Brain scans of the posterior fossa

ROBERT A. MOODY, M.D., JOHN O. OLSEN, M.D., ALEXANDER GOTTSCHALK, M.D., AND PAUL B. HOFFER, M.D.

Departments of Neurological Surgery and Radiology, University of Chicago Hospitals and Clinics, and the Argonne Cancer Research Hospitals (operated by the University of Chicago for the United States Atomic Energy Commission), Chicago, Illinois

The results of posterior fossa brain scanning in 37 patients with proven posterior fossa tumors were reviewed. Pertechnetate-99m was used as the scanning agent, and attention was paid to careful positioning of the patient. Perchlorate was used to block the parotid gland. The overall detection rate was 78%, particularly good results being obtained with meningiomas, ependymomas, juvenile astrocytomas, metastases, and acoustic neuromas, in that order.

KEY WORDS
pertechnetate-99m
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brain tumors
acoustic neuromas
juvenile astrocytomas
brain metastases
meningiomas

It has been increasingly recognized by workers in nuclear medicine that brain scanning of the posterior fossa is nearly as successful as scanning of the supratentorial region.13,24 The neurological and neurosurgical literature, however, has generally reflected a more pessimistic view. Furthermore, many of the published series are small, consisting of less than 20 cases. We have been impressed with the consistency with which certain lesions in the posterior fossa have been detected, and the generally high detection rate of all lesions in this region. This has stimulated us to review the posterior fossa scans performed at this institution from January, 1965, to June, 1970, the results of which are reported here.

This report describes 37 cases in which the diagnosis was confirmed by direct biopsy or autopsy except for three cases of metastases, where the diagnosis was inferred by knowledge of the primary lesion and location was confirmed by neurological examination and contrast studies. These cases were selected by first collecting (from the files of the neurosurgery department) all proven posterior fossa tumors that were diagnosed in the defined period. From these records were selected those cases for which routine four-view brain scans done on the ACRH scanner were available.

The Argonne Cancer Research Hospital (ACRH) brain scanner is a single organ scanner developed in the early 1960's.2 The device uses four collimated detectors arranged in two opposing pairs. The lateral views are done simultaneously as are the anterior and posterior views. The images are recorded as photoscans, utilizing a bell-shaped spot for data blending. No other contrast enhancement or background erase is employed. Low-energy high-resolution collimators are used. The loss of sensitivity introduced by the high resolution collimators is offset by the use of multiple detectors.

The scans were performed using 10–12 mCi of pertechnetate-99m as introduced at this institution by Harper, et al.14 Scanning is begun 10 min after intravenous injection of the isotope. An oral dose of 0.5 to 1.0 gm of
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<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Total</th>
<th>Positive</th>
<th>Suspicious</th>
<th>Negative</th>
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<td>10</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>metastases</td>
<td>7</td>
<td>6</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>juvenile astrocytomas</td>
<td>7</td>
<td>6</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
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<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
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</tr>
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<td>ependymomas</td>
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<td>2</td>
<td>0</td>
<td>0</td>
</tr>
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<td>hemangio-blastomas</td>
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<tr>
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<td>0</td>
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<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>29</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 1 summarizes the results according to type of lesion. It will be noted that 78% of all posterior fossa lesions were definitely diagnosed by the scan, a figure that rises to 84% if suspicious lesions are included. In general, the scans did not present subtle diagnostic problems, and the diagnoses represent the collective opinion of all the authors obtained on retrospective reading of the studies.

Of the total cases of acoustic neuromas, 83% were detected by the scan. They are characteristically seen in lateral view in the anterior portion of the posterior fossa, near the floor, contiguous with the sigmoid sinus (Fig. 1). It is important not to confuse this lesion with asymmetry of the sigmoid sinus. This can be avoided by taking note of the globoid form of uptake, and by comparison with the posterior view, in which the degree of sinus asymmetry, if any, should be apparent. On this view the area of uptake should appear in the paramedian position, often extending to the midline, just below the confluens sinuum.

Of the total cases of metastasis, 85% were detected by the scan (Fig. 2). The one metastasis that was missed was a squamous cell carcinoma in the cerebellopontine angle. In general, if the lesion is not midline, it will virtually always appear on one lateral view, and not on the other. The discrepancy in uptake between the two lateral views or the area beneath the transverse and sigmoid sinus is an important diagnostic clue to posterior fossa disease.

