

Division of Nuclear Medicine Procedure / Protocol CSC and The American Center

Infection Imaging Procedure
Includes 99mTc-WBC, 111-In WBC and Gallium-67

CPT CODE: 78805 Abscess Ltd
78806 Abscess WB
78807 Abscess SPECT

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Indications:

To identify the presence and/or location of acute abscesses/infections or inflammation in:

- Non-pulmonary chest
- Intra-Abdominal
- Cardiovascular graft
- Musculoskeletal
- Prosthetic graft
- Inflammatory bowel disease
- Fever of unknown origin

Protocolling Algorithm:

Abscess/Infection imaging can be performed using the following radiopharmaceuticals:

- 99mTc-HMPAO labelled WBCs
- 111-In labeled WBCs
- Gallium 67 citrate
- 18FDG PET

The decision on which protocol will be used is dependent on the clinical indications. A NM physician will assess each request and specify the protocol to be used.

General guidelines for which radiopharmaceutical to use in abscess/infection imaging are (Refer to Appendix 1: Infection Imaging Algorithm at the end of this protocol):

- 1) Pediatrics
 - a) Children should be imaged using: 99mTc-WBCs. For joint disruption of joints consideration of follow up with series of Tc-99m Sulfur colloid
- 2) Adults
 - a) Musculoskeletal
 - i) Spine imaging for osteomyelitis or discitis should be imaged with either: Gallium-67 citrate or FDG PET (preferred)
 - ii) All patients with history of bone procedure or disruption (Ex. hip or knee prosthesis, history of previous fracture, diabetic foot or Charcot joint) should be imaged using: 111In WBCs in addition to 99mTc Sulfur colloid bone marrow imaging. A 99mTc-MDP Three Phase Bone scan can be pursued after In-111 WBC imaging as clinically indicated.
 - iii) Patients with intact distal extremities without surgical hardware or without history of bone procedure or disruption, Tc-99m HMPAO WBC scan is preferred
 - iv) Diabetic patients without Charcot Joint but with pain or ulcers (forefoot only) could be imaged using: 99mTc-WBCs.
 - v) Diabetic patients without Charcot Joint but with pain or ulcers (mid- and hind-foot) image with In-111 WBC and Tc-99m Sulfur colloid scans
 - vi) Patients where osteomyelitis is suspected but have no history of bone procedure or disruption (Ex. osteomyelitis, fracture, orthopedic hardware, or Charcot foot) should first be imaged using: 99mTc-MDP as a Three Phase Bone Scan followed by 111 In WBC scan and 99mTc Sulfur Colloid Bone Marrow if indicated/positive.
 - b) Vascular graft: Tc-99m WBC scan (preferred) or FDG PET/CT scan
 - c) IBD: FDG PET/CT (preferred) or Tc-99m WBC scan
 - d) FUO: FDG PET/CT scan (preferred if inpatients) or In-111 WBC scan

Note 1) The purpose of adding a 99mTc Sulfur Colloid bone marrow scan is to serve as a template for normal marrow. Areas of infection have increased In-111 WBC uptake but with no increase in marrow, while those without infection but abnormal distribution or displaced marrow will have similar In-111 WBC and 99mTc Sulfur Colloid uptake.

Note 2) PET imaging for infection

- Outpatients: Prior Authorization is required and typically not authorized.
- Inpatients: Prior Authorization is not required, also a PET scan is less expensive to perform than a WBC scan.

Patient Prep:

Generally, none

A total White Blood Cell (WBC) count result from within 1 week is need.

The total White Blood Cell (WBC) count should be greater than 5000.

Nuclear Medicine staff should be consulted for WBC counts in the 2500 to 5000 range. Gallium-67 or FDG-18 PET should be considered for these patients.

Gallium-67 cases involving abdominal imaging: if the patient has infrequent bowel movements (one or less per day), suggest Dulcolax and/or Mag Citrate bowel preparations at the time of injection.

Sedation:

Sedation may be required for pediatric patients. Sedation is requested by the ordering physician via AFCH Pediatric Sedation Program.

General Anesthesia may be used in place AFCH Pediatric Sedation Program due to scheduling constraints or other medical indications.

