Neurology Asia 2024; 29(3) : 515 – 523

ORIGINAL ARTICLES

Characteristics of stroke inpatients in a single-center in Kunming: A multi-ethnic settlement with a northern sub-tropical low-latitude plateau mountain monsoon climate

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Abstract

Objective: This study aimed to evaluate the characteristics of stroke inpatients in Kunming in southwest China. *Methods:* Basic demographic information and risk factors of stroke inpatients admitted to a first-rate tertiary referral hospital in Kunming from January 1, 2015, to September 15, 2022, were retrospectively analysed. In total, 7,108 stroke inpatients with ischemic stroke (IS), primary intracerebral hemorrhage (ICH), and subarachnoid hemorrhage (SAH) were included. *Results:* IS was the most common type of stroke (75.97%), followed by ICH (13.45%) and SAH (10.58%). There were significant differences among the three groups in sex, age, ethnic, residence, occupation, and medical expenses ($P<0.05$). There was also a statistically significant difference in the proportion of inpatients between the four seasons ($P<0.05$). Hypertension, dyslipidemia, and diabetes were common risk factors for stroke. There were significant differences in the incidence of smoking, alcohol use, hypertension, dyslipidemia, diabetes, atrial fibrillation, and pulmonary infection among the three stroke subtypes ($P<0.05$).
Conclusion: Demographic information and risk factors were different among the three stroke subtypes. The number of hospitalized patients from all three groups varied slightly in different seasons in Kunming. Different types of cerebrovascular disease patients in the region have different characteristics from demographic information to risk factors.

Keywords: Ischemic stroke; intracerebral hemorrhage; subarachnoid hamorrhage; risk factors

INTRODUCTION

Stroke has become a global public health problem because of its high incidence, disability, and mortality. As China becomes an aging society, stroke is the most frequent cause of death among Chinese residents[1], placing a heavy burden on patients, their families, society, and the economy.

There are marked geographical differences in the prevalence, incidence, and mortality rates of stroke worldwide, as well as significant differences in stroke incidence according to temporal and geographical location in China. According to an epidemiological survey of cerebrovascular diseases in 2013, the incidence of stroke in China has increased, especially in rural areas, compared to that 30 years ago.[2] Morbidity has increased in rural areas, decreased in urban areas, and overall mortality has decreased in China.[3] The incidence of stroke in south China has been reported to be relatively low (81–136/100,000 persons), while the incidence in northeast China is relatively high (441–486/100,000 persons).[3] Some of the risk factors for stroke including the non-correctable

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Date of Submission: 20 March 2024; Date of Acceptance: 8 April 2024
https://doi.org/10.54029/2024prj

factors, such as age, sex, race, and heredity, and correctable factors, such as hypertension, diabetes, dyslipidaemia, smoking, alcoholism, and obesity are relatively well-known. Additionally, studies have reported that geographical location and climate may be important factors in seasonal changes in stroke incidence[4] and that the seasonal variation in incidence is greater in high latitude regions than in low latitude regions.[5] The association between stroke risk and climatic factors such as temperature, humidity, and rainfall, is more pronounced in areas with continental climate than in those with a marine climate.[5] Therefore, seasonal variations in stroke incidence are more significant in high-latitude continental climate regions.[6]

However, the pathogenicity of these risk factors varies in different areas. Kunming is located on the Yungui Plateau in southwest China, with an altitude of approximately 1,891 meters. It has a low-latitude sub-tropical and plateau mountain monsoon climate. The annual temperature difference was small, whereas the daily temperature difference is large. The annual average temperature is approximately 15°C.

Presently, there are few reports on the risk factors associated with stroke in high-altitude, low-latitude plateau areas, such as Kunming. In addition, there are 26 ethnic groups in Yunnan. This study aimed to analyze the basic demographic information, living habits, and chronic diseases of hospitalized stroke patients in Kunming to understand the risk factors for stroke in the area.

