

# Detection of acute gastrointestinal bleeding by means of technetium-99m *in vivo* labelled red blood cells

Jiří Doležal<sup>1</sup>, Jaroslav Vižd'a<sup>1</sup>, Jan Bureš<sup>2</sup>

<sup>1</sup>Department of Nuclear Medicine, Faculty Hospital, Hradec Králové, Czech Republic

<sup>2</sup>2<sup>nd</sup> Academic Department of Internal Medicine, Medical Faculty at Hradec Králové, Charles University in Prague, Czech Republic

[Received 2 I 2002; Revised 4 VII 2002; Accepted 21 X 2002]

## Abstract

**BACKGROUND:** Prognosis of gastrointestinal (GI) bleeding depends on the timely [3] and accurate [8, 18] detection of the source of bleeding and sequential surgical or endoscopy therapy. Scintigraphy with red blood cells (RBCs) *in vivo* labelled by means of technetium-99m hastened detection of source of GI bleeding and improved management of the particular disease. Gastrointestinal endoscopy is the method of choice for the diagnostics of bleeding from upper tract and large bowel. For diagnostics of bleeding from the small bowel we can use scintigraphy with *in vivo* labelled autologous red blood cells if push-enteroscopy, intra-operative enteroscopy or angiography are not available.

**MATERIAL AND METHODS:** 31 patients (13 men, 18 women, aged 20–91, mean 56 years) underwent this investigation from 1998 till 2001 at the Department of Nuclear Medicine. All patients had melaena or enterorrhagia associated with acute anaemia. Gastroscopy, colonoscopy, enteroclysis or X-ray angiography did not detect the source of bleeding.

**RESULTS:** Twenty-one patients had positive scintigraphy with *in vivo* labelled RBCs — 9 patients were already positive on dynamic scintigraphy, and 12 patients were positive on static images.

Scintigraphy with *in vivo* labelled RBCs was negative in 10 patients. GI bleeding stopped spontaneously in these 10 patients with negative scintigraphy. These patients did not undergo intra-operative enteroscopy or surgery.

The final diagnosis of the 21 patients with positive scintigraphy was determined in 16 patients by push-enteroscopy (6 patients), intra-operative enteroscopy (6 patients) or by surgery (4 patients). Of these 16 patients the correct place of bleeding was determined by scintigraphy with labelled RBCs in 11 (69%) patients.

Final diagnoses of our 16 patients with positive scintigraphy with autologous labelled RBCs were: bleeding small bowel arteriovenous malformation (6 patients), uraemic enteritis with bleeding erosions in ileum and jejunum (2 patients), Osler-Rendu-Weber disease (1 patient), pseudocyst of the pancreas with bleeding vessel communicating to the transverse colon (1 patient), bleeding submucosal varix in jejunum (1 patient), carcinoma of the ileum (1 patient), bleeding from the ileosigmoidoanastomosis six days after hemicolectomy for Crohn's disease (1 patient), bleeding from an ulcer close to the papilla of Vater (1 patient), bleeding from ulcer at jejunum after previous NSAIDs treatment (1 patient), bleeding inflammatory polyp at ileotransversoanastomosis (1 patient).

GI bleeding stopped spontaneously in 5 patients with positive scintigraphy. Therefore these patients did not undergo intra-operative enteroscopy or surgery and we could not determine the final diagnosis.

**CONCLUSIONS:** Scintigraphy with RBCs *in vivo* labelled technetium-99m hastened detection of the source of GI bleeding and improved management of disease.

