Ischemic and Hemorrhagic Strokes in Dakar, Senegal
A Hospital-Based Study

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Background and Purpose—Basic stroke features are hardly known in sub-Saharan countries, and no data are available in Senegal.

Methods—We performed a retrospective hospital-based study in Dakar, Senegal, to assess risk factors and etiology of stroke. Patients were recruited from January 1, 2003, to July 31, 2004, at the Hôpital Principal, Dakar. Strokes had to be ascertained by computed tomography.

Results—A total of 107 patients were studied. Seventy percent of strokes were of ischemic nature. For ischemic strokes, mean age was 64.2 years. Hypertension was the main risk factor, occurring in 68%, and diabetes was encountered in 37.3%. Lacunar strokes and cardioembolism accounted for 20% and 13.3%, respectively. Because of the lack of systematic investigations, two thirds of strokes were of undetermined origin. Mortality within 1 month was 38%. For hemorrhagic strokes, mean age was 51 years and 1 month mortality was 56%.

Conclusion—Hypertension is the main risk factor for both ischemic and hemorrhagic strokes in this hospital-based study.

Key Words: Africa, Western ■ risk factors ■ stroke

Although stroke is now a major public health problem in developed countries, being the second commonest cause of mortality worldwide in 1990,1 its importance in developing countries has only been highlighted recently. Very few data about stroke are available in sub-Saharan Africa (SSA).2 Half of the studies, including the 2 population-based ones, are based solely on clinical inclusion criteria.3–8

In SSA, age of onset is younger,5,9 case fatality rate is higher,8,10 and hemorrhagic strokes are commoner.11–13

In Senegal, a country in Western SSA, no data are available about key features of stroke such as incidence, prevalence, and mortality or stroke subtypes.

The study took place at the Hôpital Principal of Dakar, 1 of the 2 public hospitals of Dakar to be fitted with computed tomography (CT) scanners, the other being the Fann Hospital.

To describe risk factors and stroke subtypes in Senegal, and to compare the results with the ones of other sub-Saharan countries, we undertook a retrospective hospital-based study in Dakar, the capital of Senegal.

Subjects and Methods

We studied retrospectively any stroke patients hospitalized between January 1, 2003, and July 31, 2004, at the Hôpital Principal, Dakar, Senegal. Stroke was defined in accordance with the World Health Organization as “rapidly developing clinical signs of focal, or at times, global disturbance of cerebral function, lasting more than 24 hours or leading to death with no apparent cause other than vascular origin.”14 Thus, transient ischemic attack was discarded.

To differentiate between ischemic and hemorrhagic strokes, and to rule out differential diagnosis such as tumor, subdural hematoma, or subarachnoid hemorrhage, brain imaging was mandatory. Our hospital is fitted with 2 CT scanners, the last having been installed in September 2003. From this date, CT scans were performed on both scanners.

Registers from all medical wards of the hospital and that of the intensive care unit were screened. Age, sex, date of admission, and clinical outcome at discharge were recorded. Stroke risk factors were examined, including diabetes mellitus, hypertension, current or past history of smoking, hypercholesterolemia, and atrial fibrillation. Diabetes mellitus was defined as fasting glucose level >7 mmol/L or plasma glucose >11 mmol/L at any time of day.15 Hypertension was ascertained as known blood pressure >160/90 before admission. Patients were defined as current smokers or nonsmokers. Hypercholesterolemia was ascertained by cholesterol concentration >6.5 mmol/L. Atrial fibrillation was defined as evidence of cardiac arrhythmia by atrial fibrillation on ECG. History of previous stroke was also recorded on the basis of self and family reporting.

Causes of ischemic strokes were determined according to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification.16
Briefly, 5 categories were described: (1) large artery atherosclerosis, when there was a stenosis >50% or occlusion of a major brain artery presumably attributable to atherosclerosis; (2) cardioembolic infarcts, where cardio sources included evidence of atrial fibrillation, recent (<3 months) myocardial infarction, and infective endocarditis, defined as valvular lesions on echocardiogram and positive blood cultures; (3) lacunar infarcts, when the patient had a history of hypertension or diabetes mellitus with a clinical lacunar syndrome and an ischemic lesion not >15 mm or a normal CT and no other cause of infarct, for example, significant stenosis or atrial fibrillation; (4) other determined etiology; and (5) undetermined etiology, in cases of incomplete evaluation. To assign etiology, all imaging and radiological data were used.

In SSA, CT is far from being widely available. Requiring brain imaging in the inclusion criteria increases the validity of data about stroke but may result in creating an inclusion bias. To estimate this bias, we recorded for 2 months any patient who presented at the emergency ward with a presumed stroke, and compared patients who had CT and were subsequently hospitalized to the ones who did not have a CT and were discharged.

Statistical analysis was performed with Epi Info v6.2.2 software package (Centers for Disease Control). Comparison of 2 categorical variables was performed using the \( \chi^2 \) test. Quantitative variables were analyzed using the Student Fisher test or the Mann–Whitney test in case of inequality of variances. One-month mortality rates were calculated by the Kaplan–Meier method and compared with the log rank test.

