



Factors Associated with the Occurrence of Medical Complications in the Acute Phase of Stroke in a Reference Hospital at Ouagadougou (Burkina Faso)

**Lompo Djingri Labodi^{1*}, Cisse Kadari², Savadogo Mahamoudou³,
Kabre Nestor Judicaël¹, Napon Cristian³ and Kabore Jean³**

¹*Health Sciences Training and Research Unit, Tingandogo Teaching Hospital, University Ouaga I-Pr Joseph Ki-Zerbo, Burkina Faso.*

²*Department of Medical Biology and Public Health, Institute of Health Sciences of Ouagadougou, Burkina Faso.*

³*Health Sciences Training and Research Unit, Yalgado Ouedraogo Teaching Hospital of Ouagadougou, University Ouaga I-Pr Joseph Ki-Zerbo, Burkina Faso.*

Authors' contributions

This work was carried out in collaboration between all authors. Author LDL designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors CK and SM managed the analyses of the study. Authors KNJ and NC managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2018/41869

Editor(s):

(1) Chris Ekpenyong, Department of Human Physiology, College of Health Sciences, University of Uyo, Nigeria.

Reviewers:

(1) Adrià Arboix, University of Barcelona, Spain.

(2) Irina Iuliana Costache, Grigore T. Popa University of Medicine and Pharmacy, Romania.

Complete Peer review History: <http://www.sciencedomain.org/review-history/25116>

Original Research Article

Received 24th March 2018

Accepted 5th June 2018

Published 13th June 2018

ABSTRACT

Introduction: Medical complications are responsible for almost 50% of the causes of death in the acute phase of stroke. The purpose of this study was to identify the factors associated with the occurrence of acute stroke medical complications at the Tingandogo Teaching Hospital in Ouagadougou, Burkina Faso.

Patients and Methods: This was a prospective, cross-sectional study of patients admitted to hospital for stroke less than 72 hours from March 2015 to February 2016. Initial general, clinical and paraclinical characteristics and medical complications post stroke, were analyzed. A bivariate

*Corresponding author: E-mail: labodilompo@yahoo.fr;

and then multivariate analysis with logistic regression, made it possible to identify the independent factors associated with the occurrence of medical complications after stroke.

Results: Of the 197 patients enrolled, 63.3% were male; the average age of the patients was 61.1 years; the neurological admission deficit was severe in 30.5%; swallowing disorders were observed in 51.3%. Brain infarctions accounted for 65.5% and haemorrhagic strokes accounted for 34.5%. Broncho-pulmonary infection (42.6%), cardiac complications (25.9%), undernutrition (22.4%), malaria access (17.3%) and urinary tract infection (16.2%). %), were the main medical complications. Neurological deterioration (36%) and epileptic seizures (15.2%) were the observed neurological complications. The independent factors associated with the occurrence of medical complications were: Clinical severity of stroke (NIHSS ≥ 17) at admission (OR = 3.402, 95% CI 1.27-16.46, $p = 0.031$); swallowing disorders at admission (OR = 10.19, 95% CI 1.16-89.00, $p = 0.000$) and co-morbidities (OR = 8.72; 95% CI 1.23- 61.43, $p = 0.030$).

Conclusion: The screening and appropriate management of patients at high risk of medical complications in the acute phase of stroke, in NVUs, will reduce the incidence of these complications and help reduce mortality and disability post stroke.

Keywords: Associated factors; stroke; medical complications.

1. INTRODUCTION

Stroke is one of the biggest public health problems in the world today. It is the 3rd leading cause of death in the world after ischemic heart disease and cancers [1]. About 87% of the world's 2005 deaths from stroke occurred in developing countries; overall one month stroke mortality is about 15% in developed and emerging countries, compared with 24.1% to 41% in sub-Saharan Africa [2]. The medical and neurological complications occurring in the acute phase of stroke are frequent, encountered in 25 to 95%. They mainly include pneumonia, urinary tract infection, pressure ulcers, venous thromboembolic complications, cardiac complications, non-infectious respiratory complications, extra brain bleeding, neuropathic and/or musculoskeletal pain, neurological deterioration, epileptic seizures,... They constitute obstacles to optimal functional recovery [3], worsen the vital and functional prognosis, prolong the duration of hospitalization and increase mortality [4-7]. Prevention, early recognition and management of acute post-stroke complications are considered essential aspects of care in Stroke Units (SU) [8]. SUs have proven effective in reducing the frequency and severity of functional disability and reducing mortality in stroke patients, in countries with such care facilities [9].

