

Etiologies of Ischemic Stroke in Sub-Saharan Africa, Case of Benin

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Abstract

The purpose of our study was to investigate etiologies of ischemic stroke in the neurology university clinic of CNHU-HKM, Cotonou. **Method:** It was a cross-sectional, prospective and analytical study carried out from 1st November 2014 to 31st August 2015 in the neurology university clinic of CNHU-HKM. We included all patients with stroke whose ischemic nature was confirmed through brain CT scan or magnetic resonance imaging. Data analysis was conducted with Census and Survey Processing System (CSPRO). We carried out bivariate then multivariate analysis in identifying associated factors. Threshold value is estimated at $p < 0.05$. **Results:** 104 ischemic stroke patients participated in the study, representing 59.4% of all types of stroke. Mean age was 61.9 ± 12.3 years [26 - 87 years] with 1.6 as sex ratio. Among vascular risk factors, hypertension accounted for 85.6% of stroke cases. 29.8% suffered from aphasia. Embolic heart diseases and atherosclerosis were predominant, in a proportion of 53% and 26% respectively. Atrial Fibrillation (AF) accounted for 82% of embolic heart diseases. **Conclusion:** Etiologic investigation of stroke is important and should be systematically carried out. This study enabled to corroborate atherosclerosis predominance in etiologic investigation of ischemic stroke. Patients' outcome could be improved by promptly managing the etiology through adoption of appropriate treatment.

Keywords

Ischemic Stroke, Etiologies, Benin, Africa

1. Introduction

Just as cancer and cardiovascular diseases, stroke is one of the top public health priorities, as the understanding of epidemiological data has contributed to a bet-

ter awareness of the magnitude of this medical issue [1] [2]. It accounts for about 44.4% of admissions in the Neurology Department of Hubert Maga Kou-tougou National Teaching Hospital (CNHU-HKM) [3] and 32.9% in the neurology department of Lomé Teaching Hospital in Togo [4]. It is the most common condition observed in patients admitted to accident and emergency department, especially in Benin [5]. This serious and recurrent medical issue ultimately leads to ischemic stroke in 80% of cases [6]. Given the poor technical facilities and financial difficulties faced by Sub-Saharan Africans, very few studies were conducted to investigate the etiology of ischemic stroke. Yet, ischemic stroke prognosis is considerably associated with etiological management [7] [8]. Thus, the purpose of this study is to identify the various etiologies of ischemic stroke in Benin hospital setting so as to reduce its mortality.

2. Method

Population

It was a prospective and descriptive study carried out from 1st November 2014 to 31st August 2015. The study population was all patients followed in the neurology university clinic during the study period. Sample size was determined in accordance with Daniel Schwartz formula:

$$n = \frac{Z\alpha^2 pq}{i^2}$$

n = sample size, p = 44.4% stroke prevalence in neurology clinic of CNHU-HKM (3). q = $(1 - p) = 55.6\% = 0.56$. α = 5% hence $Z\alpha = 1.96$ (z -score refers to α risk = 5%). i = 10% (desired precision). The result obtained was $n = 95$. However, 104 ischemic stroke patients have been included. During the study period, we systematically included up to the planned maximum number, all patients with stroke whose ischemic nature was confirmed by a brain CT scan or magnetic resonance imaging, and who provide informed consent. Cerebral venous thrombosis cases have been excluded.

Diagnosis criteria

Extra and intracranial atherosclerosis was diagnosed based on the following criteria: existence of risk factors for atherosclerosis (age, diabetes, hypertension, obesity, smoking ...), presence of atheromatous plaque corroborated with Doppler ultrasound of supra-aortic trunks. Stenosis was considered as significant when above 70%.

Embolitic heart diseases were diagnosed on the basis of cardiac diagnostic tests including:

- Arrhythmia (Atrial Fibrillation, Atrial Flutter) and myocardial infarction assessed through ECG and Holter
- Transthoracic echocardiography for the diagnosis of valvular heart disease (mitral valve stenosis, calcified aortic stenosis ...), hypertrophic cardiomyopathy, patent foramen ovale and atrial septal aneurysm (ASA)

Paraclinical tests (CBC, hemoglobin electrophoresis, protein S assay, protein

C assay) are established on the basis of hematological etiologies for diagnosis.

Infectious vasculitis is established when the syphilis and retroviral serology used for their diagnosis is positive and the other etiology-driven tests are normal.

Statistical analysis

Data collected were entered and analyzed through Census and Survey Processing System (CSPRO) version 6.1. Statistical Analysis Software (SAS) version 9.3 and Excel 2013 were used to produce various tables and graphs. Sample description was carried out in compliance with common statistics: Quantitative variables were expressed through mean values with their standard deviations, interval confidence estimated at 95%.

