Hot Spot(s) of the Lung in Technetium-99m Albumin Colloid Liver-Spleen Scintigraphy: Case Report

Wei-Jen Shih, Sara Brandenburg, John J. Coupal, Jerry Dean Sullivan, Jo Anna Beeler, Sylvia Magoun, and U. Yun Ryo

Veterans Administration Medical Center and University of Kentucky Medical Center, Lexington, Kentucky

Faulty injection technique of radiocolloid for liver-spleen imaging has not been documented, although Mettler and Christie reported a focal hot spot in the lung due to atelectasis, resulting from increased pulmonary phagocytic radioactivity (*1*). Recently, we replaced ^{99m}Tc albumin colloid for ^{99m}Tc sulfur colloid as a radiopharmaceutical for liver-spleen imaging and found two instances of hot spot(s) in the lung.

The preparation procedure of albumin colloid is easier and more convenient as compared to that of sulfur colloid. Whereas replacement of ^{99m}Tc sulfur colloid by ^{99m}Tc albumin colloid is inevitable, it should be emphasized that one should avoid blood withdrawal in the syringe containing albumin colloid to prevent formation of clot(s) during the venous puncture for ^{99m}Tc albumin colloid.

CASE REPORTS

Case 1

A 73-yr-old man with poorly differentiated adenocarcinoma of the left lung was referred for a ^{99m}Tc albumin colloid liver-spleen study. The study showed mild splenomegaly with reversal of the liver-spleen uptake ratio (Fig. 1). In addition, a hot spot in the right lung was thought to be secondary to intravenous (i.v.) injection technique (aggregation of blood clot in syringe containing the radiopharmaceutical). Microscopic examination of the radiopharmaceutical on a hemacytometer (*2*) revealed no particles large enough to occlude lung capillaries. Miniaturized chromatography (*3*) of radiopharmaceutical revealed 0.03% free pertechnetate.

Case 2

Because of recent development of ascites, a 72-yr-old man with prostatic carcinoma and a history of alcohol abuse was referred for a ^{99m}Tc albumin colloid liver-spleen study. The images (Fig. 2) show a photopenic area in the inferior border of the liver that does not indicate significant interval changes as compared to the prior imaging done 2.5 mo ago. Additionally, two or three hot spots were seen in the lung, which also was thought to be due to faulty injection technique. Microscopic examination of radiopharmaceutical revealed no large particles, and radiochromatography revealed 0.06% free pertechnetate.

For reprints contact: W.J. Shih, MD, Nuclear Medicine Dept., Univ. of Kentucky Medical Center, Lexington, KY 40536.

DISCUSSION

Technetium-99m sulfur colloid preparation requires the following inconvenient steps: adding acid, boiling, and adding buffer which take approximately one hour and may increase the radiation exposure to nuclear medicine personnel. To alleviate these difficulties, ^{99m}Tc sulfur colloid has been gradually substituted by ^{99m}Tc albumin colloid (*4*) or ^{99m}Tc tin colloid (*5*). The preparation of ^{99m}Tc albumin colloid is easier and more convenient. The albumin colloid kit*, which is commercially available, has been approved by the FDA for routine clinical use.

In both patients, i.v. injection of radiocolloid was performed by the same technician; in each instance there was difficult venous puncture and some blood withdrawal into the syringe containing ^{99m}Tc albumin colloid prior to injection. The hot spot(s) in the lung of each case were thought to be due to aggregation of blood clots in the syringe, since microcolloid (albumin colloid) is made of human albumin. We hypothesized that albumin colloid, similar to MAA, actively accelerated the clotting process; clots accumulate albumin colloid when blood enters the syringe containing the radiopharamceutical. The manufacturer's package insert for the albumin colloid* recommends that "If blood is withdrawn into the syringe, unnecessary delay prior to injection may result in clot formation in situ."

There are well documented hot spots in the lung during an MAA lung imaging study. The most common cause is faulty injection technique. Therefore, Preston and Greenlaw (*6*) addressed hot spots in lung scans using MAA and also performed in vitro and in vivo studies confirming MAA accelerating clot formation. Other cases included thrombophlebitis, congestive heart failure, and faulty radiopharmaceutical preparation (*6–11*).

