Imaging

Internal Mammary Lymphoscintigraphy: A Technical Viewpoint

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A comprehensive description of the technical aspects of internal mammary lymphoscintigraphy utilizing Tc-99m antimony trisulfide colloid, an investigational drug, is presented. The technologist's very important role in the imaging procedure is highlighted; it includes specific, step-by-step instruction in patient preparation, radiopharmaceutical preparation, and injection and imaging. Precautions necessary to assure accuracy of all measurements are stressed. Emphasis is placed on the need for precise documentation to insure the validity of the procedure for ready reference by interested health care professionals.

Although an ever increasing amount of literature has been published substantiating the value of lymphoscintigraphy, and more specifically, internal mammary lymphoscintigraphy utilizing Tc-99m antimony trisulfide colloid, little has been written regarding the technical aspects of the procedure—information necessary to the technologist who performs the imaging procedure.

The procedure consists of three separate phases: patient preparation; radiopharmaceutical preparation; and injection and imaging procedures.

Patient Preparation

Technetium-99m antimony trisulfide colloid is an investigational drug which, before use, requires the informed consent of the patient. Without adequate psychologic preparation, the patient may refuse the procedure simply on the grounds that an investigational drug has no place in her body...especially when injected into the abdomen. Too often with many hospital procedures information is exaggerated or misunderstood by the patient. How often has a patient arrived in your department with an appointment slip indicating a "liver scan" and some wild idea that this will be a liver biopsy, or worse? Can you imagine what the mind could do with an appointment slip reading "internal mammary scan?" Careful explanation of the procedure prior to the day of exam can greatly alleviate anxiety on the part of the patient. An informed patient will readily consent to an exam that has been discussed previously because she has had an opportunity to prepare—both psychologically and physically—for the procedure.

Information discussed with the patient should include a layman's explanation of:

- ☐ the procedure and its potential value,
- ☐ the radiopharmaceutical,
- ☐ the injection technique, and
- ☐ imaging procedure and time involvement.

The explanation given to the patient concerning the value of the procedure and the radiopharmaceutical used should be as simple or as detailed as the individual patient requires. Since the interest varies among patients, so will the content of the explanation. The patient should have a basic understanding of the action of the radiopharmaceutical and be aware of the potential benefit of the procedure as related to treatment planning.

The injection technique is possibly the most frightening part of the procedure for the patient. A carefully detailed explanation of this portion of the procedure can do much to relieve fear. The injection will be given on either side of the abdomen, just below the rib cage. The injection does not require a local anesthetic. The patient will experience a slight to moderate burning sensation that will only last during the injection. There are no known adverse reactions associated with the injection and the patient will be able to carry out normal activities immediately following the injection.

Because the injection is given in the abdomen, the patient must undress from the waist up. Knowing this in advance will allow the patient to wear something comfortable and easily removed. If the patient is being imaged prior to radiation therapy treatments, it will be necessary to mark inferior, superior, and lateral margins of the internal mammary nodes on the patient's chest. The marking substance used tends to mark clothing permanently.

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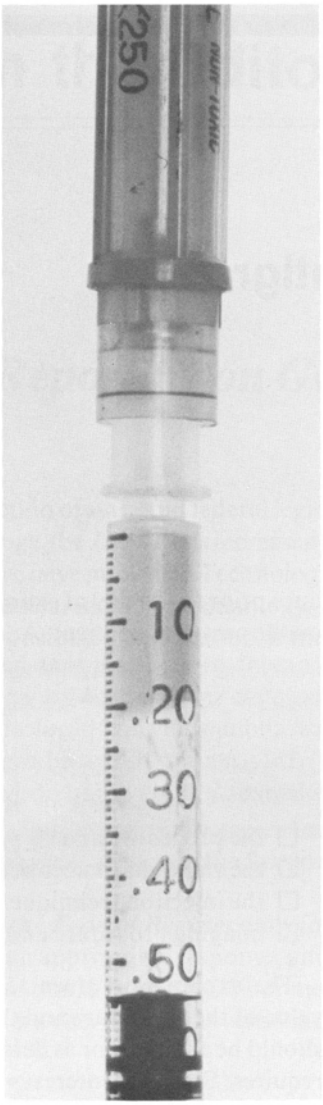

FIG. 1. Air drawn into syringe will create a piston-like effect used to drive complete dose to injection site.