**Key words:** gastrointestinal bleeding, scintigraphy with RBCs

## Introduction

Acute gastrointestinal bleeding is a severe emergency with high lethality, up to 10% [2]. Prognosis of gastrointestinal (GI) bleeding depends on timely [2] and accurate [7, 10] detection of the source of bleeding and sequential surgical or endoscopy therapy. Scintigraphy with red blood cells (RBCs) labelled by means

Correspondence to: Jiří Doležal, MD  
Department of Nuclear Medicine  
Charles University Teaching Hospital  
Sokolská 408, Hradec Králové  
Czech Republic 500 05  
Tel: (+420) 495832383, fax: (+420) 495512346  
e-mail: dolezal@fnhk.cz

of technetium-99m hastened detection of source GI bleeding and improved management of disease. Radionuclide scintigraphy with labelled RBCs is noninvasive diagnostic modality [1, 8]. Technetium-labelled red-cell scan is known to identify the site of bleeding at the rate of 0.1 ml per minute or more [9].

Gastrointestinal endoscopy is the method of choice for the diagnostics of bleeding from the upper tract and large bowel. For diagnostics of bleeding from the small bowel we can use scintigraphy with *in vivo* labelled red blood cells if push-enteroscopy, intra-operative enteroscopy or angiography are not available [2, 7, 10].

Scintigraphy was indicated in the case of failure of GI endoscopy and other imaging modality to detect source of bleeding.

## Material and methods

We used *in vivo* labelling of RBCs — we administered intravenously 2 ml of native stannous pyrophosphate. There is an abundance of stannous ions. Stannous ions cross the cellular membrane of red blood cells. After 20 minutes we injected intravenously 750 MBq sodium pertechnetate (Tc-99m). Technetium crosses the cellular membrane of red blood cells. There is technetium reduced by means of stannous ions. Reduced technetium is bounded on haemoglobin [7, 10]. Dynamic scintigraphy of abdomen was started immediately after application of 750 MBq sodium pertechnetate *i.v.* Acquisition protocol was one-second frames for 120 seconds and 60 second-frames for 10 minutes. Static 1000 k images of abdomen were done after it every 15 minutes during the first hour and every hour during the next hours of investigation. If necessary we repeated static images after 22–24 hours.

To improve sensitivity, specificity and site spatial specification of GI bleeding, we added abdomen single photon emission tomography (SPECT). We used rotating, digital, double-head gamma cameras, Helix or Varicam, with infra-red body contouring and large field of view. Collimators were used with high resolution and parallel holes. The peak of gamma emission was 140 keV and window 10%. SPECT 3–6°/20 s per frame, matrix 64 × 64. Zoom was 1–1.3. SPECT total acquisition time was about 20 minutes.

Thirty-one patients (13 men, 18 women, aged 20–91, mean 56 years) underwent this investigation from 1998 till 2001 at the Department of Nuclear Medicine. All patients had melaena or enterorrhagia associated with acute anaemia. Gastroscopy, colonoscopy, enteroclysis or X-ray angiography did not detect the source of bleeding.

## Results

Twenty-one patients had positive scintigraphy with *in vivo* labelled RBCs — 9 patients were already positive on dynamic scintigraphy, and 12 patients were positive on static images. Scintigraphy with *in vivo* labelled RBCs was negative in 10 patients.

The final diagnosis of our patients with positive scintigraphy was determined in 16 patients by push-enteroscopy (6 patients), intra-operative enteroscopy (6 patients) or by surgery (4 patients). Of these 16 patients the correct place of bleeding was determined by scintigraphy with labelled RBCs in 11 (69%) patients.

Diagnoses of our patients with positive scintigraphy with labelled RBCs were: bleeding small bowel arteriovenous malformation (6 patients) (Fig. 1, 2), uraemic enteritis with bleeding erosions in ileum and jejunum (2 patients), Osler-Rendu-Weber dis-

ease (1 patient) (Fig. 3), pseudocyst of the pancreas with bleeding vessel communicating to the transverse colon (1 patient), bleeding submucosa varix in jejunum (1 patient), carcinoid of the ileum (1 patient), bleeding from the ileosigmoidoanastomosis six days after hemicolectomy for Crohn's disease (1 patient) (Fig. 4), bleeding from an ulcer close to the papilla of Vater (1 patient), bleeding from ulcer at jejunum after previous NSAIDs treatment (1 patient), bleeding inflammatory polyp at ileotransversoanastomosis (1 patient).

