Sensitivity of Radionuclide Brain Imaging and Computerized Transaxial Tomography in Detecting Tumors of the Posterior Fossa: Concise Communication

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In a series of 25 patients with histologically proven mass lesions of the posterior fossa, computerized transaxial tomography (CTT) and radionuclide (RN) brain imaging detected 23 (92%) and 22 (88%) of the 25 tumors, respectively. In this small group of patients, the difference is not statistically significant. When the results of both techniques were combined, the detection rate was 100%, which emphasizes the complementary value of the two procedures. The two lesions not detected by CTT were metastatic carcinomas, and contrast enhancement was not employed. The three lesions not detected by RN imaging were cystic. The results may represent underestimates of the true sensitivity of both techniques since the use of contrast enhancement with CTT and of posterior flow studies and magnified static RN images of the posterior fossa would probably improve the sensitivity of both tests.

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Computerized transaxial tomography (CTT) has gained wide acclaim as a noninvasive technique for investigating brain lesions. However, the ability of this procedure to diagnose lesions of the posterior fossa has not been carefully compared with that of radionuclide (RN) brain imaging.

MATERIALS AND METHODS

Among the patients investigated for possible posterior fossa lesions at the Edward Mallinckrodt Institute of Radiology between March 1974 and March 1976, 41 had had both RN and CTT studies. Histopathologic diagnosis was available in 25 patients: following neurosurgery in 24 and autopsy in one. These 25 patients all had mass lesions of the posterior fossa.

The study group contained 13 males and 12 females, ranging in age from 3 to 80 years. The two studies were performed within 3 days of each other in 14 patients and within 7 days in eight others. In another (a patient with meningioma), the interval was 9 days; in another (hemiangioblastoma) it was 11 days. The 25th patient had a benign cyst (histologically unclassified) of the posterior fossa midline; here, the CTT was performed 27 days after the RN study.

The RN studies were performed with pertechnetate. In 15 patients, posterior cerebral bloodflow studies were performed with the scintillation camera immediately after the intravenous administration of the radionuclide bolus. Brain imaging in anterior, posterior, and both lateral projections was performed in most patients, utilizing a scintillation camera with parallel-hole collimator.* In a few patients we used a dual-head rectilinear scanner equipped with 5-in.

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low-energy focusing collimators.† Imaging was started 2–3 hr after radionuclide injection, and delayed views (3–5 hr after injection) were also obtained in many patients. In the patients who gave false-negative results, however, delayed scans were not obtained, nor was a pinhole collimator used with the scintillation camera.

The RN scans were considered abnormal when focal areas of increased radionuclide accumulation were seen in the region of the posterior fossa. The posterior cerebral bloodflow studies were considered to indicate a lesion in the posterior fossa when there were focal areas of increased or decreased flow in that region, with or without corresponding increased or decreased accumulation on the static image obtained immediately after the rapid-sequence flow study.

The CTT studies were performed on an EMI scanner using a standard technique. The x-ray tube was operated at 120 kVp and 33 mA with 8-mm collimation of the beam. The scan was conducted at a plane forming an angle of 25–30° with the orbitomeatal line. The image display consisted of an 80 × 80 matrix for seven patients examined in the early days of the EMI operation. The remaining patients were studied with a 160 × 160 matrix. Contrast enhancement was obtained in all but six patients by intravenous injection of 100 ml of iothalamate meglumine (60% solution), administered over a 4-min period, and a repeat scan was performed soon after. In children, the dose of the contrast material was adjusted according to body weight (0.75 ml/lb).

The CTT scans were interpreted as abnormal when there were cerebral densities differing, whether plus or minus, from those of the normal brain, before or after contrast injection. The fourth and lateral ventricles were evaluated for displacement and hydrocephalus, respectively, as signs of mass effect in the posterior fossa. In patients examined after excision of a posterior fossa lesion, the presence of areas showing contrast enhancement was considered as an evidence of recurrent or residual tumor tissue.

The results obtained with both CTT and RN scanning were reviewed for every patient, and the surgical as well as the histologic diagnoses were obtained from the clinical records.

RESULTS

Table 1 summarizes the results obtained with both CTT and RN in the 25 patients with proven diagnoses. The CTT and RN studies detected the tumors in 23 (92%) and 22 (88%) patients, respectively. Every patient had a positive result by at least one method. Both methods were abnormal in 20 patients.

