

# Steroid-Induced Suppression of Gallium Uptake in Tumors of the Central Nervous System: Concise Communication

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***The effect of steroids given in greater than replacement doses on the gallium and technetium glucoheptonate brain scan is evaluated by comparing the relative sensitivity of both radiopharmaceuticals in patients both on and off steroids. The study shows a significant steroid effect on the sensitivity of 95% to 64% following steroids. Steroids did not significantly alter the sensitivity of the technetium glucoheptonate study. The superiority of the TcGH brain scan over the gallium citrate brain scan in the steroid population suggests a difference in the uptake mechanism for the two radiopharmaceuticals.***

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Gallium brain scanning in the detection of CNS tumors has been evaluated by several investigators (1-5). These reports indicate that gallium is an effective agent in detecting CNS tumors, whether primary or metastatic.

One of these reports was concerned with an evaluation of a large series of patients in whom both gallium and technetium scans were performed between August 1, 1972, and May 5, 1973 (3). This study showed a 95% sensitivity for CNS neoplasm, using Ga-67 citrate. Since that time, the sensitivity for the detection of CNS neoplasm has fallen sharply in our institution. We have been able to correlate the fall in Ga-67 sensitivity with an increase in patients who have received steroids for relief of their symptoms.

This paper analyzes the effect of steroids on both technetium glucoheptonate (TcGH) and gallium brain scans, and in addition, compares the relative sensitivity of TcGH with that of gallium in patients both on and off steroid therapy.

## METHODS

Delayed TcGH and Ga-67 brain scans were done on 62 patients with proven CNS tumors. TcGH scans were done 2-4 hr following a 15-mCi injection,

whereas gallium scans were done 2-7 days following a 5-mCi injection. The gallium injection was always done within 48 hr of the technetium study. An Anger camera or dual-headed rectilinear scanner was employed, using multiple photopeaks when possible. The same instrument was used for both studies in any given patient for purposes of comparison. The TcGH and gallium brain scans were subjectively compared, using lesion-to-calvarium ratios.

The patients were categorized into a steroid or nonsteroid group. Patients who received steroids in amounts greater than replacement prior to and including the day of the scan were placed in the steroid group. The usual dose varied from 4 mg of dexamethasone b.i.d. to doses greater than 4 mg q.i.d. The average treatment dose was 4 mg of dexamethasone or equivalent t.i.d. Patients who had not received steroids, or whose steroids had been discontinued at least 1 wk before the study, were included in the nonsteroid group.

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TABLE 1. STEROID EFFECT ON GALLIUM AND TcGH BRAIN SCANS: OVERALL RESULTS

	Tc pos Ga neg	Tc > Ga	Tc = Ga	Tc < Ga	Tc neg Ga pos	Tc neg Ga neg
Steroid	12	16	10	1		3
Nonsteroids	1	2	10	4	2	

TABLE 2. COMPARISON OF TcGH AND GALLIUM BRAIN SCANS IN PATIENTS WITH CNS TUMOR

	Sensitivity TcGH	Sensitivity Ga
Steroid	$\frac{39}{42} = 93\%$	$\frac{27}{42} = 64\%$
Nonsteroid	$\frac{17}{19} = 89\%$	$\frac{18}{19} = 95\%$

The steroid group consisted of 42 patients with CNS tumors. Fourteen of these had primary brain tumors, including six glioblastomas, five astrocytomas, and three meningiomas. Twenty-eight patients had metastases to the brain from various primary sites. The nonsteroid group consisted of 19 patients. Seven of these had primary brain neoplasms, including three glioblastomas, three astrocytomas, and one meningioma. The remaining patients had metastases to the brain. The distribution of metastatic tumors was quite similar for both groups, with lung and breast representing the majority of primary sites.

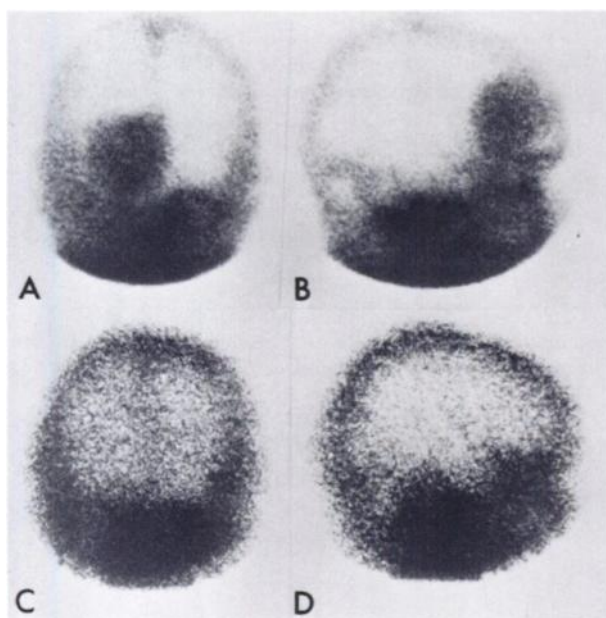


FIG. 1. Surgically proven meningioma in patient on 4 mg of decadron q.i.d. for 2 wk before brain scanning. Technetium-99m glucoheptonate scans anterior and right lateral projections (A and B), 48-hr delayed Ga-67 citrate scans anterior and right lateral (C and D). The studies were done 48 hr apart.

In addition, four patients underwent gallium and TcGH brain scans before steroid therapy, and again after being on steroid therapy for 1 wk. No other treatment, such as radiation therapy or chemotherapy, was administered during this interval.

