
The Predictive Value of Hepatic Artery Perfusion Scintigraphy

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A case in which hepatic artery perfusion scintigraphy (HAPS) correctly predicted the outcome of chemotherapy in a patient with metastatic liver disease is presented. In spite of angiography showing "proper" position of the Infusaid catheter, HAPS showed preferential perfusion to the right lobe of the liver. Computed tomography pre- and postchemotherapy showed a changing pattern of the metastatic foci correlating with the perfusion demonstrated by HAPS.

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The treatment and prognosis of patients with malignant neoplasms in several locations, among them the liver, has shown improved response to chemotherapy since the use of selective intra-arterial chemotherapy (HAC) began more than two decades ago (1). To achieve this result, the distribution of the chemotherapeutic agent has to be reliably delivered to all regions affected (10) and, specifically, the tip of the intra-arterial catheter has to be properly positioned (2).

There have been several methods proposed to evaluate the distribution of the chemotherapy and check catheter placement: percutaneous arteriography, intra-operative use of fluorescent dyes and slow flow hepatic artery perfusion scintigraphy (HAPS). HAPS with technetium-99m macroaggregated albumin (^{99m}Tc MAA) particles most closely reproduces the infusion pattern of the chemotherapy (2,3).

We report a case in which HAPS, rather than angiography, correctly demonstrated chemotherapeutic perfusion and predicted the subsequent clinical response.

CASE REPORT

A 62-yr-old woman with a history of carcinoma of the colon with metastases to the liver was admitted to our institution in March 1984 for placement of a subcutaneously implanted Model 400 Infusaid Pump*. The pump was connected to a catheter placed through the gastroduodenal artery proximal to both the right and left hepatic arteries. Chemotherapy

(FUDR) was administered directly through this catheter. An initial computed tomographic (CT) scan (Fig. 1) showed extensive metastatic deposits in the right lobe, with minimal involvement of the left lobe. An hepatic arteriogram (not shown) demonstrated a "standard" or "normal" vasculature of the hepatic bed; with both the right and left hepatic arteries arising from the common hepatic artery, a pattern present in 55 to 65% of the population (4). One month later, after obtaining an informed consent, an initial HAPS was performed using 4 mCi (148 MBq) of ^{99m}Tc MAA slowly infused (0.5 ml/min) through the side port of the Infusaid Pump and imaged with a WFOV gamma camera with a GAP collimator. Images of the liver obtained in the anterior, posterior, and right lateral projections demonstrated preferential perfusion to the right lobe, rather than to the entire liver (Fig. 2). Chemotherapy was continued without repositioning of the catheter. Three months later, a repeat HAPS (Fig. 3) again showed preferential perfusion to the right lobe with minimal if any perfusion to the left lobe. A CT scan obtained the same day (Fig. 4) showed significant increase of the metastatic involvement of the left lobe with a decrease in the number and size of the metastatic foci in the right lobe. An hepatic arteriogram, through the femoral approach, and obtained the same day (Fig. 5) showed "proper" position of the Infusaid Catheter tip. A left lobectomy, performed a month later confirmed extensive metastatic involvement.

DISCUSSION

Hepatic arterial chemotherapy has been demonstrated to be superior to systemic chemotherapy in the treatment of hepatic metastasis from colorectal carcinoma (1), as it increases the dose to the target areas and decreases its distribution to nontarget areas. Success rates range from 30 to 75% (5-7).

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FIGURE 1
Initial CT shows low density metastases involving mainly right lobe of liver