**Results**

We identified 192 stroke patients. Eighty-five patients were ruled out for missing medical records \((n=34)\), CT not performed \((n=27)\), and error in diagnosis \((n=24)\), consisting in transient ischemic attack \((n=4)\), hydrocephalus \((n=2)\), cerebral venous thrombophlebitis \((n=2)\), subarachnoid hemorrhage \((n=2)\), subdural hematoma \((n=2)\), Todd’s paresis after seizures \((n=2)\), and non-neurological disease \((n=10)\). Thus, 1 patient of 6 with symptoms suggestive of stroke did not undergo CT \((27/158)\).

For 2 months, 20 patients presented at the emergency unit with symptoms suggestive of stroke. Half of them were not hospitalized and were discharged the same day, with a follow-up appointment to see a cardiologist without undergoing CT. There was no age difference between hospitalized and nonhospitalized patients \(\text{mean age } 61.4 \text{ versus } 58.4 \text{ years} \). Women were less likely to be hospitalized than men, but the difference was not significant \((\text{male to female ratio } 0.25 \text{ versus } 1.5; P=0.08)\).

Complete data were available for 107 patients: 75 ischemic strokes and 32 hemorrhagic strokes. There were 61 men and 46 women. For all strokes, mean age was 60.4 years \(\text{median 63 years} \). Mean age for ischemic strokes was 64.2 years \(\text{median 65, range 17 to 88} \), without a significant male–female difference. Mean age for hemorrhagic strokes was 51 years \(\text{median 50, range 26 to 84} \), without a significant male–female difference. Hemorrhagic patients were significantly younger than ischemic ones \(P=0.0001)\).

Median time between the onset of symptoms and hospitalization was 2 days \(0 \text{ to } 45 \text{ days} \). Time of brain imaging was reported for 51 patients: 65% of them underwent CT the day of admission, and 82% of them within 72 hours. Only 1 patient had CT >2 weeks after the onset of stroke.

**TABLE 1. Risk Factors for Ischemic and Hemorrhagic Strokes**

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Ischemic Strokes ((n=75))</th>
<th>Hemorrhagic Strokes ((n=32))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>51 68</td>
<td>14 43.7</td>
</tr>
<tr>
<td>Untreated</td>
<td>21 41.2*</td>
<td>8 57*</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>28 37.3</td>
<td>7 22</td>
</tr>
<tr>
<td>Smoking</td>
<td>10 13.3</td>
<td>NA</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>11 14.7</td>
<td>0</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>5 6.7</td>
<td>0</td>
</tr>
</tbody>
</table>

NA indicates not available.

*Out of the No. of hypertensive patients.

**Ischemic Strokes**

There were 75 patients, 43 men and 32 women, with a male to female ratio of 0.74. Three strokes occurred among inpatients. Median length of hospital stay was 8 days \(\text{range 1 to 56 days} \). Risk factors are summarized in Table 1. Twelve patients \(16\% \) had experienced a previous stroke. Hypertension was the main risk factor, occurring in 68% \(51 \text{ of } 75 \). Fourteen patients were treated, 21 discontinued their anti-hypertensive treatment, and no data were available for 16 of them. Therefore, 41% \(21 \text{ of } 51 \) of hypertensive patients discontinued their treatment before ischemic stroke.

Assessment of etiology was compromised by the lack of systematic cardiological examinations, most of the time for financial reasons; 43 patients underwent transthoracic echocardiogram \(\text{TTE} \), 13 ultrasound examination of carotid arteries \(\text{UECA} \), 6 ambulatory electrocardiographic monitoring, and 1 transesophagus echocardiography \(\text{TEE} \). Etiologies are summarized in Table 2. Ten patients \(13.3\% \) had cardioembolic infarcts; 1 of them had infective endocarditis with valvular lesions on echocardiogram and died 6 days after the onset of stroke. The other 9 patients had atrial fibrillation on ECG. Fifteen patients had lacunar strokes. Evidence of large artery disease was found in 1 patient who had a total obstruction of a carotid artery.

Etiology of stroke of the 49 remaining patients could not be ascertained, mainly because certain cardiological examinations were unavailable; only 11 had TTE and UECA, 2 underwent ambulatory electrocardiographic monitoring, and 1 had TEE. Hence, nearly two thirds of strokes were of “undetermined etiology.”

**TABLE 2. Etiology of Ischemic Strokes, According to the TOAST Classification**

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Ischemic Strokes ((n=75))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large artery disease</td>
<td>1 1.3</td>
</tr>
<tr>
<td>Lacunar strokes</td>
<td>15 20</td>
</tr>
<tr>
<td>Cardioembolism</td>
<td>10 13.3</td>
</tr>
<tr>
<td>Other strokes</td>
<td>0 0</td>
</tr>
<tr>
<td>Undetermined origin</td>
<td>49 65.3</td>
</tr>
</tbody>
</table>
Fourteen patients died before discharge: 13 within the first month, the last patient, 2 months after admission. Median time of death after the onset of stroke was 9 days. One-month mortality was 38%.

