Tumor Treating Fields—An Emerging Cancer Treatment Modality

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Tumor treating fields (TTFs) are an evolving new anticancer modality. The U.S. Food and Drug Administration has approved the first device, the NovoTTF-100A™, that uses this technology and is indicated for use in progressive glioblastoma multiforme after standard therapies have failed. Promising clinical trial results will likely lead to expanded uses in primary brain tumors and other cancer types. This article will review the concept of TTFs and their mechanism of action, and overview the TTF device and its approved usage.

Glioblastoma

In 2013, about 23,130 people will be diagnosed with a malignant tumor of the brain or spinal cord, and an estimated 14,080 will die from these tumors (American Cancer Society, 2013). Glioblastoma multiforme is the most common and aggressive primary malignant brain tumor in adults. Median survival is about 15 months from diagnosis, with most tumors reoccurring within nine months of initial treatment (Stupp et al., 2005).

Standard initial therapy for glioblastoma multiforme includes maximal surgical resection and combined temozolomide chemotherapy with radiation, followed by at least six cycles of monthly adjuvant temozolomide (National Comprehensive Cancer Network [NCCN], 2013). Treatment options are limited for patients with recurrent glioblastoma multiforme. At the time of reoccurrence, re-resection and re-irradiation are options for some patients. Chemotherapy agents have limited effectiveness because of the blood-brain barrier, a tightly woven mesh of endothelial cells, astrocytes, and transmembrane proteins that line the vessels of the central nervous system. The barrier restricts diffusion of bacteria and other large or water-soluble molecules from the bloodstream into the brain. As a result, most chemotherapy agents cannot penetrate the brain. Agents that are used at reoccurrence include temozolomide, the nitrosoureas (carmustine and lomustine), carboplatin, irinotecan, and procarbazine. In May 2009, bevacizumab was approved and frequently is incorporated into recurrent glioblastoma multiforme treatment.