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Clinical Study

Incidence and trends of stroke and its subtypes in Changsha, China from 2005 to 2011

Xin-gang Sun [1], Yan-li Wang [2], Ning Zhang, Te Wang, Yun-hai Liu *, Xin Jin, Ling-juan Li, Jie Feng

Department of Neurology, Xiangya Hospital, Central South University, Changsha 410008, Hunan Province, China

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ABSTRACT

During the 1990s no significant changes were found for the high incidence of ischemic stroke (IS) in Changsha, in contrast to the increase observed in Beijing and Shanghai. However, the epidemiological patterns of stroke may change with economic development. This study aimed to examine the characteristics of stroke incidence transition in Changsha from 2005 to 2011. In 2007 two communities with a registered population of about 100,000 were selected and data from stroke patients who presented between 2005 and 2007 were retrospectively collected from January to June 2008. From January to December 2007 a stroke surveillance network was established and stroke patients who presented between 2008 and 2011 were prospectively registered. From 2005 to 2011 the mean annual age-adjusted incidence of first-ever stroke was 168.5/100,000 (95% confidence interval [CI] 159.0–178.0/100,000), with 189.3/100,000 (95% CI 175.1–178.0/100,000) for men and 148.7/100,000 (95% CI 136.0–161.4/100,000) for women. The mean annual age-adjusted incidence of IS, intracranial hemorrhage and subarachnoid hemorrhage was 72.6/100,000 (95% CI 66.3–78.9/100,000), 85.1/100,000 (95% CI 78.3–91.9/100,000) and 9.4/100,000 (95% CI 7.1–11.7/100,000), respectively. During the study period, the age-adjusted incidence of stroke increased at an annual rate of 3.7% ($p = 0.001$); at 4.2% for men ($p = 0.001$) and 3.1% for women ($p = 0.026$). The age-adjusted incidence of IS increased at an annual rate of 3.5% ($p = 0.003$) but no significant changes were seen for hemorrhagic stroke. Characteristics of stroke incidence transition may reflect underlying changes in risk factors and there is an urgent need to identify these factors and launch appropriate public health campaigns.

1. Introduction

Previous studies have shown a north-south gradient, with a significantly higher incidence of stroke in the north of China compared with the south [1,2]. However, Changsha, a city in the south of China, had an unexpectedly high rate of stroke [1,3,4]. Surveillance of stroke incidence from three cities in China during the 1990s showed that the overall age-adjusted incidence was highest in Changsha (150.0/100,000), followed by Beijing (135.0/100,000) and Shanghai (76.1/100,000) [4]. The age-adjusted incidence for individuals ⩾55 years of age in Changsha was higher than Western populations and the difference existed for ischemic stroke (IS) and intracerebral hemorrhage (ICH), as well as in both the male and female populations [5–8].

Hypertension, diabetes mellitus, heart disease, high cholesterol, cigarette smoking and alcohol consumption are common risk factors for stroke in China [1,9,10]. Apart from the common risk factors associated with hemorrhagic stroke, such as hypertension and smoking, IS is associated more closely with atherosclerotic risk factors, such as hypercholesterolemia, which is mainly due to an unhealthy lifestyle. In the last two decades China has been experiencing fast economic development, which has been a major driving force in greatly changing the population's lifestyle and health care. Consequently, the incidence and trends of stroke and its subtypes may have been changing [4,11]. It is important for developing Chinese cities to recognize and understand the characteristics of epidemiological transition of stroke incidence in order to implement timely stroke prevention strategies. Thus we conducted a new study of stroke surveillance in Changsha, which aimed to examine the incidence and trends of stroke and its subtypes from 2005 to 2011.

2. Patients and methods

2.1. Study population

Before the study, the Ethics Review Board of our institution examined and approved our research protocol in accordance with the Declaration of Helsinki

* Corresponding author. Tel.: +86 158 7314 2321; fax: +86 731 432 7401.
E-mail addresses: sunyanxia820701@163.com (X.-g. Sun), liuyh610622@163.com (Y.-h. Liu).
[1] Present address: Department of Neurology, Second Hospital of Shanxi Medical University, Taiyuan, Shanxi Province, China.
[2] Present address: Department of Neurology, Jingzhou Central Hospital, Jingzhou, Hubei Province, China.

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In January 2007 two communities in Changsha with a registered population of approximately 100,000 were selected for this study. The study areas were well-defined communities and the study population included all the registered residents in these areas. Data on these residents were obtained from the census register of the local administrative office. Persons who resided in this district but were not registered in the local administrative office were excluded from our study.

