DIAGNOSTIC NUCLEAR MEDICINE

A Simplified Method of Selective Spleen Scintigraphy with Tc-99m-Labeled Erythrocytes: Clinical Applications. Concise Communication

Renato R. Armas,* Mathew L. Thakur, and Alexander Gottschalk

Yale University School of Medicine, New Haven, Connecticut

We report our initial clinical experience with a simplified spleen-imaging technique that requires no red cell washing or special kits. Thirty minutes after an injection of "cold" pyrophosphate containing 0.5 mg of stannous chloride or fluoride, a blood sample is drawn, 2 mCi of pertechnetate (Tc-99m) are added, the sample is incubated at 49–50° for 35 min, and then reinjected into the patient. We have studied 13 patients with this technique, and have found it useful in the clarification of various questionable splenic abnormalities found on the sulfur colloid scan, as well as in the detection of splenosis.

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Most diagnostic questions about splenic location or structure are readily answered by sulfur colloid scintigraphy. Occasionally, however, selective spleen imaging is desirable. Examples include equivocal splenic lesions on colloid scan, poor splenic visualization caused by liver-spleen overlap on colloid scan, and low spleen contrast whereby a small or poorly functioning spleen may be obscured by hepatic radioactivity. In the latter category, the most common in our experience are asplenia, polysplenia, splenosis, and detection of accessory spleens.

Selective spleen scanning is not new. It was developed almost 20 yr ago by Johnson et al. (*1*) using chromium-51. More recently, Richards and colleagues at Brookhaven National Laboratories have developed a kit for Tc-RBC labeling that supplants the Cr-51 RBCs used previously (*2*). In spite of its obvious potential, selective spleen scanning is used rarely, if at all, by most nuclear medicine facilities. We ascribe this to two factors: (a) both of the above methods require washing the RBCs—a procedure most nuclear medicine technologists are generally unfamiliar with and thus reluctant to perform; and (b) the RBC labeling kit is not commercially available at this time.

Recently, we have developed a simplified method for selective spleen scanning with heat-damaged, Tc-99m-labeled erythrocytes that requires neither a special kit nor washing of the red blood cells, and thus can be performed in any nuclear medicine unit. We report here the results of our initial clinical experience with this technique.

MATERIALS AND METHODS

The details of our method are described elsewhere (*3*). Briefly, "cold" stannous pyrophosphate containing 0.5 mg of stannous chloride or fluoride (e.g., one half the amount in a Squibb or New England Nuclear kit) is injected intravenously. Approximately 30 min later, a blood sample (about 6 cc) is drawn, 2 mCi of Na $^{99m}TcO_4$ are added, and the sample is incubated at 49–50°C for 35 min and then reinjected into the patient. Scintigraphy is begun 1–2 hr later. In patients whose spleen is known to be present, a minimum of anterior, lateral, and posterior views (300,000-count) of the spleen are obtained with high-resolution low-energy collimators on conventional gamma cameras. In splenectomized patients suspected of splenosis, anterior

* Current address: Andre Meyer Dept. of Physics and Nuclear Medicine, The Mt. Sinai Hospital, 1 Gustave Levy Pl., New York, NY 10029.

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For reprints contact: Alexander Gottschalk, MD, Dept. of Diagnostic Radiology, Yale Univ. School of Medicine, 333 Cedar St., New Haven, CT 06510.

TABLE 1.

Pt.	Age	Indication for SSS*	SSS results
LH	81	? splenic defect on SC†	defect confirmed
SR	NB‡	large midline liver, ? asplenia	inconclusive
PM	12	trauma; ?defect on SC	defect confirmed
LL	34	multiple defects on SC	no additional information
SM	25	poor splenic uptake, ? defect on SC	defect ruled out
JB	42	overlap of liver and spleen; ? splenomegaly	splenomegaly confirmed

* SSS = selective spleen scintigraphy.
† SC = sulfur colloid study.
‡ NB = newborn.

and posterior survey views of the entire abdomen are made. In many patients, especially in trauma cases, oblique views—particularly the LPO—have been useful.

