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Localization of small bowel bleeding by arterial injection of Tc-99m-labeled RBC

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A 79-year-old man with melena was suspected of having small bowel bleeding because upper and lower endoscopic findings were negative. Technetium-99m-labeled red blood cell (Tc-99m-RBC) scintigraphy was performed by arterial injection of a radiotracer from the superior mesenteric artery (SMA) after angiography. Extravasation was seen in the ileum by scintigraphy although angiography was negative. Scintigram 2 minutes after arterial injection was consistent with the late capillary phase of balloon occluded angiography. This comparison provided a better anatomical distinction. Tc-99m-RBC scintigraphy by arterial injection through the SMA identified the bleeding site in the small bowel more accurately than conventional intravenous Tc-99m-RBC scintigraphy.

Key words: technetium-99m-labeled red blood cells (Tc-99m-RBC) scintigraphy, gastrointestinal bleeding

INTRODUCTION

TECHNETIUM-99m-labeled red blood cell (Tc-99m-RBC) scintigraphy has been reported to be useful for localizing the site of obscure gastrointestinal (GI) bleeding,[1–3] but some authors have reported that this method has limitations.[4,5] Rapid transit of Tc-99m-RBC within the gastrointestinal tract and poor anatomical resolution of Tc-99m-RBC scintigraphy hamper localization of a lesion in the GI tract. If better anatomical orientation were possible, this limitation might decrease. We combined angiography and Tc-99m-RBC scintigraphy, the advantages of which are discussed.

CASE REPORT

A 79-year-old man presenting with melena and anemia was admitted to our hospital. The patient had suffered from melena 1 or 2 times a day for more than 10 days before admission. He had been diagnosed as having idiopathic thrombocytopenia (ITP). Physical examination showed a pale face and abdominal distention. The blood pressure was 106/50 mmHg. Abnormal laboratory data included white blood cells, 10,100/μl; platelets, 46,000/μl; hemoglobin, 5.0 g/dl and blood urea nitrogen, 34.1 mg/dl. Since gastroendoscopy, colonoscopy and computed tomography were negative, small bowel bleeding was suspected.

Standard Tc-99m-RBC scintigraphy was first performed according to the *in vivo* labeling technique.[1] The patient was given an injection of 0.2 mg/kg of stannous pyrophosphate (Techne pyrophosphate kit, Daiichi-radioisotope, Tokyo, Japan) reconstituted with 4.0 ml of normal saline solution. Thirty minutes later, 740 MBq of Tc-99m-pertechnetate was injected intravenously. A large field gamma camera (Prism 2000XP, Picker, Ohio, USA) with a low energy high resolution collimator was used. Image acquisition was started immediately after injection of the radiotracer at 2 seconds per frame for 1 minute and 15 seconds per frame for the next 50 minutes. Static anterior and posterior images were also obtained 60 and 150 minutes later. The scintigraphy obtained 30 minutes

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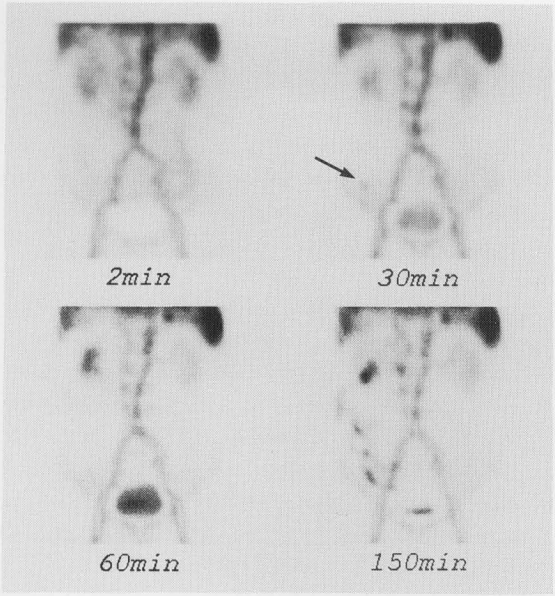

Fig. 1 Scintigraphy of intravenously injected Tc-99m-RBC. Abnormal accumulation (arrow) was seen in the iliocecal region 30 minutes after injection. Abnormal accumulation disappeared 60 minutes after injection. The radioactivity reappeared and moved gradually along the ascending colon from the iliocecal region 150 minutes after injection.

