Stroke is one of the most common fatal diseases, at least 5 times more so than is myocardial infarction. The incidence of stroke in Tibet was the highest in China according to a national survey 20 years ago, and since then, no other studies have revisited this important public health issue. In recent years, the economic climate in Tibet has changed considerably, as have people’s dietary habits and health concepts. Considering these developments, the epidemiology of stroke in Tibet may have changed during this 20-year period. Hence, in this study we described and analyzed stroke occurrence in the capital city, Lhasa, using the City Staff Medical Insurance Registry data from 2006 to 2008.

An Epidemiological Survey of Stroke in Lhasa, Tibet, China

Yuhua Zhao, MD*; Zhiping Yao, MD*; Wendyl D’Souza, MD, PhD; Cairong Zhu, PhD; Hua Chun, MM; Cidan Zhuoga, MM; Qin Zhang, MD; Xuejun Hu, MM; Dong Zhou, MD

Background and Purpose—There have not been any new epidemiological studies related to stroke in Tibet for 20 years. This study aimed to collect stroke data from The City Staff Medical Insurance Registry in Lhasa, Tibet, to describe the incidence, clinical subtypes, and associated risk factors of stroke.

Methods—We used retrospective, population-based descriptive analysis of all urban and rural workers in the City Staff Medical Insurance Registry who were admitted to designated hospitals from October 2006 to October 2008. Stroke was defined by the International Classification of Disease (ICD)-10 coded from hospital records.

Results—Workers (81 298) were listed in the City Staff Medical Insurance Registry. Stroke patients (165) were included in the study, with 133 being first-ever patients. The age-standardized incidence rate was 88.725/100 000 per year (95% CI, 72.228–105.221), and mortality rate was 25.941/100 000 per year (95% CI, 16.416–35.466). The case fatality rate was 21.82%. Seventeen of the 133 patients (12.8%) were <45 years of age. Stroke incidence rate was higher in ethnic Han patients than ethnic Tibetan patients. The most common subtype was cerebral infarction, and the most important risk factor was hypertension.

Conclusion—Since the last study 20 years ago in Lhasa, stroke remains the primary fatal disease for the elderly, and its occurrence at younger ages is higher in Lhasa than in other areas of China. However, the annual incidence rate and mortality rate have decreased. The annual incidence rate is at a similar level to that in other parts of China. The primary subtype of stroke in Lhasa is cerebral ischemia. (Stroke. 2010;41:2739-2743.)

Key Words: epidemiology ■ stroke ■ incidence rate ■ mortality rate

Materials and Methods

Research Areas

As the capital of the Tibetan Autonomous Region, Lhasa is the center of Tibetan politics, economics, and culture. The mean altitude is 3658 meters above sea level. The climate is characterized by low oxygen/atherospheric pressure, cold with extreme variability (the yearly temperature range is small and the daily range is large), low humidity, and strong ultraviolet radiation. Lhasa includes 1 subordinate central district and 7 suburban counties. At the end of 2007, the total population was 622 316; of these, 464 736 were permanent residents. Of the total population, 88.9% were of Tibetan ethnicity, 10.5% were Han, and 0.6% belonged to >30 other ethnicities. The diet there is characterized by high fat, high protein, low carbohydrate, high salt, and low fiber, seemingly contrary to the concept of a healthy, balanced diet.

Research Population

The data were culled from the City Staff Medical Insurance Registry in Lhasa, which covered 13.21% of the permanent residents there, between October 2006 and October 2008. This comprised 81 298 people, who were all >18 years old and of which 52 199 were men (63.50%). As for ethnicity, 46 079 were Tibetan (56.06%), 32 124 were Han (39.08%), and 3095 were of other ethnicities (3.76%). Of the total, 56 189 (68.36%) were employed. Table 1 shows the age distribution of the research population. Most people on the Registry were employees of governmental departments or state-owned enterprises. Treatment for stroke is listed as a cost-free disease by the local government; hence, all costs are covered when patients were hospitalized with confirmed stroke in designated hospitals. All patients admitted to these hospitals with possible stroke were investigated with a brain computed tomography scan or magnetic resonance imaging within 24 hours of presentation. If the patient had been admitted to a suburban hospital first, he or she was then transferred to the designated hospitals once his or her vital signs were normal.
Table 1. City Staff Medical Insurance Registry in Lhasa by Age and Sex