During ^{99m}Tc sulfur colloid liver-spleen imaging, diffuse pulmonary accumulation of the radiopharmaceutical has been reported mostly in patients with liver disease such as cirrhosis, and in patients with infection, neoplasia, and disseminated intravascular coagulopathy (DIC) (*12–15*). The diffuse pattern of lung uptake was thought to reflect increased phagocytosis, macrophage, or altered endothelium throughout the lungs. It is unlikely that those diffuse pulmonary tracer localizations result from in vivo macroaggregation of sulfur colloid with subsequent formation of microemboli. Radiopharmaceutical fault of high aluminum ion content diffuse pulmonary uptake during the liver-spleen scintigraphy using either ^{99m}Tc sulfur colloid (*15*) or ^{99m}Tc albumin colloid (*16*) has been documen-

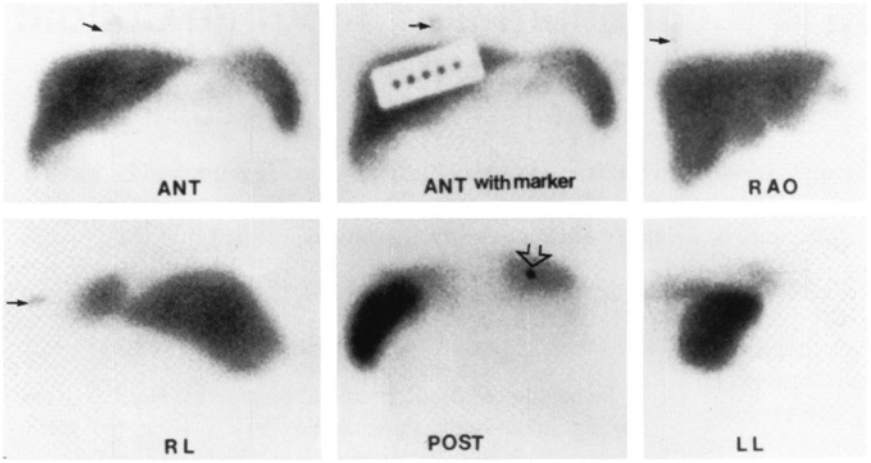

FIG. 1 Techentium-99m albumin colloid liver-spleen scintiphotos of Case 1. A focal area (arrow) of increased radioactivity is seen above the liver, corresponding to the right lung base.

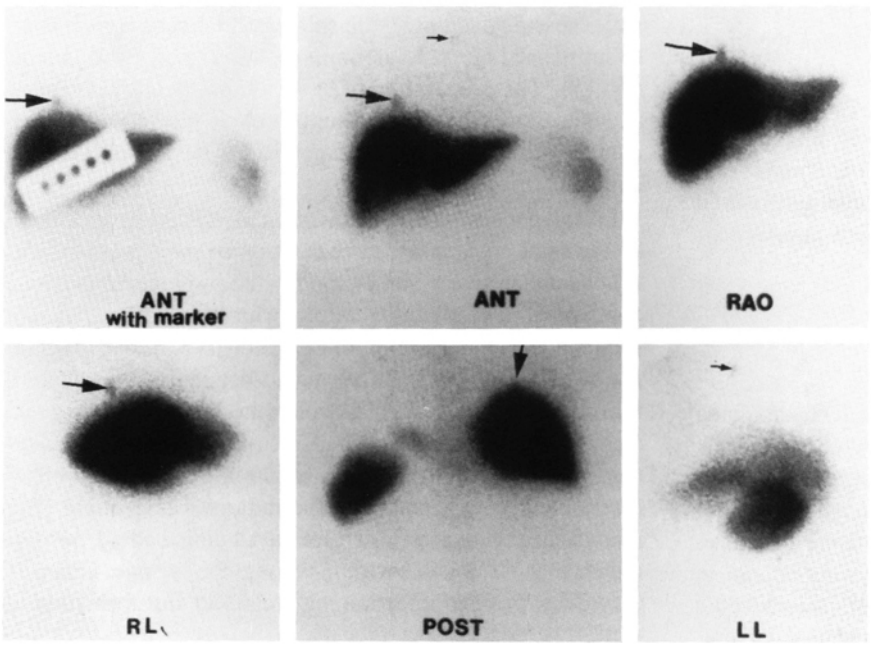

FIG. 2 Technetium-99m albumin colloid liver-spleen scintiphotos of Case 2. Two foci of increased uptake are seen in the lung: one (arrow) just above the dome of the liver, and one (smaller arrow) in the upper lung field.

