Austin Radiological Association

Nuclear Medicine Procedure

PET SODIUM FLUORIDE BONE SCAN
(F-18 NaF)

Overview

- Sodium Fluoride F18 injection is a radioactive diagnostic agent for positron emission tomography (PET) indicated for imaging of bone to define areas of altered osteogenic activity.

Indication

- Identify skeletal metastasis, including localization and determination of extent of disease.
- Unexplained bone pain
- Osteomyelitis

Examination Time

- Allow approximately 2.5 hours for the entire PET/CT visit.
- Prior to Scan: Allow 30 minutes for interview, IV, and changing followed by 1 hour uptake post injection.
- Image acquisition:

1. 78816 (full body – includes legs)
   ~60 minutes for average patient

2. 78815 (skull base to mid-thigh)
   ~30 minutes for average size patient.

3. 78614 (limited scan)
   ~dependent on number of beds acquired

Patient Preparation

- No current reimbursement coverage
- Patient should hydrate with 2 glasses of water (8oz) one hour before examination
- Dress in comfortable clothing with no metal or jewelry

Diet

No fasting – all medications are ok

Patient Interview and IV

- **Recent Surgery**
  - Record *all* surgeries. Be sure to note the date of all surgeries, including biopsies, within the last 6 months.

- **Chemotherapy**
  - Record dates and type, note if currently taking

- **Radiation Therapy**
  - Record dates and area

- **Infection**
  - Indicate any recent infections on the patient history.

Sedations (oral)

- Patients getting sedation must not take their own sedation medication within 4 hours prior to their arrival. Patients who do take their own medication will not be provided sedation by ARA.
- Sedation may be needed for claustrophobia. Alprazolam (Xanax) at 1 mg is commonly used to treat panic disorders including claustrophobia. These patients should arrive 1 hour prior to their injection. The paramedic will assess the patient and consult with the radiologist to determine the appropriate dosage.
- Patients requiring sedation must have a driver.

Patient Uptake Phase

1. The patient should lie still throughout the uptake period.
2. The patient should drink two 8oz glasses of water during uptake phase.

Equipment & Energy Windows

- Imaging system:
  - Siemens Biograph 16 PET-CT scanner.
  - GE Discovery ST PET-CT scanner.
- Collimators:
  - 3D mode (septa out or absent) *(Siemens Biograph 16 only has 3D function)*
  - 3D or 2D mode for GE Discovery ST depending on upgrade level.

- Energy windows (may vary with manufacturer and machine design): 30% window centered at 511 keV.

Radiopharmaceutical, Dose, & Technique of Administration

- Radiopharmaceutical: F-18 Sodium Fluoride.

- Dosing:

  Average Adult 10 mCi (370 MBq)

  Pediatric Patients – 0.06 mCi/kg – minimum 0.5 mCi
  Based on North American Consensus Guidelines for Radiopharmaceutical Activities in Children and Adolescents

- Technique of administration: Standard intravenous injection, contralateral to any site of concern, followed by saline flush

Patient Positioning & Imaging Field

- Patient position:
  1. Supine with a triangular bolster under the knees.
  2. Arms:
     - At sides.
  3. Place Velcro strap around patient to assist patient in lying still.

- Imaging field of view: Usually from top of skull to bottom of feet
  - The field of view may be top of skull to mid-femur
  - Scan caudal-cranial to minimize bladder activity

Acquisition Protocol

- Approximately 45-60 minutes post injection, have the patient empty his/her bladder.

- Begin image acquisition approximately 60 minutes following injection of F-18 NaF.

- Have the patient empty his/her bladder after image acquisition. Give instructions to hydrate and void often.

- CT parameter values vary with patient size and machine specific factors:
  1. Kilovolts peak (kVp) guidelines:
     a) refer to pediatric protocols for all Pedi's
     b) average adult: 120 kVp.
     c) obese adult: 140 kVp.
  2. Milliampere-seconds (mAs) guideline: Varies between approximately 200 and
     400 mAs depending on patient size. Utilize care dose when indicated.