**Hemorrhagic Strokes**

There were 32 patients, 18 men and 14 women, with a female to male ratio of 0.78. Ten patients were >40 years of age. Time between onset of symptoms and hospitalization was 0 to 31 days. Risk factors are summarized in Table 1. Hypertension was the main risk factor, occurring in 43.7% of patients. A total of 57% of them did not receive any treatment.

Twelve patients died within the first month (median time 4 days; 1 to 30 days). Mortality within 1 month was 56%. There was a significant difference with 1-month ischemic stroke mortality (P=0.004). No arteriography was performed because of lack of equipment.

**Hypertension and Stroke**

Hypertension was the main risk factor for ischemic and hemorrhagic strokes, occurring respectively in 68% and 43.7% of patients, which is significantly different (P=0.02). For each type of stroke, noncompliance with medication occurred in 44.6% patients.

**Discussion**

We performed a retrospective hospital-based study to determine risk factors, etiology, and 1-month mortality of stroke in Dakar, Senegal. No previous data were available in this country.

Our results were hampered by 2 main biases. The first is an inclusion bias attributable to the hospital-based design of the study. As in the whole SSA, Senegal has no generalized social welfare, and medical care is not free except for employees of large companies or state employees. This meant that the majority of the patients encountered came from an urban population who could afford hospitalization. Risk factors, etiology, and 1-month mortality may differ from a rural population and from a population that could not afford hospitalization. In our study, half of the patients presenting to the emergency ward were discharged the same day without having undergone a CT scan, and 16.7% of patients could not afford to undergo CT. Although not significant, there is a trend for women to be hospitalized less often than men. In Nouakchott, Mauritania, only 58% of patients presenting with presumed stroke could afford CT.10

The second bias was also attributable to the retrospective design of the study. We faced missing medical examinations and missing data because TTEs or UECAs were not performed systematically and might have accounted for the high proportion of strokes of undetermined etiology. Thus, we share Bonita and Truelsen’s point of view: “The choice is therefore to accept hospital data or have no data at all.”17

In our study, CT scan was mandatory in the inclusion criteria. We believed that brain imaging helped us with a better assessment of stroke. Clinical scales such as the Guys’ Hospital Stroke score or the Siriraj Hospital Stroke score lack sufficient validity to differentiate hemorrhagic from ischemic strokes.18 Therefore, brain imaging was mandatory to assess diagnosis and rule out what was not stroke. Clinical diagnosis of stroke was erroneous in 17%, which is higher than other reported rates, from 3.99% to 7%.9,11 However, systematic brain imaging is impossible because of the shortage of CT scans and generalized social welfare, respectively, and should not be recommended in routine management of stroke in SSA.

A total of 70% of strokes were of ischemic nature. This result was in accordance with comparable studies, with ischemic strokes ranging from 63.3% of all strokes in Zimbabwe,9 to 84.7% in Libya.19 Conversely, hemorrhagic strokes were more frequently reported in other studies, making up >60% of all strokes in 2 hospital-based studies, in Ghana11 and Tanzania.12

Mean age was 60.4 years for all strokes in our study, 58 years in Gambia,3 but 52 years in 2 other studies.5,9 Mean age for hemorrhagic strokes was 51 years compared with the mean age of 49 years in Zimbabwe9 and 56 years in Mauritania.10

One-month mortality for ischemic or hemorrhagic strokes is higher than those reported by Walker et al or Diagana et al,3,10 with 27% and 29.3%, respectively, but this unrefined data that do not take into account cases lost to follow-up. Our data are in range of case fatality within 1 month of stroke onset in meta-analysis, which is 22.9%.2

Diabetes mellitus was the second risk factor in our study, occurring in 37.3%, and was reported in 3.2% to 27.1% in other studies.5,9,12,13 This discrepancy could be explained by an inclusion bias or by differences in risk factor exposure in Mauritania, where, with the same bias, diabetes occurred in 8%.10

Hypertension is the main risk factor, encountered in 32.3% to 68% of ischemic strokes and in 44% to 93.1% of hemorrhagic strokes.9,10,12 When the type of stroke was not defined, hypertension occurred in 48% to 71%,5,8,19 with the exception of a Ghanaian study in which it was 9.1%.13 In this study, the design was retrospective and it was a radiological serial. It is possible that the risk factors were not reported properly.

Why is stroke so associated with hypertension? Several hypotheses can be proposed: compliance with long-term treatment is difficult to achieve because uncomplicated hypertension is usually symptomless, treatment is costly, and denial of the illness is common. In this last case, to be freed from treatment means to be healed, which is achieved as soon as patients feel well. In our study, 44.6% of hypertensive patients did not take their treatment. This bears striking similarity with the proportion (44.9%) found in Harare, Zimbabwe.9

Although hypertension is not taken into account as a major public health problem, stroke will remain the price to pay. Reducing salt intake is part of the solution because it has proved to reduce blood pressure.20 Low-cost treatments should be made widely available. Most of all, efforts should be focused on conceptualization of health and illness so that patients continue to take their medicine in a preventive as well as a curative perspective.
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References
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