Prognosis and Disability of Stroke Patients
After 5 Years in Akita, Japan

Saburo Kojima, MD, Toshitaka Omura, MD, Wakako Wakamatsu, Masa Kishi,
Taeko Yamazaki, Minoru Iida, MD, and Yoshio Komachi, MD

The system of registering stroke patients was begun in 1963 in Ikawa Town, Akita Prefecture, Japan. The town is located in the northeastern part of the country and in 1975 had a population of 6,427. From 1975 to 1981, 109 patients who suffered their first stroke were registered and were monitored for 5 years. The average annual incidence rates of stroke were 2.8 and 2.0 per 1,000 population in males and females, respectively. Mean age at stroke onset was 63.3 and 71.4 years in males and females, respectively (p<0.01). According to the clinical classification of stroke, 76 patients suffered cerebral infarction, 21 cerebral bleeding, and six subarachnoid hemorrhage; six strokes were unclassified. The survival rates were compared by sex, age, and clinical stroke type using Cox's proportional hazards model. The survival rate of female stroke patients was lower than that of males, but not significantly so. The survival rate of stroke patients ≥65 years old was significantly lower (p<0.01) than that of younger patients. Moreover, the survival rate of patients with cerebral bleeding was significantly lower (p<0.01) than that of patients with cerebral infarction. In the analysis of self-care among the survivors, performance of the activities of daily living in older patients indicated significantly less independence (p<0.01) in younger patients.

Follow-up of new stroke cases showed that age and clinical stroke type were significantly associated with survival and that age was also related to disability of the survivors. (Stroke 1990;21:72–77)

Mortality due to cerebrovascular disease (stroke) in Japan is much higher than in other developed countries, and from 1951 to 1980 stroke was the leading cause of death in this country. The geographic pattern of stroke mortality in Japan varies from high in eastern to low in western Japan and high in more rural areas to low in more urban ones. Furthermore, in Akita Prefecture, stroke mortality has been among the highest in the 47 prefectures of Japan.

The incidence of and mortality due to stroke are decreasing; however, the age at stroke onset and the percentage of infarction are increasing in Japan. Stroke is a major cause of disability and dementia in the elderly, and related problems in health care have become more important in recent years.

The system of registering stroke patients was begun in 1963 in Ikawa Town, Akita Prefecture, Japan. The stroke incidence rates during 1975–1979 and factors related to stroke onset have been reported. Although a number of studies have described the natural history of stroke and the factors influencing survival, it is uncommon to find a study that combines data on survival and disability of stroke patients over a long period.

The purpose of our study is to determine the differences in survival rates according to the variables sex, age at stroke onset, and clinical stroke type. We also compared the performance of activities of daily living (ADLs) according to these three variables.

Subjects and Methods

Ikawa, a town located in the northeastern part of Japan, had a population of 6,427 in 1975. The center for stroke registry was established in Akita Prefectural Institute of Public Health to contact all patients who had a new stroke, exclusive of recurrence, during the period 1975–1981. The methods used for the development of this stroke registry are those outlined by the World Health Organization study.

The center was notified of suspected stroke by general practitioners, hospital physicians, and public health nurses in charge of the locality. Death certificates and medical bills sent to the payment accounts of various health insurance plans were reviewed.

From the Akita Prefectural Institute of Public Health (S.K., W.W.), the Department of Public Health, Akita University School of Medicine (T.O.), and the Ikawa Town Office Public Health Nurse (M.K., T.Y.), Akita, the Center for Adult Diseases, Osaka (M.I.), and the Institute of Community Medicine, Tsukuba University, Tsukuba (Y.K.), Japan.

Address for reprints: Saburo Kojima, MD, Akita Prefectural Institute of Public Health, 6-6, Sensyu-Kubota-Machi, Akita, 010 Japan.

Received July 15, 1988; accepted September 14, 1989.
TABLE 1. Incidence of Stroke in Ikawa, Japan, by Sex and Age

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n)</td>
<td>(N)</td>
<td>(n)</td>
</tr>
<tr>
<td>30–39</td>
<td>2</td>
<td>415</td>
<td>0.7</td>
</tr>
<tr>
<td>40–49</td>
<td>8</td>
<td>479</td>
<td>2.4</td>
</tr>
<tr>
<td>50–59</td>
<td>12</td>
<td>314</td>
<td>5.5</td>
</tr>
<tr>
<td>60–69</td>
<td>15</td>
<td>270</td>
<td>7.9</td>
</tr>
<tr>
<td>70–79</td>
<td>20</td>
<td>144</td>
<td>19.8</td>
</tr>
<tr>
<td>80+</td>
<td>5</td>
<td>27</td>
<td>26.5</td>
</tr>
<tr>
<td>All ages</td>
<td>62</td>
<td>3,134</td>
<td>2.8</td>
</tr>
</tbody>
</table>

\(n\), strokes 1975–1981; \(N\), population in 1975.

periodically. Records of medicolegal autopsies and records of ambulances dispatched from fire stations were also reviewed in the center.

