
Significance of Intensity of Delayed Activity During Technetium-99m-RBC Gastrointestinal Bleeding Study

Shiv M. Gupta, Richard P. Spencer, and Sin Pui Chak

Departments of Nuclear Medicine, Danbury Hospital, Danbury, Connecticut and University of Connecticut Health Center, Farmington, Connecticut

In 27 patients with normal hepatic function, delayed concentration of radioactivity (during ^{99m}Tc -RBC gastrointestinal bleeding studies) was compared with liver blood-pool activity. That is, for images at 4 to 24 hr postinjection, grading was accomplished by comparison to the liver blood pool (less than, equal to, or greater than hepatic activity). There was a correlation between the accuracy of scan interpretation (for active bleeding and localization) and the intensity of activity as related to the liver. This simple grading system may be useful for interpretation of delayed images during bleeding studies.

J Nucl Med 1991; 32:2249-2252

Radionuclide scintigraphy, principally by means of ^{99m}Tc -labeled RBCs, has been widely employed for the detection and localization of gastrointestinal bleeding (1-4). While the procedure is sensitive and relatively specific when a bleeding site is noted on early imaging, there is a precipitous decline in sensitivity when pooling of activity is seen only on delayed images (3). The reason is that it may not be possible to distinguish an actual bleeding site from a delayed collection of radioactivity in other locales; secretion of pertechnetate from the gastric mucosa, or movement from a bleeding site (usually proximally located). A principal advantage of radionuclide scintigraphy in searching for gastrointestinal bleeding, as compared with endoscopy or contrast angiography, is the ability to study patients periodically, at time intervals up to about 24 hr. The intensity and patterns of delayed activity on serial images may, however, be variable. We can hypothesize that intensity of delayed activity should be more prominent in patients with active regional bleeding than in those where delayed activity is due to passage from other locales or secretion of pertechnetate. Therefore we retrospectively reviewed a group of 27 consecutive adult patients, seen during a period of 1 yr, in whom concentra-

tion of activity was seen only on delayed images. Patterns and intensity of delayed activity were examined and graded in an effort to establish guidelines for more accurate interpretation.

MATERIALS AND METHODS

Of 97 consecutive patients seen for the detection and localization of gastrointestinal bleeding during a 12-mo period, we reviewed the records of 27 patients who had evidence of delayed gastrointestinal bleeding (noted on images at 4 to 24 hr after intravenous labeling of erythrocytes). Each patient had a medical history suggesting acute or intermittent chronic gastrointestinal bleeding. There were 14 women and 13 men, with an average age of 67 yr (range 17-88). In vivo labeling of RBCs was performed using the standard method by intravenous administration of 10-25 mCi (370-925 MBq) of [^{99m}Tc]pertechnetate 20 min after injection of the contents of a commercially available kit (in 3 ml sterile saline) that contained 3.2 mg stannous chloride and 11.9 mg sodium pyrophosphate.

Imaging was performed with LFOV gamma cameras utilizing all-purpose parallel-hole collimators. The energy level was set at 140 keV with a 20% window. Output of the gamma camera was to both a photographic display and to a digital computer. Due to the lack of any appreciable thyroidal or gastric activity to indicate presence of significant pertechnetate on our in-vivo labeled RBC studies for gastrointestinal bleeding during the past several years, routine nasogastric aspiration during the study was not employed. However, each patient had nasogastric aspiration or upper gastrointestinal endoscopy to rule out apparent bleeding in the stomach, esophagus, or duodenum prior to imaging. Upon injection of the pertechnetate, anterior dynamic images of the abdomen were obtained at 4-sec intervals up to 2 min. This was followed by serial images every 5 min up to 2 hr. Oblique and lateral images also were obtained as needed. Additional delayed images were obtained at 4 and 6 hr and again at approximately 10 to 24 hr postinjection. Each patient had endoscopy and/or contrast angiography within 48 hr of the radionuclide study. Laboratory tests, including a complete blood count as well as liver function tests, were reviewed. None of the 27 patients had a history of hepatic disease and liver function tests were in the normal range.

Delayed activity, seen on images between 4 and 24 hr, was graded by comparison with blood-pool activity in the liver. Grading criteria are shown in Table 1. Grading was performed independently by two observers, and a consensus was reached in the

Received Mar. 26, 1991; revision accepted Jun. 21, 1991.
For reprints contact: Shiv M. Gupta, MD, Director, Department of Nuclear Medicine, Danbury Hospital, Danbury, CT 06810.

TABLE 1
Grading of Delayed Activity Noted on Gastrointestinal Bleeding Study*

Grade I = Activity less than hepatic blood pool.
Grade II = Activity equal to hepatic blood pool.
Grade III = Activity greater than hepatic blood pool.

* Each of the patients in this series had normal hepatic function.

few cases in which the gradings were initially not identical. Correlation was then made with endoscopic/angiographic findings.

