

Epidemiology and clinical characteristics of lacunar ischemic stroke in Burkina Faso

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Abstract

Background: Lacunar stroke is a common occlusive stroke with significant morbidity and mortality. The objective of this study was to determine the prevalence and risk factors of lacunar stroke in patients admitted to the neurology department of Yalgado Ouedraogo University Hospital.

Patients and methods: This cross-sectional study was carried out in stroke patients admitted to the neurology department from January 1, 2018, to December 31, 2020.

Results: Lacunar stroke accounted for 30.6% of all ischemic strokes. The mean age of lacunar stroke patients was 61.59 ± 14 years ranging from 28 to 90 years. The most prevalent vascular risk factors were hypertension (90.3%), diabetes mellitus (34.9%) and smoking (13.6%). Neurological examination revealed pure motor deficit (99%), aphasia (54.4%) and pure sensory disorders (21.35%). Seventy patients (68%) had a NIHSS score ≤ 15 . On brain CT, the main localizations of lesion were the internal capsule (39.8%), the cerebellum (18.4%) and the lenticular nucleus (10.7%). Multiple localization was found in 58.2% of patients. The number of lacunae per patient was 2.86. A cardio-embolism source was found in 35.9% of patients. Carotid stenosis $\geq 50\%$ was present in 10.7% of patients. Rankin score ≤ 2 in 27.2% of patients. The death rate was 5.8%. Length of stay ≤ 7 days was observed in 45.6% of patients. Factors associated with lacunar stroke were age ($p = 0, 01415$), hypertension ($p = 0.0012$) and diabetes mellitus ($p = 0.0027$).

Conclusion: Lacunar stroke accounting for a quarter of all ischemic strokes. Hypertension, age, and diabetes have been the most frequently associated risk factors.

Keywords: Lacunar ischemic stroke, Neuroimaging, Associated risk factors, Burkina Faso

Introduction

Stroke is the most common cause of disability and the number two cause of death worldwide [1,2]. The TOAST classification denotes five subtypes of ischemic stroke, large-artery atherosclerosis, cardioembolism, small-vessel occlusion, stroke of other determined etiology and stroke of undetermined etiology [3]. Lacunar strokes are not isolated cerebrovascular events, but often represent the tip of the iceberg of a systemic disease affecting the microcirculation, defined as small vessel disease (SVD), which is considered to be the second cause of dementia, as well as the cause of other severe neuropsychiatric disorders, extrapyramidal symptoms, and frailty in the elderly [4]. Lacunes infarction accounts about 20-35% of all ischemic strokes [5,6]. It refers to a small cortical infarction located in the internal capsule, basal ganglia, corona radiata, thalamus or brainstem, which is caused by the occlusion of a perforating artery [7]. On the basis of neuroimaging, lacunar infarcts are generally defined as a round or ovoid subcortical cavity measuring 3 to 15 mm in diameter [8]. Most lacunar infarcts result from small artery occlusion, but large artery atherosclerosis and cardiac embolism may also be involved [9-11]. However, about 20% of patients who had a lacunar stroke will present a recurrent cerebrovascular event, 25% will not survive, and 30% will have some degree of functional dependence at five-year follow-up [12]. Lacunar infarcts present a paradoxical course with a favorable short-term prognosis, characterized by low early mortality and reduced functional disability [8]. In

Africa, despite the fact that the most common aetiological subtype of ischaemic stroke is small vessel disease (SVD) [13,14], there are few data concerning lacunar ischemic stroke. In Burkina Faso, the most common causes of ischemic stroke were large vessel diseases, and no lacunar ischemic strokes were less. The aims of the study were to determine the prevalence of lacunar stroke among ischemic stroke and identify its associated factors in the african setting.

Patients and Methods

Study area

This study was carried out in the neurology department of the Yalagado Ouedraogo University Teaching Hospital in Ouagadougou (Burkina Fas).

Type of study

This cross sectional study was conducted on data of stroke patients admitted during the period from January 1st, 2018 to December 31st, 2020.

