Cerebrovascular diseases are the most common cause of death in the People's Republic of China (PRC), with stroke at least five times as common as myocardial infarction (MI) and the stroke incidence about 1.5 times that in North Americans. Since the population of the PRC is large (approximately 1.1 billion), an estimated 2 million new strokes occur each year. Since 1949, Chinese lifestyles have undergone profound and accelerating changes in diet, employment activity, urbanization, and medical care—all potentially contributing to an evolving spectrum of stroke. Since much information about stroke in the PRC is unfamiliar to non-Chinese-speaking physicians, recent data and current ideas about this most major health problem are reviewed, along with aspects unique to the PRC.

The stroke incidence in the PRC averaged 219/100,000 people in six Chinese cities in 1982 (age-adjusted to 1960 US population). All surveys have shown a marked geographic difference in stroke incidence and prevalence, generally following a north-south gradient, with stroke rates almost three times higher in northern China (Figure 1). This gradient is independent of racial background (approximately 94% of Chinese are of Han ancestry) and suggests the potential importance of environmental factors. Hypertension (blood pressure of >160/95 mm Hg by World Health Organization [WHO] criteria) affects 5–8% of adult Chinese, with a similar north-south gradient, and is more common in urban than in rural areas.

Epidemiologic studies have linked stroke risk to hypertension. As morbidity and mortality of infectious diseases decline and as the mean population age increases in the PRC, vascular disease is an increasingly important public health problem. While trends seem to indicate an increasing rate of stroke and MI in recent years, comparison of stroke incidence and type both among countries and longitudinally within countries is heavily influenced by diagnostic criteria, population age distribution, and methods of case collection. In 1984, the WHO MONICA project began a survey of >700,000 residents of Beijing, prospectively assessing trends and risk factors for cardiovascular disease using standardized diagnostic criteria and comprehensive case finding. Stroke incidence was more than eight times that of acute MI during 1984–1985 (191 acute MIs vs. 1,692 strokes in the study population). The stroke incidence in Beijing appears to be higher than in occidental cities (Table 1). In the Sino-MONICA-Beijing study, almost one third of patients with stroke were not admitted to hospitals and were sometimes treated by local traditional doctors, precluding direct comparison with earlier surveys relying primarily on hospital records.

At least one third and perhaps nearly half of all strokes in the PRC are intracerebral hemorrhages, predominantly occurring in chronically hypertensive people. The fraction of strokes that are intracerebral hemorrhages in the PRC is approximately three times that in North Americans but is similar to that in other Asian nationalities (e.g., Chinese of Taiwan and Hong Kong, and Japanese). The diagnosis of intracerebral hemor-
rhage in community-based surveys has usually been based on the clinical syndrome combined with bloody cerebrospinal fluid and has been associated with a high (40-50%) mortality.\textsuperscript{1,2,17} Many small intracerebral hemorrhages are probably diagnosed as infarcts, and the actual prevalence of intracerebral hemorrhage may be even higher (and the overall mortality lower).\textsuperscript{21} Comparison of the clinical diagnosis of intracerebral hemorrhage with subsequent computed tomographic (CT) results has shown approximately 75% to be correctly diagnosed, with clinical diagnostic errors in both directions (F.L. Shi, C.L. Li, C.Q. He, D.X. Pu, and C.L. Ke, personal communication).\textsuperscript{22}

The causes of ischemic stroke in the PRC include a variety of illnesses. Autopsy studies are biased by case selection, especially by including young patients, but such studies suggest that cardioembolic stroke due to rheumatic heart disease, marantic endocarditis, and ischemic cardiomyopathy is more common than cerebrovascular atherosclerosis.\textsuperscript{23} The importance of nonrheumatic atrial fibrillation is ill-defined, but this cause was recognized in only 1.1% of acute strokes in one large series.\textsuperscript{24,25} Recent profiles of lacunar infarcts defined by CT criteria showed many characteristics similar to North American stroke registries, including location of the infarcts and the prevalence of chronic hypertension (72-75%), diabetes (4-15%), and preceding transient ischemic attacks (TIAs) (17-19%).\textsuperscript{18,26,27} Evaluation of a relatively young group of TIA patients showed no increased prevalence of mitral valve prolapse by echocardiography.\textsuperscript{28} Leptospiral arteritis is often implicated in moyamoya syndrome and ischemic strokes in young people.\textsuperscript{29,30} Moyamoya syndrome in young adults is frequent in the PRC (and in Japan).\textsuperscript{16,29,31} The link between hypertension and stroke in the PRC has received considerable attention, with widespread community screening and control.\textsuperscript{5} The influence of other risk factors is more difficult to assess because evolving socioeconomic changes confound longitudinal comparisons. The Chinese diet is generally lower in fats and higher in carbohydrates than Western diets, but this is evolving, as well as more sedentary lifestyles for urban dwellers.\textsuperscript{32} In recent surveys, >60% of the men in the PRC smoked cigarettes, and public awareness of the detriments of tobacco smoking has just begun.\textsuperscript{5,33} Environmental hazards (e.g., coal fumes) relating to stroke are being explored.\textsuperscript{6}

