Incidence of Cerebral Infarction in Northwest China From 2009 to 2018

Yu-Xuan Shang 1, Lin-Feng Yan 1, Elyse M. Cornett 2, Alan D. Kaye 2, Guang-Bin Cui 1, Hai-Yan Nan 1

1. Department of Radiology & Functional and Molecular Imaging Key Lab of Shaanxi Province, Fourth Military Medical University, Shaanxi, CHN 2. Department of Anaesthesiology, Louisiana State University (LSU) Health Shreveport, Shreveport, USA

Corresponding author: Hai-Yan Nan, nanhy000@163.com

Abstract

Background: There is a lack of epidemiological analysis of patients with cerebral infarction in northwest China. In the present investigation, we conducted a retrospective analysis to collect information on epidemiological characteristics of patients with cerebral infarction in five provinces of northwest China and the Shaanxi Province of patients who were hospitalized in the Tangdu Hospital. This project should provide a scientific basis for active prevention and treatment of cerebral infarction.

Material and methods: A retrospective analysis of patients with epidemiological characteristics of cerebral infarction that were admitted to the Tangdu Hospital of northwest China from January 2009 to December 2018.

Results: A total of 18,302 patients (aged 1-97 years) with confirmed cerebral infarction, including 12,201 males and 6,101 females, were retrospectively enrolled in this study. The most common lesion site was the cerebellum (51.5%). The incidence of cerebral infarction was slightly higher in workers and laborers, favoring male patients and those aged 40-70 years. The difference between men and women gradually increased after the age of 30.

Conclusions: In this study, 18,302 hospitalized patients with cerebral infarction from different occupations were included. Those engaged in physical labor were more likely to have a cerebral infarction. The incidence of cerebral infarction in males was higher than in females. Cerebellar and cerebral area infarctions were the most common.

Keywords: stroke, cerebral infarction, epidemiology, cerebrovascular disease, distribution

Introduction

Stroke is a severe form of cerebrovascular disease caused by the interruption of blood supply to the brain [1,2]. During a stroke, oxygen and nutrients cannot reach the brain due to the rupture of blood vessels or clots, which causes brain tissue damage. Stroke can occur rapidly and has a high disability rate and mortality rate [3,4]. According to epidemiological surveys, there are 1.5 - 2 million new stroke cases in China every year [5,6]. Of these cases, 70% are cerebral infarctions with corresponding high morbidity and mortality [7,8]. Of note, hypertension is significantly associated with the incidence and mortality of stroke in these populations [9,10]. In other studies [11,12], the elderly suffer from cerebral infarction, while young patients become vulnerable to cerebral infarction [13]. However, older patients are at a greater risk of cerebral infarction than younger patients. With age, arteries naturally become narrower and harder and are more likely to become clogged with fatty material (atherosclerosis). Some research indicates that the occurrence of cerebral infarction increases every five years after the age of 40, and the average onset age of cerebral infarction is 60 years old [14]. Several previous studies suggested that the incidence of cerebral infarction rises with the increase of age [15]. A 2005 study in China showed that the incidence of cerebral infarction was higher in northern cities than in southern cities, and that patients with cerebral infarction in some Chinese cities were older than foreigners in western cities [5]. A 2010 study in Tibet, China, revealed that the age of cerebral infarction decreased. Among the patients with first cerebral infarction, those younger than 45 years old accounted for 12.8%, higher than that in other studies [16]. However, in the past decade, patients' epidemiological characteristics with cerebral infarction in Northwest China are still unclear. Therefore, we retrospectively enrolled cerebral infarction patients in a tertiary hospital with the hope of revealing the epidemiological characteristics of cerebral infarction patients in northwest China, to understand the trend of cerebral infarction incidence during the past decade, and analyze the age or gender difference of cerebral infarction incidence.

Materials And Methods

Ethics statement
The ethical approval of this study was waived because of its retrospective nature.

**Date source**

This study was a retrospective investigation and in compliance with the national China guidelines. The diagnostic criteria for the clinical diagnosis of cerebral infarction cases are based on the diagnostic criteria for various cerebrovascular diseases in 2013.

