A Case of Oligodendroglioma Studied with Technetium-99m Pertechnetate, the Scintillation Camera, and Multiplane Tomographic Gamma-Ray Scanner

Technical Note

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With the improvement of instrumentation in brain scanning, $^{99mTc}$ pertechnetate has become one of the widely used radionuclides. The tissue distribution of Tc-99m pertechnetate has been studied in animals and in human beings by several authors,\(^5\)\(^6\) and the anatomical correlation of scintiphotos can be ascertained by actual tissue count. We have studied these aspects of a case of oligodendroglioma.

Case Report

Our patient was an 11-year-old boy with a history of mild generalized weakness, headache and dizziness of a few months' duration.

Examination. There was bilateral papilledema, increased tendon reflexes in the right leg and right ankle clonus. Plain x-ray films showed a calcified mass on the posterior frontal areas near the midline which extended toward the left side. Brain scintiphotos with 5 mCi Tc-99m injection showed an area of high count in the posterior frontal area at the midline (Fig. 1). Repeat brain scintiphotos 22 hours later without additional injection of Tc-99m showed a relatively wide area of high count at the entire left frontal region (Fig. 2). Because there was an obvious discrepancy in the location of the high count area, a tomographic scan was performed with 6 mCi Tc-99m injection (Fig. 3). A left carotid angiogram on the same day showed a shift of both anterior cerebral arteries toward the right (Fig. 4), which correlated well with the scintiphoto exposed between 7.5 to 10 sec after injection in the dynamic study (Fig. 5).

Operation. Left frontal craniotomy disclosed 30 cc of yellowish cystic fluid in the left frontal area. At the medio-posterior aspect of this cavity a grayish, friable, solid tumor extended toward the midline approxi-
mately 3 cm below the convexity. A left frontal lobectomy was performed.

Postoperative Course. The patient showed no gross neurological deficit. The pathological report was oligodendroglioma. The cystic fluid, tumor tissue, and brain tissue were sent for residual Tc-99m count approximately 26 hours after the second Tc-99m injection; the results appear in Table 1.

Discussion

Technetium-99m pertechnetate can be used in a relatively large amount because of its physical characteristics. These include a physical half-life of 6 hours, the absence of beta emission, a gamma emission of 140 keV, and an estimated total body dose of 0.11 rad from 10 mCi Tc-99m in a 70-kg man.

Rapid sequential cranial scintiphotos for dynamic study can be obtained in an exposure time ranging from 1.5 sec² to 5 sec, depending on the technique and instrumentation. We are using 2.5 sec at present.

The identification of the first appearance of the sagittal sinus in a series of dynamic studies provides a good guide for interpretation of the vascular pattern, because the picture taken immediately prior to the appearance of the sagittal sinus probably represents the cerebral arterial or capillary phase. In our series the average time for the appearance of the sagittal sinus was 13.5 sec (ranging from 8 to 18 sec), and it is somewhat shorter in children. Fish, et al., have reported an earlier onset of this venous phase; their injection technique and 1.5-sec exposure time might account for the difference. The volume of the internal cerebral veins is so small and they are so deeply situated that they cannot be identified with the present scanning technique. Therefore, only the early arterial picture can show the shifting of the cerebral hemisphere. This limits the detection of shifting of the cerebral hemisphere to a certain area. Figure 5 was taken at 7.5 to 10 sec after the injection of 6 mCi Tc-99m, and a rather striking shift of the arterial vascular pattern can be seen. This was confirmed by the carotid angiogram on the same day (Fig. 4).

A 1-min scintiphoto taken 10 min after the injection showed the sagittal sinus shadow overlapping the high count area (Fig. 1 left). However, the scintiphoto taken

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Residual Tc-99m activity count</th>
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<tr>
<td>Source</td>
<td>Residual counts</td>
</tr>
<tr>
<td>Cystic fluid</td>
<td>775 c/cc/min</td>
</tr>
<tr>
<td>Tumor tissue</td>
<td>348 c/gm/min</td>
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<tr>
<td>White matter</td>
<td>231 c/gm/min</td>
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<tr>
<td>Gray matter</td>
<td>136 c/gm/min</td>
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Fig. 3. Tomographic scans. Top: Anteroposterior view, at 1-inch intervals from 1 to 6 inches.
Bottom: Lateral view at 1-inch intervals from 1 to 6 inches.
22 hours after the injection showed a high count area on the left side (Fig. 2 left). From the operative findings and residual tissue Tc-99m count, we think that Fig. 1 left shows the solid part of the tumor and Fig. 2 left represents mostly the cystic part of the tumor. Miller and Simmons recommended a waiting period of at least 30 to 60 min for tumor detection. McAfee, et al., indicate a somewhat higher tumor-to-brain ratio at 3 hours in comparison with that of the 1-hour ratio. Tauxe and Thorsen show the optimal interval between injection and scanning to be at least 3 hours. Mishkin and Truksa have described a negative scan in cerebral cysts. Although we did not study this patient serially and follow the changing distribution, we think that the marked difference in a picture at 22 hours warrants further studies of cystic lesions at later times.

With the Anger multiplane tomographic gamma-ray scanner we are able to take cross-sectional pictures at 1-inch intervals, providing better resolution at each level. In the coronal series (Fig. 3 top), the roof of the orbits is well outlined on the No. 2 cut, and the tumor shows clearly in the No. 4 picture in which the sagittal sinus is not seen (Fig. 1 left). In the sagittal series (Fig. 3 bottom) the No. 4 picture represents a midline cut and shows very little overlapping of normal shadows. These features of tomography provide a potential method for more accurate localization and delineation of the abnormal area.

Summary

A case of oligodendroglioma was studied preoperatively by the scintillation camera and multiplane tomographic gamma-ray scanner with Tc-99m pertechnetate; a residual tissue Tc-99m count was performed. The anatomical significance and clinical value of the scan picture obtained by this modified technique has been discussed in relation to related reports.

Acknowledgment

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References

3. Harper, P. V., Beck, R., Charleston, D., and