Scheduling:

IN-111 WBC

- In-111 WBC imaging requires two days to complete.
- Indium-111 Oxine must be ordered by 1 PM the day prior to starting of the blood draw/labeling, however, it is preferred to be 2 business days out.
- The first appointment is a blood draw in the early morning (allow 15 minutes). The blood sample is then sent to an outsourced vendor for labeling of the white cells (WBCs) and typically takes 3-4 hours to complete. Check with radiopharmacy staff for approximate return time of the labelled cells as the outsource vendor only labels one patient blood sample at a time. Thus, our position in the work queue can greatly affect the turnaround time.
- Upon return of the radioactive labelled white blood cells (WBC's) the patient is reinjected.
- Images are obtained at 18-24 hours for whole body, extremity and SPECT/CT imaging; allow 4 hours for imaging time.

As noted above, a 99mTc MDP bone and/or 99mTc Sulfur colloid bone marrow scan maybe imaged concurrently with the In-111 WBC scan.

- For a Three Phase Bone scan (see protocol in skeletal section)
 - Option 1) Concurrent: the blood sample for In-111 WBC labelling will be drawn prior to injecting the 99mTc MDP and delayed scanning of the bone scan is completed before WBC reinjection. Dual isotope imaging the next day is possible.
 - Option 2) Three Phase Bone scan before In-111 WBC with one full day between the appointments. This is to allow time to order the In-111 Oxine.
 - Option3) Three Phase Bone scan after In-111 WBC, the bone scan can be as early as the next day.
- For a Bone Marrow Scan: This order is not scheduled independently but linked to the last infection appointment once scheduled. It is unlinked if not needed.

99mTc-WBC

- This procedure should be scheduled at least 2 days after other 99mTc studies.
- The first appointment is a blood draw in the early morning (allow 15minutes). The blood sample is then sent to an outsource vendor for labeling of the white cells (WBCs) and typically takes 3-4 hours to complete. Check with radiopharmacy staff for approximate return time of the labelled cells as the outsource vendor only labels one patient blood sample at a time. Thus, our position in the work queue can greatly affect the turnaround time.
- Upon return of the radioactive labelled blood white cells (WBC's) the patient is reinjected.
- Images are obtained at 1-hour, 4 hours and possibly 24 hours post. 90 minutes allowed for each session.

GALLIUM-67 Abscess

- The Gallium 67 Citrate must be ordered at least two business day prior to injection.
- The first appointment (15 min) is an injection typically followed by 24-hour delay imaging (90 minutes).
- Early views at 4 hours may be used in attempting to detect intraabdominal or inflammatory bowel disease.
- Also, 72-hour imaging delays may be done to assess for pulmonary activity in sarcoidosis, pneumoconiosis and other interstitial disease.
- Manual scheduling will be required as there is no Health Link build for gallium.

| | IN-111 WBC | | 99mTc-WBC | Ga-67 |
|--|---|--------------------------------------|---|--|
| Radiopharmaceutical | 0.2-0.6 mCi In-111 labeled WBC's | | 6-24 mCi 99mTc-WBC labeled with HMPAO (Ceretek) | 5 mCi ± 20% Ga-67 Gallium Citrate |
| | Dose dependent on WBC count. This range is optimal in most cases, physician consultation on doses outside this range. | | | |
| | Adjust dose for patient weight per NMIS or weight table | | | |
| Imaging Device: Camera Collimator | GE Infinia I Hawkeye I, GE Infinia II Hawkeye IV, GE MPS or GE Optima 640 MEGP | | LEHR | MEGP |
| Data Acquisition: GE/User predefined protocol: | Abscess/ IN-111 WBC | Abscess/ IN111 WBC+ 99mTc Bone | 99mTc-WBC Abscess | Ga-67 Abscess |
| Energy windows: | 171 kev +/- 10% 245 kev +/- 10% | 140 kev +/- 9% 245 kev +/- 10% | 140 kev +/- 10% | 93 kev +/- 13% 184 kev +/- 10% 300 kev +/- 10% |

| Acquisition Procedure: | Select the patient from the worklist | | | |
|--|--|------------------------------------|------------------------------------|--|
| Whole body images Matrix scan speed | 256x1024 5 cm/minute | 256x1024 8 cm/minute | 256x1024 5 cm/minute | |
| Static images Matrix imaging time | 256*256 20 minutes/image | 256*256 15 minutes/image | 256*256 15 minutes/image | |
| SPECT/CT images Matrix Time per stop Degrees/stop | 128*128 30 seconds 3 degrees | 128*128 20 seconds 3 degrees | 128*128 20 seconds 3 degrees | |
| Acquisition File Name | Time Delay and Body Part with orientation based on allowable space (i.e. 4hr Rt Ant Chest Lt) | | | |

