

FIG. 1 Top left: Tc-SC liver-spleen scintiphoto in patient with colon cancer metastatic to liver. Top center: Patient has surgically placed catheter and subcutaneous infusion pump perfusing right lobe of liver as shown on this Tc-MAA HAPS study. Top right: Second percutaneously placed angiographic catheter is infused with Tc-MAA demonstrating perfusion of left lobe. Bottom left, center, right: Computer subtraction images of Tc-MAA perfusion images after first, third, and fifth injection of starch microspheres through surgically placed catheter, demonstrating change in perfusion pattern with increasing starch dosage. Progressive intrahepatic shunting of blood flow from right lobe to left lobe is seen.

could also adversely affect the benefit of the intraarterial approach to chemotherapy.

We have reviewed serial computer subtraction images (14 studies) in 12 patients who received increasing dosages of starch microspheres as described in our report, in order to evaluate possible resulting changes in intrahepatic perfusion. In nine studies no change in intrahepatic perfusion pattern was seen. Six of these patients received five consecutive injections, one patient received four injections, and two patients received three injections. The other five studies did show a change in intrahepatic perfusion with increasing doses of DSM. Two showed moderate (25-60%) changes in perfusion away from tumor areas after the fifth injection of starch microspheres. Only one had a major change in perfusion pattern (Fig. 1). The other two patients actually showed somewhat improved perfusion of the tumor areas after the first injection, compared with baseline. So major intrahepatic changes in perfusion away from tumor occurred infrequently in the dose range studied and usually with the larger doses of starch microspheres.

Since DSM temporarily block hepatic blood flow, it is not surprising that changes in intrahepatic and extrahepatic perfusion may result with increasing numbers of administered particles. Tc-99m MAA HAPS allows us to evaluate these potential changes qualitatively and quantitatively in order to safely apply new adjunctive forms of intraarterial chemotherapy.

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# Tc-99m DMSA Uptake by Metastatic Carcinoma of the Prostate

Technetium-99m dimercaptosuccinic acid (Tc-99m DMSA) has a high affinity for renal cortex and is a very valuable agent for imaging of the renal parenchyma without interference from pelvicalyceal activity (1). Besides localization of Tc-99m DMSA within the normal renocortical tubules, there has been a report that



FIG. 1. Anterior (left) and posterior (right) total-body scintigrams performed  $2\frac{1}{2}$  hr after injection of Tc-99m MDP, showing multiple focal areas of increased activity in keeping with metastatic lesions in lower cervical spine, upper, mid, and lower thoracic spine, acetabular regions of pelvis bilaterally, right ilium, left intertrochanteric regions, and proximal shaft of left femur. No definite primary tumor was known at this stage.

FIG. 2. In search of a primary lesion, a renal study was undertaken using Tc-99m DMSA. Kidneys were essentially normal, but there was unusual accumulation of Tc-99m DMSA in areas coinciding precisely with the Tc-99m MDP skeletal lesions. Posterior image of kidneys taken at 2 hr (left). Posterior image of lower cervical and midthoracic spine (center). Note uptake in left rib. Image of posterior pelvis taken at 7 hr, showing even more Tc-99m DMSA uptake by both acetabuli, right ilium, and intertrochanteric area of left femur (right).



Tc-99m DMSA concentrated in a hypernephroma (2). A case of renal tubular adenoma was also reported to concentrate Hg-203 chloromerodrin (3). The mechanism of the localization in both of these cases is not clear.

We report here a case of histologically proven metastatic carcinoma of the prostate that took up Tc-99m DMSA in bony metastases. A 76-yr-old man presented with bone pain and diarrhea. Six months earlier he had had a transurethral resection of the prostate for benign prostatic hypertrophy, but microscopy had detected a tiny focal adenocarcinoma felt to be consistent with his age. Serum acid phosphatase was normal both then and on this admission. Bone scintigrams on this admission (Fig. 1) showed evidence of disseminated metastases, mainly in the spine and pelvis. Renal scintigrams were made in search of the primary, using Tc-99m DMSA (Fig. 2). The renal images were found essentially normal, including the oblique views, but there was intense uptake of Tc-99m DMSA (Fig. 2) in the same skeletal lesions that are evident in Fig. 1. The accumulation of Tc-99m DMSA was more intense at 7 hr than at 2 hr, indicating that this was not a simple blood-pool effect. A biopsy of the left femoral intertrochanteric region confirmed metastatic carcinoma from the prostate.

The mechanism of the uptake of Tc-99m DMSA by the metastases is not clear in this case. Neither is the mechanism of Tc-99m DMSA uptake by normal tubular cells clear, but there is evidence pointing to the intracellular localization in the cortical region of proximal and distal tubular cells, probably with binding to metallothionein, a protein binder of heavy metals (1,4). Subcellular localization studies of Tc-99m DMSA have suggested that these complexes may be bound to cytosol protein and the mitochondria, and to a lesser extent to nuclei and microsomes (5). Several possibilities may be considered in attempts to explain Tc-99m DMSA localization in malignant tumors, including nonspecific binding. If the latter turns out to be the case, it might provide a potentially useful test in a search for at least some metastases. Another possibility to be considered is the nature of the cytosol proteins in some of these tumors, which may be similar to those found in renocortical tubules. The metallothionein content of the tumor is also possibly involved in this intense uptake of Tc-99m DMSA. Regarding nonspecific binding, it has been shown in Sprague-Dawley rats that several factors influence Tc-99m DMSA renal uptake, including change of acid-base balance and state of hydration (6). It has been suggested that in cases of severe renal impairment a late image may demonstrate Tc-99m DMSA accumulation in hypervascular tissue such as bone or hypervascular tumor (7). Our patient, however, had no evidence of renal impairment, with serum creatinine and blood urea nitrogen of the upper limits of normal.

We have presented a case of metastatic adenocarcinoma of the prostate that takes up Tc-99m DMSA intensely in the presence of normal renal function. We have no clear explanation for these findings but have discussed some of the possibilities. We would appreciate hearing of the experiences of others.

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## Visualization of the Thyroid during Cardiac Imaging

Incidental visualization of the thyroid during gated blood-pool imaging with in-vivo-labeled red blood cells (RBCs) has been observed and reported by several workers in the past 2 yr (1,2). Several possible explanations have been postulated by these workers, including trapping of pertechnetate by an avid gland, increased thyroid blood pool, and incomplete in vivo RBC labeling.