ted. A focal hot spot due to lung pathology in ^{99m}Tc sulfur colloid liver-spleen imaging has been reported (*1*). To our knowledge, occurrence of pulmonary hot spots in ^{99m}Tc sulfur colloid or ^{99m}Tc albumin colloid liver-spleen imaging study in the absence of underlying lung disease has not been reported. Occurrence of hot spot(s) using ^{99m}Tc albumin colloid in our patients is apparently due to the nature of the radiopharmaceutical being similar to MAA and dissimilar to sulfur colloid. In practice, albumin colloid is more convenient to prepare as compared to sulfur colloid. Whereas replacement of ^{99m}Tc sulfur colloid by ^{99m}Tc albumin colloid may be inevitable, we would like to emphasize that during the venous puncture for ^{99m}Tc albumin colloid, one should avoid blood withdrawal in the syringe containing albumin colloid to prevent formation of clots.

ACKNOWLEDGMENT

The authors wish to thank Brenda Hensley for typing this manuscript.

NOTE

*Microlite™, DuPont NEN Medical Products, N. Billerica, MA

REFERENCES

1. Mettler FA, Christie JH. Focal lung uptake of Tc-99m sulfur colloid. *Clin Nucl Med* 1982;7:322-323.

2. Branson BM, Bucher JE, Hamilton DR, et al. Workshop manual for radionuclide handling and radiopharmaceutical quality assurance. *HHS Publication FDA 82-8191.* Rockville, MD: U.S. Department of Health and Human Services; 1982:28-29.

3. Zimmer AM, Pavel DG. Rapid miniaturized chromatographic quality-control procedures for Tc-99m radiopharmaceuticals. *J Nucl Med* 1977;18: 1230-1233.

4. Saha GB, Feiglin DH, O'Donnell JK, et al. Experience with technetium-99m albumin colloid kit for reticuloendoethelial system imaging. *J Nucl Med Technol* 1986;14:149-151.

5. Hilditch TE, Elliott AT, Murray T and Whateley TL. Formation of large particles in a Tc-99m tin colloid preparation. *Nucl Med Commu* 1986;7: 845-850.

6. Preston DF, Greenlaw RH. "Hot spots" in lung scans. *J Nucl Med* 1970;11:422-5.

7. Natasa B, Ugo F, Igor B. Pulmonary radiation microemboli. *J Nucl Med* 1978;19:1183.

8. Lutzker LG, Perez LA. Radioactive embolization from upper-extremity thrombophlebitis. *J Nucl Med* 1975;16:241–42

9. Goldberg E, Lieberman C. "Hot spots" in lung scans. *J Nucl Med* 1977;18:499.

10. Burdine JA, Ryder LA, Sonnemaker RE. Tc-99m human albumin microspheres (HAM) for lung imaging. *J Nucl Med* 1971;12:127–130.

11. Ryo UY, Bekerman C, Pinsky SM. *Atlas of nuclear medicine artifacts and variants*. Chicago: Year Book Medical Publishers, Inc.; 1985:49.

12. Klingensmith WC, Tsan MF, Wagner HN. Factors affecting the uptake of Tc-99m sulfur colloid by the lung and kidney. *J Nucl Med* 1976;17:681–684.

13. Klingensmith WC, Yang SL, Wagner HN. Lung uptake of Tc-99m sulfur colloid in liver and spleen imaging. *J Nucl Med* 1978;19:31–35.

14. Keyes JW, Wilson GA, Quinones JD. An evaluation of lung uptake of colloid during liver imaging. *J Nucl Med* 1973;14:687–691.

15. Imarisio JJ. Liver scan showing intense lung uptake in neoplasia and infection. *J Nucl Med* 1975;16:188–190.

16. Chia HL, DeSchrijver M. Modified in vivo behavior of Tc-99m labeled liver-spleen preparations due to Mo-99m/Tc-99m generator eluate impurities. *Eur J Nucl Med* 1983;8:450–453.