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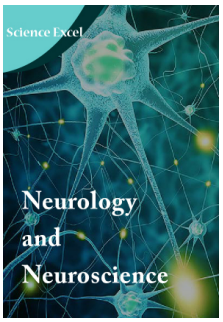

Factors Associated With Stroke Mortality in an Urban-Rural Environment: The Case of the MONKOLE Hospital Centre

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Abstract

Background: Stroke is a fatal disease, and knowledge of the factors associated with this mortality in different environments is necessary in order to take appropriate action. This article presents data from a hospital located in an urban-rural setting in Kinshasa: The Monkole hospital centre.

Methods: This is a cross-sectional study conducted at Monkole hospital Centre from 01/01/2020 to 31/01/2023 in all patients with a confirmed diagnosis of stroke admitted to intensive care, emergency or internal medicine. Sociodemographic, clinical, paraclinical, therapeutic and outcome data were collected from hospital registers and patient records. Student's t, Anova, Chi-squared or Fischer's exact tests and logistic regression were performed with SPSS 25.0 with p less than 5%. Ethical principles were respected.

Results: Of 3,629 patients admitted during the study period, 148 (4%) were admitted for stroke. The mean age was 62.6 years and the predominant sex was male. 51.4% of patients were admitted from home, with the following comorbidities: arterial hypertension, diabetes mellitus and embolism-induced heart disease. Frequent reasons for consultation were: disturbed consciousness, increased blood pressure and convulsions. Frequent physical signs were: disturbed consciousness, increased blood pressure, neurological deficit and pupillary abnormalities. The average time to hospital was 13.6 ± 8.2 hours. The accident was ischaemic in 70.3% and haemorrhagic in 29.7%. Treatment was medical in 100% of cases, with no thrombolysis. Mortality was 11.5% and 36.5% of survivors had moderate to severe functional disability. Advanced age (OR 2.34, 95% CI 1.36-4.04), hypertension (OR 2.19, 95% CI 1.24-3.88) and low socio-economic status (OR 1.81, 95% CI 1.02-3.21) were associated with mortality.

Conclusion: Mortality in this series was 11.5%, associated with advanced age, hypertension and low socioeconomic status. Controlling blood pressure and improving living conditions could reduce this mortality.

Introduction

Stroke is a major cause of morbidity and mortality worldwide, including in the Democratic Republic of Congo (DRC). It is a global health problem, defined by the World Health Organisation (WHO) as the sudden onset of localised or global clinical signs of cerebral dysfunction, with symptoms lasting more than 24 hours, which can lead to death with no apparent cause other than a vascular origin [1].

In Western countries, stroke is the third leading cause of death after heart disease and cancer, the second leading cause of dementia and the leading cause of disability in adults [2]. It will become the second leading cause of death by 2020 [3]. In sub-Saharan Africa, stroke is also a major concern in terms of morbidity and mortality [4]. Stroke is the third leading cause of death and motor disability in the region's neurology centres [5], accounting for 45% of hospitalisations in neurology at the Fann University hospital centre in Dakar [6] and 32.9% of hospitalisations in the neurology department of the Campus University hospital centre in Lomé, Togo [7]. The WHO has emphasised that stroke and cardiovascular disease will be a major challenge for the healthcare systems of developing countries in the coming years [8]. It noted a high prevalence of premature death among young adults in these countries, with more than 30% of deaths occurring from stroke [9].

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Several poor prognostic factors have been identified in the literature. These include the type of stroke, the time of admission, cardiovascular risk factors, the patient's clinical condition, complications in the acute phase, the aetiological subtype, biological factors (hyperglycaemia, hyperleukocytosis, high CRP, hypercreatininemia) and other parameters such as the level of disability before the stroke and cognitive status [10-12].

In the Democratic Republic of Congo (DRC), Bugugu's study at the university clinics in Kinshasa found a case fatality rate of 21% for ischaemic stroke, with the associated factors of haemorrhagic infarction, subtentorial lesions and accelerated blood sedimentation rate [13].