RESULTS

Patient data for those with Grade I activity, are summarized in Table 2. Those with Grade II are listed in Table 3, while patients with Grade III are summarized in Table 4.

For Grade I activity, five of the seven cases (Patients 1, 2, 3, 6, 7) had either negative endoscopic examinations for active bleeding or bleeding site could not be correctly localized. In two cases (Patients 4 and 5), there was evidence of active bleeding at the site of activity on the scan. Overall, in the group with Grade I activity, only two out of seven cases had correct localization of the active bleeding (Fig. 1). With Grade II activity (Table 3), activity equal to the liver, two out of three cases had accurate localization of gastrointestinal bleeding (Fig. 2). Of the patients with Grade III activity, there was accurate localization of the bleeding site in 15 (Fig. 3). In these patients, the bleeding site was subsequently found to correspond to the delayed activity site.

Patterns of delayed Grade III activity were similar in patients with confirmed lower gastrointestinal bleeding and those with bleeding duodenal ulcers. This would tend to confirm the hypothesis that intensity of delayed activity

TABLE 2
Final Diagnosis in Patients with Grade I Activity on Delayed Images

Patient no.	Age/Sex	Apparent site on images and time	Final diagnosis
1	85 F	Ascending colon; 18 hr	Endoscopy: UGIB
2	84 F	Transverse colon; 18 hr	Endoscopy: NAB
3	88 F	Cecum; 20 hr	Endoscopy: NAB
4	75 M	Ascending colon; 13 hr	Endoscopy: bleeding colon polyp
5	56 M	Cecum; 24 hr	Endoscopy: bleeding cecal polypectomy site
6	55 M	Cecum; 22 hr	Endoscopy: peptic ulcer
7	77 M	Ascending colon; 21 hr	Undetermined, NAB

NAB = no apparent bleeding and UGIB = upper gastrointestinal bleeding.

TABLE 3
Final Diagnosis in Patients with Grade II Activity on Delayed Images

Patient no.	Age/Sex	Apparent site on images and time	Final diagnosis
8	83 F	Cecum and ascending colon; 16 hr	Endoscopy: bleeding cecal polyp
9	85 M	Cecum; 13 hr	Endoscopy: bleeding polyp
10	71 F	Cecum; 18 hr	Endoscopy: multiple polyps; NAB

NAB = no apparent bleeding.

on scanning in most cases is directly proportional to the presence of active bleeding.

Thus, the confirmed cases of active bleeding correctly localized are as follows:

Grade I: 2/7, 28%

Grade II: 2/3, 67%

Grade III: 15/17, 88%.

DISCUSSION

The importance of early diagnosis in the management of gastrointestinal bleeding in clinical practice is well documented. Radionuclide scintigraphy provides a safe and simple procedure that is available in most medical centers. In the event of high clinical suspicion of active bleeding, ^{99m}Tc-labeled sulphur colloid scintigraphy may be employed. In experimental studies, even bleeding of as little as 0.1 ml/min can be detected (1). However, scanning with this agent has limitations for detection of upper gastrointestinal bleeding due to high background in the adjoining liver, spleen and bone marrow of the vertebrae. Moreover, rapid clearance of radiocolloid from the circulation (T_{1/2} = 2 min) provides only a short window in which to study such cases. The intermittent nature of gastrointestinal bleeding also precludes sulphur colloid scanning; therefore, blood-pool imaging with technetium-labeled autologous RBCs is routinely employed. Although up to 50% of positive studies may be identifiable within the first 10 min (1), detection of active bleeding is directly related to the severity of bleeding. In some patients with low-grade and intermittent bleeding, the test may not become positive until several hours later. While longer lived radionuclides might be used for blood-pool imaging, there is an associated increased radiation exposure (5,6). One major caveat of studies performed with technetium-labeled RBCs is the dramatic deterioration of sensitivity and accuracy when extravasation of activity is seen only on the delayed phase with normal early images. Such concentration may either be due to movement of activity from a proximal bleeding site or else due to accumulation of free pertechnetate secreted by mucoid gastric cells or other sites. In