Inclusion criteria

All patients hospitalized for ischemic stroke confirmed by brain CT in the neurology department of Yalgado Ouedraogo University Hospital from 2018 to 2020 were included in the study.

Sample size determination

Our recruitment was non-random with systematic selection of patients with stroke during the study period.

Non-inclusion criteria

Patients who did not receive confirmatory imaging for ischemic stroke and whose hospitalization records were incomplete and unusable.

Data collection methods and sources

The data collected was recorded on a microcomputer and then analyzed using Epi info software in its French version 7.2.2.16. Quantitative variables were expressed by their mean $\pm$ 0 standard deviation and qualitative variables by number and percentage. The chi-square test was used to compare qualitative variables for counts $\geq$ 5. For counts < 5, we used Fisher's exact test. Student's t-test was used to compare quantitative variables. The test was significant if p-value <0.05.

Study variables

The study variables consisted of sociodemographic data (age, sex, residence, level of education), clinical data (time of admission to the department, reason for consultation, mode of installation, personal and family risk factors for stroke, physiological constants, neurological abnormalities on examination), para-clinical data (cerebral CT scan would specify : nature of lesion (lacuna or other), location and number of lesions; electrocardiogram, cardiac ultrasound, ultrasound of supra-aortic trunks, biological tests, blood count, glycemia, creatininemia, lipid profile, 24 h proteinuria, etiologies: atheromatous, cardio-embolism, carotid dissection) and therapeutic and evolutionary data (drug treatment: anti-hypertensive, anti-oedematous, anti-coagulant, anti-aggregant, statins, solutions, antibiotics, functional rehabilitation) and (types of complication during hospitalization: acute lung oedema, pulmonary embolism, urinary tract infection, bronchopneumonia,

bedsores, decompensation of disorders, cognitive disorders; mode of discharge: exeat, transfer to another department, discharge against medical advice, deceased, escaped; length of stay).

Data collection and analysis

Data entry and analysis were carried out on a microcomputer using Epi-info software version 7.1.5. For the descriptive aspects of the analysis, frequency distributions were generated for all variables and the mean for quantitative variables. The Student's t-test was used to compare means when variances were homogeneous (parametric test), and the Kruskal Wallis test for non-homogeneous variances (non-parametric test). The chi-square test or Fischer's exact test (theoretical numbers less than 5) was used to compare the proportions of categorical variables. The p-value is significant when it is less than 0.05.

Ethical approval

We had the authorization of the Ethics Committee of the Joseph Ki Zerbo University School of Medicine and of Yalgado Ouedraogo University.

Results

Lacunar stroke frequency

From January 1, 2018 to December 31, 2020, 337 patients were hospitalized in the neurology department for stroke for ischemic stroke. Of these, lacunar ischemic stroke was identified in 103 patients (30.6%).

Sociodemographic characteristics

The study focused on 57 males (55.3%) and 46 females (44.7%). The mean age of the patients was 61.59 ± 14 years, with extremes of 28 and 90 years. It was respectively 61.35 ± 13.04 years in men and 61.89 ± 11.71 years in women. **Table 1** gives the sociodemographic characteristics of patients with lacunar stroke.

Clinical characteristics

The most common vascular risk factors were hypertension (90.3%), diabetes mellitus (34.9%) and smoking (13.6%). The mean admission time was 05 ± 11.6 days, with extremes ranging from 23 hours to 20 days. Six (5.8%) patients were admitted after a delay of 24 hours. On admission, six (4 %) patients had disturbed consciousness with GSC < 10, 13 (12.6%) hyperthermia ($> 38.5^{\circ}\text{C}$) and 82 patients (79.6%) had elevated blood pressure. The mean systolic blood pressure was 156.16 mm Hg and the mean diastolic blood pressure was 90.25mm Hg. The most lacunar syndrome were motor hemiparesis in 84 (81.5%), pure sensory disorders in 22 (21.3%) and dysarthria in 7 (6.8%). Seventy patients (68 %) had an NIHSS score $\leq$ 15. Cognitive impairment occurred in 5 patients (4.5%). **Table 2** presents the vascular risk factors and clinical characteristics of lacunar stroke.