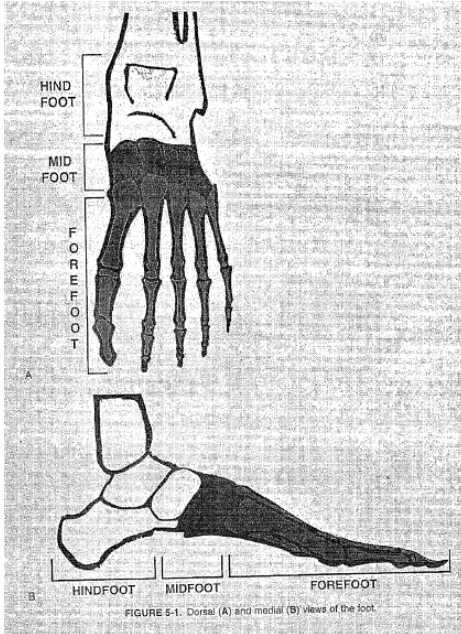
| | IN-111 WBC | 99mTc-WBC | Ga-67 |
|---------------------------|---|--|--|
| Imaging Procedure: | <ul style="list-style-type: none"> For most indications, static images of the area of interest. If FUO is the indication, then whole body. After the NM physician reviews the 111 In WBC images. Patients requiring 99mTc-Sulfer Colloid imaging are injected with 10 mCi 99mTc-Sulfer Colloid and 30 minutes post injection. A Ant/Post planar view and possible other projections are obtained using the 99mTc and 111-In windows. Images are acquired using a matrix of 256*256 for 15 minutes/image. | <ul style="list-style-type: none"> Images will be obtained at 1 (IBD & FUO) and 4 hours (all indications) post injection. For FUO whole body images, all others static images of the area of interest. | <ul style="list-style-type: none"> For most Gallium abscess imaging images are obtained at 24 hours and limited to the area of interest. For sarcoidosis the imaging area may be limited to the chest. |
| | <ul style="list-style-type: none"> Ask patient to void before test. Ensure that draining ulcer dressing is changed just prior to imaging. For osteomyelitis imaging of the affected area should be imaged to include orthogonal projections (e.g. for feet acquire plantar and lateral images) All images are reviewed by the NM Physician. SPECT/CT imaging of the affected area ca be performed at the discretion of the NM physicians. | | |

| | IN-111 WBC | 99mTc-WBC | Ga-67 |
|--|---|-----------|-------|
| Processing Procedure: | | | |
| Volumetric Ml Filter / Power Slice Thickness | Butterworth cutoff 0.4 / 5 2 pixels/slice which equals 8.84 mm/slice | | |
| SPECT/CT slices | Transaxial, Coronal, and Sagittal slices SPECT data should be displayed and screen captured in a 5*5 slice format. <ul style="list-style-type: none"> File name format in front of the default Screen Capture is: <i>Delay time - Slice</i> | | |
| Static images and whole body images | Displayed and saved as screen captures for all images <ul style="list-style-type: none"> File name format in front of the default Screen Capture is: <i>Delay time - Scan type (WBC, SC etc)</i> Annotated with orientation (right, left, ant, post etc) and type of Infection study and other pertinent information. | | |
| PACS: | Send to PACS: raw data static images, all screen-cap files, reconstructed SPECT OSEM IRAC transaxial data, Hounsfield converted CT data and MIP files. | | |

Interpretation:

WBC + 99mTc-Sulfur Colloid Imaging: The WBC-marrow study is positive for infection when there is activity on the WBC image without corresponding activity on the marrow image; in other words, the images are spatially incongruent. When any other pattern is present, the study is negative for infection.

Gallium Imaging: Gallium-67 is positive for vertebral osteomyelitis is uptake is judged to be more than that seen on the corresponding 99mTc-MDP bone scan.



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Appendix 1: Infection Imaging

