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Intra-hospital mortality of stroke and its predictive factors in a reference hospital in Ouagadougou, Burkina Faso

Lompo Djingri Labodi[1], Cisse Kadri[3], Yameogo Nobila Valentin[2], Napon Christian[2] and Kabore B Jean[2]

[1]University Hospital of Tingandogo, Unit of Formation and Research of the Sciences of the Health, University Ouaga I-Pr Joseph Ki-Zerbo

[2]University Hospital of Yalgado Ouedraogo of Ouagadougou, Unit of Formation and Research of the Sciences of the Health, University Ouaga I-Pr Joseph Ki-Zerbo

[3]Institute of Research in Health Sciences, Ouagadougou, Department of Medical Biology and Public Health

Abstract

Introduction: The aim of this study was to identify predictive factors for intra-hospital stroke mortality in a cohort of patients hospitalized for stroke within 72 hours of the onset of signs at the Tingandogo University Hospital in Ouagadougou, (Burkina Faso).

Patients and methods: It was a prospective, analytical study of consecutive patients hospitalized for stroke from March 2015 to February 2016. Sociodemographic characteristics, vascular risk factors, comorbidities, clinical, neuroradiological and biological data at admission, as well as Intra-hospital mortality rates have been described. An univariate, then multivariate analysis with logistic regression allowed to identify the independent predictors of intra-hospital mortality of stroke.

Results: During the study period, 157 patients were consecutively hospitalized for stroke, 113 cases of cerebral infarction (72%) and 44 cases of intracerebral hemorrhage (28%). The male patients accounted for 61.1% of the workforce, the average age was 61.8 years (range 28-92 years). At admission, the National Institute of Health Stroke Score (NIHSS) averaged 15 (range 0-38), neurological deficit was severe (NIHSS ≥ 17) in 46.7%, Glasgow admission score averaged 13.7 (extremes 3 and 15) and 12 patients (7.6%) were in a coma (Glasgow ≤ 8). The mean hospital stay was 13.2 days (range 3 and 40 days). The intra-hospital mortality rate was 28.7% with an average intra-hospital death rate of 12.1 days (range 3 and 40 days). Independent predictive factors for intra-hospital mortality were NIHSS at admission ≥ 17 (OR 2.909, p = 0.036), admission hyperglycemia (OR 6.752, p = 0.000), renal failure at admission (OR 3.903, p = 0.031), hemorrhagic stroke (OR 5.580, p = 0.003) and cardiac comorbidities (OR 6.393, p = 0.009). Intra-hospital mortality is high in Tingandogo University Hospital in Ouagadougou, Burkina Faso. Reasons for the increased mortality rate have been discussed.

Conclusion: Intra-hospital mortality of stroke remains high in Tingandogo University Hospital. Reducing early mortality by stroke in sub-Saharan hospitals requires early access to the highest number of patients to quality care in high quality specialized facilities such as stroke units.

Introduction

Stroke appears today as a major cause of preventable death and disability in the world [1,2]. Today, early intra-hospital or monthly mortality per stroke varies from less than 15% to 22.9% in Western countries [3-5]. Early mortality of cerebral infarcts has declined sharply, dropping from 10. 2-12. 7% in 2003 to 8. 4-10. 1% in 2013, as a result of improved access to quality care, including timely patient transportation, evidence-based medical interventions, and specialized high-quality facilities such as stroke units (SU) [6]. About Intracerebral haemorrhage (ICH), their intra-hospital mortality has remained quasi-stationary [7] due to the absence of specific therapeutics effective in reducing mortality [8].

Developing countries account for nearly 85% of stroke deaths worldwide [1,2] and intra-hospital mortality rates or one month per stroke range from 25 to 46% [9]: 24. 10% in Senegal [10]; 25% in Congo-Brazzaville [11]; 26. 8% respectively in Cameroon and Uganda [12-14]; 35 to 46 per cent in Nigeria [15,16], except for a South African study that reported a 3-month mortality rate of 22.5% [17].

This high stroke mortality rate in sub-Saharan Africa may be due to the higher proportion of ICHs in blacks [18] and their high lethality around the world, the high incidence of severe or catastrophic stroke [19,20], the shortage and prohibitive costs of medico-technical equipment, inadequate health human resources [21, 22]. Many predictive characteristics of early stroke death have been identified [14,23,24]. Hospital mortality of stroke is an excellent tool for measuring performance and quality of hospital management of stroke; its evaluation and a better understanding of its predictive factors are useful for the implementation of specific therapies and effective strategies for the management of high-risk patients [4,25], in a resource-constrained environment. To our knowledge, no studies have yet been made in Burkina Faso on the intra-hospital mortality of stroke and its predictive factors of occurrence.

