake. Subclinical injury (especially the rib-cage and costochondral junctions) may cause increased ^{18}F uptake.

The use of quantitative indices, such as standardized uptake value, has not been validated, and their value in clinical studies is undefined. Quantitative assessment of bone metabolism using kinetic modeling has been described but requires dynamic imaging of the skeleton at 1 bed position up to 1 h after injection.

Accurate interpretation requires correlation with clinical history, symptoms, prior imaging studies, and other diagnostic tests.

VI. DOCUMENTATION/REPORTING

A. Goals of a report

See Section VII.A of the SNM Procedure Guideline for General Imaging.

B. Direct communication

See Section VII.B of the SNM Procedure Guideline for General Imaging.

Significant abnormalities should be verbally communicated to the appropriate health care provider if a delay in treatment might result in significant morbidity. An example of such an abnormality would be a lesion with a high risk of pathologic fracture. An abnormality suggesting a high likelihood of unexpected malignancy should also be communicated verbally.

Reporting of abnormalities requiring urgent attention should be consistent with the policy of the interpreting physician's local organization.

C. Written communication

See the American College of Radiology (ACR) Practice Guideline for Communication of Diagnostic Imaging Findings and Section VII.C of the SNM Procedure Guideline for General Imaging.

Written documentation of verbal reporting should be made in the medical record, usually as part of the PET/CT report.

D. Contents of the report

See Section VII.D of the SNM Procedure Guideline for General Imaging.

1. Study identification

The report should include the full name of the patient, medical record number, and date of birth.

The name of the examination should also be included, with the date and time it is performed. The electronic medical record provides these data, as well as a unique study number.

2. Clinical information

   At a minimum, the clinical history should include the reason for referral and the specific question to be answered. If known, the diagnosis and a brief treatment history should be provided. The results of relevant diagnostic tests and prior imaging findings should be summarized.

3. Procedure description

   The type and date of comparison studies should be stated. If no comparison studies are available, a statement should be made to that effect.

   Study-specific information should include the name of the radiopharmaceutical (sodium ^{18}F-fluoride), dose in megabecquerels (MBq) or millicuries (mCi), route of administration (intravenous), and the date and time of administration. The site of administration is optional. The name, dose, and route of administration of nonradioactive drugs and agents should also be stated. The type of camera should be specified, but specific equipment information is optional.

   A description of the procedure should include the time at which the patient is scanned or the time interval between administration of ^{18}F and the start time of the scan. The part of the body that is scanned should be described from the starting to the ending point. The position of the patient (supine or prone) and the position of the arms (elevated or by the sides) should be stated if nonstandard.

   Description of the CT part of the examination may be limited to a statement that CT was performed for attenuation correction and anatomic registration of the emission images. If CT was optimized for diagnosis, then a more complete description of the protocol should be provided.

   Routine processing parameters are usually not stated in the report, but any special circumstances requiring additional processing, such as motion correction, should be described.

4. Description of the findings

   Significant findings should be described in a logical manner. Findings may be grouped by significance or described by body region. An integrated PET/CT report is preferred, although CT optimized for diagnosis may be reported separately.

   The location and extent of significant findings should be described. The information should include the name of the bone. At a minimum, extent should be described as focal or diffuse. Designation of the involved anatomic subdivision of a bone should be included, if appropriate. The appearance of the corresponding finding on CT should be described (e.g., normal, sclerotic, lucent, lytic, blastic, or mixed). The size of focal lesions measured on CT should be reported in at least 1 axial dimension if this information is clinically important. The description of significant abnormalities may also include a description of the relative level of ^{18}F uptake, but there is no standard nomenclature. Standardized uptake value may be used as a purely descriptive means of reporting, but the measurement should not be used to render a specific diagnosis.

   Uptake in the urinary tract and soft tissues should be described. Significant nonskeletal CT findings should also be described as fully as possible.

   Limitations should be addressed. When appropriate, factors that can limit the sensitivity and specificity of the examination should be identified.

   The report should address or answer any pertinent clinical questions raised in the request for imaging examination.

   Comparisons with previous examinations and reports, when possible, should be a part of the imaging consultation and report. Integrated PET/CT studies are more valuable when correlated with previous diagnostic CT, previous PET, previous PET/CT, previous MRI, and all appropriate imaging studies and clinical data that are relevant.

