ABSTRACT

Background The correct incidence of brain tumors remains unknown in Japanese population, based on large number of individuals with brain check-up.

Purpose To examine the incidence of brain tumors in the retrospective study of brain check-up in PL Tokyo Health Care Center, Japan. We also evaluated whether multiphasic health tests, including physical and brain check-up, have benefits for the early diagnosis of brain tumors.

Method We analyzed 2,312 participants who received brain and physical check-up simultaneously between April 1, 2001 and January 31, 2002. Male was 1,592 subjects and female was 720 subjects. Mean age was 53.5 (SD 11.0) years in all, 53.7 (SD 11.0) years in men, and 53.1 (SD 11.1) years in women. Among them, the first brain check-up was performed in total of 1,343 (58.1%) subjects, 868 (54.4%) in men, and 475 (66.0%) in women. Brain check-up was produced by 1.5-tesla superconducting system (Stratis II, Hitachi Medical Co., Japan). Conventional magnetic resonance imaging (MRI) and magnetic resonance angiography were studied in all subjects.

Results Brain tumors were seen in total of 16 subjects (10 men and 6 women). The overall incidence was 0.69%, 0.63% in men and 0.83% in women. The mean age of subjects with tumors was 55.1 (SD 10.5) years in all, 55.1 (SD 13.0) years in men, and 55.0 (SD 5.5) years in women. The first study of brain check-up revealed brain tumors in 14 of 16 subjects (9 men and 5 women). The overall incidence of tumors on the first brain check-up was 1.04%, 1.04% in men and 1.05% in women. The mean age was 54.7 (SD 10.9) years in total, 54.0 (SD 13.2) years in men, and 56.0 (SD 5.5) years in women. The results of self-questionnaire indicated that 14 of 16 subjects had no significant symptoms. The retrospective study supported that physical check-up showed no malignant tumors in other organs in all subjects with brain tumors. Primary brain tumors were diagnosed in all cases. Neuropathological diagnoses were confirmed in 10 subjects. The histological results indicated meningioma (1 man), pituitary adenoma (1 man and 2 women), glioma (1 man and 1 woman), neurinoma (1 man and 1 woman) and malignant lymphoma (1 man). In two follow up subjects, meningioma was diagnosed by typical patterns of MRI. Benign lipoma (4 men) was diagnosed with fat-suppression MRI.

Conclusion Our studies indicate that the incidence of primary brain tumors is 690 per 100,000 population on all check-up and 1,040 per 100,000 population on the first check-up. The brain check-up-based evidence elucidates that the incidence of brain tumors is approximately 50 to 100 fold higher, in comparison with previous reports of Japanese prevalence. Multiphasic health tests are valuable for a differential diagnosis between primary and metastatic tumors. Brain check-up frequently discovers asymptomatic tumors. Thus, we should pay more attention to asymptomatic brain tumors in subjects with brain check-up.

INTRODUCTION

Recently, brain check-up is commonly performed and provide health promotion in Japan. Several studies of brain check-up show epidemiology of cerebrovascular diseases, such as cerebral aneurysms and anomaly of cerebral arteries. Brain check-up is also a useful tool for detection of asymptomatic brain tumors. The annual prevalence of primary brain tumors is thought to be approximately 10 to 15 per 100,000 in Japanese, American or Canadian population. Those statistical data consist of patients with symptomatic brain tumors in neurosurgical hospitals. The correct incidence of brain tumors on the basis of a large brain check-up study remains unknown in Japan. The purpose of this study is to examine the current incidence of brain tumors in adulthood, based on brain check-up data. We also studied whether multiphasic health tests, including simultaneous physical and brain check-up, have benefits for the early diagnosis of brain tumors. Here we report the incidence and the clinical features of brain tumors in our health institute.