All patients who were alive at the time of notification were examined by a staff physician from the center, and their clinical histories were confirmed. If possible, electrocardiography, ophthalmoscopy, a cerebrospinal fluid test, and various hematologic tests were also performed. If a patient had died by the time of notification, a physician from the center collected clinical information from the patient's relatives and the physician who signed the death certificate. Information on the patient's clinical history and the results of various special procedures (particularly computed tomography [CT] and cerebral angiography), and results of autopsy were collected from clinics and hospitals. Patients with signs and symptoms indicating subarachnoid hemorrhage, cerebral bleeding, or cerebral infarction were included in this register, but those with signs and symptoms of transient cerebral ischemic attacks were not. The details of the registration system are as described previously.

In all patients who died \(\leq 5\) years after the registered stroke, the cause of death was recorded according to the death certificate or autopsy findings. Surviving patients, who initially suffered a stroke between 1975 and 1981, were contacted 3 weeks, 3 months, and yearly until 5 years after the stroke onset. For each surviving patient, five ADLs (eating, washing, excretion, and walking) were tested at each follow-up examination. From the ADL results, the patient's condition was classified as independent (could perform all five ADLs without support by other persons), partially dependent, or totally dependent (needed help to perform all five ADLs).

The 5-year survival rates were compared by sex, age at stroke onset, and clinical stroke type. When the survival rates were compared across one variable, the other two might affect the result as confounders. The multivariate analysis of Cox's proportional hazards model was used to adjust for the effect of confounding variables. This model asserts that the effect of the study variables on the hazard rate in the study population is multiplicative and does not change over time. For example, the proportional hazards model for two variables \(x_1\) and \(x_2\) asserts that the rate \(\lambda(t)\) at time \(t\) is \(\lambda(t)=\lambda_0(t)\exp(x_1)+\exp(x_2)\), where \(\lambda_0(t)\) is the rate when \(x_1=x_2=0\).

The self-care classes of the surviving patients were also compared by sex, age at stroke onset, and clinical stroke type at 3 weeks to 5 years after stroke onset. Because the statistical method of self-care analysis was univariate, partial correlation coefficients of the three variables were calculated at each time to indicate the relation between self-care ability and one variable, excluding the effects of the other two variables as confounders.

Results

Between 1975 and 1981, 109 stroke patients were registered. The average annual stroke incidence rates were 2.8 and 2.0 per 1,000 population in males and females, respectively (Table 1). The sex ratio was 1.32, with 62.4% of the stroke patients >65 years old. Mean age at stroke onset was 63.3 and 71.4 years in males and females, respectively (\(p<0.01\)).

According to the clinical classification of stroke, 76 patients (69.7%) suffered cerebral infarction, 21 (19.3%) cerebral bleeding, and six (5.5%) subarach-
TABLE 5. Multivariate Analysis of Survival Rates for 97 Stroke Patients Using Cox's Proportional Hazards Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>( r )</th>
<th>SEE</th>
<th>( t )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>0.196</td>
<td>0.275</td>
<td>0.711</td>
<td>NS</td>
</tr>
<tr>
<td>Age</td>
<td>0.062</td>
<td>0.016</td>
<td>3.975</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Type</td>
<td>1.264</td>
<td>0.317</td>
<td>3.981</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Sex: male=1, female=2; type: infarction=1, bleeding=2. NS, not significant.

Subarachnoid hemorrhage; six strokes (5.5%) were unclassified (Table 2).

The age distribution of patients with two stroke types by sex are compared in Table 3. Patients with infarction were relatively older than patients with bleeding in both sexes, but the differences were not significant.

Because there were few patients with subarachnoid hemorrhage and unclassified stroke, they were excluded from the analysis of survival rate, giving a total of 97. Crude survival rates and standard errors are shown in Table 4; >60% of the patients died ≤5 years after stroke onset.

Adjusted survival rates for selected time points over the 5-year follow-up period by sex, by two age groups (30–64 and >65 years) and by two stroke types (i.e., bleeding and infarction) were calculated using Cox's proportional hazards model. The regression coefficients for age group and stroke type were significant (Table 5). Those two variables were independently predictive of survival because the patients with bleeding were relatively younger than those with infarction (Table 3).

The survival rate of females was lower than that of males during the 5 years, but the two curves were not significantly different (Figure 1).

