TECHNETIUM-99m-GLUCOHEPTONATE AS A BRAIN-SCANNING AGENT: CRITICAL COMPARISON WITH PERTECHNETATE

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Delayed ^{99m}Tc-glucoheptonate and pertechnetate scans were evaluated in a paired study for their ability to detect brain lesions. Glucoheptonate was found to be superior in eight of 17 cases of brain tumor and in two of ten patients with cerebral infarction. In addition, early (30 min) ^{99m}Tc-glucoheptonate brain scans were compared with delayed studies: the former were inferior in 48% of the cases. We conclude that ^{99m}Tc-glucoheptonate is a promising agent for delayed brain scanning, offering better lesion detection than pertechnetate.

Technetium-99m-glucoheptonate (^{99m}Tc-GH) has been used as an agent for renal and myocardial-infarct scanning (*1–3*). We have chosen to evaluate this radiopharmaceutical as a brain-scanning agent because of its enhanced blood clearance and its ability to concentrate in abnormal tissue. The purpose of this study was to compare detection of brain lesions with pertechnetate and ^{99m}Tc-GH and also to compare early (30 min) and delayed (3–5 hr) ^{99m}Tc-GH scans.

TABLE 1. COMPARISON OF DELAYED ^{99m}Tc-PERTECHNETATE AND DELAYED ^{99m}Tc-GLUCOHEPTONATE BRAIN SCANS

	GH (Pos.) TcO_4 (Neg.)	GH > TcO_4	GH = TcO_4	GH < TcO_4	GH (Neg.) TcO_4 (Neg.)
Tumor	1	7	8	1	0
Infarct	1	1	8	0	0
Normal	0	0	0	0	15

METHODS

Forty-two patients were evaluated with paired delayed $^{99m}TcO_4$ and ^{99m}Tc-GH studies following the intravenous administration of 20 mCi of each radio-

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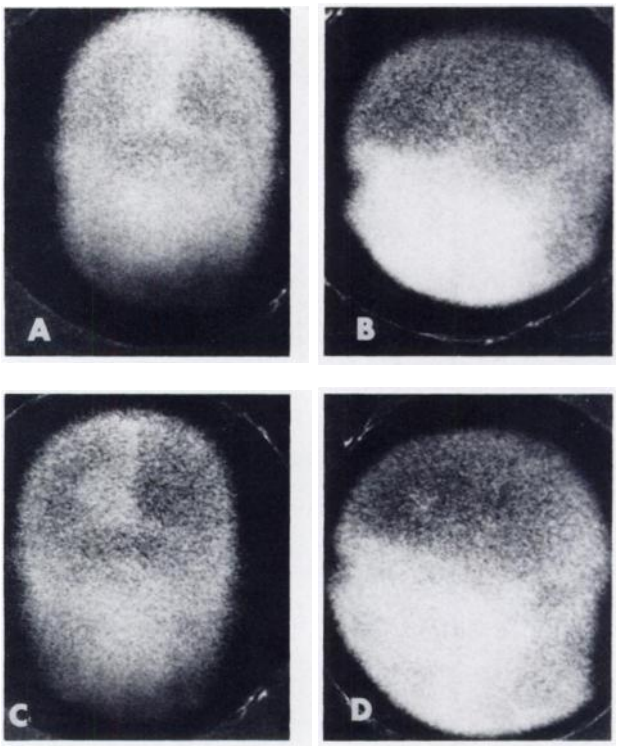

FIG. 1. Posterior and left lateral delayed images using pertechnetate (A,B) and ^{99m}Tc-glucoheptonate (C,D) in patient with melanoma.