METHODS

Data source and patients

This study was approved by the Ethics Committee of the First People's Hospital of Yunnan Province. We retrospectively analysed 7,108 stroke inpatients admitted to the First People's Hospital of Yunnan Province from January 1, 2015 to September 15, 2022. The hospital is one of the largest hospital in Yunnan Province, which is located in central Kunming. According to WHO standards, stroke is defined as a clinical sign of rapidly developing focal (or global) dysfunction of the brain, lasting for more than 24 hours or leading to death, with no obvious cause other than related to blood vessels.[7] There are four main stroke subtypes: ischemic stroke (IS), intracerebral hemorrhage (ICH), subarachnoid hemorrhage (SAH), and unclassified complete stroke (UND). In this study, 5,400 inpatients has IS, 956 inpatients with ICH, and 752 inpatients with SAH were included. All inpatients included have stroke as primary diagnosis. Those with acute central nervous system abnormalities caused by trauma, tumors, infections, metabolic disorders, and abnormal coagulation function were excluded.

The demographic information of the inpatients included sex, age, ethnic group (divided into Han and minority groups), residence (divided into Yunnan and other provinces), and occupation (student, worker, farmer, employed, retired, and unemployed). The behavioral characteristics analyzed were smoking, alcohol consumption and the risk factors were hypertension, diabetes, and dyslipidemia.

Statistical analysis

Categorical variables are expressed as counts (n, %) and continuous variables are expressed as mean ± standard deviation (SD). The chi-square test was used to assess differences in variables besides age among stroke subtypes. One-way analysis of variance was used to compare age among the stroke types.

RESULTS

Demographic data

A total of 7,108 stroke inpatients were hospitalized during the study period, among whom IS inpatients accounted for the highest proportion (75.97%), while ICH and SAH accounted for 13.45% and 10.58%, respectively (Table 1). There were significant differences among the three groups in terms of sex, age, ethnic, residence, and occupation ($P<0.05$). The proportion of men was higher than that of women in all three groups of stroke. The male to female ratios in the IS, ICH and SAH groups were 1.86:1, 2.21:1, and 1.15:1, respectively. Among ICH inpatients, the proportion of men was the highest.

The mean age of inpatients with IS was higher than that of inpatients with ICH or SAH. The age groups of the inpatients are shown in Table 1 and Figure 1. The majority of inpatients with IS were aged 60–69 years. The majority of inpatients with ICH and SAH were 50–59 years old. The onset age of inpatients in the latter two groups was lower than that of inpatients with IS. While 87.17% of the IS inpatients were residents of Yunnan province, the proportion of Yunnan province residents was slightly lower among ICH and SAH inpatients. The ethnic distribution of inpatients included the Han ethnic group and 20 other ethnic minorities; most minorities were Hui, Yi, Bai, and

Table 1: Demographic of the patients by type of stroke

Characteristics	IS	ICH	SAH	P
Total, n(%)	5400 (75.97)	956 (13.45)	752 (10.58)	
Sex, n(%)				<0.001
Men	3509 (64.98)	658 (68.83)	402 (53.46)	
Women	1891 (35.02)	298 (31.17)	350 (46.54)	
Age (mean±SD)	63.79±14.19	57.30±15.01	52.90±13.49	<0.001
Men (mean±SD)	62.56±14.30	56.52±14.71	48.38±12.64	<0.001
Women (mean±SD)	66.05±13.69	59.04±15.56	58.09±12.55	<0.001
Age groups, n(%)				<0.001
<40	258 (4.78)	93 (9.73)	103 (13.70)	
40-49	623 (11.54)	212 (22.18)	194 (25.80)	
50-59	1114 (20.63)	241 (25.21)	223 (29.65)	
60-69	1411 (26.13)	201 (21.03)	147 (19.55)	
70-79	1252 (23.19)	128 (13.39)	64 (8.51)	
⩾80	742 (13.74)	81 (8.47)	21 (2.79)	
Ethnic, n(%)				0.023
Han	4921 (91.13)	866 90.59	662 88.03	
minority	479 (8.87)	90 9.41	90 11.97	
Residence, n(%)				<0.001
Yunnan	4707 87.17	771 80.65	642 85.37	
other	693 12.83	185 19.35	110 14.63	
Occupation, n(%)				<0.001
Student	10 0.19	11 1.15	8 1.06	
Farmer	1143 21.17	236 24.69	295 39.23	
Employee	2022 37.44	420 43.93	338 44.95	
Retired /unemployed	2137 39.57	278 29.08	102 13.56	
Missing	88 1.63	11 1.15	9 1.20	
medical expense payment				<0.001
URBMI	1598 29.59	308 32.22	198 26.33	
UEBME	2199 40.72	279 29.18	137 18.22	
NRCMS	1303 24.13	311 32.53	357 47.47	
free medical service	153 2.83	14 1.46	4 0.53	
Missing	147 2.72	44 4.60	56 7.45	