The purpose of this study was to evaluate intra-hospital mortality and to identify independent predictive factors for intra-hospital deaths of patients hospitalized with stroke less than 72 hours.

Patients and methods

This is a prospective, transverse, observational, descriptive and analytical study carried out at the University Teaching Hospital (UTH)

Correspondence to: Lompo Djingri Labodi, University Hospital of Tingandogo, Unit of Formation and Research of the Sciences of the Health, University Ouaga I-Pr Joseph Ki-Zerbo, Burkina Faso; Tel : +226 70 23 98 34; E-mail: labodilompo@yahoo.fr

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of Tingandogo in Ouagadougou. It is one of the tertiary hospitals (3rd reference level) of the city of Ouagadougou, political capital of Burkina Faso. The hospital has 600 beds in 15 pavilions, of which only 200 are operational at the present stage. Our study was conducted in the department of neurology, housed in the department of medicine and medical specialties, which has 34 beds distributed in 12 rooms. Our study lasted 18 months, from March 1, 2015 to August 30, 2016. It examined adult patients (> 16 years of age) of all sexes, consecutively hospitalized in the Department of Neurology, for neuroimaging (CT or Brain MRI) confirmed stroke, up to 72 hours after its onset, excluding subarachnoid haemorrhages. For each patient, the following tests were performed at admission: blood pressure (BP), temperature, capillary blood glucose; National Institutes of Health Stroke Score (NIHSS), Glasgow coma score (GCS); Electrocardiogram (ECG) standard; brain scan; creatininemia & blood urea, numeration blood formula-platelet levels, blood crest, blood ionogram. In case of cerebral infarction, the lipid balance (total cholesterol, Low Density Lipoprotein (LDL) cholesterol, High Density Lipoprotein (HDL) cholesterol, triglycerides), transthoracic heart ultrasound and holter ECG were also performed, if necessary. The radiologists performed the interpretation of the brain scan. Additional tests were performed on a case-by-case basis: standard chest x-ray in case of suspicion of bronchopneumopathy, biological check-ups if necessary; tick drop in case of suspicion of malaria, cytobacteriological examination of the urine if suspicion of urinary infection, blood culture, in case of suspicion of septicemia; brain scanner if needed, ...

The evolution of the patients during hospitalization was monitored daily by a clinical evaluation possibly aided by complementary examinations on a case by case basis and the complications regularly noted in the medical file, until the end of the hospitalization. The complications sought included those observed at admission or which appeared during hospitalization. Upon discharge from hospital, patients were subdivided according to discharge status, surviving patients and deceased patients.

Patients were treated according to the recommendations of the European Stroke Organization (ESO 2008). The Department of Neurology does not yet have SU.

The variables studied included socio-demographic characteristics, vascular risk factors (VRFs), modified Rankin score (mRS) before stroke, comorbidities, care pathway, (temperature, BP, GCS, NIHSS), radiographic data on initial CT scan [nature of stroke, ICH volume, other neuroradiological abnormalities), qualitative biological data at admission (hemoglobin, leukocytes, blood sugar, serum sodium, serum potassium, serum creatinine); medical complications, present at admission or occurring during hospitalization (thromboembolic venous complications, haemorrhagic complications, metabolic complications, infectious complications, cardiac complications, respiratory complications, neurological complications present on admission or appearing during hospitalization: neurological deterioration during hospitalization (increased neurological deficit, including alertness), epileptic seizures, relapse or extension of stroke, life-threatening prognosis at the end of hospitalization (survivors / deceased).

The consent of the patients or that of their legal representatives was ensured before the recruitment. The study protocol was approved by the ethics committee of the University of Ouaga I-Pr Joseph KI-ZERBO and by the national ethics committee of Burkina Faso.

