# CASE REPORTS

## I-131 Total-Body Scan: Localization of Disseminated Gastric Adenocarcinoma. Case Report and Survey of the Literature.

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**This is a case of striking radioiodine and [$^{99m}$Tc]pertechnetate uptake by disseminated nonthyroidal (gastric) adenocarcinoma. A 65-yr-old man was euthyroid and serum thyroglobulin concentration was normal at 11 ng/ml. Bone-marrow biopsy showed that the metastatic tumor cells were negative for thyroglobulin on immunoperoxidase stain and the secretory product was mucicarmine-positive. We estimate that radioiodine uptake in the normal thyroid gland was less than 10% of total tumor uptake. At autopsy, the stomach was the site of the primary tumor, which had the same cellular and histochemical characteristics as the metastatic lesions in bone and liver. It is emphasized that the use of pertechnetate for screening patients with gastric adenocarcinoma may be clinically useful in the early detection of metastatic lesions.**

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Iodine-131 total-body scan is specific for demonstrating metastatic, differentiated thyroid carcinoma (*1–5*). False-positive studies are extremely rare in nonthyroidal tumors (*4,6–10*). In recent reports of I-131 scanning to detect metastatic differentiated thyroid carcinoma, the specificity was as high as 98% (*11–16*). One false-positive case was due to minimal concentration of radioiodine in an infectious pulmonary fungal lesion (*11*). We present a patient with disseminated gastric adenocarcinoma with remarkable uptake of radioiodine in the presence of a normal thyroid gland. This case is reported to emphasize that pertechnetate and radioiodine may be useful in locating metastatic lesions of gastric adenocarcinoma. The possible role of radioiodine in the treatment of similar cases also deserves further investigation.

### CASE REPORT

A 65-yr-old black male was admitted for hypercalcemia and a pathological fracture of the right scapula. History revealed a stab wound, suffered 8 yr earlier, that resulted in a C-7 incomplete quadriplegia. Physical examination showed no cervical lymphadenopathy. The thyroid gland was normal on palpation. The right shoulder was tender, with limited movement.

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Laboratory evaluation revealed: serum calcium 13.5 mg/dl (normal 8.5–10.5); albumin 2.9 g/dl (normal 3.5–5.0); hemoglobin 9.4 g/dl (normal 14–18); $T_4$ 8.6 $\mu$g/dl (normal 5.5–11.5); $RT_3U$ 33% (normal 25–36); TSH 2.2 $\mu$U/ml (normal 0–6); alkaline phosphatase 210 mU/ml (normal 30–115); LDH 824 mU/ml (normal 100–225); acid phosphatase 0.5 IU/l (normal 0.1–0.9); HCG $\beta$-subunit 32 mIU/ml (normal 0–1.5); CEA > 600 ng/ml (normal 0–3); $\alpha$-fetoprotein 33 IU/ml (normal 0–15). Urinalysis was unremarkable and stool was negative for occult blood. Serological screen for fungal antibodies was negative.

Radiographs showed large extrapleural masses on the right side posterolaterally and at the left apex, and multiple lytic lesions in ribs, both scapulae, and pelvis. Liver image demonstrated multiple focal defects, especially in the inferolateral aspect of the right lobe, which were compatible with metastases (Fig. 1). The tomographic bone scan (Tc-99m MDP) revealed focal areas of increased activity in right shoulder, anterior ribs, sternum, spine, and pelvis (Fig. 2). Photopenic lesions were present in left scapula and at L-4 vertebra. Increased soft-tissue activity was present in the hepatic region.

