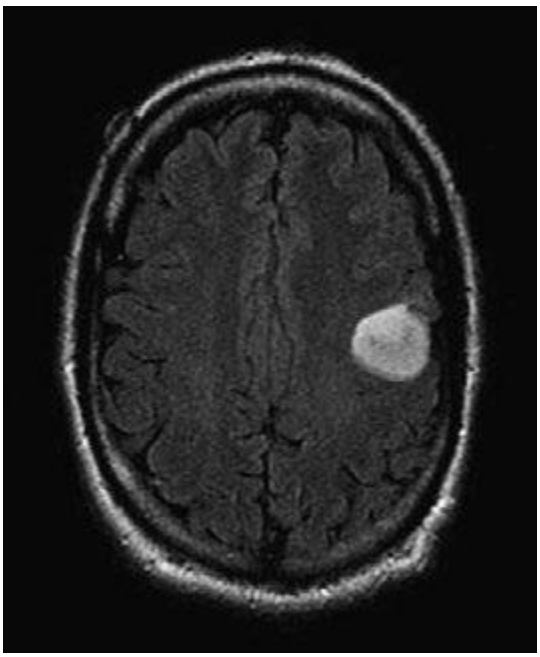

**FIGURE 118-1 Fluid-attenuated inversion recovery (FLAIR) MRI of a left frontal low-grade astrocytoma.** This lesion did not enhance.

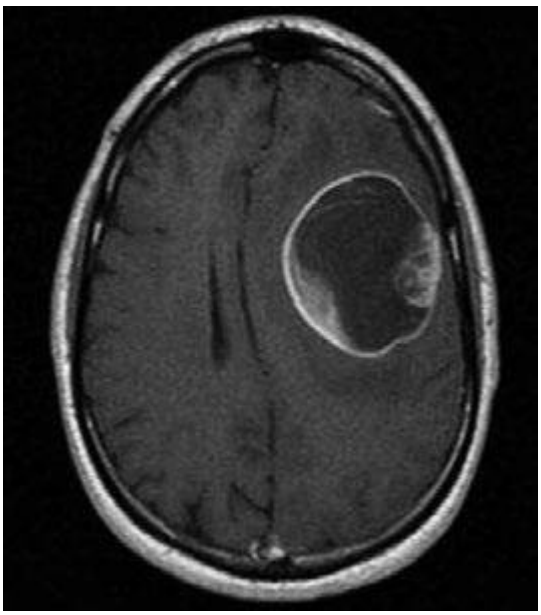

**FIGURE 118-2 Postgadolinium T1 MRI of a large cystic left frontal glioblastoma.**

with an enhancing mural nodule. These are well-demarcated lesions that are potentially curable if they can be resected completely. Giant-cell subependymal astrocytomas are usually found in the ventricular wall of patients with tuberous sclerosis. They often do not require intervention but can be treated surgically or with inhibitors of the mammalian target of rapamycin (mTOR).

***GRADE II ASTROCYTOMAS*** These are infiltrative tumors that usually present with seizures in young adults. They appear as nonenhancing tumors with increased T2/FLAIR signal (Fig. 118-1). If feasible, patients should undergo maximal surgical resection, although complete resection is rarely possible because of the invasive nature of the tumor. Radiation therapy (RT) is helpful, but there is no difference in overall survival between RT administered postoperatively or delayed until the time of tumor progression. There is increasing evidence that chemotherapeutic agents such as temozolomide, an oral alkylating agent, can be helpful in some patients. The tumor transforms to a malignant astrocytoma in the majority of patients, leading to variable survival with a median of about 5 years.

### High-Grade Astrocytoma

***GRADE III (ANAPLASTIC) ASTROCYTOMA*** These account for approximately 15–20% of high-grade astrocytomas. They generally present in the fourth and fifth decades of life as variably enhancing tumors. Treatment is the same as for glioblastoma, consisting of maximal safe surgical resection followed by RT with concurrent and adjuvant temozolomide or by RT and adjuvant temozolomide alone.

***GRADE IV ASTROCYTOMA (GLIOBLASTOMA)*** Glioblastoma accounts for the majority of high-grade astrocytomas. They are the most common malignant primary brain tumor, with over 10,000 cases diagnosed each year in the United States. Patients usually present in the sixth and seventh decades of life with headache, seizures, or focal neurologic deficits. The tumors appear as ring-enhancing masses with central necrosis and surrounding edema (Fig. 118-2). These are highly infiltrative tumors, and the areas of increased T2/FLAIR signal surrounding the main tumor mass contain invading tumor cells. Treatment involves maximal surgical resection followed by partial-field external-beam RT (6000 cGy in thirty 200-cGy fractions) with concomitant temozolomide, followed by 6–12 months of adjuvant temozolomide. With this regimen, median survival is increased to 14.6 months compared to only 12 months with RT alone, and 2-year survival is increased to 27%, compared to 10% with RT alone. Patients whose tumor contains the DNA repair enzyme $O^6$-methylguanine-DNA methyltransferase (MGMT) are relatively resistant to temozolomide and have a worse prognosis compared to those whose tumors contain low levels of MGMT as a result of silencing of the MGMT gene by promoter hypermethylation. Implantation of biodegradable polymers containing the chemotherapeutic agent carmustine into the tumor bed after resection of the tumor also produces a modest improvement in survival.

Despite optimal therapy, glioblastomas invariably recur. Treatment options for recurrent disease may include reoperation, carmustine wafers, and alternate chemotherapeutic regimens. Reirradiation is rarely helpful. Bevacizumab, a humanized vascular endothelial growth factor (VEGF) monoclonal antibody, has activity in recurrent glioblastoma, increasing progression-free survival and reducing peritumoral edema and glucocorticoid use (Fig. 118-3). Treatment decisions for patients with recurrent glioblastoma must be made on an individual basis, taking into consideration such factors as previous therapy, time to relapse, performance status, and quality of life. Whenever feasible, patients with recurrent disease should be enrolled in clinical trials. Novel therapies undergoing evaluation in patients with glioblastoma include targeted molecular agents directed at receptor tyrosine kinases and signal transduction pathways; antiangiogenic agents, especially those directed at the VEGF receptors; chemotherapeutic agents that cross the blood-brain barrier more effectively than currently available drugs; gene therapy; immunotherapy; and infusion of radiolabeled drugs and targeted toxins into the tumor and surrounding brain by means of convection-enhanced delivery.

The most important adverse prognostic factors in patients with high-grade astrocytomas are older age, histologic features of glioblastoma, poor Karnofsky performance status, and unresectable tumor. Patients whose tumor contains an unmethylated MGMT promoter resulting in the presence of the repair enzyme in tumor cells and resistance to temozolomide also have a worse prognosis.

**Gliomatosis Cerebri** Rarely, patients may present with a highly infiltrating, nonenhancing tumor of variable histologic grade involving more than two lobes of the brain. These tumors may be indolent initially, but will eventually behave aggressively and have a poor outcome. Treatment involves RT and temozolomide chemotherapy.

## OLIGODENDROGLIOMA

Oligodendrogliomas account for approximately 15–20% of gliomas. They are classified by the WHO into well-differentiated oligodendrogliomas (grade II) or anaplastic oligodendrogliomas (AOs) (grade III). Tumors with oligodendroglial components have distinctive pathologic