Statistical analyzes were carried out using the SPSS12 software. Student's t-test was used to compare the averages and the Pearson Chi-square test to compare percentages; the value of $p < 0.05$ was considered as a threshold of statistical significance. Univariate analyzes between the different characteristics of the patients and intra-hospital mortality made it possible to select the variables significantly associated with intra-hospital mortality. Finally, multiple logistic regression analysis identified independent factors influencing intra-hospital mortality. Only variables with a $p < 0.20$ value in bivariate analysis were taken into account for multivariate analysis.

Results

During the study period, we recorded 157 cases of stroke, 113 cases of cerebral infarction (72%) and 44 cases of ICH (28%). There were 61 female patients (38.9%), a sex ratio of 1.57. The mean age of the patients was 61.8 years (range 28 and 92 years); the majority of patients (54.8%) were ≤ 65 years of age; 67.5% of patients had no education; 68.2% of the patients resided in urban areas; 112 patients (73.3%) were referred from a health facility, while 45 patients (28.7%) consulted directly; the majority of patients (83.4%) consulted within ≤ 24h; for 75.2% of patients, CT was performed within 12 hours after arrival in the emergency room. At least one VRF was found in 131 patients, either 83.4%.

At admission, 90 patients (57.3%) had NIHSS ≤16 (mild to moderate neurological deficit) versus 67 (42.7%) patients with NIHSS> 16 (severe to very severe neurological deficit), 110 patients (70.1%) had a normal vigilance state, 35 patients (22.3%) had altered vigilance and 12 patients (7.6%) were in a coma. Anomalies of clinico-biological constants at admission were dominated by hypertension with 111 cases (70.7%), hyperglycemia with 71 cases (45.2%), and hyperleukocytosis with 45 cases (28.7 %). The initial volume of HIC was ≤ 60 cc in 31 patients (70.5%) and> 60 cc in 13 patients (29.5%). General and neurological complications present at admission or appearing during hospitalization were dominated by fever with 85 cases (54.5%), pneumonia with 75 cases (48.7%), neurological deterioration with 60 cases (38.9%) and epileptic seizures with 27 cases (17.8%).

Table 1 shows the distribution of patients according to their main characteristics.

The mean hospital stay was 13.2 days (range 3 and 40 days). At the end of the hospitalization, 45 patients died, ie an intra-hospital stroke mortality rate of 28.7% for an average life expectancy after stroke in the 12.1 days (extremes 3 and 40 days) and an average hospital stay of 13.7 days (extremes 4 and 33 days) in survivors ($p = 0.019$). Depending on the nature of the stroke, there were 26 cases of cerebral infarction deaths and 19 cases of HIC deaths, ie intra-hospital fatality rates, 23% for infarcts and 43.2% for the ICHs ($p = 0.012$). The intra-hospital mortality rate was 12.7% at day 7, 21% on day 14 and 28.7% at the end of hospitalization.

At the end of hospitalization, there were 112 survivors (71.3%), of which 39 patients (34.8%) were independent or autonomous (mRS≤2).

After univariate analysis, cardiac comorbidities, an admission delay of> 24 hours, a time to perform CT ≤ 4 hours, initial clinical severity of stroke (NIHSS ≥ 17), intake swallowing disorders, coma on admission (GCS ≤ 8), intake fever, intake hyperglycemia, intake dyskalaemia, intake dysnatraemia , renal failure at admission, intake leukocytosis, hemorrhagic nature of stroke, were the variables significantly associated with intra-hospital mortality.

After multivariate analysis using the ascending logistic regression method, the following independent intra-hospital mortality predictive

Subject	Numbers	Frequencies
Vascular risk Factors		
High Blood Pressure (HBP)	119	75.8%
Hypercholestérolemia	41	26.1%
History of stroke	34	21.7%
Diabetes mellitus	20	12.7%
Alcoholism	12	7.6%
Smoking	10	6.4%
Obesity	8	5.1%
Comorbidities	47	29.9%
Pre-existing handicap	8	5.1%
Clinical data at admission		
NIHSS - Mean : 15,01 - Extremes : 0-38		
GCS - Mean : 13,70 - Extremes : 3-15		
Coma (GCS ≤8)	12	7.6%
HBP	111	70.7%
Hyperthermia	23	14.6%
biological intake data		
Hyperglycemia	71	45.2%
Hyperleukocytosis	45	28.7%
Hypokaliemia	39	25.3%
Renal failure	31	19.7%
Hyponatremia	23	15%
Hypernatremia	15	9.8%
Anemia	14	9.1%
CT scan data at admission		
Leucoaraiosis	66	42%
Cicatricial lesions	37	23.6%
Early signs of cerebral ischemia	10	8.9%
Initial volume of ICH - Mean : 43.9 cc - Extreme 18- 91cc		
Cerebral edema	44	28%
Brain swelling	33	21%
Hemorrhagic transformation	20	17.7%
Malignant sylvian infarction	15	13.2%
Ventricular flood of ICH	24	54.5%
Medical and neurogical complictions at admission and during hospitalisation		
Fever	84	54.5%
Pneumopathy	75	48.7%
Neurological deterioration	61	38.9%
Epileptic seizures	28	17.8%
Cardiac complications	25	16.2%
Malaria	21	13.6%
Urinary tract infections	20	13%
Venous thrombo embolic complications	10	6.4%
Respiratory complications	7	4.5%
Sepsis	6	3.9%
Hemorrhagic complications	5	3.2%
Recurrence of stroke	3	1.9%