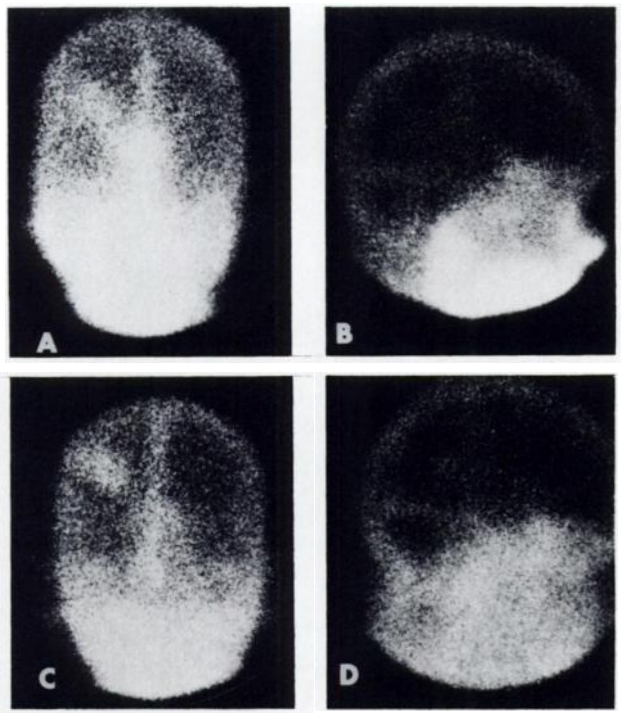

FIG. 2. Posterior and right lateral delayed pertechnetate (A,B) and ^{99m}Tc-glucoheptonate (C,D) images in patient with bronchogenic carcinoma. Note that posterior temporal lesion on right lateral projection (D) is only seen with glucoheptonate.

pharmaceutical. In 18 cases, ^{99m}Tc-GH was administered before the pertechnetate, while in 24 cases the sequence was reversed. Sodium perchlorate (500 mg) was given 30 min before the $^{99m}TcO_4$ administration, whereas no perchlorate was given with ^{99m}Tc-GH. A 48-hr period was allowed between studies. Either scintillation cameras or double-headed rectilinear scanners were used, but the same instrument was always employed for both parts of a comparative study.

For the delayed $^{99m}TcO_4$ scintigrams done on the Anger camera, 500,000 counts were accumulated. The delayed ^{99m}Tc-GH studies were limited to 8 min per view, giving from 160,000 to 300,000 counts. Delayed studies were begun 3–5 hr after injection. Only three of the 42 cases were studied with rectilinear scanners.

In addition, early (30 min after injection) and delayed studies were compared for 57 positive ^{99m}Tc-GH scans. Qualitative estimation of the lesion-to-calvarium concentration ratio served as the reference for comparison. In all cases the diagnosis was proven by angiography, surgery, or necropsy.

RESULTS

The results of the paired studies are summarized in Table 1. Glucoheptonate offers a significant improvement in lesion detection (for both infarcts and tumors) using a subjective comparison of the lesion-to-calvarium ratios. The results were similar for camera and rectilinear scanner.

Figure 1 compares a 4-hr pertechnetate study (top) with a 4-hr ^{99m}Tc-GH scan (bottom) in a patient with metastatic melanoma. A similar comparison favoring glucoheptonate was noted in the only other case of metastatic melanoma in this series. Figure 2 is a study of a patient with bronchogenic

