Austin Radiological Association

Nuclear Medicine Procedure

WHITE BLOOD CELL MIGRATION STUDY
(In-111-WBCs, Tc-99m-HMPAO-WBCs)

Overview

- The White Blood Cell Migration Study demonstrates the distribution of labeled autologous white blood cells within the body at various times after intravenous injection. When labeled with technetium-99m, the study can be completed in several hours and is optimal for imaging inflammatory bowel disease. When labeled with indium-111, the study can be extended over two days and is preferred for the diagnosis of vertebral body osteomyelitis. White blood cells labeled with either radioisotope may be used for imaging osteomyelitis outside of the spine and soft tissue abscesses.

Indications

- Detection of abscesses and infection in soft tissues, particularly in patients without localizing findings.
- Diagnosis of infection in the skeleton.
- Evaluation of inflammatory bowel disease.

Examination Time

- Initially: 15 minutes for withdrawal of 60 mL of blood.
- At 3 hours: 15 minutes for injection of the radiopharmaceutical labeled WBC's. WBC's must be injected no later than 5 hours after tagging process.
- Later:
  - > In-111-WBCs: 1 hour for imaging at 3 and/or 24 hours. (Delayed images beyond the routine set of images may be needed.)
  - > Tc-99m-HMPAO-WBCs: 1 hour for imaging at 3 hours.

Patient Preparation

- None (antibiotics do not appear to interfere).

Equipment & Energy Windows

- Gamma camera: Large field of view, preferably with dual heads.

- Collimator:
  - > In-111-WBCs: Medium energy, parallel hole.
  - > Tc-99m-HMPAO-WBCs: Low energy, high resolution, parallel hole.

- Energy windows:
  - > In-111-WBCs:
    - > One pulse height analyzer: 156 to 272 keV.
    - > Two pulse height analyzers: 20% windows centered at 171 and 245 keV.
  - > Tc-99m-HMPAO-WBCs: 20% window centered at 140 keV.

Radiopharmaceutical, Dose, & Technique of Administration

- Radiopharmaceutical:
  - > In-111-white blood cells - equal for infection of skeleton and soft tissue infection.
  - > Tc-99m-HMPAO-WBCs - radiopharmaceutical of choice for inflammatory bowel disease, equal for soft tissue infection.
  - > Ga-67 – radiopharmaceutical of choice for the spine.

- Dose:
  - > In-111-WBCs: 500 μCi (18.5 MBq). Pedi dose by NACG chart.
  - > Tc-99m-HMPAO-WBCs: 15-25 mCi (555 - 925 MBq). Pedi dose by NACG chart.

- Technique of administration: Standard intravenous injection.

Patient Position & Imaging Field

- Patient position: Supine.

- Imaging field: Usually entire torso; check with the nuclear medicine physician.

Acquisition Protocol

- Initial imaging:
  - > In-111-WBCs : 4 and 24 hours post injection.
  - > Tc-99m-HMPAO-WBCs: 3 hours post injection.

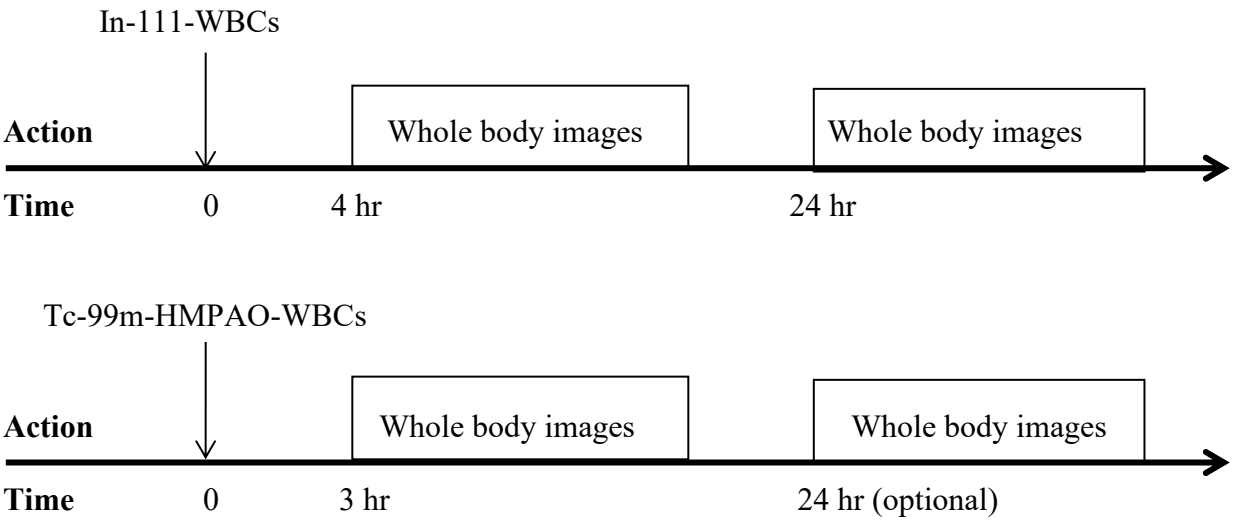
- ANT and POST images are acquired of the torso, and of the extremities as indicated; occasionally other projections are obtained.

