The patient was a 31-y-old woman with invasive ductal carcinoma of the right breast without evidence of metastases to the axillary lymph nodes. She had undergone bilateral mastectomy and was currently undergoing radiation therapy. A CT scan performed 10 d previously demonstrated “a 3 cm hypodensity within the anterior right hepatic lobe that is suspicious for a metastatic focus although benign etiology such as hemangioma cannot be excluded” (Fig. 1). A $^{99m}$Tc-red blood cell (RBC) scan was ordered to exclude malignancy.

The patient was injected with 1,106.3 MBq (29.9 mCi) of $^{99m}$Tc in vitro–labeled RBCs. Early and 2-h delayed planar images were taken in the anterior and posterior projections of the abdomen (heart through aortic bifurcation), with SPECT images of the early phase and SPECT/CT images of the 2-h delayed phase. Limited-field-of-view, low-dose CT was performed for anatomic localization and attenuation correction of the SPECT data.
99mTc-RBC scintigraphy is highly specific for cavernous hemangioma (5); therefore, we consider here some differential diagnoses based on only the CT scan results. One possibility is focal nodular hyperplasia, another benign tumor that would be equivocal on 99mTc-RBC scintigraphy and better imaged by 99mTc-sulfur colloid scanning, on which it typically shows increased uptake. Focal nodular hyperplasia can incidentally be seen on hepatobiliary imaging as well (1,2).

Another possibility is hepatic adenoma. Although considered a benign tumor, hepatic adenoma is associated with life-threatening hemorrhages. Both hemangiomas and hepatic adenomas appear as photopenic defects on 99mTc-sulfur colloid scans, but adenomas will be photopenic on 99mTc-RBC scans as well (1,2,5). Suspected hepatic adenomas should be imaged by MRI, where in general, they will appear hyperintense relative to background liver on T1- and T2-weighted images (3).

A third possibility is metastatic or primary malignancy. Depending on the pathology, hepatic malignancies may or may not be imaged successfully by SPECT or PET techniques. On 99mTc-RBC scintigraphy, malignant lesions would have normal or decreased uptake, with the exception being the extremely rare angiosarcomas, which are the only notable cause for false-positive cases (1,5). MRI remains the modality of choice for characterizing suggestive hypodense lesions seen on staging CT scans (3).

**QUESTION 1**

For a potential hemangioma larger than 1.5 cm, what is the modality of choice?

A. Ultrasound.
B. MRI.
C. 99mTc-RBC SPECT.
D. Dynamic contrast-enhanced CT.
QUESTION 2

What is the typical appearance of a hemangioma on a liver–spleen sulfur colloid scan?
A. Intense circumscribed lesion.
B. Photopenic circumscribed defect.
C. Normal hepatic uptake.
D. Photopenic on early images, becoming intense on delayed.

CASE DISCUSSION

Cavernous hemangioma is the most common primary hepatic tumor. These tumors are frequently asymptomatic and incidentally discovered on imaging, surgery, or autopsy. They arise from ectasias in the endothelial lining of hepatic blood vessels and consist of multiple large, vascular channels lined by a single layer of endothelial cells and supported by collagenous walls. They are often associated with high estrogen states including puberty, pregnancy, oral contraceptive use, and steroid use. Though they are benign, hemangiomas need to be distinguished from other tumors. Rare complications include abdominal discomfort, fullness, and, rarer still, spontaneous rupture (1,6).

99mTc-RBC scintigraphy combined with multichannel SPECT cameras has a nearly 100% positive predictive value. Although the sensitivity was previously dependent on size, the advent of SPECT/CT has allowed detection of hemangiomas as small as 0.5 cm with sensitivity of 88%. The high diagnostic accuracy, low cost, and relatively low radiation dose make 99mTc-RBC scintigraphy a useful, although underutilized, diagnostic study for the work-up of suspected benign hepatic lesions (3,5,6).

Our patient had a diagnosis of breast cancer without evidence of metastasis to the axillary lymph nodes. Therefore, the possibility of liver metastasis was considered less likely. 99mTc-scintigraphy was a low-cost, high-yield study to confirm the diagnosis of the hepatic lesion and spare the patient an unnecessary attempt at biopsy or surgical intervention.

REFERENCES


*For the answers, see page nn.
Question 1
Answer = C

A. Although many hepatic hemangiomas are initially discovered on ultrasound as a hyperechoic mass with well-defined margins and posterior acoustic enhancement, this finding is neither sensitive nor specific to hemangiomas and additional imaging is always needed to make a diagnosis (3,4).

B. Cavernous hemangiomas have a characteristic appearance on MRI, with a low signal compared with that of liver on T1-weighted images, and high intensity on T2-weighted images that increases as the time to echo increases, known as the “light bulb” sign (3,4). However, some of the rarer hepatic malignancies such as sarcomas, endocrine tumors, and cystadenocarcinomas can mimic this appearance, reducing specificity (6). MRI is useful for detecting smaller lesions and those adjacent to the vasculature (1); however, the advent of SPECT/CT has largely negated this advantage (6).

C. The specificity for hemangiomas on ⁹⁹ᵐTc-labeled RBC imaging approaches 100%, with reported false-positives being exceedingly rare (usually highly vascular angiosarcomas) (1). The sensitivity of a 2-head SPECT camera is comparable to MRI for hemangiomas larger than 1.5 cm (2,6). The use of SPECT/CT further increases sensitivity, especially for smaller lesions (as small as 0.5 cm) or those in less than ideal anatomic positions (6). Although MRI may be slightly more sensitive, it is less specific and far more costly. Hepatic angiograms have also been used to successfully image cavernous hemangiomas (3–5), with the highly specific appearance of pooled contrast within the suspected lesion. However, this procedure is invasive and carries the risk of infection, contrast reaction, acute renal failure, and thrombosis, among others.

D. On dynamic contrast-enhanced CT, a hemangioma would typically show peripheral contrast enhancement during the rapid bolus dynamic phase, progressive opacification toward the center of the lesion, and a complete isodense fill-in by 30 min after contrast administration (3). Lesions that satisfy all the criteria have high specificity but a sensitivity of only 55% (3,6). This figure is even lower with multiple hemangiomas.

Question 2
Answer = B

Cavernous hemangioma will appear as a well-circumscribed cold defect on a sulfur colloid scan; however, this finding is not specific, as hepatomas, hepatic cell adenomas, many malignant lesions, liver abscesses, and up to 30% of focal nodular hyperplasias (1,2) will also appear photopenic. Answer D describes the appearance of a hemangioma on a ⁹⁹ᵐTc-RBC scan, whereas answer A can apply to most cases of focal nodular hyperplasia, cirrhosis with regenerating nodules, Budd-Chiari syndrome, and inferior vena cava obstruction (1,2).