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The Accuracy of Predicting Histologic Grades of Supratentorial Astrocytomas on the Basis of Computerized Tomography and Cerebral Angiography

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Summary. This report concerns a group of 49 patients who had been diagnosed as having gliomas on the basis of CT scans plus angiograms and for whom histologic proof was available. Ninety percent were found to be gliomas, 4% were metastases, and histology was unclear in the rest. Combining the CT criteria of inhomogeneous enhancement and surrounding edema with one or more of three angiographic signs (early venous drainage, stain, abnormal vessels) allowed a more confident diagnosis of glioblastoma.

The effectiveness of computerized tomography (CT) in demonstrating the presence of intracranial tumors, especially after injection of contrast media, is well known. Several authors have attempted to differentiate gliomas, meningiomas, and metastases on the basis of CT findings, without clear success except for meningiomas and multiple metastases [1-3, 7]. However, Steinhoff et al. made the correct diagnosis, based on CT findings, in 70% of glioblastomas [4], and Tchang et al. believed that differences in appearance of various gliomas was sufficient to allow predictions of grades of malignancy [5]. There are practical reasons for attempting to identify gliomas and distinguish high from low grades. Surgery may be beneficial for the low-grade tumors, while prognosis is bleak for the high-grade gliomas [3]. If the diagnosis is highly probable, the risk of biopsy may not be worthwhile.

Materials and Methods

The CT scans performed at UCLA Medical Center from 1974 to 1977 were reviewed to find those cases reported as showing tumors. The angiogram reports of these patients were then checked. A group of patients was defined in whom the probable diagnosis of glioma had been made following CT and angiography. Surgical pathology and autopsy reports were then reviewed and 49 cases were found which had been diagnosed as probable gliomas and which had pathologic proof. The CT scans were performed on an EMI 160 matrix scanner, before and after infusion of 300 ml methylglucamate iothalamate 30%. These scans were reviewed and the density of the lesion on the precontrast scan was graded as hypodense, hyperdense, or mixed. Density after contrast was graded as absent, homogeneous enhancement, or inhomogeneous enhancement. The angiograms were checked for the presence of stain, abnormal-looking vessels, and early venous filling. These findings were correlated with the histologic diagnoses. The astrocytomas were divided into three groups: grade I-II, grade II-III, and grade III-IV. The need for the intermediate group arose because five tumors were so graded.

Results

Histologic diagnoses of the 49 cases are listed in Table 1. Ninety percent of the cases were gliomas, with 43% of these being grade III-IV. Two cases (4%) were metastases, both ovarian carcinoma. There were two cases of undifferentiated malignancy and biopsy was undiagnostic in one case.

On precontrast scans, 80% of the gliomas and 66% of the glioblastomas were hypodense. Glioblastomas were classified as hypodense when that was the predominant visual impression, though parts of the tumor rim may have been isodense. All but one of the glioblastomas (95%) showed contrast enhancement (Table 2). Enhancement was inhomogeneous in 90% of the glioblastomas, usually consisting of an irregular, stained rim surrounding a central hypodensity. No enhancement occurred in 73% of the grade I-II astrocytomas, with inhomogeneous enhancement in the others. There were too few gliomas in the other categories to allow generalizations regarding enhancement.

Angiograms (Table 3) showed staining in 90% of glioblastomas, and abnormal vessels or early filling veins in 71% (not necessarily the same cases). All the glioblastomas had at least one of these signs, 81% had two, and 52% had all three. Angiograms of the two undifferentiated malignancies and the one ganglioglioma also showed

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Table 1. CT density – precontrast

	Number of cases	Hypodense	Mixed	Isodense	Hyperdense
Astrocytoma					
Grade I-II	11	10	-	1	-
Grade II-III	5	4	-	1	-
Grade III-IV	21	18	-	-	3
Oligodendroma	2	1	1	-	-
Mixed glioma	3	1	2	-	-
Ganglioglioma	1	-	1	-	-
Glial cyst	1	1	-	-	-
Metastasis (ovarian carcinoma)	2	-	-	-	2
Undifferentiated malignancy	2	1	-	1	-
Nondiagnostic biopsy	1	-	-	-	1

Table 2. CT enhancement pattern

	Number of cases	None	Homogeneous	Inhomogeneous
Astrocytoma				
Grade I-II	11	8	-	3
Grade II-III	5	3	-	2
Grade III-IV	21	1	1	19
Oligodendroma	2	1	-	1
Mixed glioma	3	1	2	-
Ganglioglioma	1	1	-	-
Glial cyst	1	1	-	-
Metastasis (ovarian carcinoma)	2	-	2	-
Undifferentiated malignancy	2	-	-	2
Nondiagnostic biopsy	1	-	-	1