3. Results

Over the study period, a total of 250 patients were admitted. Frequency of stroke was recorded 70% (175/250). Ischemic stroke accounted for 59.4% (104/175) of all types of stroke. Mean age of the 104 patients with ischemic stroke was 61.9 ± 12.3 years [26 - 87 years] with 1.6 as sex ratio. Our study highlighted hypertension and obesity as predominant personal medical history, with respectively 85.6% and 39.4%.

Systolic BP ranged from 80 to 240 mmHg with $166.6 (\pm 30.8)$ mmHg as mean value. Diastolic BP was 95.5 ± 20.7 , with 100 and 159 mmHg as extreme values. All patients developed motor impairment. 29.8% of our patients suffered from aphasia. **Table 1** summarized socio-demographic and clinical characteristics.

Upon the biological tests carried out, 23.3% had high level of total cholesterol, and its mean was estimated at $1.9 (\pm 0.526)$ g/L, with extreme values ranging from 1.03 - 3.8 g/L. 26.2% of the study population had high LDL cholesterol, with $1.3 (\pm 0.5)$ g/l and 0.4 - 3.3 g/L as mean value and extreme values respectively. Furthermore, hypertriglyceridemia was recorded in 23.8% of the patients. 30.6% of our study population had hyperuricemia, with $59.6 (\pm 20.1)$ mg/L as mean value. Treponema-specific bacterium test was negative in all patients included in the study, however, two (02) patients representing 1.9% tested positive for HIV.

As regards paraclinical tests, 95 out of 104 patients performed electrocardiogram (ECG). It was abnormal in 15.8% of cases. **Table 2** highlights the various ECG abnormalities.

Holter-ECG was performed in 79 patients. Some patients had normal ECG and abnormal Holter-ECG. 25.3% of the study population had abnormal Holter-ECG, hence the need of performing Holter-ECG in etiological investigation of ischemic stroke. **Table 3** highlights patients' distribution according to Holter-ECG.

Doppler echocardiography was performed in 85 patients. It revealed abnormalities in 7.1% of patients, including 3.5% valvular heart disease, 2.3% ischemic heart disease and 1.2% atrial septal aneurysm and right ventricular apical aneurysm (**Figure 1**).

Table 1. Socio-demographic and clinical characteristics of ischemic stroke.

	Number (n)	Percentage (%)
Age		
<55y	32	30.8
≥55y	72	69.2
Gender		
Male	64	61.5
Female	40	38.5
Style of life		
Alcoholism	45	43.3
Tabagism	9	8.7
Inactivity	83	79.8
Occupation		
Retirement	44	42.3
Household	23	22.1
Official	25	24.1
Artisan	12	11.5
Level of education		
Illiterate	11	10.8
Primary	38	36.3
Secondary	43	41.2
University	12	11.7
Medical history		
Hypertension	89	85.5
Obesity	41	39.4
Diabetes	31	29.8
Stroke	27	25.9
Cholesterol	2	1.9
Arteritis obliterans of the lower limbs	9	8.6
Hormonal contraception	1	1
Motor deficiency		
Paralysis	60	57.5
Paresis	44	42.5
Disorders of consciousness		
Aphasia		
Broca	18	58
Wernicke	2	6.5
Mixed	11	35.5

Table 2. Patients distribution according to the result of abnormal ECG.

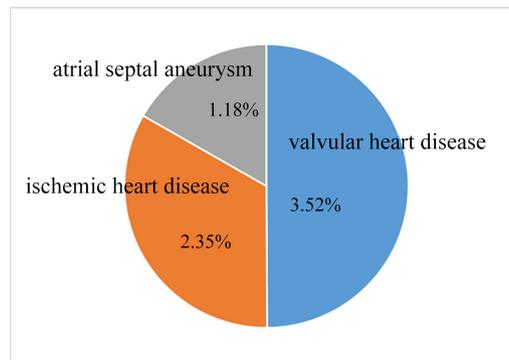
ECG result	Number (n)	Percentage (%)
Normal	80	84.21
Myocardial infarction	2	2.11
Arrhythmia (AF) *	13	13.68
Total	95	100

* AF: Atrial Fibrillation.

Table 3. Patients distribution according to the result of the abnormal Holter-ECG.

Results of Holter-ECG	Number (n)	Percentage (%)
Normal	59	74.68
Myocardial infarction	2	2.53
Arrhythmia (AF)*	18	22.79
Total	79	100

* AF: Atrial Fibrillation.

**Figure 1.** Abnormalities found on Doppler echocardiography.

Of the 104 patients included in the study, 85 performed Doppler ultrasound of supra-aortic trunks. Nonstenosing and stenosing atheromatous plaques were in a proportion of 95.6% and 4.4% respectively.

Atherosclerosis (53%) was the leading etiology in our study population. **Figure 2** highlights patients' distribution according to the etiology.