Investigations

All patients had CT scans done. The lesions of lacunae were most commonly located in the internal capsular (39.8%), cerebellum (18.4%), and lenticular nucleus (10.7%). Lobar lesions were seen in 23 (22.3%) patients. Multiple lesions were observed among 60 (58.2%) patients. The lesion count was 2.86 per person, with extremes between 1 and 4. The majority of patients (90.3%) had a number of lesions $\leq$ 3. **Table 3** gives the distribution of patients

Table 1. Sociodemographic characteristics of patients with lacunar ischemic stroke.		
Parameter	Study population (N=103)	Percentage
Age (years)		
>30	1	1
30-39	4	3.9
40-49	12	11.6
50-59	20	19.4
60-69	38	36.9
≥ 70	28	27.2
Sex		
Male	57	55.3
Female	46	44.7
Residence		
Urban	56	54.9
Rural	46	45.1
Educational level		
No	87	84.5
Primary	10	9.7
Secondary	6	5.8
Occupation		
Housewife	34	33
Farmer	45	43.7
Merchant	19	18.4
Driver	4	3.9
Official	1	1

Table 2. Vascular risk factors and clinical characteristics of lacunar stroke.		
Variable	Study population (N=103)	Percentage
Vascular risk factor		
Hypertension	99	96.1
Diabetes mellitus	36	34.9
Tobacco	14	13.6
Sedentary	09	08.7
Alcohol	04	03.9
Obesity	04	03.9
Clinical characteristics		
Pure hemiparesis	84	81.5
Pure hemiparesthesias	22	21.3
Memory disorders	11	
Dysarthria	7	6.8
Apraxia	1	1

Table 3. Distribution of patients according to CT scan lesions.		
Variable	Number (N= 103)	Percentage
Lacunar lesions		
Internal capsule	60	58.2
Lobar	22	21.3
Cerebellum	19	18.4
Lenticular	11	10.7
Thalamus	08	7.8
Brainstem	05	4.8
Number of lesions		
01	43	41.7
02	18	17.7
03	32	31.1
04	10	9.7
Associated brain injury		
Cortico-subcortical atrophy	48	46.6
Cortical atrophy	33	32
Periventricular leukoencephalopathy	17	16.5

according to CT scan lesions. Electrocardiogram, holter ECG and TT cardiac Doppler were performed respectively in 99% (n=102), 28.1% (n=29) and 94.2% of patients (n=97). A potential source of cardioembolism was observed in 37 patients (35.9%), including recent myocardial infarction (7.84%), atrial fibrillation (3.9%), intracavitary thrombus (20.4%) and dilated cardiomyopathy (3.9 %). Carotid disease has been reported in 41 (39.8%) patients. Cervical Doppler (n=84) had found a mobile plaque in 34 (40.5%), diffuse intimal infiltrate in 32(38.1%) and carotid stenosis $\geq$ 50% in 11 (10.7%) patients.

Treatment and clinical outcome

Antiplatelet agents (81.5%), statins (37.9%) and OAC (14.6%) were the drugs used. Functional motor rehabilitation was conducted

in 59 (57.3%) inpatients. The mean duration of hospitalization was 8.46 days. The length of stay was <7 days in 47 (45.6%), between 7-14 days in 39 (37.9%) and >14 days in 17 (16.50%). In the hospital outcome, 7 (6.80%) patients had urinary tract infections, 16 (15.5 %) had respiratory infections, and 46 (44.7 %) had pressure sores. The mean mRS was 3.44. Twenty eight patients (27.2%) had a modified Rankin score $\leq$ 2. Six patients (5.8%) died during hospital course. **Table 4** gives the factors associated with lacunar stroke.

