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Review Article

Ischemic stroke due to embolic heart diseases and associated factors in Benin hospital setting

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ABSTRACT

Introduction: Poor access to cardiovascular checkups is a major cause of ignorance of embolic heart diseases as the etiology for ischemic stroke.
Objective: Study ischemic strokes due to embolic heart diseases and their associated factors.
Method: It was a cross-sectional, prospective, descriptive and analytical study conducted from November 1, 2014 to August 31, 2015 on 104 patients with ischemic stroke confirmed through brain imaging. Embolic heart diseases included arrhythmia due to atrial fibrillation (AF), atrial flutter, myocardial infarction (MI), heart valve diseases and atrial septal aneurysm (ASA). The dependent variable was embolic heart disease while independent variables encompassed socio-demographic factors, patients' history, and lifestyle. Data analysis was carried out through SAS 9.3.
Results: The rate of embolic heart diseases (EHD) as etiology for ischemic stroke was 26% (28/104). AF accounted for 69% of embolic heart diseases and 22.8% of etiologies for ischemic stroke. Ischemic strokes prevalence was 3.5%, 2.5% and 1.2% respectively for heart valve diseases, MI and ASA. The associated factor was age ($p = 0.000$).
Conclusion: The diagnosis of a potential cardiac source of embolism is essential because of therapeutic and prognostic implications. Wherefore, there is need for cardiovascular examination particularly Holter ECG and cardiac ultrasound examination which are not always accessible to our populations.

1. Introduction

As in developed countries, stroke is the third cause of mortality in sub-Saharan Africa [1]. With 29% as estimated rate of mortality [2], stroke leads to functional disability in 69% of cases [3]. Among ischemic type of strokes, 20% are associated with embolism of cardiac origin and are accessible to effective prevention through early diagnosis of cardiac anomaly [4]. In sub-Saharan Africa, technical and financial accessibility is a major obstacle to the diagnosis of embolic heart diseases. In fact, the costs of check-ups required in the process of locating cardioembolic causes were fully borne by the authors stymied by high frequency of stroke recurrence within the Neurology University Clinic. This was specific to low socio-economic segment of the population. Given this unfortunate situation, and keen to understand stroke etiologies, the authors have committed to carry out this study, the first ever of its kind in Benin. The purpose is to draw our politico-administrative authorities' attention on the importance of etiological assessment in stroke management in order to leverage resources which will systematically enable these assessments to facilitate background therapy which could improve the vital prognosis of these patients. This study was initiated to determine the proportion of embolic heart diseases in the occurrence of ischemic stroke in Benin hospital setting.

2. Framework and methodology

2.1. Framework of the study

The study was conducted at the Department of Neurology of CNHU-HKM Cotonou.

It is Benin referral hospital positioned at the central level in the health pyramid. It is based in a city of 600,000 inhabitants. In this hospital, the Emergency Department, Intensive Care Unit, Cardiology

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and Neurology Departments take care of stroke cases. To date, CNHU-HKM Cotonou has neither neurovascular unit nor neurovascular specialist. This study was self-financed by the authors, in a developing country with technical facilities and health policy far behind those of developed countries. In Benin, healthcare and healthcare services are directly paid by the client and most of the time healthcare is provided after payment. Based on the above, the difficulties in realizing this study are obvious.

2.2. Methodology

2.2.1. Patients

This study took place from 1st November 2014 to 31st August 2015. It was a cross-sectional, prospective, descriptive and analytical study on all ischemic stroke patients seen during the study period. Individuals included in the study were stroke patients who gave their informed consent (or otherwise consent from a close relative) to participate in the study and whose ischemia was confirmed through cerebral CT scan or magnetic resonance imaging.

2.2.2. Diagnosis of cardioembolic heart diseases

Embolic heart diseases were selected on the basis of cardiac paraclinical tests namely ECG, Holter ECG and transthoracic echocardiogram. The electrical anomalies tested were cardiac rhythm disorders such as arrhythmia due to atrial fibrillation (AF), atrial flutter and myocardial infarction. Ischemic heart diseases included in the study are those preceding stroke within < 4 weeks. The transthoracic echocardiogram sought heart valve diseases (mitral valve stenosis, calcified aortic stenosis...), hypertrophic cardiomyopathies, myocardial infarction, patent foramen ovale (PFO) and atrial septal aneurysm (ASA). Heart diseases were selected based on TOAST classification [5] (Table 1).