4. Discussion

The mean age of our patients was 61.9 ± 12.3 years [26 - 87 years], similar to the figure recorded by Gombert *et al.* in 2007 in Brazzaville [9]. As regards vascular risk factors, hypertension was present in 85.5% of patients followed by obesity in a proportion of 39.4%. A study conducted in Mali highlighted similar results *i.e.* 61% hypertensive patients and 45.8% obese [10].

Hypertension is the most important modifiable risk factor for myocardial infarction in both sexes, regardless of age. It increases the risk of myocardial infarction by 4, and 40% to 85% of patients with cerebral infarction are hypertensive [11]. The role of obesity as an independent risk factor for cerebral infarction

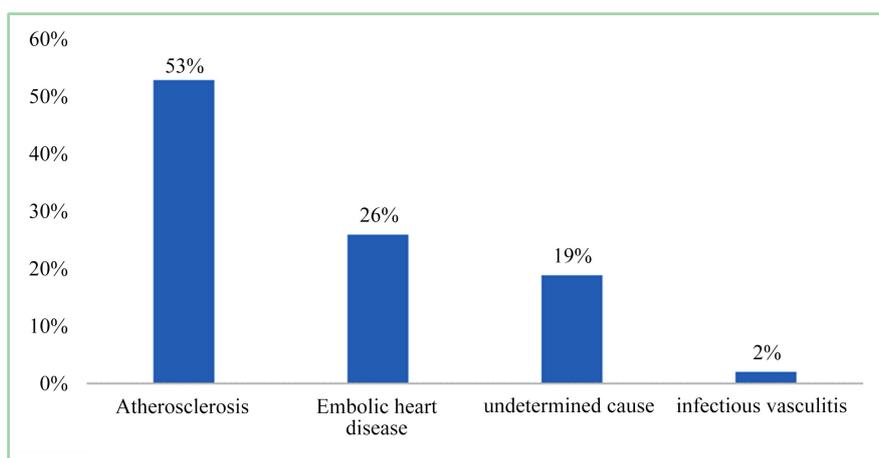


Figure 2. Etiology of ischemic stroke.

is demonstrated through a relative risk increased by a factor of 2 [12], exacerbated by risk factors such as hypertension, diabetes and hypercholesterolemia. Weight loss resulting in lowered blood pressure and remediation of cholesterol abnormalities, may reduce the risk of stroke, though this is yet to be established [13]. The mean value for systolic and diastolic blood pressure was respectively 166.6 ± 30.8 and 95.5 ± 20.7 . Secondary prevention requires lowering this blood pressure, because according to Gorelick *et al.*, 9 mmHg drop in systolic blood pressure and 4 mmHg diastolic blood pressure would reduce by 26% the risk of stroke recurrence [14]. Biologically, the presence of cholesterol was noted in 23.3% of patients. This figure is higher than results of Tazi and all in Morocco [15] who recorded 10.9% hypercholesterolemia. This gap could be explained by the fact that consumption of non-vegetable oil is much higher in our country. It's known that lipid-lowering effect of statins is considerable in secondary stroke prevention, with a reduced risk from 19% to 32% [16]. As regards the etiology of ischemic stroke, atherosclerosis was in large proportion, followed by embolic heart disease and finally infectious vasculitis in a proportion of 53%, 26% and 2% respectively. Nearly 19% of the etiology of ischemic stroke was unknown. Kolominsky-Rabas *et al.* reported similar results with 41.1% atherosclerosis, 30.2% embolic disease, 39.3% unknown etiology, and 2.1% for other etiologies [17]. Other studies carried corroborate the fact that atherosclerosis is the most common etiology of ischemic stroke with respectively 51%, 62%, and 41% [18] [19]. However, Tardy *et al.* [20] in Toulouse and Suissa *et al.* in Nice in 2009 in France recorded predominant cardioembolic etiology followed by atherosclerosis etiology. They reported respectively 53.6% and 16% then 41.5% and 28.2%. Westernization of lifestyle in sub-Saharan Africa and increased vascular risk factors confer on atherosclerosis the leading position in ischemic stroke etiologies.

5. Conclusion

Etiologic investigation of stroke is important and should be systematically car-

ried out. This study enabled to corroborate atherosclerosis predominance in etiologic research of ischemic stroke. Patients' outcome could be improved by promptly managing the etiology through adoption of appropriate treatment.

6. Limitations of the Study

This prospective descriptive study may have been tainted by information bias, particularly prevarication. Indeed, age was self-reported and, in an environment where the illiteracy rate is not negligible, subjects tend to under- or overestimate their age. Nevertheless, to limit this effect, whenever subjects were asked for their national identity card or voter's card or birth certificate, they were provided it if possible. We also found a selection bias related to inclusion criteria based on the completion of the brain scan. However, we are in an environment where not all patients have the financial means to perform this examination. In addition, the rate of indeterminate strokes could have been lower if all the tests involved in the etiological research were performed.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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