Risk factors and treatment of stroke in Chinese young adults

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Objective: To evaluate the risk factors and treatment status of Chinese stroke patients aged 35–45 years old.

Methods: We collected data from 1988 in-hospital stroke patients aged 35–45 years old from 36 hospitals in mainland China and compared it to 12,260 health controls with the same age. Information about stroke risk factors was obtained through a questionnaire. Multiple logistic regression and chi-square test were performed to explore the association between risk factors and stroke in young patients.

Results: Of the stroke patients, 94.3% had an ischemic stroke and 73.0% were male. Frequencies of stroke risk factors were significantly higher in patients than those in controls, including history of hypertension (41.0% versus 9.0%, $p<0.05$), diabetes (5.2% versus 1.7%, $p<0.05$), hypercholesterolemia (4.2% versus 2.9%, $p<0.05$), heart diseases (7.2% versus 1.6%, $p<0.05$), stroke (14.9% versus 1.3%, $p<0.05$), smoking (38.8% versus 33.3%, $p<0.05$) and drinking (38.0% versus 24.9%, $p<0.05$). Furthermore, only 12.8% of patients with hypertension took antihypertensive drugs regularly, and 27.9% of diabetic patients took hypoglycemic drugs regularly. Risk factors when compared between male and female patients were as follows: history of heart diseases (5.9% versus 10.8%, $p<0.05$), smoking (50.9% versus 6.5%, $p<0.05$) and drinking (50.4% versus 5.8%, $p<0.05$).

Conclusion: Majority of the Chinese stroke patients aged 35–45 years were male and had suffered an ischemic stroke. The history of stroke, heart disease and hypercholesterolemia could increase the risk of stroke in young adults, and the risk factors in the order of importance were hypertension, smoking, alcohol drinking, previous stroke, heart disease, diabetes mellitus and hyperlipidemia. Hypertension, smoking and alcohol drinking were found to be the main risk factors; treatment state and lifestyle should be improved for young stroke patients.

Keywords: Stroke, epidemiology, risk factor, young

Introduction

Stroke is the leading cause of severe long-term disability in adults and the main cause of morbidity in the world population. Although it is more prevalent in older age groups, its socioeconomic impact is greater when it affects young patients. In this population, the annual incidence of ischemic events is estimated between 6 and 26 per 100,000. It was reported that up to 12% of patients admitted are aged 45 years and below. In the young population, despite extensive investigation, up to 40% of cases do not have a clear etiology and are called cryptogenic. Stroke is the leading cause of death and disability in mainland Chinese patients; this has led to more studies investigating stroke in the younger population. We can benefit from understanding the differences between young individuals versus older patients to identify high risk populations and devise preventative strategies. Established risk factors for various strokes include age, gender, race/ethnicity, smoking, hypertension, heart disease, diabetes and positive family history of stroke. Naess et al. reported that compared with controls and the general Norwegian population, young population suffered ischemic strokes due to lower quality of life. Waje-Andreassen et al. found that long-term mortality was significantly increased among young stroke patients, mainly due to lifestyle factors, such as high consumption of alcohol and tobacco. Drawing upon the nationally collected cases of young stroke patients in mainland China, the present work focuses on the incidence, characteristics and risk factors of stroke in young Chinese patients, when compared with health controls, in order to explore the influence of these risk factors in young stroke patients.

Subjects and methods

Subjects

We conducted a case-control study. From 1 January 1996 to 31 December 2000, the Beijing Neurologist Club organized 36 hospitals from 18 provinces in...
mainland China and collected consecutively a total of 1988 hospitalized patients aged 35–45 years with first diagnoses of stroke. The stroke diagnosis was confirmed by computed tomography and magnetic resonance imaging; ischemic strokes as well as hemorrhagic strokes were included. The neurological deficit was graded on admittance using the NIH Stroke Scale. The risk factors included history of cardiovascular diseases, stroke, hypertension, diabetes mellitus (DM), smoking, alcohol consumption, etc., and these risk factors were compared between patients and health controls. The data of the control population were gathered from the nationwide survey of Further Study of Cardiovascular Risk Factors held in 11 provinces in China (National ‘85’ Problem-Tackling Project, Department of Epidemiology of Beijing Anzhen Hospital).