Table 1. Distribution of patients according to the main characteristics at admission and / or during hospitalization

factors were identified: cardiac comorbidities (OR 6.393, 95% CI 1.591-25.694, p = 0.009), cardiac comorbidity NIHSS ≥17 (severe neurological deficit) on admission (OR 2.909, 95% CI 1.071-7.900, p = 0.036), haemorrhagic stroke (OR 5.580, 95% CI 1.822-17.091, p = 0.003) , admission hyperglycemia (OR 6.752, 95% CI 2.432-18.744, p = 0.000), renal insufficiency at admission (OR 3.903, 95% CI 1.131-13.475); p = 0.031). The results of the univariate and multivariate analysis are summarized in the following Table 2.

Discussion

Intra-hospital mortality

The intra-hospital mortality rate of 28.7% found in this study remains high, but it is comparable to the results of the recent African sub-Saharan stroke studies, where intra-hospital mortality rates ranged from 25% to 46% [9,11,16]: 24.10% in Senegal [10]; 25% in Congo-Brazzaville [11]; 26.8% in Cameroon and Uganda respectively [12-14], 41% in the Gambia [26]; 35 to 46% in Nigeria [15,16,22]. However, in a South African study, the mortality rate at 3 months post-stroke was 22.5% [17].

Intra-hospital mortality in our study is, however, significantly higher than that reported in developed countries, where it varies from less than 15% to 22.9% [3-5,17,18,27]. The lowest rates are for cerebral infarcts, whose mortality dropped from 10.2-12.7% to 8.4-10.1% between 2003 and 2013. The early mortality rate for ICHs has remained virtually unchanged [16]: 34% in France [27], 40% in the USA [8], because no specific therapies have yet proved effective in reducing mortality after ICH [8]. Reduction of early mortality in ischemic stroke patients in developed countries is due to improved access to quality care, including timely patient transportation, evidence-based medical interventions and specialized facilities of high quality such as SU [6]. Moreover, better prevention of vascular risk factors is more effective, which has reduced the incidence of catastrophic stroke still too frequent in Africa [1,19,20]. Conversely, the high mortality rate of stroke in sub-Saharan Africa may be due to a number of factors: the highest proportion of ICHs in blacks [18], the highest ICH lethality reported worldwide [18,27]; inadequate primary prevention of stroke [19,20], the shortage and prohibitive costs of medical-technical equipment, and the inadequacy of qualified human resources for investigations, emergency care and rehabilitation of stroke patients in sub-Saharan Africa [28].

Independent predictors of intra-hospital mortality

Our study identified several independent predictors of intra-hospital mortality after stroke.

The initial clinical severity of stroke (initial NIHSS ≥ 17) recognized as an independent predictor of early mortality by our study and several other studies [13-15], directly reflect the extent and severity of neurological damage secondary to stroke [3,13,14,27]. We have shown, like other studies [13,14,29-32], that admission hyperglycemia was a predictor of early post-stroke mortality. Indeed, hyperglycemia often complicates severe acute strokes, in response to the major stress triggered by lesions of extensive cerebral necrosis, which explains the pejorative life prognosis in these patients. Hyperglycaemia, in turn, contributes to an aggravation of the initial infarction, via its toxicity in the ischemic penumbra zone and potentiation of early reperfusion lesions; the ultimate consequence is an increase in the final volume of the cerebral infarction, a greater risk of hemorrhagic transformation and a pejorative functional and vital prognosis [29-32]. Some studies have reported that hyperglycemia is associated with a poor prognosis after ICH but the underlying mechanisms have not yet been identified [33,34]. Onset, vigilance, severity of neurological deficit and blood glucose levels identify subgroups of patients at increased risk of early stroke death to ensure appropriate monitoring and care ideally in an intensive care stroke unit.