At the Monkole hospital centre in 2018, the prevalence was 4.8%, with a mortality rate of 20% (14). A great deal of progress has been made in the management of stroke, and it would be useful to update the data to identify current mortality factors. We therefore conducted this study with the aim of determining the morbidity and mortality of stroke at the Monkole hospital centre, as well as the associated factors.

Methods

Type, setting and period of study

This is a cross-sectional documentary study covering the period from 01/01/2020 to 31/01/2023 conducted at the Monkole hospital centre. This is a secondary-level hospital, acting as the general referral hospital for the Mont Ngafula I urban-rural health zone in Kinshasa, and providing all medical and medico-technical services.

Study population and sampling

The study population included all patients admitted to Monkole Hospital centre with a confirmed diagnosis of stroke during the study period. Exhaustive register sampling was used. In order to perform valid statistical tests, we considered it appropriate to calculate the sample size using the SCHWARTZ formula:

$$N= (eZ^2\ pq) / i^2$$

N: sample size; e: cluster effect (2); i: precision (5%); Z: standard deviation (1.96) corresponding to the risk of error of 5; P: prevalence of stroke mortality = 4.8% (14); q: 1-p, 1-0.048 = 0.952; $N = (2(1.96)^2(0.048)(0.952))/0.05^2$ N= 140

With a risk of 5%, a precision of 5% and a p-value of 4.8% [14], this formula made it possible to set the minimum sample size at 140 patients.

All patients with a CT-confirmed diagnosis of stroke hospitalised in one of three departments (intensive care, emergency and internal medicine) were included in the study, and no patient was excluded.

Data collection

Data were collected from hospital admission registers and patients' medical records. The variables sought were:

- Demographic characteristics (age: according to date of last birthday; sex, socio-economic level according to ability to pay for care or not, divided into three categories: low, medium and high, marital status: single, married, widowed, divorced).
- Comorbidities.
- Time between onset of symptoms and admission to hospital
- Patient's place of origin (home, health centre or other hospital institution).
- Clinical characteristics: reason for consultation, Glasgow score, blood pressure, temperature, neurological deficit, pupils, oxygen saturation).
- Available paraclinical data, including at least a brain scan: diagnosis adopted and time taken to perform the scan.
- Therapeutic data: medical (thrombolysis, anticoagulants, antiplatelet agents), surgical, physiotherapy.
- Progression to hospital discharge: in-hospital mortality, presence of sequelae.

Statistical analysis

The data were entered into an Excel 2013 file. They were checked, coded and transferred to SPSS 25.6 for analysis. Quantitative variables were presented as mean and median and qualitative variables as frequency. Means were compared using Student's t-test or Anova, and proportions (frequencies) were compared using Chi-square or Fischer's exact test. Logistic regression was used to identify factors associated with morbidity and mortality. The strength of association between a factor and a complication was assessed by calculating odds ratios and their 95% confidence intervals. The p-value was set at less than 5%.

Ethical and regulatory aspects

The principles of anonymity and confidentiality were respected at all stages of data collection and analysis. Authorisations were obtained from Monkole hospital centre management. The local ethics committee had given its approval (reference: 006/CEFA-MONKOLE/CEL/2023). We have no conflict of interest in this work.

Results

Frequency of strokes

During the period from January 1, 2020 to January 31, 2023, 3629 patients were admitted to the 3 departments: emergency, internal medicine and intensive care, and 148 were admitted for a stroke, i.e. a hospital frequency of 4.07%.

Socio-demographic characteristics of patients

Table 1 shows the socio-demographic characteristics of the patients.

The mean age of the patients was 62.6 ± 13.5 years (range 25 to 96), 66 or 44.6% were aged under 60 and 82 or 55.4% were aged 60 and over. There were 93 men (62.8%) and 55 women (37.2%), with a M/F sex ratio of 1.69. There were 99 married people (66.9%), 26 single people (17.6%), 21 widowers (14.2%) and two divorced people (1.4%). The socio-economic level was average for 109 patients (73.6%), high for 25 patients (16.9%) and low for 14 patients (9.5%). There was no significant difference for any of these variables (p>0.05).