Quality control of case report form

Information about stroke risk factors was obtained from questionnaires administered by trained interviewers. For patients with a language barrier that impeded the questionnaire administration, first-degree relatives of the patient were asked to fill out the questionnaires instead.

Statistical processing

Pearson’s $\chi^2$ test was used to analyse risk factors between patients and control group. Odds ratio was estimated by multivariate logistic regression. $p$ value $<0.05$ or $p<0.01$ was considered significant. All statistical analyses were performed using SPSS statistical software (version 11.5).

Results

The mean age of all stroke patients was 41.3 years old, and 94.3% (1874/1988) suffered an ischemic stroke. Out of the 1988 stroke patients, only 46.3% stroke patients with history of hypertension were taking antihypertensive drugs (Table 1). Among the 1874 ischemic stroke patients, there were 1455 patients with cerebral infarctions, 104 with thrombotic cerebral infarction, 107 with lacunar infarction, 70 with vertebrobasilar ischemia and 138 with transient ischemic attack.

Incidence of risk factors in the case group was much higher than those in controls, and the difference between the two groups was statistically significant ($p<0.01$, Table 2).

Risk factors when compared between male and female patients were as follows: history of heart diseases (5.9 versus 10.8, $p<0.01$), smoking (50.9 versus 6.5, $p<0.01$) and drinking (50.4 versus 5.8, $p<0.01$; Table 3).

Discussion

Epidemiology

Stroke is the leading cause of adult disability and is the second commonest cause of death worldwide. This epidemiological study has demonstrated that the occurrence of stroke in young people has become more and more prevalent. There are around 120,000 female and 105,000 male stroke patients in the group aged <45 years of the US population. The annual incidence of ischemic stroke was 11.3/100,000 in the 18–44-year-old population according to a survey in the northern Swedish population during 1991–1994. The annual incidence of first-onset ischemic stroke was 11.4/100,000 in the 15–49 year old Western Norway population. Male and female incidences of stroke were 18–142/100,000 and 23–95/100,000, respectively, in the Chinese 35–45 year old population. The incidence of stroke in individuals aged 18–45 years was 9.77% in Chinese stroke patients, so more evidence strongly suggested that young Chinese adults might face a higher stroke risk in mainland China.

The subtype of young stroke and gender

As shown in this work, 94.3% of young Chinese stroke patients had an ischemic stroke (Table 1), while in the previous data, this ranges from 63.3 to 84.7%. Conversely, a retrospective hospital-based study revealed that 60.1% stroke patients had a hemorrhage stroke in Tanzania and sub-Saharan Africa. In our work, 73.0% of young stroke patients were male, consistent with the studies in India (76.3%) and Qatar (80.0%). This means that stroke patients aged 35–45 years in mainland China were mostly men who largely suffered an ischemic stroke.

Risk factors of young stroke

It is important to clarify the etiology of stroke in young patients so as to effectively prevent its occurrence. Etiology of young stroke varies among patients, and it may be history of hypertension, DM, exercises, vascular disease, high body mass index, history of atherosclerotic or cardiac embolism, smoking, drinking or other risk factors such as genetics, blood total homocysteine, dissection of the cerebral arteries, intracranial aneurysm and atrial septal abnormalities.