Bone-marrow biopsy revealed the replacement of normal marrow elements by adenocarcinoma. The neoplastic cells were columnar to cuboidal, arranged in a glandular fashion and showing signs of secretion (Fig. 3). The differential diagnosis of the primary included adenocarcinoma from lung, gastrointestinal tract, pancreas, prostate, or thyroid. A thyroid uptake with 400 $\mu$Ci I-123 demonstrated a neck uptake of 5.9% at 4 hr and 9.5% at 24 hr. An attempt to image the thyroid gland with a pinhole collimator at

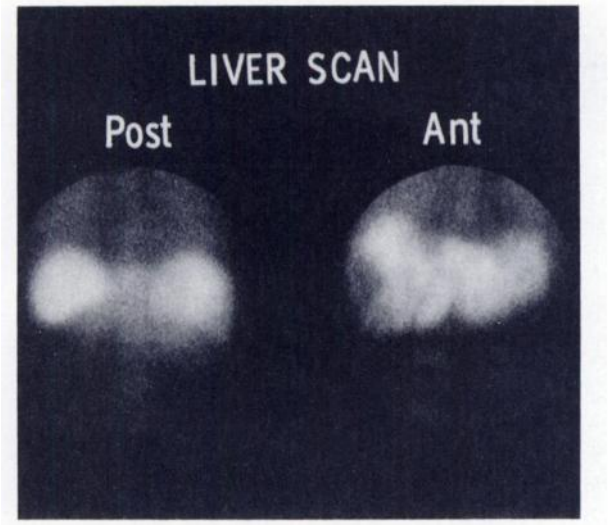


FIG. 1. Liver study demonstrates multiple focal defects, especially in inferolateral aspect of right lobe.

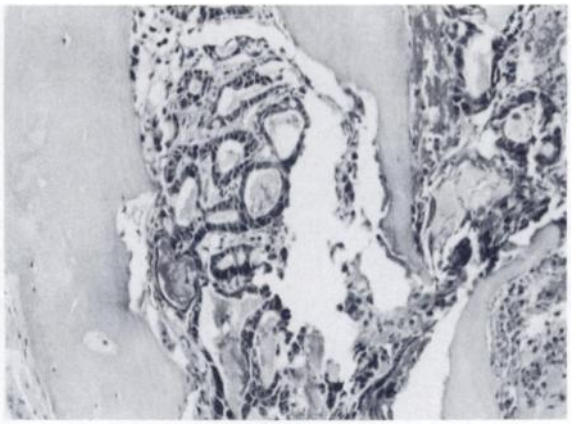

FIG. 3. Bone-marrow biopsy shows replacement by adenocarcinoma. Tumor cells are cuboidal to columnar, arranged in moderately well-formed glandular pattern (×100)

6 hr was unsuccessful. Repeat imaging with parallel-hole collimator again failed to visualize the thyroid gland. However, focal concentration of I-123 was present in both shoulders and in the right lateral chest corresponding to the extrapleural masses noted on chest radiograph. A total-body scan 30 min after 20 mCi of Tc-99m demonstrated numerous areas of abnormal uptake throughout the chest, shoulders, spine, liver, and pelvis (Fig. 4). A 72-hr I-131 (5 mCi) total-body scan showed disseminated uptake of radiotracer throughout the body in areas corresponding to the abnormal areas seen with pertechnetate (Fig. 5). On both tomoscan and camera scintigraphy with a high-resolution parallel-hole collimator, the thyroid gland was clearly visible. The images were stored on a computer (MDS $A^2$ with a 80-megabyte disk) in a 128 × 128 matrix. Of the total tumor radioactivity throughout the body, 7.1% was in the thyroid gland.

Because of the numerous extrathyroidal concentrations of radioiodine, the initial clinical impression was differentiated thyroid carcinoma. However, serum thyroglobulin (hTg, RIA) was 11 ng/ml (normal 3.4–35.1), the thyroglobulin immunoperoxidase

