Radioisotope Scanning In Posterior Fossa Lesions

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It has been alleged that radioisotope scanning of posterior fossa lesions is of little value (1-8) or at best, difficult (9,10) and frequently unrewarding (11). Some clinics even report the virtual abandonment of posterior fossa scanning (12,13). On the other hand, there are those who maintain that scanning of the posterior fossa is a worthwhile adjunct in the evaluation of lesions in that region (14-19). Two of the studies (17, 18) employed multifocal probe scanning as opposed to conventional rectilinear scanning.

Much of the prejudice directed against posterior fossa scanning is of long standing and is felt to have originated in the period when brain scanning was a relatively new technique. It was during this era when iodinated human serum albumin was the scanning medium commonly employed, and when less sophisticated equipment was available for use. Both of these factors contributed to poor definition of lesions in an area where anatomical factors compounded the difficulties of interpretation. In addition to the confluence of the sinuses at the torcular, the transverse or lateral sinuses traverse the posterior fossa adding confusing vascular pickup. The statistical contribution of these vascular structures must be evaluated in the study of posterior fossa disease. With improved scanning media, the mercurials and more recently Tc, the vascular structures are more sharply delineated. Their delineation is enhanced by the improved technical depiction afforded by today's modern scanning equipment. A normal lateral scan, with the posterior fossa landmarks indicated, is shown in Fig. 1.

Inherent in the diagnosis of a posterior fossa lesion is its demonstration on at least two projections. In addition to the appropriate lateral view, a posterior scan should be obtained. Posterior fossa disease will often be obscured or missed on the anterior scan.

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The clinical material employed in this study originated from the regular work load of the Division of Nuclear Medicine. No arbitrary selection of patients was made. This report is based upon the first 27 cases of posterior fossa disease encountered in an approximate volume of 2200 routine brain scans performed for various reasons.

Most of the 2200 patients were referred to the Division of Nuclear Medicine because of the presence of neurological signs or symptoms. Sometimes, there was merely a history of head trauma. Often, demonstrable neurological signs were lacking but a convulsive disorder or headache syndrome were present. Occasionally, the examination was essentially a screening procedure in psychiatric cases or in patients with a known or suspected malignancy, particularly of lung or breast origin.

In a majority of the posterior fossa cases (22 of 27), there were clinical signs or symptoms referable to posterior fossa disease. The charts of all patients referred for any type of scanning are evaluated and abstracted by a physician of the Division. This abstract is incorporated into the patient's record in the department.

In the posterior fossa study, all patients with positive scans were followed until a diagnosis had been established by means of tissue or ancillary clinical studies (serial neurological examination, cerebral angiography, pneumoencephalography or ventriculography).

Fig. 1. Normal lateral scan with landmarks accented. Legend: A. Free edge of tentorium cerebelli, B. Tentorium cerebelli, C. Transverse sinus, D. Torcular (Confluence of the sinuses), E. Posterior margin, foramen magnum, F. Clivus and basilar plexus, G. Sella.
Obviously, the 27 cases cited did not represent all cases of posterior fossa disease seen in this institution. Many patients, particularly in the earlier phase of the study, received definitive therapy without benefit of brain scanning. Furthermore, within the group of 2200 patients studied, there may well have been undetected "false negative" cases, where scans were normal and posterior fossa disease was not detected or suspected on the basis of clinical and/or contrast studies.

It might be noted that of the 27 cases reported, five (18.5%) were children. Four were proven neoplasms and, one was a case of cerebellar contusion. The apparent low incidence of posterior fossa tumors in children is again felt to reflect the fact that the diagnosis was established clinically and often verified by contrast studies. Immediate surgical intervention occurred without the consideration of the benefits afforded by brain scanning. This situation obtains to a lesser degree at the present time.

MATERIALS AND METHODS

All patients but one were examined by means of radioactive mercurial compounds, either $^{197}$Hg or $^{203}$Hg chlormerodrin. An evaluation of the vascular contribution of the two mercurials is not feasible in this study due to the relatively small number of cases. Only the children and a few adults were examined with $^{197}$Hg. The last case included in this series was studied with $^{99m}$Tc as is

Fig. 2. Nine-year-old white female. Grade I astrocytoma. 2a. Posterior scan; 2b. Left lateral scan.
now our current practice. A multipurpose scanning instrument\(^1\) was employed with a three inches by two inches Tl-activated NaI crystal and a 19 hole focusing collimator. The instrument was modified in such a way that the spectrometer window was adjustable from 5\%-15\% of the energy range employed. For the Hg studies, a scanning speed of 30 cm/min was used. In almost all cases, a renal blocking dose of stable meralluride, 1 cc, was given 10 to 18 hours before the scan. Scanning was usually undertaken approximately two hours following injection of the radioactive material.

RESULTS

Both vascular and neoplastic lesions were defined by the scans. In the latter category, the pathologic foci were both primary and secondary. While many of the lesions were readily detectable on the anterior scan, they were often better delineated on the posterior scan as well as on the lateral projection. A posterior scan was performed when there was a suspicion of a posterior fossa lesion or where the lateral scan was positive in unsuspected or equivocal cases. Usually, the clinical information afforded, or the appearance of the anterior scan dictated which lateral projection was obtained. A recent modification in all brain scanning cases is the performance of the lateral study first, in order to determine whether an anterior or posterior coronal study should be made when there are no localizing signs.

\[\text{Fig. 2b. Left lateral scan.}\]

\(^1\)Nuclear-Chicago Pho-Dot.
Fig. 3. Sixty-year-old white female Metastatic adenocarcinoma (rectal primary). 3a. Posterior scan; 3b. Anterior scan; 3c. Left lateral scan. Note improved delineation of the lesion on the posterior scan.
ILLUSTRATIVE CASES

Figure 2 shows a brain photoscan of a nine-year-old white female prior to surgery. Operation revealed a Grade I astrocytoma involving the left cerebellar hemisphere primarily but extending across the midline. The size of the lesion on the scan correlated well with the actual size of the tumor as one would expect, there being no distortion or magnification of a well collimated depiction of a structure.

