The descriptive epidemiology of craniopharyngioma

Greta R. Bunin, Ph.D., Tanya S. Surawicz, M.P.H., Philip A. Witman, M.P.H., M.Phil., Susan Preston-Martin, Ph.D., Faith Davis, Ph.D., and Janet M. Bruner, M.D.

Division of Oncology, Children’s Hospital of Philadelphia, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania; Central Brain Tumor Registry of the United States, Division of Epidemiology and Biostatistics, School of Public Health, University of Illinois, Chicago, Illinois; Division of Chronic Disease Epidemiology, Department of Epidemiology and Public Health, Yale University School of Medicine, New Haven, Connecticut; University of Southern California, Norris Cancer Center, Los Angeles, California; and Department of Pathology, University of Texas, M.D. Anderson Cancer Center, Houston, Texas

Object. In this report the authors describe the epidemiology of craniopharyngioma.

Methods. The incidence of craniopharyngioma in the United States was estimated from two population-based cancer registries that include brain tumors of benign and borderline malignancy: the Central Brain Tumor Registry of the United States (CBTRUS) and the Los Angeles county Cancer Surveillance Program. Information on additional pediatric tumors was available from the Greater Delaware Valley Pediatric Tumor Registry (GDVPTR). The overall incidence of craniopharyngioma was 0.13 per 100,000 person years and did not vary by gender or race. A bimodal distribution by age was noted with peak incidence rates in children (aged 5–14 years) and among older adults (aged 65–74 years in CBTRUS and 50–74 years in Los Angeles county). Survival information was available from GDVPTR and the National Cancer Data Base (NCDB), a hospital-based reporting system. In the NCDB, the 5-year survival rate was 80% and decreased with older age at diagnosis. Survival is higher among children and has improved in recent years.

Conclusions. Craniopharyngioma is a rare brain tumor of uncertain behavior that occurs at a rate of 1.3 per million person years. Approximately 338 cases of this disease are expected to occur annually in the United States, with 96 occurring in children from 0 to 14 years of age.

Key Words • craniopharyngioma • incidence • survival

The demographic patterns of craniopharyngioma are not well described because the tumor is rare. In addition, most cancer registries collect data only on malignant conditions and, therefore, they are not useful in the study of craniopharyngioma, considered to be of borderline histological malignancy. The objective of this report is to describe the epidemiology of craniopharyngioma. Incidence rates by gender, age, and race were calculated from three population-based cancer registries that include data on brain tumors of benign and borderline malignancy. Survival rates were estimated from a pediatric population-based tumor registry and a hospital-based registry.

Data Collection Methods

Tumor Incidence

Data on the incidence of craniopharyngioma were available from three population-based registries: the Central Brain Tumor Registry of the United States (CBTRUS), Greater Delaware Valley Pediatric Tumor Registry (GDVPTR), and the University of Southern California/Los Angeles County Cancer Surveillance Program (CSP).

CBTRUS. The CBTRUS obtained data for the years 1990 to 1993 from 10 state cancer registries that catalog benign and malignant primary brain tumors: Arizona, Colorado, Connecticut, Delaware, Idaho, Maine, Minnesota, Montana, North Carolina, and Utah, a population totaling 26.8 million people. These registries are population based and reporting is required by law. The population data for each state were obtained from the Web site of the Surveillance, Epidemiology, and End Results program, which receives yearly population estimates from the U.S. Bureau of the Census. For the analyses reported here, all diagnoses of craniopharyngioma (International Classification for Diseases of Oncology code 935011) were included.

GDVPTR. The GDVPTR is a population-based registry of pediatric cancer that covers a 31-county region in the eastern U.S. consisting of eastern Pennsylvania, southern New Jersey, Delaware, and one northern Maryland county. Approximately 1.8 million children under the age of 15 years live in the region. Incidents of cancers are regis-
tered if diagnosed on or after January 1, 1970, in a child younger than 15 years, and who resided in the region at the time of diagnosis. For the period 1970 to 1989, cases were ascertained from all the major medical centers in the region and several centers outside the region that treated children with cancer. In addition, nearly all the other hospitals in the region that care for children reported cases. Although the GDVPTR relied on voluntary, mostly passive reporting, the incidence rates reported for this period are similar to other U.S. rates, such as those from the Surveillance, Epidemiology, and End Results Program.\(^3,9,20\)

Only malignant neoplasms are generally registered, but benign and borderline brain tumors were ascertained for the period of 1970 to 1989 as part of a special project.