2.2.3. Statistical analysis

The dependent variable was embolic heart disease while the independent variables encompassed socio-demographic factors (age, gender, marital status, level of education, place of residence), vascular risk factors (HBP, diabetes, obesity, physical inactivity, alcohol and tobacco consumption). Data analysis was conducted through *Statistical Analysis Software* (*SAS*) version 9.3 and Excel 2013. Quantitative variables were expressed in average with their standard deviation, confidence interval estimated at 95% while the comparison of proportions was made using Pearson's chi square statistical test with p below 0.05 as a significance threshold. For the purpose of identifying associated factors, we first conducted a bivariate analysis. At this stage, the variables associated with embolic heart diseases were subject to a multivariate analysis for final identification of associated factors.

Table 1
Classification of cardioembolic stroke according to their risk.

High risk	Moderate risk
Prosthetic mechanical valve	Mitral valve prolapse
Mitral stenosis with atrial fibrillation	Mitral annular calcification
Atrial thrombus	Mitral stenosis with no atrial fibrillation
Sick sinus syndrome	Calcified aortic stenosis
Recent myocardial infarction (< 4 weeks)	Inter-atrial septal aneurysm
Left ventricle thrombus	Patent foramen oval
Atrial myxoma	Non-bacterial endocarditis
Infectious endocarditis	Left atrial spontaneous echo contrast

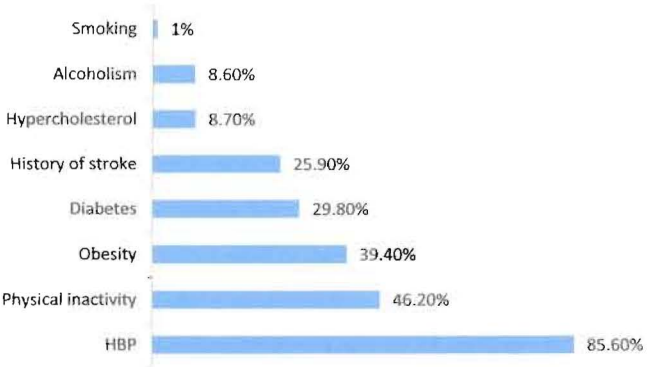

Fig. 1. Frequency of vascular risk factors.

3. Results

3.1. Frequency

175 stroke patients were seen during the study period. We recorded respectively 104 and 71 cases of ischemic and hemorrhagic stroke representing 59.4% and 40.6% frequency.

3.2. Socio-demographic and clinical characteristics

The average age of the 104 ischemic stroke patients was 61.9 years ± 12.3 [26–87 years]. Sex-ratio (M/F) was 1.6. Fig. 1 shows the frequency of vascular risk factors in ischemic stroke patients. On average, the patients waited for 64.94 h (± 96.12) with extremes values of 1 to 456 h before reporting to the referral hospital. Clinically, 18.9% developed impaired consciousness, 29.8% aphasia and 57.5% hemiplegia.

3.3. Paraclinical assessment

Based on brain imaging, 75% of the lesions observed are located in the carotid territory and 25% account for vertebrobasiliar lesions.

The rate of ECG completion was 91.3% (95/104) with 15.8% cases of embolic heart disease. The rate of Holter-ECG completion was 75.9% (79/104) with 25.3% cases of embolic heart disease. Systematic Holter ECG made it possible to diagnose 5 additional cases of paroxysmal atrial fibrillation in patients who previously had normal ECG.

81.7% (85/104) of the patients whose results are presented in Table 2, carried out transthoracic cardiac ultrasound.

Among heart valve diseases diagnosed through cardiac ultrasound, there was one case of mitral valve stenosis and two cases of calcified aortic stenosis.

3.4. Embolic heart disease

Out of the total 104 ischemic stroke patients, 26 (25%) developed

Table 2
Patients distribution based on transthoracic cardiac ultrasound.

	Number (n)	Percentage (%)
Normal	79	92.9
Heart valve disorders	3	3.5
Ischemic heart disease[a]	2	2.4
Aneurysm[b]	1	1.2
Total	85	100

[a] Ischemic heart disease with impairment of the function of ventricular systolic ejection.

[b] Inter-atrial septal aneurysm and apical aneurysm of the right ventricle.

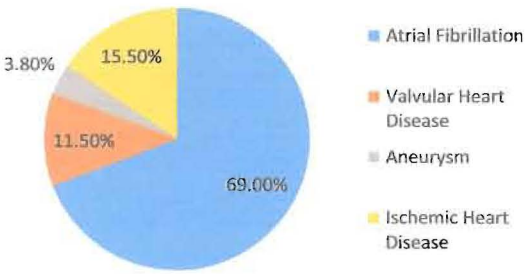

Fig. 2. Types of embolic heart diseases.

embolic heart disease distributed according to Fig. 2.

No patient had several associated heart diseases.

3.5. Associated factors

Factors associated with embolic heart diseases are highlighted in Table 3.

