Cysts in malignant gliomas
Identification by computerized tomography

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The clinical course, computerized tomography (CT) scans, and postmortem reports for 265 patients treated for malignant brain tumors were reviewed. Forty-one patients underwent reoperation for tumor recurrence and one had needle aspiration as a diagnostic procedure; of these patients, seven (3% of 265 and 17% of 42) were diagnosed as harboring tumor cysts and 10 (25% of 41) as having necrotic tumor centers. The CT scans on the 17 patients harboring tumors with surgically confirmed cysts and necrotic centers were reviewed; criteria for distinguishing between cysts and central necrosis are suggested. The relative benefits of repeated aspiration and surgical therapy for these cystic lesions are discussed.

KEY WORDS: malignant glioma, computerized tomography, intratumoral cyst

The value of computerized tomography (CT) for the follow-up review of brain-tumor patients undergoing therapy has been described. Alterations in the size, shape, and consistency of the tumor demonstrated by CT influence the treatment schedules. A method to analyze CT-demonstrated central tumor lucencies to distinguish between central tumor necrosis and tumor cyst would be clinically useful. If cystic transformation of a primarily solid tumor can be reliably detected, then cyst aspiration and/or other surgical procedures can be applied to relieve elevated intracranial pressure and associated neurological symptoms.

Clinical Material and Methods

The clinical course and CT scans of 265 patients with malignant supratentorial gliomas treated on the Neuro-Oncology Service of the Brain Tumor Research Center, Department of Neurological Surgery, School of Medicine, University of California, San Francisco, were reviewed. These patients were treated between January 1, 1976, and March 1, 1978 (26 months). Diagnosis was confirmed at operation in 239 patients. All patients received both systemic chemotherapy and radiation therapy, in conformance with one of several protocols. Patients were evaluated at 6- to 8-week intervals by neurological examination, radionuclide brain scan, and CT scans. The period of treatment and observation varied from 3 months to several years. Forty-one patients underwent reoperation. In six of these patients, the tumors were cystic; cyst formation was also identified by needle aspiration in one of the nonoperated patients, making a total of seven patients with cystic glioma.

The CT scans were performed on an EMI Mark I or 5005 scanner. All patients were studied following intravenous injection of contrast material (42 gm of meglumine iothalamate). Precontrast scans were obtained routinely every third visit or earlier if the patient had a significant change in clinical status.

Summary of Cases

Clinical Course

The clinical course and relative efficacy of cyst aspiration in the seven patients with cystic glioma are summarized in Fig. 1; the sequential CT scans of four of the seven patients are shown in Figs. 2 to 5. None of the cysts communicated with the ventricular system. Cyst protein content ranged from 0.5 to ~3.5 gm/dl. There was no pleocytosis. Tumor histology was determined after the initial operation. On the basis of angiography, CT findings, and clinical course, it was thought at the time of clinical recurrence that all of the
astrocytomas had transformed to malignant tumors; this was confirmed at postmortem examination.

In Cases 1 to 4 (highly malignant tumors), rapid clinical deterioration necessitated cyst aspiration as a lifesaving measure. All four patients improved promptly. After surgical evacuation of the cyst, the clinical status of Case 2 (initially an unoperated glioblastoma multiforme) was superior to the clinical status at the time of initial diagnosis. In Cases 5 and 6, deterioration of consciousness and focal signs was gradual, but accelerated abruptly before cyst drainage. All patients improved promptly after aspiration, but reaccumulation of fluid necessitated repeated aspirations in Cases 4 and 5, and placement of a ventriculoperitoneal shunt in Cases 5 and 6. In Case 7, hemiparesis and aphasia gradually became more pronounced; cyst aspiration did not effect a change, probably because the cyst fluid pressure was only moderately elevated. Clinical improvement occurred only after the chemotherapy regimen was changed.

