Liver–Spleen Scan in Sickle Cell Anemia

Goy and Crowe (*1*) recently reported splenic accumulation of ^{99m}Tc-diphosphonate in a patient with sickle cell anemia. We describe below one of our cases of sickle cell anemia, which also involved unusual scan findings.

A 24-year-old man was referred for a liver scan with a diagnosis of cirrhosis of the liver. His history suggested repeated hemolytic episodes. On physical examination the liver was 3–4 fingers palpable, firm, and tender, while the spleen was 2–3 fingers palpable and firm but not tender.

Liver–spleen scans with 2 mCi of ^{113m}In-colloid showed an enlarged liver with several "cold" areas (Fig. 1A). The enlarged spleen was not visualized at all, even in the posterior view (Fig. 1B). Chromium-51-tagged RBCs, injected intravenously, also failed to show the spleen. This functional asplenia (*2*) prompted us to further investigation. Sickle cell anemia was proved by finding sickle cells on a peripheral smear and by the presence of HbS on electrophoresis.

Coeliac axis angiography showed splenic artery occlusion. The liver showed "nonvascular" areas with occlusion of the blood vessels corresponding to the "cold" areas on the scan.

The sequelae of sickle cell anemia attributed to reduction and crystallization of hemoglobin, with subsequent stasis and sludging of sickled erythrocytes in the splenic vessels, are well recognized (*3*). Vascular occlusions, ischemic parenchymal degeneration, and necrosis result in atrophy and fibrosis. In our case, the "cold" areas in the liver and the functional asplenia correlated with the narrowed and occluded blood vessels, suggesting the presence of infarcts in the liver and spleen.

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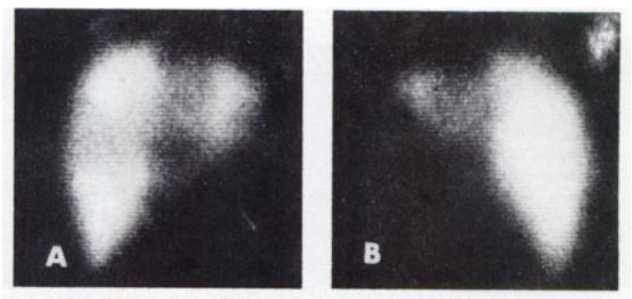

FIG. 1. Liver–spleen scan done with ^{113m}In-colloid shows numerous "cold" areas in liver. Spleen is not visualized in anterior (A) and posterior (B) views.

Pleural Oligemia Seen in Bone Scanning

In the January issue of the *Journal*, Preisman and Halpern described bone scans in two patients with underlying lung disease (*1*). The authors attributed the increased clarity of the ribs to oligemia in the underlying lung. In both of these cases there was severe concomitant pleural disease. Considering the HVL of only 4.5 cm for the 140-keV ^{99m}Tc photon in soft tissues, and the considerable blood clearance of pyrophosphate expected by the time of imaging, it initially seemed to us that the phenomenon might be explained equally well by attenuation of the gamma photons emitted by the underlying tissues. However, we later encountered a similar scan with increased distinctness of the left rib cage (Fig. 1). The patient had had a left upper lobectomy for bronchogenic carcinoma in 1971 and a subsequent course of radiation therapy to the mediastinum for recurrent tumor involving the left hilum. The chest radiogram showed loss of volume and oligemia of the left lung with only minimal pleural changes at the costophrenic angle. A lung scan taken with ^{99m}Tc-macroaggregated albumin revealed markedly decreased perfusion of the left lung compared to the normal right lung (Fig. 2). The disparity was much greater than could be attributed to the difference in respective lung volumes, thus indicating reduced pulmonary blood flow per

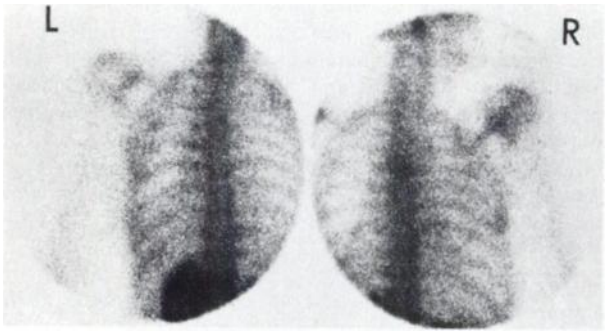

FIG. 1. Posterior views of thorax on ^{99m}Tc-pyrophosphate bone scan show increased distinctness of ribs on left side.