Prior knowledge of this will alert the patient to bring along additional clothing to wear home.

The imaging procedure takes approximately 30-45 min per node chain, but there is a 3-hr delay between time of injection and the imaging procedure. If bilateral internal mammary nodes are to be imaged on the same day, the second injection will be made following the imaging of the first node chain. Thus, the procedure may require 7½ to 8 hr of the patient's time with 6 hr of these designated as "waiting time." Awareness of this time schedule gives the patient the opportunity to plan activities to pass the time. A shopping trip or lunch with a friend can do much to help pass what could become boring and possibly anxious hours of waiting. Planning is the key.

The imaging procedure is performed with the patient in the supine position. If the patient has a difficult or painful time lying supine, it may be necessary to plan pain medication accordingly.

It is important to take enough time to explain the procedure to make certain the exam is clear in the mind of the patient. A knowledgeable patient is a confident patient, willing to participate in every phase of the procedure.

Radiopharmaceutical Preparation

Preparation of the Tc-99m antimony trisulfide colloid is similar to the preparation of any radiopharmaceutical colloid. Including the 30-min boiling period, preparation time will be approximately 50 min. Chromatography should demonstrate less than 10% unbound technetium.

When the colloid is ready for use, a dose of 1 mCi is drawn into a tuberculin syringe. The volume used for injection should be approximately 0.2 ml. When dealing with such high specific activity, it is necessary to have a force behind the dose to push it to the injection site; otherwise, a significant portion of the dose may be left within the needle and hub of the syringe. To create this necessary force, draw a minimum of 0.3 ml of air into the syringe. Lightly tapping the syringe, needle side down, against the corner of a solid object (e.g., lead brick) will force the dose to gravitate toward the needle creating an air piston behind the dose (Fig. 1). The air piston will be used to drive the dose to the injection site. A 22-gauge 1½-in. needle will be used for the injection unless the patient is obese, in which case a 25-gauge 2½-in. needle is utilized.

Injection and Imaging Procedure

On the day of the procedure, the patient will undress from the waist up and put on a hospital gown open to the front. Before the patient signs the consent form, the physician will explain the procedure once again and answer any last minute questions. Allow adequate time for the patient's last minute questions to put her as much at ease as possible.

Teamwork is the key to a successful injection. The physician will stand on the opposite side to be injected; that is, he will stand on the right side to inject the left (Fig. 2). The technologist will stand on the side being injected. The physician may choose to mark bilateral costal margins and the approximate injection site, so it is helpful to have a felt marker available. Other materials necessary for the injection will include tuberculin syringe and appropriate syringe shield, alcohol prep pads, 2×2 gauze, and additional needles (including 2½-in. spinal needles). This list will vary with each institution, but always be prepared for the unexpected. Careful planning and preparation can avoid confusion and extra steps on the day of the procedure.

The technologist will assist the physician as necessary, but more importantly, the technologist will assist the patient during the injection. The patient's response to pain will be to tense her muscles and hold her breath. As with any intramuscular injection, the more relaxed the muscle, the easier the injection. Therefore, it is important to stress to the patient to relax and to breathe slowly and rhythmically. This will keep the abdominal muscles relaxed and help make the injection go quickly and smoothly. A small Band-Aid is the only dressing required on the injection site.

The accuracy of the injection will be determined by taking a 5-min delayed camera image over the injection site

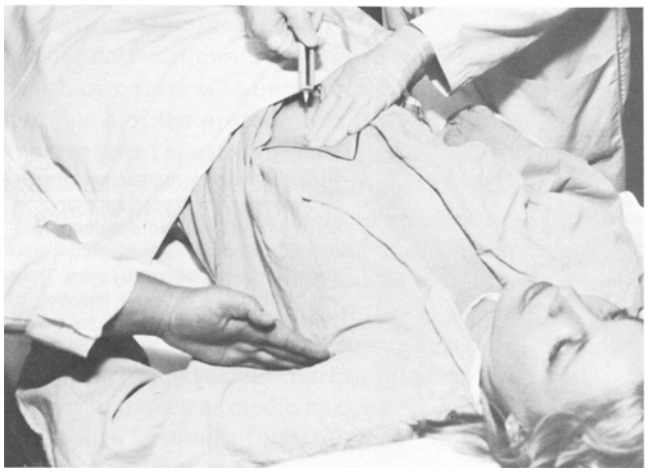

FIG. 2. Abdominal injection technique is performed on model from side opposite that to be injected.

