been significantly delayed without the guidance of a positive bone scan, and the information derived secondarily.

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# "Hollow Spleen" in Histiocytic Lymphoma

Several causes of voids in Tc-99m sulfur colloid images of the spleen are known, including cysts, infarcts, trauma, and neoplasms (1). The appearance of the lesion can be suggestive of a particular diagnosis, but is not pathognomonic. We have recently had the opportunity to make spleen scintigrams in three patients who revealed similar findings—splenomegaly with a large nonfunctioning central portion—that created the appearance of a "hollow" spleen. All three patients had histiocytic lymphoma.

**Case 1.** A 49-year-old man was admitted to the hospital for evaluation of lymphadenopathy. He had left axillary tenderness with an enlarged node for 2 mo. A 1-cm left supraclavicular node and 2-cm tender matted left axillary nodes were palpated. The liver-spleen scintiphoto (Tc-99m sulfur colloid) showed a normal liver, but a large defect occupied the center of the spleen (Fig. 1). Axillary lymphnode biopsy was performed. Microscopically, broad sheetlike proliferation of undifferentiated, thin histiocytic cells was seen, and a diagnosis of histiocytic lymphoma was made.

**Case 2.** A 46-year-old woman was admitted to the hospital with a 2-mo history of a progressively enlarging left upper quadrant mass, as well as weight loss. A hard, rounded 8- by 8-cm mass, moveable with respiration, was palpable in the left upper quadrant. A liver-spleen radiocolloid scintiphoto revealed an enlarged spleen with a center that was "hollow." There was a suggestion of partitions or "septa" of functional tissue in the central splenic lesion (Fig. 2). A radiogallium scan was then performed; revealing intense left upper quadrant activity in an area corresponding to the enlarged spleen.



FIG. 1. Posterior scintiphoto of spleen in Case 1. Large defect is apparent. No abnormalities were noted in liver.



FIG. 2. Images are anterior (left) and left lateral abdominal (right) scintiphotos (Tc-99m sulful colloid). On lateral view, anterior is to viewer's left. Massive splenic size (27 cm) and "hollow" center can be seen. There is a suggestion of "septa."

An exploratory laparotomy revealed a massive spleen (2060 g). Infiltration of tumor in the transverse mesentery and enlarged retroperitoneal nodes, up to the celiac axis, was noted. Microscopically, there was extensive tumor infiltrate. The overall appearance was that of a poorly differentiated malignant lymphoma of the histiocytic type.

Case 3. A 50-year-old man had been admitted to the hospital 8 yr previously for evaluation of a right submandibular mass that had been present for 2 mo. At surgery, a 3- by 5-cm irregular mass of tan tissue, partially encapsulated, was found. Microscopically, the specimen showed undifferentiated malignant cells suggesting histiocytic lymphoma. In addition to chemotherapy, the patient had radiation therapy to the midabdomen totaling 4,000 rads. A liverspleen scan 2 yr later (thus 6 yr before the present admission) showed an enlarged liver with an absent left lobe (presumably due to radiation therapy) and a 5-cm rounded focal defect in the right hepatic lobe. The enlarged spleen showed an approximately 8-cm rounded focal defect in the superior-posterior region. Repeat scans in later years, the last being 6 yr after the first, showed a normal-appearing spleen (Fig. 3).

A defect on radiocolloid scan of the spleen does not establish an etiologic diagnosis. When combined with all available data, however, the nature of the lesion often becomes apparent. Silverman and coworkers noted that not all patients with histologically proven Hodgkin's disease in the spleen had a splenic defect on scanning (2). The three individuals we have seen all presented with splenomegaly and a "hollow" spleen on radiocolloid image; that is, the central portion of the spleen was apparently replaced by nonfunctioning tissue, the periphery of the organ being spared. All three had histiocytic lymphoma. Splenic involvement in lymphoma can be but one manifestation of the disease, although in some instances the spleen appears to be the principal organ involved (3).

Other causes for loss of reticuloendothelial tissue in the center of the spleen are known. For example, a splenic cyst can force functional reticuloendothelial cells to the far poles of the organ (4). Johnson and Muroff (5) described a case of histiocytic lymphoma ("reticulum-cell sarcoma") in which the spleen was encased by tumor in addition to having a central defect. The appearance was not dissimilar to those in our three cases. In Case 2, we had evidence for the probable lymphomatous nature of the splenic lesion because of its avid accumulation of radioactivity following administration of Ga-67 citrate. The findings of splenomegaly, and



FIG. 3. Upper image is a posterior rectilinear scan of spleen and liver (Tc-99m sulfur colloid). Large splenic defect in an organ 18 cm in length, as well as right hepatic lobe lesion and absent left lobe (probably due to irradiation) can be seen. Bottom image, a posterior scintiphoto, was obtained 6 yr later. Absence of left lobe of liver was noted on anterior view as well. Spleen was of normal configuration.

a "hollow" appearance on radiocolloid scan, should suggest the diagnosis of histiocytic lymphoma.

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# **Inversion of the Spleen—Scintigraphic Features**

Focal defects of the spleen observed on radionuclide images are usually due to infarction, neoplasms, trauma, cysts, and congenital diseases (1-3). Recognition of the upsidedown spleen, an anatomic variant that may present as a more serious abnormality (4), became of utmost clinical importance to a patient recently encountered who had a malignant melanoma and a focal splenic defect on a spleen scan.

Two years before this admission, a 50-year-old white male had had a malignant melanoma resected from his right shoulder. Although apparently free of tumor, he began to complain of upper abdominal pain with no other gastrointestinal symptoms. A liver-spleen scintigram revealed a defect in the upper pole of the spleen (Fig. 1A and 1B), and metastasis was suspected. Physical examination, laboratory studies, and an upper gastrointestinal series were unremarkable. A celiac arteriogram demonstrated a "vascular tumor" in the left upper quadrant of the abdomen supplied by gastric vessels. Ultrasound study of the left upper abdomen was not diagnostic. Review of the spleen scans and the angiogram together suggested an anatomical variant, the upside-down spleen (4). For this reason, a combined radionuclide study of the stomach (oral <sup>90m</sup>TcO<sub>4</sub><sup>-</sup>) and spleen (Tc-99 SC) was performed. This procedure demonstrated that the spleen was inverted and that the V-shaped defect of the spleen was filled in by pertechnetate that was located in the horizontal fundus of the stomach (Figs. 2A and 2B). Subsequently, the abdominal pain subsided, and he became asymptomatic.

There is considerable variation in the configuration of



FIG. 1. Posterior (A) and left lateral (B) scintiphotos following injection of Tc-99m sulfur colloid shows notch-like defect directed superiorly.



FIG. 2. Posterior (A) and left lateral (B) scintiphotos with pertechnetate in stomach; Tc-99m sulfur colloid in the spleen shows the V-shaped defect to be filled in by the stomach activity. Together they present a smooth convexity toward the diaphragm.