

Cerebral Arterial Stenosis and Economic Development in Different Regions of China

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Abstract Background and Purpose: The prevalence of intracranial occlusive cerebrovascular disease is thought to be higher in Hong Kong than in others of P.R. China. We investigated whether the economic development is correlated with prevalence of intracranial arterial stenosis. **Methods:** To determine the occlusive arteries in the craniocervical circulation of consecutive patients who were hospitalized for acute stroke, we examined the extra-intracranial arteries with supplementary duplex ultrasound of the carotid arteries and magnetic resonance angiography (MRA). The data of the 2001~2003 gross domestic products(GDP) per capita was gathered in the National Bureau of Statistics of China. All analyses were performed with the use of SPSS/Windows version 13.0 statistical software. **Results:** 1151 patients with acute stroke were recruited from 25 hospitals of 12 cities or regions in China from December 2001 to December 2003. The average age of the patients was 61.91 ± 11.072 years, among which 750 were males and 401 were females. The rate of intracranial stenosis was the highest in the rich regions of China (35.9%) where the GDP per capita ranged from 19000 to 43000 ¥, in contrast the second richest regions, the rate decreased to 23.4%. And in the poor countryside and the Northwest regions, the rate of intracranial stenosis went on decreased to 21.2% which is statistically significant difference with the richest regions ($P=0.000$). **Conclusions:** Intracranial stenosis rate is correlated with the regional economic development in China. It's a big challenge for China to prevent the stroke caused by extro-intracranial stenosis with the economic development.

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Key words: cerebral artery stenosis; stroke; gross domestic product; economic; regions

Introduction

Stroke is the third most common cause of death and the most common disabling neurologic disorder worldwide. And 25% of the cases are led by the cerebral artery stenosis. As we know, the cerebral artery stenosis is relation with some risk factors, including diabetes mellitus and hypertension.(Toyoda et al., 2006; Alkan et al., 2009; Asil et al.,2006) In the world, the disease is think to be a rich disease, which is relation with diet of patients.(Kai et al.,2011) Intracranial artery stenosis is the predominant vascular lesion found in patients of Asian, African, or Hispanic ancestry(Caplan et al.,1986) whereas extracranial artery stenosis is more common in Caucasians. Therefore there are marked differences in the distribution of arterial lesions among different populations. In epidemiological surveys of different areas in China, the prevalence is also different.

We performed a study to analyze the economic correlation of economics with occurrence of cerebral arterial stenosis in acute stroke patients within China.

Subjects and Methods

We examined consecutive patients in 25 teaching hospitals of 13 cities or provinces from Dec.2001 to Dec. 2003. We limited the scope of the study to include patients whom had symptoms within 7 days, and those who were assessed 4~25 by

National Institute of Health Stroke Score (NIHSS), or those whose organs didn't failure up, excluding patients who were subarachnoid hemorrhage or tumor stroke. Each patient's history was taken and Glasgow Coma Score (GLS) and NIHSS were determined, as soon as admission. The baseline examination included a physical examination, routine blood biochemistry, a 12-lead ECG, CT scan of the brain, transcranial Doppler ultrasound and duplex ultrasound with in 2 days of admission. According to the state of patients, examination methods included MRI,MRA and DSA were selected. All nurses were taught how to assess the scales. We established nursing records. The Prince of Wales Hospital was restrained to monitor the trial. The methods were approved by the hospital's Ethics Committee.

Transcranial Doppler, MRA, DSA and duplex ultrasound examination were carried out to evaluate the extra-intracranial arteries stenosis or occlusion. Extracranial arteries includes subclavicle artery (SCA), common carotid artery(CCA), terminal internal carotid artery(TICA), and intracranial arteries includes anterior cerebral artery(ACA), middle cerebral artery(MCA), posterior cerebral artery(PCA), siphon internal carotid artery (SICA), vertebral artery (VA), basal artery (BA).

An intracranial artery was considered to be

stenotic if it met the following criteria: 1) If the mean flow velocity greater than 80cm/sec and the difference compared to control greater than 30% compared to control;2) the difference between velocities is greater then 30%, observe turbulence signs;3) If velocity in both sides is < 80cm/sec, observe 30% difference and turbulence signs. (Felberg et al.,2002)

We divided the hospitals into three regions depending on economic wealth. Region 1 represented the rich regions including Beijing, Shanghai, Guangzhou, Nanjing in the middle and South of China. Region 2 represented the secondary rich regions including Chengdu, Shijiazhuang, the big hospitals in the Northeast and Northwest. Region 3 represented the poor regions including Liaocheng, Xining, Xian, Tangshan, Baotou, Pinggu district of Beijing, and the small hospitals in the countryside and the Northwest.

The data of the 2001 to 2003 per capital GDP were gathered from the Yearbooks in the National Bureau of Statistics of China.

