Osmotic Blood-Brain Barrier Modification for the Treatment of Malignant Brain Tumors

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The American Cancer Society estimated that in the United States, more than 18,400 cases of primary malignant brain tumors will be diagnosed in 2004. From these, 12,690 deaths are expected to occur (Jemal et al., 2004). The 2000 Central Brain Tumor Registry of the United States (CBTRUS) predicted that 39,550 new cases of primary benign and malignant brain tumors would be diagnosed in 2002. Metastases to the brain from a systemic primary cancer are even more common, with an estimated 100,000 new cases each year (CBTRUS, 2000). In adults, the most common brain metastases originate from lung cancer (34%), breast cancer (21%), and melanoma (12%) (Chidel, Suh, & Barnett, 2000). Primary brain tumors affect people of all ages, with peak incidences of certain tumor types, such as pilocytic astrocytomas and medulloblastomas, in early childhood and others, such as meningiomas and glioblastomas, in later adulthood.

Although treatment approaches with new chemotherapeutic agents have improved the outcomes of cancer treatment for systemic diseases, survival for malignant central nervous system (CNS) lesions has been poor. Chemotherapy has been relatively ineffective, and radiation therapy has caused neurotoxicity, often leaving patients with serious cognitive impairments (Crossen, Garwood, Glatstein, & Neuwelt, 1994). Limited penetration of cytotoxic drugs across the blood-brain barrier (BBB) and intrinsic tumor cell resistance are believed to be partially responsible for treatment failures (Bart et al., 2000). Issues involving drug delivery to tumors, including blood flow, drug concentration, and time of exposure, are believed to be compounded for tumors in the CNS because of the BBB.

The Blood-Brain Barrier

The BBB is a physiologic barrier that protects the brain from toxic substances, including most of the chemotherapeutic agents used today. The BBB may be partly responsible for the poor efficacy of chemotherapy for malignant primary or metastatic brain tumors. A technique of osmotic modification of the BBB, known as BBB disruption (BBBD), is used to increase the delivery of chemotherapy to the brain. This article discusses the technique of osmotic opening of the BBB, the national BBBD program, the role of nurses in the care and management of patients undergoing BBBD treatment, outcomes of this technique with a variety of brain tumors, and the future directions of the BBBD program.

Key Words: brain neoplasms, blood-brain barrier