**Inclusion and exclusion criteria**

We collected patient data and excluded: (1) multiple lacunar cerebral infarction and lacunar cerebral infarction; (2) patients with fracture and hematoma; (3) cerebral hemorrhage; (4) malignant tumors.

**Data collection and management**

According to the new cerebrovascular disease classification, cerebral infarction inpatients in Tangdu hospital were screened and collected. All the data were stratified according to the following four factors: gender, age (<40 vs. ≥40 years old), onset time (spring, summer, autumn, and winter), occupation. Categorical variables were summarized as frequency counts and percentages.

**Epidemiological characteristics**

Incidence was calculated based on the number of confirmed cerebral infarctions and the total number of hospitalizations in the corresponding year (2009–2018). The age distribution of cerebral infarction cases was analyzed in a 10-year-bin group. To describe the geographic distribution of cerebral infarction patients in northwest China, we collected the areas where the patients came.

**Statistical analysis**

Comparisons between two or more groups of variables were performed using Fisher’s exact test. A P value of <0.05 was considered statistically significant. All statistical analyses were performed using Statistical Package for Social Sciences (SPSS) software, version 20.0 (SPSS Inc. Chicago, IL, USA).

**Results**

1. **Incidence**

A total of 18,302 patients with cerebral infarction from 2009 to 2018 were collected to analyze the annual incidence (including sex-specific incidence) based on the hospitalized patient population. From 2009-2018, the overall incidence of cerebral infarction increased to reach a peak of 2.0 cases per 100,000 patients in 2013 and then decreased until 2017. From 2009 to 2018, the incidence rate in men was higher than that in women. The increased tendency in women was modest, while men’s incidence during that period is not stable (Figures 1-2).

![Graph showing annual incidence of cerebral infarction](image)

**FIGURE 1**: The annual incidence (per 10,000-person year) of cerebral infarction based on hospital patient population during the past decade (2009–2018).
2. The location

The common sites of cerebral infarction are basal ganglia, cerebellum, left hemisphere, right hemisphere, and pons. According to our review of patients admitted to Tangdu hospital with cerebral infarction from 2009 to 2018, the cerebellum (34%) is the most common site of patients admitted with cerebral infarction in our hospital, followed by basal ganglia (22%) and left and right hemispheres (Figure 3).

3. Age and season

Patients were divided into the youth group (below 46 years and a total of 1,924) and the elderly group (age 46 and above, a total of 1,6378). The incidence was highest in both the youth and the elderly groups in winter and lowest in spring. The number of infarctions in the youth group increased significantly from 2011 to 2013, while the number of the elderly group increased from 2012 to 2013, but then stabilized (Figure 4).
4. Occupation

The relationship between cerebral infarction and occupation was investigated in the young (below 46 years old, a total of 1,924) and old (46 years old and above, a total of 1,637) groups. The incidence of cerebral infarction in farmers, workers, retirees, small groups, teachers, students, staff, other workers, and technicians were calculated and compared. Farmers, workers, or other occupations engaged in heavy labor had a higher incidence of cerebral infarction than other occupations including, students, teachers, clerks, retired people, or technicians (Figures 5-6).

5. The geographical distribution

The geographical distribution of cerebral infarction patients is presented in Figure 7 and shows the number of hospitalized patients with cerebral infarction in five provinces in northwest China and Shanxi Province.
Most patients were farmers and manual laborers. These patients’ access to medical treatment was not considered sufficient, so they were transferred to our hospital for further treatment.

FIGURE 7: The number of hospitalized patients with cerebral infarction in five provinces in northwest China and Shanxi Province.

Discussion

Overall, our results reveal that the incidence of cerebral infarction gradually increased until 2013, however in northwest China, it decreased slightly from 2009 to 2018. The incidence of cerebral infarction began to increase drastically after the age of 40. The incidence of cerebral infarction was higher in males than in females, and the incidence difference between males and females gradually increased after the age of 40.

The cerebral infarction was mainly located in the cerebellum and basal ganglia, followed by the left cerebral hemisphere, the right hemisphere, and pons. According to two studies in 2005, brain infarction locations are not uniform and occur in the left hemisphere more frequently than the right hemisphere [17-18]. However, in this study, we found cerebral infarction was mainly located in the cerebellum. Therefore, cerebellum infarction may be more common than previously thought. Reporting of cerebellar infarction is likely small because most of these infarctions may be asymptomatic or mild, nonspecific or focal symptoms, such as dizziness, nausea and vomiting, gait instability, and headache [19,20]. Therefore, it is possible that most cerebellar infarcts can evade clinical attention in the acute phase [21].