GI bleeding was spontaneously stopped in 5 patients with positive scintigraphy. Therefore these patients did not undergo intra-operative enteroscopy or surgery.

GI bleeding stopped spontaneously in 10 patients with negative scintigraphy. These patients did not undergo intra-operative enteroscopy or surgery.

## Discussion

For the preparation of technetium-99m RBCs we used the labelling method *in vivo*. The method *in vivo* has lower labelling efficiency than the method *in vitro* [7, 10], nevertheless we did not see accumulation of free unbound technetium-99m in gastric mucosa and sequential secretion into gastrointestinal tract. We saw only a modicum of free technetium in the urinary tract.

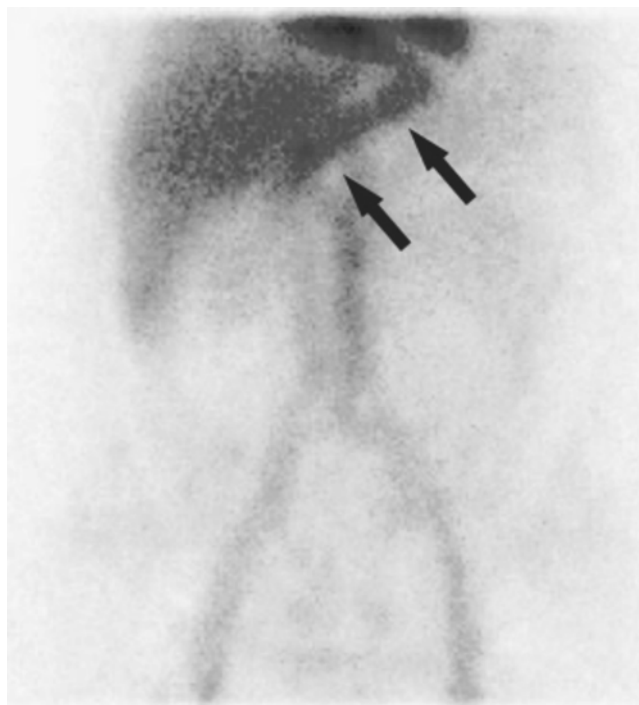
Endoscopy is the method of choice to detect the source of bleeding. Scintigraphy with RBCs is only a complementary imaging method for detection of the bleeding place. Scintigraphy with labelled RBCs can be successful for the detection of the bleeding site in the small bowel. Twenty-one patients had positive scintigraphy with labelled RBCs. The source of bleeding was in jejunum or ileum in 15 patients out of those with positive scintigraphy with labelled RBCs. Only 1 patient had a bleeding ulcer close to the papilla of Vater. GI bleeding stopped spontaneously in 5 patients with positive scintigraphy and in 10 patients with negative scintigraphy. Therefore these patients did not undergo intra-operative enteroscopy or surgery.

Our findings on scintigraphy with labelled RBCs are similar as in literature. For example Caruana et al. [3] described scintigraphic detection and localisation of a bleeding leiomyosarcoma of the jejunum utilising Tc-99m labelled RBCs [3]. Bagga et al. [1] described scanning with Tc-99m labelled RBCs in two patients with recurrent postoperative GI bleeding after partial colonic resection. Imaging correctly identified the source of bleeding at the anastomatic site in the large bowel [1]. Hansen et al. [6] described two patients with alcoholic cirrhosis, portal hypertension and rectal bleeding. Tc-99m RBCs studies demonstrated mesenteric varices and extravasation into the adjacent bowel [6].