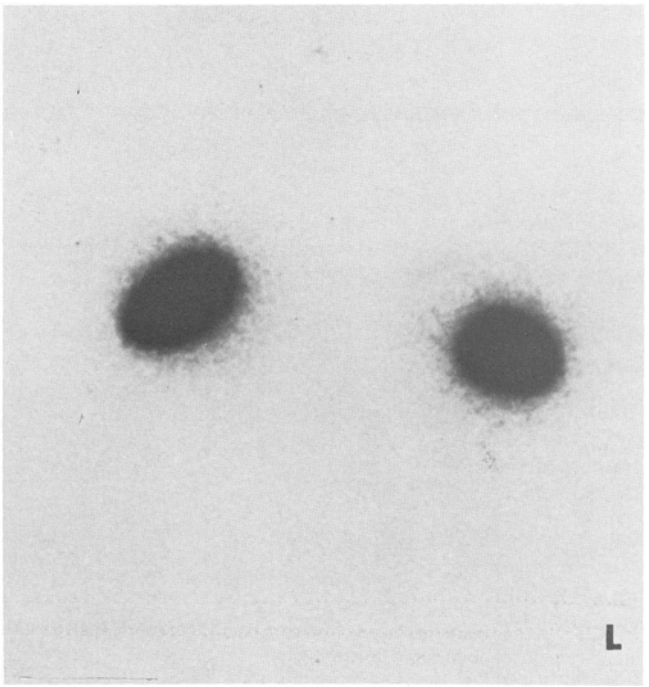

FIG. 3. Anterior abdominal image postinjection demonstrates typical "hot spots" of a dose that has not penetrated abdominal cavity.

(Fig. 3). The image is taken with a high resolution parallel hole collimator or a general purpose collimator for 250 K counts. The image should indicate defined "hot spots." If a diffuse pattern of activity is seen, the injection has penetrated the abdominal cavity and should be repeated. An injection that is too shallow will also be indicated as a "hot spot"; therefore, the final determinate of a successful injection will be the 3-hr delayed images.

At 3 hr the patient will be imaged in the anterior and lateral projections. The camera will again be used with a high resolution or general purpose collimator. Time/count will be set at 500 K counts/600 sec.

The anterior view is obtained with the patient in the supine position. Because it is difficult to differentiate source markers from internal mammary nodes, two anterior images are taken (Fig. 4). The first image, the marker image, is taken by placing source markers on the suprasternal notch and the xyphoid process and imaging for 25 sec. Then without moving the patient, the source markers are removed and the second image, the position image, is taken for 500 K counts/600 sec. The intense count rate from the injection site may obliterate resolution of the internal mammary nodes located near the xyphoid process. A lead shield placed over the injection site will reduce the number of counts collected from the injection site, thus, increasing the count rate and resolution of nodes. If there is concern regarding the lead shield covering the internal mammary nodes, additional images without the shield may be taken.

Depending on torso length and the scintillation camera used, it may be necessary to take the anterior image in two parts; that is, to include the suprasternal notch on the first set of images and the xyphoid process on the second set. Internal mammary nodes that extend beyond the source markers may also require additional images.

The lateral image is obtained for the determination of node depth. The patient will remain in the supine position and the camera is rotated 90° to insure no rotational error may occur because of patient positioning. The patient should have either a small knee pillow under her head or no pillow at all. A large pillow will elevate the shoulders and interfere with accurate depth determination. The arm of the side being imaged will be raised above the head. This is another common source of rotational error so patient positioning should be carefully checked.