Studies in counties and climatic regions worldwide have shown an increase in the incidence of cerebral infarction and the number of hospitalizations for cerebral infarction in the cold seasons (winter and spring), compared with the warm seasons (summer and autumn). In Japan, cerebral infarction incidence was the highest in winter and spring [22]. According to an Australian study, cerebral infarction incidence increases from summer to winter [23]. Our survey found that rates of infarction were highest in young and elderly inpatients in the winter and lowest in the spring. The results echo the Australian study and are similar to the study in Japan. However, differences in data may be related to different populations and locations.

A survey in our hospital found that cerebral infarction is more likely to occur in jobs that require more manual labor. For example, farmers and workers are the two types of occupations that are the most prone to cerebral infarction. Most of these two occupational groups come from rural areas, belong to low-income groups, work long hours, lack exercise, have an irregular diet and lifestyle, and are prone to high blood pressure and other diseases, leading to cerebral infarction. According to two studies in 2014 and 2016, the risk of cerebral infarction between urban and rural residents varies greatly [24,25]. Young urban people are more engaged in work involving mental labor and higher income, while rural people are involved in lower-income work and likely have low awareness of disease prevention. Therefore, the risk factors for cerebral infarction in rural areas are much higher than that of urban high-income people. The incidence rate is relatively stable for other occupational groups, and it is more common among the elderly.

This study has some limitations. First, because this study is retrospective, we were unable to retrieve all the necessary information. Second, based on the hospital population, the investigation of the incidence of cerebral infarction in a single center may lead to biased conclusions. To consolidate this conclusion, a multicenter investigation based on general assumptions is needed.

