Early and Delayed Tc-99m Glucoheptonate Brain Scintigraphy: Are Routine Early Images Indicated?

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Both early and delayed Tc-99m glucoheptonate brain images were evaluated in 859 patients in order to determine whether the early imaging with this agent is clinically useful. The results suggest that the early brain images are inferior to the delayed ones in detecting CNS lesions. Use of both, however, may help to differentiate skull or scalp abnormalities from true lesions of the brain.


Because of scheduling difficulties involved in 3- or 4-hr delayed brain scintigrams, several agents have been evaluated for their sensitivity in detecting CNS abnormalities with immediate or early studies (1-3).

The purpose of this study was to evaluate early or immediate brain images using Tc-99m glucoheptonate (TcGH), and to determine when the early series should be used to complement the delayed study.

METHODS

Fifteen to twenty mCi of TcGH were administered as a bolus i.v. injection. Brain images were obtained 15–20 min following the dynamic flow, and repeated 2–4 hr postinjection. An Anger camera with a high-resolution low-energy collimator was used in all studies. Scan findings were compared with those of angiography, surgery, pathology, or clinical followup for at least 1 yr. At least two independent observers compared the early and delayed static images using subjective estimates of lesion-to-calvarial (scalp, skull, dura) ratio, as well as lesion size, in forming an opinion.

FIG. 1. W. E., 49-year-old man with proven right CVA.
TABLE 1. COMPARISON OF LESION DETECTION WITH EARLY VS. DELAYED Tc-99m GLUCOHEPTONATE BRAIN
SCINTIGRAPHY

<table>
<thead>
<tr>
<th>Lesion type</th>
<th>E - D+</th>
<th>E &lt; D</th>
<th>E = D</th>
<th>E &gt; D</th>
<th>E+ D-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain tumors</td>
<td>7</td>
<td>24</td>
<td>8</td>
<td></td>
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</tr>
<tr>
<td>CVA</td>
<td>18</td>
<td>15</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bone tumors</td>
<td>2</td>
<td>2</td>
<td>9</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Skull fractures</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Craniotomies</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Infections</td>
<td>2</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDH</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
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<td>Scalp</td>
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<tr>
<td>AVM</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>False positive</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>37</td>
<td>52</td>
<td>27</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Percentage</td>
<td>29</td>
<td>41</td>
<td>21</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

E = early; D = delayed

RESULTS

We have studied 859 patients with 927 scintigrams. One hundred patients lost to followup, or not documented, were excluded. One hundred twenty-three patients were found to have 126 lesions. Normal scintigrams were found in 634 patients. Two patients gave false-positive studies. The results are summarized in Table 1.

In 29% of these patients the early TcGH brain scintigram was normal and the delayed study positive. An additional 41% showed the delayed images to be superior. In 6% the early study showed greater activity in the abnormality than in the delayed images. This group contained one patient with an AVM, whereas the other patients had superficial abnormalities of either the scalp or skull. Two additional patients, one with a craniotomy and the other with a scalp abnormality, were read as positive only on the early study, with the delayed being read as normal.

Figure 1 compares early and delayed scintigrams in a patient with a proven thrombosis of the right middle cerebral artery. Figure 2 compares early and delayed studies in a patient with proven brain metastases from an oat-cell carcinoma. Figure 3 illustrates a case in which extracerebral abnormalities are better visualized on early than on delayed studies in a patient with proven skull metastases.

In lesions near major blood vessels, or in the posterior fossa, the early study helps to differentiate normal anatomic structures from true lesions by allowing a comparison of normal vascular structures with abnormalities that are seen only on delayed views. This is demonstrated in Fig. 4 in a patient with a cerebellar astrocytoma (Grade 1).

DISCUSSION

Early imaging using pertechnetate and Tc-99m DTPA has been evaluated for sensitivity in detecting CNS abnormalities (1,2). An earlier report comparing early and delayed pertechnetate scans showed abnormalities to be more obvious on delayed scans in 53% of the cases (1). A clinical comparison of early and delayed DTPA scintigrams showed the early (30-min) DTPA study to be significantly inferior to the delayed (3 hr) study. This report stated that 27% of lesions detected on the delayed study were not seen at all in the early images (2). TcGH has been shown to be effective agent in brain scintigraphy when compared with other agents (3,4). A study comparing pertechnetate

FIG. 2. C.W., 65-year-old woman with proven brain metastases.
with TcGH for brain scanning also analyzed a few cases to compare early and delayed TcGH brain scintigrams. It found that 48% of the delayed studies were superior to the early images (3). Rollo’s data (5) suggest that the 90-min glucoheptonate study gives satisfactory brain findings, but earlier imaging was not indicated. LeVeille et al. (6) have obtained much better TcGH brain images with a delay of 5–9 hrs rather than the usual 2 hrs.

The current study clearly shows the superiority of delayed TcGH studies in the evaluation of cerebral vascular disease or CNS tumor. The early scintigram showed the higher uptake in only one true case of CNS abnormality, later shown to be an AVM. If the activity on a delayed study is significantly less, however, the early study is helpful in determining whether an abnormality observed on the delayed study is within the scalp or skull. This finding parallels the results of Hoffer et al. who used pertechnetate (7). In addition, abnormalities close to normal vascular structures can be evaluated more clearly with the help of early images, since the vascular structures tend to fade with time.

The early TcGH brain scintigram, then, is not a substitute for a study delayed 2–4 hr. The former helped us, however, in 8% of the cases studied. A repeat injection following the delayed image can imitate an “early” scintigram, since the residual activity is low by comparison with the new.

We note that additional information was obtained in 8% of the patients when both early and delayed studies were done. Currently, we are not using a routine early study but choose to reinject whenever it is indicated. Exceptions occur when we scan early in patients with scalp or skull lesions and in those suspected of an AVM.

**REFERENCES**

4. Tanasecu DE, Wolfstein RS, Waxman AD: Critical


Accepted Articles to Appear in Upcoming Issues

Fixation of Gallium (Letter to the Editor). Accepted 7/7/78.
Jose Pierrez and Alain Bertrand
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