Patient anamnestic data

Table 2 presents the anamnestic data.

Patients came from home in 76 cases (51.4%), from a dispensary in 47 cases (31.8%) and from another hospital in 25 cases (16.9%). The comorbidities were: arterial hypertension: 113 (76.5%), diabetes mellitus: 30 (20.3%), emboligenic heart disease: 21 (14.2%), dyslipidaemia: 4 (2.7%) and anticoagulants: 2 (1.4%). The reasons for consultation were: disturbed consciousness: 112 (75.7%), increased blood pressure: 44 (29.7%), convulsions: 18 (12.2%), headache: 16 (10.8%), dysarthria: 12 (8.1%), heaviness

Table 1. *Socio-demographic characteristics of patients*

Variables	N	[Xmin-Xmax]	[Mean ± SD]	%	p
Sex					
Female	55			37.2	0.076
Male	93			62.8	
Age (year)	148				
<60	66	[25-96]	62,6 ± 13,5	44.6	0.24
≥60	82			55.4	
Civil status					
Single	26			17.6	
Divorced	2			1.4	0.742
Married	99			66.9	
Widowers	21			14.2	
Socio-economic level					
Low	14			9.5	0.642
High	25			16.9	
Average	109			73.6	

Table 2. *Anamnestic data*

Variables	N	%
Patient origin		
Dispensary	47	31.8
Hospital center	25	16.9
Domicile	76	51.4
Comorbidities		
Arterial hypertension	113	76.4
Diabetes mellitus	30	20.3
Emboligenic cardiopathy	21	14.2
Dyslipidaemia	4	2.7
Taking anticoagulants	2	1.4
Consultation reason		
Disturbed consciuosness	112	75.7
Increased blood pressure	44	29.7
Convulsions	18	12.2
Headache	16	10.8
Dysarthria	12	8.1
Heaviness of the hemi-body or limb	11	7.4
Mouth deviation	9	6.1
Dizziness	4	2.7
Vomiting	2	1.4
Time since symptoms appeared		
< 6 hours	10	6.7
6 hours to < 24 hours	86	58.1
1 day to 7 days	37	25.0
≥ 7 days	15	10.1

of the hemicircle or limb: 11 (7.4%), mouth deviation: (6.1%), dizziness: 4 (2.7%) and vomiting: 2 (1.4%). The time from symptom onset to hospital admission was: < 6 hours: 10 (6.7%), 6 hours to < 24 hours: 86 (58.1%), 1 to 7 days: 37 (25%) and ≥7 days: 15 (10.1%).

Patient physical examination data

Table 3 shows the physical examination data.

The mean Glasgow score was 11.2 ± 3.1, < 13 in 77 patients (52%), ≥13 in 71 (48%) with no significant difference (p = 0.124). Mean systolic blood pressure was 159.9 ± 34.8 mmHg, <90mmHg in one patient (0.7%), between 90 and 140mmHg in 112 (75.7%), ≥140mmHg in 35 patients (23.6%) with no significant difference (p = 0.068). Mean diastolic blood pressure was 95.7±20.1mmHg, <60mmHg in two patients (1.4%), between 60 and 90mmHg in 86 (58.1%), >90mmHg in 60 patients (40.5%) with no significant difference (p = 0.07). Mean peripheral oxygen saturation was 94.7 ± 4.4, < 90% in 15 patients (10.1%), ≥90% in 133 (89.9%) with a significant difference (p = 0.014). Mean temperature was 36.6 ± 0.64°C, 36.5 to 37.5°C in 131 patients (88.5%), ≥37°C in 17 (11.5%) with a significant difference (p = 0.012). Motor impairment was absent in 39 cases (26.4%), hemiplegia in 68 cases (45.9%) and hemiparesis in 41 cases (27.7%). The pupils were reflex isocoric in 121 cases (81.8%), mydriatic in 20 cases (13.6%), of which bilateral and 13 unilateral, and myosis in 9 cases (6.3%).