CSP. The University of Southern California/Los Angeles County CSP has collected reports on all new intracranial neoplasms diagnosed in the county population of almost 10 million people since 1972.\(^*\) Inclusion criteria have been consistent, and reporting of both benign and malignant tumors has been at least 95% complete since the beginning. Data were collected on 228 Los Angeles County residents with craniopharyngioma first diagnosed between 1972 and 1995. Specially trained CSP personnel abstracted information from hospital charts on age, gender, race, address, religion, birthplace, occupation, and industry, as well as details of the pathological diagnosis. Age-adjusted incidence rates were calculated by the direct method and standardized to the U.S. 1970 population.

Survival Data

Data were available from the GDVPTR and the National Cancer Data Base (NCDB).

NCDB. The NCDB, a joint project of the Commission on Cancer of the American College of Surgeons, requests data from hospitals in the U.S. with cancer registries. For the periods 1985 to 1988 and 1990 to 1992, data were available on intracranial tumors, including those in the pituitary, which were voluntarily electronically submitted to the NCDB from approximately 1000 hospitals. Of 68,042 records, 1064 were identified by the NCDB as duplicates and deleted. In addition, 3726 records were deleted because of invalid or illogical data. The remaining 63,252 records included 285 craniopharyngiomas, which are analyzed here.

GDVPTR. Survival estimates from the GDVPTR were generated with an SAS\(^{15}\) software package using the Kaplan–Meier method. Observed survival rates were obtained from product-limit estimates of entire curves and were not adjusted for deaths due to other causes.

**Results**

**Tumor Incidence**

In the 4-year period of 1990 to 1993, 135 craniopharyngiomas were diagnosed in the geographic areas of the CBTRUS. The incidence in males and females was nearly identical: 0.13 and 0.12 per 100,000 per year, respectively (Table 1). No racial difference in incidence was apparent, with a rate of 0.12 in Caucasians and 0.13 in African Americans.

Incidence seemed to vary with patient age, being somewhat higher in patients aged 5 to 14 years than in any other age group except those aged 65 to 74 years (Fig. 1). In late adolescence and early adulthood (ages 15–34 years), incidence was the lowest. Starting at age 35 years, incidence appeared fairly constant except for a higher rate in patients aged 65 to 74 years and the absence of any cases after the age of 84 years. Given the small numbers of craniopharyngiomas in any age group, the observed differences could have occurred by chance.

In Los Angeles county, 228 craniopharyngiomas were diagnosed between 1972 and 1995. The incidence rates by gender (0.13 in males and 0.11 in females) are comparable to those ascertained by CBTRUS (Table 1), and no racial differences were noted. Higher rates were noted among children (aged 5–14 years) and older adults (aged 50–74 years) (Fig. 2). The lowest incidence occurred among those aged 15 to 34 years.

In the GDVPTR area, 67 craniopharyngiomas were diagnosed in children aged 0 to 14 years between 1970 and 1989, giving an incidence rate of 0.18 per 100,000 per

---

**TABLE 1**

*Average annual incidence rates of craniopharyngioma by gender, race, and registry*\(^*\)