Figure 3 illustrates a posterior fossa lesion which proved to be metastatic at postmortem examination. It was located high in the vermis. There was a history of surgery for adenocarcinoma of the rectum four years earlier. The vermis lesion was consistent with this primary on pathologic evaluation.

Figure 4 represents the sequela of a vascular lesion of the cerebellar hemispheres. Encephalomalacia secondary to thrombosis was demonstrated at postmortem examination. While bilateral involvement was present, the lesion was predominantly left-sided.

In all but one of the cases which were verified by surgery or postmortem examination, a diagnosis of a posterior fossa lesion was made on the basis of the scan prior to surgery or the demise of the patient. There was one false negative study in a patient with a cystic astrocytoma of the right cerebellar hemisphere. Other authors report difficulty with the scan depiction of low grade astrocytomas, although we have not found this to be the case in several of our patients with such tumors.

We have a group of scans which show abnormal localization of the radioisotope in the posterior fossa and which were clinically proven to have posterior fossa disease. This expression indicates proof other than by tissue. Such proof might include contrast angiography, air studies, localizing neurological signs.

<table>
<thead>
<tr>
<th>Table I</th>
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<tbody>
<tr>
<td><strong>Lesion</strong></td>
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<tr>
<td>A. Tumor</td>
</tr>
<tr>
<td>1. Primary Neoplasm</td>
</tr>
<tr>
<td>a. Astrocytoma, Grade I</td>
</tr>
<tr>
<td>b. Hemangioblastoma</td>
</tr>
<tr>
<td>c. Fibrosarcoma</td>
</tr>
<tr>
<td>d. Cystic Astrocytoma (Missed)</td>
</tr>
<tr>
<td>2. Metastatic Neoplasm</td>
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<tr>
<td>3. 1st or 2nd Neoplasm</td>
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<tr>
<td>B. Vascular Lesions</td>
</tr>
<tr>
<td>1. Infarction</td>
</tr>
<tr>
<td>2. Contusion</td>
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<tr>
<td>C. Unknown Etiology</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
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Fig. 4. Fifty-four-year-old white female. Encephalomalacia secondary to vascular thrombosis. 4a. Posterior scan; 4b. Anterior scan; 4c. Left lateral scan. Note the superior sagittal and transverse sinuses in the posterior scan.
or a combination of two or more of these ancillary methods of establishing posterior fossa disease. There were 11 cases in this group of clinically proven but not tissue verified lesions. In addition, there were two other patients in whom posterior fossa disease could not be established due to lack of tissue or loss of the patient to follow up before clinical proof could be obtained.

A breakdown of the material contained within this study is presented in Table I.

**DISCUSSION**

Based upon our experience with posterior fossa scanning, it is felt that this procedure is a worthwhile adjunct in the evaluation of patients with intracranial disease. In our series, there is only one known false negative examination. The number of possible false positive studies cannot be stated with certainty as all patients did not have a tissue diagnosis. Those with a cellular diagnosis, and the patients with clinically proven posterior fossa disease numbered 25. An analysis of the 26 positive scans is depicted in Table II. Correlation of the scans with contrast studies and the presence or absence of posterior fossa clinical signs is tabulated. Comment is warranted regarding the 11 clinically proven cases, those without a tissue diagnosis. Five had contrast studies, of which three were positive and one suspicious. Only one was frankly negative. Of the six patients with no contrast studies in this group, five had serial brain scans showing enlarging metastatic lesions in the posterior fossa. Because of the obvious nature of their disease, these patients were not subjected to the rigors of further diagnostic examinations. Furthermore, the initial diagnosis was confirmed or established and subsequent progress was well documented by a safe and nonmorbid procedure, the brain scan. Fortunately, the technique is not limited by the lack of satisfactory scanning equipment or satisfactory radiopharmaceuticals.

**TABLE II**

**ANALYSIS OF 26 POSITIVE BRAIN SCANS**

<table>
<thead>
<tr>
<th>Type of Case</th>
<th>Arteriography or Air Studies</th>
<th>No Contrast Studies</th>
<th>Post. Fossa Signs (Clinical)</th>
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<tbody>
<tr>
<td>Tissue Diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(13)</td>
<td>6</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Clinically Proven</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(No Tissue) (11)</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Unproven (2)</td>
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<td>0</td>
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<td></td>
<td>1</td>
<td>1</td>
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1Five of these six had serial scans showing enlarging metastatic lesions.
SUMMARY AND CONCLUSIONS

The results of photoscanning in the evaluation of posterior fossa disease have been reviewed. It is maintained that this is a valuable adjunctive procedure. Twenty-four of 25 cases were diagnosed on the basis of the scan prior to surgery, postmortem examination or other definitive diagnostic measures. The search for posterior fossa disease should not be undertaken with pessimism.

REFERENCES

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