#### RESULTS

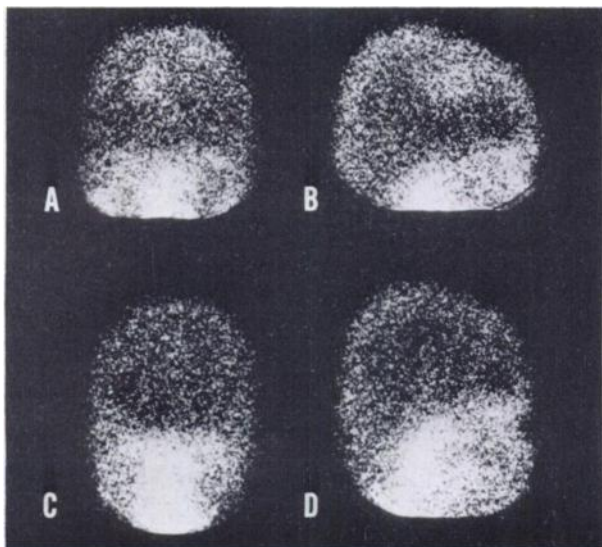
The results are summarized in the two tables. Table 1 shows the relative technetium-to-gallium uptake in the two patient populations. There is a significant deterioration in the gallium uptake relative to technetium in the steroid group. Table 2 shows the sensitivity of both the TcGH and gallium as brain scanning agents in the steroid and nonsteroid group. The sensitivity for gallium in the steroid group is significantly less than in the nonsteroid group, whereas the TcGH sensitivity shows no significant difference.

Figure 1 illustrates a patient on steroids with a known meningioma. Note the strongly positive technetium scan, whereas the gallium scan was normal. This patient had been on 4 mg of decadron q.i.d. for 2 wk before the brain scans.

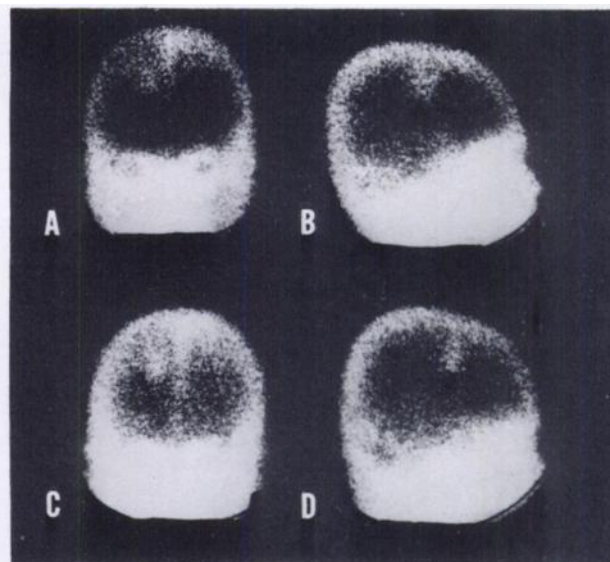
Of the four patients who underwent gallium and TcGH brain scans before steroid therapy and again after being on steroids for 1 wk, the gallium brain scan, in all cases, showed either a disappearance or reduction in gallium uptake by the tumor. The TcGH brain scan was either not affected, or affected only slightly by subjective analysis. Figures 2 and 3 give an example of such a patient. This tumor was subsequently proven to be metastatic from carcinoma of the breast. Note the reduction of gallium uptake (Fig. 2, C & D) following 1 wk of dexamethasone (4 mg q.i.d.), whereas the TcGH study is unchanged (Fig. 3, C & D).

#### DISCUSSION

In 1973, Marty and Cain demonstrated the effect of corticosteroid administration on the [<sup>99m</sup>Tc] pertechnetate brain scan (6). In their series, 12 patients underwent brain scans before and after dexamethasone therapy. Ten of these patients showed a reduction in brain-lesion activity following steroids. These authors postulated that the dexamethasone decreased the sodium and water content in the extracellular space of the brain, and thus limited the technetium distribution in the area of the lesion. Using TcGH,



**FIG. 2.** Gallium-67 citrate scans at 48 hr in a patient with surgically proven metastases from a breast carcinoma. Presteroïd anterior and right lateral projections (A and B). Repeat gallium scans following 1 wk of 4 mg of dexamethasone q.i.d. (C and D). Note reduction in gallium activity in the poststeroid study.



**FIG. 3.** Same patient as in Figure 2. Presteroïd Tc-99m glucoheptonate study (A and B). Poststeroid study (C and D). Note lack of change with Tc-99m glucoheptonate following steroid therapy in contrast to marked reduction in gallium uptake (Fig. 2, C & D).

we were unable to demonstrate a significant effect of the steroids on this radiopharmaceutical. This raises the possibility of other mechanisms being involved in the handling of TcGH as compared with pertechnetate. Waxman et al. have previously demonstrated the superiority of TcGH over pertechnetate in the detection of CNS lesions (7). These findings were later substantiated by Rollo, who also found that TcGH was superior to TcDTPA as well as to pertechnetate (8).

The intent of this report is simply to report the observation of reduced gallium uptake by CNS tumors in patients on steroid therapy. The mechanisms cannot be explained by this paper. The superiority of the TcGH scan over the gallium citrate scan in the steroid population suggests a difference in the uptake mechanism for the two radiopharmaceuticals.

The high incidence of patients placed on steroids before brain scanning would support the use of TcGH over pertechnetate and Ga-67 citrate in the radionuclide evaluation of CNS neoplasm.

#### ACKNOWLEDGMENT

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