URBMI, urban resident basic medical insurance; NRCMS, new rural cooperative medical scheme; UEBME, urban employee basic medical insurance. IS, ischemic stroke; ICH, intracerebral hemorrhage; SAH, subarachnoid hemorrhage.

Naxi. IS and ICH inpatients were mainly retired/unemployed inpatients, and the majority of SAH inpatients were farmers and employed. In terms of medical expense payment, urban employee basic medical insurance (UEBMI) was the major mode of payment for IS inpatients, while the new rural cooperative medical scheme (NRCMS) and urban resident basic medical insurance (URBMI) were the chief modes of payment for inpatients with ICH and SAH.

Seasonal distribution

The year was divided into the following four seasons: spring (March to May), summer (June to August), autumn (September to November), and winter (December to February). The seasonal distribution of inpatients with cerebrovascular disease is shown in Table 2 and Figure 2. There was significant difference in the number of hospitalized patients among the three groups for the four seasons (P<0.05). The number of

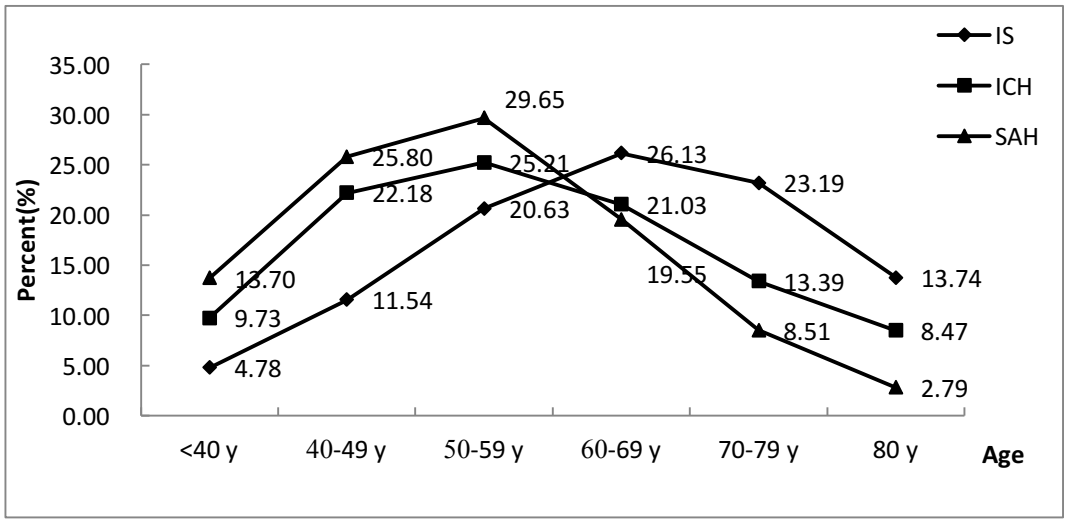

Figure 1. Distribution of the stroke patients according to the age groups

inpatients with IS was slightly higher in summer and autumn. More ICH inpatients were admitted in winter and the lowest in fall. However, SAH inpatients were more frequent in summer and winter.