Statistical analysis

Cross tabulation by X^2 test were used for comparing categorical variables. All analyses were performed with the use of SPSS/Windows version 13.0 statistical software. Statistical significance was set at $P \leq \alpha$ by 2-sided analyses. To study the effect of the presence on outcome, logistic regression analysis with all potential variables entered at the same time was used. $P < 0.01$ was set as the independent risk factors.

Results

We enrolled 1151 Chinese patients within 2 years. Their ages ranged from 19 to 92 years (mean 61.91 ± 11.072), and 701(65.2%) were males. 667 patients (38.9%) had a history of hypertension and 199 patients (17.3%) had diabetes mellitus. There were 964 (83.8%) cases of ischemic stroke, 187(16.2%) cases of hemorrhagic stroke. 412 patients(35.8%) had stenosis-occlusive artery detected, among which 60 cases(5.2%) had extracranial lesion only, 262 cases(22.8%) had intracranial lesion only, and 90 cases (7.8%) had extra-intracranial lesion both.

As shown in table 1 and 2, we can conclude that the rate of extra-intracranial stenosis in the Region 1 (the richest regions which GDP per capita is from 19000 to 43000 ¥) is much higher than that of Region 2 or Region 3. When we combine Region 2 and Region 3 to represent the poor, we can compare the prevalence of cerebral arterial stenosis between the rich regions and the poor ones. The prevalence of cerebral arterial stenosis in the rich region is dramatically higher than the one of in the poor region. Though the risk factors of extra-intracranial stenosis is different, the type of region is dramatically correlate with the cerebral arterial stenosis. Hypertension is the independent risk factor of the intracranial stenosis which is more important for Chinese to prevent the stroke, male is the partial risk factor for the extracranial stenosis, whereas history of diabetes mellitus and ischemic stroke is the risk factors for the cerebral arterial stenosis.

Table1: Cerebral stenosis rate in different regions

Region	GDP per capita(¥)	Total, n	Extracranial stenosis rate, n (%)	Intracranial stenosis rate, n (%)	Cerebral arterial stenosis, n (%)
1	19000~43000	724	111(15.3)*	260(35.9)*	297(41.0)*
2	16000~23000	64	1(1.6)*	15(23.4)	15(23.4)*
3	6000~18000	363	38(10.5)	77(21.2)*	100(27.5)

* $P < 0.05$.

Table2 :The difference between the rich and the poor regions.

Region	GDP per capita(¥)	Total, n	Extracranial stenosis rate, n (%)	Intracranial stenosis rate, n (%)	Cerebral arterial stenosis, n (%)
The rich	19000~43000	724	111(15.3)	260(35.9)	297(41.0)
The poor	6000~23000	427	39(9.1)	92(21.5)	115(26.9)
<i>P</i>			0.003	0.000	0.000

Discussion

The present study is the first large prospective cross-sectional study to assess the economical or regional importance of intracranial occlusive disease

in clinical practice. In 1986, a large-scale population survey which investigated 29 provinces and cities in China found there was a tendency for the rates to increase gradually from south to north and to

decrease progressively from east to west, which is different from our research. In the previous study, (Xue et al.,1991; Wong et al.,1998) the intracranial stenosis rate(33%) from Beijing is close to that of Region 1 (table 1). Although the rate (47%) from Hong Kong is much higher than ours, though these studies had the approximate male rate and mean years old of Chinese.

The distribution of intracranial artery stenosis rate isn't equal in China and is different from the distribution of stroke which is higher in the North than in the South and higher in the West than in the East, whereas the Middle and the South of our study had the highest prevalence. With the GDP per capita ascending, the intracranial stenosis rate was rising, which may be a reason why Hong Kong had so high prevalence (GDP per capita is 183790 HKD in 2003). With the development of Chinese economy, the GDP per capita will ascend more than the current level 10000 ¥. Thus, we should take measures to prevent it early.

Transcranial Doppler(Sloan et al.,2004) is a noninvasive method of measuring blood velocities in the intracranial basal arteries. Combined with MRA and duplex ultrasonography, (Soule et al., 2003) it offers a reliable method of detecting stenosis or occlusion of vessels supplying the brain and will be used more widely to early diagnose and treat the intracranial artery stenosis of the stroke patients in China. Although GDP per capita is less than the income to evaluate economic development, it can describe the economics objectively and exactly.

Even though all patients came from cities, the different of their occupation isn't consider which may impact prevalence of the cerebral arterial stenosis due to the difference of the diet and physical activity. GDP per capita maybe describe the economics less objectively and exactly than the Engel's coefficient ,but it's directly and comprehensible. Thus, a profound study with more indices needed to elucidate the cerebral arterial stenosis and the economic development in different region of China.

In conclusion, Intracranial stenosis rate is higher with more economically developed regions. China is facing a big challenge of the disease.

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