SUBJECTS AND METHODS

In PL Tokyo Health Care Center, 31,646 subjects (19,901 men and 11,745 women) underwent physical check-up between April 1, 2001 and January 31, 2002. Among them, we analyzed 2,312 adults (7.3%) who received brain check-up. Participants were summarized in Table 1. Male was 1,592 subjects (68.8%) and female was 720 subjects (31.1%). Mean age was 53.5 (SD 11.0) years in all, 53.7 (SD 11.0) years in men and 53.1 (SD 11.0) years in women. The first brain check-up was performed in total of 1,343 subjects (58.1%), 868 subjects (54.4%) in men and 475 (66.0%) in women. Mean age on the first check-up was 54.7 (SD 10.9) years in all, 54.0 (SD 13.2) years in men, and 56.0 (SD 5.5) years in women. The results of self-questionnaire indicated that 14 of 16 subjects had no significant symptoms. The retrospective study supported that physical check-up showed no malignant tumors in other organs in all subjects with brain tumors. Primary brain tumors were diagnosed in all cases. Neuropathological diagnoses were confirmed in 10 subjects. The histological results indicated meningioma (1 man), pituitary adenoma (1 man and 2 women), glioma (1 man and 1 woman), neurinoma (1 man and 1 woman) and malignant lymphoma (1 man). In two follow up subjects, meningioma was diagnosed by typical patterns of MRI. Benign lipoma (4 men) was diagnosed with fat-suppression MRI.

Table 1 Participants in multiphasic brain and physical tests in our health institute.

<table>
<thead>
<tr>
<th>Total</th>
<th>Male</th>
<th>Female</th>
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<tbody>
<tr>
<td>Number of subjects</td>
<td>2312</td>
<td>(1343)</td>
</tr>
<tr>
<td>the first brain check-up</td>
<td>58.1%</td>
<td>54.5%</td>
</tr>
<tr>
<td>Age (mean ± SD years)</td>
<td>53.5 ± 11.0</td>
<td>53.7 ± 11.0</td>
</tr>
<tr>
<td>(51.8 ± 11.0)</td>
<td>(51.8 ± 11.0)</td>
<td>(51.7 ± 11.0)</td>
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Parenthesis showing the number and age of subjects with the first brain check-up.
Brain magnetic resonance imaging (MRI) and magnetic resonance angiography (MRA) were studied as routine brain check-up. Conventional T1- (TR/TE = 400/20 msec) and T2-weighted images (TR/TE = 4,750/120 msec) were performed in all subjects. Besides conventional images, fluid attenuated inversion recovery (TR/TE/TI = 10,000/200/100 msec), gadolinium-enhanced T1- or fat-suppression T1- (TR/TE = 400/20 msec) weighted imaging was done in a part of subjects. For fat-signal inhibition, spectral presaturation with inversion recovery method was applied. A slice/gap thickness of MRI was 6.0/0.5 mm and the matrix size was 224 x 256 for all sequences. All images were obtained in axial plane. Number of acquisitions was 2. MRA was applied by three dimensional time-of-flight technique. A slice thickness was 0.6 mm and the matrix size was 140 x 140 in MRA. One experienced neurologist and one diagnostic radiologist reviewed MRI and MRA images.

**RESULTS**

Brain check-up detected tumor lesions in total of 16 subjects (10 men and 6 women). The overall incidence was 0.69%. The incidence of sex distribution was 0.63% in men and 0.83% in women. The mean age of subjects with tumors was 55.1 (SD 10.5) years in all, 55.1 (SD 13.0) years in men, and 55.0 (SD 5.5) years in women (Table 2). The first brain check-up discovered brain tumors in 14 of 16 subjects (9 men and 5 women). The overall incidence of tumors on the first brain check-up was 1.04%, 1.04% in men and 1.05% in women. The mean age on the first check-up was 54.7 (SD 10.9) years in all, 54.0 (SD 13.2) years in men and 56.0 (SD 5.5) years in women (Table 3). Multiphasic physical check-up showed no malignant tumors in other organs, including lung, gastrointestinal ducts, colon, liver, kidney, mammary gland, prostate, ovary and uterus in all subjects with brain tumors. The retrospective data of neuropathology and health check-up suggested that all of 16 cases had primary brain tumors. The histological patterns of tumors were summarized in Table 4. Neuropathological diagnosis was made in 10 cases. The histological studies exhibited meningioma (1 case), pituitary adenoma (4 cases), glioma such as glioblastoma and astrocytoma (2 cases), neurinoma originated from the glosopharyngeal nerve (2 cases) and malignant lymphoma originated from the central nervous system (1 case). Brain lipoma was diagnosed in four cases by fat-suppression MRI. They needed no neurosurgical procedures because small benign lipoma was localized in the intraventricular areas. In two follow up cases, meningioma was diagnosed by typical appearances on MRI. Two men had fatal malignant tumors, including glioblastoma and malignant lymphoma. The overall incidence of fatal brain tumors was 0.09% on all brain check-up. The rate was 0.15% on the first brain check-up. When four men with benign lipoma were excluded, the overall incidence of operable tumors was 0.52% on all check-up. The sex ratio was 1.0 (6 men and 6 women). The overall incidence of operable tumors on the first brain check-up was 0.74%. The sex ratio was 1.0 (5 men and 5 women). The localization of tumors was listed in Table 5. Brain tumors existed in the cerebral lobes (5 cases), the intra- or peri-ventricular regions (5 cases), the pituitary gland or the third ventricle (4 cases) and the cranial base (2 cases). Clinical self-questionnaire for brain and physical check-up was analyzed retrospectively in all subjects with brain tumors. Fourteen of 16 subjects had no significant symptoms. They received brain check-up by themselves for healthy confirmation. Two subjects had loss of body weight, anorexia and headache. Physical examination was normal in 15 subjects. Acromegaly was seen in one man with pituitary adenoma. Neurological examination was normal in 14 subjects. Each one subject with glioblastoma or malignant lymphoma had mild mental changes, such as confusion and depression. These results supported the clinical aspects that most of our subjects with brain tumors had no symptoms or deficits on physical and neurological examination.

