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Epidemiology of Brain/Nervous System Tumors in Children

Parviz Ghadirian, Ph.D.,1,4Kazem Fathie, M.D., Ph.D.," Jean-Pierre Thouez, Ph.D.'

'Depamnent of Nutrition, Faculty of Medicine, University of Montreal, and Centre de recherche, CHUM-HOtel-Dieu, Montreal, Quebec, Canada - Hospital Sainte-Justine, Research Center, Montreal, Quebec, Canada

'Chairman of the American Academy of Neurological and Orthopedic Surgeons

'Department of Geography, Faculty of Arts and Science, University of Montreal, and Centre de recherche, CHUM-H6tel-Dicu, Montreal, Quebec, Canada

Introduction

In the United States cancer is relatively less frequent among children. It has been estimated that[1] only I in 540 children will develop cancer. The relative rate of cancer occurring before the age of 15 years and among children less than 5 years of age is around 40%.[2] Although this disease is uncommon among young individuals, the mortality due it is high, accounting for more than 11% of all causes of death among children.[3] In other words, childhood cancer is the second leading cause of death, after accidents. The age-adjusted rate for all cancers combined among white children aged less than 15 years in the

The most common malignancy in children is leukemia which represents almost one-third of all cancer sites.5 Malignant neoplasms of the brain and central nervous system(CNS) are the next most common cancer in children, at about one-fifth of all cancer sites. In other words, I out of 5 cancers in children involve brain tumors. In the United States, it appears that the major types of tumors in the CNS are astrocytomas (21%), medulloblastomas (19%), gliomas (18%), glioblastomas (14%), astroblastomas (13%) and, finally, ependymomas.[6]

In general, because of early detection and progress with therapeutic methods, mortality due to malignant diseases as a whole during childhood has been decreasing. Although rnortality from all cancers in

In England, a significant rise (1.8% on average) in the annual incidence rate for all CNS cancers, particularly for neuroectodermal rumors (3. 1 % elevation) was observed in 1974-1995.[8] These increases are not explained by an increment in the proportion of histologically-verified tumors.

Genetic Factors

Susceptibility to certain types of childhood cancers may also follow an autosomal dominant pattern of inheritance. For example, it has been estimated that 40% of retinoblastomas are due in part to an autosomal dominant germ cell mutation.[9] Neurofibromatosis is another autosomal dominant syndrome associated with the occurrence of cancer in childhood.[10]

Socio-economic Status

It appears there is no significant association between socioeconomic status, ethnicity and CNS tumors.8

Age

In general, there is no apparent age-dependency of brain and CNS cancer sites, but a specific age pattern averages for some CNS malignancies. For example, neuroblastoma is more common among children aged less than I year, and is rare after 5 years of age.[11] The highest incidence rate of astrocytomas belongs to 3 years old children. Its rate decreases afterward, while medulloblastoma occurs mostly at 5 years, and glioblastoma is more common among 7 year-old.[12]

In general, the incidence of primary cancer and CNS tumors seems to be increasing in the United States among all age groups. In a large cohort of children less than 15 years old,[13] a modest rise in

Infectious diseases

In a case-control study in Greece, a significant association was found between influenza in pregnant women and tumor occurrence in the index child. In other words, the risk increased more than 3-fold among children from mothers who had influenza during pregnancy. [14]

Gender

The lowest male:female ratio (0.3) for all brain and CNS tumors in the world comes from Mali (Bamako), and the highest ratio (1.8) from China (Tianjin). In North America, The lowest male:female ratio (0.3) for all brain and CNS tumors in the world comes from Mali (Bamako), and the highest ratio (1.8) from China (Tianjin). In North America, the lowest male:female ratio is seen among Los Angeles the highest ratio (1.3) among the non-black population of the Greater Delaware Valley in the United States.15

Contact with Domestic and Farm Animals

It has been suggested that domestic and farm animals may increase the risk of brain cancer in children. In a large in the United States in 1984-91, it was found that childhood. brain tumors were more common among children mothers had been exposed to pigs (OR = 3.8) and horses (OR = 2.2) during the index pregnancy.16 It seems that children diagnosed with primitive neuroectoderrnas have a higher risk for childhood brain tumors with personal and maternal prenatal exposure to swine (OR = 4.0 for child and 11.9 for mother) or poultry (OR = 3.0 for child and 4.0 for mother). A non-significant increased risk for childhood brain tumors has also been found for children mothers who had worked on livestock farins compared with controls.16

Smoking

A large body of evidence implicates cigarette-smoking in the etiology of childhood cancer, particularly brain tumors. Most of these studies concentrated on the effect of maternal smoking. In a case-central study in Shangha17 paternal preconception smoking was related to a significantly elevated risk of childhood cancers, particularly brain tumors (OR = 2.7); the second most common cancer in children after leukemia, yet its etiology remains unknown. N-nitroso compound precursor is one of several dozens of toxic compounds downstream of tobacco smoke. Fetuses and infants have incompletely-formed blood-brain barriers that may allow the passage of carcinogenic tobacco metabolites into the CNS and initiate the formation of neural tumors.18

Other factors

In a nested case-central study utilizing data from a national birth registry in Sweden,19 the risk for brain tumors (all types) was elevated significantly when the mother of the index case had been exposed to oral contraceptives prior to conception (OR = 1.3) or Penthrane (OR = 1.5) during delivery as well as after treatment for neonatal distress (OR = 1.6) and, finally neonatal infections (OR = 2.4).