In our investigation, risk factors like history of hypertension, DM, hypercholesterolemia, heart diseases, stroke, smoking and drinking were significantly higher in patients than those in controls. Hypertension carries the highest risk of stroke among all risk factors followed by smoking and drinking. These findings are consistent with another study, in which hypertension and DM were the first and the

<table>
<thead>
<tr>
<th>Items</th>
<th>Case group</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years)</td>
<td>41.38 ± 2.97</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1451</td>
<td>73.0</td>
</tr>
<tr>
<td>Ischemic stroke</td>
<td>1874</td>
<td>94.3</td>
</tr>
<tr>
<td>History of stroke</td>
<td>206</td>
<td>14.9</td>
</tr>
<tr>
<td>History of hypertension</td>
<td>816</td>
<td>41.0</td>
</tr>
<tr>
<td>Antihypertensive drugs</td>
<td>378</td>
<td>46.3</td>
</tr>
<tr>
<td>Antihypertensive drugs regularly</td>
<td>104</td>
<td>42.3</td>
</tr>
<tr>
<td>History of DM</td>
<td>104</td>
<td>5.2</td>
</tr>
<tr>
<td>Hypoglycemic drugs</td>
<td>44</td>
<td>27.9</td>
</tr>
<tr>
<td>Hypoglycemic drugs regularly</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>History of hyperlipemia</td>
<td>84</td>
<td>4.2</td>
</tr>
<tr>
<td>History of heart disease</td>
<td>143</td>
<td>7.2</td>
</tr>
<tr>
<td>Smoking</td>
<td>771</td>
<td>38.8</td>
</tr>
<tr>
<td>Drinking</td>
<td>760</td>
<td>38.2</td>
</tr>
</tbody>
</table>
second most important risk factors for ischemic stroke patients aged 64.2 in a hospital-based study\textsuperscript{23}.

In Table 1, most risk factors are modifiable or controlled. For example, 41.0\% of young stroke patients have a history of hypertension, which can be controlled to minimize the risk of stroke. Similarly, diabetes and hypercholesterolemia can also be controlled. Unfortunately, only a few patients received any treatment in our work.

Our data in this work also show smoking and drinking to be second and third risk factors, which implies that life style is another important factor for young stroke patients. There is strong and convincing evidence that cigarette smoking is an independent risk factor for ischemic stroke at all ages, in both sexes and among different racial/ethnic groups\textsuperscript{19–24}. The effect of alcohol on stroke is controversial, but chronic alcoholism and heavy drinking are risk factors for all stroke subtypes\textsuperscript{12,24–28}. More health education for young people should be paid more attention.

Some young adults with stroke do not have any of the traditional risk factors associated with stroke, prompting a search for other mechanical and hypercoagulable causes. For those suffering from cryptogenic stroke, the following possibilities should be considered:

- **Antiphospholipid antibody syndrome** may be the underlying cause for recurrent stroke in young people. Kluger et al. reported a young man presenting with stroke who was subsequently diagnosed with a carotid dissection\textsuperscript{29}. Recurrent strokes in a patient while on heparin prompted a search for another etiology, and the patient was found to have antiphospholipid antibody syndrome\textsuperscript{30}.

- The role of oral contraceptives and their interaction with thrombophilia in ischemic stroke have been investigated. A case-control study on women with first ischemic stroke at age younger than 45 years was carried out. Oral contraceptives doubled the risk of ischemic stroke in the first 6–18 months of use, and hyperhomocysteinemia increased the risk by 3.5-fold. The risk of ischemic stroke in oral contraceptive users was 13 times higher in women who were also carriers of factor V Leiden and nine times higher in those who also had hyperhomocysteinemia\textsuperscript{29}.

- Recurrent ischemic stroke or transient ischemic attack in patients may be an index event for patent foramen ovale, a significant cryptogenic risk factor for stroke in young adults. In the last two decades, a significant portion of cryptogenic cases has been attributed to paradoxical embolism, and the main example is the patent foramen ovale. The statistical association between ischemic cerebrovascular events and patent foramen ovales has already been widely documented in univariate analyses. There were also some studies that presented the causal association between patent foramen ovale and ischemic stroke\textsuperscript{31}.