The distribution of months for the number of stroke cases among the different types is shown in Figure 3. There was no significant difference in the number of inpatients with IS throughout the year; however, there was a slightly higher number of inpatients in May and October. The number of inpatients with ICH were slightly higher in October. The number of SAH was slightly increased in May, September and October.

Risk factors

The detection rates of risk factors differed among the three stroke subtypes (Table 3). Common risk factors were hypertension, dyslipidemia, and

Table 2: Distribution of season in stroke patients

Seasons	IS, n (%)		ICH, n (%)		SAH, n (%)		*P*
Spring	1160	21.48	251	26.26	155	20.61	
Summer	1495	27.69	251	26.26	222	29.52	
Autumn	1399	25.91	188	19.67	165	21.94	
Winter	1346	24.93	266	27.82	210	27.93	
Total	5400	100.00	956	100.00	752	100.00	<0.001

IS, ischemic stroke; ICH, intracerebral hemorrhage; SAH, subarachnoid hemorrhage.

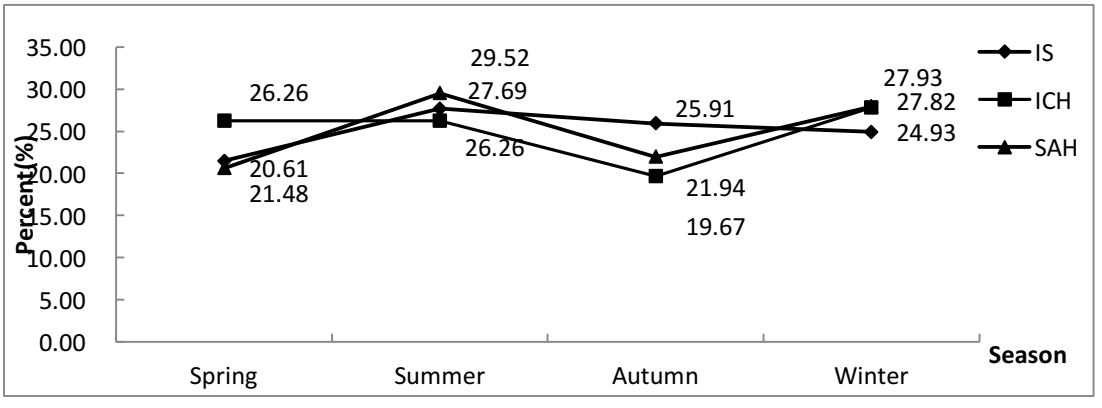

Figure 2. Distribution of the stroke patients according to the season

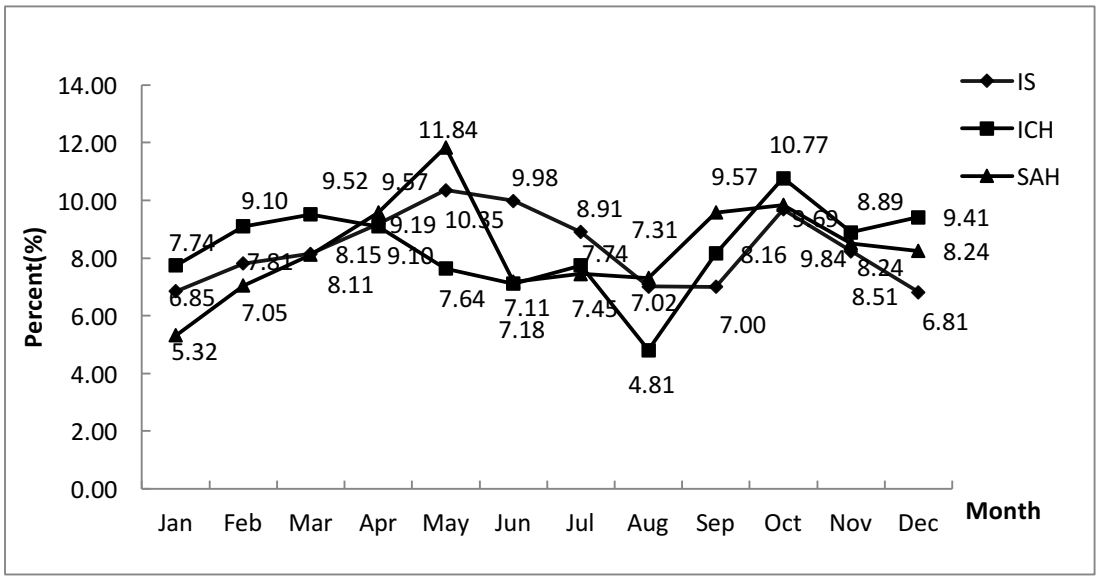

Figure 3. Distribution of the stroke patients according to the month

diabetes in stroke inpatients. The risk factors, such as alcohol use, smoking, hypertension, dyslipidaemia, diabetes, and atrial fibrillation were significantly different among the three groups (P<0.05), while deep vein thrombosis (DVT) was not significantly different (P>0.05). The incidence of pulmonary infection was higher in ICH and SAH inpatients, which was 12.55% and15.16 %, respectively.

DISCUSSION

In this study, it was found that the most common cerebrovascular diseases were IS, and the

Table 3: Prevalence of risk factors among stroke patients

Risk factors		IS n(%)		ICH n(%)		SAH n(%)		p
Current smoking	NO	3514	65.07	595	62.24	539	71.68	<0.001
	Yes	1544	28.59	269	28.14	166	22.07	
	Missing	342	6.33	92	9.62	47	6.25	
Alcohol use	NO	4061	75.20	661	69.14	611	81.25	<0.001
	Yes	316	5.85	62	6.49	26	3.46	
	Missing	1023	18.94	233	24.37	115	15.29	
Hypertension	NO	1629	30.17	209	21.86	448	59.57	<0.001
	Yes	3771	69.83	747	78.14	304	40.423	