However, stroke units are still very seldom available in sub-Saharan Africa in general and absent in Burkina Faso in particular. In our opinion, improving the quality of care for stroke patients in the acute phase, despite the absence of SU, could significantly reduce the frequency

and severity of medical and neurological complications of the acute phase of stroke. This would induce a significant reduction in mortality and post-stroke functional sequelae. In the absence of SU in our context, the availability of data on the frequency of medical and neurological complications and the factors associated with their occurrence, in the acute phase of stroke, was a prerequisite for the significant reduction in post-stroke intra-hospital mortality and functional sequelae, in our hospitals. The aim of this study was to evaluate the frequency predefined medical and neurological complications in patients consecutively hospitalized for stroke at Tingandogo University Hospital, Ouagadougou (Burkina Faso), and then identify among the characteristics of the patients, the factors associated with the occurrence of these post-stroke complications.

2. PATIENTS AND METHODS

It was a hospital, prospective, cross-sectional, descriptive and analytical study, which ran from November 1st, 2015 to October 31st, 2016. All patients over the age of 16 years, consecutively hospitalized at Tingandogo University Hospital for ischemic or haemorrhagic stroke, less than 72 hours old, confirmed by brain scan, were included in the study. These patients or a family member had to give their informed consent to participate in the study. Patients younger than 16 years old, those hospitalized beyond 72 hours after the stroke, those who did not have a brain scan and / or for whom the data could not be obtained, those hospitalized for other neurological diseases, or those for which consent

to participation in the study could not be obtained, were not included in this study.

2.1 Study Variables

- Sociodemographic variables: Age, sex, level of education, place of residence and mode of admission,
- Clinical variables: admission delay, history (vascular risk factors, comorbidities, modified Rankin score (mRS) before stroke), admission constants, Glasgow admission score, National Institute of Health Stroke Score (NIHSS) at baseline 'admission. - Paraclinical variables: Brain scan, chest x-ray, ECG, echocardiography, electroencephalogram, biological examinations on admission.
- Evolutionary variables: duration of hospitalization, acute non-neurological medical complications or acute neurological complications (absent at admission, then appearing during hospitalization).

2.2 Study Protocol

Sociodemographic data, vascular risk factors, antecedents and co-morbidities, admission delay, were completed on admission. Vital constants (temperature, blood pressure), neurological and general clinical data, neuroradiologic and biological data were recorded at admission and then during hospitalization until discharge from hospital. All patients were initially seen and then followed during hospitalization by a senior neurologist. The interpretation of brain scan or brain magnetic resonance imaging (MRI) was performed by radiologists. The ECG was systematic for all patients on admission and, depending on the case, repeated during hospitalization.

The standard biological assessment performed systematically for each patient on admission included: serum creatinine, serum sodium, serum potassium, proteinase, blood count-platelet count, C-reactive protein (CRP), lipid status (cerebral infarction). Other examinations were prescribed on a case-by-case basis depending on the patient's clinical condition: Standard chest radiography, cytobacteriological examination of urine (ECBU), blood culture, thick blood for the diagnosis of malaria, HIV serology, etc.

NIHSS and Glasgow Coma Scale (GCS) were used for evaluation of clinical severity and state of alertness in the acute phase of stroke and

mRS for the evaluation of functional autonomy. An NIHSS score of ≤ 16 characterized moderate neurological deficit, while an NIHSS score ≥ 17 defined a severe neurological deficit. A GCS ≤ 8 defined coma, a GCS between 9 and 14 defined an impairment of alertness and a GCS = 15 defined normal vigilance. Localization of hemorrhagic stroke was classified as supratentorial (lobar, deep), infratentorial (brain stem, cerebellum), intraventricular pure.

Acute medical complications were recorded as they appeared from admission to discharge from hospital. The management of stroke was done according to the recommendations of the European Stroke Organization (ESO) 2008: Swallowing test on admission, nasogastric tube if swallowing disorder; scope with cardio-tension monitoring of cerebral infarctions; bed rest until cervical vascular ultrasound is performed in case of cerebral infarction; oxygen to glasses if oxygen saturation $< 95\%$ in ambient air; paracetamol 1g / 6h or cold pack in case of temperature $> 37.5^{\circ}\text{C}$; prevention of deep vein thrombosis of limb or stress ulcer, respectively by enoxaparin (40 mg) and by omeprazole (20 mg); fast insulin protocol to the electric syringe pump if capillary glycaemia > 11 mmol / l; Nicardipine IV protocol at electric syringe pump when blood pressure (BP) $> 220/120$ mm Hg (ischemic stroke) or BP $> 160/95$ mm Hg (hemorrhagic stroke) during the first 72 hours following stroke; Aspirin (160-300 mg / day) in case of infarction or low molecular weight heparin (LMWH) or calciparin at curative doses in the following cases: emboligenic high risk heart disease, carotid stenosis $> 70\%$ pre-surgical, carotid dissection, thrombus floating in an artery of large caliber with encephalic destiny; antibiotics or artemether respectively in case of bacterial infection or access to malaria.