TABLE 4
Final Diagnosis in Patients with Grade III Activity on Delayed Images

Patient no.	Age/Sex	Apparent site on image and time	Final diagnosis
11	64 F	Ascending colon; 18 hr	Endoscopy: bleeding polyp
12	79 M	Cecum; 18 hr	Endoscopy: bleeding duodenal ulcer
13	80 M	Splenic flexure; 22 hr	Endoscopy: bleeding diverticulum
14	60 M	Ascending colon; 18 hr	Endoscopy: bleeding polyp
15	42 M	Ascending colon; 12 hr	Endoscopy: bleeding ulcerative colitis
16	69 F	Ascending and transverse colon; 4 hr	Angiogram: multiple bleeding AVM
17	78 M	Hepatic flexure; 4 hr	Angiogram: bleeding AVM
18	44 F	Cecum and ascending colon; 24 hr	Endoscopy: bleeding diverticulum
19	17 M	Ileocecum; 18 hr	Endoscopy: bleeding nodular hyperplasia; angiograph: negative
20	80 F	Transverse colon; 18 hr	Endoscopy: bleeding diverticulum
21	61 F	Cecum and ascending colon; 20 hr	Angiogram: equivocal Endoscopy: bleeding AVM
22	86 F	Splenic flexure and descending colon; 15 hr	Endoscopy: bleeding diverticulum
23	78 F	Ascending and transverse colon; 7 hr	Endoscopy: bleeding duodenal ulcer
24	74 M	Cecum; 14 hr	Endoscopy: bleeding polyp
25	86 F	Cecum and transverse colon; 22 hr	Endoscopy: bleeding likely AVM
26	58 F	Splenic flexure and descending colon; 4 hr	Endoscopy: multiple bleeding polyps
27	73 M	Multiple colon sites; 18 hr	Endoscopy: multiple bleeding polyps

AVM = arteriovenous malformation.

our earlier study, accuracy of GI bleeding scans for detection and localization was over 94% when the examination became positive within 2 hr of RBC tagging; this fell to 57% when the test became positive beyond 2 hr postinjection (3). More frequent imaging could be helpful in some instances. However, it may neither be possible in a busy department nor convenient for such patients, since they may be quite sick and at times hemodynamically unstable. Recently, reinjection with a second dose of labeled red cells has been advocated for better localization (7). Because of the intermittent nature of bleeding, delayed imaging may still be needed despite its inherent limitations.

Assuming that the hepatic blood pool is normal, grading of radionuclide concentration as seen on the delayed im-

ages provides an objective assessment for increasing confidence in the interpretation. There was a direct correlation between intensity of delayed activity with the accuracy of the test as shown statistically. This increased from 28% to 88% (in the presence of delayed activity from Grade I to III, respectively). The hepatic blood pool (if normal) serves as a reliable reference source since it is easily seen and has no other major blood pool superimposed on it. Caution however should be observed in assessing the hepatic blood pool away from renal activity and the major vascular structures in the abdomen. Any underlying chronic liver disease, such as cirrhosis or portal hypertension, might influence the hepatic blood pool and should be ruled out. In all patients in the series, there was no history of chronic

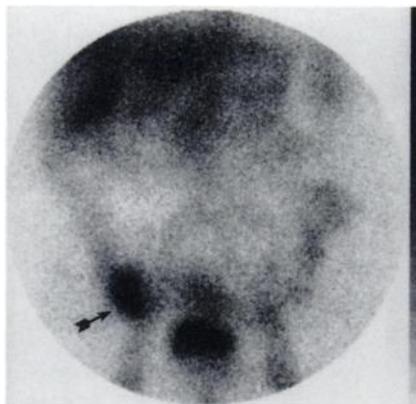


FIGURE 1. Grade I: Concentration of activity in the right colon at 16 hr. Intensity of activity is less than the hepatic blood pool.



FIGURE 2. Grade II: Delayed activity in the cecum and ascending colon is equal to the hepatic blood pool.

FIGURE 3. Grade III. Delayed focal cecal activity (arrow) is greater than the hepatic blood pool. Minimal activity is also seen throughout the colon due to movement of activity from cecum.



liver disease and liver function tests were normal. Moreover, the hepatic blood pool stayed relatively constant when seen on the delayed images between 4 and 24 hr.

We conclude that grading of delayed activity on gastrointestinal bleeding scans may provide an objective as-

essment, thus helping in interpretation and improving the accuracy of scintigraphy for the detection of active bleeding and its precise localization.

REFERENCES

1. Alavi A, Dann RW, Biery DN. Scintigraphic detection of acute gastrointestinal bleeding. *Radiology* 1977;124:753-756.
2. Gupta SM. Scintigraphic detection of and localization of GI bleeding. *Res Staff Physician* 1982;28:42-52.
3. Gupta SM, Luna E, Kingsley S, et al. Detection of gastrointestinal bleeding by radionuclide scintigraphy. *Am J Gastroenterol* 1984;79:26-31.
4. Winzelberg GG, McKusick KA, Froelich JW, et al. Detection of gastrointestinal bleeding with Tc-99m-labeled red blood cells. *Semin Nucl Med* 1982;12:139-146.
5. Ferrant A, Dahasque N, Leners N, et al. Scintigraphy with In-111-labeled red cells in intermittent gastrointestinal bleeding. *J Nucl Med* 1980;21:844-845.
6. Ariel JM. The site of upper gastrointestinal bleeding: detection by radioactive tagged red blood cells. *JAMA* 1962;180:212-214.
7. Jacobson AF. Delayed positive gastrointestinal bleeding studies with Tc-99m-labeled red blood cells: utility of a second injection. *J Nucl Med* 1991;32:330-332.