![Figure 1. Map of stroke incidence (first completed stroke, all types) in six cities in People's Republic of China in 1982 (mean 219/100,000/yr) and Rochester, Minnesota, expressed as strokes per 100,000 people/yr, age-adjusted to 1960 total US population. Adapted from Li and colleagues.\textsuperscript{2}](image)

<table>
<thead>
<tr>
<th>Location</th>
<th>Time</th>
<th>Annual rate (per 100,000)</th>
<th>Male:female</th>
<th>Annual rate in males (per 100,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Occidental</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rochester, Minnesota\textsuperscript{6}</td>
<td>1975–1979</td>
<td>510</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Espoo-Kauniainen, Finland\textsuperscript{10}</td>
<td>1978–1980</td>
<td>647</td>
<td>1.7</td>
<td>872</td>
</tr>
<tr>
<td>Tilburg, Netherlands\textsuperscript{11}</td>
<td>1978–1980</td>
<td>688</td>
<td>1.2</td>
<td>747</td>
</tr>
<tr>
<td>Auckland, New Zealand\textsuperscript{12}</td>
<td>1981–1982</td>
<td>491</td>
<td>2.0</td>
<td>677</td>
</tr>
<tr>
<td>Oxfordshire, United Kingdom\textsuperscript{13}</td>
<td>1981–1986</td>
<td>690</td>
<td>1.4</td>
<td>811</td>
</tr>
<tr>
<td>Perth, Australia\textsuperscript{8}</td>
<td>1986</td>
<td>590</td>
<td>1.8</td>
<td>798</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>603</td>
<td>1.6</td>
<td>781</td>
</tr>
<tr>
<td><strong>Oriental</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shibata, Japan\textsuperscript{15}</td>
<td>1976–1978</td>
<td>890</td>
<td>2.7</td>
<td>1,380</td>
</tr>
<tr>
<td>Beijing, People’s Republic of China\textsuperscript{1}†</td>
<td>1985</td>
<td>1,069 (822)</td>
<td>1.5</td>
<td>1,305 (1,004)</td>
</tr>
<tr>
<td>Six cities, People’s Republic of China\textsuperscript{2‡}</td>
<td>1982</td>
<td>1,050</td>
<td>1.3</td>
<td>—</td>
</tr>
</tbody>
</table>

*Population-based "ideal" recent studies, as discussed and defined by Malmgren et al.\textsuperscript{14}
†All first-ever strokes except for Beijing MONICA survey of first events; in older age groups, approximately one third of strokes are recurrences and the estimated corrected Beijing incidence is given in parentheses, although this is influenced by initial stroke mortality.
‡Estimated from authors’ Figure 3; uncertain if figures are first-ever strokes or first stroke during study interval.
Spring Festival Stroke

For a long time, Chinese neurologists have observed anecdotally that the number of stroke patients increases around the Spring Festival holidays. Spring Festival is traditionally the most grand celebration in the PRC, occurring after New Year’s Day, according to the Chinese lunar calendar, in either January or February. Unfortunately, stroke never takes a holiday, and this catastrophic event shifts some people from jubilation into tragedy. The etiology and precipitating mechanisms of Spring Festival strokes are uncertain. It has been the belief of most doctors in the PRC that an acute increase of arterial blood pressure in hypertensive patients may precipitate intracerebral hemorrhage.\(^3\) Overexcitement in older people who have chronic hypertension may further increase their blood pressure at the time of Spring Festival, when the weather is cold in many parts of the PRC. Many elderly people still keep the tradition of celebrating during the entire night on the eve of Spring Festival. It is common to see stroke patients on this night or during the next days. While the phenomenon of Spring Festival stroke deserves further quantitative epidemiologic study, it is widely recognized among Chinese neurologists. Differences in mortality have been similarly associated with major social occasions in Western cultures (e.g., the “Passover effect”).\(^3\)

Traditional Chinese Medicine

While modern medicine in the PRC is practiced using principles and therapies similar to those in Western countries, traditional Chinese medicine continues to have a role in the treatment of cerebrovascular diseases.\(^36\)-\(^38\) For >3,000 years, Chinese physicians have used herbal medications to treat hemiplegia. Specific combinations of herbs are prescribed based on principles of Ying–Yang and the five elements, the five organs and six viscera, the seven feelings and six orexises theory. Ying–Yang is a fundamental concept of traditional medicine, holding that all things, including illness, can be classified within a spectrum of polar opposites: Ying is negative, weakness, soft, or interior while Yang is positive, strength, hard, or exterior. The therapeutic key is recognizing the deficiency in a patient’s organic functions and choosing the appropriate herbs to restore the balance.