Discussion

In this study, the prevalence of lacunar ischemic stroke was up to 30% of all ischemic strokes in line with few studies in Africa by Diagana in Mauritania [15] and Tshikwela in Congo RDC [16]. It was also similar to several studies carried out in Africa [17-21]. In

Table 4. Factors associated with lacunar ischemic stroke.			
Variable	Study population		p-value
	Lacunar	not lacunar	
Age (years)			
>60	95	73	0.01415
<60	7	30	
Gender			
Male	57	55	0.4200
Women	46	48	
Residence			
Urban	57	42	0.1223
Rural	46	61	

Vascular risk factors			
Hypertension	93	43	0.0012
Sedentary	36	06	0.1053
Diabetes mellitus	14	03	0.0027
Smoking	12	15	0.2724
Alcoholism	4	11	0.1103
Obesity	4	7	0.1875
Contraception	0	3	0.0610
HIV infection	0	1	1.0049
Hemoglobinopathy	0	1...	1.0049
NIHSS			
<15	37	29	1.8715
≥15	66	74	
Mortality	6	8	0.392
mRS			
≤ 2	05	09	1.0195
>2	98	94	

contrast, lower prevalences were observed in Madagascar (20.3%) [22], South Africa (23%) of lacunar infarcts in Rural South Africa [23], Senegal (20%) [24], England (27%) [25], Germany (25.8%) [26], France (26.8%) [27], Italy (24%) [28], Indonesia (26.7%) [29], Iran (22.5%) [30], China (29.48% and 28.6 %) [31,32]. The differences between the studies could be explained by the characteristics of sample, type of stroke (first-time and recurrent strokes), imaging methods (only CT scan or cerebral IRM). For example, in the Middle East, the estimated prevalence of LS ranged from 8.9-59.7% among acute ischemic stroke subtypes [33]. According to sociodemographic characteristics, the mean age of patients was under 70 years (61.59 ± 14 years) and quite similar to those observed by Tao (61 years) [34], Mohamed (61 years) [17], Radhika et al. (60.8 years) [35], Valdés et al. (59.74 years) [36], and Wassermann (64 years) [23] and Chung-Fen et al. in China (67.8 years) [37], (65 ± 13 years) [38]. It was lower than those observed by Hajat et al. in England (71.4 years) [25]. These differences were particularly due to the life expectancy in these countries. Male predominance is constant in several studies [31,32,36] except the study of Bejot in France which found female predominance [21]. According to one study in Nigeria, lacunar stroke was more frequent in men than in women [39]. Hypertension was the most prevalent vascular risk factor in our study (90.3%), as in several studies [40-42]. Early neurological deterioration occurred in few patients (3.96%), in comparison with the littérature (20-30%) [43]. The most lacunar syndrome was motor hemiparesis in 81.5% before pure sensory disorders (21.3%) and dysarthria (6.8%). Regarding the initial severity of stroke, the majority of patients (67.96%) had an NIHSS score ≤ 15 , in line with the studies of Fan et al. [44] in Beijing in 2018, who found that minor strokes were predominantly represented in 84.50%. Cognitive disorders, a complication of lacunar stroke was seen in 4.5% of patients. The most common lesion of lacunar ischemic stroke was located in internal capsule (58.6 %), in contrast with brain MRI or CT scanning studies which showed