Data Processing

- The PET images are reconstructed using iterative reconstruction. Settings for the Siemens PET/CT scanner include: Matrix 180, 4 iterations, 10 subsets, Gaussian filter, filter FWHM 3.0, zoom 1.0. Settings for the GE Discovery ST PET/CT scanner include: 2D reconstruction, OSEM, 21 subsets, 2 iterations, 128 matrix, post filter 8.5, loop filter 5.47, diameter 70, center L 0, center P 0, z axis filter (yes), measured attenuation.
- Construct tomographic images with and without attenuation correction. In general, attenuation corrected images are used for primary interpretation and non-attenuation corrected images may be used in problem solving.
- A rotating maximum intensity projection (MIP) display facilitates lesion detection.
- Create Coronal CT reformation as well as axial soft tissue and bone recons.

Optional Maneuvers

- Oral administration of F-18 NaF: In patients without intravenous access, the radiopharmaceutical may be given orally.

Principle Radiation Emission Data - F-18

- Physical half-life = 109.8 minutes.

Radiation	Mean % per disintegration	Mean energy (keV)
Positron	100	250
Gamma ±	200	511

Radiation Dosimetry

The age/weight- based estimated absorbed radiation doses (mGy/MBq) from intravenous injection of Sodium Fluoride F 18 Injection are shown in Table 1. These estimates were calculated based on human data and using the data published by the Nuclear Regulatory Commission [1] and the International Commission on Radiological Protection for Sodium Fluoride Injection [2]. The bone, bone marrow and urinary bladder are considered target and critical organs.

Table 1: Estimated Absorbed Radiation Doses after Intravenous Administration of Sodium Fluoride F 18 Injection

Organ	Estimated Radiation Dose mGy/MBq				
	Adult 70 kg [1]	15 year 56.8 kg [2]	10 year 33.2 kg [2]	5 year 19.8 kg [2]	1 year 9.7 kg [2]
Adrenals	0.0062	0.012	0.018	0.028	0.052
Brain	0.0056	N/A	N/A	N/A	N/A
Bone surfaces	0.060	0.050	0.079	0.13	0.30
Breasts	0.0028	0.0061	0.0097	0.015	0.030
GI Gallbladder wall	0.0044	N/A	N/A	N/A	N/A
Stomach wall	0.0038	0.008	0.013	0.019	0.036
Small intestine	0.0066	0.012	0.018	0.028	0.052
Upper large intestine wall	0.0058	0.010	0.016	0.026	0.046
Lower large intestine wall	0.012	0.016	0.025	0.037	0.063
Heart wall	0.0039	N/A	N/A	N/A	N/A
Kidneys	0.019	0.025	0.036	0.053	0.097
Liver	0.0040	0.0084	0.013	0.021	0.039
Lungs	0.0041	0.0084	0.013	0.020	0.039
Muscle	0.0060	N/A	N/A	N/A	N/A
Ovaries	0.011	0.016	0.023	0.036	0.063
Pancreas	0.0048	0.0096	0.015	0.023	0.044
Red marrow	0.028	0.053	0.088	0.18	0.38
Skin	0.0040	N/A	N/A	N/A	N/A
Spleen	0.0042	0.0088	0.014	0.021	0.041
Testes	0.0078	0.013	0.021	0.033	0.062
Thymus	0.0035	N/A	N/A	N/A	N/A
Thyroid	0.0044	0.0084	0.013	0.020	0.036
Urinary bladder wall	0.25	0.27	0.4	0.61	1.1
Uterus	0.019	0.023	0.037	0.057	0.099
Other tissue	N/A	0.010	0.015	0.024	0.044
Effective Dose Equivalent mSv/MBq	0.027	0.034	0.052	0.086	0.17

[1] Data from Nuclear Regulatory Commission Report, Radiation Dose Estimates for Radiopharmaceuticals, NUREG/CR-6345, page 10, 1996.
[2] Data from ICRP publication 53, Radiation Dose to Patients from Radiopharmaceuticals , Ann ICRP, Volume 18, pages 15 and 74, 1987

Dosimetry - Computed Tomography

- Actual effective doses will depend on the user-specific exam protocol and the specific CT scanner used. Care dose should be used when indicated.

Effective dose	rem	mSv
Diagnostic CT	1.9	19.0
Low dose CT	0.3	3.0