For ischemic or hemorrhagic stroke complicated by stupor or coma, specific herbs are often used. By traditional theory, impaired consciousness is due to a disturbance of the link between the heart and brain, with the heart controlling consciousness. These medications “open the aperture” to restore alertness. For ischemic stroke in alert patients, several herbal combinations such as Bu Yang Huan Wu Tang can be used based on principles of “support vital functions and consolidating the energy,” “invigorating the blood circulation and eliminating stasis,” and “dredging through the arteries and veins.” After the acute period, Ginseng Zai Zao Wan, Di Huang Yin (Tang), and other herbal concoctions using this or that Tang are used to promote neurologic recovery by “invigorating the strength of the bones and muscles.” The potential mechanisms of action of some of these herbs have been explored in recent experimental and pharmacologic studies. For example, Dang Shen, mainly composed of Dang Shen Tong, increases fibrinogenolysis, reduces platelet aggregation, and decreases blood viscosity. Chi Shao has been found to antagonize arachidonic acid and to reduce platelet aggregation.\(^37\)

Stroke patients may go to see traditional Chinese medical doctors directly or may be referred to them by modern medical doctors. Massage, acupuncture, electric acupuncture, and injection of acupoints with herbs are commonly used. While most modern doctors in the PRC receive some training in traditional methods, they practice primarily modern medicine. Other Chinese doctors are trained primarily in the traditional ways. The value of traditional Chinese herbal and acupuncture therapies in cerebrovascular diseases has often not been established by blinded, randomized trials; this is similar to most modern Western treatments for stroke.

Modern therapy for acute ischemic stroke in the PRC includes the use of diuretics, steroids, low-molecular-weight dextrans, and hyperbaric oxygen.\(^25\)-\(^39\) Recently, a randomized, nonblinded trial of pit viper (Agkistrodon halys) venom for acute ischemic stroke showed benefit.\(^40\) The degree of fibrinogenolysis with the doses employed in that trial was less than that achieved in an ongoing North American trial of ancrod venom from a related viper, A. rhodostoma.\(^41\) Heparin and warfarin are very seldom used in the PRC.

Conclusions and Speculations

Stroke is the leading cause of death in the PRC and is far more common than MI. Intracerebral hemorrhage is especially common, comprising one third of all strokes. The prevalence of definite hypertension in adults (WHO criteria, blood pressure of >160/95 mm Hg) is 5–8% in the PRC, apparently lower than the 10–15% prevalence in North American adults.\(^42\)-\(^43\) The incidence of intracerebral hemorrhage (defined by clinical criteria) in North America before the availability of effective antihypertensive therapy was still only a fraction of its current incidence in the PRC.\(^44\) Thus, uncontrolled chronic hypertension alone does not seem to fully account for the high rate of brain hemorrhage in the PRC.

Why Chinese and many other Asian people are predisposed to intracerebral hemorrhage remains a mystery. While environmental and dietary factors and hypertension may play important roles,\(^45\)-\(^47\) genetic influences are supported by the existence of other intracranial arteriopathies (e.g., moyamoya disease) that are much more common in Asians.
Hypothetically, chronic levels of blood pressure below those usually defined as hypertensive may not be tolerated by Chinese. The pathogenesis of intracerebral hemorrhage may be quite complex. Epidemiologic evidence has consistently linked low total serum cholesterol levels with intracerebral hemorrhage in Japan, the PRC, and more recently in North America, especially in modestly (>90 mm Hg diastolic blood pressure) hypertensive people. Recent large trials suggest that chronic aspirin therapy may be associated with an increased risk of intracerebral hemorrhage, so the use of aspirin in Chinese people may require special study.

While direct comparison of stroke incidence rates and especially diagnostic categories among countries is confounded by the aforenoted methodologic caveats, the age-adjusted stroke incidence rate in the PRC (approximately 219/100,000/yr) is probably 1.5 times that of many occidental countries (90–145/100,000/yr). Estimating that 10% (range 8–13%) of strokes in occidental countries are due to intracerebral hemorrhage, it can be calculated that the stroke incidence in the PRC excluding intracerebral hemorrhage approximates that of occidental cities. It appears that the excess stroke rate in the PRC is due largely to intracerebral hemorrhage. The rate of intracerebral hemorrhage appears to be five times that of North Americans.

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Stroke in the People's Republic of China.
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