The Diagnosis of Splenic Injury Using Tc-99m Red Blood Cells

Spleen scanning is a simple innocuous procedure and has become a part of the initial series of examinations following blunt trauma to the chest and upper abdomen (*1–4*). The spleen scan can identify occult injury through: (A) discontinuity of splenic outline, (B) an indistinct margin resulting from subcapsular hematoma ("double-density sign"); or (C) displacement of the spleen from the body wall ("splenic-crowding sign"). However, a subcapsular hematoma, which causes a blurred splenic margin, is not easily defined by standard imaging techniques using Tc-99m sulfur colloid. The present report describes a subcapsular hematoma that required the in vivo labeling of red blood cells by pertechnetate to delineate the avascular perisplenic region. This procedure used Sn-pyrophosphate* and the technique of Zimmer et al. (*5*).

A 61-year-old white man was admitted to the hospital because of left chest pain and dyspnea. He had fallen in his bathroom several days before this admission. He subsequently developed a tender abdomen and a fall in the hematocrit from 31% to 19%. He received 4 units of blood and a spleen scan with Tc-99m sulfur colloid. This study (Fig. 1), as well as other views of the spleen, on two occasions showed some blurring of the spleen margins but was inconclusive. Two days later, an imaging study was done with red blood cells labeled in vivo with technetium-99m. The posterior projection showed an avascular ("photon-deficient") perisplenic area (Fig. 2). Oral Tc-99m DTPA was given and ruled out the possibility that this clear area might be due to the stomach (Fig. 3). Later, a contrast celiac angiogram confirmed the diagnosis of a subcapsular hematoma, and at surgery a huge subcapsular splenic hematoma was found. The location of the hematoma corresponded with the photon-deficient area seen on the scan. A liter of bloody material was aspirated from the mass and a splenectomy was performed. The spleen itself was not remarkable, measuring 11 cm in greatest length and 4 cm in thickness.

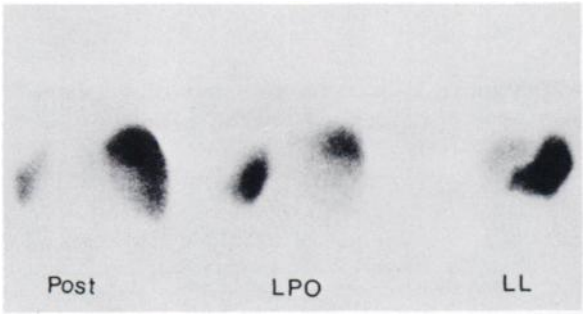

FIG. 1. Series of Tc-99m sulfur colloid images of spleen in posterior, left posterior oblique, and left lateral projections.

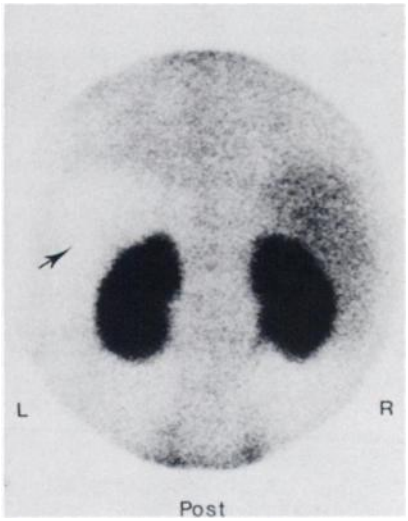

FIG. 2. Scintigram with Tc-99m-labeled red blood cells showing decreased activity or "photon-deficient" area corresponding to large perisplenic hematoma (arrow).

The delineation of a hematoma has previously been described as a photon-deficient area in splenic rupture (*6*), as well as in renal transplants (*7*). Our case is of interest because of a more recent and simple technique for imaging the blood pool. In this patient 20 mCi of Tc-99m as sodium pertechnetate was injected 30 min after the intravenous administration of the contents of a vial containing 15.4 mg of stannous pyrophosphate. The contents of the reaction vial were diluted with 5 ml of sterile normal saline. Scanning was begun within 5 min of the injection of pertechnetate. With this technique the in vivo tagging of red blood cells probably occurs due to the intracellular reduction of pertechnetate by the previous tin label (*5,8*).

