

Disease Focus - Central Nervous System Tumors

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Central nervous system (CNS) tumors, the 2nd most common cancer diagnosed in children after acute leukemia, account for 20% of pediatric malignancies¹. Annual incidence in the United States (US) varies based on age. For the younger pediatric group (0 – 14 years of age), it is 5.65 cases per 100,000, while in the adolescent and young adult (AYA) group, it is slightly higher at 11.20 per 100,000. The central brain tumor registry estimates that approximately 3,720 new pediatric cases and 12,290 AYA new cases are expected to be diagnosed in 2019 alone². Mortality remains a significant issue for those diagnosed with CNS tumors. During the period of 2011 – 2015, the average annual mortality rate for pediatric CNS tumors in the US was 4.37 per 100,000, with approximately 77,000 deaths attributed to primary malignant brain and spinal cord tumors alone in 2018. Even with an increase in the five-year relative survival rate to 74.1%, CNS tumors have surpassed all other pediatric cancers to become the leading cause of cancer-related death in children^{2,3}.

There are several risk factors that may predispose to development of these tumors; however, less than 10% of children with CNS tumors have a genetic disorder that places them at an increased risk. These genetic syndromes that are known to be associated with an increase in predilection for CNS tumor development include: Neurofibromatosis type 1 (NF1), Neurofibromatosis type 2 (NF2), Tuberous Sclerosis (TS), Von-Hippel-Lindau (VHL), and Li-Fraumeni. Other less common disorders include Cowden syndrome, Gorlin syndrome, Turcot syndrome, hereditary retinoblastoma, Rubenstein-Taybi, and Rhabdoid Tumor Predisposition Syndrome. Given this, the American Academy of Pediatrics, International Tuberous Sclerosis Complex Consensus Group, and American Association for Cancer Research have published diagnostic guidelines and surveillance recommendations for patients with these known genetic diagnoses⁴⁻⁶.

Children with CNS tumors often present with nonspecific symptoms, such as headache, nausea, vomiting, lethargy, or changes in balance and coordination. Tumors that involve the visual pathways in the brain may present with double vision, blurry vision, or abnormal eye movements. In contrast, tumors involving the pituitary or hormone regulation center may present with growth arrest or increased thirst and urination related to endocrine disorders that are common. Once a CNS tumor is suspected, imaging of the entire brain and/or spinal cord should be performed to identify tumor location as well as assist in treatment planning.

