



Primary Hemorrhagic Neurovascular Diseases in Tibetans: A Retrospective Observational Study

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BACKGROUND: Although there have been many studies on primary hemorrhagic neurovascular diseases (PHNVs) in different populations, a study focusing on PHNVs in Tibetan people was lacking. This study aimed to explore the notable characteristics of Tibetan PHNVs by comparing the 3 most common PHNVs (aneurysmal subarachnoid hemorrhage, spontaneous intracerebral hemorrhage, and arteriovenous malformation) in our institution between Tibetan and Han patients.

METHODS: In this retrospective observational study, the hospital information system was used to access the records of patients with PHNVs. A total of 249 Tibetan patients and 2093 corresponding contemporary Han patients were recruited from January 2012 to January 2016. Sociodemographic information and clinical data on each PHNV subtype were collected and compared between the 2 races.

RESULTS: For Tibetan patients, a significantly higher incidence ($P < 0.05$) of rebleeding and cerebral infarction was observed in all 3 PHNV subtypes. In the aneurysmal subarachnoid hemorrhage group, Tibetan patients had significantly higher incidence of blood blisterlike aneurysms (BLAs) (19.6% [19/97] vs. 3.2% [34/1071]; $P < 0.001$). In the spontaneous intracerebral hemorrhage group, Tibetan patients had a significantly higher incidence of brainstem hemorrhage in the subtentorial area (10.8% vs. 5.1%; $P = 0.035$).

CONCLUSIONS: For Tibetan PHNVs, a high incidence of BLAs in aneurysmal subarachnoid hemorrhage, a tendency toward brainstem hemorrhage in subtentorial spontaneous

intracerebral hemorrhage, and a high rate of infarction and rebleeding in all 3 subtypes were all recognized.

INTRODUCTION

Primary hemorrhagic neurovascular diseases (PHNVs) have been a challenge for neurosurgeons because of their high rates of morbidity and mortality. Although there have been many studies on PHNVs in different populations, the research focusing on Tibetan people was lacking. In China, most of the population are Han (>1.2 billion). Although there are only 7.8 million Tibetans, they are the most populous human race living in the Himalaya plateau area, which has an especially high-altitude atmosphere with low pressure and thin oxygen levels. Because of their different living environment and customs, the diet of Tibetans is composed of high-fat and high-salt food, increasing the risk of hypertension, hyperlipidemia, and therefore, hemorrhagic stroke.¹⁻³ Few studies of PHNVs in Tibetans have been published since a national survey explored the high incidence of stroke in the Tibet area 20 years ago.⁴ As the largest medical center in West China, the West China Hospital of Sichuan University receives many patients with PHNV from different regions of western China, including the Tibetan plateau. In our study, we analyzed and compared the medical data for 3 common PHNVs (aneurysmal subarachnoid hemorrhage [aSAH], spontaneous intracerebral hemorrhage [sICH], and arteriovenous malformation [AVM]) in Tibetan and Han people in the West China Hospital of Sichuan University

Key words

- Aneurysmal subarachnoid hemorrhage (aSAH)
- Arteriovenous malformation (AVM)
- Ethnic
- Primary hemorrhagic neurovascular diseases (PHNVs)
- Spontaneous intracerebral hemorrhage (sICH)

Abbreviations and Acronyms

- aSAH:** Aneurysmal subarachnoid hemorrhage
- AVM:** Arteriovenous malformation
- BLA:** Blood blisterlike aneurysm
- CT:** Computed tomography
- IHM:** Intrahospital mortality
- MRI:** Magnetic resonance imaging

PHNV: Primary hemorrhagic neurovascular disease

sICH: Spontaneous intracerebral hemorrhage

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from January 2012 to January 2016 to explore the notable characteristics of these PHNVDS in Tibetans for clinical doctors.

METHODS

Study Design and Participants

In this retrospective observational study, the hospital information system was used to access the records of patients with PHNVDS in our institute from January 2012 to January 2016. The study patients were selected by their stated race as either Tibetan or Han. The diagnosis of the selected patients was confirmed by 2 neurosurgeons and 1 neuroradiologist, who reviewed their inpatient medical records and imaging data. In total, 254 Tibetan patients with PHNVDS meeting the criteria were enrolled, including 97 with aSAH, 102 with sICH, 50 with AVM, 3 with cavernous hemangioma, and 2 with Moyamoya diseases. Because of an insufficient sample size, patients with cavernous hemangioma and Moyamoya disease were excluded from our study. Correspondingly, 2093 Han patients with PHNVDS were enrolled, consisting of 1071 with aSAH, 826 with sICH, and 196 with AVM, for the comparison analysis.