that the lesions of LACI were mainly located in the basal ganglia area (72.7%) [45]. Multiple lesions were prevalent in 58.2% of patients, lower than in the studies of Li (73.2%) [46]. Potential cardioembolic source were observed in 35.9% of patients, in line with the study of Tan who found that 25% of patients with clinical radiologically defined lacunas had a potential cardiac cause for their strokes [47]. A previous study has shown that 36% of patients presenting with clinical and radiographic evidence of lacunar infarction had a potential non-SAD etiology [38]. In this study, the cause of lacunar stroke was carotid disease in 39.8% of patients. Mead et al. suggested that carotid stenosis in patients with lacunar infarction might be an incidental finding [48]. However, other studies have shown that intracranial artery stenosis might be associated with lacunar infarction [6,49]. The 30 day mortality rate was 5.82%, comparable to the study of Sacco (4.3%) [20], and Pablo (5.1%) [50] but higher than the study of Strautmane (0.5%) [51] and those of Bejot (3.8%) [21]. The mean case fatality was 2.5% (range, 0% to 10%) at 30 days [12] and under 2% [52]. The median Rankin score between 2 and 3 (moderate and moderately severe disability) was found for the majority of patients. However, Iria et al. [42] in Spain, in a study of retinal vascularization and lacunar stroke, found a Rankin score of 0 as the median. Our study identified three factors associated with ischemic lacunar stroke: age, hypertension, and diabetes. However, we observed 16.5% in subjects under 50. Pu et al. [32] in China in 2016, and Tshikwela et al. [16], also found a significant association between lacunae and elderly subjects. Our results diverge from those of Chen et al. in 2009, who did not find a significant association between age and the occurrence of ischemic lacunar stroke [53].

This discrepancy could be explained by the diversity of our study populations. In our series, hypertension was the most important modifiable risk factor for cerebral arteries. Along with age and diabetes, it was the main factor associated with the occurrence of deficiencies according to the literature. We found a significant association in our study. Pu et al. in 2016 [32], Chen et al. in

2009 [53] also found a significant link between hypertension and lacunae. Jickling et al. in 2011, on the other hand, did not find a significant association between atrial hypertension and lacunae [54]. This difference could be explained by the fact that the majority of our patients had a low socio-economic level. Diabetes was an associated factor in our study. According to the literature, diabetes is associated with the occurrence of the three main subtypes of cerebral infarction: lacunar infarcts occurring as part of small artery disease, infarcts of cardioembolic and atherothrombotic origin. Ohira et al. [55] suggest that diabetes, by contributing to the development of the lipohyalinosis involved in small artery disease, is particularly associated with lacunar infarcts. Other studies, such as Béjot et al. [56] and Schulz et al. [57], found no such association. Apart from classic factors such as age, hypertension, and diabetes, which were the main factors associated with the occurrence of lacunar stroke, other factors have been reported by certain authors as being major determinants in the occurrence of lacunar stroke. Indeed, Mohammed et al. [17], Jickling et al. [54] found a significant association between lacunae and ischemic heart disease; lacunae and smoking [53].

Study limitations

This cross-sectional hospital based study had some limitations due to the incompleteness of certain data (patient histories, biological tests and data on disease progression). The major advantage of our study is the continuous and well-defined ascertainment from 1989 to 2006 in a small population and the collaboration of numerous investigators from all fields of patient management, which ensured the exhaustiveness of case ascertainment.

Conclusion

Lacunar stroke accounts for a quarter of all ischemic strokes. Hypertension, age, and diabetes have been the most frequently associated risk factors.

List of Abbreviations

AH: Atrial Hypertension; CT: Cranial Tomography; LACI: Lacunar Ischemic Stroke; MRI: Magnetic Resonance Imaging; NIHSS: National Institutes of Health Stroke Scale Score; SAD: Small Arterial Disease; SVD: Small Vessel Diseases; TOAST: Trial of Org 10172 in Acute Stroke Therapy

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Authors' Contributions

Dr. Alfred Anselme Dabilgou, Dr. Alassane Dravé, Dr. Julie Marie Adeline Wendlamita Kyelem, Dr. Bayima Célestin Boro, Pr Christian Napon, Pr Athanase Millogo, Pr Jean Kaboré. All listed authors have made a significant scientific contribution to the research in the manuscript approved its claims and agreed to be an author.

Declarations

Informed consent of participants

Not applicable.

Publication consent of participants

Not applicable.

Consent for publication

All authors of the manuscript have read and agreed to its and are accountable for all aspects of the accuracy and integrity of the manuscript in accordance with ICMJE criteria.

Competing interests

The authors declared no conflict of interest.

Availability of supporting data

The data are available from the corresponding author.

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