Table 3. Angiograms

	Number of cases	Abnormal vessels	Staining	Early veins
Astrocytomas				
Grade I-II	11	-	1	-
Grade II-III	5	2	1	1
Grade III-IV	21	15	19	15
Oligodendroma	2	-	-	-
Mixed glioma	3	-	1	-
Glial cyst	1	-	-	-
Metastasis (ovarian carcinoma)	2	1	-	-
Undifferentiated malignant tumor	2	2	2	2
Ganglioma	1	1	1	1
Nondiagnostic biopsy	1	-	-	-

all three signs. Angiograms of the two metastases showed abnormal vessels in one.

In brief, 95% of the glioblastomas showed inhomogeneous staining on CT and all glioblastomas had at least one of the three angiographic signs.

Discussion

In this series, all histologically proved gliomas had positive CT scans and the specific diagnosis of glioblastoma had been suspected in all but one of the tumors later proved to be glioblastoma. The glioblastomas were generally hypodense before contrast injection, and showed a high frequency of inhomogeneous staining, irregularity of tumor margins, and surrounding edema following enhancement, all signs which have been noted by others [4-6]. These were not the only criteria which had been considered in making the initial CT diagnosis of probable glioblastoma. Other factors favoring this diagnosis are edema of moderate degree, a relatively large tumor, and a relatively deep location. Growth across the corpus callosum is also highly suggestive. Clinical information was also reviewed; this helped eliminate most metastases, and is a major reason why none of the abscesses encountered during this period was incorrectly diagnosed as glioblastoma.

Angiography is advised by some authors for nearly all cases of suspected glioma to provide more diagnostic and presurgical information [3, 7], and we adhere to this principle. In this series, angiograms showed, in each case of glioblastoma, one or more of the three signs evaluat-

ed: stain, early venous filling, abnormal vessels. This helped separate glioblastomas from low-grade astrocytomas, which rarely showed these signs. Angiography also allows recognition of the rare meningioma that resembles glioblastoma on CT. Indeed, some metastases resemble glioblastomas on both CT and angiography. However, the therapeutic consequences of calling a metastasis a glioblastoma are small compared to those of misdiagnosing a benign tumor. Adding angiography to CT allows one to make a diagnosis of glioblastoma with a high degree of probability, a factor to consider when deciding whether or not to perform a biopsy.

References

1. Claveria, L.E., Kendall, B.E., du Boulay, G.H.: Computerized axial tomography in supratentorial gliomas and metastases. In: The first European seminar on computerized axial tomography in clinical practice, pp. 85-93 (eds. G.H. du Boulay, I.F. Moseley). Berlin: Springer 1977
2. Grumme, T., Steinhoff, H., Wende, S.: Diagnosis of supratentorial tumors with computerized tomography. In: Cranial computerized tomography, pp. 80-89 (eds. W. Lanksch, E. Kazner). Berlin: Springer 1976
3. Logue, V.: The radiologic management of cerebral tumors. In: The first European seminar on computerized axial tomography in clinical practice, pp. 76-84 (eds. G.H. du Boulay, I.F. Mosely). Berlin: Springer 1977
4. Steinhoff, H., Lanksch, W., Kazner, E., Grumme, T., Meese, W., Lange, S., Aulich, A., Schindler, E., Wende, S.: Computed tomography in the diagnosis and differential diagnosis of glioblastomas. A qualitative study of 295 cases. Neuroradiology 14, 193-200 (1977)
5. Tchang, S., Scotti, G., Terbrugge, K., Melancon, D., Belanger, G., Milner, C., Ethier, R.: Computerized tomography as a possible aid to histologic grading of supratentorial gliomas. J. Neurosurg. 46, 735-739 (1977)
6. Thomson, J.L.G.: Computerized axial tomography and the diagnosis of a glioma: A study of 100 consecutive histologically proven cases. Clin. Radiol. 27, 431-441 (1976)
7. Wende, S., Aulich, A., Schindler, E., Grumme, T., Meese, W., Lange, S., Kasner, E., Steinhoff, H., Lanksch, W.: A German multicentric study of intracranial tumors. In: The first European seminar on computerized axial tomography in clinical practice, pp. 111-117 (eds. G.H. du Boulay, I.F. Mosely). Berlin: Springer 1977

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