A Prospective Study of Stroke in Young Adults in Cantabria, Spain

Carlos Leno, MD; José Berciano, MD; Onofre Combarros, MD; José Miguel Polo, MD; Julio Pascual, MD; Fernando Quintana, MD; Jesús Merino, MD; Carmen Sedano, MD; Rafael Martín-Durán, MD; Concepción Alvarez, MD; and Javier Llorca, MD

Background and Purpose: The aim of this study was to determine the incidence, type, and prognosis of stroke in young adults in Cantabria, Spain.

Methods: We investigated prospectively all patients aged 50 years or below who were admitted with the diagnosis of a stroke to the University Hospital “Marqués de Valdecilla” from April 1, 1986, to March 31, 1988. This is the main hospital of the region to which all patients with neurological problems are referred. These patients underwent a complete clinical and laboratory assessment for stroke and had 1-year mean follow-up.

Results: The total series included 81 patients. The annual age-specific crude incidence rates of stroke were 17.3 and 10.4 per 100,000 for males and females, respectively. Twenty-four patients (30%) were diagnosed as having nonembolic cerebral infarction, 14 (17%) embolic cerebral infarction, 20 (25%) subarachnoid hemorrhage, 22 (27%) spontaneous cerebral hemorrhage, and one case (1%) cerebral venous thrombosis. Eighteen patients (22%) died within 30 days of the cerebrovascular event, and two others died during the follow-up period. Seventy-nine percent of the survivors recovered and were completely self-sufficient.

Conclusions: The incidence of stroke in the young found in Cantabria is comparable with that in previous studies. The initial hospital mortality was not negligible, but the prognosis among the survivors was favorable. (Stroke 1993;24:792–795)

Key Words • cerebrovascular disorders • epidemiology • Spain

It is generally conceded that cerebral vascular disease reaches its peak incidence in the later decades of life. Stroke in the elderly reflects the development of cardiac or vascular disorders related to age. Stroke in young adults occurs before the expected age and tends to excite interest because there is a feeling that the study of such a group may teach us more about strokes. As shown in previous epidemiological studies, the occurrence of stroke in the young is not rare.1,2 However, until now no detailed data concerning stroke epidemiology in young adults have been available for Spain. Therefore, the aim of this study was to screen a limited geographical area of northern Spain to establish figures of incidence and clinical pattern of stroke in young adults.

Subjects and Methods

Our study was performed in the autonomous community of Cantabria, which lies in northern Spain and covers an area of 5,289 km² with a population of 527,326 (1991 census).

We investigated prospectively all patients aged 50 years or below who were admitted with the diagnosis of a stroke to the University Hospital “Marqués de Valdecilla” from April 1, 1986, to March 31, 1988. This is the main hospital in which all patients with neurological problems are referred. A recent survey has estimated that more than 90% of people always use the public health service (according to the 1988 official statistics of the Spanish Sociological Investigations Center). As established in our previous epidemiological studies,3–5 the neurological patient population in this hospital is truly representative of the region of Cantabria.

To estimate the extent to which the total number of cases of stroke in the population were detected, examination of the official hospital diagnosis lists for patients with cerebrovascular diagnoses (codes 430–437, International Classification of Diseases, 8th Revision6) was carried out at the end of the study. Furthermore, death certificates of all residents of Cantabria who had died during the same 2-year period were reviewed. Patients included in the study had suffered their stroke just before admission or while in the hospital; if a patient had more than one stroke during the study period, we included only the first.

Cerebrovascular disease was defined according to criteria of the World Health Organization (WHO)7 and the Oxfordshire Stroke Project.8 We labeled a stroke as

---

From the Departments of Neurology (C.L., J.B., O.C., J.M.P., J.F.), Neuroradiology (F.Q.), Immunology (J.M.), Hematology (C.S.), Cardiology (R.M.-D.), and Biochemistry (C.A.), University Hospital “Marqués de Valdecilla,” Faculty of Medicine, and “Dirección Provincial del Ministerio de Sanidad, Sección Sanidad Exterior” (J.L.), Santander, Spain.

Address for correspondence: Dr. José Berciano, Service of Neurology, University Hospital “Marqués de Valdecilla,” 39008 Santander, Spain.

Received August 25, 1992; revision received February 4, 1993; accepted February 8, 1993.
emphatic cerebral infarction if a patient with an established cerebral infarction had a potential source of embolism or cerebral angiography with evidence of an occlusive embolic lesion, in absence of another etiology. The patients were then grouped into diagnostic categories consisting of the following: nonembolic cerebral infarction, embolic cerebral infarction, subarachnoid hemorrhage (SAH), spontaneous cerebral hemorrhage (CH), and cerebral venous thrombosis (as confirmed by cerebral angiography).