5. Impression

   a. A precise diagnosis should be given whenever possible.
   b. A differential diagnosis should be given when appropriate.
   c. When appropriate, follow-up and additional diagnostic studies should be recommended to clarify or confirm the impression.

VIII. EQUIPMENT SPECIFICATIONS

See the SNM Procedure Guideline for Tumor Imaging with ^{18}F-FDG PET/CT.

See the "Equipment Specifications" and "Quality Control" sections from the ACR Practice Guideline for the Performance of Computed Tomography (CT) of the Extracranial Head and Neck in Adults and Children, the ACR Practice Guideline for the Performance of Pediatric and Adult Thoracic Computed Tomography (CT), and the ACR Practice Guideline for the Performance of Computed Tomography (CT) of the Abdomen and Computed Tomography (CT) of the Pelvis.

IX. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION CONCERNS

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR and

TABLE 1
Radiation Dose Comparison Between ^{18}F-Fluoride and ^{99m}Tc-MDP

Patient	Intravenous administered activity	Organ receiving largest radiation dose	Effective dose
^{18}F-fluoride			
Adult	185–370 MBq (5–10 mCi)	Bladder*: 0.22 mGy/MBq (0.81 rad/mCi)	0.024 mSv/MBq (0.089 rem/mCi)
Child (5 y old)	2.22 MBq/kg (0.06 mCi/kg)	Bladder*: 0.61 mGy/MBq (2.3 rad/mCi)	0.086 mSv/MBq (0.32 rem/mCi)
^{99m}Tc-MDP			
Adult	740–1,110 MBq (20–30 mCi)	Bone surfaces: 0.063 mGy/MBq (0.23 rad/mCi)	0.0057 mSv/MBq (0.021 rem/mCi)
Child (5 y old)	7–11 MBq/kg (0.2–0.3 mCi/kg)	Bone surfaces: 0.22 mGy/MBq (0.81 rad/mCi)	0.025 mSv/MBq (0.092 rem/mCi)

*Voiding interval, 3.5 h. Changes in bladder wall dose are approximately linear with changes in voiding interval; for voiding interval of 2.0 h, dose to bladder wall would change by factor of 2/3.5.
Data are from the International Commission on Radiological Protection (*42,43*).

SNM policies on quality control, and patient education when appropriate.

In all patients, the lowest exposure factors that would produce images of diagnostic quality should be chosen.

Equipment performance monitoring should be in accordance with the ACR Technical Standard for Medical Nuclear Physics Performance Monitoring of PET/CT Imaging Equipment.

See the SNM Procedure Guideline for General Imaging; the SNM Procedure Guideline for Use of Radiopharmaceuticals; and, for equipment performance guidelines and quality control, the SNM Procedure Guideline for Tumor Imaging with ^{18}F-FDG PET/CT.

X. RADIATION SAFETY IN IMAGING

See also Section X of the SNM Procedure Guideline for General Imaging.

The effective dose for ^{18}F is 0.024 mSv/MBq (0.089 mrem/mCi). For a typical activity of 370 MBq (10 mCi), the effective dose is 8.9 mSv (0.89 rem).

For comparison, the effective dose for ^{99m}Tc-MDP is 0.0057 mSv/MBq (0.021 rem/mCi). For a typical activity of 925 MBq (25 mCi), the effective dose is 5.3 mSv (0.53 rem).

Thus, the radiation dose to patients is approximately 70% higher using ^{18}F-fluoride (370 MBq × 0.024 mSv/MBq = 8.9 mSv) than using ^{99m}Tc-MDP.

A radiation dose comparison between ^{18}F-fluoride and ^{99m}Tc-MDP is presented in Table 1, and fetal dose estimates are presented in Table 2.

