
SUBJECT: WHITE BLOOD CELL STUDY

Overview

- The White Blood Cell 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. (In conjunction with **Bone Marrow** study)
- Evaluation of inflammatory bowel disease.

Examination Time

- Initially: 15 minutes for withdrawal of 50 mL of blood.
- At 3-4 hour: 15 minutes for injection of the radiopharmaceutical.
- Later:
 - > In-111-WBCs: 2 hours for imaging 24 hours. (Delayed images beyond the routine set of images may be needed.)
 - > Tc-99m-HMPAO-WBCs: 1 hour for imaging at 1 and 4 hours.

Patient Preparation

- A light bowel prep may be necessary depending on the location of issue.

Equipment & Energy Windows

- Gamma camera: Large field of view, preferably with opposing dual heads.
- Collimator:
 - > In-111-WBCs: Medium energy, parallel hole.
 - > Tc-99m-HMPAO-WBCs: LEHR.
- Energy windows:
 - > In-111-WBCs:

- 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 - radiopharmaceutical of choice for infection of the spine, equal for infection of rest of skeleton and soft tissue infection.
 - > Tc-99m-HMPAO-WBCs - radiopharmaceutical of choice for inflammatory bowel disease, equal for soft tissue infection .
- Dose:
 - > In-111-WBCs: 500 μ Ci.
 - > Tc-99m-HMPAO-WBCs: 20 mCi (15-25 mCi) .
Pediatric dosing: 0.1-0.2 mCi/kg with minimum dose being 5.0 mCi
- Technique of administration: Standard intravenous injection.

Patient Position & Imaging Field

- Patient position: Supine.
- Imaging field: Depends on clinical indication; check with the nuclear medicine physician.

Acquisition Protocol

- Initial imaging:
 - > In-111-WBCs : 24 hours.
 - > Tc-99m-HMPAO-WBCs: 1 and 4 hours.
- ANT and POST images are acquired of the torso and head, ANT images are obtained of the extremities; occasionally other projections are obtained.
 - For moving acquisition: Use a camera/table motion of approximately 5-10 cm/min.
 - Static acquisition protocol: Acquire images for approximately 5 minutes each.
- SPECT imaging - use routinely for limited studies and areas of uncertainty:
 1. Image acquisition parameters:
 - a) degrees of rotation: 360.
 - b) number of images: 120.
 - c) time per image: 20 seconds.
- Delayed imaging (may be needed to increase the certainty of diagnosis):
 - > In-111-WBCs: 24 and 48 hours.
 - > Tc-99m-HMPAO-WBCs: 24 hours for Tc-99m-WBCs.

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) check the images for patient motion and apply a motion correction algorithm if indicated and if available.
- b) 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.
- c) Y axis filter with FBP analytic set up; 6 iterations; Butterworth reconstruction filter with cut off of 0,55 and order of 5.0 (usually 1 or 2 pixels)
- d) reconstruct transverse, sagittal, and coronal image.

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. To be completed at 24 hour images (see section on Bone Marrow Study).
- Liver-spleen subtraction imaging with Tc-99m-sulfur colloid: May be used in conjunction with In-111-WBC studies in evaluating the upper abdomen for abscesses.
- Bone mineral imaging with Tc-99m-HMP or MDP: May be performed in conjunction with In-111-WBC studies for osteomyelitis to increase specificity.

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 (22,23)

Organ	rads/500 μ Ci	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 (25)

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

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Normal Findings

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