The diagnosis was based on the findings of computed tomography (CT), magnetic resonance imaging (MRI), cerebral angiography, two-dimensional echocardiography, cerebrospinal fluid examination, 24-hour Holter monitoring, or autopsy, and in a few cases only on clinical data. A detailed history and thorough clinical examination were conducted on each patient. Systematic investigations performed included standard blood and urine tests, twelve-lead electrocardiography, chest roentgenograms, and luetic serology. Other diagnostic studies were performed on an individual basis (Table 1).

At the time of follow-up, disability was graded as complete recovery if absent, mild if it did not interfere with activities of daily living, and severe if disability interfered significantly with aforementioned activities or the patient depended on others for most activities.

On the basis of verified cases, the annual incidence of stroke was calculated per 100,000 inhabitants. The study population comprised the calculated population of Cantabria on April 1, 1987. The calculation was based on the last census (March 1, 1981) and the last local register (April 1, 1986). The hypothesis that mortality and emigration rate remained constant during the aforementioned period for each age group was taken into account for the above calculation. Incidence rates were age adjusted by the direct method by using European standard population as described by WHO.9

**Results**

The total series included 81 patients, 51 males and 30 females. Five cases of suspected stroke were discovered upon revision of death certificates. Clinical data were so scarce that we could not confirm this diagnostic label; therefore, these five cases were not included in the present series. Stroke occurred during hospitalization for other illnesses in two patients (2.4%). Only one patient of the series had a history of stroke.

The annual age-specific crude incidence rates of stroke in young adults were 17.3 and 10.4 per 100,000 for males and females, respectively. The incidence rate for both sexes for the age-specific (11–50 years) population was 13.9 per 100,000 (95% confidence interval, 9.6–18.2). After age adjustment the male and female rates were 20.4 and 11.8, respectively (Table 2). To compare the rates with those in previous studies, we also calculated the annual crude incidence rate for both sexes for the age-specific range of 11–45 years as 10.9 (95% confidence interval, 6.9–14.9), and for that of 16–45 years as 12.0 (95% confidence interval, 7.5–16.5). We observed a marked increase of the stroke incidence after the age of 36, and another one after 46. In fact, the highest incidence was recorded between 46 and 50 years (Table 2). The male-to-female ratio was 1.7, significantly higher than the 1.02 ratio in the overall Cantabrian population of the same age (p<0.05). The male preponderance was seen in all diagnostic categories, including SAH.

The distribution of cases according to sex and diagnostic category is shown in Table 3: 24 (29.6%) patients were diagnosed as having nonembolic cerebral infarction, 14 (17.3%) as having embolic cerebral infarction, 20 (24.7%) as having SAH, 22 (27.2%) as having CH, and one (1.2%) as having cerebral venous thrombosis.

Eighteen patients died within 30 days of the cerebrovascular event (22.2%, 1-month mortality); these deaths included two (8.3%) cases of nonembolic cerebral infarction, one (7.1%) of embolic cerebral infarction, 5 (25.0%) of SAH, and 10 (45.4%) of CH. The main cause of death was the stroke itself, that is, increased intracranial pressure with herniation syndromes. Two additional patients died 4 and 6 months after their strokes, one of complications due to stroke-related disability and one of sudden death most probably related to ischemic heart disease.

At the 1-year follow-up, 79% of survivors had recovered and were completely self-sufficient, 8% had only a mild disability, and 13% were severely disabled. The highest rate of disability was found in the embolic cerebral infarction group (36%), followed by the CH group (33%), but it was in the latter group that more severe disability (25%) occurred.

**Discussion**

Studies of stroke incidence in young adults have been performed in North America,10 Europe,1,11,12 Africa,2

<table>
<thead>
<tr>
<th>Test</th>
<th>Nonembolic cerebral infarction (n=24)</th>
<th>Embolic cerebral infarction (n=14)</th>
<th>Subarachnoid hemorrhage (n=20)</th>
<th>Spontaneous cerebral hemorrhage (n=22)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
</tr>
<tr>
<td>CT or MRI</td>
<td>24 100.0</td>
<td>14 100.0</td>
<td>19 95.0</td>
<td>19 86.3</td>
</tr>
<tr>
<td>Cerebral angiography</td>
<td>20 83.3</td>
<td>7 50.0</td>
<td>18 90.0</td>
<td>14 63.6</td>
</tr>
<tr>
<td>Echocardiography</td>
<td>18 75.0</td>
<td>12 85.7</td>
<td>5 25.0</td>
<td>10 45.4</td>
</tr>
<tr>
<td>Contrast echocardiography</td>
<td>8 33.3</td>
<td>3 21.4</td>
<td>24</td>
<td>10 45.4</td>
</tr>
<tr>
<td>24-hour Holter monitoring</td>
<td>16 66.6</td>
<td>11 78.5</td>
<td>8 33.3</td>
<td>7 33.3</td>
</tr>
<tr>
<td>Cerebrospinal fluid examination</td>
<td>16 66.6</td>
<td>2 14.2</td>
<td>18 90.0</td>
<td>10 45.4</td>
</tr>
<tr>
<td>Autopsy</td>
<td>2 8.3</td>
<td>1 7.1</td>
<td>3 13.6</td>
<td>3 13.6</td>
</tr>
</tbody>
</table>

n, Number of patients (the diagnosis in one patient was cerebral venous thrombosis secondary to sepsis); CT, computed tomography; MRI, magnetic resonance imaging.