Diabetes	NO	3919	72.57	808	84.52	699	92.95	<0.001
	Yes	1481	27.43	148	15.48	53	7.05	
Dyslipidemia	NO	4363	80.80	731	76.46	523	69.55	<0.001
	Yes	511	9.46	128	13.39	98	13.03	
	Missing	526	9.74	97	10.15	131	17.42	
Atrial fibrillation	NO	5281	97.80	952	99.58	751	99.87	<0.001
	Yes	119	2.20	4	0.42	1	0.13	
DVT	NO	5397	99.94	955	99.90	751	99.87	0.688
	Yes	3	0.06	1	0.10	1	0.13	
Pulmonary infection	NO	5051	93.54	836	87.45	638	84.84	<0.001
	Yes	349	6.46	120	12.55	114	15.16	

IS, ischemic stroke; ICH, intracerebral hemorrhage; SAH, subarachnoid hemorrhage.

proportion of ICH and SAH was less than 25%, which was consistent with the epidemiological surveys of larger sample populations in China.[8,9] In eastern Asia, especially China, the incidence of IS was higher than that of haemorrhagic stroke.[10] A national study conducted in China from 1996 to 2000 concluded that IS was the main type of stroke, accounting for 45.5–75.9%, whereas ICH accounted for 17.1–39.4%. IS was more common than hemorrhagic stroke, and its rate was about 1.1–3.9% (mean 2.0%).[8] According to a survey of cerebrovascular disease epidemiology in China in 2013, IS accounted for 69.6%, ICH for 23.8%, and SAH for 4.4%.[9] In Western countries, the proportion of IS and ICH accounted for 67.3–80.5% and 6.5–19.6%, respectively.[11] According to an American survey in 2013, IS accounted for 87%, ICH for 10%, and SAH for 3%.[12]

The survey found that more than 80% of the inpatients lived in Yunnan Province. The ethnic distribution of the inpatients covered almost all the ethnic groups in Yunnan, with the ethnic minorities accounting for less than 10%, most of whom were Yi, Bai, Naxi and Hui. Compared to other areas, the proportion of ethnic minorities was higher[13], which was related to the ethnic distribution of the Yunnan population. Yunnan is a multi-ethnic inhabited area, with 25 ethnic minorities in addition to the Han ethnicity. Different ethnic groups have different cultural habits, environments, behavioral characteristics, and genetic backgrounds. Therefore, conducting an epidemiological investigation of stroke in Yunnan is important.