Table 2. Results of the uniivariate and multivariate analysis using the ascending logistic regression method.

Independent variables		Discharge statut		Univariate analysis	Multivariate analysis	
		Survivants	Décédés			
		n (%)	n (%)	p	OR (95% IC)	P
Sex	Male	68 (70.8%)	28 (29.2%)	0.862		
	Female	44 (72.1%)	17 (27.9%)			
Age groups	> 65 years	48 (67.6%)	23 (32,4%)	0.351		
	≥ 65 years	64 (74,4%)	22 (25.6%)			
Levels of education	No	74 (69.8%)	32 (30.2%)	0.545		
	Secondary ou higher	38 (74.5%)	13 (25.5%)			
Residence	Urban	77 (72%)	30 (28%)	0.802		
	Rural	35 (70%)	15 (30%)			
Mode of reference	Home	36 (80%)	9 (20%)	0.130		
	Health service	76 (67.9%)	36 (32.1%)			
Alcohol	yes	8 (66.7%)	4 (33.3%)	0.712		
	no	104 (71.7%)	41 (28.3%)			
HBP	yes	87 (73.1%)	32 (26.9%)	0.388		
	no	25 (65.8%)	13 (34.2%)			
History of stroke	yes	28 (82.3%)	6 (17.6%)	0.110		
	no	84 (68.3%)	39 (31.7%)			
Tabacco	yes	7 (70%)	3 (30%)	0.924		
	no	105 (71.4%)	42 (28.6%)			
Obesity	yes	4 (50%)	4 (50%)	0.173		
	no	108 (72.5%)	41 (27.5%)			
Hyper -cholestero -lemia	yes	34 (82.9%)	7 (17.1%)	0.057		
	no	78 (67.2%)	38 (32.8%)			
Sédentarity	yes	9 (64.3%)	5 (35.5%)	0.544		
	no	103 (72%)	40 (28%)			
Diabetes	yes	12 (60%)	8 (40%)	0.233		
	no	100 (73%)	37 (27%)			
Cardiac comorbidities	**yes**	**9 (47.4%)**	**10 (52.6%)**	**0.014**	6.393 (1.591-25.694)	**0.009**
	no	**103 (74.6%)**	**35 (25.4%)**		**1**	
Comorbidities	yes	30 (63.8%)	17 (36.2%)	0.176		
	no	82 (74.5%)	28 (25.5%)			
Delays in performing cérébral CT	> 4H	90 (76.3%)	28 (23.7%)	0.017	1	0.107
	≤ 4H	22 (56.4%)	17 (43.6%)		3.248 (0.776-13.597)	
Terms of arrival	Personal vehicle	42 (80.8%)	10 (19.2%)	0.067	2.124 (0.684-6.596)	0.193
	Transfer	70 (66.7%)	35 (33.3%)			
Pre stroke mRS	mRS 3-5	7 (87.5%)	1 (12.5%)	0.302		
	mRS 0-2	105 (70.5%)	44 (29.5%)			
NIHSS	**NIHSS ≥17**	**37 (55.2%)**	**30 (44.8%)**	**0.000**	2.909 (1.071-7.900)	**0.036**
	NIHSS≤ 16	**75 (83.3%)**	**15 (16.7%)**		**1**	
Temperature at admission	Fever	10 (43.5%)	13 (56.5%)	0.001	2.686 (0.626-11.524)	0.184
	Normal temperature	102 (76.1%)	32 (23.8%)		1	
HBP at admission	yes	81 (73%)	30 (27%)	0.485		
	no	31 (67.4%)	15 (32.6%)			
Blood glucose at admission	**Normal**	**75 (87.2%)**	**11 (12.8%)**	**0.000**	**1**	**0.000**
	Hyperglycemia	**37 (52.1%)**	**34 (47.9%)**		6.752 (2.432-18.744)	
Natraemia at admission	Normal	94 (79.7%)	24 (20.3%)	0.000	1	0.094
	Dysnatraemia	18 (46.2%)	21 (53.8%)		2.419 (0.859-6.813)	
Leukocyt count at admission	Normal	96 (85.7%)	16 (14.3%)	0.000		
	Hyperleukocytosis	16 (35.6%)	29 (64.4%)			
Creatinine at admission	**Renale failure**	**14 (45.2%)**	**17 (54.8%)**	**0.000**	**3.903 (1.131 – 13.475)**	**0.031**
	Normal	**98 (77.8%)**	**28 (22.2%)**		**1**	
Kaliemia at admission	Normal	87 (76.3%)	27 (23.7%)	0.025	1	0.066
	Dyskaliemia	25 (58.1%)	18 (41.9%)		2.607 (0.937-7.255)	
Cicatricial lesions at initial cerebral CT	yes	31 (83.8%)	6 (16.2%)	0.056	0.414 (0.113-1.516)	0.183
	no	81 (67.5%)	39 (32.5%)		1	
Type of stroke	**ICH**	**25 (56.8%)**	**19 (43.2%)**	**0.012**	**5.580 (1.822 – 17.091)**	**0.003**
	Cerebral infarct	**87 (77%)**	**26 (23%)**		**1**	