![Fig. 1. Right and left lateral and posterior view of a right acoustic neuroma (arrows). The radiolucent vertical line is a scanner artifact where the two collimators meet.](image-url)
The juvenile astrocytomas were detected in 86%, or six of seven cases. These astrocytomas are also seen in a midline or paramedian position on the posterior view (Fig. 3). They are, however, higher, and tend to overlie the confluens sinuum. In the lateral view they tend to be high, close to the transverse sinus. They may be seen either in the anterior portion of the fossa, close to the sinus, or posteriorly near the confluens sinuum.

All meningiomas were detected. In the case of those in the cerebellopontine angle, there was little about their appearance or location to suggest a histological diagnosis that would distinguish them from the acoustic neuromas. As a general rule, meningiomas tended to have the greatest uptake of any of the lesions.

Neither of the two medulloblastomas was positively detected. Two other children with medulloblastomas, however, were examined with an Anger scintillation camera instead of the ACRH scanner, because of their lack of cooperation, and are not included in this series; in both instances, the lesion was detected.

Both cases of ependymomas were detected, while only one of two hemangioblastomas was visualized, and the single cholesteatoma was missed.

**Discussion**

It is difficult to compare the results of the present series with those recorded by others, for two reasons. First, the larger series were performed with a variety of agents such as pertechnetate-99m, $^{197}$Hg-chlormerodrin, $^{203}$Hg-chlormerodrin, or $^{131}$I-HSA, most of them with the latter two agents. Second, the types of scanning devices varied widely. As a result, the success rates reported have varied from 20% to greater than 90%.$^{1,10,15,19,26}$ Many of the series consist of less than 10 cases, and it is difficult to draw significant
conclusions from them. One author reports a detection rate of 87% with 203Hg-chlormerodrin and 66% with pertechnetate-99m, but although there were 38 mercury scans, only six pertechnetate scans were obtained, and it may be that a larger sample would have reduced this difference. In some series, the isotopes are either not specified, or are mixed. It seems to be generally agreed that the difficulties in posterior fossa scanning with many tracers are primarily attributable to the overlying venous sinuses, especially the confluence of sinuses, and the heavy investment of muscles with their rich vascular supply at the posterior fossa. These problems are compounded by poor patient positioning in the posterior view. Many scanning systems make adequate flexion difficult or impossible.

Despite the variation in scanning techniques and isotopes used, there seems to be a general agreement that meningiomas are detected with great frequency. Metastases also are reported to be detectable in a large percentage of cases by some, although others report success in 50% or fewer cases. Planiol and Sachs were able to increase the percentage of detection considerably by the addition of special techniques such as contact counting and gamma-planigraphy using 131I-HSA. Gates and Dore report increasing success in detection by the use of delayed brain scanning with 99mTc.

It is interesting that the literature on acoustic neuromas is equivocal. Although many authors report a high degree of success in detection of this lesion, others have found a detection rate well below 50%. Although authors using similar isotopes report wide discrepancies in this case, there seems to be a tendency for greater success in detection of this tumor with pertechnetate-99m. We feel that adequate suppression of parotid activity is important in allowing visualization of cerebellar pontine angle tumors, and for this purpose, a dose of 1 gm perchlorate is currently used routinely.

Astrocytomata, especially cystic astrocytomata, are also detected in a high proportion of cases, except by Planiol and coworkers and Paillas and colleagues who used 131I-HSA. The reason for this discrepancy in these large series remains to be elucidated.

Success with medulloblastomas has been mixed, ranging from nearly 100% in some series to 50% or less in others while one author reports one positive, one equivocal, and one negative scan. As noted above, we detected neither of two positively with scanning, although one was suspicious. It should be noted that when the camera was used with the same isotope, we detected two of two. The difference, therefore, appears to be unrelated to isotope specificity.

Other lesions were reported in such small numbers as to defy meaningful comparison, but ependymomas may often be detected, and brain stem gliomas frequently so, although some authors rate this very low.

The location of the various tumors on the scan has been described by DeLand and Wagner and is the same as that noted in this series.

Conclusion

We believe that scanning of the posterior fossa should yield an accuracy close to that reported for the supratentorial region. Technetium-99m appears to be an adequate agent if the parotid gland is well blocked with perchlorate. The proper positioning of the patient is essential for good results. When the scan is properly performed, one can expect to detect nearly 100% of meningiomas, over 85% of ependymomas, metastases, and juvenile astrocytomata, and over 80% of acoustic neuromas. Our overall detection rate was 78%.

References

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