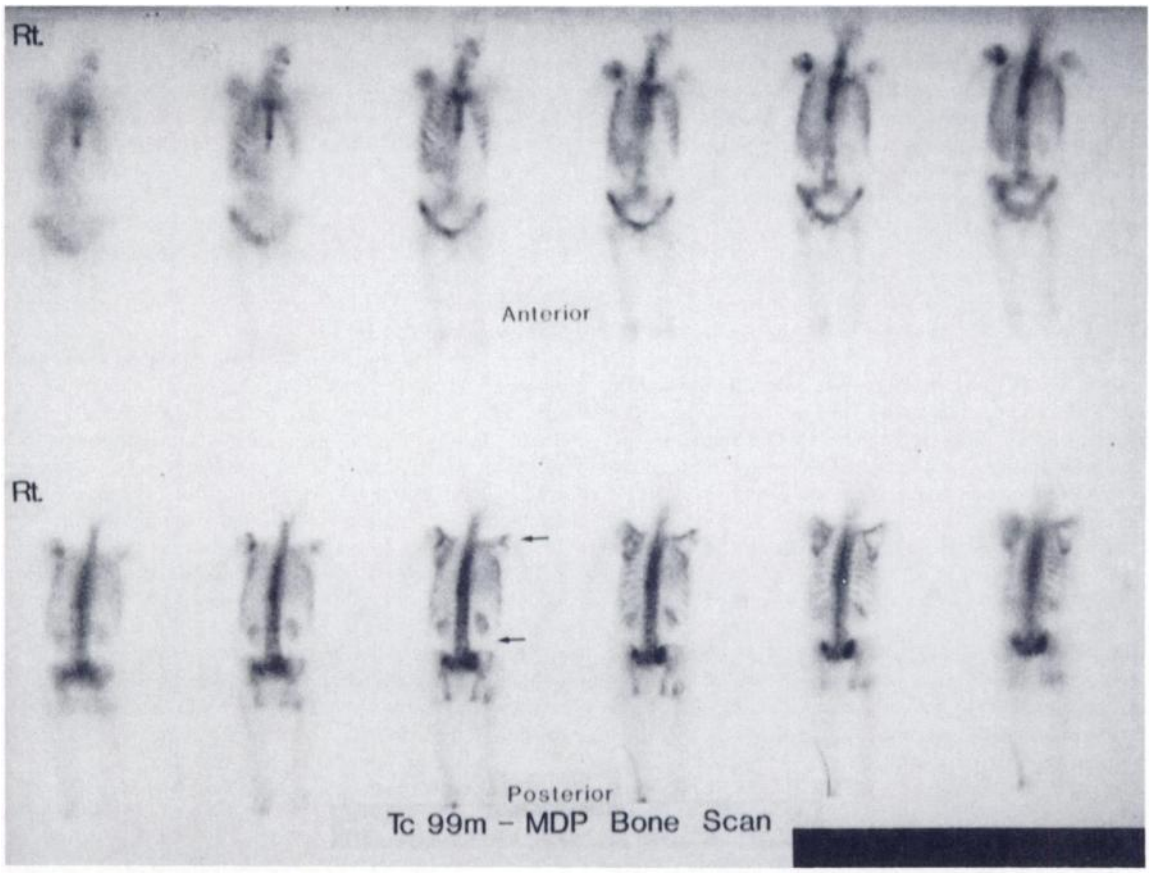


FIG. 2. Bone tomoscan reveals abnormal foci in right shoulder, anterior ribs, sternum, spine, and pelvis. Photopenic lesions (arrows) are present in left scapula and at L-4. Compare these areas with those areas of increased uptake on Tc-99m and I-131 scans.