Among the three groups, there were more men than women, which may be related to other risk factors such as hypertension, diabetes, and smoking, all of which were more common in men.[14] Some studies have found that estrogen has a relatively neuroprotective effect, including anti-atherosclerosis effects in blood vessels and adipogenesis regulation.[15] This may be a reason for the lower incidence of IS in women than in men. However, in postmenopausal women, a decrease in estrogen levels is also associated with increases the risk of stroke.[16] The average age of IS inpatients was the highest. This may be correlated with the development of atherosclerosis and the increase of cardiogenic thrombi with old age. Hemorrhagic stroke inpatients were younger than IS inpatients. The average age of inpatients with SAH was the lowest, which may be related to the rupture of congenital aneurysm.

Farmers accounted for a higher proportion of inpatients with hemorrhagic stroke, which may be related to the poor control of risk factors among rural inpatients in China. Moreover, economic and behavioral differences can affect the risk of stroke.[17] However, retired/unemployed inpatients accounted for approximately 40% of IS inpatients. In China, health insurance programs cove more than 95% of the population, and the coverage populations of NRCMS and UEBMI are rural residents and urban employees, respectively.[18] Accordingly, most of the hemorrhagic stroke inpatients were reimbursed by the NRCMS, while the ischemic stroke inpatients were reimbursed by the UEBMI.

A Japanese study concluded that the incidence of IS and ICH varied with seasons, with the highest incidence in spring, followed by winter; however, no seasonal change was observed in the incidence of SAH.[19] A sudden change in ambient temperature may lead to an increase in stroke admissions.[20] A study in Wujin, a city in southeast China, reported that the incidence of stroke changed according to the month and season; the incidence of stroke was highest in September and lowest in January, while the incidence of IS and ICH was highest in autumn.[6] However, these results are inconsistent with those of our study. The number of inpatients did not significantly change throughout the year in the study. One reason may be that Kunming is in a low-latitude plateau, and the annual temperature difference is small, generally 10–15 °C. The average temperature on the hottest days in summer is approximately 19–22 °C, and the average temperature in the coldest months in winter is approximately 6–8 °C. The other reason may be that the sample size in the study was not large, so we need to expand the sample size and extend the observation time in the future.

Smoking and alcohol consumption were the leading lifestyle-related risk factors for stroke inpatients, and were more common in stroke inpatients under 45 years of age.[21] According to a survey in 2010, the number of smokers has significantly increased among Chinese men aged 40–59 years.[22] Most stroke inpatients had never smoked, accounting for more than 65% of all inpatients. The proportion of non-smokers among ICH inpatients was slightly lower, which could be due to the high proportion of men among ICH inpatients, because the majority of smokers in China are male.[23] Low alcohol consumption is associated with a reduced risk of IS and stroke mortality, but has no effect on hemorrhagic stroke. However, heavy alcohol intake (>30 g/day) can increase the risk of stroke.[24]

Hypertension, hyperlipidemia, and diabetes

are the most common risk factors for stroke in inpatients aged 46–79 years.[21] The prevalence of hypertension in China was approximately 25%, and it was higher in the north, approximately 30%.[25] According to the report, only approximately 20% of Chinese inpatients with hypertension have control over their blood pressure, far lower than that of UK and USA, and the proportion of patients with controlled blood pressure in rural China is even lower.[26-29] Hypertension was observed in 69.83% of IS inpatients, 78.14% of ICH inpatients, and 40.43% of SAH inpatients in this survey. However, it was reported that the effect of hypertension on stroke differs by ethnicity, with an 8% increase in the stroke risk for people of Caucasian descent for every 10 mm Hg increase in systolic blood pressure and a 24% increase for people of African descent.[30]

