Overview

The Gastrointestinal Bleeding Study detects the extravasation of radiolabeled red blood cells from the vascular space into the gastrointestinal lumen. The subsequent movement of the extravasated red blood cells within the gastrointestinal lumen secondary to peristalsis allows localization of the site of bleed along the gastrointestinal tract. The patient must be bleeding actively at the time of the study to localize the site of bleeding. Studies in dogs have indicated that the minimal detectable rate of bleeding is 0.1 mL/min. (1) It is likely that in clinical studies a bleeding rate 2 to 3 times this level would be required for the procedure to locate accurately the site of bleeding. (2)

Indications

Localization of active gastrointestinal bleeding site.

Examination Time

Variable depends on whether and when the site of bleeding is identified.

The study may be terminated as soon as the bleeding site and the direction of the bleeding flow is identified.

Imaging can be performed for up to 36 hours with a single injection of radiopharmaceutical. Usually the patient will not tolerate lying under the camera for more than 3 hours at a time. However, imaging may be stopped and restarted.

Patient Preparation

None.

Contraindications

Barium contrast studies performed in the preceding 48 hours may cause attenuation of radioactivity form the gastrointestinal tract and obscure the site of bleeding. This procedure is best performed when the patient is actively bleeding.

Equipment & Energy Windows

Gamma camera: Large field of view.

Collimator: VXGP or LEHR

Energy window: 20% window centered at 140 keV.

Computer.

Radiopharmaceutical, Dose & Technique of Administration

Radiopharmaceutical: Tc-99m-red blood cells

Dose: 20mCi
Methods of labeling:

1. In vitro method (UltraTag Kit) – see instructions with kit
   - mix for 20 minutes
   - re-inject patient with labeled blood
2. In vivo method – this is for patients with difficult veins, or Jehovah Witnesses
   - inject mixed pyrophosphate into patient. Use whole vial.
   - Wait 30 minutes
   - Inject 30 mCi of /Tc-99m pertechnetate

Technique of administration: Standard intravenous injection.

Patient Position & Imaging Field

Patient position: Supine, with entire abdomen and pelvis in field of view

Acquisition Protocol

Dynamic acquisition, 128x128, 90-fames/60 sec

Start the acquisition just before or simultaneously with injection of the radiopharmaceutical.

Periodically show the images to the nuclear medicine physician on the computer display using the cine mode.

Continue image acquisition for at least 2 hours or until:
   1. The side of bleeding is localized.
   2. The patient will no longer lie under the camera.
   3. The nuclear medicine physician terminates the imaging session.

Imaging may be resumed without an additional radiopharmaceutical injection for up to 36 hours.

When a delayed image shows activity within the intestine and active bleeding is suspected, but not obvious, a second injection of Tc-99m-RBCs can improve detectability.

Data Processing

Compress dynamic images to 5 minutes/frame, then display 9 images per page.

Label all appropriately for orientation, laterality and name of study, radiopharmaceutical.

Optional

Provocative gastrointestinal bleeding study: Heparin may be given intravenously at the time of imaging in an attempt to increase the likelihood of a bleed (13,14).

Enhanced cine display: The initial 1 minute images may be summed and subtracted from subsequent images to create a "subtraction cine" and/or the cine may be played backwards to improve appreciation of the source of the bleed.

Other projections: Images in other projections may be acquired if needed, e.g. R LAT or L LAT.
Intraoperative localization: Imaging of sequential segments of small intestine in an ex vivo fashion may improve localization of the bleeding site.

**Interpretation**

In patients with a significant amount of active bleeding, visual inspection of the dynamic studies demonstrates increased accumulation of radiotracer in a distribution consistent with the large or small bowel. A review of the dynamic study in cine mode is useful in determining the location of the site of bleeding and in detection small amounts of bleeding. With time and/or increased bleeding, the activity progresses along the lumen of the bowel (retrograde movement can occur).

**Additional Notes**

1. Poor labeling of the red blood cells may allow excretion of the pertechnetate through the stomach and kidneys, thus confounding interpretation.
2. If during the prescribed imaging time there is suggestion of a region of bleeding, the imaging sequence should be extended to look for further accumulation and movement of tracer through the bowel. This dynamic imaging often aids in characterizing the exact location of the site of blood loss in the gastrointestinal tract.

**Radiation Dosimetry**

The estimated absorbed doses in organs and tissues of an average subject (70kg) from an IV injection of 20 mCi Tc-99m labeled red blood cells are shown in Table 1.(5)

**Principle Radiation Emission Data - Tc-99m**

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>

**Table 1. Absorbed Radiation Doses in a 70-kg Adult from Tc-99m**

**Dosimetry - Tc-99m-Labeled Red Blood Cells**

<table>
<thead>
<tr>
<th>Organ</th>
<th>rads/20 mCi</th>
<th>mGy/740 MBq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spleen</td>
<td>2.20</td>
<td>22.0</td>
</tr>
<tr>
<td>Heart wall</td>
<td>2.0</td>
<td>20.0</td>
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<tr>
<td>Blood</td>
<td>0.80</td>
<td>8.0</td>
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<tr>
<td>Kidneys</td>
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<td>14.0</td>
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<td>Liver</td>
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<td>5.80</td>
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<tr>
<td>Red marrow</td>
<td>0.3</td>
<td>3.0</td>
</tr>
<tr>
<td>Whole body</td>
<td>0.3</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**References**


Normal Findings