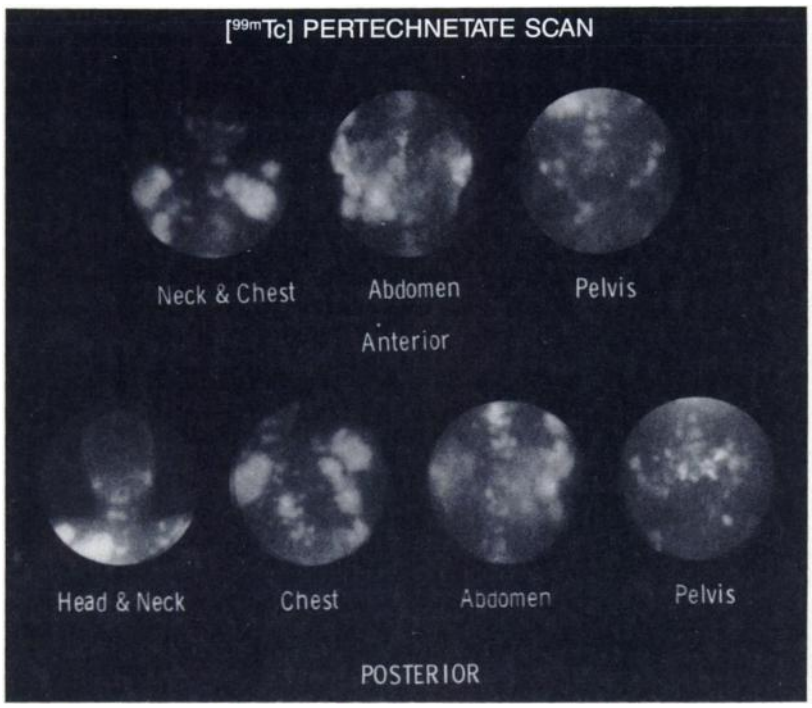


**FIG. 4. Total-body scan 30 min after 20 mCi of pertechnetate demonstrates numerous areas of abnormal uptake throughout chest, shoulders, spine, liver, and pelvis.**

stain of the bone-marrow biopsy was negative, and the secretory product was mucicarmine-positive (*17*). His liver function deteriorated and the clinical course was rapidly downhill. He died 2 mo after admission.

Autopsy revealed a moderately differentiated mucin-secreting adenocarcinoma of the stomach. It was ulcerated, measured 3.5 by 2.8 cm, and was located slightly above the pylorus. It involved the full thickness of the gastric wall, penetrating toward the pancreas. Metastases, which had the same cellular and histochemical characteristics as the primary tumor, were present in the regional lymph nodes and liver. The liver weighed 2600 g, 70% of which was metastatic tumor. All bone specimens examined contained tumor metastases. The ribs were expanded by tumor masses bilaterally up to 12 cm in diameter, compressing the parietal pleura and lungs but not invading them. No other organ metastases were found. The thyroid, which weighed 16 gm, was sectioned at 2–3 mm intervals and revealed only a 3-mm nodule in the right lobe. Microscopically, the nodule was a well-encapsulated adenoma. Mucicarmine stain of the adenoma was negative and a thyroglobulin immunoperoxidase stain was positive. Incidental findings included an adenomatoid tumor, 4 mm in diameter, in the left testicle.

## DISCUSSION

The I-131 total-body scan is specific and sensitive for demonstrating metastatic differentiated thyroid carcinoma (*1–5,11–16*). Recent studies of a total of 345 patients (*11–16*) showed that the I-131 total-body scan had a sensitivity of 84.4% for detecting metastatic differentiated thyroid carcinoma. This approached the 90.4% sensitivity for hTg assay in 846 patients (*11–16,18–23*). With regard to specificity, however, the total-body scan is slightly better than the hTg assay (98.1 compared with 94.3%). In interpreting the I-131 total-body scan, the normal tracer activity found in gastrointestinal tract, salivary glands, oropharynx, lactating breast, and urinary bladder may hinder interpretation (*1–4*). Liver uptake of radioiodine may also occur when there is significant residual functional thyroid tissue present. Presumably this is because the liver is active in metabolizing thyroid hormones and their analogs (*24,25*). Ectopic thyroid tissue is occasionally substernal (*2*), sublingual (*2,5*), or intrathoracic (*3,4,26*). Since radioiodine normally concentrates in saliva and gastric juice, one may find tracer activity in the esophagus in a variety of conditions, such as esophageal stricture (*27*), Zenker's diverticulum (*28*), gastroesophageal reflux (*29*), hiatal hernia (*4*), achalasia (*30*), Barrett's esophagus (*31*), intrathoracic gastric cyst (*32*), and postoperative colon interposition (*30*). In one case, false positivity was due to a small amount of I-131 localized in an infectious pulmonary fungal lesion (*11*). In women, struma ovarii may enter into the differential diagnosis (*7*). The existence of lateral rests of aberrant thyroid tissue is a matter of controversy. A few may represent normal thyroid tissue (*33*), but the rest are lymph node metastases from thyroid carcinoma (*34*).

