Overview
The resting electrocardiographic Gated Blood Pool Study evaluates right and left regional ventricular wall motion and ejection fraction at rest. A radiotracer that is confined to the vascular space, such as Tc-99m-red blood cells, is used to acquire images of the heart at multiple intervals throughout the cardiac cycle. These images are displayed dynamically to evaluate wall motion visually or are analyzed with regions of interest to quantitate ventricular ejection fraction.

Indications
Evaluate ventricular regional wall motion (1,2). Quantitate ventricular ejection fractions (1-3). Monitor cardiotoxicity of chemotherapy drugs (4,5). Differentiate pulmonary and cardiac causes of dyspnea.

*Exams ordered for indications which are not listed above need to be discussed with the Nuclear Medicine Physician.

Examination Time
1 hour.

Patient Instructions
Patients should take all medications in accord with their usual schedule.

For both outpatients and inpatients, no heavy meals for four hours; light snacks are okay up to two hours prior to scan. Unsweetened liquids may be taken two hours prior to exam.

Lab / Image Correlation
Have any prior MUGA or Myocardial perfusion scan images available on the reading workstation for comparison.

Patient Preparation
Place 3 EKG leads on the patient:
1. Ensure good electrical contact; this can be done by preparing the skin with methyl alcohol and/or extra-fine sandpaper (6).
2. The right arm lead is placed in the region of the right axilla, the left arm lead in
the region of the left axilla, and the right leg lead in the right upper quadrant of the abdomen.

Remove all metal objects, breast prostheses or other items that cover the chest and might obscure cardiac blood pool.

**Equipment & Energy Windows**

Gamma camera: Large field of view camera (40 cm) with electronic magnification to a 25 cm field of view (approx. 2.2x zoom).

Collimator: Low energy, high resolution, parallel hole

Energy window: 20% window centered at 140 keV (7)

Matrix 64x64.

Computer with gated blood pool software.

Cardiac gating device, either built into the camera or stand alone.

**Radiopharmaceutical, Dose, & Technique of Administration**

Radiopharmaceutical: Tc-99m-labeled red blood cells (Ultratag)

Dose: 30 mCi (1110 MBq) IV.

**NOTE:** In-vivo labeling of RBC's will only be used if Ultratag is not available.

1. "Cold injection" of stannous chloride and sodium pyrophosphate IV. Follow package insert for actual dose, which varies with different kits. Do not inject via reseal.

2. "Hot dose" of Tc-99m Pertechnetate, 30 mCi, IV, no sooner than 20 minutes after the first injection. Reseal may be used for "hot" dose. In patients with known heart failure or congestive cardiomyopathy, the minimum delay should be 30 minutes.

**Patient Positioning & Imaging Field**

Patient position: Supine.

Imaging field of view: Center on the heart in the lower left chest. **The heart should occupy 50% of the usable field of view.** If a prior MUGA has been performed, review the study and try to mimic positioning.

**Acquisition Protocol**
Inject the radiopharmaceutical into a vein in patients arm.

For patients in normal sinus rhythm, set the cardiac cycle-length acceptance window at 15%. For patients with irregular rhythms, e.g. atrial fibrillation, set the cardiac cycle-length acceptance window at a percentage appropriately greater than 15%.

Set the computer program to divide each cardiac cycle into 24 frames (17). If diastolic analysis is to be performed, gating must be done at 32 frames.

Position the camera in the LAO projection in order to maximize separation of the right and left ventricles. The LAO view should always contain a 15-20 degree caudal tilt in order to separate the left atria and left ventricular blood pools. The Anterior view is obtained in a straight anterior projection (0°) or at an angle approximately 45° less than the best septal view. The lateral view is obtained as a cross table lateral or at an angle at least 45° greater than the best septal view.

Acquire approximately 10 minute gated (EKG synchronized) images [6 million total counts] in the LAO, ANT and left LAT projections.

Data Processing

MUGA PROCESSING (SIEMENS)
- In Processing verify Volumes Curve Smoothing being used
- Butterworth order 5, Cutoff 0.4
- Zoom 1
- ROI setting on Semi Auto
- Threshold 50%
- In Gated Blood Pool tab at the bottom of the page click Determine LV center (Use the LAO view).
- On image that pops up click in the center of the LV
- Verify ROI is tracing correctly on the cine at the top of the screen
- Verify background ROI is not laying over any cardiac or spleen activity in cine
- If ROI needs adjustment click on ROI tool at bottom of screen under appropriate image and make adjustments. Confirm in cine again that ROI is now correctly positioned
- On LT of screen click on second Gated Blood Pool tab and repeat all steps manually drawing ROI around LT ventricle this time. Your EF results should be + or – 5% of the Auto EF in the first processing
- Click complete to save and send
Principle Radiation Emission Data - Tc-99m (33)

Physical half-life = 6.01 hours.

<table>
<thead>
<tr>
<th>Radiation</th>
<th>Mean % per disintegration</th>
<th>Mean energy (keV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamma-2</td>
<td>89.07</td>
<td>140.5</td>
</tr>
</tbody>
</table>

Dosimetry - Tc-99m-Labeled Red Blood Cells (34)

<table>
<thead>
<tr>
<th>Organ</th>
<th>rads/25 mCi</th>
<th>mGy/925 MBq</th>
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</thead>
<tbody>
<tr>
<td>Heart</td>
<td>2.0</td>
<td>20.0</td>
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<tr>
<td>Liver</td>
<td>1.8</td>
<td>18.0</td>
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<tr>
<td>Spleen</td>
<td>1.5</td>
<td>15.0</td>
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<tr>
<td>Lungs</td>
<td>1.4</td>
<td>14.0</td>
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<tr>
<td>Kidneys</td>
<td>1.4</td>
<td>14.0</td>
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<tr>
<td>Blood</td>
<td>1.4</td>
<td>14.0</td>
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<tr>
<td>Red marrow</td>
<td>0.8</td>
<td>8.0</td>
</tr>
<tr>
<td>Whole body</td>
<td>0.4</td>
<td>4.0</td>
</tr>
</tbody>
</table>

References


Normal Findings


Note: This procedure complies with the Society of Nuclear Medicine procedure guideline for Gated Equilibrium Radionuclide Ventriculography approved June 15, 2002.