Diffuse Lung Uptake of Technetium-99m Sulfur Colloid in Malaria

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Diffuse lung accumulation of colloid was seen on liver-spleen imaging in a patient during the acute stage of vivax malaria. A repeat study was performed following successful therapy and showed complete disappearance of lung uptake. Possible mechanisms for this unusual observation are discussed, with the conclusion that this phenomenon is probably related to increased reticuloendothelial system activity, due to a malaria-induced increase in the pulmonary macrophages.

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Diffuse lung uptake of radiocolloid during liver-spleen imaging is an uncommon phenomenon. It has been associated with several clinical conditions including liver diseases and infectious processes (*1*). A review of the literature revealed only one report of such findings associated with malaria in a patient scanned during the acute stage of the infection. The pulmonary uptake was attributed to increased pulmonary reticuloendothelial system (RES) activity (*2*). To our knowledge, reversible lung uptake of colloid in successfully treated malaria has never been reported in humans. We report a case of vivax malaria scanned during both the acute and recovery stages of the infection.

CASE REPORT

The patient was a 43-yr-old nurse who spent 6 years on a mission in Ethiopia. She took chloroquine regularly until the day she left the endemic area. Two months after her return to Canada, she presented with chills and fever associated with anorexia, fatigue, and frontal headache. Physical examination revealed a pale and icteric woman. Temperature was 37.5 C, pulse 130/min and blood pressure 100/70 mmHg. The liver and spleen were enlarged and tender. A peripheral blood smear showed 3% Plasmodium vivax parasitemia, anemia (Hb 8.9 g/100 ml), normal leucocyte count (6% monocyte) and thrombocytopenia (23,000/cubic mm). Total bilirubin was 5.6% mg, direct bilirubin 2.5% mg, and liver enzymes were slightly elevated. Chest x-ray was normal. A liver-spleen scan was requested in order to evaluate organ size and revealed hepatosplenomegaly with increase splenic uptake. There was a moderate accumulation of colloid in the lung but only very slight uptake by the bone marrow (Fig. 1).

Treatment was started immediately with chloroquine followed by primaquine for 14 days. She recovered completely. Liver-spleen scan was repeated 3 mo later and showed resolution of all the abnormalities including the pulmonary colloid uptake (Fig. 2).

DISCUSSION

Colloid particles are phagocytosed by the RES cells, and their distribution depends on many factors such as organ blood flow, reticuloendothelial cell function, serum factors (opsonins), and physical characteristics of particles (*3*). Approximately 80% of sulfur colloid is extracted by the liver, 15% by the spleen, and 5% by the bone marrow (*4*). Normally, the lungs are not visualized on appropriately exposed images because <1–2% of the injected dose is taken up by the relatively few pulmonary macrophages in contact with the circulating colloid.

Increased lung uptake has been reported in 1.6–8% of conventional liver-spleen imaging (*5,6*). It has been associated with various clinical conditions such as liver diseases, malignancy, hematologic diseases, type II mucopolysaccharidose, amyloidosis, and with some infectious diseases including falciparum malaria (*7–13*). Although many patients had associated liver diseases, the pulmonary accumulation could not be explained by simple compensatory uptake because, as in cirrhosis, the bone marrow would be expected to take up more colloid than the lung.

Several alternative mechanisms have been proposed

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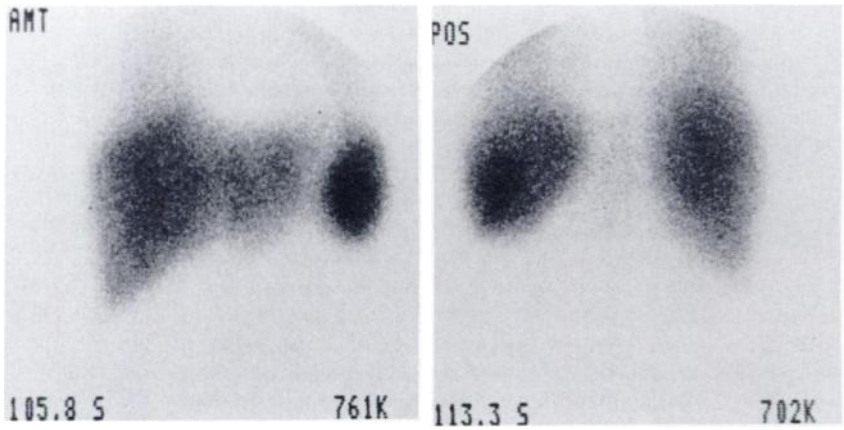