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–19</td>
<td>62</td>
<td>37</td>
<td>99</td>
</tr>
<tr>
<td>20–29</td>
<td>6501</td>
<td>5407</td>
<td>11 908</td>
</tr>
<tr>
<td>30–39</td>
<td>12 935</td>
<td>8370</td>
<td>21 305</td>
</tr>
<tr>
<td>40–49</td>
<td>13 436</td>
<td>7295</td>
<td>20 731</td>
</tr>
<tr>
<td>50–59</td>
<td>10 575</td>
<td>4069</td>
<td>14 644</td>
</tr>
<tr>
<td>60–69</td>
<td>6110</td>
<td>2902</td>
<td>9012</td>
</tr>
<tr>
<td>70–79</td>
<td>2185</td>
<td>845</td>
<td>3030</td>
</tr>
<tr>
<td>80 and older</td>
<td>395</td>
<td>174</td>
<td>569</td>
</tr>
<tr>
<td>Total</td>
<td>52 199</td>
<td>29 099</td>
<td>81 298</td>
</tr>
</tbody>
</table>

stable. Those patients confirmed with stroke received further examinations such as blood pressure monitoring, a cholesterol level test, blood glucose, electrocardiography, and echocardiogram for risk-factor screening.

Research Methods

The City Staff Medical Insurance Registry was searched for patients with certain International Classification of Disease (ICD) codes of discharge diagnosis (ICD-10 codes I60.901-I63.902) and relevant medication received during hospital stay (such as anticoagulants and antiplatelet drugs and drugs administered for hypertension, coronary heart disease, myocardial infarction, and diabetes mellitus). The selected patients were verified against their hospital medical records, including test results. Finally, patients with uncertain relevant past histories were telephoned and any deficient details were collected. Two neurologists were asked to check all patient information and rectify the diagnosis and classification until they reached agreement. Strokes were classified by subtypes of cerebral infarction, spontaneous intracerebral hemorrhage, and spontaneous subarachnoid hemorrhage. Nine cases of transient ischemic attacks were excluded.

Death due to stroke was determined by death within 30 days of last hospital stay (ICD-10 codes I60.901-I63.902) and relevant medication received during hospital stay (such as anticoagulants and antiplatelet drugs and drugs administered for hypertension, coronary heart disease, myocardial infarction, and diabetes mellitus). The selected patients were verified against their hospital medical records, including test results. Finally, patients with uncertain relevant past histories were telephoned and any deficient details were collected. Two neurologists were asked to check all patient information and rectify the diagnosis and classification until they reached agreement. Strokes were classified by subtypes of cerebral infarction, spontaneous intracerebral hemorrhage, and spontaneous subarachnoid hemorrhage. Nine cases of transient ischemic attacks were excluded.

Results

General Social Characteristics

Patients (165) were diagnosed with stroke according to the criteria; 133 of these were first-ever patients, and of those, 109 were men (82%) and 24 were women (18%). Among first-ever patients, 71 patients were Tibetan (53.4%), 61 patients were Han (45.9%), and 1 patient belonged to another ethnicity. Thirty-seven patients were employed (27.8%) and 96 patients were retired (72.2%). Seventeen patients were <45 years of age (12.8%). Most of the included cases were employees from the geologic survey, as well as from governmental, educational, and traffic departments.

Incidence Rate of Stroke

Annual Incidence Rate

Between October 1, 2006 and October 1, 2008, there were 133 new-onset cases in the registry population, giving a crude annual incidence rate for stroke of 81.798/100 000 per year (95% CI, 62.328–105.221), and an age-standardized annual incidence rate of 88.725/100 000 per year (95% CI, 72.228–105.221).

Seasonal Diversity

No differences in incidence rate were observed by season (Table 2).

Incidence Rate by Sex and Ethnicity

The incidence rate among men was much higher than that among women. The incidence rate in Lhasa of Tibetan people was lower than that of Han people (Table 3).

Stoke Subtypes

Among first-ever stroke patients, cerebral infarction was the most common subtype, followed by intracerebral hemorrhage. Among all stroke patients, the proportion of cerebral infarction was 97/165 (58.79%), and spontaneous cerebral hemorrhage was 60/165 (36.36%); the ratio of the 2 was 1.46. However, in Tibetan patients, the ratio was 1.00, which was much lower than that in Han patients (2.28) (Table 3).

Average Incidence Rate by Age

Onset age of stroke patients ranged from 26 to 85 years, with a mean of 60.32±1.044 years and a median of 61 years. With
aging, the incidence rate increased, and between 20 to 89 years, was statistically significant (Table 5).

**Mortality Rate and Fatality Rate**

Of the 165 patients, 36 patients died within 30 days of stroke onset. The case fatality rate was 21.82%, and the age-standardized annual mortality rate was 25.941/100 000 (95% CI, 16.416–35.466).

**Risk Factor Analysis**

Hypertension was the most common risk factor for stroke, occurring in 81/133 new-onset patients (60.9%). This was followed by heart disease in 18/133 patients (13.5%), and diabetes mellitus in 14/133 patients (10.5%). In Tibetan patients, hypertension was still the primary risk factor (47/71, 66.2%) as was the case in Han patients (33/61, 54.1%). However, with regard to the crude annual incidence rate in the research population from 2006 to 2008, hypertension was still the highest at 208.492/100 000 per year, but diabetes was second with 194.347/100 000 per year, and heart disease followed with 71.342/100 000 per year.

