Epidemiological study of primary intracranial tumors: a regional survey in Kumamoto Prefecture in the southern part of Japan

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This survey consists of 1117 residents of Kumamoto Prefecture who were diagnosed with primary intracranial tumors between 1989 and 1994. Age, sex, tumor type, and date of diagnosis were recorded in all cases; 79% of the diagnoses were confirmed histologically. The overall age-adjusted incidence rate was 9.47 per 100,000 population per year. Among males, the age-adjusted incidence rate was 8.24 per 100,000 per year, and the breakdown included 2.36 gliomas, 1.56 meningiomas, 1.46 pituitary tumors, and 0.99 neurinomas. Among females, the comparable overall rate was 10.7; that included a rate of 3.95 for meningiomas, 2.04 for gliomas, 2.16 for pituitary tumors, and 0.75 for neurinomas. Meningiomas were the most common tumor, with an average annual age-adjusted incidence of 2.76 per 100,000 population. The highest incidence of meningiomas was 13.02 per 100,000 among women aged 70 to 79 years. The highest incidence of gliomas (5.71 per 100,000 males and 5.29 per 100,000 females) was seen in patients between 60 and 69 years of age. Meningiomas, pituitary adenomas, and malignant lymphomas occurred at a higher rate in females (male/female ratio: 0.39, 0.68, and 0.81, respectively). On the other hand, gliomas, neurinomas, and germ-cell tumors occurred more often in males (male/female ratio: 1.16, 1.32, and 4.29, respectively). Meningiomas and germ-cell tumors tended to exhibit gender specificity.

KEY WORDS • intracranial tumor • epidemiological study • incidence

BRAIN tumors are second only to stroke as the leading cause of death from neurological disease. Most earlier reports examining the incidence of intracranial tumors were based on the experience of individual neurosurgeons, on autopsy series, or on proportionate rates of hospital admissions. These data do not necessarily provide an accurate picture of the true incidence of intracranial tumors. Furthermore, we can assume that the introduction of computerized tomography (CT) and magnetic resonance (MR) imaging changed the proportion of types of intracranial tumors diagnosed and that environmental changes affect the incidence of different intracranial tumors. A low incidence of intracranial tumors has been reported for Asian populations, including the Japanese, when compared to other ethnic groups. In the present study, we analyzed the incidence of clinically significant intracranial tumors in Kumamoto Prefecture in Japan. This is the first population-based epidemiological study of intracranial tumors in a Japanese population.
Incidence Rate

Age-adjusted incidence rates were calculated by the direct method, using 10-year age groupings with the incidence in the total Japanese population in 1992 as the standard. Population figures were obtained from published decennial tabulations for Kumamoto Prefecture and Japan. The adjusted rates allow an overall comparison among different populations because the rates are standardized for dissimilarities in the age and sex distribution. Age-specific incidence rates were calculated for all intracranial tumors and for each type of intracranial tumor.

Results

During the 6-year period from 1989 to 1994, 1117 new cases of primary intracranial tumors were diagnosed in Kumamoto Prefecture. The number of tumors diagnosed each year was relatively constant.

Table 1 shows the distribution by tumor type of the 1117 intracranial tumors. Meningiomas represented 31.2% of all such cases, followed by gliomas (23.3%), adenomas (18.2%), and neurinomas (8.8%). Males had a higher incidence of glioma, neurinoma, craniopharyngioma, and germ-cell tumors, whereas females had a higher incidence of meningioma and pituitary adenoma.

As shown in Table 2, the average annual age-adjusted incidence rate per 100,000 population was 9.47. Among males, the age-adjusted incidence rate was 8.24 per 100,000 per year; among females it was 10.7. Meningioma was found to be the tumor type with the highest incidence and women of all ages had higher incidences of meningioma than men. Gliomas had the next highest incidence rates; these tumors occurred at a higher rate in males. There were too few medulloblastomas to draw any conclusions.

The average annual age-specific incidence of intracranial tumors is shown in Fig. 1. The incidence of primary intracranial tumors increases with age; the highest incidence rate is seen in 60- to 69-year-old men and 70- to 79-year-old women. The age-specific incidence per 100,000 per year was 17.3 for 60- to 69-year-old men and 22.9 for 70- to 79-year-old women. The rates are higher in females than in males in all age groups except for the 10- to 19- and 30- to 39-year-old groups.