Paraclinical data

Table 4 shows the data from paraclinical examinations

The mean haemoglobin level was 12.4g/dl, ≤12g/dl in 53 cases (35.8%), >12g/dl in 95 cases (64.2%). Mean natraemia was 139mmol/l, ranging from 135-145mmol/l nain 123 patients (83.1%), below 135mmol/l in 3 patients (2%) and above 145mmol/l in 22 patients (14.9%). Mean blood glucose was 138 mg/dl, between 140 and 180 mg/dl in 19.6% of patients, above 180 mg/dl in 35 (23.6%) and between 60 and 140 mg/dl in 84 (56.8%). Mean creatinemia was 1.2 mg/dl, ≤1.3 mg/dl in 92 patients (62.2%), greater than 1.3 mg/dl in 56 patients (37.86%). The mean LDL cholesterol level was 115.5mg/dl, less than or equal to 100mg/dl in 60 cases (40.5%) and greater than 100mg/dl in 88 cases (59%). The mean prothrombin level was 75%, ≤ 70% in 55 patients (37.2%) and > 70% in 93 patients (62.8%). On electrocradiogram, 11 patients (7.4%) had atrial fibrillation. The mean time to CT scan was 24 hours, less than 4 hours in 14.9%, between 4 and 6 hours in 6.8% and more than 6 hours in 78.4%, with a significant difference (p = 0.024). The stroke was ischaemic in 104 patients (70.3%) and haemorrhagic in 44 patients (29.7%).

Table 3. *Physical examination data*

Variables	N	[Xmin-Xmax]	Mean ± SD	%	p-Value
Glasgow score <13 ≥13	148 77 71	[3-15]	11.2 ± 3.1	52 48	0.124
SBP in mmHg <90 90-140 ≥140	148 1 112 35	[145-300]	159.9 ± 34.8	0.7 75.7 23.6	0.068
DBP in mmHg <60 60-90 >90	148 2 86 60	[54-149]	95.7 ± 20.1	1.4 58.1 40.5	0.07
SpO2 % <90 ≥90	148 15 133	[75-100]	94.7± 4.4	10.1 89.9	0.014
Temperature en °C 36.5 to <37.5 ≥37.5	148 131 17	[35,8-38,5]	36.6±0.64	88.5 11.5	0.012
Motor impairment None Hemiparesis Hemiplegia	 39 41 68			 26.4 27.7 45.9	
Pupils Isocoric reflexive Unilateral areflexic mydriasis Bilateral areflexic mydriasis Bilateral reflexic mydriasis Bilateral reflexic myosis Unilateral myosis	 121 13 3 2 2 9			 81.8 8.8 2.0 1.4 1.4 6.3	

Legend: SBP = systolic blood pressure, DBP = diastolic blood pressure, SpO2: peripheral oxygen saturation, °C = degree Celsius.

Table 4. *Data from paraclinical examinations*

Variables	N	[Xmin-Xmax]	Median (EIQ)	%	P
Haemoglobin (g/dl) ≤12 >12	148 53 95	[6-19]	12.4 (11-14)	35.8 64.2	
Naetremia (mmol/l) <135 135-145 >145	148 3 123 22	[111-170]	139(135-142)	2 83.1 14.9	
Glycemia (mg/dl) 60 – 140 140 -180 >180	148 84 29 35	[25-346]	138(110-175)	56.8 19.6 23.6	
Creatininemia (mg/dl) ≤1.3 >1.3	148 92 56	[0.1-18]	1.2(0.8-1.6)	62.2 37.8	
LDL-cholesterol (mg/dl) ≤100 >100	148 60 88	[12-307]	115.5(81-145)	40.5 59.0	
Prothrombin rate (%) ≤70 >70	148 55 93	[20-141]	75(68-81)	37.2 62.8	

Variables	N	[Xmin-Xmax]	Median (EIQ)	%	P
Disorder electrocardiogram Non AF	 137 11			 92.6 7.4	
Scanning time (in hour) <4 4-6 >6	 22 10 116	 [1-72]	 24(6-48)	 14.9 6.8 78.4	 0.024
Type of stroke on CT scan Haemorrhagic stroke Ischaemic stroke	 44 104			 29.7 70.3	

Legend: AF = atrial fibrillation, LDL = low density lipoprotein.