---

**TABLE 1. Frequency of Tests Performed**
and Asia.\textsuperscript{13} The annual incidence rate of stroke in this group of age as reported by worldwide studies varied from 9 to 39.8 per 100,000 population.\textsuperscript{1,2,11} The lowest values have been found in Florence, Italy,\textsuperscript{1} and in Oxfordshire, England\textsuperscript{14}; the highest incidences were recorded in Hiroshima, Japan,\textsuperscript{13} and Benghazi, Libya.\textsuperscript{2}

The annual incidence found in Stockholm, Sweden\textsuperscript{12} (34 cases per 100,000 inhabitants) was due to the inclusion of patients in the age group under 55. The high incidence found in Libya (39.8 cases per 100,000 population) was most probably due to poor control of risk factors among young stroke victims in Benghazi.\textsuperscript{2} Our findings (13.9 cases per 100,000) are similar to those gathered in the United States\textsuperscript{10} and several European countries.\textsuperscript{1,11} In the present study the incidence rates rose with increasing age, a classic finding observed in many other studies.\textsuperscript{10,11}

The sex ratio in stroke in the young differed greatly in reported series. As we found, in some there was a male preponderance,\textsuperscript{14} whereas in others the ratio was similar for both sexes.\textsuperscript{1} However, a clear male prevalence in the ischemic\textsuperscript{15} and intracerebral hemorrhage groups\textsuperscript{16} has been reported. The sex incidence rates showed that primary SAH occurs equally in both sexes. The apparent female predominance in most series resulted from the large proportion of females in older age groups, in which the incidence of SAH is greater.\textsuperscript{17} Possibly, the male predominance in the SAH group observed in our series is incidental.

TABLE 3. Distribution of Cases According to Sex and Diagnostic Category

<table>
<thead>
<tr>
<th>Diagnostic category</th>
<th>Males</th>
<th>Females</th>
<th>Both sexes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n)</td>
<td>(n)</td>
<td>n</td>
</tr>
<tr>
<td>Nonembolic cerebral infarction</td>
<td>15 (9)</td>
<td>24 (9)</td>
<td>29.6</td>
</tr>
<tr>
<td>Embolic cerebral infarction</td>
<td>10 (4)</td>
<td>14 (7.3)</td>
<td></td>
</tr>
<tr>
<td>Subarachnoid hemorrhage</td>
<td>12 (8)</td>
<td>20 (24.7)</td>
<td></td>
</tr>
<tr>
<td>Spontaneous cerebral hemorrhage</td>
<td>13 (9)</td>
<td>22 (27.2)</td>
<td></td>
</tr>
<tr>
<td>Cerebral venous thrombosis</td>
<td>1 (1.2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All types: 51 (30) 81 (100)  

n, Number of patients.

In previous studies of stroke in the general population, thromboembolic episodes predominated largely over hemorrhagic episodes.\textsuperscript{19} This was also the case in some of the series involving young people.\textsuperscript{2} However, in other studies (our own included), a high rate of hemorrhagic stroke was found in young age groups.\textsuperscript{1,13} The reason for this divergence is not obvious, but we think that it may result from the rise in the incidence with age of each type of stroke not being the same, with cerebral infarction being more marked.

We found that initial hospital mortality was not negligible, and it was similar to that described by other investigators.\textsuperscript{18} As reported in our series, the mortality rates are high for hemorrhagic lesions\textsuperscript{12,14} and low for ischemic lesions.\textsuperscript{14,15,19}

Finally, our study indicates that the prognosis for recovery among young adults who survive a stroke is favorable; in fact, 79\% of survivors improved and became functionally independent. Patients with cerebral thrombosis have the best prognosis,\textsuperscript{19} embolic patients have a higher incidence of severe deficits, and patients with intracerebral hemorrhage have the worst prognosis.\textsuperscript{20}

Acknowledgments

The authors thank Derek Christie for stylistic revision and Marta de la Fuente for secretarial help.

References

A prospective study of stroke in young adults in Cantabria, Spain.
C Leno, J Berciano, O Combarros, J M Polo, J Pascual, F Quintana, J Merino, C Sedano, R Martín-Durán and C Alvarez

Stroke. 1993;24:792-795
doi: 10.1161/01.STR.24.6.792
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 1993 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/24/6/792

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org/subscriptions/