As shown in Fig. 2, the incidence of meningiomas increased with age until 79 years in both males and females. With advancing age more women than men had meningiomas. The incidence per 100,000 population per year in women in the 70- to 79-year-old group was 13.02, compared to 5.5 in men. The age-specific incidence of gliomas peaked at 5.71 per 100,000 population in 60- to 69-year-old men and at 5.29 per 100,000 in the 60- to 69-year-old age group. Males had a higher incidence of gliomas than females in all age groups except the 20- to 29-year-old group.

Women evidenced two peaks in the incidence of pituitary adenomas. One (3.36/100,000/year) was in the child-bearing age group (20–29 years) and the other (3.70/100,000/year) was in the 60- to 69-year-old group. In males, the rate increased with age. It peaked in the 70- to 79-year-old group (3.57/100,000/year) and decreased thereafter. In females, neurinomas had two small peaks. One was in the 20- to 29-year-old and the other in the 70- to 79-year-old groups.

Concerning the less common primary intracranial tumors, as shown in Fig. 3, the peak incidence for malig-
nant lymphomas in women occurred in the 60- to 69-year-old group (1.05/100,000/year), and in the 70- to 79-year-old group in men (1.19/100,000/year). In males, the rates of craniopharyngioma decline after a peak in childhood (0.64 at ages 0–9 years). The rate of Rathke’s cleft cyst peaks in both sexes in the 50- to 59-year-old group. Germ-cell tumors in males showed a peak incidence in the 10- to 19-year-old group, in which it is 4.5 times higher than in females.

Discussion

As shown in Fig. 1, the incidence of intracranial tumors among residents of Kumamoto Prefecture increases until 69 years of age in both sexes. Because the incidence of brain tumors is affected by the age-specific distribution of the population, we adjusted the crude incidence rates of intracranial tumors for age to control for the effects of differences in the age distribution of our study populations. Our survey indicates that the age-adjusted incidence rate of intracranial tumors is 9.47 in Kumamoto Prefecture. According to published epidemiological surveys conducted in several countries, the incidence of primary intracranial tumors ranges from 4.5 to 14.5 cases per 100,000 population per year.2,8,11,19,23,24,27 This geographic variation may be a reflection of the quality of medical care, the availability of diagnostic facilities, and the level of organization of registries for data collection and coding. In addition, improved medical services for the elderly, in whom age-specific rates of primary intracranial tumors are highest, may account for the higher rates found in socioeconomically advanced societies. Over the last two decades, medical care has become more accessible, noninvasive neuroimaging techniques such as CT and MR imaging have gained wide acceptance, and autopsy rates have decreased.20 Radhakrishnan, et al.,20 examined the average annual age-adjusted incidence rates of primary intracranial tumors in different countries, computed by calculating the mean of different reported rates. They found that socioeconomically developed countries have higher incidence rates for each sex than less developed countries. When all histological types of primary intracranial tumors are combined, Sweden has the highest rate (10/100,000/year), closely followed by the United States and Israel. Asian and African countries report lower rates. According to their review, the incidence of primary intracranial tumors in Japan is less than three per 100,000 per year. To our knowledge, no accurate population-based epidemiological survey of intracranial tumors in Japan has been reported to date. Racial factors may play a role in the pathogenesis of intracranial tumors, because different racial or ethnic groups living in the same geographic region have markedly different incidence rates.11 Because the Japanese population is homogeneous and unique, we can exclude race differences as a factor in the incidence rate of intracranial tumors in Japan. In addition, the level of medical care is similar in the different geographic regions in Japan, so that the incidence rate in Kumamoto Prefecture may accurately reflect the incidence in the country as a whole.

Many reports regarding the incidence rate of primary intracranial tumors in distinct population groups worldwide have been published (Table 3). The incidence rate per 100,000 population per year in Rochester, Minnesota, was 14.5.18 This high incidence rate of intracranial tumors may be attributable to superior diagnostic and reporting practices rather than to any true difference in frequency. In fact, 37% of the brain tumors in the series reported by Percy, et al.,18 were first diagnosed at autopsy, and only one-third of these were symptomatic before death. Thus, if only cases diagnosed before death are included, the age-adjusted incidence rate for primary brain tumors in Rochester falls to 10 per 100,000 per year.15,24
Epidemiological study of primary intracranial tumors