<table>
<thead>
<tr>
<th>Registry &amp; Variable</th>
<th>No. of Tumors</th>
<th>Incidence Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CBTRUS, 1990–1993</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>135</td>
<td>0.13</td>
</tr>
<tr>
<td>male</td>
<td>68</td>
<td>0.13</td>
</tr>
<tr>
<td>female</td>
<td>67</td>
<td>0.12</td>
</tr>
<tr>
<td>Caucasians</td>
<td>109</td>
<td>0.12</td>
</tr>
<tr>
<td>African Americans</td>
<td>11</td>
<td>0.13</td>
</tr>
<tr>
<td><strong>Los Angeles County, 1972–1995</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>228</td>
<td>0.12</td>
</tr>
<tr>
<td>male</td>
<td>121</td>
<td>0.13</td>
</tr>
<tr>
<td>female</td>
<td>107</td>
<td>0.11</td>
</tr>
<tr>
<td>Caucasian males</td>
<td>63</td>
<td>0.14</td>
</tr>
<tr>
<td>African American males</td>
<td>12</td>
<td>0.12</td>
</tr>
<tr>
<td>Caucasian females</td>
<td>61</td>
<td>0.12</td>
</tr>
<tr>
<td>African American females</td>
<td>12</td>
<td>0.11</td>
</tr>
</tbody>
</table>

* Rates are per 100,000 person years and age-adjusted using the 1970 U.S. standard population.

---

\(^*\) Inclusion criteria have been consistent, and reporting of both benign and malignant tumors has been at least 95% complete since the beginning.

---

**FIG. 1.** Graph showing the age-specific incidence of craniopharyngioma derived from the CBTRUS data.
year, a rate similar to children in Los Angeles county and the CBTRUS areas (Table 2). The incidence in children in the GDVPTR regions did not differ by gender but was significantly higher in African Americans compared with Caucasians. No craniopharyngiomas occurred in children who were neither Caucasian or African American; two tumors would have been expected if children of other races experienced the same incidence as the population as a whole.

**Survival Rates**

The NCDB included data on 285 patients with craniopharyngioma, 35 of whom died. Survival percentage was estimated to be 86% at 2 years and 80% at 5 years postdiagnosis. Survival varied notably by age group, with excellent survival for patients younger than 20 years of age and poor survival for those older than 65 years of age (Table 3).

In the population-based GDVPTR, children with craniopharyngioma had a 5-year survival rate of 83%, which was lower than that for children in the NCDB data. The NCDB data are from the late 1980s and early 1990s whereas the GDVPTR data include a time period beginning in 1970. The most recent time period in the GDVPTR data, 1985 to 1989, is similar to the period of NCDB data. For patients diagnosed with craniopharyngioma in 1985 to 1989 in the GDVPTR region, 5-year survival is 94% based on 16 patients and one death compared to 99% in the NCDB data with 72 patients and two deaths.

**Discussion**

The overall incidence of craniopharyngioma observed in the CBTRUS and Los Angeles county data is similar to that seen in other populations. Stiller and Nectoux reported a similar rate in U.S. data combined from several areas that do not overlap with the states that contributed to the CBTRUS data. The incidence in Rochester, Minnesota, was higher (0.3) but was based on only six tumors.

In the present study, virtually identical incidence rates were seen in Caucasians and African Americans. Similarly, in the U.S. data collected by Stiller and Nectoux, the rates were 0.07 for Caucasians and 0.10 for African Americans, an insignificant difference. In the GDVPTR data, the rate in African-American children appeared to be approximately twice that in Caucasian children, a statistically significant difference. However, in the CBTRUS and Los Angeles county data, African-American and Caucasian children experienced similar rates. The discrepant incidence rates might have occurred by chance, given the small number of African-American cases (four in the CBTRUS data, five in Los Angeles county, and 20 in the GDVPTR data). A geographic difference in the incidence rates in African Americans is also a possible explanation.

We did not observe any differences in incidence between males and females overall. There was also no gender difference in a population-based study in Finland. However, in a large hospital-based series of cases from the United Kingdom, there were 107 males and 66 females, a ratio of 1.3. In case series of craniopharyngiomas in children, the male/female ratios were 0.9 based on 42 tumors and 1.6 based on 105 tumors. Although in Los Angeles county tumor rates were higher in boys than girls, there was no evidence of a gender difference among children in the CBTRUS or GDVPTR data. Considering all the data, craniopharyngioma may occur slightly more often in boys.

