INTRAVENOUS RADIONUCLIDE HEPATOMOGRAPHY
IN THE DIFFERENTIAL DIAGNOSIS OF
INTRAHEPATIC MASS LESIONS

Shin-Hwa Yeh, Wei-Jen Shih, and Jyh-Chwen Liang
Veterans General Hospital and National Defense Medical Center, Taipei, Taiwan

Intravenous perfusion hepatography with $^{113m}$In eluate was used to evaluate capillary perfusion of hepatic masses shown by $^{99m}$TcS colloid scintigraphy. The scintiphotos of 95 proven cases were analyzed. The results indicate that the perfusion study combined with radioactive colloid liver scintigraphy may help to differentiate neoplastic lesions, especially hepatomas, from benign liver diseases such as abscess, hematoma, or congenital solitary cyst. This simple and innocuous approach would be a useful screening technique.

The value of selective hepatic angiography in the diagnosis of liver disease has been well established (1-4). Recently, $^{198}$Au liver scanning combined with $^{131I}$-macroaggregated albumin intra-arterial hepatic scanning has been introduced for the identification of hypervascular tumors of the liver (5,6). With a scintillation camera one may visualize the pattern of perfusion of the liver after intravenous injection of a radionuclide bound to one of the plasma proteins. Such a radionuclide perfusion image would roughly correspond to the hepatogram phase of angiography and would provide without catheterization useful diagnostic information for clarifying the nature of filling defects shown on a conventional scan. This report presents the results of intravenous radionuclide perfusion hepatography combined with $^{99m}$TcS-colloid liver scintigraphy in the diagnosis of neoplastic lesions, especially hepatomas and benign space-occupying lesions of the liver. A portion of this work has been published preliminarily in abstract form (7).

METHODS

The studies were performed with a Nuclear-Chicago Pho/Gamma III scintillation camera as follows: Liver scintigraphy after intravenous administration of 2-4 mCi of $^{99m}$TcS colloid (8) was performed first to localize areas of reduced uptake; and then without changing the patient’s position, another scintiphoto was taken immediately after intravenous injection of 4-7 mCi of $^{113m}$In eluate with the same scintigraphic factors except for changing the spectrometer from the 140-keV $^{99m}$Tc window to the 397-keV $^{113m}$In window. A 410-keV parallel-hole collimator was used for both studies. Each scintiphoto accumulated 300,000 events. The perfusion study was done with the patient in that position in which a filling defect had been most clearly shown on $^{99m}$TcS-colloid scintiphoto. The colloidal $^{99m}$Tc scintiphoto was compared with the $^{113m}$In perfusion image, and a value for the degree of perfusion was assigned into one of three categories: (A) good perfusion, when the previously shown defect could not be distinguished from the surrounding parenchyma because both of them were equal in radioactivity; (B) poor perfusion, when a defect was low in radioactivity in comparison with the parenchyma; and (C) no perfusion of the defect.

Technetium-$^{99m}$sulfur colloid liver scintigraphy is performed in most patients seen at this hospital for suspected lesions of the liver. From September 1971 to August 1972, hepatic filling defects were identified in 208 patients. Although all these patients were studied by the method described above, proof of diagnosis was obtained by biopsy or postmortem examination only in 95 cases. These cases form the basis for this report.

RESULTS

The correlation between the histologic diagnosis and the assigned degree of perfusion is summarized
TABLE 1. CORRELATION OF PATHOLOGICAL DIAGNOSIS WITH DEGREE OF PERFUSION

<table>
<thead>
<tr>
<th>Type of lesion</th>
<th>Degree of perfusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good</td>
</tr>
<tr>
<td>Hepatoma</td>
<td></td>
</tr>
<tr>
<td>without necrosis</td>
<td>39</td>
</tr>
<tr>
<td>with central necrosis</td>
<td>10</td>
</tr>
<tr>
<td>Cholangioma</td>
<td>3</td>
</tr>
<tr>
<td>Metastases</td>
<td>21</td>
</tr>
<tr>
<td>Amebic abscess</td>
<td>13</td>
</tr>
<tr>
<td>Pyogenic abscess</td>
<td>6</td>
</tr>
<tr>
<td>Congenital solitary cyst</td>
<td>2</td>
</tr>
<tr>
<td>Calcified hematoma</td>
<td>1</td>
</tr>
</tbody>
</table>

in Table 1. All 22 lesions absent in perfusion were benign lesions such as abscess, hematoma, or congenital solitary cyst. In contrast, all 39 lesions showing good perfusion were hepatomas. Poor perfusion occurred in 21 lesions of hepatic metastases, 3 cholangiomas, and 10 hepatomas with central necrosis. Ten such cases accounted for 20% of 49 cases of hepatoma examined. The primary neoplasms of the 21 hepatic metastases were: one carcinoma of cervix; one bronchogenic carcinoma; one fibrosarcoma of right temporal region; two poorly differentiated carcinomas of unknown origin; one adenocarcinoma of rectum; five carcinomas of stomach; five nasopharyngeal carcinomas; and five adenocarcinomas of colon. The $^{113m}$In perfusion images in representative cases are shown in Figs. 1–3.