A mucin-secreting adenocarcinoma of the lung was shown to have marked uptake of pertechnetate, but a radioiodine study was not performed (*35*). Reported cases of nonthyroidal tumor concentrating I-131 are extremely rare, with only one case for each of the following: Warthin's tumor (*6*), papillary meningioma (*8*), primary lung carcinoma (*9*), and undifferentiated bronchogenic carcinoma (*10*). In these the radioiodine uptake was limited to the primary tumor (*6,8*) or to regional metastasis (*9,10*).

The present case is unique in three aspects. First, there was scintigraphically demonstrable uptake of I-131 by a metastatic gastric adenocarcinoma. Second, the I-131 image revealed the diffusely disseminated metastatic lesions in liver and in bone. Third, the total radioiodine uptake in metastatic tumor masses far exceeded that in the normal thyroid, to the extent that initial 6-hr thyroid study with 400 $\mu$Ci of I-123 showed only neighboring tumor uptake and failed to reveal a thyroid shadow.

The preliminary impression, after the total-body I-131 scan, was metastatic differentiated thyroid carcinoma, presumably follicular. However, the serum hTg was only 11 ng/ml in the absence of anti-Tg antibody, which made the diagnosis of metastatic functional thyroid carcinoma highly unlikely (*11–16,19–24*). Further evidence of a nonthyroidal primary was the negative thyroglobulin

