Differences Between Adult and Pediatric Brain Tumors

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Childhood brain tumors are not just the same tumors that arise in adulthood. Brain tumors in children and adults differ significantly in their incidence, tumor type, and treatment. Overall, survival rates for those with brain tumors are better in childhood than in the adult years. However, the immaturity of the child's brain makes treatment decisions difficult, especially in infants.

The majority of adult tumors are metastatic lesions secondary to tumors such as cancers of the colon and lung whereas metastatic lesions are uncommon in children. When considering only tumors that primarily arise in the brain, adult tumors are ten times more common than those arising in children. The majority of adult primary brain tumors are malignant gliomas or meningiomas, primarily occurring in the cerebral cortex.

In comparison, childhood brain tumors are rare, arising in 2.5 to 3 children per 100,000 at risk, but are the leading cause of cancer-related death in childhood and comprise the majority of all solid tumors occurring in those less than 18 years of age. Approximately 50% of childhood brain tumors are benign (especially low-grade, pilocytic gliomas), and they tend to occur more frequently in the lower portions of the brain, called the posterior fossa. Childhood brain tumors can also arise in the cerebral cortex, as in adulthood.

There are two other potential hotspots for the development of childhood supratentorial brain tumors: the suprasellar region (the area behind the eyes and on top of the pituitary gland) and the pineal region. Each has its own specific types of presentation and array of tumor types.

As regards the types of tumors which arise in children, more children than adults will develop embryonal tumors, the most common of which is medulloblastoma. Because of the primitive nature of childhood embryonal brain tumors, they are likely to spread to other parts of the central nervous system early in illness or at time of relapse. This is why treatment often has to be given to the entire brain and spine at the time of diagnosis, where this type of approach is less commonly needed in adult brain tumors.

Despite the primitive nature of many childhood brain tumors, overall survival rates are much better in children with malignant tumors than in adults with malignant lesions. As an example,
the survival rate for children with medulloblastoma, the most common malignant tumor of childhood, especially in tumors occurring in children greater than three years of age and having tumors amenable to complete resection, is as high as 90% at five years; with the majority of children cured of their disease. However, the price paid for this high survival rate is daunting.

Even with apparent identical tumor types, new information concerning the molecular biology of brain tumors strongly suggests that brain tumors are different in adults and children. The molecular composition of childhood high-grade gliomas does not fit neatly into the sub-groupings used for adults and they are likely biologically different tumors.

Childhood low-grade gliomas are infrequently grade 2 tumors and are more likely to be pilocytic (grade 1) tumors which have a significantly different prognosis than adult low-grade tumors. The majority of pilocytic tumors have a characteristic molecular signature and a far better prognosis than grade 2 tumors, remaining benign throughout life.

The most common low-grade tumor type in adults is the grade 2 tumor which has a tendency to mutate into higher grade lesions over a three to five year period of observation. Other tumor types, such as the atypical teratoid/rhabdoid tumor and some primitive neuroectodermal tumors rarely, if ever, arise in adults, but make up a considerable percentage of childhood brain tumors.

A major issue in the management of brain tumors, in general, is the nihilistic attitude often present approaching adult malignant tumors compared to the more positive attitude mandatory to effectively manage childhood brain tumors. It is true that some childhood brain tumors, such as diffuse intrinsic brain stem gliomas and atypical teratoid/rhabdoid tumors in very young children, carry a poor prognosis.

However, overall, 75% or more of children diagnosed with a brain tumor within the first 18 months of life can be expected to be alive five years later, at least two-thirds of whom are likely cured of their disease. Since the majority of children with primary central nervous system tumors can be expected to be "cured" with initial treatment, appropriately there has been a great deal of concern raised over the quality of life of survivors.

The majority of children with malignant brain tumors will require both radiation and chemotherapy for long-term disease control. For the embryonal tumors, radiation therapy usually needs to be given to the entire brain and spine to eradicate disease that has already spread to the neuroaxis (which may not even be evident on neuroimaging studies) at the time of diagnosis.

Such treatment, especially in the very young child, can result in significant progressive long-term cognitive, endocrinological, and psychological damage. This is another major difference between adults and children. Other factors, including preoperative neurologic status, postoperative neurologic complications, chemotherapy, and poorly understood host genetic susceptibilities also play a significant role in the development and severity of long-term sequelae.

There is increasing hope that the treatment of childhood brain tumors will improve significantly in the near future. Over the past decade, a great deal more has been learned about the molecular makeup of childhood brain tumors. In time, the goal is to translate this information into more personalized, safer treatment. Molecular-based therapies are now being incorporated into management of childhood brain tumors utilizing anti-blood vessel agents (angiogenesis drugs), anti-growth factor agents, and other biologic approaches.

Although exciting, a major challenge in the future will be to determine how these biologic factors affect the immature central nervous system and making sure that these treatments actually result not only in improved survival, but in an improved quality of life.