FIG. 1. Hepatoma. Anterior view (left) of $^{99m}$TcS colloid scintiphoto revealing large filling defect in right lobe. Intravenous $^{113m}$In perfusion study (right) showing good perfusion of liver including filling defect seen in left frame.

FIG. 2. Amebic abscess (left). Technetium-99m-sulfur colloid scintiphoto disclosing large space-occupying lesion in right lobe. Indium-113m perfusion image (right) showing correspondent cold area. Note blood pool in heart and lung encircling upper border of abscess.

FIG. 3. Metastatic adenocarcinoma to liver from colon. Technetium-99m-sulfur colloid scintiphoto (left) showing mass in right lobe. $^{113m}$In perfusion image (right) showing poor perfusion of lesion.

DISCUSSION

Frequently, hepatoma is highly vascularized, whereas cholangioma or metastatic tumor is much less vascular (9,10). The contents of hepatic abscess or cyst are devoid of vascularity. A scintillation camera combined with in vivo labeling of transferrin with $^{113m}$In will depict the vascularity of hepatic masses in the form of capillary perfusion roughly correspondent to the hepatogram phase of selective angiography. Thus this radionuclide technique can provide useful information for the diagnosis of hepatic mass lesions.

Our results indicate that the degree of perfusion of hepatic filling defects is significantly correlated with the presence or absence of hepatic neoplasms especially when the lesions are hepatomas and benign hepatic lesions such as abscess, hematoma, or congenital solitary cyst. Because poor perfusion is noted in metastatic lesions, cholangioma, and hepatoma with central necrosis, the perfusion study is not useful in differentiating these entities. Hepatoma with central necrosis falls in the group of poor perfusion mainly because of the influence of surrounding liver blood pool on the necrotic area.

The extreme vascularity of hepatic hemangioma has been shown by $^{113m}$In and $^{131}$I-HSA blood-pool scanning (11,12). No such lesion is found in the present study.

Liver blood-pool scanning after the intravenous injection of $^{113m}$In (12) has been reported as an aid in elucidating the nature of intrahepatic space-occupying lesions detected by the conventional colloid hepatic scan. The quality of photoscans is rather poor because of the length of time required by the rectilinear technique in conjunction with the rela-
tively low $^{113m}$In concentration in the liver blood pool and the rapid decay of $^{113m}$In. The scintiphographic technique is considerably more rapid and is potentially more useful in the perfusion study.

Gallium-67-citrate has been found helpful in the differential diagnosis of focal liver defects detected by a $^{99m}$TcS-colloid scan (13). A focal liver defect that takes up more gallium than the surrounding normal parenchyma is more likely to be due to cancer or abscess than to a benign condition such as cirrhosis, benign cyst, or hemangioma. In this technique instead of scanning immediately after intravenous injection, the $^{67}$Ga liver scan was obtained at least 24 hr later. Accordingly, in contrast to $^{113m}$In eluate the mechanism of $^{67}$Ga localization would depend more on cellular uptake or permeability than on capillary perfusion. In conjunction with the radioactive colloid scanning, $^{75}$Se-selenomethionine has been used for the evaluation of hepatic focal lesions mainly on the basis of metabolic activity of the lesions (14).

The perfusion study combined with $^{99m}$TcS-colloid liver scintiphography carries the advantage of often differentiating between hepatoma and benign masses. Furthermore the technique requires no intra-arterial catheterization and can be performed routinely without risk in hospitalized and ambulatory patients. Thus it would be a useful screening procedure for elucidating hepatic mass lesions especially in the countries where the prevalence of hepatoma and amebic abscess is high. The occurrence rate of hepatoma in Taiwan has been reported to be 15% of all neoplasms (15) and 19.5% of all male cancer patients (16).

ACKNOWLEDGMENTS

The authors wish to express their gratitude to Kerrison Juniper, Jr., for his comments and assistance in preparation of the illustrations. They also thank Joseph P. Kriss for his comments. This research was supported in part by grants from E. R. Squibb and Sons, Inc., U.S.A., and Daiichi Radioisotope Laboratories, Japan.

REFERENCES

Intravenous Radionuclide Hepatography in the Differential Diagnosis of Intrahepatic Mass Lesions

Shin-Hwa Yeh, Wei-Jen Shih and Jyh-Chwen Liang