While most splenic ruptures can be diagnosed by the use of the Tc-99m sulfur colloid scans (*9*), there are disturbing instances, such as the present one, in which there is an "apparently normal" spleen associated with displacement by a subcapsular hematoma. Appropriate marking of the left flank at the time of the sulfur colloid study might have helped, by indicating splenic displacement, to make a definitive diagnosis in the initial study. Our routine study proved to be diagnostically inadequate, but with the additional blood-pool imaging we were able to show the hematoma in the absence of obvious rupture. The increase in the size of the subcapsular hematoma during the interval between the two studies is the best explanation for nonvisualization of the spleen with the tagged red blood cells after previous visualization with sulfur colloid.

We strongly recommend blood-pool imaging following sulfur colloid scans when (A) the clinical history is suggestive of splenic trauma, and (B) the routine spleen scans are normal or nondiagnostic, as was the case here.

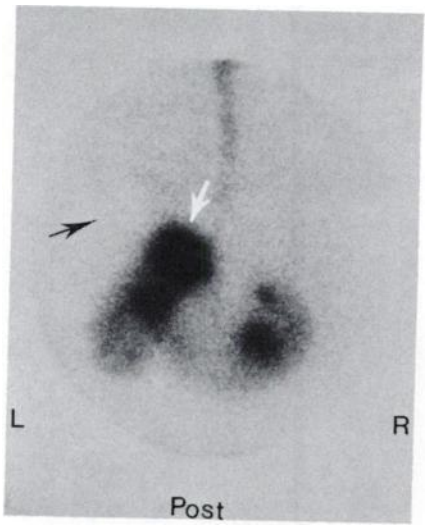

FIG. 3. Posterior scintigram after oral administration of Tc-99m DTPA to illustrate separation of stomach (white arrow) from photon-deficient area of perisplenic hematoma (black arrow).

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FOOTNOTE

*Mallinckrodt/Nuclear.

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Detection of Prethrombotic or Thrombotic States

The detection of prethrombotic or thrombotic states by laboratory methods has long been neglected. Von Kaulla and von Kaulla (*1*) have described a panel of procedures that evaluate various pertinent coagulation parameters and provide information useful for both diagnosis and treatment. The panel requires performance by well trained technicians, thus removing it from most laboratory situations. However, two tests within the capability of a routine clinical laboratory may provide useful information as to thrombin generation (a reflection of both the speed and amount of thrombin formed in plasma, and thus, by inference, extent of clotting) and loss of protective mechanisms that interfere with clotting. The first of these tests is the modified ethanol gelation test, and the second is the functional serum antithrombin assay (*1,2*). In the presence of active clotting, the ethanol gelation test is positive and the serum antithrombin III levels are depressed. Resolution is correlated with a return to normal levels. Heparin does not interfere with the assays.

Radionuclide techniques for thrombus detection offer the advantage of localization of thrombus formation, much as contrast venography does, but are severely limited by confinement to use in the lower extremities. Clots occur in many other areas. Tow (*3*) has well summarized the approaches using radionuclide techniques.

Caretta et al. (*4*) notes variable correlation of radionuclide findings with clinical results of anticoagulant therapy. This is not surprising in that such techniques ignore temporal patterns and physiologic bases of clot formation and dissolution. This limits the utility of the procedure.

Nuclear medicine is a discipline that merges laboratory, imaging, and physiologic approaches in delineating regional and global function for diagnostic purposes and in planning or implementing therapy. A limitation of focus of the discipline of nuclear medicine, as suggested by current approaches to thrombus detection, is self-defeating.

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A Qualitative Method for Determining the Level of Oxidant in a Solution of [^{99m}Tc] Pertechnetate

The presence of trace levels of oxidants in various sources of pertechnetate has often been blamed for the inability of some kit radiopharmaceuticals to bind the added technetium-99m adequately. Some years ago, many manufacturers of molybdenum-99–technetium-99m generators used trace levels of hydrogen peroxide or sodium hypochlorite (*1*) in the eluant to ensure that all the technetium would be in the form of pertechnetate and would therefore be