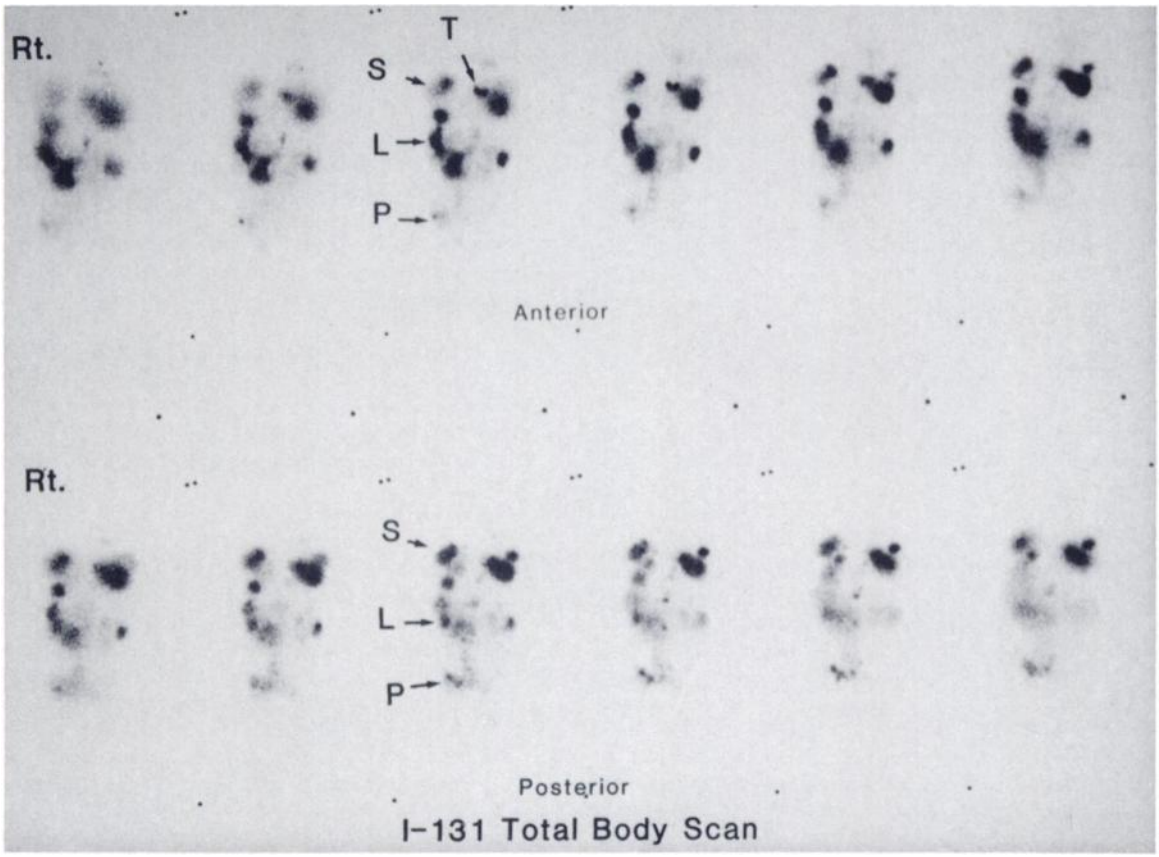


**FIG. 5.** I-131 total-body tomoscan at 72 hr after oral administration of 5 mCi of I-131 reveals disseminated foci throughout body in areas corresponding to abnormal activities seen on pertechnetate scan (as shown in Fig. 4). The thyroid gland (T) is clearly visible in anterior sections. (Other markers: S, right shoulder; L, Liver; P, Pelvis.)

immunoperoxidase stain of the bone-marrow biopsy. In addition, the secretory product was mucicarmine-positive (*17*). The histology and histoimmuno-stain exclude a thyroid origin of the carcinoma (*36*), thereby favoring a lung or gastrointestinal primary. The markedly elevated serum level of CEA is certainly consistent with a gastrointestinal primary and massive liver metastases; the latter may also explain the increase of serum $\alpha$-fetoprotein (*37–39*). An elevated level of $\beta$-subunit, hCG, as in this case, was also found in 20% of gastric and colon carcinomas and 7% of bronchogenic carcinomas (*40*). The bone-marrow biopsy and laboratory findings favored the diagnosis of metastatic lung or gastrointestinal adenocarcinoma and was in agreement with the postmortem diagnosis.

A computer estimation of the I-131 thyroid uptake at 72 hr after tracer administration was 7.1% relative to total tumor activity. The value is probably overestimated for the following reason. First, only large lesions present on the I-131 study were included in the calculation, whereas a higher-resolution pertechnetate scan (Fig. 4) revealed the presence of more diffuse metastases including multiple smaller lesions not evident on the I-131 study. Second, the 72-hr scan may not indicate the initial uptake of the tumor, which may have cleared more rapidly than the thyroid. In addition, iodine released from tumor may be picked up continuously by a normally functioning thyroid gland. The latter possibility is substantiated by the finding that the 6-hr I-123 study showed a thyroid-to-tumor (neighboring) uptake ratio near zero, whereas in the 72-hr I-131 image, a ratio was 0.27. Third, the "background" activity, which was subtracted in the computer calculation, undoubtedly contained widespread small metastases, as shown by the pertechnetate scintiphoto. The initial estimates of "thyroid" uptake—5.9% at 4 hr and 9.5% at 24 hr—were unquestionably too high due to unavoidable inclusion of neighboring tumor activity.

The tumor was not functional in the sense that it generated no thyroid hormones. The patient was clinically euthyroid and serum $T_3$, $T_4$, $RT_3U$, TSH, and hTg were normal. The G-25 Sephadex column fractionation (*41*) of the patient's serum obtained at Days 4, 10, and 18 after I-131 ingestion showed that nearly all of the radioactivity was in the free-iodine peak (Wu S-Y, unpublished result). Measurements of radioactivity in various tissues obtained at autopsy revealed that the metastatic tumor in bone had a much higher specific radioactivity (somewhat lower in liver) than the primary gastric tumor, which was similar to normal gastric mucosa in radioactivity (Wu S-Y, unpublished results). It is possible that the radioiodine was incorporated into the metastatic tumor in bone (and liver) through an unspecified process. We speculate that cell dedifferentiation at the biochemical level may have occurred, enabling the metastatic tumor to retain enough radioiodine to be visualized at 72 hr. The fact that the primary gastric tumor, as well as the normal gastric mucosa, showed near-background radioactivity suggests that the mechanism causing visualization of the metastases includes steps beyond the simple trapping of radioiodine.