- Several studies suggested a role for genetic factors predisposing to thrombophilia and moderate hyperhomocysteinemia. Madonna et al. evaluated 132 consecutive patients for a history of young adult ischemic stroke (age <51 years at first event), the prevalence of factor V Leiden, prothrombin (FII) G20210A and C677T and 5,10-methylene-tetrahydrofolate reductase gene mutations and high

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**Table 2 Comparison of stroke risk factors between two groups**

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Case group (n=1988)</th>
<th>Control group (n=12,260)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>41.38 ± 2.98</td>
<td>41.38 ± 2.80</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>History of hypertension</td>
<td>816</td>
<td>1163</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>History of diabetes</td>
<td>104</td>
<td>221</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>History of hypercholesteremia</td>
<td>84</td>
<td>367</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>History of heart diseases</td>
<td>143</td>
<td>210</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>History of stroke</td>
<td>296</td>
<td>166</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Smoking</td>
<td>771</td>
<td>4312</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Drinking</td>
<td>760</td>
<td>3208</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

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**Table 3 Risk factors between male and female**

<table>
<thead>
<tr>
<th></th>
<th>Female (n=537)</th>
<th>Male (n=1451)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of hypertension</td>
<td>211</td>
<td>605</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>History of diabetes</td>
<td>344</td>
<td>71</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>History of hypercholesteremia</td>
<td>17</td>
<td>69</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>History of heart diseases</td>
<td>58</td>
<td>85</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>History of stroke</td>
<td>84</td>
<td>212</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Smoking</td>
<td>35</td>
<td>738</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Drinking</td>
<td>31</td>
<td>731</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

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fasting serum total homocysteine levels. Total homocysteine levels differed significantly between patients and controls. Mutations of factor V Leiden and of prothrombin G20210A gene are currently reported to be associated with a tendency toward ischemic stroke. They believe that moderate hyperhomocysteinemia is the only variable that helps to identify young adults with a history of ischemic stroke.

It is very important that we should keep the above-mentioned factors in mind for the intervening measures.

**The status of treatment**

The treatment of risk factors is another serious problem for young stroke patients. In the UK and the USA, young stroke survivors were reported to have worse condition and medication affordability. In the USA, young stroke survivors were reported to have worse condition and medication affordability. Furthermore, compliance with long-term treatment is difficult to achieve because hypertension in young people is usually symptomless, treatment is costly and denial of the illness is common.

In our work, only 46.3% of hypertensive patients received antihypertensive agents before stroke, and only ~12.8% patients used antihypertensive drugs regularly. A similar situation was found in patients with DM; 42.3% had taken hypoglycemic drugs before stroke onset, but only 27-9% patients with DM took hypoglycemic drugs regularly. The treatment of hypertension and diabetes was severely neglected by young Chinese stroke patients.

There is strong evidence to confirm that lowering blood pressure and blood glucose can reduce the risk of stroke. A systematic review revealed that lowering blood pressure or treating hypertension with a variety of antihypertensive agents reduce stroke. Tight control of blood pressure in DM patients has been shown to reduce the incidence of stroke significantly.

**Table 3** shows that women experienced more heart disease than their men. This result is similar to a recent study, which found that female gender had a higher stroke rate.

In China, smoking and drinking rate in women is lower than that in men; this observation may be due to traditional Chinese culture and customs.

Young stroke patients bear certain special characteristics; however, recent years have witnessed many studies highlighting its etiology rather than its treatment. These studies along with our data revealed that most risk factors of young stroke patients were modifiable.

We suggest that medical institution must attach importance to these modifiable risk factors in young people. Young stroke patients should be evaluated for their modifiable risk factors as well as examined carefully for any unusual etiology, and they should be referred to medical centers where a careful examination should be performed such as an evaluation of heart and great vessels, including carotid artery and digital subtraction angiography if necessary.

In all, we should pay more attention to a young stroke patient’s modifiable risk factors; we should take measures to control hypertension, diabetes and hypercholesterolemia, decrease the risks for heart disease, and counsel for smoking cessation and limited use of alcohol, which would result in earlier secondary prevention of ischemic stroke.

**References**