Table 5. *Therapeutic data and outcome*

		[Xmin-Xmax]	Median (EIQ)	%
Treatment of haemorrhagic stroke Medical Surgical	n = 44 44 0			 100 0
Treatment of ischaemic stroke Antiplatelet agents Anticoagulants Thrombolytics	n = 104 79 93 0			 53.4 62.8 0
Early physiotherapy No Yes	n = 144 124 24			 83.8 16.2
Post-treatment outcome Deaths Haemorrhagic stroke Ischaemic stroke Alive without sequelae Alive with sequelae	n = 144 17 11 6 78 53			 11.5 7.4 4 52.7 35.8
Lengh of hospital stay (days) <7 7-14 >14	n = 144 76 49 23	 [1-74]	 7 (4-12)	 51.4 33.1 15.5

Therapeutic data and outcome

Table 5 presents the therapeutic data and outcome

Haemorrhagic stroke was treated medically in all patients; ischaemic stroke was treated with antiplatelet agents in 79 patients (53.4%), anticoagulants (low molecular weight heparin) in 93 patients (62.8%), and no patient underwent thrombolysis. Early physiotherapy was performed in 24 patients (16.2%) and not performed in 124 patients (83.8%). The post-treatment outcome was as follows: 78 patients (52.7%) discharged alive with sequelae, 53 patients (35.8%) discharged alive without sequelae, and 17 patients (11.5%) died, 11(7.4%) for haemorrhagic stroke and 6 (4%) for ischaemic stroke. The average length of hospital stay was 7 days, less in 51.4% of cases, between 7 and 14 days in 33.1% and more than 14 days in 15.5% of cases.

Factors associated with mortality

Table 6 shows the factors associated with mortality

In univariate analysis, hypertension (6-fold increase in the risk of death), the presence of pupillary abnormalities (6.8-fold increase in the risk of death) and age over 60 (3-fold increase in the risk of death) were the factors associated with death and therefore with a poor prognosis.

In multivariate analysis, the same factors persisted: hypertension (6.7-fold increase in the risk of death), the presence of pupillary abnormalities (7-fold increase in the risk of death) and age over 60 (3-fold increase in the risk of death) were the factors associated with death and therefore with a poor prognosis.

Table 6. *Factors associated with mortality*

	Univariate analysis			Multivariate analysis		
	OR	CI 95%	p-Value	ORa	CI 95%	p-Value
No maried	1.713	0.50-5.83	0.389	-	-	-
Low socio-economic level	1.977	0.20-19.5	0.560	-	-	-
Arterial hypertension	6.046	1.06-34.43	0.043	6.796	1.23-37.34	0.027
Diabetes mellitus	2.870	0.67-12.28	0.155	3.014	0.73-12.33	0.125
Pupillary abnormalities on admission	6.864	2.24-20.95	0.001	7.075	2.83-21,00	<0.0001
Age ≥ 60 years	3.486	1.10-11.04	0.034	3.253	1.079-9.8	0.036
Masculine sex	1.778	0.57-5.50	0.319	-	-	-
SBP ≥ 140mmHg	1.959	0.55-6.87	0.293	1.752	0.51-6.0	0.372
Glasgow score < 13	1.321	0.48-4.87	0.412	-	-	-
SpO2<90%	1.007	0.16-6.17	0.994	-	-	-

Legend: SBP= systolic blood pressure, peripheral oxygen saturation.