**Table 2**

Average annual incidence rates in children with craniopharyngioma, categorized by gender*

<table>
<thead>
<tr>
<th>Age Group (yrs)</th>
<th>CBTRUS</th>
<th>GDVPTR</th>
<th>Los Angeles County</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
<td>Total</td>
</tr>
<tr>
<td>0–4</td>
<td>0.09 (4)</td>
<td>0.15 (6)</td>
<td>0.12 (10)</td>
</tr>
<tr>
<td>5–9</td>
<td>0.19 (8)</td>
<td>0.20 (8)</td>
<td>0.20 (16)</td>
</tr>
<tr>
<td>10–14</td>
<td>0.17 (7)</td>
<td>0.18 (7)</td>
<td>0.17 (14)</td>
</tr>
</tbody>
</table>

* Number of tumors is presented in parentheses.

**Table 3**

National Cancer Data Base 5-year survival rates in patients with craniopharyngioma by age at diagnosis

<table>
<thead>
<tr>
<th>Age at Diagnosis</th>
<th>No. of Patients</th>
<th>No. of Deaths</th>
<th>Survival Rate</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>82</td>
<td>2</td>
<td>0.99</td>
<td>0.96–1.0</td>
</tr>
<tr>
<td>20–64</td>
<td>168</td>
<td>21</td>
<td>0.80</td>
<td>0.71–0.88</td>
</tr>
<tr>
<td>≥65</td>
<td>35</td>
<td>12</td>
<td>0.38</td>
<td>0.08–0.67</td>
</tr>
</tbody>
</table>

* CI = confidence interval.
These data indicate that a smaller proportion of all craniopharyngiomas occur in childhood. Roughly one-third of the patients in our study were younger than 20 years of age at the time of diagnosis (35% in CBTRUS, 33% in Los Angeles county); the proportion younger than 15 years of age was only 30% and 27%, respectively. In previous studies it has been reported that 50% of craniopharyngiomas occurred in children.1,4

A bimodal age distribution of incidence rates is apparent in the CBTRUS and Los Angeles county data. Although the numbers of cases in each age category are limited, the pattern is consistent in both populations with larger peaks noted in older adults (Figs. 1 and 2). Whereas increasing mortality rates from all brain tumors among the elderly have been correlated with increased use of diagnostic procedures, especially among people 65 years of age and older covered by Medicare,10 the increased incidence among adults in Los Angeles county occurs between the ages of 50 and 74 years and is not likely due to a diagnostic bias in the elderly. A bimodal distribution has been suggested and different histologies noted in younger and older patients in large clinical series: adamantinous tumors are more common in children and squamous papillary tumors are more common in adults.4,5,14 These data indicate that there may be two distinct etiologies for the younger and the older patients. Craniopharyngiomas are coded under a single morphology code in the International Classification for Diseases of Oncology; therefore, it is not possible to distinguish these subtypes in our data.

Craniopharyngioma is believed to develop from rests of embryonal cells in the pituitary. Two hypotheses have been proposed: the first relates to the development of the adenohypophysis during embryogenesis, which is consistent with pediatric tumor development; the second proposes that residual squamous epithelium from the adenohypophysis undergoes metaplasia, which explains the adult tumors.14 A consensus on this has not been achieved. It may be of value to note the age distribution of other tumors believed to develop from embryonal cells, such as neuroblastoma and medulloblastoma. Although approximately one-third of all craniopharyngiomas occur in children, the percentage of embryonal childhood tumors ranges from 75 to virtually 100%.

There is some suggestion of international variation in the incidence of these tumors, which is often taken to indicate an environmental etiology. For example, Stiller and Nectoux19 have reported that the proportion of craniopharyngioma among central nervous system tumors varied substantially; the percentages were 1.5% in Australia, 4.7 to 7.9% in Europe, 3.9% in Japan, 2.7% in U.S. Caucasians, 4.9% in U.S. African Americans, and 11.6% in Africa. In the CBTRUS craniopharyngiomas comprised 4.2% of the tumors reported in children 0 to 14 years of age. Because it is likely that not all brain tumors are diagnosed in developing countries, examination of incidence rates will lead to an exaggerated estimate of international variation. Percentages are useful in comparing international rates because they will be less influenced by incomplete reporting. However, percentages are influenced by the proportions of other types of tumors, including those with nonspecific diagnosis such as brain tumors. A malignant brain tumor. Although the international comparison indicates that craniopharyngioma occurs more frequently in Africa and less frequently in Australia, conclusions are not possible.