A source marker that is flexible enough to shape to the contour of the patient's body and long enough to extend from the suprasternal notch to the xyphoid process will be placed against the patient's skin (Fig. 5) and a 25-sec image taken. After removing the marker, the position image is superimposed over the marker image for 500 K counts/600 sec (Fig. 6). It may be necessary to hold or tape a lead shield at the side of the patient to reduce the number of counts collected from the injection site. Also, it may be necessary to hold a very large breast out of the field of view to avoid possible artifacts or reduced count rate. Obese patients may require longer imaging time for adequate resolution of the internal mammary nodes.

For the determination of node depth, a 10-cm marker image will be taken by placing two source markers on the face of the collimator 10 cm apart and imaging for 25 sec (Fig. 7). From this image and the lateral image, a ratio may be set up to determine the depth of the internal mammary nodes:

$$\frac{\text{actual measure (10cm)}}{\text{measurement on film}} = \frac{\text{(X) actual node depth}}{\text{node depth on film}}.$$

As the electronics of the camera tend to change slightly from day to day, it is essential to take this 10-cm marker image with *each* procedure performed. Human error is a common problem with this image. Individuals differ in their placement of source markers on the face of the

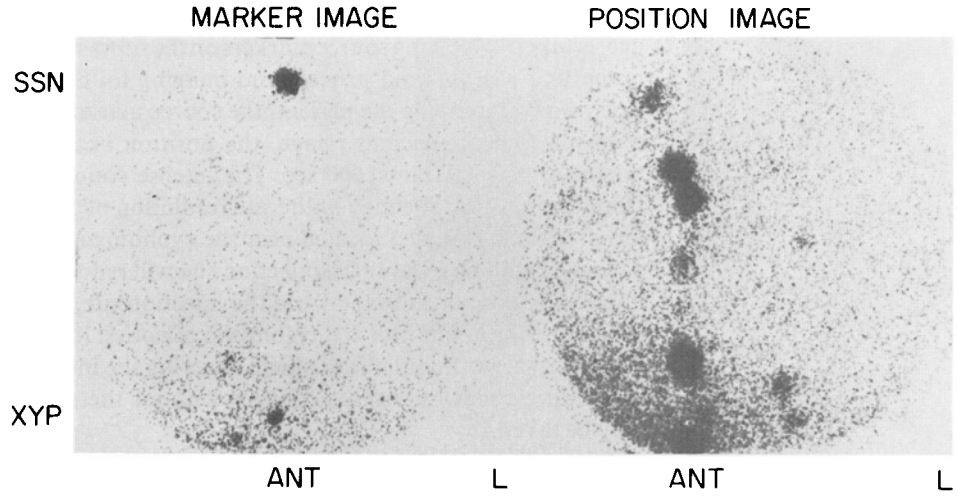

FIG. 4. Anterior marker image is taken separately from corresponding position image to avoid possible visual obstruction or confusion of source markers with internal mammary nodes. There was 3-hr delay between injection of Tc-99m SbSc and these images.

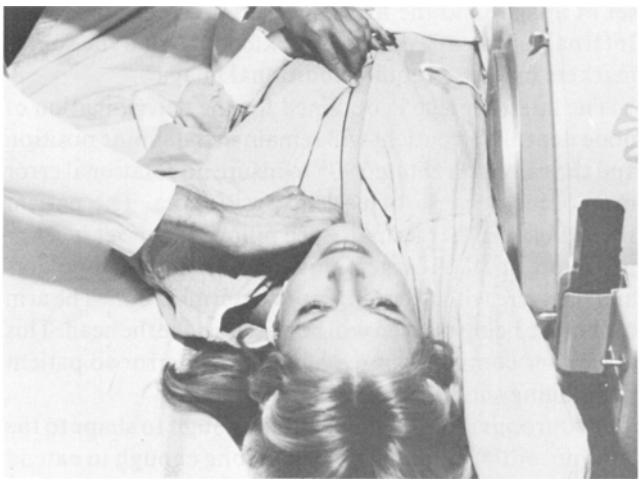

FIG. 5. Lateral marker image is obtained on model by extending flexible source marker from suprasternal notch (SSN) to xyphoid process (XYP).

