Gastrointestinal Bleeding Scintigraphy: Revised Guidelines

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Gastrointestinal Bleeding Scintigraphy (GIBS):
Educational Objectives

- Learning pertinent definitions
- Learning proper indications for GIBS
- Learning optimal technique for GIBS
- Learning how to set up a system for the most effective diagnosis and treatment
- Learning the diagnostic criteria for GIBS
- Learning SPECT/CT advantages

Where GI Specialists Place GIBS

American Gastroenterological Association (AGA) Institute Technical Review on Obscure Gastrointestinal Bleeding

GASTROENTEROLOGY
2007;133:1697–1717

Where is GIBS?!?
NOWHERE!!!!
WHY?!

Classification of GI Bleeding:
Based on the Source & Signs/ Symptoms

- Obscure GI bleeding is bleeding from an unknown source that persists or recurs after negative diagnostic evaluation.
  - Obscure overt bleeding - has associated acute clinical bleeding (hypotension, tachycardia, melena, etc.), presumed to be from small bowel, but the site is obscure.
  - Obscure occult bleeding - has no acute clinically evident bleeding, and is usually detected by fecal occult blood testing.

The Traditional Classification:
Upper Versus Lower GI Bleeding

- GI bleeding has been defined as upper or lower GI bleeding based on the location of the bleeding either proximal or distal to the ligament of Treitz.
The Contemporary Classification: Upper, Mid, Lower GI Bleeding

- **Upper GI bleeding** – site is above the ampulla of Vater, within the reach of an esophagogastroduodenoscopy (EGD)
- **Mid GI bleeding** – site is in the small intestine, from the ampulla of Vater to the terminal ileum, best investigated by capsule endoscopy, push enteroscopy and Double-Balloon Enteroscopy (DBE)
- **Lower GI bleeding** – the site is in the colon, evaluated by colonoscopy

Upper GI Tools: Must-Know Basics

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<th>Application</th>
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<td>Dx (5+) and Rx (5+)</td>
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<td>2. Push Enteroscopy</td>
<td>Reaches – mouth to the ligament of Treitz</td>
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<td>3. DBE (&quot;push-and-pool enteroscopy&quot;)</td>
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<td>4. Capsule Endoscopy</td>
<td>3. Dx (5+) and Rx (2-3+)</td>
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<td></td>
<td>Reaches – entire small bowel</td>
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<td>Diagnostic (4+), No therapeutic use</td>
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GI Bleeding Scan: Indications

- The main indication – determine the activity & location of mid/low, obscure, overt GI bleeding
- Is it active (extravasation is happening now!)?
- If active, is it in the small (how far from ligament of Treitz or the pylorus) or large (left, transverse, right, or the rectosigmoid colon) bowel?
- Guides intervention (angiography vs. surgery vs. endoscopy)

- The results can be used to determine the rate of mid/low GI bleeding, which can give prognostic information. This is not a common or recognized indication.

GI Bleeding Scan: Not Indicated For:

- It is not indicated in the upper GI bleeding where EGD is the main diagnostic method
- Not an appropriate study for obscure occult GI bleeding

Basics About GI Bleeding

- Hematemesis is usually produced by bleeding above the ligament of Treitz
- Bleeding sufficient to produce hematemesis usually results in melena (hematin)
- Melena usually denotes upper GI bleeding
- Approximately 60 ml of blood is required to produce a single black stool
- After stool color returns to normal, test for occult blood remains positive for up to a week
- 85% of all bleedings will stop spontaneously

GI Bleeding Scan: The Ideal Radiotracer Characteristics

- The tracer tags and stays in the intravascular blood pool
- No or negligible excretion into bowel
- If extravasated into bowel, it shouldn’t be reabsorbed
- The tracer should not be taken up in abdominal organs to obscure bowel (kidneys, uterus, adrenals, liver, spleen)
- Good imaging characteristics (99mTc-x)
- Radiation dose should be low
GI Bleeding Scintigraphy

GI Bleeding Scan Interpretational Criteria

1. Extravasation, growing activity, outside physiological sites (spleen, heart, etc.)
2. Changing pattern over time (“moving”)
   - In small bowel moves in wavy (serpiginous - in the shape of a snake or serpent) pattern
   - In large bowel moves in straighter, linear pattern along the expected position of the colon

Is There Active GI Bleeding?