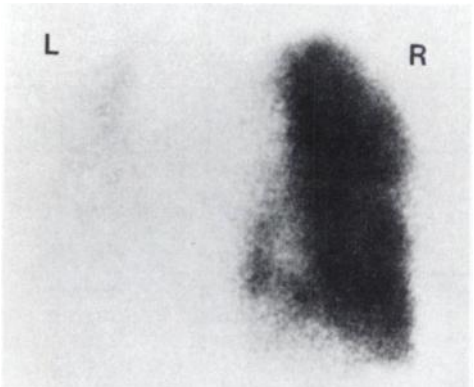

FIG. 2. Lung scan taken with ^{99m}Tc-macroaggregated albumin shows severely diminished blood flow to left lung.

unit volume of tissue. Thus, Preisman and Halpern's postulate was corroborated by our case.

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Effects of Iron on ^{67}Ga Uptake

In their description of experiments concerning the effects of added iron on ^{67}Ga incorporation into leukocytes, Hill et al. did not specify the type of filter used to trap the leukocytes prior to washing and counting. We have observed that many filters show a strong affinity for gallium and that, once adherent, the gallium cannot be removed by washing. In some instances, depending on the nature of the filtered material, the gallium binding is increased by the presence of iron. Our experience with this effect is detailed in Table 1.

These results were obtained after filtration of 10 μCi of ^{67}Ga-citrate in cell-free nutrient medium, followed by fivefold washings with identical volumes of physiologic saline. The concentration of ferric chloride was 10^{-1} *M*. All the filters tested by us retained gallium to a variable extent characteristic of the material of which they were constructed. With the methylcellulose and nylon filters, the retention was greatly increased by the presence of ferric ion. We have not studied the effect at other iron concentrations. Since Hill et al. found an increased gallium retention on the filter at 10^{-4} *M* and more so at lower concentrations, one must know the gallium-retaining properties of the filters themselves before any conclusions can be drawn about the significance of their results.

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Reply

The interesting results presented by Dr. Driedger have little or no meaning in terms of our recently published paper. The most important consideration is the fact that the increased ^{67}Ga accumulation on cells in the presence of iron ($FeCl_3$) occurs at concentrations two orders of magnitude lower than those observed by Dr. Driedger. At the levels of iron that these investigators used (10^{-4} *M*), the association of ^{67}Ga with cells, seen in our experiments, decreases rather than increases. In addition, the effect is seen with iron dextran as well as $FeCl_3$. These data are presented in Tables 1 and 2 of our publication.

That the increase in ^{67}Ga uptake is a cellular increase can be shown by autoradiography. The ^{67}Ga is not washed off by repeated washings of the cells on the filter, but it is digested off the cells with short trypsin treatments. Lastly, it should be added that when the cells are centrifuged and washed, the remaining pellet of cells shows the same increase of ^{67}Ga uptake in the presence of iron as the cells did when trapped on the Millipore filter.

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Myocardial Localization of ^{99m}Tc-Pyrophosphate

We are prompted to write concerning a report (*1*) of two patients with malignant disease in whom unexplained myocardial localization of ^{99m}Tc-pyrophosphate was observed. It would be of interest to know what therapy was used in these patients, one of whom developed cardiac decompensation. The tumor types involved (lung and breast) are relatively responsive to adriamycin, and a side effect of this drug is to cause a cardiomyopathy, reportedly associated with mitochondrial granules interpreted as concentrations of Ca^{+2} and Mg^{+2} cationic complexes (*2*). Thus, we wonder whether the type of therapy might explain the finding described.

Those of us working in oncologic centers need to be aware of the possible myocardial localization of ^{99m}Tc-pyrophosphate and its analogs in patients treated with adriamycin,

TABLE 1. RETENTION OF GALLIUM ON MILLIPORE FILTERS AND THE EFFECTS OF Fe^{+3}

	Filter Type					
	Mf (cellulose esters)		Duralon (nylon)		Mitex (Teflon)	
Experiment	Control	With Fe^{+3}	Control	With Fe^{+3}	Control	With Fe^{+3}
1	54,434	224,582	77,686	634,895	13,400	22,993
2	50,708	442,368	72,101	291,151	41,440	34,484
3	99,012	531,942	142,025	529,494	91,080	89,765
Mean	68,051	399,630	97,271	485,180	48,640	49,081
Percent increase		437%		444%		1%