### TABLE 3

<table>
<thead>
<tr>
<th>Location &amp; Author(s)</th>
<th>Time Period</th>
<th>Incidence/100,000/Year</th>
<th>No. of Tumors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iceland; Gudmundsson</td>
<td>1954–1963</td>
<td>7.8</td>
<td>186</td>
</tr>
<tr>
<td>Caucasians</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African Americans</td>
<td></td>
<td>4.2</td>
<td>216</td>
</tr>
<tr>
<td>Connecticut; Schoenberg, et al.</td>
<td>1935–1964</td>
<td>4.9</td>
<td>3210</td>
</tr>
<tr>
<td>Faroe Islands, Denmark; Joensen</td>
<td>1962–1975</td>
<td>9.9</td>
<td>52</td>
</tr>
<tr>
<td>Trento, Italy; Lovaste, et al.</td>
<td>1977–1984</td>
<td>8.5</td>
<td>301</td>
</tr>
<tr>
<td>Los Angeles County, CA; Preston-Martin</td>
<td>1972–1985</td>
<td>8.5</td>
<td>8612</td>
</tr>
<tr>
<td>Kumamoto, Japan; present study</td>
<td>1989–1994</td>
<td>9.47</td>
<td>1117</td>
</tr>
</tbody>
</table>

Although a significant number of asymptomatic brain tumors go undiagnosed during life, recent advances in CT and MR imaging techniques make it unlikely that more than 10% of primary intracranial tumors go undetected. The study by Joensen on an isolated population in the Faroe Islands yielded a rate of 10.2 per 100,000 population per year for primary brain tumors. Therefore, we posit that an incidence rate of approximately 10 per 100,000 population per year is acceptable.

With regard to histological types, we draw attention to the high incidence of meningioma in Kumamoto. In the other surveys, gliomas were the predominant histological type, accounting for 40% to 67% of the primary tumors in population-based studies. In those same studies, 9% to 27% of the tumors were meningiomas. In the Rochester study, 35% of the primary brain tumors were gliomas and 40% were meningiomas. This unusual distribution may be attributable to the high autopsy rate in Rochester; at autopsy many asymptomatic meningiomas were detected in the elderly. It is interesting that the glioma/meningioma ratio was 0.3:1 in the Rochester autopsy series and 1.4:1 in the biopsy series. In our series, approximately 35% of the meningiomas were asymptomatic. The increase in the use of MR imaging led to an increase in the detection rate of asymptomatic meningiomas among intracranial tumors.

Brain tumors are thought to be more common in males than in females. A comparison using international data of the incidence of primary intracranial tumors of all histological types results in an average male/female ratio of 1.4 (range 0.9–2.6) across geographic areas. In addition to the significant variation in the male/female ratio across geographic areas (0.9–2.6), the ratio also varies considerably by age group and histological type. In our series, the estimated annual age-adjusted incidence rate for all types of intracranial tumors was higher among females than males. As in previous reports, our study detected a higher rate of glioma in males and a higher incidence of meningiomas and pituitary adenomas in females. Meningiomas were the most common histological tumor type in our study and this may have contributed to the high incidence of females with this type of tumor. The higher annual incidence of gliomas among males and meningiomas among females coincides with published results of other surveys.

There are few community-based studies on the incidence of meningiomas, and most of these predate the introduction of CT and MR studies. In our survey, the age-adjusted incidence was 2.76 per 100,000 in Kumamoto for both males and females, and 63.9% of the meningiomas were symptomatic. The age-specific incidence of meningiomas increased until 70 to 79 years of age. The pattern of the age-specific incidence rates was similar for males and females. The annual age-adjusted incidence of gliomas from major studies varies from 2.1:100,000 to 7.1:100,000; it is highest in the more recent studies. A comparison using international data of the meningiomas was asymptomatic. The increase in the incidence of meningiomas and pituitary adenomas in these women. There has been a recent dramatic rise in the incidence of primary brain lymphomas in immunosuppressed and immunologically normal persons. Lutz and Coleman reported that the incidence of malignant lymphomas of the brain unrelated to immunosuppression in patients 20 years of age or older is now some nine times higher than it was only 10 years ago. On the other hand, Thorne, et al., noted a decline in the incidence of medulloblastoma. In our survey, the incidence of medulloblastoma was much lower than in previous reports. Although the cause of the increase in cerebral lymphomas and the decrease in the incidence of medulloblastomas remains unknown, there may be a relationship between maternal diet and the occurrence of medulloblastoma. We posit that the profile of intracranial tumors may change due to improved diagnostic techniques and environmental changes.

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References


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