Leucoaraiosis at brain scan	yes	52 (78.8%)	14 (21.2%)	0.080		
	no	60 (65.9%)	31 (34.1%)			
Swallowing disorders	yes	46 (53.5%)	40 (46.5%)	0.000		
	no	66 (93%)	5 (7%)			
Admission times	> 24h	23 (88.5%)	3 (11.5%)	0.035		
	≤ 24h	89 (67.9%)	42 (32.1%)			
GCS at admission	<= 8 (coma)	9 (47.4%)	10 (52.6%)	0.014	3.160 (0.959-10.904)	0.054
	> 9	103 (74.6%)	35 (25.4%)		1	

We have found as others [13,22,27,35] that ICHs were an independent predictive factor of early post-stroke intra-hospital mortality. It is universal that ICHs, compared to cerebral infarcts, have a higher mortality rate [18,27]. Indeed, they are more often accompanied by an early alteration of vigilance, or even coma, due to a more frequent and earlier intracranial hypertension.

We have shown, like others [25,36-38], that cardiac comorbidities were also an independent predictive factor of intra-hospital mortality, due to the often advanced age of these patients, the usual clinical extent and severity of cardiac embolism, of a high rate of early cardiac mortality [36,39,40]. Specialized cardiac assessment and management is required in patients with acute stroke associated with cardiac comorbidities [36].

Finally, we identified renal insufficiency at admission as an independent predictive factor of intra-hospital mortality per stroke, in agreement with some publications [41-44]. This could be explained by an increase in the susceptibility of these patients to infections and a greater frequency of fatal cardiac complications secondary to metabolic disorders [45].

Other independent predictors of intra-hospital stroke mortality, identified by some authors, such as sex and especially age [27], severe initial hypertension [22], history of stroke [10,22], were not found in our study.

However, our study suffered from a number of shortcomings: the fact that patients were hospitalized more than 72 hours after the onset of stroke significantly reduced the number of patients, the late admission of some patients (16.6%) did not make it possible to obtain the early data of the beginning of the stroke and finally we did not have the neuroradiological data for the intra-hospital follow-up of our patients because of the non-accessible financial possibility of the cerebral scanner. However, these shortcomings have not hindered the relevance of our study.

Conclusion

Intra-hospital mortality of stroke remains high in Sub-Saharan Africa, ranging from 25% to 45%, and the hospital mortality rate of 28.7% in our study falls within this range. The initial clinical severity of the stroke and initial hyperglycemia, indicative of the extent of neurological damage caused by stroke, cardiac comorbidities due to the usual severity of cardio-embolic infarction and resulting cardiac mortality, the haemorrhagic nature of stroke due to high coma propensity due to intracranial reaction hypertension and renal failure by associated cardiac and infectious complications are the independent predictive factors of early post-stroke deaths. Strategies to reduce early stroke mortality should include screening, monitoring and management of subgroups of patients most at risk of early death, specifically those with hyperglycemia and / or severe neurological deficit and / or coma at the outset, as well as early detection and specialized cardiac and / or nephrological management of patients with cardiac or renal comorbidities. These strategies should also include the prevention and early treatment of intracranial hypertension, ideally in SUs that have proven to be highly effective in reducing mortality and stroke disability around the world.

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