Data Collection

Sociodemographic data and individual risk factors (history of hypertension, diabetes, coronary artery disease, dyslipidemia, hemoglobin, tobacco use, alcohol use, previous stroke, and peripheral vascular disease) were collected, as was information on each PHNVDS subtype as follows.

aSAH

- Number and location of the aneurysms based on computed tomography (CT) angiography and digital subtraction angiography
- Complications and intrahospital mortality (IHM) with different therapeutic options, including surgery and nonsurgical treatment

sICH

- Location of the hematoma based on CT and magnetic resonance imaging (MRI)
- Complications and IHM with different therapeutic options, including surgery and nonsurgical treatment

AVM

- Spetzler-Martin AVM grading scale based on an imaging examination (digital subtraction angiography)
- Complications and IHM with different therapeutic options, including surgery and nonsurgical treatment

Treatment

Surgery. Surgery was classified as craniotomy or interventional treatment. For patients with aSAH, craniotomy indicated aneurysm-clipping surgery, and interventional treatment included endovascular coiling and cerebral artery stenting. For patients with sICH, craniotomy indicated hematoma evacuation or hematoma evacuation plus decompressive craniectomy. There was no interventional treatment for patients with sICH. For patients with AVM, craniotomy indicated the surgical removal of AVM lesions, and

interventional treatment indicated the endovascular embolization of AVM.

Nonsurgical. Nonsurgical treatment was defined as medication therapy or radiation therapy (such as Gamma Knife [Elekta, Stockholm, Sweden] for AVM).

Patients who experienced multiple treatment methods, if they underwent any craniotomy or interventional treatment, were analyzed in the surgical group. Otherwise, the patients were categorized in the nonsurgical group.

Complications and IHM

Complications such as rebleeding, infarction, hydrocephalus, and epilepsy were analyzed. Rebleeding was defined as any increase in the hematoma volume after admission on imaging examination (CT or MRI). Infarction was confirmed by an imaging examination during hospitalization (CT or MRI). Hydrocephalus was defined as an apparent radiologic expansion of the ventricular system. Epilepsy was recorded according to the daily patient record or the results of electroencephalography. IHM was defined as death as a result of all causes during hospitalization.

Statistical Analysis

Univariable analyses were conducted using the χ^2 test or Fisher exact tests, Student *t* tests, and Mann-Whitney *U* tests, as appropriate. The χ^2 test or Fisher exact tests were used to compare the complications and IHM between Tibetan and Han patients with PHNVDS. Significance was defined as $P < 0.05$ and 95% confidence intervals were used. All statistical analyses were performed using SPSS 19.0 (IBM Corp., Armonk, New York, USA).

RESULTS

Among the 249 Tibetan patients with PHNVDS admitted from January 2012 to January 2016, 97 had aSAH, 102 had sICH, and 50 had AVM. A total of 2093 corresponding contemporary Han patients with PHNVDS were enrolled, including 1071 with aSAH, 826 with sICH, and 196 with AVM. Compared with the Han patients, the Tibetan cohort had more males, tobacco smokers, patients with hypertension, and patients with hypercholesterolemia ($P < 0.001$). They also tended to have a higher hemoglobin level ($P < 0.001$). The 2 populations did not differ in age, gender, admission delay in hours, history of diabetes mellitus, coronary artery disease, or previous stroke ($P > 0.05$) (Table 1).

The mean age of the Tibetan aSAH cohort ($n = 97$) was 53.4 ± 17.6 years, with 42.3% ($n = 41$) male and 85.6% ($n = 83$) having a single aneurysm, 94.0% of which ($n = 78$) were located in the anterior circulation. The mean age of the Han aSAH cohort ($n = 1071$) was 51.2 ± 19.3 years old, with 44.6% (478) being male and 85.5% ($n = 916$) having a single aneurysm, 94.4% ($n = 865$) of which were located in the anterior circulation. The 2 cohorts did not differ significantly in age, gender, and location of aneurysms ($P > 0.05$) (Table 2). Further, 19.6% ($n = 19$) of the aneurysms in the Tibetan group were blood blisterlike aneurysms (BLAs), which are defined as a special subtype of cerebral aneurysm characterized by the hemispherical fragile thin wall with a predilection to the nonbranching dorsal part of the internal carotid artery. However, the ratio of BLAs was 3.2% in the Han group,

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