At 1 and 2 hours the same appearance

Tc-99m Sulfur Colloid: Principle

- Radiotracer, following intravenous injection, would accumulate in the bowel at the site of the bleeding vessel – i.e. extravasation
- Extravasated radiotracer (target) would be best detected as the background is rapidly cleared by mononuclear phagocyte system (MPS) of liver/spleen

Tc-99m Sulfur Colloid Technique

- 10 mCi of Tc99m SC injected IV
- Cleared by RES with T1/2 of 3 min, by 12-15 min most of the background activity is cleared
- Obtain flow images (3 sec/frame), than 750-1000K static images every 2 min, for 20 min
- Dynamic acquisition is preferred
- Anterior views, at the end of test get LAO view to better visualize splenic flexure
- Examination can be repeated minutes or hours later – but no more than once in 24 hrs

Tc-99m Sulfur Colloid Scan: Normal

Flow Frames

Static Frames
GI Bleeding Scintigraphy

### Tc-99m Sulfur Colloid Scan: Abnormal

- **4 min**
- **10 min**

### Tc-99m Sulfur Colloid Scan Limitations

- Bleeding in sites close to liver or spleen can be initially or entirely missed.
- Provides only a few minute “snap shot”
- Can be repeated only a few times a day
- Does not provide a reader with an impression of bleeding severity
- Patients with liver disease have increased T1/2 and poor background clearance

### Tc-99m Red Blood Cell Scan: RBC Labeling Techniques

- **In-vivo** technique: 1 mg of stannous chloride, wait 20 min., inject Tc-99m pertechnetate IV.
  - Expected labeling efficiency: 80-85%
- **Modified in-vivo/in-vitro**: 1 mg of stannous chloride IV, wait 20 minutes, withdraw 3ml of blood into Tc-99m pertechnetate (20 mCi) containing syringe, incubate for additional 10 minutes (invert every minute).
  - Expected labeling efficiency: ~92%
- **In-vitro** (UltraTag®): Takes 3-5 ml of blood, labeling takes place completely in the tube.
  - Expected labeling efficiency >98%

### Comparison of SC and RBC Scanning

- Out of 68 bleeding patients RBC study identified 55 cases (81%).
- Out of same 68 patients SC scan detected only 7 (10%).


### Superiority of RBC Over SC Scanning

100 patients were studied with both SC and RBC scanning.

- **SC Scanning**: Sensitivity 12% Specificity 100%
- **RBC Scanning**: Sensitivity 93% Specificity 95%


### Bleeding Scan (RBCs)

- Rapid frame (15 s/frame, 15 min sequence) cine improves detection of subtle GI bleeding sites, i.e. sensitivity
- Rapid frame cine improves accurate localization, specificity of the test
- Abnormal activity in the bowel on 24 hr delay views associated with worse prognosis, but cannot identify the site

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**EXAMPLE OF RAPID BLEED:**
THE SITE CAN BE MISSED OR MISCLASSIFIED

15 sec/frame

**Detection of the Bleeding Rate (Canine Model):**
- Tc-99m SC 0.05 - 0.1 ml/min.¹
- Tc-99m RBCs 0.04 ml/min.²
- Angiography 0.5 - 1.0 ml/min.³


**Why RBC is Better Than SC?**
- The superiority of RBC scanning is due to the fact that GI bleeding is intermittent; therefore, continuous monitoring with RBC scanning over hours has a better chance than the "snapshot" approach of SC in capturing active bleed.
- Clinical indicators of acute bleeding are not reliable; hence, timing SC injection by clinical indication of active bleeding is unreliable.

**Predicting Positive Scan: Hemodynamic Instability**
- Hemodynamic instability was defined as a heart rate >100 beats per minute or a systolic blood pressure <100 mmHg during the 24 hours before scanning
- 62% of unstable patients were positive
- 21% of stable patients had positive scan


**Predicting Positive Scan: RBC Units in 24 hours**
- 3 or more units of RBCs transfused in 24 hours – 64% had positive scan
- 2 or less units of RBCs transfused in 24 hours – 32% had positive scan


**GI Bleeding Scan: Screening Requests**
- Is the patient actively bleeding?
  - Hemodynamic instability (HR>100, SBP<100 mmHg)
  - ≥2 Units of RBCs transfused in preceding 24 hours
  - Melena or blood in stool is not a convincing evidence of active GI bleeding
- Is there a plan for a positive test?
  - Angio service – aware, plan in place
  - surgery service – aware, plan in place
GI Bleeding Scintigraphy

Where is the bleeding site?