TABLE 1. RESULTS OF RADIONUCLIDE BRAIN SCANNING AND COMPUTERIZED TRANSAXIAL TOMOGRAPHY IN PATIENTS WITH PROVEN POSTERIOR FOSSA TUMORS

Diagnosis	Number of patients	Scanning (positive/total)	Tomography (positive/total)
Astrocytoma	2	2/2	2/2
Medulloblastoma	5	5/5	5/5
Ependymoma	1	1/1	1/1
Differentiated gliocytoma	1	1/1	1/1
Hemangioblastoma	3	3/3	3/3
Meningioma	3	3/3	3/3
Schwannoma	3	3/3	3/3
Glial cyst	1	1/1	1/1
Benign cyst (histologically unclassified)	1	0/1	1/1
Epidermoid cyst	1	0/1	1/1
Epidermoid carcinoma	1	0/1	1/1
Metastatic carcinoma	3	3/3	1/3
Total	25	22/25	23/25

The cerebral bloodflow study was abnormal in the posterior fossa in nine of the 15 patients on whom the procedure was performed. Among the three patients with false-negative RN scans, the flow study was normal in one (epidermoid carcinoma) and was not obtained in the remaining two (histologically unclassified benign cyst and epidermoid cyst). No patient in the entire group had an abnormal flow study and a normal scan. However, in two patients with hemangioblastoma, the abnormal flow study was a definitive factor contributing to the correct interpretation of the scan since the abnormal changes on the latter were very subtle.

In one patient with recurrent medulloblastoma, the RN scan was considered abnormal because it showed uptake in the posterior fossa. Although it was not possible to differentiate between recurrent tumor and postcraniotomy changes, the scan's abnormality led to further workup and detection of the tumor. The CTT scan of this patient showed contrast enhancement of the lesion and this suggested the presence of tumor, which was later proven at surgery.

In 19 of the 23 patients with abnormal CTT studies, displacement of the fourth ventricle or dilatation of the lateral ventricles could also be detected on the CTT scans.

The two patients who gave false-negative CTT results were among those examined without radiographic contrast and with an 80 × 80 image matrix. Both patients had cerebellar metastases, secondary to carcinoma of the breast in one and of the colon in the other.

DISCUSSION

Radionuclide brain imaging of the posterior fossa, it has been increasingly recognized, is nearly as successful as that of the supratentorial region (*1–3*). However, the literature has reported varied success for CTT in detecting posterior fossa tumors (*4–6*).

Paxton and Ambrose report the detection by CTT of 24 (83%) of 29 posterior fossa neoplasms, with all the unrecognized lesions being cerebellar metastases (*4*). Gawler et al. state that only 55% of posterior fossa tumors were clearly seen on the CTT scans (*5*). In a series of 15 patients examined by CTT, Passalaqua et al. obtained positive detection rates of 71% and 67%, respectively, for primary and metastatic lesions of the posterior fossa (*6*). Gado et al. has suggested that RN scanning may be more accurate in the posterior fossa than CTT (*7*).

In our present series, the overall detection rate of posterior fossa tumors by RN and CTT studies are 88% and 92%, respectively. When the results of both procedures are combined, the detection rate becomes 100%, indicating the complementary value of both procedures.

The positive yield of our RN studies might have been improved if posterior flow studies had been carried out in all cases. Delayed views of the posterior fossa (3–5 hr after injection), especially if performed with the scintillation camera and a properly angled pinhole collimator, might also have improved the RN results if these had been done in all negative cases, especially since cystic (avascular) lesions are more likely to be detected on delayed views. Two of the three false-negative cases had cystic lesions, and in the third (with epidermoid carcinoma) a cystic component was also found at surgery.

Either RN brain imaging or CTT of the head is adequate for the detection of mass lesions of the posterior fossa. In our series, the CTT gave a slightly higher yield and also provided additional information related to the secondary mass effects on the ventricular system. However, RN brain imaging costs much less than CTT. Although more data are required for confirmation, it appears from this series and that of Paxton and Ambrose (*4*) that the false-negative CTT results in the posterior fossa were done with an image matrix of 80 × 80 without contrast enhancement in patients with cerebellar metastases. In such cases RN brain imaging may be more informative. If a negative result is obtained with one method in a patient with a high index of suspicion for a posterior fossa mass lesion, the other procedure should provide an excellent noninvasive complementary tool.

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FOOTNOTES

* Searle Radiographics Pho/Gamma III or IV HP scintillation camera (Des Plaines, Ill.).

† Ohio-Nuclear, Solon, Ohio.

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