**Discussion**

This is the first epidemiologic investigation on stroke in Tibet since a study in 1986. Our findings revealed the basic stroke status in recent years. The most common subtype was cerebral infarction and the most important risk factor was hypertension. Stroke seemed less common in Tibetan people than it was in Han people. The incidence in men was greater than it was in Han people. The incidence in women was also restricted to data in the newly established City Staff Medical Insurance Registry. In addition, the research population from 2006 to 2008, hypertension was still the primary risk factor (47/71, 66.2%) as was the case in Han patients (33/61, 54.1%). However, with regard to the crude annual incidence rate in the research population from 2006 to 2008, hypertension was still the highest at 208.492/100 000 per year, but diabetes was second with 194.347/100 000 per year, and heart disease followed with 71.342/100 000 per year.

**Table 3. Stroke Incidence Rate by Sex and Ethnicity**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Stroke Cases (of 133)</th>
<th>Interviewed (of 81 298)</th>
<th>Average IR per 100 000 yr (95% CI)</th>
<th>Standardized IR by 2000 World Population per 100 000/Year (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>109</td>
<td>52199</td>
<td>104.408 (76.698–132.113)</td>
<td>103.468 (82.927–125.486)</td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>29099</td>
<td>41.239 (17.911–64.567)</td>
<td>52.409 (28.500–76.319)</td>
</tr>
<tr>
<td>Tibetan</td>
<td>71</td>
<td>46079</td>
<td>77.042 (51.708–102.376)</td>
<td>79.798 (59.544–100.052)</td>
</tr>
<tr>
<td>Han</td>
<td>61</td>
<td>32124</td>
<td>94.945 (61.266–128.62)</td>
<td>108.888 (79.038–138.737)</td>
</tr>
</tbody>
</table>

**Table 4. Stroke Subtypes and Average Incidence Rate**

<table>
<thead>
<tr>
<th>Stroke Subtype</th>
<th>Male</th>
<th>Female</th>
<th>Tibetan, n (%)</th>
<th>Han, n (%)</th>
<th>Constituent Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebral infarction</td>
<td>61</td>
<td>15</td>
<td>34 (47.89%)</td>
<td>41 (67.21%)</td>
<td>57.14</td>
</tr>
<tr>
<td>Intracerebral hemorrhage</td>
<td>44</td>
<td>8</td>
<td>34 (47.89%)</td>
<td>18 (29.51%)</td>
<td>39.10</td>
</tr>
<tr>
<td>Subarachnoid hemorrhage</td>
<td>4</td>
<td>1</td>
<td>3 (4.22%)</td>
<td>2 (3.28%)</td>
<td>3.76</td>
</tr>
<tr>
<td>Total</td>
<td>109</td>
<td>24</td>
<td>71</td>
<td>61</td>
<td></td>
</tr>
</tbody>
</table>

**Table 5. Average Incidence Rate by Age**

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Stroke Cases (of 133)</th>
<th>Interviewed (of 81 298)</th>
<th>Rude Average Incidence Rate per 100 000/Year (95% CI)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–19</td>
<td>0</td>
<td>99</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>20–29†</td>
<td>1</td>
<td>11 908</td>
<td>4.199 (3.376–5.022)</td>
<td>0.0168</td>
</tr>
<tr>
<td>30–39</td>
<td>6</td>
<td>21 305</td>
<td>14.081 (12.488–15.674)</td>
<td>0.02</td>
</tr>
<tr>
<td>40–49</td>
<td>17</td>
<td>20 731</td>
<td>41.001 (13.44–68.558)</td>
<td>0.04</td>
</tr>
<tr>
<td>50–59</td>
<td>34</td>
<td>14 644</td>
<td>116.088 (100.138–232.041)</td>
<td>0.00</td>
</tr>
<tr>
<td>60–69</td>
<td>43</td>
<td>9012</td>
<td>238.57 (137.85–339.294)</td>
<td>0.00</td>
</tr>
<tr>
<td>70–79</td>
<td>28</td>
<td>3030</td>
<td>462.046 (220.57–703.52)</td>
<td>0.00</td>
</tr>
<tr>
<td>80 and older</td>
<td>4</td>
<td>569</td>
<td>487.80 (186.6–1162.2)</td>
<td>0.00</td>
</tr>
</tbody>
</table>

*Probability values were estimated by logistic regression analysis.†In analysis of age, the data from the age group of 20–29 years were used as the baseline for comparison.
are the result of improvements in the living conditions and medical services of Tibet in recent years. The increase of mean life expectancy of Tibetan people from 44 years to 67 years also explained the changes. The case fatality rate in this study was 21.82%, lower than that of India (40.08%)\(^6\) but higher than that in studies in China\(^\text{11,12}\); it is also in the middle of the range (17%–33%) observed in reports from other countries.\(^\text{12–16}\)