Conclusions

This retrospective investigation found that cerebral infarction incidence is higher in males than females.
People engaged in manual labor are more likely to have cerebral infarction, and the morbidity and mortality of cerebral infarction increase with age. The most common sites of infarction are the cerebellum and basal ganglia. Finally, patients born in the five provinces of northwest China tend to be stable but show a slightly higher incidence of infarction in the summer and the highest incidence of infarction in the winter.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. NA issued approval NA. This study was a retrospective investigation and in compliance with the national China guidelines. The ethical approval of this study was waived because of its retrospective nature. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Gao Y, Jiang B, Sun H, et al.: The burden of stroke in China: results from a nationwide population-based epidemiological survey. PLoS One. 2018, 13:e0208398. 10.1371/journal.pone.0208398
2. Putaala J, Ylisetoinen N, Waje-Anderssen U, et al.: Demographic and geographic vascular risk factor differences in European young adults with ischemic stroke: the 15 cities young stroke study. Stroke. 2012, 43:2624-30. 10.1161/STROKEAHA.112.662896
3. Fang MC, Coca Peralta M, Ghost K, Cutler DM, Rosen A.: Trends in stroke rates, risk, and outcomes in the United States, 1988 to 2008. Am J Med. 2014, 127:608-15. 10.1016/j.amjmed.2014.03.017
4. Islam MS, Anderson CS, Hankey GJ, Hardie K, Carter K, Broadhurst R, Jamrozik K.: Trends in incidence and outcome of stroke in Perth, Western Australia during 1989 to 2001: the Perth Community Stroke Study. Stroke. 2008, 39:776-82. 10.1161/STROKEAHA.107.495645
5. Jiang B, Wang WZ, Chen H, et al.: Incidence and trends of stroke and its subtypes in China: results from three large cities. Stroke. 2006, 37:63-8. 10.1161/01.STR.0000194955.54602.78
6. Osbiagelo B: Nationwide trends in in-hospital mortality among patients with stroke . Stroke. 2010, 41:1748-54. 10.1161/STROKEAHA.110.585455
7. Wu S, Wu B, Liu M, et al.: Stroke in China: advances and challenges in epidemiology, prevention, and management. Lancet Neurol. 2019, 18:394-405. 10.1016/S1474-4422(18)30500-3
8. Chen X, Li F, Yin Q, et al.: Epidemiology of tick-borne encephalitis in China, 2007–2018. PLoS One. 2019, 14:e0226712. 10.1371/journal.pone.0226712
9. Feigin VL, Forouzanfar MH, Krishnamurthi R, et al.: Global and regional burden of stroke during 1990–2010: findings from the Global Burden of Disease Study 2010. Lancet. 2014, 383:245-54. 10.1016/S0140-6736(13)61953-4
10. Feigin VL, Lawes CMM, Bennett DA, Barker-Collo SL, Parag V: Worldwide stroke incidence and early case fatality reported in 56 population-based studies: a systematic review. Lancet Neurol. 2009, 8:535-69. 10.1016/S1474-4422(09)70025-0
11. Andersen KK, Andersen ZF, Olsen TS: Age- and gender-specific prevalence of cardiovascular risk factors in 40,102 patients with first-ever ischemic stroke: a nationwide Danish study. Stroke. 2010, 41:2768-74. 10.1161/STROKEAHA.110.595785
12. Kissela BM, Khoury JC, Alwell K, et al.: Difference in recognition of right and left hemispheric stroke. Neurology. 2012, 79:1781-7. 10.1212/WNL.0b013e318270401d
13. Medin J, Nordlund A, Ekberg K: Increasing stroke incidence in Sweden between 1989 and 2000 among persons aged 30 to 65 years: evidence from the Swedish Hospital Discharge Register. Stroke. 2004, 35:1047-51. 10.1161/01.STR.0000125866.78674.96
14. Lozano R, Naghavi M, Foreman K, et al.: Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012, 380:2095-2128. 10.1016/S0140-6736(12)61728-0
15. European Registers of Stroke (EROS) Investigators: Incidence of stroke in Europe at the beginning of the 21st century. Stroke. 2009, 40:1557-63. 10.1161/STROKEAHA.108.550088
16. Zhao Y, Yao Z, D’Souza W, et al.: An epidemiological survey of stroke in Lhasa, Tibet, China . Stroke. 2010, 41:2739-45. 10.1161/STROKEAHA.110.586669
17. Fink N: Underdiagnosis of right-brain stroke . Lancet. 2005, 366:549-51. 10.1016/S0140-6736(05)67004-3
18. Foerch C, Misselwitz B, Sitzer M, et al.: Difference in recognition of right and left hemispheric stroke . Lancet. 2005, 366:592-93. 10.1016/S0140-6736(05)67024-9
19. Elov LH, Newman-Toker DE, Savitz SL: Diagnosis and initial management of cerebellar infarction. Lancet Neurol. 2008, 7:951-64. 10.1016/S1474-4422(08)70216-3
20. Comptor A, Kappelle LJ, Algra A, van der Worp HB: Nonfocal symptoms are more frequent in patients with vertebral artery than carotid artery stenosis. Cerebrovasc Dis. 2015, 35:378-84. 10.1159/000354849
21. De Cock C, Gheerlings MI, Hartkamp NS, et al.: Cerebellar infarct patterns: the SMART-Medea study . NeuroImage Clin. 2015, 8:514-21. 10.1016/j.nicl.2015.02.001
22. Turin TC, Kita Y, Murakami Y, et al.: Higher stroke incidence in the spring season regardless of conventional risk factors: Takashima Stroke Registry, Japan, 1988-2001. Stroke. 2008, 39:745-52. 10.1161/STROKEAHA.107.495929
23. Wang Y, Levi CR, Attia JR, D’Este CA, Spratt N, Fisher J: Seasonal variation in stroke in the Hunter Region, Australia: a 5-year hospital-based study, 1995-2000. Stroke. 2003, 34:1144-50. 10.1161/01.STR.0000067705.71251.B6

24. Mi T, Sun S, Du Y, et al.: Differences in the distribution of risk factors for stroke among the high-risk population in urban and rural areas of Eastern China. Brain Behav. 2016, 6:e00461. 10.1002/brb3.461

25. Wang J, Bai L, Shi M, et al.: Trends in age of first-ever stroke following increased incidence and life expectancy in a low-income Chinese population. Stroke. 2016, 47:929-35. 10.1161/STROKEAHA.115.012466