The patient's age at stroke onset had a marked effect both on short- and long-term survival. The survival rate of older (aged >65 years) patients was significantly lower than that of younger (aged 30–64 years) patients (\( p < 0.01 \), Figure 2). The sex ratio of the patients was 2.73, and that of the older patients was 0.89 (\( p < 0.05 \)). The percentage of patients with infarction in the older and younger age groups were 59% and 76%, respectively.

During the first year, 67% (14 of 21) of the patients with bleeding and 22% (17 of 76) of those with infarction died (\( p < 0.01 \)). The difference in survival rates was apparent within 3 weeks after stroke onset. That is, the rates for patients with bleeding and infarction were 52% and only 7%, respectively. After the first year, there was very little mortality due to bleeding, whereas mortality due to infarction continued at a steady, low rate (Figure 3).

Three weeks after stroke onset, 38% of the male and 28% of the female patients were independent in self-care; 44% of the male and 50% of the female patients were totally dependent on other people (Figure 4). During follow-up, these patterns gradually changed, and by 5 years, 72% of the male and
56% of the female patients were independent; 28% of the male and 22% of the female patients were still totally dependent.

The ADLs of older patients indicated more disability than those of younger patients throughout the 5 years (Figure 5). The percentage of totally dependent younger patients decreased from 3 weeks to 3 months and later; however, the percentage of totally dependent older patients remained almost the same during the 5 years (64% at 3 weeks, 45% at 1 year, and 53% at 5 years).

Although the survival rate of patients with bleeding was lower than that of those with infarction (Figure 3), the percentage of totally dependent patients among survivors with bleeding was lower than among survivors with infarction (Figure 6).

Partial correlation coefficients of the three variables with self-care classification were calculated for each time after stroke onset (Table 6). Age was strongly and significantly related to self-care ability throughout the 5 years. Male patients were significantly more disabled than female patients only 2 years after stroke onset. Moreover, there was no significant difference in self-care ability between bleeding and infarction stroke types except at 3 weeks after stroke onset.

Discussion

In our study, the survival rate of female patients was lower than that of male patients during the 5 years after stroke onset, but the difference was not significant. Although the survival rate of patients with bleeding was very poor compared with that of patients with infarction, there was no significant difference in stroke type by sex (Table 2). Abu-Zeid et al and Eisenberg et al reported that the survival rate of males was better than that of females. However, some researchers have reported no significant differences in survival rates by sex; moreover, Marshall and Shaw reported that the survival rate of females was higher than that of males.

When we compare survival rates by sex, we should consider the marital status of the patients. Abu-Zeid et al reported that married stroke patients survived better than single patients, after adjusting for age. In our study, 90% of the male patients' wives but only 48% of the female patients' husbands were alive. Differences in the marital status of stroke patients by sex may be explained by the difference in life expectancy (approximately 5 years at age 0) and the difference in mean age at marriage (about 3 years) between males and females in Japan. However, the survival rate of female patients was lower than that of male patients even considering only patients whose spouses were alive at stroke onset. The mean age at stroke onset of our male and female patients was 63.3 and 71.4 years, respectively, a difference of approximately 8 years. We suggest that the difference in survival rates by sex can be explained by a difference in age at stroke onset by sex.
The survival rate of older patients was lower than that of younger patients. Among the younger patients, the percentages of bleeding and of males were higher than among the older patients. The fact that age was a very important variable in predicting the survival rate of stroke patients is consistent with all previous studies.6-11 The older patients had a higher risk than the younger patients for all kinds of fatal diseases and may have suffered from more advanced underlying diseases.

The survival rate of patients with bleeding was significantly lower than that of patients with infarction (Figure 3); the difference was evident by 3 weeks after stroke onset. Therefore, Aho et al.12 reported that deaths within the first 3 weeks after stroke onset could be termed "initial mortality." There was no significant difference in 5-year survival rates by stroke type when considering only survivors, the older patients were more highly dependent than the younger patients during the 5 years after stroke onset. Disability of male patients was significantly greater than that of females only 2 years after stroke onset. However, there was no significant difference in self-care ability by stroke type except at 3 weeks after onset. Therefore, the variables associated with survival rate were not exactly the same as those related to disability.

In conclusion, our follow-up of 97 new cases of stroke revealed that two variables, age and clinical stroke type (i.e., cerebral bleeding versus infarction), were significantly associated with survival. In addition, age was also related to disability of the survivors.

References


KEY WORDS • cerebrovascular disorders • prognosis • Japan • stroke registry
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Stroke. 1990;21:72-77
doi: 10.1161/01.STR.21.1.72
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

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