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THE CLINICAL LIMITATIONS OF BRAIN SCANNING IN METASTATIC DISEASE

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Brain scans of forty-seven patients who underwent craniotomy for metastatic brain tumors from 1965 to 1972 were studied. Scans were performed with ^{99m}Tc-pertechnetate. Seventy-six percent of the patients had positive brain scans with the best correlation existing in metastatic lesions from the lung and malignant melanoma. Brain scans of patients with metastatic adenocarcinoma of the colon were "negative, in spite of a surgically significant space-occupying lesion". The solitary lesions averaged 4-cm in diameter and were grossly totally removed. It can be concluded that a negative brain scan in a patient with cancer and symptoms suggesting neurological disease cannot definitely rule out cerebral metastases. This conclusion is particularly true in patients with colonic cancer.

The brain scan has become the diagnostic study of preference in patients with suspected metastatic disease because of its safety and high clinical correlation. Although it has been reported that the positive yield of metastatic tumors approaches 90%, Krishnamurthy, et al (*1*) found 31% false-negative brain scans in patients with autopsy-proven cerebral metastases. Delayed scanning may improve the tumor uptake yet the total yield is unchanged (*2,3*).

In this communication, the surgical experience of the Neurosurgical Service at the University Hospital from 1965 to 1972 is evaluated and the findings correlated with preoperative brain scans. To the best of our knowledge, this is the first correlation of surgical pathology with brain scanning in the assessment of cerebral metastases. Only patients that came to craniotomy are included in this study. Those patients with clinical and radiological evidence of cerebral metastases but who did not come to surgery are not included. This retrospective study was begun to correlate the sensitivity of brain scans with the histopathology of cerebral metastases.

MATERIALS AND METHODS

Forty-seven patients from 1965 to 1972 underwent craniotomy for metastatic brain tumors. Neurological determination, particularly increased intracranial pressure, associated with a single lesion was used as the indication for surgical intervention. The majority of patients had skull x-rays, EEG, angiography, and/or air encephalography in addition to brain scanning as a part of the evaluation. Scans were performed with ^{99m}Tc-pertechnetate. Anterior, posterior, and two lateral views were routinely obtained immediately and 2 hr after injection of radioactive traces. Either scintillation camera images or rectilinear scans were obtained. The histology of each lesion was reviewed and was compatible with metastatic spread from the proven primary.

RESULTS

The comparison of histology and brain scanning is shown in Table 1. About 76% of the patients in this study had positive brain scans. These data indicate the best correlation exists in metastatic lesions from the lung and malignant melanoma. Only 4 of 22 (19%) patients with cerebral metastatic melanoma had a negative brain scan. This fact is consistent with the findings of others (*4,5*) and supports the value of brain scanning in the diagnosis of cerebral metastases.

Of six patients with adenocarcinoma of the colon, none had a positive scan in spite of a surgically sig-

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TABLE 1. COMPARISON OF BRAIN-SCAN RESULTS WITH HISTOLOGY OF CEREBRAL METASTASES

Source of cerebral metastases	Positive scans	Negative scans	% Negative
Lung	22	4	19
Breast	4	1	25
Genitourinary	4	0	0
Melanoma	6	0	0
Colon	0	6	100
	36	11	24%

nificant space-occupying lesion. Although one patient was found to have cerebral metastases prior to demonstration of the primary site, there was an average of a 19-month (range 0–26 months) interval between initial diagnosis of colon cancer and the onset of signs and symptoms suggesting metastatic disease to the CNS. An average of 5 months (range 0–8 months) lapsed between neurologic manifestation and demonstration with removal of the solitary metastatic lesion. The lesions averaged 4 cm in diam (range 3–5 cm) and were grossly totally removed.

The cause of the false negativity of brain scans in association with colon cancer requires further explanation. Although one lesion which was found in the posterior fossa may have been missed because of mastoid area uptake, the others were supratentorial without overlying bony or vascular structures that could "hide" a positive lesion. All six lesions were demonstrated by angiography and were at least 2 cm in diam. Thus, the false-negative scans were not secondary to undetectably small lesions. In a separate study, 869 brain scans performed at the University of Kentucky Medical Center in the calendar year of 1969 were analyzed and a false-negative rate of 14% was found. This would discount any technical difficulty which would account for a general abnormally high incidence of false negativity. Increased vascularity, abnormal vascular permeability, enlarged extracellular space, reactive edema, pinocytosis, and cellular metabolism have all been shown to be important in the uptake of various radiopharmaceuticals (*6*). The consistently high correlation with metastatic melanoma is probably related to the vascularity and hemorrhage that is associated with this tumor. The disparity of positive scans between lung and colon metastases cannot be explained readily although it may be related to differences in cellular metabolism, since clinically there is no difference in vascularity or reactive edema.

It can be concluded that although brain scanning is safe and relatively easy, a negative scan in a patient with cancer and symptoms suggesting neurological disease cannot definitely rule out cerebral metastases. This is particularly true in patients with colonic cancer. A negative pertechnetate brain scan is the rule rather than the exception with cerebral metastases from adenocarcinoma of the colon.

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REFERENCES

1. KRISHNAMURTHY GT, MEHTA A, TOMIYASU U, et al: Clinical value and limitations of ^{99m}Tc brain scan: an autopsy correlation. *J Nucl Med* 13: 373–378, 1972

2. RAMSEY RG, GUINN JL: Comparison of accuracy between initial and delayed ^{99m}Tc-pertechnetate brain scan. *J Nucl Med* 13: 131–134, 1972

3. GATES GF, DORE EK, TAPLIN GV: Interval brain scanning with sodium pertechnetate Tc-99m for tumor detectability. *JAMA* 215: 85–88, 1971

4. SPIERS ASD: Cerebral metastases from carcinoma of the lung. *Med J Aust* 67L178–183, 1969

5. YOUNG RL, ROCKETT RF: The brain as a routine screening procedure. *South Med J* 65: 65–70, 1972

6. BLAHD WH: *Nuclear Medicine*, 2nd ed, New York, McGraw-Hill, 1969, pp 238–240