A. The breastfeeding patient

International Commission on Radiological Protection Publication 106, Appendix D, does not provide a recommendation about interruption of breastfeeding for ^{18}F-fluoride; the authors recommend that no inter-

TABLE 2
The Pregnant or Potentially Pregnant Patient: Fetal Dose Estimates

Stage of gestation	Estimated mean dose	Estimated dose range
^{18}F-fluoride*		
Early	0.022 mGy/MBq (0.081 rad/mCi)	4.1–8.1 mGy (0.41–0.81 rad)
3 mo	0.017 mGy/MBq (0.063 rad/mCi)	3.1–6.3 mGy (0.31–0.63 rad)
6 mo	0.0075 mGy/MBq (0.028 rad/mCi)	1.4–2.8 mGy (0.14–0.28 rad)
9 mo	0.0068 mGy/MBq (0.025 rad/mCi)	1.3–2.5 mGy (0.13–0.25 rad)
^{99m}Tc-MDP†		
Early	0.0061 mGy/MBq (0.023 rad/mCi)	1.1–2.3 mGy (0.11–0.23 rad)
3 mo	0.0054 mGy/MBq (0.020 rad/mCi)	1.0–2.0 mGy (0.10–0.20 rad)
6 mo	0.0027 mGy/MBq (0.010 rad/mCi)	0.5–1.0 mGy (0.050–0.10 rad)
9 mo	0.0024 mGy/MBq (0.0089 rad/mCi)	0.44–0.89 mGy (0.044–0.089 rad)

*No information about possible placental crossover of this compound was available.
†Information about possible placental crossover of this compound was available and was considered in estimates of fetal doses.
Data are from Russell et al. (*44*).

ruption is needed for breastfeeding patients administered ^{99m}Tc-phosphonates (*42*).

B. Issues related to the CT radiation dose from PET/CT

With PET/CT, the radiation dose to the patient is the combination of the radiation dose from the PET radiopharmaceutical and the radiation dose from the CT portion of the study. Radiation dose in diagnostic CT has attracted considerable attention in recent years, in particular for pediatric examinations. It can be misleading to quote a "representative" dose for a CT scan because of the wide diversity of applications, protocols, and CT systems. This also applies to the CT component of a PET/CT study. For example, a body scan may include various portions of the body using protocols aimed to reduce the radiation dose to the patient or aimed to optimize the CT scan for diagnostic purposes. The effective dose could range from approximately 5 to 80 mSv (0.5–8.0 rem) for these options. It is therefore advisable to estimate CT dose specific to the CT system and protocol.

Pediatric and adolescent patients should have their CT examinations performed at an amperage (mAs) appropriate for patient size, because radiation dose to the patient increases significantly as the diameter of the patient decreases.

The effective dose for a typical adult whole-body CT scan performed for attenuation correction and registration of emission images is 3.2 mSv (0.32 rem), using the following parameters: voltage of 120 keV, current of 30 mA, rotation of 0.5 s, and pitch of 1.

XI. ACKNOWLEDGMENTS

The Committee on SNM Guidelines consists of the following individuals: Kevin J. Donohoe, MD (Chair) (Beth Israel Deaconess Medical Center, Boston, MA); Dominique Delbeke, MD (Vanderbilt University Medical Center, Nashville, TN); Twyla Bartel, DO (UAMS, Little Rock, AR); Paul E. Christian, CNMT, BS, PET (Huntsman Cancer Institute, University of Utah, Salt Lake City, UT); S. James Cullom, PhD (Cardiovascular Imaging Technology, Kansas City, MO); Lynnette A. Fulk, CNMT, FSNMTS (Clarian Health Methodist, Kokomo, IN); Ernest V. Garcia, PhD (Emory University Hospital, Atlanta, GA); Heather Jacene, MD (Johns Hopkins University, Baltimore, MD); David H. Lewis, MD (Harborview Medical Center, Seattle, WA); Josef Machac, MD (Mt. Sinai Hospital, Haworth, NY); J. Anthony Parker, MD, PhD (Beth Israel Deaconess Medical Center, Boston, MA); Heiko Schoder, MD (Memorial Sloan-Kettering Cancer Center, New York, NY); Barry L. Shulkin, MD, MBA (St. Jude Children's Research Hospital, Memphis, TN); Arnol M. Takalkar, MD, MS (Biomedical Research Foundation of Northwest Louisiana, Shreveport, LA); Alan D. Waxman, MD (Cedars-Sinai Medical Center, Los Angeles, CA); and Mark D. Wittry, MD (West County Radiological Group, Inc., St. Louis, MO).

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XIII. APPROVAL

This Practice Guideline was approved by the Board of Directors of the SNM on June 4, 2010.