Microsphere Angiography of the Liver

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Radionuclide microsphere angiography of the liver, utilising capillary blockade of the hepatic arterial system, is presented as a means of evaluating hepatic mass lesions. Masses with an arterial circulation of greater density than normal liver will be identified as focal areas of increased activity. The technique can also document perfused volume and catheter location during organ perfusion chemotherapy.


Over the past decade, labeled particles have been widely used to evaluate organ perfusion by means of capillary blockade. Most notable examples are the lungs and the heart. This report describes a role for microsphere angiography of the liver in the evaluation of hepatic lesions.

CASE REPORT

A 51-year-old woman, presenting with a painless mass in the right upper quadrant, was found to have inoperable adenocarcinoma of the liver. Treatment of the hepatic lesions consisted of intermittent intra-arterial chemotherapy. The agent was delivered by an indwelling catheter that had been surgically placed in the proximal hepatic artery.

Technetium-99m sulfur colloid imaging by peripheral venous injection, before and 6 mo after the initiation of treatment, demonstrated lesions in the region of the porta hepatitis and at the inferior margin of the left lobe (Fig. 1). There was no substantial change in the size or shape of these lesions when compared with the pretreatment study, and no new defects were found. The patient was then referred to determine whether the catheter continued to remain in proper position and whether it was delivering the chemotherapeutic agent primarily to the liver. A history of allergy to iodinated contrast media precluded standard angiography.

METHOD AND RESULTS

The arterial catheter was flushed with 5 cc of normal saline. Three mCi of commercially available Tc-99m albumin microspheres were injected in a total volume of 0.5 cc containing 100,000 ± 3,000 particles. Mean particle size was 24.9 ± 1.6 microns (±2 SD) with a range of 10–45 microns. The tracer injection was followed by a second saline flush. Static gamma-camera images were obtained in multiple projections for 400 K each. No immediate or delayed adverse effects were noted.

![FIG. 1. Composite of Tc-99m sulfur colloid liver images (a, b, c) and Tc-99m-albumin microsphere liver images (d, e, f). (a) and (d) imaged with a lead costal marker to provide spatial orientation. Focal defects in region of porta hepatic and inferior margin of left lobe seen with colloid imaging (b, c) are contrasted with focal accumulations obtained with microsphere angiography (e, f).](image-url)
noted on the peripheral, venous, colloid examination (Fig. 1). The costal marker provided orientation. The lesion in the region of the porta hepatis was to be much larger than was appreciated by the i.v. colloid imaging and the one at the inferior margin of the left lobe is now more clearly identified. It was also noted that the perfusion of the liver was markedly nonhomogeneous, and that most of blood flow (estimated at >80%) was to the two mass lesions. No significant activity, above expected background, was evident in the spleen or lungs.

**DISCUSSION**

Radionuclide microsphere angiography of the liver, as presented in this case, is a satisfactory method of documenting perfused volume and catheter location during organ perfusion chemotherapy. Of more significance, however, is that high-resolution images of intrahepatic tumors can be obtained without selective intrahepatic catheterization. This finding suggests that the technique may be a valuable adjunctive technique in the evaluation of suspected mass lesions.

The liver possesses a dual blood supply, with blood delivered by both the portal system and the hepatic artery. These two vascular systems run essentially in parallel. The hepatic artery functions as an end-organ blood supply, however, since ligation of this vessel can result in necrosis and even death.

The liver is normally imaged by using the phagocytic capability of its reticuloendothelial system (Kupffer cells). A colloid solution (Tc-99m sulfur colloid) administered by peripheral, venous injection, is delivered to the liver primarily through the portal venous system, and the particles are extracted from the circulation by the reticuloendothelial cells normally with homogeneous distribution of radioactivity. Mass lesions are identified as areas of decreased accumulation. This diagnostic technique is fraught with difficulty, however, when it is necessary to identify small lesions or to determine the maximum diameter of a spherical lesion, since there is high surrounding activity that can obscure the borders of a small deficit.

Dynamic hepatic scintiangiography with Tc-99m sulfur colloid is a simple and useful technique for increasing the specificity of colloid imaging by demonstrating neoplastic arterialization (1). This technique, however, provides low resolution images and is limited to one projection per injection.

In contrast, this report describes a technique that images the liver by means of capillary blockade following intraarterial injection of larger labeled particles (Tc-99m albumin microspheres). The mass lesion with greater capillary density per volume of tissue, as compared with normal liver, will be imaged as an area of increased activity. In addition, since the hepatic artery provides the main blood supply of both primary and secondary tumors, particulate imaging through this vessel might be expected to be a sensitive imaging technique for neoplastic lesions (1,2). In the case presented, both the identification of the masses and appreciation of their size and shape were markedly facilitated.

The applicability of this technique can be broadened by utilizing the mobile gamma camera. It is now feasible to perform hepatic microsphere angiography at the time of elective, exploratory abdominal surgery or in the catheterization laboratory together with contrast angiography. The ability to detect and localize intrahepatic neoplastic lesions for the purposes of biopsy and diagnosis can potentially be improved by this imaging technique.

**REFERENCES**