References

1. Young JL, Jr, Percy CL, Asire AJ. Surveillance, Epidemiology and End Results: Incidence and Mortality Data, 1973-77. National Cancer Institute Monograph 57. Washington, DC: U.S. Department of Health and Human Services, 1981.
2. Robinson LL. General principles of epidemiology in childhood cancer. In Principles and Practice of Paediatric Oncology (Pizzo PA, Poplack DG, eds.). Philadelphia Lippincott, pp. 3-10,1993.
3.National Center for Health Statistics. Advance report of final mortality statistics, 1981. Monthly Vital Stat Rep 1984; 33:18-20
4. Ries LAG, Miller BA, Hankey BF, et al. SEER Cancer Statistics Review, 1973-1991: Tables and Graphs, National Cancer Institute. NIH Pub. No. 94-2789, Bethesda, MD 1994.
5. Greenberg RS, Shuster JL, Jr. Epidemiology of cancer in children. Epidemio Rev 1985; 7:21-48.
6. Young JL, Jr, Miller RW. Incidence of malignant tumors in US children. J Pediatr 1975; 86:254-258.
.7.Nishi M, Miyake H, Takeda T, Hatae Y. Epidemiology of childhood brain tumors in Japan. lnt J Onco 1999: 15(4):721-725.
8. McKinney PA, Parslow RC, Lane S, BOey CC, Lewis 1, Picton S, Cartwright RA. Epidemiology of childhood brain tumors in Yorkshire, UK, 1974-95: geographical distribution and changing patterns of occurrence. Br J Cancer 1998; 78(7):974-979.
9. Knudson AG, Jr. Mutation and cancer: statistical study of retinoblastoma. Proc Natl Acad Sci USA 1971; 68:820-823.

10. Swift M. Single single gene syndromes. In: Cancer Epidemiology and Prevention. Schottenfeld D, Fraumeni JF, Jr, eds. Philadelphia, PA: WB Saunders, 1982; 475- 482.
11. Bader JL, Miller RW. US cancer incidence and mortality tobacco smoke. In the first year of life. Am J Dis Child 1979; 133:157- 159.
12. Schoenberg BS, Schoenberg DG, Christine BW, et al. The epidemiology of primary intracranial neoplasms of childhood: a population study. Mayo Clin Proc 1976; 51:51056.
13. Linet MS, Ries LA, Smith MA, Tarone RE, Devesa SS.; Cancer surveillance series: recent trends in childhood cancer incidence and mortality in the United States. JNCI In a 1999; 91(12):1051-1058.
14. Linos A, Kardara M, Kosmidis H, Katrious D, Hatzis C, Kontcoglou M, Koumandakis E, Tzartzatou- F. Reported influenza in pregnancy and childhood tumor. Eur J Epidemiol 1998; 14(5):471-475.
15. Parkin E, Kramarova E, Drafer GJ, et al. International incidence of childhood cancer. Volume 2. Lyon, France: 1988, LARC Scientific Publication No. 144.
16. Holly EA, Bracci PM, Mueller BA, Preston-Martin S. Farm and animal exposures and pediatric brain tumors: results from the United States West Coast Childhood Brain Tumor Study. Cancer Epidemiol Biomarkers Prevent 1998; 7(9):797-802.
17. JI BT, Shu XO, Linet MS, Zheng W, Wacholder S, Gao YT, Ying DM, Jin F. Paternal cigarette smoking and the risk of childhood cancer among offspring of non-smoking mothers. JNCI 1997; 89(3):238-244.
18. Norman MA, Holly EA, Preston-Martin S. Childhood brain tumors and exposure to tobacco smoke [Review]. Cancer Epiderniol Biomarkers Prevention 1996; 5(2):85- 91.
19. Linet MS, Gridley G, Cnattingius S, Nicholson HS, Martinsson U, Glimelius B, Adami HO, Zack M. Matemal and perinatal risk factors for childhood brain tumors (Sweden). Cancer Causes & Control 1996; 7(4):437-448

4To whom correspondence should be address:
Epidemiology Research Unit, Research Centre-CHUM-Hbtel-Dieu
3850 St-Urbain
Montreal (Quebec) H2W IT8
Tel. (514) 843-2742; Fax: (514) 843-2715
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