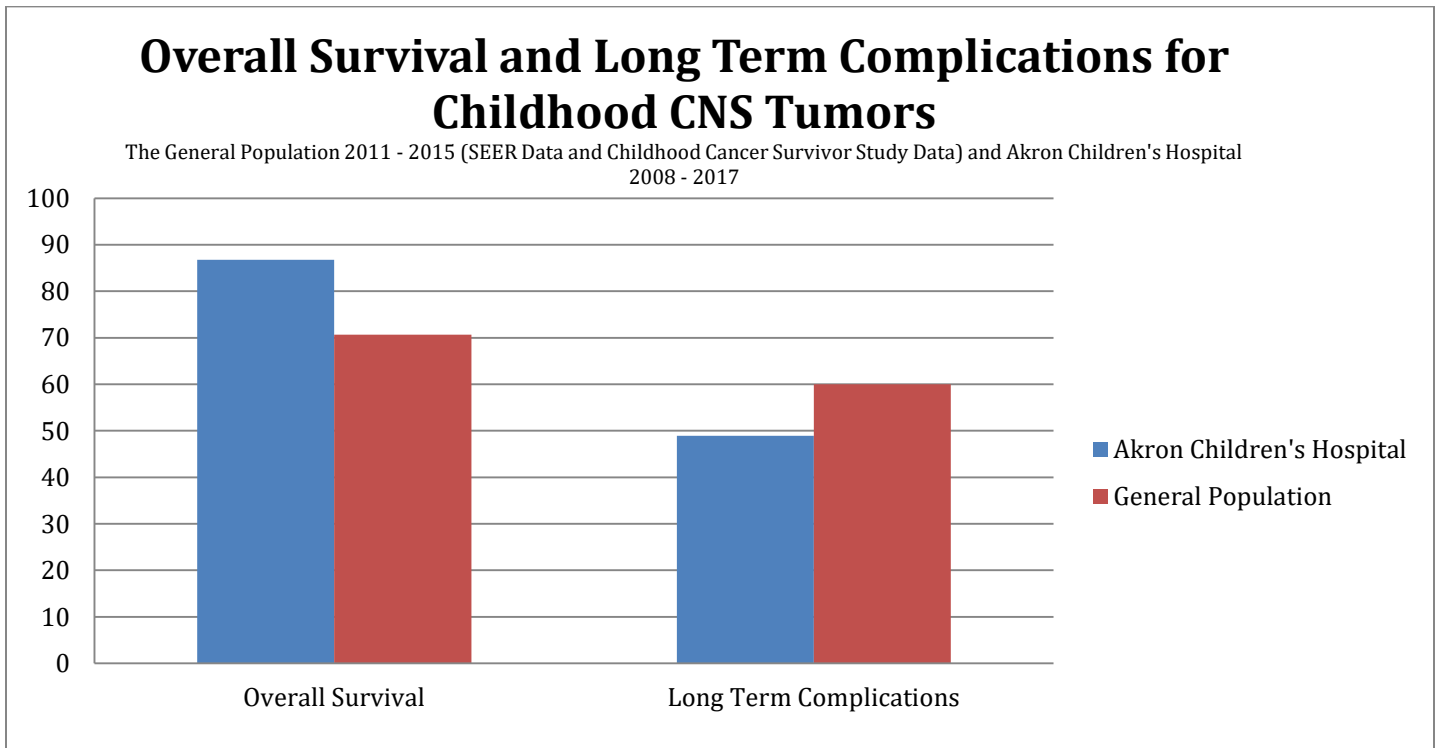
Initial treatment for nearly all CNS tumors involves surgical resection, as the best outcomes are associated with tumors that are completely or near completely resected. Tumors involving the visual pathway and brainstem (area of the brain that controls major functions of the body such as breathing, heart rate, and blood pressure) are more challenging to resect and as such typically only a biopsy is undertaken, due to the neurologic risks associated with removal. Following surgical resection, additional treatments may be required including: chemotherapy, radiation therapy, or a combination of both. These adjunct therapies are often chosen based on pathologic diagnosis, tumor grade, tumor spread, the age of the child, and availability of clinical trials.

Overall survival is largely dependent on pathologic diagnosis and tumor grade. The mortality risk increases for those tumors that are higher in grade or more widely disseminated. Low survival rates are not the only challenge these children will encounter unfortunately. Often these children incur significant long term complications related to surgery, chemotherapy, radiation, or tumor itself. The most common complication is cognitive in nature, with children having lower IQ scores, lower test scores, problems with memory and attention, and slowed development for younger children. These challenges can impact their school performance as well as their success in later life with many survivors struggling to graduate and pursue higher education, holding jobs and even maintaining successful relationships later in life. Therefore the goals are two-fold: early identification of tumors and improve treatments to help ensure better chances for survival while minimizing these long term complications that come as a result of the treatment needed to cure.

While there are many collaborative research organizations aimed at improving treatments, early identification of tumors is still quite important. Though many studies have shown that early diagnosis may not necessarily decrease survival rates, it does improve long term tumor or treatment related complications.

We reviewed our experience treating patients with CNS tumors over a 10-year period from January 2008 to December 2017. During this period, 235 new cases of CNS tumors were diagnosed, with an average of 24 newly diagnosed cases annually (15 to 32 cases per year). All tumors are diagnosed based on tissue pathology and if eligible are tested for distinct tumor genetic mutations. Median age of diagnosis was 9 years. There were 34 (14.5%) patients that were found to have an associated genetic disorder, with the most common being NF1. The most common tumor type was WHO Grade I Astrocytoma, followed by WHO Grade IV Medulloblastoma, and WHO Grade IV Glioblastoma. The 10 year relative survival rate for all tumors was 86.8% with less than half (48.9%) reporting long term tumor or treatment related complications. These numbers are similar or slightly better than national data (Figure 1).

For patients diagnosed at Akron Children’s Hospital, patients are eligible to enroll on open clinical trials based on diagnosis through collaborative research organizations, such as Children’s Oncology Group (COG). In addition, we have a tissue bank to store tumor samples that can be used for future research into the cause and treatment of CNS tumors in pediatric patients.



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