The rate at which cysts developed in these primary tumors of the central nervous system was quite variable, but in general it was more rapid with more malignant lesions. In astrocytomas that transformed to more malignant tumors, cyst development occurred a minimum of 1 year after the initial operation, and persisted for 10 to 24 months. Ultimately, the fluid compartment in three of these cysts progressively diminished in size, but was replaced by a solid tumor. Developing central tumor cysts produced vary-
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**FIG. 3.** Case 4. Serial computerized tomography of a cystic malignant glioma. S/P = status post; RT = radiation therapy.

**FIG. 4.** Case 5. Serial computerized tomography of a malignant glioma. The cyst fluid level was observed 12 months after recurrence. S/P = status post.
FIG. 5. One hour delayed scan on a patient harboring a cystic malignant glioma. Note the contrast fluid level and the shift of level when the patient is placed in the decubitus position (right). 

In two of the seven cystic lesions studied, an intracystic contrast fluid level was seen. This phenomenon was accentuated by rescanning the patient 1 hour after infusion. In these cases, on delayed scans the central lucency will often increase in density in a relatively homogeneous manner over time (Fig. 6). In tumors with central necrosis, a fluid level does not develop.

Discussion

Reoperation of supratentorial malignant gliomas is usually associated with high morbidity and mortality. Although some authors mention the occurrence of cystic tumors in patients who experience a recurrence, only Poisson, et al. cited statistical information from a series; they found a frequency of 5% to 8% of cystic tumors in patients harboring malignant gliomas. They designated them "pseudocysts," and advocated surgery as the treatment of choice. The series reported here is only approximate and probably underestimates the true incidence of tumor cysts, because it includes only patients with diagnoses of cyst formation verified at operation.

From the total study population of 265 patients, seven cysts were detected by operation or cyst aspiration. In this series, 17% (seven of 42 patients) had intratumoral cysts (the incidence of which is probably too high), while the absolute incidence of 3% (seven of 265 patients) is probably far too low; we estimate that a true absolute incidence is 8% to 10%.

Although cyst formation is well recognized in primary hemispheric gliomas, its occurrence is more common in well differentiated astrocytomas. Glioblastoma multiforme and anaplastic astrocytoma are considered to contain small or occasional spontaneously developing large cysts that arise from rapidly progressing tissue necrosis and subsequent fluid accumulation. The degree to which intensive radiation therapy and chemotherapy modifies this process is not clear.

In four of the seven patients with cystic recurrent tumor, the evolution of a cyst was accompanied by clinical signs of acutely increased intracranial pressure. Aspiration produced prompt relief. In the other three patients, the temporal relationship between cyst development and alteration in clinical status was less direct. In Case 6, cyst formation preceded a modest decrease in mentation (Fig. 1); a more pronounced decline in mental status and progression of focal signs appeared later. Aspiration alone gave satisfactory improvement in two patients. Case 7 is remarkable in that the long-term presence of a cyst did not produce signs of increased intracranial pressure. Aspiration of the cyst did not cause clinical improvement in Case 7.

Our experience suggests that clinical status at the time of cyst formation determines the expected benefits of cyst aspiration. A rapid and pronounced improvement can be expected if the formation or enlargement of the cyst initially causes rapid clinical...
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deterioration. A single aspiration was sufficiently palliative in five of the seven patients. In two patients, reaccumulation of cyst fluid necessitated repeated taps and, ultimately, placement of a reservoir and/or permanent shunt. Subsequent to this study, in patients in whom tumor cyst fluid reaccumulation persists despite repeated taps and/or shunt procedures, we have instilled phosphorus-32 (32P)-colloid directly into the cyst with good results.

From a radiological point of view, the CT appearance of intratumor cyst is that of a relatively well marginated lesion on its inner aspect with a low-density center. If a cyst is suspected, then a delayed scan should be obtained to determine if a contrast fluid-cyst fluid level can be demonstrated. In general, the mean density of the low-density tumor center does not distinguish it from an area of central necrosis, although the latter lesions tend to have more irregular margins. It is hoped that, in the future, analysis of histograms of these central lesions will serve to better distinguish cysts from necrosis.

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References


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