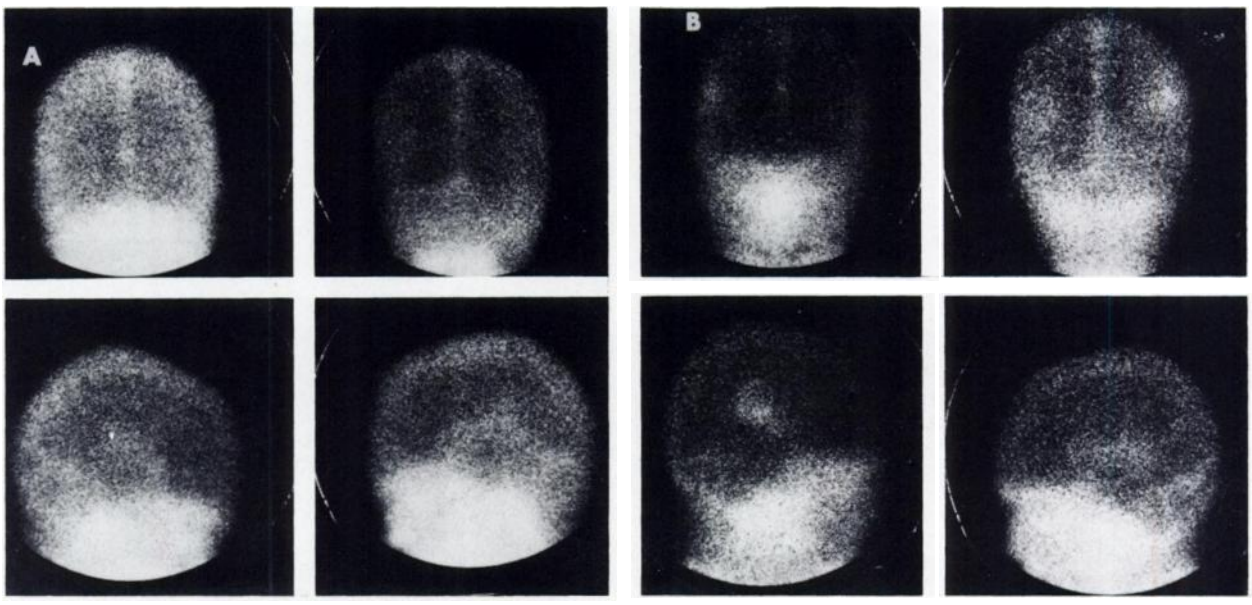

FIG. 3. Bilateral cerebral infarctions. Four-view delayed study with pertechnetate (A) and ^{99m}Tc-glucoheptonate (B). Lesion-to-calvarium ratio is clearly higher for ^{99m}Tc-GH. Studies were done 48 hr apart.

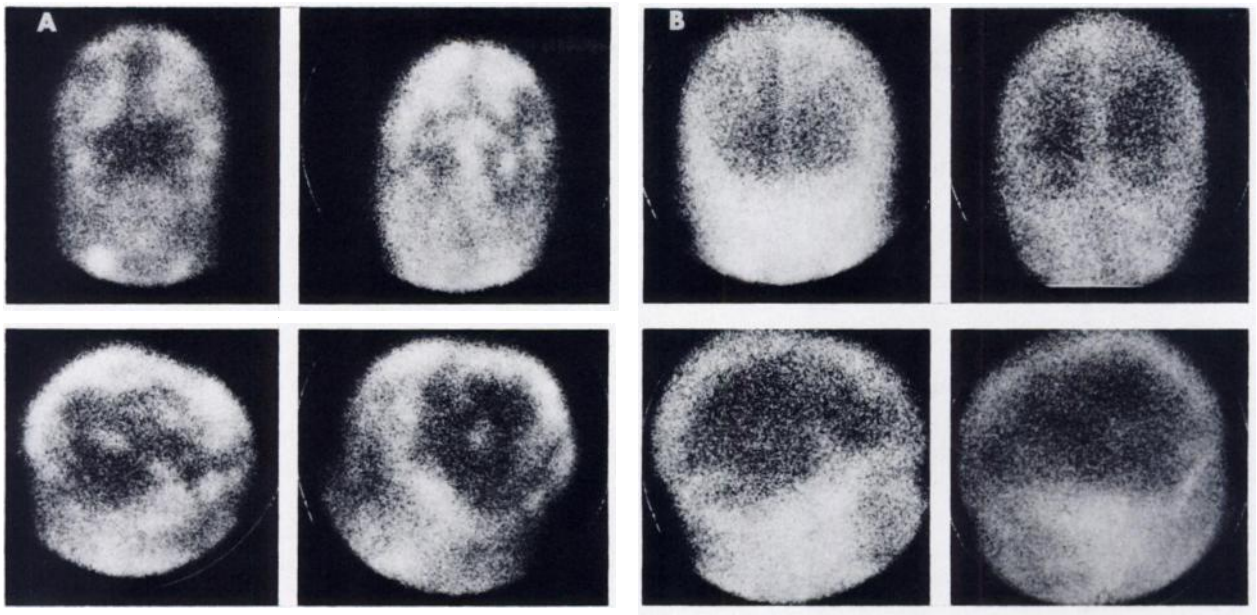

FIG. 4. Cervical carcinoma metastatic to bone. Four-view delayed study using pertechnetate (A) and ^{99m}Tc-glucoheptonate (B). Numerous skull and scalp lesions are poorly shown with ^{99m}Tc-GH. Studies were done 48 hr apart.

carcinoma metastatic to the brain. Bilateral cerebral infarctions are shown in Fig. 3. Figure 4 is a comparative study in a patient with carcinoma of the cervix metastatic to brain, scalp, and skull. Figure 5 is a comparative study of early (30 min) and delayed (4-hr) ^{99m}Tc-GH brain scanning in a patient with metastatic brain carcinoma. The results of all similar studies are summarized in Table 2.

DISCUSSION

In eight of 17 cases of documented tumor and in two of ten cases of infarction, the delayed ^{99m}Tc-GH scans were superior to the delayed $^{99m}TcO_4$ scans. In each group, one lesion was noted on the ^{99m}Tc-GH study only.