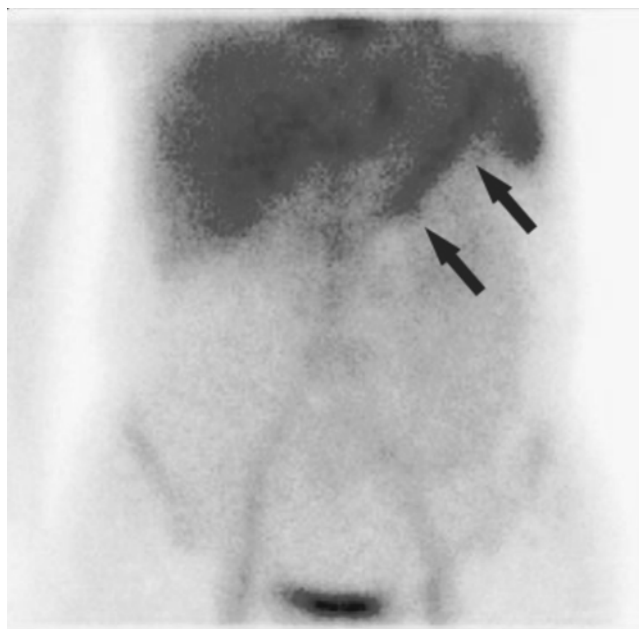
Dusold et al. [4] described 153 patients who underwent a tagged red blood cell scan for evaluation of gastrointestinal bleeding at their institution from 1981 to 1991. Of a total of 153 patients, 90 (59%) had positive scans, whereas in 63 (41%) they were negative [4].

Our results were: Thirty-one patients underwent scintigraphy with RBCs in our study, 21 (68%) patients had positive scintigraphy and 10 (32%) patients had negative scintigraphy.

Dusold et al. [4] described that the correct bleeding site was identified by red blood cell scanning in 75% patients [4]. Emslie et al. [5] described that the site of bleeding in 88% patients was confirmed [5].



**Figure 1.** Positive scintigraphy with autologous RBCs obtained in 83-year-old woman with enterorrhagia. Bleeding arteriovenous (AV) malformation in proximal jejunum.

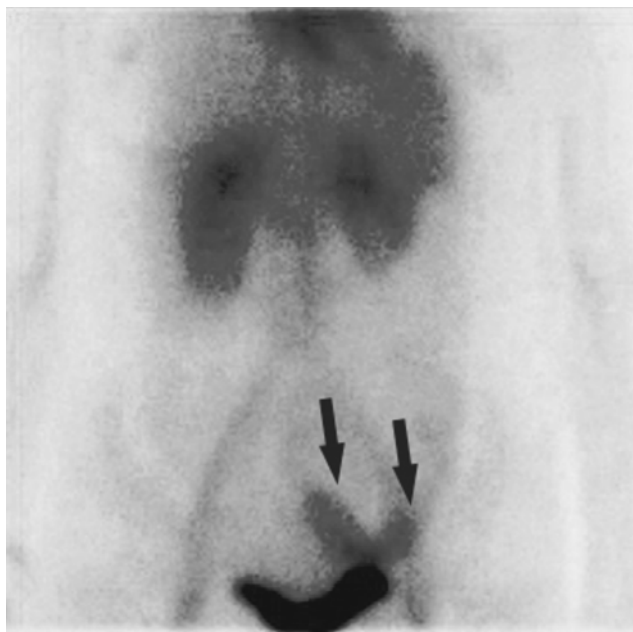


**Figure 2.** Positive scintigraphy with autologous RBCs obtained in 48-year-old man with enterorrhagia. Bleeding AV malformation in proximal jejunum.