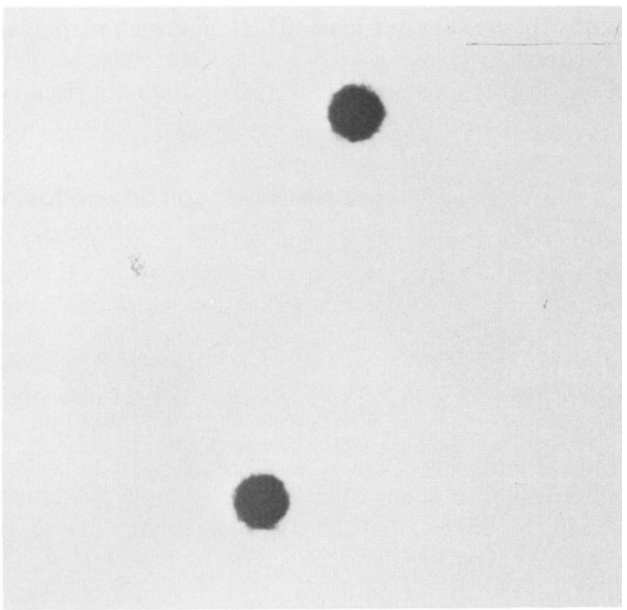

FIG. 7. Source markers placed on camera face 10 cm apart provide a reference image for node depth determination.

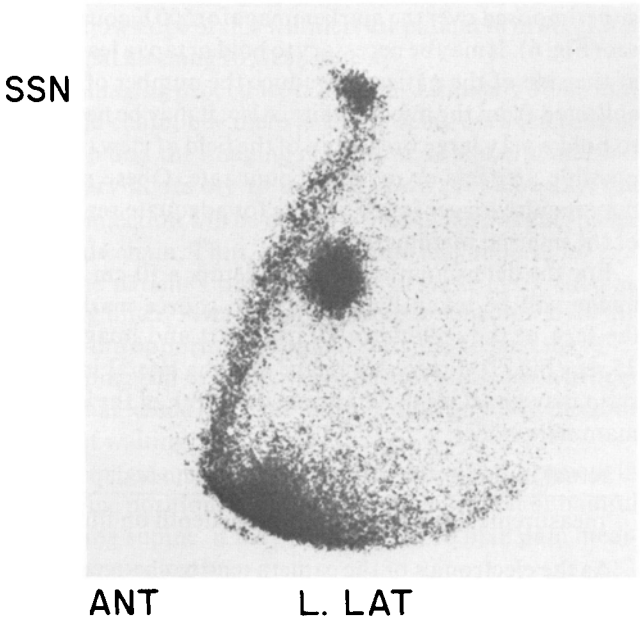

FIG. 6. Lateral image superimposed over marker image with suprasternal notch (SSN) marked for reference. There was 3-hr delay between injection of Tc-99m SbSc and this image.

camera. Therefore, to insure uniform measurement, permanent marks should be placed on the face of the collimator, e.g., with a felt-tipped marker.

For those patients scheduled to receive radiation therapy, the margins of the internal mammary nodes will be marked at the completion of the imaging procedure. The patient is positioned in the same manner in which she will be receiving her radiation treatment. Communication now becomes essential between departments. Pillow size and arm position directly affect the marks placed on the patient's chest. Using a Tc-99mO_4 source marker, the inferior, superior, and lateral margins of the internal mammary nodes are located and marked. As simulation for radiation therapy may not occur for 2–3 days following the imaging procedure, it is essential to use a marking substance that will not easily wash off.

Procedure Documentation

The most common response to this procedure by the health care team is to question the validity, accuracy, or usefulness of the procedure as it relates to the diagnosis and treatment plan for the patient. To establish the protocol for this procedure, it is important to seek the cooperation of the physics department in all phases of planning. The physicist should be on hand to document the procedure step by step. The procedure should initially be performed using phantoms to insure the validity and accuracy of all measurements that will subsequently be calculated from patient images. A report should be filed in both the physics and nuclear medicine departments indicating the established method of measurement, images taken with reference to depth measurements, and any graphs, charts, etc. Thus, when a member of the health care team requires documentation of the validity of the procedure, it will be readily available. Careful documentation of the procedure will, in most cases, convince even the most skeptical health care professional.

References

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