IV thrombolysis with tissue plasminogen activator (t-PA) is not yet available in Burkina Faso. Stroke patients benefit from neurovascular expertise as soon as they are admitted to the emergency department, in collaboration with emergency physicians, via an operational strain. Data entry and analysis were performed using Epi info software 7.1.5.2. The chi-square test and the student test served as statistical tests with a significance level of 5%. To determine the factors associated with the occurrence of medical and neurological complications, a bivariate analysis was first performed to find an association between admission variables and complications that occurred during hospitalization. Then, a multivariate analysis with the use of the logistic

regression model allowed to identify the factors associated independently with the occurrence of medical or neurological complications.

2.3 Ethical Considerations

An authorization from the administration of the Tingandogo Teaching Hospital was obtained, as well as the informed consent of the patients or a member of their family. We also obtained the authorization of the bioethics committee of Burkina Faso.

2.4 Operational Definitions

- Pulmonary infection or pneumonia: Auscultatory crackling rales with fever and purulent sputum or radiographic evidence of pneumonia, requiring antibiotic therapy.
- Septicemia: Evidence of bacteremia in the blood culture during a febrile spike.
- Urinary infection: clinical symptoms of urinary tract infection (dysuria, foul urine and fever), with pyuria, or confirmation at uroculture or cyto-bacteriological examination of urine, requiring antibiotic therapy.
- Deep vein thrombosis of limb: clinical diagnosis of deep venous thrombosis of limb confirmed to venous doppler of limbs.
- Pulmonary embolism: Clinical diagnosis of pulmonary embolism confirmed by thoracic CT angiography.
- Cardiac complications: Sustained cardiac arrhythmias, symptomatic atrio-ventricular block, acute myocardial infarction, cardiac insufficiency, ... diagnosed on the clinic, ECG, cardiac enzymes or echocardiography.
- Musculoskeletal pain: Shoulder-hand pain syndrome, algo-neurodystrophic syndrome, central post stroke pain.
- Pressure ulcers: Any solution of cutaneous continuity or necrosis resulting from insignificant pressure or trauma (skin trauma resulting directly from a fall has not been included).
- Extra cranial bleeding : Any extra cranial bleeding requiring close observation, transfusion or surgery.
- Neurological deterioration: Aggravation of more than 2 points of the total NIHSS score persisting for more than 24 hours.
- Epileptic seizure: Occurrence of single or recurrent epileptic seizures, after the constitution of stroke, without evidence of a history of epilepsy before stroke.

- Hyperglycemia was defined by a mean blood glucose > 8.0 mmol/L (> 1.44 g / L); hypoglycemia was defined as a mean blood glucose <4.0 mmol/ L (0.72 g / L). Renal impairment was defined as serum creatinine > 100 µmol/L measured by enzymatic method. Hypo- and hypernatremia were respectively defined by natremia <136 mmol/L and > 145 mmol/L; hypo- and hyperkalemia with serum potassium <3.3 mmol/L and > 5.0 mmol/L, during the hospital phase after stroke.

3. RESULTS

3.1 Descriptive Study

The mean age of the patients was 61.1 ± 14.4 years (range 26 to 90 years). The median age was 63 years old. The age groups 50 to 80 years and over were the most representative with 76.7%. The majority of patients were male with 124 cases (63.27%), residing in Ouagadougou with 120 cases (60.91%), not attending school with 115 cases (58.4%). Vascular risk factors (VRF) were present in 161 patients (81.7%). High Blood Pressure (HBP) was the largest VRF at 73.60%, followed by alcohol (16.2%) and a history of stroke (12.7%). Comorbidities were found in 41 patients (20.8%). The admission delay was relatively early (≤ 3 hours) for 45 patients (22.8%), and more than 40% of patients were admitted within 6 hours, however patients admitted after 6 hours were the most numerous with 117 patients (59.4%).