**DISCUSSION**

The correct incidence of brain tumors has not been studied in Japanese population, based on large number of subjects with brain check-up. In the present studies, we elucidated the current incidence of brain tumors on the basis of multiphasic health tests, including simultaneous physical and brain check-up. Among 2,312 participants, primary malignant and benign brain tumors were seen in 16 subjects. There were no metastatic brain tumors in our studies. The overall incidence of primary brain tumors was
The incidence of fatal malignant tumors, including glioblastoma multiforme, the overall incidence of operable tumors was 520 per 100,000 population on total check-up and 740 per 100,000 population on the first check-up. The incidence of fatal malignant tumors is calculated as 690 per 100,000 population on all check-up and 150 per 100,000 population on the first check-up. The incidence of operable tumors was 520 per 100,000 population on total check-up and 740 per 100,000 population on the first check-up. The retrospective data show that the incidence of brain tumors is higher on the first brain check-up than on repeated check-up. In general, Japanese annual prevalence of primary brain tumors is calculated as 690 per 100,000 population for all check-up and 150 per 100,000 population for the first check-up. The incidence of operable tumors was 520 per 100,000 population on all check-up and 740 per 100,000 population on the first check-up. The incidence of fatal malignant tumors is 90 per 100,000 population on all check-up and 150 per 100,000 population on the first check-up. The incidence of operable tumors was 520 per 100,000 population on total check-up and 740 per 100,000 population on the first check-up. The retrospective data show that the incidence of brain tumors is higher on the first brain check-up than on repeated check-up.

The mean age of participants in our studies was 53.5 (SD 11.0). Brain check-up could discover slow-growing tumors such as lipoma, meningioma, pituitary tumor and astrocytoma. Physical and neurological examination were normal in most of our subjects with brain tumors. The hallmark of clinical self-questionnaire also showed asymptomatic brain tumors.

Registry of Japanese brain tumor reports that adult brain tumors occur frequently in the sixth to seventh decade. The statistical data point out that senile onset of brain tumors is increased in proportion to older population. The range of age in our subjects with brain tumors was 35 to 75 years and the mean age was 55.1 years. The sex ration was almost equal. Our histological studies revealed that benign lipoma was detected frequently. The frequency of other oncological types was almost identified to previous reports. The localization of brain tumors was classified to four regions; 1) the cerebral lobe, 2) the intra- or peri-ventricular regions, 3) the pituitary gland/the third ventricle and 4) the cranial base. The topographic frequency of tumors was varied in our cases.

Our retrospective studies indicate that simultaneous physical and brain check-up can exclude metastatic brain tumors. Multi-phasic brain and physical health tests are useful for a differential diagnosis between primary and metastatic brain tumors. Both data could also contribute to the determination of therapeutic strategy in several subjects wit brain tumors. Based on the evidence of brain check-up, the up-to-date incidence of primary brain tumors is approximately 600 to 1,000 per 100,000 (0.6 to 1.0%) in Japanese adults. Surprisingly, the ratio is much higher than previous prevalence of primary brain tumors. Neurosurgeons or neurologists usually examine patients with symptomatic brain tumors. Otherwise, brain check-up plays a crucial role in the discovery of asymptomatic brain tumors. Our data elucidate that the incidence of brain tumors is higher in subjects with the first brain check-up, as compared to repeated check-up. Thus, we should pay more attention to asymptomatic tumors in individuals with the first check-up although they have no neurological symptoms. We are currently analyzing longitudinal studies of brain check-up in our health institute.

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REFERENCES