4. Discussion

The insignificant gaps observed in our comparisons may be due to the small sample size, which is merely representative of ischemic patients in Benin. Furthermore, the selection bias on universally admitted clinical trials could be heightened by the low socio-economic level of the population and the socio-cultural representations of the disease which do not allow all patients to benefit from adequate support. In Benin, stroke is still considered as a spiritually bound supernatural disease, caused by a sorcerer spell cast. Its sudden onset, often nocturnal with functional impairment in a patient previously healthy, buttresses this perception [6]. More so, Benin is subjugated to traditional practices and recourse to a neurologist in the event of stroke is not yet common. Patients lack of financial resources and non-availability of funds for research also contributed to the discontinuation of the study, given that the authors had to self-finance virtually all the cost involved in etiologic research. It is worth noting poor technical facilities required not only for diagnosis but especially for therapeutic approach including MRI, trans-esophageal echocardiogram and cardiovascular surgery unit.

In our study, on average our patients waited for 64.94 h (± 96.12) with extremes values of 1 to 456 h to report to the referral hospital. Thus, a significant amount of door-to-balloon time is wasted outside of the hospital. The importance of this time is not insignificant in the patients' vital and functional prognosis given the rapid development toward irreversible lesions. The ideal admission waiting time is 4 h 30mn maximum, to allow patients benefit from thrombolytic therapy, even if in Benin, we have no neurovascular unit. Our findings are similar to those recorded by Rhissassi et al. in 2010 in Morocco [7] and

Table 3
Factors associated with embolic heart diseases, Cotonou 2015. Bivariate and multivariate analyses.

	Total	Embolic heart disease		OR [$CI_{95\%}$]	P value
		N	%		
Bivariate analysis					
Age					0.003
< 45 years	7	1	14.3%	1.62 [0,91–3,64]	
≥ 45 years	97	25	25.8%	3.06 [1,31–6,76]	
Gender					0.202
Male	64	14	21.9%	1.13 [0,69–1,51]	
Female	40	12	30%	1.06 [0,34–4,02]	
Marital status					0,633
Living alone	21	4	19%	0.82 [0,45–2,04]	
Live with a partner	83	22	26.5%	2.91 [1,43–6,54]	
Place of residence					0,774
Urban areas	94	23	24.5%	2.71 [0,85–2,64]	
Rural areas	10	3	30%	4.56 [0,11–5,07]	
Level of education					0.083
Uneducated	11	2	18.2%	2.56 [0,54–3,14]	
Primary school	38	10	26.3%	3.02 [0,78–2,05]	
Secondary education	43	12	27.9%	1.57 [0,93–2,66]	
University	12	2	16.7%	1.20 [0,66–1,85]	
Risk factors					0.093
HBP	89	14	15.7%	1.06 [0,28–4,05]	
Diabetes	31	5	16.2%	1.59 [0,93–2,77]	
Obesity	41	8	19.5%	1.13 [0,67–1,89]	
Stroke history	27	5	18.5%	0.84 [0,38–1,99]	
Motor deficit					0.002
Full	60	18	30%	1.85 [1,08–4,25]	
Partial	44	8	18.2%	1.07 [0,28–2,33]	
Consciousness disorders					0.001
Yes	20	10	50%	5.27 [3,32–10,7]	
No	84	16	19%	2.34 [0,56–3,22]	
Aphasia					
Yes	8	8	25.8%	1.19 [0,21–2,36]	0.283
No	18	18	24.7%	0.99 [0,18–1,99]	
Arterial territory					
Carotid	78	24	30.7%	2.55 [1,51–4,36]	0.003
Vertebrobasilar	21	2	9.5%	0.83 [0.35 to,98]	
Multivariate analysis					
Age				1	–
< 45 ans					
≥ 45 ans	97	25	25.8%	1.43 [1,26–2,14]	0.03

* Significant results.

Boughammoura in Tunisia in 2012 [8] who noted an average consultation waiting time estimated respectively at 61 h and 54.4 h after onset of first symptoms. However, in France in 2007 Tardy et al. in Toulouse Purpan hospital recorded an average consultation waiting time of 40 mn and 2 h 25mn as door-to-balloon time, thrombolytic therapy included, after onset of first symptoms [9]. This proves the existence of efficient treatment for stroke patients. In developed countries, the organization of stroke management mechanism allows the medical team to reach patients' bedside either by intensive care ambulance or helicopter for distances beyond 15 km, whereas such is not the case in our nations where patients are transported by road via inappropriate vehicles such as two-wheeled motorcycles. Onc the onc hand, delayed stroke patients treatment in the developing countries is due to lack of information (belief in supernatural cause i.e. spell cast) and on the other hand lack of population awareness on the severity and extreme emergency and then signs and symptoms suggestive of stroke. Much more education and awareness should be carried to raise the level of knowledge and develop the populations reflex to immediately report to the hospital in the event of stroke occurrence.