At admission, mean BP was 162 / 95.2mmHg (range 80-240 / 60-180mmHg), with 118 cases (59.9%); 34 patients (17.3%) had fever, 19 patients (9.6%) were in coma; the mean NIHSS was 16.7 (range 6 to 36) and 69 patients (35%) had a severe to very severe neurological deficit (NIHSS ≥ 17). Hyperglycemia with 89 patients (45.2%), leukocytosis in 54 patients (27.5%), renal failure in 37 patients (18.8%), hypokalemia in 15.2%, hypoprotidemia in 28 patients (14, 2%), hyponatremia in 14.2% of patients, were biological abnormalities present at admission.

Of the 197 patents collected, there were 129 cases of cerebral infarction, 65.5% and 68 cases of hemorrhagic stroke or 34.5%. Infarctions of the Middle Cerebral Artery (MCA) territory with 106 cases (82.2%), were the most frequent. Among the hemorrhagic strokes, the deep

localization of the hematoma was the most involvement and 25% of capsulo-thalamic represented with 26.5% of capsulo-lenticular involvement.

Table 1. Sociodemographic, clinical and paraclinical characteristics of patients present at patient admission

Sociodemographic characteristics	Effectives	Frequencies
Sex :		
• Male	124	63.3%
• Female	73	36.7%
Scholing :		
• No	115	58.4%
• Yes	82	41.6%
Residence :		
• Urban	120	60.9%
• Rural	77	39.1%
Vascular risk factors		
HBP	145	73.6%
Alcohol	32	16.2%
Prior stroke	25	12.7%
Tabacco	23	11.7%
Diabetes mellitus	22	11.2%
Sédentarity life style	15	7.6%
Obesity	14	7.1%
Hypercholestrolemia	11	5.6%
Oral contraceptive	6	3.1%
Heart disease	5	2.5%
Cervical atherosclerosis	1	0.5%
Comorbidities	41	20.8%
Admission dealine		
• ≤ 3 hours	45	22.8%
• 3-6 hours	35	17.8%
• 6-72 hours	117	59.4%
Clinical features		
• HBP	75	38.1%
State of alertness at admission		
• GCS = 15 (normal vigilance)	124	62.9%
• 14 ≤ GCS ≤ 9 (impairment of alertness)	54	27.4%
• ≤ 8 (coma)	19	9.7%
Neurologic deficit on admission (NIHSS)		
• Light (0-5)	6	3%
• Moderate (6-16)	122	61.9%
• Severe (17-25)	60	30.5%
• Very severe (> 26)	9	4.6%
Admission swallowing disorders	102	51.3%
Biological examinations at admission		
• Hyperglycemia	89	45.2%
• Hyperleukocytosis	54	27.6%
• Renal insufficiency	37	18.8%
• Anemia	33	16.8%
• Hypokaliemia	30	15.2%
• Hypoproteinemia	28	14.2%
• Hyponatremia	28	14.2%
• Hypernatremia	13	6.6%
• Hypoglycemia	2	1%
• Hyperkaliemia	1	0.5%

Neuroradiological characteristics		
•	Nature of stroke :	
-	Cerebral infarction cérébral	129 65.5%
-	Hemorrhagic stroke	68 34.5%
Territory of cerebral infarction		
-	MCA	106 82.2%
-	ACA	7 5.4%
-	AChoA	7 5.4%
-	Vertebro-basilar	16 12.4%
-	Junctional	4 3.9%
•	Topography of hemorrhagic stroke	
-	Deep localization (basal ganglia and internal capsule)	47 69.1%
-	Lobar	13 19.2%
-	Brainstem	3 4.4%
-	Cerebelleux	4 5.9%
-	Intra ventricular pur	1 1.5%
Etiologies of cerebral infarctions (n=129)		
•	Atheroma	34 26.3%
•	Emboligenic heart diseases	28 21.7%
•	Chronic diseases of small cerebral arteries	20 15.5%
•	Unknown causes	45 34.9%
•	Other causes	2 1.5%
Etiologies of haemorrhagic strokes (n=68)		
•	Cerebral micro angiopathy secondary to HBP	53 77.9%
•	other causes	8 11.8%
•	Undetermined causes	7 10,3%

The socio-demographic, clinical and paraclinical characteristics of patients at admission are summarized in the following Table 1.

3.2 Intra-Hospital Medical Complications

A fever was found in 112 patients or 56.9%. The most frequently encountered infectious complications were pulmonary infection in 84 cases (42.6%), Plasmodium falciparum malaria in 34 cases (17.3%), urinary tract infection in 32 cases (16,2%). Venous thromboembolic complications were found in 8 cases (4.1%). Malnutrition was found in 45 patients (22.8%). Hemorrhagic complications were found in 5 patients or 2.5%. Skin ulcers were noted in 21 patients, ie 10.7%. Painful and orthopedic complications were noted in 13 patients, ie 6.6%. Cardiac complications, sometimes associated, occurred in 51 patients (25.9%). A respiratory complication with respiratory distress type was recorded in 4 patients (2%). Clinical neurological complications were found in 77 patients (39.1%); isolated or associated in the same patients, they were distributed in neurological deterioration with 71 cases (36%) and epileptic seizures, 30 cases (15.2%). The intra-hospital medical complications observed are summarized in the following Table 2.