2.2. Data collection

From January to June 2008, we carried out door-to-door inquiries in the two communities to retrospectively survey and register stroke cases that occurred from January 2005 to December 2007. In China all deaths are legally required to be reported by the patient's relatives to the local medical workers for household cancellation and cremation, so fatal stroke cases were also obtained from a review of death certificates [4]. In each case of stroke, detailed patient information was registered. Then a qualified neurologist from Xiangya Hospital confirmed the diagnosis through a review of the collected data. A single neurologist was responsible for the diagnosis of all patients. For the possible stroke patients whose diagnosis could not be confirmed in this way, who had never gone to hospital or had died in transit to the hospital, another three qualified neurologists from Xiangya Hospital would visit the patient's house, gather patient data, discuss the patient and confirm or discard the diagnosis of stroke.

Stroke cases that occurred from January 2008 to December 2011 were registered through the stroke surveillance network. From January to December 2007, a community-based stroke surveillance network was established to prospectively identify stroke patients. The details of this system were described by Jiang et al. [4]. In brief, possible stroke patients were initially reported to the Institute of Neurology at Xiangya Hospital through public health workers, who received the information from directors of residents' committees or building gate volunteers (individuals who monitored fellow residents for possible stroke). A neurologist was then immediately sent to visit the patient at home or in hospital. During the visit detailed clinical information including clinical signs and symptoms, previous medical history, medication and imaging results were obtained. Patients whose information was not obtained by the directors of residents' committees or building gate volunteers, those who died at home or those who did not go to hospital were identified by local medical workers during their routine work. These data were supplemented by our door-to-door inquiries conducted annually from January to March by our research group, and if a possible patient was identified the research team would pay a home visit immediately. The rate of CT scan and/or MRI use for stroke was also calculated. Silent strokes with positive imaging but without clinical symptoms or signs were excluded from this study.

2.3. Stroke diagnosis and classification

The diagnosis of stroke was defined according to a slightly revised version of the one used in the Atherosclerosis Risk in Communities study [12]. In brief, the minimum criteria for a probable or definite stroke diagnosis included evidence of sudden or rapid onset of neurological symptoms lasting for >24 hours or leading to death without evidence for a non-stroke cause. Exclusions included major brain trauma, neoplasm, coma attributable to disorders of fluid or electrolyte balance or metabolic disorders, central nervous system infections, peripheral neuropathy, vasculitis involving the brain, or hematologic abnormalities. Silent brain infarctions (patients without clinical symptoms and signs) and transient ischemic attacks were not included.

The classification of stroke was performed according to published criteria and then grouped into three major types [12]: IS (including thrombotic brain infarction, cardio-embolic stroke, and lacunar infarcts), ICH, or subarachnoid hemorrhage (SAH). Patients who died at home or did not go to hospital or fell into two different subtypes were defined as "undetermined stroke".

2.4. Quality control

To ensure the quality of information collection, a manual of operations was compiled to standardize the research methods and procedures. The contents included criteria for the diagnosis of stroke and how to register and verify stroke patients. All staff members who participated in the project, including the public health workers, building gate volunteers and local residents' committee directors, received annual training on how to survey and register stroke patients according to the standard operating manual. Researchers from the Hunan Neurological Institute, the Institute of Neurology at Xiangya Hospital and community hospitals met monthly to review research progress and to resolve problems encountered during the study.

2.5. Data analysis

All of the data were checked, coded, and keyed into computers by specially trained workers and the incidences of first-ever stroke and stroke subtypes were calculated. The 95% confidence interval (CI) for incidence was also calculated [13]. To compare the surveillance results of our study with data obtained during the 1990s in Changsha [4], the incidence of first-ever stroke and stroke subtypes were directly standardized to the 5 year age distribution of Segi's world population, which was based on the sum total of male and female populations of the 46 countries in the 1950 publications of the World Health Organization [14].

The average annual stroke incidence change was calculated by using a regression model: $\log(R_t) = \alpha + \beta \times t$. In this analysis age-adjusted incidence was used. Annual percentage change equals $100 \times (\exp\beta - 1)$, where β is the maximum likelihood estimate of the slope parameter and $\exp\beta$ estimates the relative risk associated with 2 consecutive years. $100 \times \beta$ percent of the incidence rate at time t is given to denote the instantaneous change rate per year at time point t because $(\exp\beta - 1)$ approximates β for small changes [4].

3. Results

3.1. Patient characteristics

The number and percentage of strokes observed during the study period, broken into stroke subtypes, is shown in Table 1. ICH was the predominant subtype. Overall, there were more men (n = 1002; 57.5%) than women (n = 742; 42.5%) (Table 2). The average (±standard deviation) age at onset was 61.2 ± 8.9 years (men 61.9 ± 9.4; women 60.4 ± 7.8), and 97.7% (n = 1704) of patients were hospitalized for the condition. The number and percentage of patients analyzed by CT scan and/or MRI is shown in Table 3. The rate of CT scan and/or MRI use increased annually for IS ($p = 0.026$) and ICH ($p = 0.049$) patients. More than half of SAH patients (51.0%) were <60 years of age.

3.2. Incidence of stroke and its major subtypes

The crude annual incidence and age-adjusted incidence of stroke is shown in Table 4. All incidences are reported per 100,000 population. During the study period, the mean annual