The incidence of embolic heart diseases was 26%. They represented over one quarter of ischemic stroke etiologies. However, the poor diagnostic methods utilized in our study account for this low incidence of embolic heart diseases compared with studies carried out in developed countries. In fact, Vinsonneau et al. [10] estimated an incidence of 52%. This higher incidence is out of the result of systematically coupling TTE with TOE in the etiological assessment of ischemic stroke. In Germany, Knebel et al. [11] who assessed the incidence of embolic heart diseases at 52.6% between 1996 and 2000 used the same diagnostic tools. The profitability and performance of coupling TTE with TOE in the diagnosis of embolic heart diseases is established, because several studies revealed 12.5 to 30% increase in the number of embolic heart diseases after transesophageal echocardiography among patients who have already taken transthoracic echocardiogram [12]. Unfortunately, transesophageal echocardiography is not available in Benin.

Over 2/3 of embolic heart diseases in our series were represented by atrial fibrillation (69%). Atrial fibrillation can cause stroke through both thrombotic embolism and cerebral hypo-perfusion in the event of hypotension with fast ventricular response [13]. In our series, 15.8% of ECG abnormalities were revealed. These anomalies were predominantly AF in 13.7% cases followed by ischemic heart disease in 2.1% of cases. Systematic Holter ECG made it possible to diagnose 5 additional cases of paroxysmal atrial fibrillation in patients who previously had normal ECG. In 2012, Lazzaro et al. showed that it was challenging to highlight atrial fibrillation on ECG record especially when it is ephemeral and asymptomatic [14]. In 2010, Ferro et al. indicated that the increased duration and the repetitive records could improve the chance of diagnosing a paroxysmal rhythm disorder [15]. Our findings are similar to those of Liao et al. who noted in 2007 a supplementary 5% rate of AF detected through Holter in comparison with ECG [16]. Conversely, in 2012 Bendriss et al. recorded the same rate for Holter and ECG [17]. Despite the lack of consensus on duration, the recording method and the ideal time to detect a paroxysmal rhythm disorder, it is obvious that Holter remains a simple, non-invasive and very profitable way in the diagnosis of paroxysmal AF in either acute phase or mid-term stage. Due to its non-invasive nature and high diagnostic performance, cardiac ultrasound examination is a key tool to confirm cardio-embolic etiology [18]. Heart valve diseases including mitral valve stenosis and calcified aortic stenosis represented only 3.5% in our series. In Togo, heart valve diseases represented 10.99% [19]. We can assume that the lack of transesophageal echocardiography in our context, led us to deflect from some anomalies. In fact, ASA was recorded up to 1.2% and no cases of patent foramen ovale was observed. However, Gaspar et al. after performing TOE found ASA and a PFO among 36.7% of patients [20]. Although ischemic stroke increases with the aging of the population [21], it appears that embolic heart diseases occur at any age. This assertion will be corroborated by the study of Damorou where embolic heart diseases are found in both the young and the elderly with extremes values of 29 and 92 years [19]. In our series, embolic heart diseases were associated with age ($p = 0.03$) and patients aged above 45 years were 1.43 times more exposed to embolic heart diseases than those aged below 45 years. Our data are comparable to those reported by the literature. Indeed, in France in 2011, MURESAN et al. noted that the risk of ischemic stroke induced by embolic heart disease varies significantly with age ($p < 0.01$), from 1.5% between 50 and 59 years to 23.5% between 80 and 89 years [22]. It is also the case with Mofou et al. in 2012 in Togo [23], Vogel et al. [24] who showed that ischemic stroke induced by cardio embolism occur particularly in the elderly population. This situation suggests that the elderly are more exposed to thromboembolic events and highlights the need to systematically examine it among the elderly for the purpose of prevention. However, in 2011 Napon et al. in their study conducted in CHU of Yalgado in Burkina Faso noted a cardio embolic origin dominated by AF as ischemic stroke etiology in a population aged 15 to 45 years, suggesting that cardio embolic stroke is not specific to the elderly [25].

5. Conclusion

Ischemic stroke is the first cause of adulthood acquired disability and the third cause of mortality after cancer. It is a multifactor-based pathology. The cardio embolic origin of ischemic stroke is common in our context and represents 26% of etiologies. If we consider the absence of transthoracic ultrasound which is accessible in common practice, this incidence would be under-reported. It is obvious that cardiac examination is essential for the etiologic investigation of ischemic stroke. Enhancement of technical facilities could improve early detection and support for heart diseases, thus reduce the incidence of ischemic stroke.

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