The average length of hospital stay was 12.7 ± 8.4 days (range 2 to 57 days). During the hospitalization, we recorded 51 cases of death, ie an intra-hospital mortality rate of 25.9%. Immediate causes were divided into neurologic complications directly attributable to stroke (cerebral edema, brain swelling, acute hydrocephalus,...) with 25 cases (49%) and non-neurological medical complications with 26 cases (51%): infections (sepsis, pulmonary infection,..), 11 cases (21.6%); cardiac complications, 6 cases (11.8%); respiratory distress, 4 cases (7.8%); multisystem failure, 3 cases (5.9%); unexplained sudden death, 2 cases (3.9%). Of the 146 surviving patients, 38 (26%) were autonomous or independent (mRS 0-2) and 108 patients (74%) were dependent for activities of daily living (mRS 3-5).

3.3 Analytical Study

In univariate analysis, the socio-demographic characteristics, the VRF, the comorbidities, the clinical and paraclinical data at the time of the admission of the strokes, significantly associated with the occurrence of the medical complications post stroke, at the acute phase were: Age > 65 years, comorbidities, hypercholesterolemia, sedentary lifestyle, hypertension, coma on admission (Glasgow ≤ 8), initial clinical severity of

Table 2. Intra-hospital medical and neurological complications observed

Type of complications	Number of people	Frequencies
	Infectious complications	
• Fever	112	56.9%
• Pulmonary infection	84	42.6%
• Malaria	34	17.7%
• Urinary tract infection	32	16.2%
• Septicemia	13	6.6%
Malnutrition	45	22.8%
Cardiac complications	51	25.9%
• Heart failure	31	24%
• Sustained heart rythm disorders	15	11.7%
• Symptomatic atrioventricular block	5	3.9%
• Acute myocardial infarction	5	3.9%
Respiratory distress	4	2%
Venous thromboembolic complications	8	4.1%
• Pulmonary embolism+/- DVT of limb	7	3.6%
• Isolated DVT of limb	1	0.5%
Extracranial haemorrhages	(digestive haemorrhage 3, hematuria 2)	2.5%
Skin bedsores	21	10.7%
Painful and orthopedic complications	13	6.6%
• Algoneurodystrophy	6	3%
• Neuropathic pain	5	2.6%
• Tendon retraction	2	1%
Neurologic complications	77	39.1%
• Neurologic deterioration	71	36%
• Epileptic seizures	30	15.2%

stroke (NIHSS ≥ 17), leukocytosis. The results of the univariate analysis comparing the occurrence of intra-hospital medical complications according

to the sociodemographic, clinical and paraclinical characteristics present at the admission of the patients, are summarized in Table 3 below.

Table 3. Results of the bivariate analysis on the occurrence of intra-hospital medical complications according to socio-demographic, clinical and paraclinical characteristics, present at the admission of acute stroke patients admitted to hospital

Variables	Complications		OR [95% IC]	P
	Yes	No		
Age				
≤ 65 years	82	21		
>65 years	80	14	1.46 [0.69-3.08]	0.314
Sex				
Male	62	32	1.50 [0.70-3.20]	0.287
Female	38	13		
Schooling				
Yes	32	50	0.54 [0.17-4.23]	0.219
No	62	53		
Comorbidities				
Yes	38	3	3.24 [1.93-11.21]	0.034
No	121	31		
Hypercholesterolemia				
Yes	9	0	1.48 [1.32-1.67]	0.016
No	92	45		
Oral contraceptive				