Case 1

Lt. Lateral

Upper GI Bleeding: GIBS Not Indicated

- 85% of bleeds will stop spontaneously.
- Upper GI bleeding is best worked up by endoscopy.
- Identify high-risk patients:
  - Advanced age
  - Patients who develop bleeding during hospitalization
  - Multisystem disease
  - Bleeding for <12 hrs prior to presentation
- Exception – EGD unsuccessful in treating GIB

How Uncommon is Upper GI Bleeding on Bleeding Scan?


4.2%
Nasogastric Tube in Upper GI Bleeding

- 93% of positive aspirates are due to true upper GI bleeding.
- 7% are due to traumatic tube placement.
- 16% of patients with clear nasogastric tube aspirates were proven to bleed actively above the ligament of Treitz.


Where is the bleeding site?

Case 3

First 30 min.

30-60 min.

60-90 min.

Low GI Bleeding

- Hemorrhoids
- Anal fissures
- Diverticular bleeding
- Intestinal infection (such as bacterial enterocolitis)
- Vascular malformation
- Inflammatory bowel disease
- Tumor
- Colon polyps or colon cancer
- Trauma or foreign body
- Bowel ischemia

Small Bowel Diverticula in Adults

- They are usually multiple and occur in the upper jejunum.
- Single diverticula may occur near the ligament of Treitz.
- Hemorrhage is usually due to ulceration and is likely to be severe. In exceptional cases it may be chronic.
- Segmental resection is possible.
Tumors of Small Intestine

- **Benign tumors**: Most common are primary adenomas (adenomatous polyp, villous adenomas, Brunner’s gland adenoma). Rare - leiomyomas, lipomas, fibromas, angiomas, pancreatic rests, and hemartomas (Peutz-Jegher polyps)
- **Malignant tumors**: adenocarcinoma, carcinoids, lymphosarcomas, and leiomyosarcomas.

***Bleeding from Leiomyomas is frequently massive***
Case 4

14-year-old female with Peutz-Jeghers syndrome.

Case 4

45 year-old male with bright red blood per rectum. Are we seeing the active bleeding?

Case 2

Dynamic Images 0-30 min (brighter images)

View dynamic images – more sensitive than static

Vascular Lesions Of The Small Intestine

• AVM - common in the small intestine, usually occurs in the young.
• Angiodysplasia - usually occurs in the older patients.
• Mesenteric varices - in portal hypertension, splenic and superior mesenteric vein thrombosis (pancreatitis)

False-Positive RBC GIBS

• Penile activity - easily mistaken for rectosigmoid bleeding
• Accessory spleen or ruptured spleen
• Bleeding from peritoneal dialysis catheter
• Abdominal soft tissue or gluteal hematoma
• Retroperitoneal bleed
• Pancreatic bleeds (pancreatitis, pseudocyst)
• AAA or ruptured AAA
• Horse-shoe kidney
• Left ovarian vein
• Ischemic bowel
• Hepatic hemangioma
• Diverticula abscess
• Uterine leiomyoma
Bleeding From The Large Intestine

- Diverticular:
  - more common in the left colon, but a majority of bleedsers located proximal to the splenic flexure
- Angiodysplasia:
  - developmental condition, defined in 1960, affects predominantly the right colon, single or multiple, extravasation is uncommon to see on angiography

How Long Should RBC Study Last?

In one study (Bunker et al.) 83% of positive examinations demonstrated bleeding within 90 minutes. Others report a much fewer positive studies within the first 90 minutes. Patient selection is the major reason for variable rates.

Guidelines will recommend localization depends on short intervals between the images. Continuous dynamic imaging is optimal. Multiple static images (60 sec per frame) every few (usually 5 minutes) suboptimal.
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Enhanced Bleeding Scanning

- Glucagon administration may improve detection of small bowel bleeding (1). It decreases motility and allows higher tracer concentrations in the area of the bleeding.
- Heparinization during the scanning is described in a case report (2).
- Heparin and Urokinase safely disclosed site of bleeding in 20% of those (10 pts) with extensive, but negative prior work-up (3).


SPECT/CT GIBS

- 19 pts with positive planar GIBS had SPECT/CT
- In 5 non-localizing planar studies, SPECT/CT was clear on localization
- In 1 case it correctly changed small bowel on planar to colon on SPECT/CT

Conclusion: Improves sensitivity and specificity of localization


Case 6

The site was precisely localized, it could be reached by push endoscopy, which successfully stopped the bleeding.

Conclusions

- It is important to set up a coherent system for working up GIB – be an active part of the hospital “disease management” committees
- Technique is critical – rapid dynamics imaging is preferred
- Apply standard criteria in your interpretation
- Watch out for the false positives
- Use SPECT/CT whenever in doubt or need to precisely localize the site of bleeding