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EDITORIAL

Diagnostic Imaging of the Liver

Diagnostic imaging of the liver may be undertaken for the identification of focal neoplastic disease or diffuse hepatic functional disorders. Anatomy-based hepatic imaging in patients with known or suspected liver cancer constitutes the vast majority of liver studies today. Evaluation for diffuse functional diseases is not commonly undertaken because unless these disorders are advanced they do not produce alterations in gross hepatic morphology (size and shape) to permit detection with anatomic imaging studies.

DIFFUSE LIVER DISEASE

In this issue of *JNM* (*1*), Delcourt and colleagues report that in patients with alcohol-related diffuse liver abnormalities, quantitative tomoscintigraphy (SPECT) correlates well with liver histology and therefore provides clinically useful diagnostic information. This study establishes the need to further develop functional hepatic imaging and demonstrates that despite limited anatomic resolution (for example, in comparison to CT) it can be effective for such diagnostic evaluation.

Diffuse hepatic disorders that produce an alteration in hepatic function must be investigated with markers targeted to specific hepatic cells and therefore assess specific cellular activity. In their report, Delcourt and colleagues show that hepatic reticuloendothelial (RE) function is reduced in patients with alcoholic liver disease. As a result, there is decreased hepatic sequestration of the radiocolloid and a relative increase in splenic uptake. It is of interest that in addition to hepatic fibrosis and cirrhosis, even diffuse fatty-change, the earliest and only reversible manifestation of alcoholic liver disease, produces such a colloid shift. Not surprisingly, the functional tomoscintigraphic liver examination (SPECT) was superior to anatomy-based imaging studies (CT and US). These conclusions would not have been different even if the CT examination was performed on state-of-the-art equipment or if the US comparison was undertaken on real-time images.

An important inference that can be made from these results is that information on tomographic images is superior to projection images. As a result, one may speculate that with its superior anatomic resolution, functional MRI with hepatocyte-specific or RE cell-specific contrast agents (*2*) may be even more effective for the evaluation of diffuse liver diseases. Indeed such cell-specific contrast agents are already undergoing clinical trials. Additional investigations will be required to determine if functional imaging studies can be useful in a setting of nondiffuse functional disorder (for example, focal fatty-change) or in other diffuse liver diseases such as hepatitis (alteration in hepatocellular function). Furthermore, a most basic issue also remains unresolved, which is whether functional imaging studies can accurately portray the earliest manifestations of diffuse liver disease and hence replace the need for a liver biopsy.

FOCAL LIVER DISEASE

Due to inferior display of gross liver anatomy, it is unlikely that conventional scintigraphic functional imaging studies will be useful in oncologic patients for the diagnosis of focal liver cancer (primary or metastatic). In these patients, lesion detection and lesion tissue characterization are two equally important concurrent diagnostic goals. The importance of the latter objective has been highlighted by recent recognition of a high (>20%) prevalence of benign liver tumors in adults (*3*). Hence benign liver tumors (hemangiomas, focal nodular hyperplasia) can occur in patients with a history of cancer or benign and malignant liver tumors may coexist.

Contrast-enhanced CT is presently the examination of choice for survey or screening examination of the liver for neoplasms (*4*). Precise implementation of techniques (*5*) for contrast administration and CT scanning is critical for optimal liver examination. Although contrast-enhanced CT misses approximately 50% of individ-

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ual liver lesions, it correctly identifies approximately 85% of patients with liver cancer. Wide utilization of contrast-enhanced CT for screening the liver is also based on the ability of CT to concurrently survey the extra-hepatic abdomen (for example, adrenal glands, abdominal and retroperitoneal lymph nodes). CT during arterial portography (CTAP) is a comparatively more sensitive examination for detection of liver tumors, especially for lesions under 1 cm in size. CTAP identifies approximately 85% of liver lesions, but due to its invasive character (it requires catheterization of the superior mesenteric artery) the examination is reserved for patients being evaluated for liver resection. However, both contrast-enhanced CT and CTAP are unable to adequately tissue characterize (for example, distinguish benign from malignant) focal liver lesions. This differentiation is best provided by MRI and is necessary when patient management (medical or surgical) may be affected. The utility of conventional US for liver lesion detection is variable and depends upon the interest and expertise of the individual performing the examination. In experienced hands, the sensitivity of US for detecting liver tumors is comparable to contrast-enhanced CT (*6*). When performed in the operating room with a high-resolution transducer placed directly on the liver surface, intraoperative US is the most reliable method of hepatic examination and is even superior to surgical palpation for lesion detection (*6*). Hence in centers with large volume liver surgery, intraoperative US is commonly used to evaluate the liver and to guide surgical resection. PET is an evolving technique that is undergoing clinical investigation in a number of institutions, and, at present, it is too early to speculate on its potential role in patients with liver cancer.

In the near future, it is likely that contrast-enhanced MRI with cell-specific contrast agents will emerge as a highly reliable noninvasive hepatic examination that will provide high sensitivity for lesion detection as well as high specificity for lesion characterization (*7*). Indeed, preliminary reports show that the sensitivity for lesion detection with contrast-enhanced MRI using a hepatocyte-specific contrast agent is comparable to CTAP (*8*). It is intriguing to consider that routine application of targeted cell-specific MRI contrast agents may lead to a unified imaging examination displaying hepatic anatomy as well as hepatic function, the latter with regional precision. If this proves to be true, then it will be possible to investigate functional and anatomic disease processes concurrently, since they do occur simultaneously (for example, hepatocellular carcinoma in patients with cirrhosis or hepatitis).

CONCLUSION

Strategies for liver imaging have undergone considerable change over the past 10–15 yr. Utilization of US, CT and MRI have increased at the expense of diagnostic hepatic angiography and planar sulfur-colloid liver scintigraphy. It is likely that cell-specific contrast-enhanced MRI and PET will further alter our approach to diagnostic examination of the liver.

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