Variables	Complications		OR [95% IC]	P
Yes	2	2	0.43 [0.05-3.18]	0.224
No	99	43		
Obesity				
Yes	6	0	1.47 [1.35-1.65]	0.052
No	95	45		
Prior stroke				
Yes	15	5	1.39 [0.47-4.10]	0.284
No	86	40		
Atrial Fibrillation				
Yes	2	0	1.45 [1.30-1.62]	0.238
No	99	45		
Alcohol				
Yes	17	9	0.81 [0.33-2.07]	0.321
No	84	36		
Sedentarity				
Yes	8	0	3.87 [1.32-9.66]	0.023
No	93	45		
Tabacco				
Yes	9	8	3.25 [1.15-1.31]	0.071
No	92	37		
Diabetes mellitus				
Yes	9	2	2.09 [0.47-14.75]	0.143
No	92	43		
Cervical atherosclerosis				
Yes	1	0	1.43 [0.30-1.61]	0.340
No	100	45		
HBP				
Yes	81	28	2.44 [1.11-5.36]	0.013
No	20	17		
Fever				
Yes	31	3	0.62 [0.33-1.16]	0.130
No	130	32		
HBP admission				
Yes	101	17	0.57 [0.27-1.89]	0.132
No	61	18		
Type of stroke				
Ischemic	32	14	1.02 [0.48-2.23]	0.476
Haemorrhagic	69	31		
Glasgow admission				
≤8	7	0	1.46 [1.30-1.64]	0.037
>8	94	44		
NIHSS				
≥17	36	4	4.66 [1.95-11.44]	0.018
<17	69	37		
Swallowing disorders				
Yes	56	21	4.44[1.48-8.23]	0.000
No	45	75		
Carotid infarction				
Yes	90	24	0.57 [0.26-1.25]	0.157
No	72	11		
VB infarction				
Yes	12	4	0.62 [0.18-2.06]	0.430
No	150	31		
Junctional infarction				

Variables	Complications		OR [95% IC]	P
Yes	5	0	--	0.293
No	157	35		
Deep hematoma				
Yes	43	6	1.74 [0.67-4.52]	0.244
No	119	29		
Brainstem hematoma				
Yes	3	0	--	0.418
No	159	35		
Cerebellar hematoma				
Yes	3	1		
No	159	34	0.64 [0.06-6.39]	0.702
Hyperglycemia				
Yes	38	18	0.90[0.43-1.88]	0.392
No	63	27		
Hyponatremia				
Yes	28	6	1.26[1.02-1.55]	0.028
No	73	39		
Hypernatremia				
Yes	8	0	1.48[1.32-1.66]	0.023
No	93	45		
Hypokaliemia				
Yes	30	11	1.30 [0.58-3.00]	0.263
No	71	34		
Hyperkaliemia				
Yes	1	0	1.45 [0.01-1.61]	0.345
No	100	45		
Hypoproteinemia				
Yes	8	1	3.75[0.57-8.66]	0.102
No	93	44		
Leucocytosis				
Yes	19	3	1.30 [1.06-1.60]	0.028
No	82	42		
Anemia				
Yes	8	2	1,84 [0.40-9.16]	0.240
No	93	43		
Renal failure				
Yes	16	3	1.25 [0.99-1.58]	0.065
No	85	42		
Unknown cause				
Yes	39	6	1.02 [0.52-1.49]	0.344
No	125	27		
Emboligenic heart diseases				
Yes	27	1	3.30 [0.73-14.79]	0.098
No	135	33		
Atheroma				
Yes	30	9	0.65 [0.25-1.55]	0.333
No	132	26		
Diseases of small arteries				
Yes	8	12	0,51[0,24-1,67]	0.752
No	100	77		

At the end of the multivariate analysis with logistic regression step by step, 3 independent predictors of occurrence of intra-hospital medical complications, in the acute phase of stroke were identified, these are:

- Clinical severity of stroke (NIHSS ≥ 17) at admission (OR = 3.402, 95% CI 1.27-16.46, $p = 0.031$);
- Swallowing disorders on admission (OR = 3.08, 95% CI 2.16-4.00, $p = 0.000$)
- Comorbidities (OR = 8.72, 95% CI 1.23-61.43, $p = 0.030$).

4. DISCUSSION AND COMMENTS

Pulmonary infections found in 42.7% of our patients, represented the most common medical complications after acute stroke, confirming the data in the literature, which estimate its incidence between 2.4 to 47%. The lowest rates, estimated between 9 and 17.2%, are observed in developed countries because of the positive effect of stroke units [10,11,12,13,14]. The highest incidence rates of pulmonary infection, estimated between 32 and 37%, are reported in the series of developing countries [15,16], with the exception of a Cameroonian series [17] that reported a lung infection in 15.1% of cases. These high incidence rates of pulmonary infections observed in developing countries could be explained on the one hand, by the absence of stroke units, and on the other hand, by prolonged bed rest due to the severity of stroke, because of the high frequency of swallowing disorders, in contrast to the lack of preventive measures for swallowing pneumonia in reception services. Indeed, the decubitus reduces the tone of the respiratory muscles, resulting in a reduction of the amplitude of the respiratory movements, favoring the stasis of the bronchial secretions. Dehydration increases this phenomenon. In addition, disorders of swallowing favor bronchial infections by bronchial inhalation.