RESULTS

We have now performed simplified selective spleen scans in 13 patients and in a normal volunteer. The indications and results for six of these patients are listed in Table 1. The remaining seven patients had a prior splenectomy following trauma, and were examined for suspicion of splenosis, a condition that has been shown to be quite common in this group (*4*). These seven are listed in Table 2, along with the results of the sulfur colloid (TcSC) scan.

Of the six patients imaged for various indications listed in Table 1, three had an abnormality suspected on TcSC scintigraphy confirmed by the selective spleen images (see Fig. 1); in one with poor splenic uptake, the defect was excluded (see Fig. 2); and in two no additional significant information was obtained. Of the patients studied for splenosis, in four the selective spleen images demonstrated the splenic tissue better than the TcSC examination (see Fig. 3), whereas in three no splenic tissue was demonstrated by either procedure.

DISCUSSION

Our data show that, in selected cases, the simplified Tc-RBC spleen study is a useful technique. The TcSC liver-spleen examination, a simpler and less time-consuming procedure, will provide sufficient information about the spleen in most cases. In almost all instances, however, where the TcSC is inconclusive and more information about splenic structure is required, selective spleen scanning provides sufficient detail of the spleen to clarify the problem.

Although our series is too small for statistical confirmation, the fact that the Tc-RBC study consistently demonstrated small amounts of splenic tissue better than the TcSC scintigram suggests that Tc-RBC scintigraphy may be a more sensitive procedure for the detection of early splenosis and for the evaluation of spleens that trap sulfur colloid poorly ("functional hyposplenia"). Whether selective spleen scintigraphy is as sensitive as hematologic methods (such as in the "pit" RBC count (*4*)) for detecting small volumes of functioning splenic tissue remains to be determined.

Further improvements in our technique to make it

TABLE 2.

Pt.	Age	Indication for SSS	SSS results
MD	6	no splenic tissue*	small focus of splenic tissue in LUQ†
BS	8	splenic tissue very faintly seen in LUQ	ovoid focus of splenic tissue well seen in LUQ
DZ	33	splenic tissue present (?)	no splenic tissue
TT	8	small, round focus of splenic tissue in LUQ	same, better delineated
SL	22	multiple nodules, well seen	same, heavy uptake
RZ	68	no splenic tissue	no splenic tissue
AR	27	no splenic tissue	no splenic tissue

* Colloid study performed 4 mo before Tc-RBC scintigraphy.
† LUQ = left upper quadrant.