In future screening of such nonthyroidal iodine-concentrating metastatic lesions, pertechnetate imaging would be more appropriate, to prevent unnecessary radiation to the thyroid. In fact, as shown in the present study, the Tc-99m scintigram demonstrated more detail of the metastatic lesions than did the iodine image. After an initial Tc-99m study, confirmation and kinetic studies

could be carried out by I-131 in selected patients, who eventually might be benefited by radioiodine therapy.

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# Intraoperative Scintigraphic Localization of a Gastrointestinal Bleeding Site

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**We present a case report of intraoperative scintigraphic localization of an active gastrointestinal bleeding site in a 65-yr-old female who had repeatedly negative endoscopy and angiography.**

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Gastrointestinal bleeding, even when clinically massive, generally occurs intermittently (*1*); in order for invasive procedures, such as endoscopy and angiography to be successful, the patient must be actively bleeding at the time of the study. Recently, scintigraphy of gastrointestinal bleeding with Tc-99m sulfur colloid or Tc-99m-tagged red cells has proven to be an accurate and effective method for the detection and localization of upper and lower gastrointestinal bleeding (*2,3*). We present a case report of intraoperative scintigraphic location of an active GI bleeding site.

## CASE REPORT

A 65-yr-old female, with a 3-wk history of melena and a hemoglobin of 4.5 g, received seven units of packed red blood cells and one unit of fresh-frozen plasma; however, her hemoglobin and hematocrit continued to drop slowly and her stools remained heme-positive. A barium enema and upper GI series were unremarkable. Endoscopy demonstrated a duodenal ulcer but no discrete bleeding site. A tagged-red-cell study was performed (*4*) but no evidence of active bleeding was noted on the first day of the study. On the following day the study was repeated, and a focus of radioactivity was observed in the left upper quadrant of the abdomen (Fig. 1). Sequential imaging over the next 4 hr showed movement of the radionuclide into the right lower quadrant (Fig. 2), indicating that the bleeding originated in the small bowel and not in the colon. Celiac, superior mesenteric, and inferior mesenteric arteriography were found normal. An exploratory laparotomy was not revealing. Multiple enterotomies and intraoperative endoscopies were performed, extending from the ligament of Treitz to the ileocecal valve, but no bleeding site was found. The patient was stable for approximately 48 hr following surgery but then began passing tarry stools; her hemoglobin dropped from 10 to 8 g. The tagged-RBC study was repeated and was virtually identical to the initial study, again demonstrating active intermittent bleeding in the left upper quadrant, presumably in mid jejunum. Repeat arteriograms and upper endoscopy to the ligament of Treitz were negative.

At a second operation, an attempt was made scintigraphically to locate the bleeding site more precisely with an uncollimated

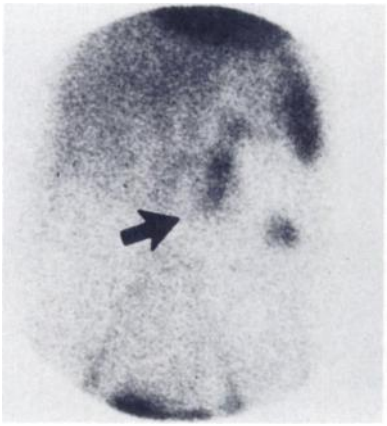

**FIG. 1.** Anterior image of abdomen showing abnormal radionuclide accumulation in left upper quadrant. Note anteriorly displaced left kidney (arrow) medial to bleeding site. LPO image confirmed location of left kidney, which was displaced by large photon-deficient region confirmed on angiography to be cyst.

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