In our series, malaria was found in 17.3% of cases; this result is higher than the 1.5% reported in Cameroon [17]. Nevertheless, few studies have mentioned this intercurrent complication in the acute phase of stroke, which is endemic and epidemic in tropical zones. This high prevalence of malaria in our series is due to the high prevalence of malaria in our context, the lack of collective or individual preventive measures of malaria transmission in public hospitals in our country; moreover, the majority of our patients were recruited during the wet season, period of malaria epidemic peak.

Urinary tract infections accounted for 16.2% of our patients, similar to the results of other studies in sub-Saharan Africa, which reported this infection in 15.6% to 25% of stroke patients in

the acute phase [15,17,18]. By contrast, in most developed countries, an average urinary tract infection rate of about 12% of patients with acute stroke is reported, due to the beneficial effect of stroke units [10,11,13,14]. This high prevalence of urinary tract infections in our study and in sub-Saharan Africa is due to poor hygiene, insufficient asepsis when bladder catheters are placed, and long delays in urinary catheter replacement for economic reasons.

Sepsis was diagnosed in 6.6% of our patients, significantly lower than those observed in Congo-Brazzaville (42.1%) [15] in Senegal (33.3%) [19], because they related to comatose stroke hospitalized in resuscitation services.

In our study, thromboembolic complications were identified in 4.1% of cases. This result is close to that of the literature, where a venous thromboembolic complication was reported in 3.7 to 5.8% of cases [14,17,20]. In contrast, Danish [10] and Korean [13] series respectively found only 0.6% and no case of pulmonary embolism or DVT of limb.

In our series, decubitus sores affected up to 10.7% of our patients, a result comparable to that of Mapoure et al. [17] who found this complication in 4% of cases. This type of complication has almost disappeared in the series of developed and emerging countries since the advent of stroke units [14]. Stroke units are intended to provide an effective organization for the prevention, early identification, and management of acute phase stroke complications [21]. However, pressure ulcers remain a serious complication for acute stroke hospitalized patients in sub-Saharan Africa due to the virtual absence of stroke units, lack of anti-decubitus mattress, poor hygiene and nursing. In our health system, there are no caregivers, the nursing of patients is left to the care of families.

In our series, undernutrition was noted in 22.8% of patients, in agreement with data from the literature. In fact, the incidence of undernutrition varies from 7 to 15% at admission, from 22 to 35% after 2 weeks [22]. It appears to be favored by dietary restrictions due to swallowing disorders, vomiting and impaired alertness associated with intracranial hypertension complicating certain stroke, hypercatabolism and acute stroke diets.

The relatively high incidence of cardiac complications (cardiac arrhythmias, particularly

atrial fibrillation, heart failure, MI, sudden death) explain in part the poor short-term prognosis of patients with cardioembolic stroke in comparison with other ischemic stroke subtypes [23,24]. A significant minority of patients have elevated levels of blood troponin indicative of heart damage [25], not found in our study.

In our study, in multivariate analysis, the initial clinical severity of stroke (NIHSS ≥ 17) was identified as an independent factor associated with the occurrence of medical complications in the acute phase of stroke. This observation confirms what several other studies have already shown: the initial severity of stroke is strongly associated with a higher risk of most medical complications in the acute phase of stroke [14,26,27,28].

This could be explained by the fact that the most severely deficient patients, especially those with impaired alertness and / or complete hemiplegia, have swallowing disorders and are confined to prolonged immobilization, which exposes them to pneumonias of inhalation, and other complications of decubitus (urinary infections, venous thrombo-embolic complications, bedsores, etc.). At the opposite, in a recent clinical study, in-hospital medical complications (vascular, urinary, and infectious) were relevant factors influencing duration of hospitalization after acute stroke [28]. The risk of broncho-inhalation is increased by the depth of the impairment of alertness, due to the lack of protective reflexes in these patients. It is thought that most stroke-related pneumonia results from dysphagia and subsequent inhalation of oropharyngeal material or gastric contents. This is confirmed in our study, where deglutition disorders were present at admission in more than half of our patients and were an important independent risk factor for the occurrence of medical complications after stroke.

In addition, the use of invasive procedures such as urinary catheterization or mechanical ventilatory support in these intensive care patients increases the risk of infection by facilitating the entry of pathogens.