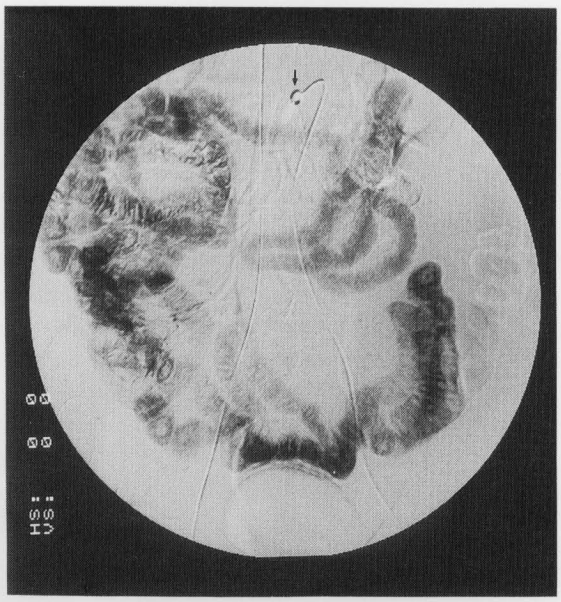

Fig. 2 Late capillary phase of balloon (arrow) occluded angiography of SMA. The anatomy of the small bowel was clearly identified.

after the injection showed abnormal accumulation in the right lower abdomen, suggesting that the bleeding site may be the iliocecal region. It disappeared 60 minutes and reappeared 150 minutes later, which indicated intermittent bleeding (Fig. 1). After the scintigraphy, selective angiography of the superior mesenteric artery (SMA) and

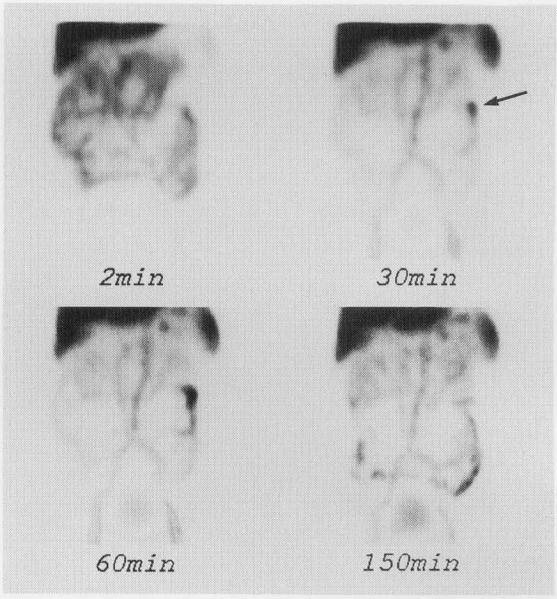

Fig. 3 Scintigraphy by arterial infusion of Tc-99m-RBC. Extravasation (arrow) was seen in the ileum 30 minutes after arterial infusion of the radiotracer. In the later images, the radioactivity had moved gradually from the ileum to the ascending colon. Note that the merged image of 0 to 2 minutes after injection was quite similar to the late capillary phase of the balloon occluded angiography (Fig. 2).

then superselective angiography were performed but were unable to detect any extravasation or vascular anomaly. A digital subtraction angiography system (Integris C2000, Philips Medical System, Tokyo) was used. The image repetition rate was two frames per second during all phases. Contrast media (25–30 m*l*) in selective angiography were injected at a flow rate of 5–6 m*l* per second with a power injector. The manually injected volumes in super selective angiography and balloon occluded angiography were 5 and 12 m*l*, respectively. Since transarterial embolization was unable to be performed, vasopressin was infused at 0.2 units per minute via the SMA for 12 hours. The melena had disappeared by the next day but reappeared two days after the infusion of vasopressin. Angiography was performed again 8 days after the first scintigraphy because the melena was still present and transfusion of 2–3 units of blood per day was required, but the angiography and additional balloon occluded superior mesenteric angiography were both negative (Fig. 2).

Repeated scintigraphy by intraarterial injection of radiotracer via the SMA was attempted to identify the bleeding site more accurately. The same amount of reconstituted stannous pyrophosphate as in the first study was injected intravenously in the angiography room 30 minutes before injecting the radiotracer. The patient was then moved to a nuclear medicine laboratory and given an injection of radiotracer via the SMA. Imaging was started immediately after injection of the radiotracer at 30 sec-

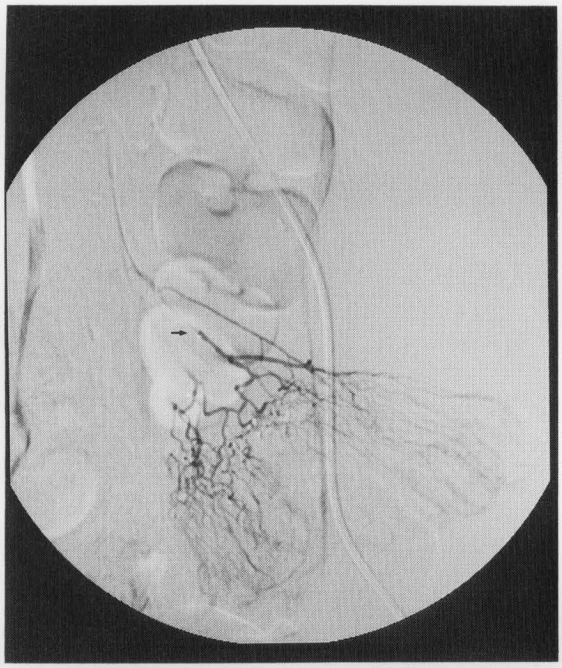

Fig. 4 Superselective angiography demonstrated neither extravasation nor vascular anomaly. Arrow indicates catheter tip.