In our study, stroke was still the most common fatal disease, with the incidence rate about 11 times more than that of myocardial infarction, in accordance with other reports.\(^\text{17}\) Hypertension was confirmed to be the primary risk factor in our study, as it was in other domestic investigations.\(^\text{18}\) The investigation in 2002\(^\text{19}\) revealed the prevalence rate of hypertension in the elderly of Lhasa to be 40.68%; various factors such as special geologic conditions, lifestyle, low education level, inadequate exercise, and high intake of fat and salt contributed to it.

The decreased onset age was another tendency revealed in our study, that men showed prominent incidence than women, as 12.8% of first-ever stroke patients were <45 years old, which is higher than the ratio from other studies.\(^\text{2,20–21}\) A large-scale, hospital-based study on risk factors for stroke in 18 mainland Chinese provinces showed that 19- to 45-year old patients accounted for 9.77% of 64,558 stroke inpatients; ischemic stroke was the most common subtype (63.3%).\(^\text{22}\) The crucial risk factors for stroke in young patients were hypertension (41.0%), smoking (38.8%), drinking (38.3%), prior stroke (14.9%), heart disease (7.2%), diabetes (5.2%), and hyperlipidemia (4.2%). Male patients accounted for 72.7% of the whole, with the main risk factors of hypertension, smoking, and drinking being higher than in female patients (\(P<0.05\)). Meanwhile, the study in 264 stroke patients ages 18 to 45 years from Taiwan showed hyperglycemia (53.1%), smoking (49.8%), and hypertension (45.8%) to be the most common factors.\(^\text{23}\) Our study did not include data from risk factors related to diet; however, the much higher intake of alcohol in men and in young people could be one of the reasons.

Several studies suggested that stroke occurred most often at the end of autumn and winter.\(^\text{20–24}\) In our study, no influence of seasons on the occurrence of stroke was found; this might be the result of the small yearly temperature range in Lhasa compared with the distinct seasonal variations in eastern China. Differences in the stroke incidence rates between ethnicities was found in this study. The incidence of stroke in Lhasa was higher in Han people than in Tibetan people, even though these groups share similar habits and environment. This could result from the different adaptability and susceptibility between aboriginal residents and immigrant Han people. The difference of the ratio of cerebral infarction over hemorrhage between Han and Tibetan stroke patients could also be evidence. But the investigations about the influence of ethnicities on vascular diseases in Tibet were unavailable to reveal the underlying reasons.

Compared with the figure in domestic investigations, the age-standardized annual incidence rate of Han people in Tibet is 103.121/100 000 per year (by Segi population), similar to the level of 76.1/100 000 per year in Shanghai (southern seaside) and 135.0/100 000 per year of Beijing (northern) from 1991 to 2000.\(^\text{25}\) These were sampled from a community-based stroke-monitoring database and standardized by Segi population. Among Han people, the interregional difference at a similar altitude did not seem evident and migration into different environments did not show much impact on stroke occurrence. Because of the lack of data regarding Tibetan people in different regions, it is uncertain whether this holds true for all ethnic Tibetan people.

In our study, cerebral infarction was most common subtype (58.79%). Although the reported range is wide, studies in China show similar proportions of cerebral ischemia (45.5%–75.9%) and cerebral hemorrhage (17.1%–55.4%).\(^\text{25}\)

In our study, it was found that, with developments in Tibet, the incidence of stroke decreased and the prognosis of stroke improved. Meanwhile, the necessity for prevention of stroke was still severe with the increasingly prominent trend of younger onset. Hypertension and unhealthy diet played critical roles in stroke occurrence. Active promotion and advocacy for a healthy diet and lifestyle to prevent hypertension and stroke presented a critical project for the local medical institutions and health authority. In addition, wider investigations and more specific subanalysis, especially about the risk factors and prognostic factors of stroke in the whole of Tibet, are essential and urgent for additional development and application of stroke strategy.

Acknowledgments

Great thanks for the strong support and help from the Social Insurance Bureau of the Tibetan Autonomous Region. This work was supported in part by grants from the National Nature Science Foundation of China (30960113).

Disclosures

None.

References


An Epidemiological Survey of Stroke in Lhasa, Tibet, China

Yuhua Zhao, Zhiping Yao, Wendyl D'Souza, Cairong Zhu, Hua Chun, Cidan Zhuoga, Qin Zhang, Xuejun Hu and Dong Zhou

Stroke. 2010;41:2739-2743; originally published online October 21, 2010;
doi: 10.1161/STROKEAHA.110.586669

Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2010 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/41/12/2739

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/