Diabetes is a risk factor for stroke, and the course of diabetes is also a risk factor for stroke. Compared with non-diabetic patients, the risk of having a stroke increased by 1.7 times in patients with diabetes for less than 5 years, 1.8 times in patients with a disease course of 5–10 years, and 3.2 times in patients with a disease course ≥10 years.[31] In addition, long-term hyperglycemia can lead to abnormal lipid metabolism.[32] In this study, 27.43% of patients with IS had diabetes, whereas approximately 10% of inpatients with hemorrhagic stroke had diabetes. Hypertension and diabetes were also common causes of hospitalization within 31 days of discharge.[33]

In this study, the incidence of dyslipidemia among stroke inpatients was approximately 10%. The detection rate of dyslipidemia in IS inpatients was 9.46%. The ICH and SAH detection rates were 13.39% and 13.03%, respectively. Hypertension, diabetes, and smoking were more common among men, whereas high cholesterol, lack of exercise, and obesity were more common among women in Asia.[10]

Atrial fibrillation, one of the most common persistent arrhythmias, is an independent risk factor for stroke. The incidence of stroke in inpatients with atrial fibrillation was significantly higher than that in inpatients without atrial fibrillation (12.0% vs 2.3%).[25] The prevalence of atrial fibrillation was 2.58% in Chinese people aged ≥40 years, which increased linearly with age. The prevalence of atrial fibrillation among people aged ≥65 years was 2.2 times than that among people aged 40-64 years[34], and the elderly had a higher possibility of suffering from a cardioembolic stroke.[35] The prevalence of atrial fibrillation in stroke patients also increased with age.[21,34] The prevalence of stroke in patients with atrial fibrillation in this study was lower than that reported previously. Perhaps atrial fibrillation in IS patients was paroxysmal, and not all patients undergo dynamic ECG for diagnosis. Another reason was possibly because atrial fibrillation distribution was significantly regional high in the north and low in the south of China.[34] The incidence of atrial fibrillation in patients with IS (2.20%) was higher than that in patients with ICH or SAH (0.42% and 0.13%). In this study, the DVT detection rate in inpatients with the three types of stroke was relatively low, which is consistent with the findings of a Chinese study published in 2012.[21] This may be due to the lack of DVT-related examinations for clinical patients.

A higher mortality rate is associated with patients with ICH and SAH than IS patients[8], and the higher incidence of pulmonary infection in hemorrhage patients may be a reason why the mortality rate for hemorrhagic stroke patients is higher than that of IS patients. A recent prospective study of patients with IS in China also found that pulmonary infection was the most common complication[36], and that the pulmonary infection rate increased with age in patients with stroke.[21] However, studies in the United States and Denmark have found that urinary tract infection(UTI) is the most common complication in IS patients.[37,38]

This study has some limitations. First, it was conducted in only one hospital in the area and was not representative of the entire region. Second, the hospital is in an urban area, and most patients belong to the urban or rural population living in the urban area; therefore, the patient characteristics may be closer to those of the urban population. Finally, the data were not statistically analysed according to sex.

In conclusion, the different stroke subtypes in Kunming, Yunnan showed differences in age, sex and occupation, as well as different detection rates of associated risk factors. Demographic information and risk factors differed among the three stroke types; however, the number of hospitalized patients in all three groups varied little throughout the year in Kunming.

DISCLOSURE

Financial support: This work was supported by the National Natural Science Foundation of China (Grant No. 81460188 and 81960228); the Medical Leading Talents Program of Yunnan Province (No. L-2017013); the Ten thousand

Talents program-famous Doctor Project of Yunnan Province(No.YNWR-MY-2018-018); Basic Research Project of Yunnan Province-General Project (No. 202101AT070235); Basic Research Program of Yunnan Province (Special Project of Kunming Medical Association) (No. 202101AY070001-245).

Conflicts of interest: None

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