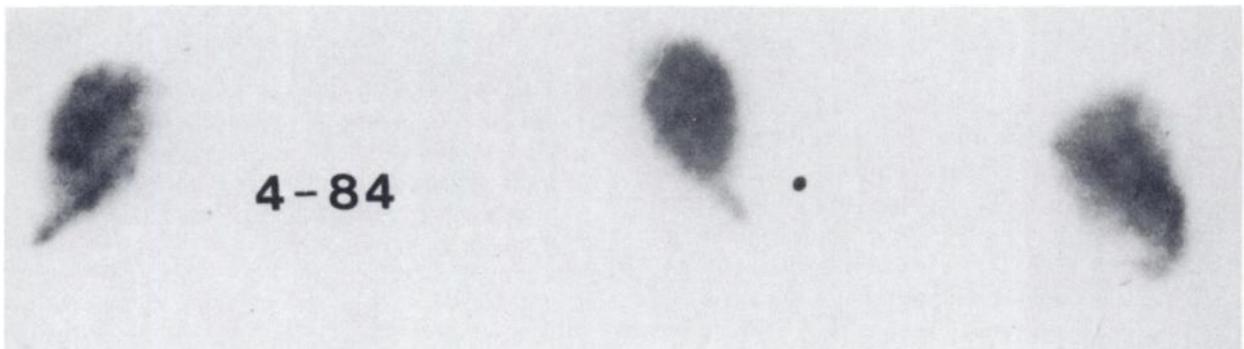


FIGURE 2
Initial HAPS showing preferential perfusion to right lobe of liver

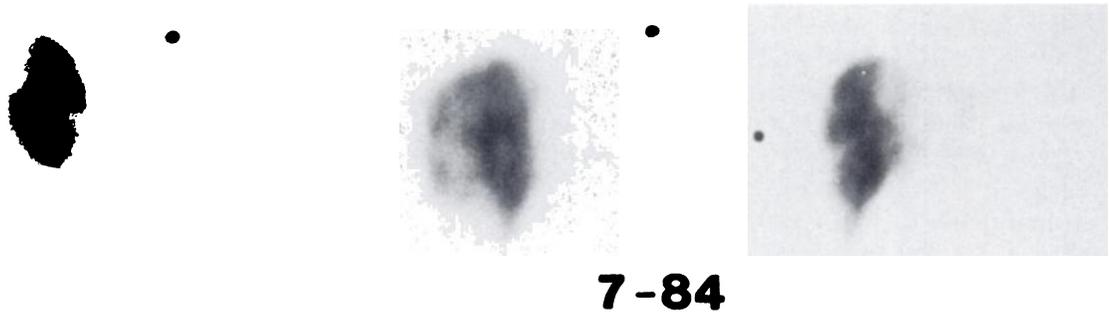


FIGURE 3
Follow-up HAPS shows continued preferential perfusion to right lobe of liver

Hepatic artery perfusion scintigraphy has become the method of choice to evaluate HAC by demonstrating the microdistribution of the chemotherapeutic

agent. The study is performed by slow infusion (0.5 ml/min) of [^{99m}Tc] MAA particles which become lodged in the hepatic arterial first capillary bed encountered, in



FIGURE 4
Follow-up CT showing decrease in size and number of metastatic foci in right lobe and progression of metastatic disease to left lobe

parallel fashion to that of the chemotherapy (8). HAPS is able to show the patency of the catheter, the presence of AV shunting to the lungs, and the perfusion pattern of the chemotherapy by slowly infusing MAA particles in a way similar to that of the Infusaid Pump (9).

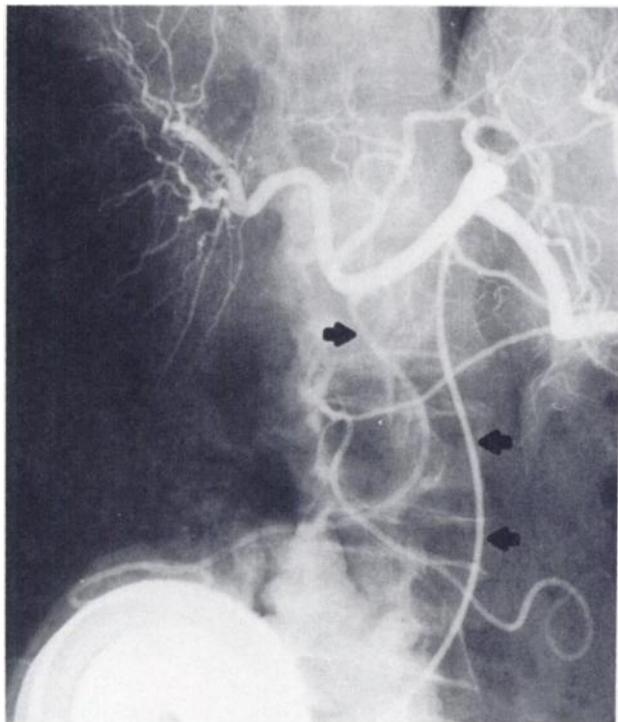


FIGURE 5
Celliac axis (double arrow) angiogram showing Infusaid catheter (single arrow) in "proper" position

Fluorescent dyes, although demonstrating the patency of the catheter, cannot image the capillary network, providing only a superficial map of the liver perfusion (8). In addition, HAPS allows for multiple assessments of the distribution of the chemotherapeutic agent while fluorescent dyes can only be used in the operating room at the time of the initial placement of the catheter.

The angiographic evaluation of HAC through a percutaneous catheter has several deficiencies: It demonstrates only the pattern of the large vessels and not the first capillary bed encountered where MAA particles and chemotherapeutic agents gain access to tumors (1); the speed of the flow of the contrast material is too fast to be correlated with that of the chemotherapeutic agent. Additional drawbacks are catheter recoil and flow reversal (8). Because of the small bore of the Infusaid Catheter tip, contrast injection through these surgical catheters is not feasible.

Ziessman et al. (9) has shown that only 88% of patients (93% of those with "normal" hepatic vascular anatomy) have perfusion of the entire liver. Yang et al. (8) has indicated the need for performing HAPS intraoperatively at the time of the placement of the Infusaid Catheter. Our case, in which this protocol was not followed, serves as a model to demonstrate the validity of those concepts. With the patient's left hepatic lobe serving as a control, HAPS demonstrated preferential perfusion and chemotherapy, to the right lobe and decreased perfusion to the left lobe, with failure of the treatment. Although femoral angiography demonstrated "proper" anatomic positioning of the catheter tip, radionuclide functional evaluation more accurately assessed slow flow perfusion and subsequent chemothera-

peutic distribution.

We feel that this case demonstrated the clear advantage of HAPS over percutaneous angiography and fluorescent dyes in the assessment of HAC distribution and, as demonstrated by Kaplan (2), its predictive value in the treatment of these patients.

FOOTNOTE

*Metal Bellows, Sharon, MA.

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