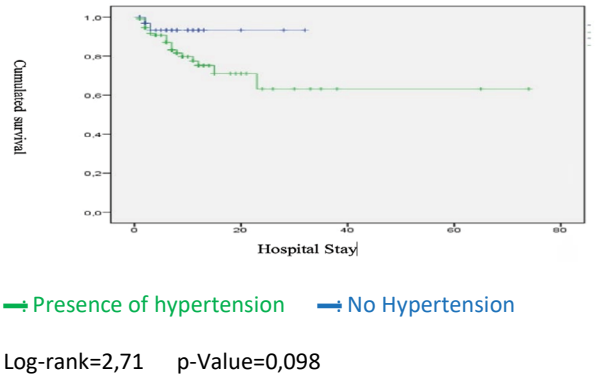

Figure 1. *Patient survival according to history of hypertension*

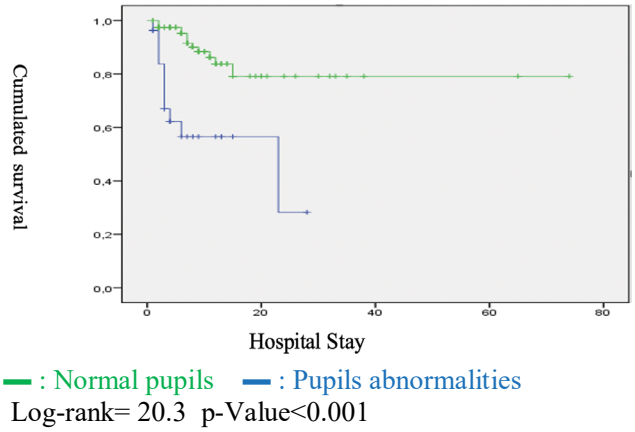

Figure 2. *Survival curve according to the presence of pupils abnormalities*

Survival curves

Survival curve according to history of hypertension

Figure 1 shows the survival curve for patients with a history of hypertension.

Patients with a history of hypertension had poorer survival than those without. At least 20% died within the first five days of hospitalisation.

Survival curve according to the presence of pupils abnormalities

Figure 2 shows the survival curve for patients with pupils' abnormalities.

Patients with pupil's abnormalities had poorer survival than those without. At least 30% died within the first five days of hospitalisation.

Survival curve as a function of age

Figure 3 shows the survival curve for patients according to age.

Patients aged over 60 years had a poorer survival than those aged under 60 years. At least 10% died within the first five days of hospitalisation.

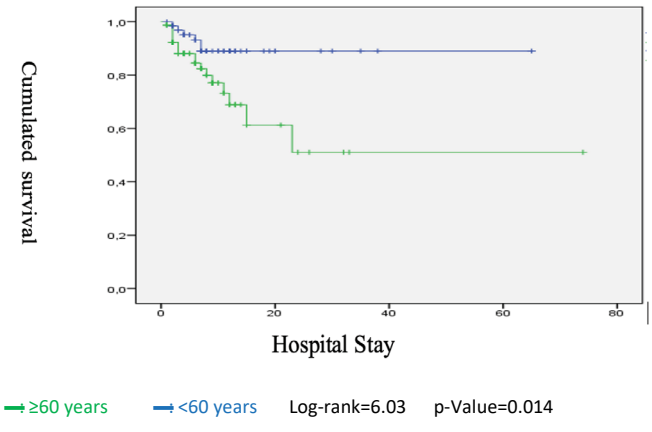

Figure 3. *Survival curve as a function of age*

Discussion

Our study investigated the factors associated with mortality in patients admitted for stroke to the Monkole hospital centre. Our results indicate that stroke accounted for 4% of all hospitalisations, mainly ischaemic (70%) rather than haemorrhagic (30%).

Men aged 60 and over, married, of average socio-economic status and from home were most affected. Patients often had hypertension and/or diabetes mellitus as comorbidities, and consulted their doctor within two days of the accident. The main symptoms of consultation were disorders of consciousness, with arterial pressures often normal, desaturation in 10% of cases and pupils abnormalities in 18% of cases. Treatment was exclusively medical, using antiplatelet agents and anticoagulants, without recourse to thrombolysis. The average hospital stay was 7 days, and the mortality rate was 11.5% (7.4% for haemorrhagic stroke and 4% for ischaemic stroke), compared with 20% in 2018 in emergency departments alone [14]. The factors associated with mortality were hypertension, the presence of pupillary anomalies and age over 60.