FIGURE 1
Liver-spleen scan during the acute stage of vivax malaria showing hepatosplenomegaly with increased splenic uptake. Note moderate accumulation of colloid in the lung with only very slight uptake by the bone marrow.

including intravascular clumping of colloid with secondary microembolization and colloid adherence to or phagocytosis by damaged endothelial cells. However, the most accepted theory is an increased RES activity in the lung due to an increase in the number of macrophages. Various factors are known stimulators of the RES activity: endotoxins, attenuated bacteria, foreign proteins, triglycerides, dextrose, thyroid, yeast extracts, heparin, and estrogen (*14*).

Plasmodium infection also is a potent stimulator of RES cells. These cells are thought to play a major role in the pathophysiology of malaria, particularly during the erythrocytic phase of the disease, when they serve as the primary scavengers removing the debris of the host-parasite interaction. This phagocytic defense mechanism gives rise to marked reticuloendothelial hyperplasia in the liver, spleen, bone marrow, and lymph nodes. Clinically, the spleen becomes palpable in 70–80% of patients and hepatic enlargement occurs in most (*15*).

Malaria-induced accumulation of macrophages within the pulmonary vascular bed is a well documented fact and was demonstrated by MacCullum using an animal model (*16*). During the acute stage of experimental malaria infection, large numbers of macrophages accumulate in the pulmonary vascular bed. These cells are observed in the alveolar capillaries and adhere to the venous endothelium. It is believed that most of the macrophages are derived from the liver, spleen, and bone marrow and are mechanically trapped in the first capillary bed encountered, that of the lung. However, the veins contain more macrophages than their corresponding arteries. Thus, other factors must be involved and may be related to the tendency of macrophages to adhere to the pulmonary venous endothelium or to the greater blood flow through arteries. With progression of infection there is a continuous influx of macrophages into the lung. However, during therapy, the number of macrophages in the pulmonary vascular bed falls rapidly.

In light of these experimental data, the increased pulmonary uptake of colloid observed in human malaria should be reversible following appropriate therapy. In our patient, the increased pulmonary uptake seen during the acute stage of infection and, as predicted, its resolution following successful therapy suggest that these experimental data can be applied to human malaria.

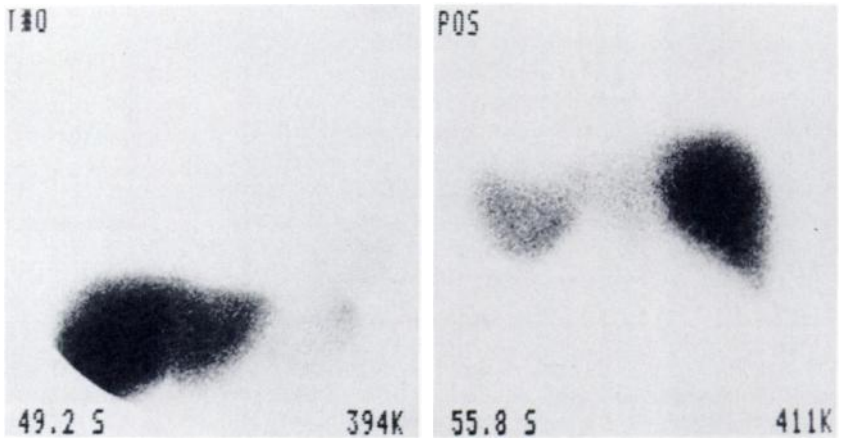

FIGURE 2
Repeat liver-spleen scan after treatment showing resolution of every abnormalities including the pulmonary colloid uptake.

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