> For moving acquisition: Use a camera/table motion of approximately 8 cm/min.
> Static acquisition protocol: Acquire images for 5 - 10 minutes each.

- SPECT imaging - use routinely for limited studies and areas of uncertainty:
  1. Image acquisition parameters:
     a) degrees of rotation: 180°.
     b) number of images: 60.
     c) time per image: 30 seconds.

- Delayed imaging (may be needed to increase the certainty of diagnosis):
  > In-111-WBCs: 48 hours.
  > Tc-99m-HMPAO-WBCs: 24 hours.

Protocol Summary Diagrams



Data Processing

- SPECT image reconstruction:
  1. The exact procedure for processing SPECT images depends on the computer software being used. This varies with the manufacturer and, in general, the manufacturer's protocol should be followed.
  2. The reconstruction process in general terms is:
     a) correct the 120 planar images for uniformity (camera non-uniformity) using a high count, e.g. 30 million count, cobalt-57 flood acquisition.
     b) check the images for patient motion and apply a motion correction algorithm if indicated and if available.

c) if the entire field of view is not of interest, indicate the region that is of interest so that computer time is not expended reconstructing tomograms outside the region of interest.
d) Flash 3D iterative processing with Gaussian filter
e) reconstruct transverse, sagittal, and coronal images.

Optional Maneuvers

- Bone marrow imaging with Tc-99m-sulfur colloid: May be performed in conjunction with In-111-WBC studies for osteomyelitis to increase specificity.

- Pethidine to reduce hepatobiliary excretion: When imaging inflammatory bowel disease with Tc-99m-HMPAO-WBCs, can give pethidine (an opiate) to constrict the sphincter of Oddi and reduce excretion of Tc-99m-WBC by products.

- Bone mineral imaging with Tc-99m-HMP or MDP: May be performed in conjunction with In-111-WBC studies for osteomyelitis to increase specificity.

- If performed to evaluate dialysis fistula, delay imaging at 4 hours post injection and 24 hour delay.

.

Principle Radiation Emission Data - In-111

- Physical half-life = 2.83 days.

Radiation	Mean % per disintegration	Mean energy (keV)
Gamma-2	90.2	171.3
Gamma-3	94.0	245.3

Dosimetry - In-111-White Blood Cells

Organ	rads/500 μCi	mGy/18.5 MBq
Spleen	11.9	119.0
Liver	1.9	19.0
Lungs	0.8	7.5
Marrow	0.3	3.3
Total body	0.2	2.0
Ovaries	0.1	0.7
Testes	0.01	0.1

Principle Radiation Emission Data - Tc-99m

- Physical half-life = 6.01 hours.

Radiation	Mean % per disintegration	Mean energy (keV)
Gamma-2	89.07	140.5

Dosimetry - Tc-99m-HMPAO-White Blood Cells

Organ	rads/10 mCi	mGy/370 MBq
Spleen	2.3	23.3
Liver	1.6	16.3
Kidneys	1.4	13.7
Bladder wall	0.6	6.3
Lungs	0.4	3.7
Marrow	0.1	1.5
Total body	0.1	1.5
Ovaries	0.1	0.7
Testes	0.04	0.4