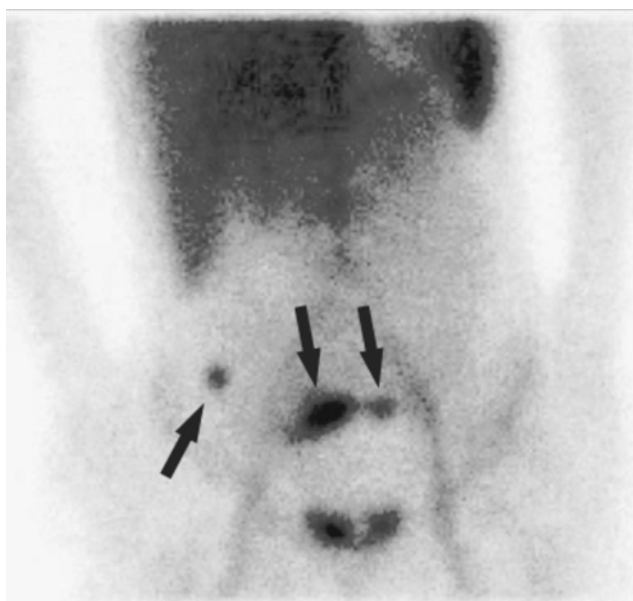
The correct place of bleeding was determined by scintigraphy with RBCs in our study in 69% patients. This is similar with literature.

## Conclusions

Scintigraphy with RBCs in vivo labelled technetium-99m hastened the detection of the source of GI bleeding and improved



**Figure 3.** Positive scintigraphy with autologous RBCs obtained in 50-year-old woman with enterorrhagia. Source of bleeding was at the ileum. Rendu-Osler-Weber disease.



**Figure 4.** Positive scintigraphy with autologous RBCs obtained in 18-year-old woman with enterorrhagia. Bleeding in ileosigmoidoanastomosis six days after hemicolectomy for Crohn's disease.

management of disease. Scintigraphy with labelled RBCs can be successful for the detection of bleeding site in the small bowel. Twenty-one patients in our study had positive scintigraphy with labelled RBCs. The source of bleeding was in jejunum or ileum in 15 patients out of those with positive scintigraphy with labelled RBCs. Only 1 patient had a bleeding ulcer close to the papilla of Vater. No patient had the source of bleeding in the colon.

GI bleeding stopped spontaneously in 5 patients with positive scintigraphy and in 10 patients with negative scintigraphy. There-

fore these patients did not undergo intra-operative enteroscopy or surgery.

## References

1. Bagga S, Gupta SM et al. Scintigraphic localization of recurrent anastomotic site bleeding in the gastrointestinal tract. *Clin Nucl Med* 1996; 21: 296–298.
2. Bureš J, Rejchrt S et al. *Small Bowel Investigation & Atlas of Enteroscopy*. Grada Publishing, Praha 2001.
3. Caruana V, Swayne LC et al. Scintigraphic localization of a bleeding leiomyosarcoma of the proximal jejunum. *Clin Nucl Med* 1991; 16: 230–232.
4. Dusold R, Burke K et al. The accuracy of technetium-99m-labeled red cell scintigraphy in localizing gastrointestinal bleeding. *Am J Gastroenterol* 1994; 89: 345–348.
5. Emslie JT, Zarnegar K et al. Technetium-99m-labeled red blood cell scans in the investigation of gastrointestinal bleeding. *Dis Colon Rectum* 1996; 39: 750–754.
6. Hansen ME, Coleman RE. Scintigraphic demonstration of gastrointestinal bleeding due to mesenteric varices. *Clin Nucl Med* 1990; 15: 488–490.
7. Harbert JC, Eckelman WC et al. *Nuclear Medicine — Diagnosis and Therapy*. Thieme Medical Publ., Inc., New York 1996.
8. Orrellana P, Vial I et al. 99mTc red blood cell scintigraphy for assessment of active gastrointestinal bleeding. *Rev Med Chil* 1998; 126: 413–418.
9. Ryan P, Styles CB et al. Identification of the site of severe colon bleeding by technetium-labeled red-cell scan. *Dis Colon rectum* 1992; 35: 219–222.
10. Thrall JH, Ziessman HA. *Nuclear medicine — The requisites*. Second edition. Mosby, Inc. A Harcourt Health Sciences Company, St. Louis, Missouri 2001.