Acute stroke can result in induced immunosuppression, a systemic anti-inflammatory response that is associated with increased susceptibility to infection [29]. This anti-inflammatory response has been found in various clinical studies of patients with acute stroke, and includes an excessive anti-

inflammatory cytokine response and alterations in cell-mediated immunity [29]. Some features of this response—that is, reduced lymphocyte counts, delayed regeneration of T-cell loss—were more pronounced in patients developing post-stroke infections [29,30]. These results suggest that immunological changes may facilitate infection during acute stroke.

Thus, treatment that may reduce the size and severity of the initial brain injury may be the most important factor for further reduction of post-stroke complications. Therefore, early and effective treatment of stroke, such as thrombolysis and control of physiological parameters and homeostasis [31] in evidence-based stroke units [32], may be the most important way to reduce acute medical complications after stroke. In addition, primary stroke prevention, including control of vascular risk factors, by reducing the severity of stroke, also contributes to the reduction of medical complications after stroke.

Our study also identified the presence of comorbidities as an independent factor associated with the occurrence of medical complications after stroke, confirming the data already reported in the literature. Indeed, for some authors [28,33], the presence of comorbidities, mainly pre-stroke disability, was the most important risk factor for acute medical complications of stroke, particularly for venous thromboembolic complications, pressure ulcers, pain, anxiety and depression. Other authors have identified other comorbidities such as chronic obstructive pulmonary disease, smoking status and diabetes [34,35].

Care supports in stroke units reduces the risk of complications due to comorbidities.

In the literature, advanced age, most often > 65 years, has been identified as an independent factor associated with the occurrence of medical complications following ischemic stroke [36,37]. In fact, the elderly person's stroke has the particularity of worse, vital, functional and cognitive prognosis, a longer hospital stay, because of the particularly high frequency of medical complications, especially intercurrent post stroke infections, more frequent comorbidities (polypathological context), a preexisting physical and cognitive handicap, the greater risk of under-optimal "ageism" treatment of Anglo-Saxons, hence a higher intra-hospital mortality [38]. This observation could not be

made in our series because of the strong representation of haemorrhagic strokes (about 1/3 of the strokes in our series), characterized by a younger age of onset compared to cerebral infarctions, and causes dominated by chronic hypertension, early onset, untreated, because most often unrecognized.

The presence of vigilance disorders on admission has also been reported in the literature as an independent factor associated with the occurrence of medical complications [39]. Indeed, patients with impaired alertness, frequently have swallowing disorders due to the disappearance of the airway protection reflex, which exposes to broncho inhalation and therefore to the risk of inhalation pneumonia. These patients are also subjected to a prolonged immobilization which exposes them to the complications of decubitus (pneumonias, urinary infections, venous thrombo-embolic complications, bedsores, ...) [27,28]. Our study used coma on admission (defined by the Glasgow score ≤ 8) as an independent variable and not an impairment of alertness (defined by a Glasgow score of ≤ 14). We did identify coma at admission as a factor associated with the occurrence of medical complications in univariate analysis, but failed to confirm it as an independent factor in multivariate analysis because of low numbers (7/197) comatose patients on admission.

5. LIMITS OF THE STUDY

Certain medical complications occurring during the acute phase of stroke were not considered in our study. These include traumatic fall injuries with or without fractures, severe sphincter disorders such as stubborn constipation, urinary or anorectal incontinence or urinary retention, severe electrolyte disturbances, and others.

We used rigorous criteria for the diagnosis of pulmonary embolism; these criteria included a symptomatic presentation associated with radiological evidence. Thus, we were able to underdiagnose some cases of pulmonary embolism or DVT, particularly in patients who were asymptomatic or whose symptomatology was masked by a pulmonary infection, or those who could not stand the imagery test for example of an alteration of consciousness, or those who did not have the financial means to carry out this examination. Most of the patients in our study were treated with antithrombotic agents.

6. CONCLUSION

Medical and neurological complications remain frequent in the acute phase of stroke at Tingandogo University Hospital, Burkina Faso, due to the absence of stroke units, the unavailability of fibrinolysis of cerebral infarctions. They are dominated by pulmonary infections, neurological deterioration, cardiac complications, malnutrition, malaria, urinary tract infection. Initial clinical severity of stroke, swallowing disorders at admission, and comorbidities were the factors associated with the occurrence of post-stroke medical complications. Treatments to reduce the size and severity of initial brain injury, such as thrombolysis and control of physiological parameters and homeostasis, screening and management of swallowing disorders and comorbidities, ideally in stroke units, are the most important means for a significant reduction in post-stroke complications. Screening and adequate management of patients at high risk of medical complications in the acute phase of stroke will reduce the incidence of these complications and help reduce mortality and disability after stroke.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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