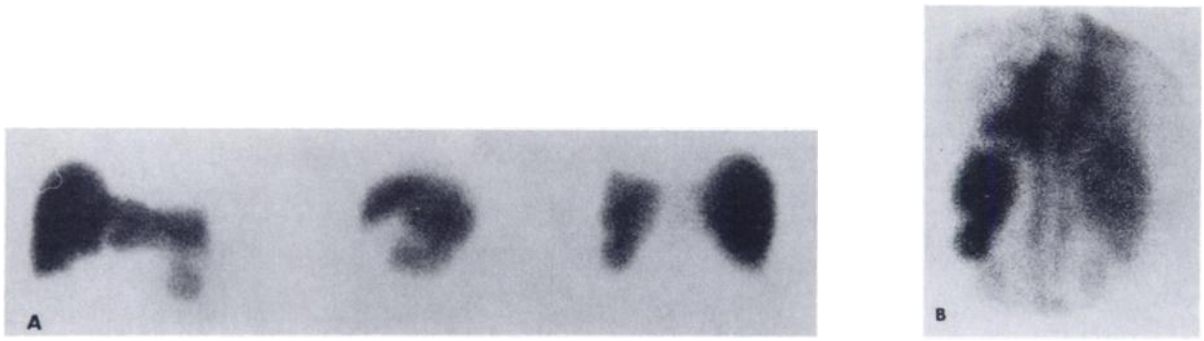

FIG. 1. Female, age 81, with left upper quadrant pain. (A) Anterior, left lateral and posterior views with TcSC suggest splenic defect near lower pole. Considerable overlap of liver and spleen, however, raises possibility of "pseudodefect." (B) posterior scintigram with Tc-RBC clearly shows splenic defect. (This was an early study, using an incubation period of 15 min; insufficient RBC damage resulted in incomplete sequestration by the spleen, and high blood-pool activity. Note that this does not interfere with the diagnostic value of images.)

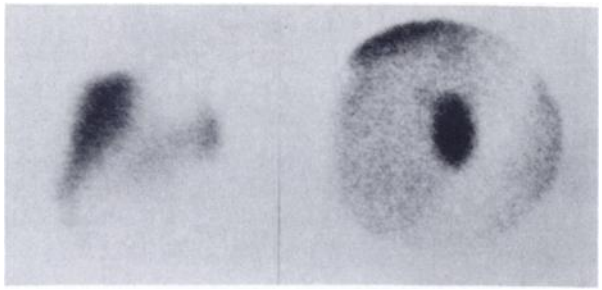

FIG. 2. Male, age 27, with complex medical history, including macrocytic anemia, thalamic neoplasm treated with radiation and chemotherapy (BCNU-CCNU), and pulmonary fibrosis. Left: left lateral view with TcSC shows poor splenic uptake. Right: left lateral view with Tc-RBC shows the spleen well. Poor sulfur colloid uptake was attributed to "functional hyposplenia", probably induced by chemotherapy.

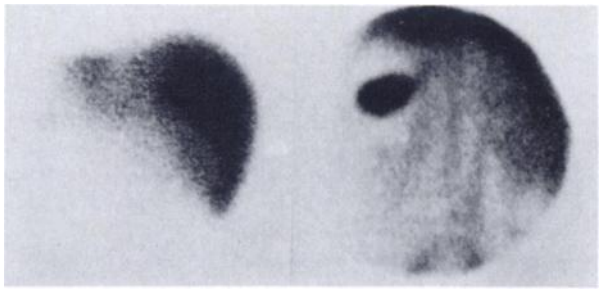

FIG. 3. Eight-year-old patient, 1 yr after posttraumatic splenectomy. Left: posterior view with TcSC shows slightly increased activity barely visible below left lobe of liver. Right: posterior view with Tc-RBC clearly demonstrates ovoid collection of splenic tissue, in position agreeing with colloid scan. Note marked increase in blood-pool activity seen here; we believe insufficient splenic tissue failed to trap many of damaged RBCs. To date, blood-pool activity has been present in all of our splenosis cases.

even simpler and faster are potentially possible; these include addition of the tin in vitro and replacement of heat damaging by chemical damage. We have attempted addition of stannous pyrophosphate in vitro, at different concentrations of stannous ion, with disappointing results to date. Labeling efficiencies obtained are generally low and unpredictable, in contrast to the 90–95% labeling consistently obtained with our current in vivo technique. Heat damaging of the RBCs is undoubtedly the most cumbersome step of the procedure. There are several compounds capable of causing erythrocyte damage and inducing splenic sequestration (*5,6*). At this writing, however, none of these compounds is FDA-approved for use in humans, and therefore they are not usually available in most nuclear medicine facilities.

In conclusion, our procedure for selective spleen scanning is relatively simple, does not require special laboratory skills, and is thus easily performed in any nuclear medicine unit. Although it does not replace the sulfur colloid scan as the routine technique for evaluation of the spleen, it can be a valuable adjunct in those cases where the colloid scan provides insufficient splenic detail. It is particularly useful in those cases where minimal splenic tissue is present (e.g., splenosis), when spleen uptake is poor ("functional hyposplenia"), and when overlap of liver and spleen on colloid scan makes splenic visualization difficult.

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