An interesting observation is illustrated in Fig. 4. This concerns a 38-year-old woman with carcinoma

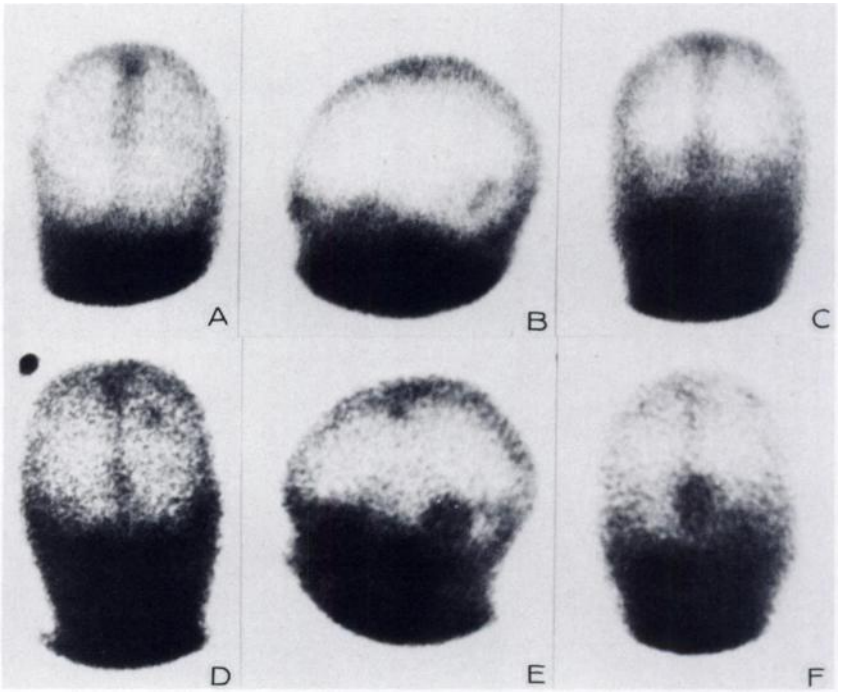

FIG. 5. Early (30-min) and delayed (4-hr) ^{99m}Tc-glucoheptonate brain scans in patient with metastatic breast carcinoma. Early (A,B,C) and delayed (D,E,F) anterior, left lateral, and posterior views are shown.

TABLE 2. COMPARISON OF EARLY AND DELAYED ^{99m}Tc-GLUCOHEPTONATE BRAIN SCANNING

	Late (Pos.) Early (Neg.)	Late > Early	Late = Early
Tumor	3	12	18
Infarct	2	10	12

of the cervix; she had extensive metastatic involvement of the skull and scalp, documented by x-rays and physical examination. Her neurologic signs and symptoms consisted of lethargy, weakness, and slurring of speech, but there were no definite localizing findings. An angiogram was not done. Thus, the presence of cerebral metastasis was not proven in spite of the neurologic symptoms. The striking difference between the markedly abnormal pertechnetate scans and the only faintly abnormal glucoheptonate scans may be explained in one of two ways: either the lesions were highly vascular or the glucoheptonate is not localized in skull and scalp lesions. Since this is the only such observation so far, the problem remains unsolved.

The mechanisms of glucoheptonate uptake in lesions of the central nervous system may be similar to those of pertechnetate. However, the striking uptake in myocardial infarction (*2,3*) suggests that an additional mechanism of glucoheptonate accumulation is present in altered brain tissue. Whether this is due to a specific process or is dependent on nonspecific binding to damaged tissues is unclear.

The advantages of ^{99m}Tc-GH over $^{99m}TcO_4$ in terms of higher target-to-nontarget ratios and absence of choroid plexus uptake are offset in part by its higher cost, lower count rates, and longer imaging times.

The superiority of delayed over early ^{99m}Tc-GH scans is shown in Table 2. Twenty-seven of 57 studies (48%) showed the delayed study to be superior to the early study. Of those 27, five lesions (9%) were noted in the delayed scans only. A recent report with ^{99m}Tc-DTPA (*4*) showed that in 34 of 55 studies (62%) delayed studies were superior to early ones and in 15 of 55 studies (27%) the early version was falsely read as normal. An earlier report (*5*) comparing early and delayed pertechnetate scans showed that the density of abnormal uptake was higher on the delayed scan in 39 of 74 patients (53%). Thus, if only an early scan is possible, ^{99m}Tc-GH offers no significant improvement in the detection of cerebral lesions.

In summary, we feel that ^{99m}Tc-glucoheptonate is a promising brain-scanning agent when used for delayed static imaging. Our preliminary data in a limited series require confirmation with a larger patient group. Early ^{99m}Tc-GH scans either failed to detect lesions subsequently detected on the delayed images (9%) or visualized them less well (39%). Early ^{99m}Tc-glucoheptonate scanning appears to offer no significant improvement over ^{99m}Tc-pertechnetate studies.

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