In the NCDB data, the survival rate at 5 years was 80% overall, with survival much better among children than the elderly. Observed survival is expected to be lower in the elderly, as our survival estimates were not adjusted for death due to other causes. Reports on survival in the literature are difficult to interpret because some are based on patients who received treatment and, therefore, had to survive long enough to do so. To our knowledge, the only population-based report of survival after diagnosis of craniopharyngioma is an analysis of data from the Finnish Cancer Registry for patients diagnosed from 1951 to 1982.17 The overall 5-year survival rate was 69%; 73% for patients diagnosed in the 1970s. Neurosurgical techniques and the introduction of computerized tomography scanning have led to lower surgical mortality rates and more complete resections and, therefore, improved survival. The survival rate in the NCDB data for patients diagnosed from 1985 to 1992 was slightly higher than in the report from Finland. The NCDB is hospital based but does include all patients diagnosed at the participating hospitals, regardless of treatment.

Conclusions

In summary, craniopharyngioma is a rare brain tumor of uncertain behavior that occurs at a rate of 1.3 per million person years. Incidence rates are similar in males and females and between Caucasians and African Americans. Tumors are more common among children (aged 5 to 14 years) and older adults (aged 65 to 74 years in CBTRUS and 50 to 74 years in Los Angeles county); the lowest rates occur among those aged 15 to 34 years. Survival is highest for patients diagnosed at a younger age and has improved for children diagnosed since the mid-1980s. Based on the rates reported here, 338 cases are expected to occur annually in the U.S. with 96 occurring in children 0 to 14 years of age (estimated for 1996).

Acknowledgments

The registries and participants who provide data to CBTRUS include: Arizona Cancer Registry, Ms. Georgia Yee; Colorado Central Cancer Registry, Ms. Robin Bott; Connecticut Tumor Registry, Mr. John Flannery; Delaware State Tumor Registry, Ms. Carol Marker; Cancer Data Registry of Idaho, Ms. Stacey Carson; Maine Cancer Registry, Ms. Melanie Lacnot; Massachusetts Cancer Registry, Dr. Susan Gershman; Minnesota Cancer Surveillance System, Dr. Sally Bushhouse; Missouri Cancer Registry, Dr. Jian Chang; Montana Central Tumor Registry, Ms. Debbi Hellhake; North Carolina Central Cancer Registry, Dr. Rebecca Martin; and Utah Cancer Registry, Ms. Rosemary Dibble and Dr. Janet Stanford.

The authors thank the NCDB Data Request Committee and Mr. Herman Menck of the American College of Surgeons for providing the NCDB data. We also thank Dr. Wendy Cozen for facilitating our data request.

References

Epidemiology of craniopharyngioma


Manuscript received October 13, 1997. Accepted in final form May 29, 1998.

This work was conducted under contract to the Central Brain Tumor Registry of the United States and supported by the Pediatric Brain Tumor Foundation of the United States through the Ride for Kids Fundraising Program, sponsored by the American Honda Motor Company, Motorcycle Division.

Cancer incidence data for Los Angeles County were collected with support from grant CA17054 and contract N01-CN-25403 from the National Institutes of Health and subcontracts 050(C-L)-8709 from the California Department of Health Services as part of its statewide cancer reporting system.

*Address reprint requests to:* Tanya S. Surawicz, M.P.H., Central Brain Tumor Registry of the United States, Division of Epidemiology and Biostatistics, School of Public Health, University of Illinois, 2121 West Taylor Street, Chicago, Illinois 60612. email: surawicz@uic.edu.