The prevalence of stroke was 4.03% in this series, the same as that found by Tshilanda [14] in 2018 in the same institution. Our study found that the mean age was 62.6 years corroborating the findings of Tshilanda [14]: mean age 64.6 ± 14.1 years and Sonfo [15]: mean age 61.8 ± 2.4 years and Bugugu [13]: mean age 62±14 years. Male predominance was also noted by other authors [13,16]. Saposnik, et al. [17] reported an average age of 74.8 years in countries with a long life expectancy.

The majority of patients had an average socio-economic status, as Feigin, et al. [18] had highlighted the association between unfavourable socio-economic status and an increased risk of stroke. But, low socio-economic level had not effect on mortality. More than half the patients came directly from home, contrary to the opinion of Hacke [19], because of the absence of pre-hospital care. The delay of the consultation was long, making thrombolysis impossible [18,19]. Hypertension and diabetes mellitus were the most frequent comorbidities associated with stroke, as Norrving and Rothwell [20, 21] had found.

Ischaemic stroke was predominant accounting for 70.3% of cases, in accordance with the data in the literature [18]. The mortality was higher for haemorrhagic stroke than for ischaemic stroke. The majority of patients had undergone a CT scan more than 6 hours after the accident, contrary to the 2021 American recommendations [22], essentially due to a lack of financial resources, as care was paid for by the poor families themselves.

Our series found that hyperglycaemia (>180mg/dl in 23.6%) was not associated with poor outcome, contrary to the work of Tshituta [23]. Treatment of haemorrhagic stroke was solely medical, as Anna Johnson had also emphasised [24]. Anticoagulation was the only treatment for the aetiology of ischaemic stroke in the absence of thrombolysis, in accordance with the work of Mohammad Mehdi [25]. Early physiotherapy was used less frequently, in disagreement with the results of Sonfo and Satoshi Otokita [15,26]. Half the patients had sequelae on discharge, as Ramon Luengo-Fernandez had observed [27].

The average length of hospital stay was 7 days, with significant variability. This length of stay is dictated by the patient's condition and should allow better functional recovery [28].

Lompo, et al. [29] identified a statistically significant link between age and mortality (OR: 3.302; 95% CI: 1.039-10.497; p = 0.043), as did Wilaiwan Chongruksut [30], also corroborating the results of the present study, in which advanced age multiplied mortality by a factor of three. Marietta Pohl [31] had emphasised the importance of hypertension as a major risk factor for stroke-related complications, data confirmed by this study with seven times more deaths in cases of hypertension. The presence of pupillary anomalies increased the risk of death sevenfold, corroborating the results of Stephen S. Phillips [32]. Hypertension, pupillary anomalies and advanced age were also associated with a poor prognosis in the study by Tomohisa Nezu [33], corroborating the results of this study. The detrimental role of hypertension in stroke, especially haemorrhagic stroke, is well known, and the presence of pupillary abnormalities such as mydriasis is a sign of intracranial hypertension, reflecting the severity of the cerebral damage.

This study has the weakness of being documentary, monocentric and with a short follow-up period, but it has shown that stroke is fatal, with hypertension and age playing an important role as risk factors.

Conclusion

This study found that stroke mortality is 11% and is associated with advanced age, hypertension and the presence of pupillary anomalies. These results are consistent with the literature. A longitudinal study with long-term follow-up of patients would seem useful to clarify the evolution of stroke patients in this hospital.

Authors' contributions

Grâce Likinda and Wilfrid Mbombo: conception of the study and drafting of the manuscript

Gédéon Bukasa, Freddy Mbuyi and Alphonse Mosolo: data collection

Marc Tshilanda: Statistical analysis

Rémy Kashala, Mike Madika, Marine Moanda and Grâce Faray: reading of the manuscript.

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