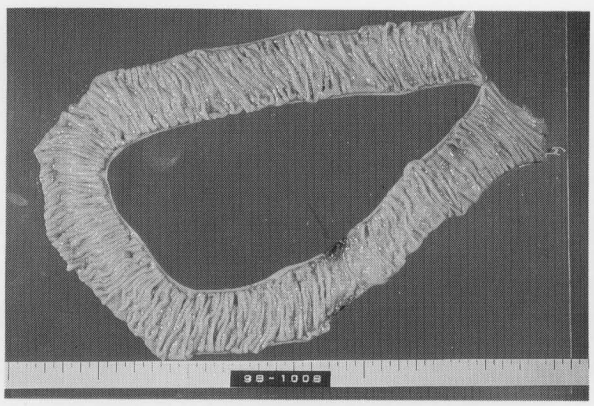

Fig. 5 Resected ileum is 60 cm in length. Arrow indicates erosion. Microscopic examination revealed the hematoma was located mainly in the submucosal layer.

onds per frame for 50 minutes. Static anterior and posterior images were obtained after 60 and 150 minutes as before. Extravasation was clearly seen in the ileum 30 minutes post-injection (Fig. 3). The merged image 0 to 2 minutes after intraarterial injection was quite similar to the late capillary phase of balloon occluded angiography, so that these images indicated the bleeding site to be the ileum.

Surgical operation was decided on 10 days after the first scintigraphy, and angiography was performed again to determine the surgical range. Although the catheter tip was introduced into the bleeding site previously identified, superselective angiography revealed no abnormal findings (Fig. 4). With the catheter still in the bleeding site, an operation was performed. To decide the range of resection, indigocarmine was injected through the catheter, and the ileum was enhanced for about 20 cm from a point 1 m from the terminal ileum to the oral side. The enhanced ileum was resected for 60 cm including each 20 cm on both sides. A hematoma in the submucosal layer and erosion of the mucosa were seen (Fig. 5).

DISCUSSION

It is very important to identify the bleeding site in patients with gastrointestinal bleeding for effective treatment. There are several techniques for identifying the bleeding site, including endoscopy, barium study, angiography and scintigraphy. Many authors have reported that scintigraphy is the most sensitive examination among them.[2,3] Its advantages include not only high detectability but also repeatability of the examination in the case of inconclusive results. The lowest rate of bleeding detectable by scintigraphy is less than that by angiography. Thorne et al. reported the minimal detectable rate of bleeding is as low as 0.04 ml/min by scintigraphy,[6] whereas Baum et al. reported it is at most 0.5 ml/min by angiography.[7] As shown in this case, scintigraphy is commonly able to detect a bleeding site but angiography is not.

Our arterial scintigraphy visualized not only the bleeding site but also the normal small intestine, so that the bleeding site was accurately pointed out. As the small intestine moves vigorously within the intraperitoneal cavity, the anatomical orientation is important for accurate identification of the bleeding site. We were able to point out the bleeding site accurately with our technique, which improved anatomical orientation without losing the advantages of conventional Tc-99m-RBC scintigraphy, but if the examination time is delayed because of intermittent bleeding, movement of the small intestine may result in failure to identify the bleeding site.

St. George et al. have already reported arterial scintigraphy in detecting gastrointestinal hemorrhage with Tc-99m-colloid.[8] The advantages of this method are detectability superior to that of angiography and the potential to conduct further therapy. Arterial injection in Tc-99m-RBC scintigraphy is applicable only to cases of small intestinal and right hemicolonic bleeding. Therefore, gastric and colorectal bleeding should be studied by endoscopy or with barium before applying this method. The ideal indication for this method is continuous bleeding from the small intestine or right hemicolon.

Erosion corresponding to the bleeding point was confirmed by surgery. The etiology of this erosion was unknown, but a vascular malformation could be excluded pathologically.

The balloon occluded SMA angiography induced mesenteric hyperemia and consequently showed the outline of the small intestine clearly. Phillips et al. mentioned the

potential of balloon occluded angiography in making the bleeding lesion more obvious,[9] though we were unable to detect the bleeding site in our case. The merged image 0 to 2 minutes after arterial infusion of Tc-99m-RBC was consistent with the late capillary phase of balloon occluded angiography. It was therefore possible to detect the bleeding site accurately by comparing Tc-99m-RBC scintigraphy of arterial infusion with balloon occluded angiography.

In conclusion, arterial injection of Tc-99m-labeled RBC seems to be more precise for detecting obscure small intestinal bleeding and the bleeding site.

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