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Evolving Profile and Determinants of Post-Stroke Cognitive Impairment in the 3rd Month among Kinshasa's Survivors (Democratic Republic of the Congo)

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Abstract

Background: Neurocognitive impairments are common among stroke survivors. Despite their negative impact on daily life, their evolving, and deter- minants are not fully known in our context. To determine evolving charac- teristics of post-stroke cognitive impairment in the 3rd month as well as deter- minants among Kinshasa's adult survivors is the aim of this study. **Methods:** We sought to determine neurocognitive deficits in the 3rd month in a prospective single-group cohort study in 3 hospital centers in Kinshasa. Eighty-six adult stroke survivors with a neurological and neuroimaging computerized diagnosis of stroke were assessed using MOCA (Montreal Cognitive Assessment) in the first and the third months post-stroke. **Results:** Neurocognitive disorders ranged from 79.1% in the first month to 54.7% in the third month after stroke (with 4.7% with severe decline). Gender female [AOR = 86.3 ($CI_{95\%}$: 2.8 - 2643.7); $p < 0.01$], Chronic hypertension ([AOR = 26.8 ($CI_{95\%}$: 2.55 - 282.55); $p < 0.01$]), the pathological lipid profile [AOR = 8.7 ($CI_{95\%}$: 1.10 - 68.82); $p = 0.04$] and worse MOCA score at the first month ([AOR = 41.2 ($CI_{95\%}$: 8.13 - 2134.81); $p = 0.021$]) were identified as worse predictors of cognitive impairments at the third month post-stroke. **Conclusion:** Post-stroke cognitive impairment is common and decreases in the 3rd month post-stroke. Chronic hypertension, gender, lipid profile, and the first month MOCA score are predictors of worse cognitive performance in Kinshasa survivors. These findings suggested the role of early management in improving cognition and the control of stroke risk factors.

Keywords

Stroke, Post Stroke Cognitive Disorders, MOCA

1. Introduction

Stroke is now experienced as a global pandemic. The severity of stroke is based not only on its mortality but especially on the resulting disabilities, including cognitive impairment. Post-stroke cognitive impairment defined as cognitive decline occurring 3 months after stroke due to neuroanatomical changes in cerebral strategic areas is common in stroke survivors while their underlying mechanisms are not completely elucidated [1] [2]. It is estimated that 64% of stroke survivors develop cognitive impairment [3] with deplorable consequences for their socio-professional future. Despite this, post-stroke cognitive disorders are underdiagnosed and underestimated in favor of motor disorders which come first in the majority of cases. Epidemiological data of PSCI are divergent, due to methodological approaches of studies. But there is, at least, an agreement on their high frequency. In Europe, particularly in Britain, the prevalence of cognitive impairment 3 months after stroke was estimated at 24% [4]. In Holland out of 176 subjects assessed 6 months after stroke, the prevalence of cognitive impairment was estimated at 70% [5]; in Norway, 57% of survivors had developed cognitive impairment 1 year after having a stroke [6]. In the USA out of 212 subjects included in the Framingham study, 19.3% had developed cognitive impairment 10 years after stroke [7]. In Africa, in Nigeria, the CogFast study noted a prevalence of 48.3% of cognitive impairment 3 months after stroke [8].

A large number of risk factors including the neuroanatomical and neuroimaging characteristics of the stroke, the pre-existing and co-existing cardiovascular risk factors as well as the clinical and demographic characteristics of the patient contribute to the pathogenesis of post-stroke cognitive impairment [9]. Identifying these risk factors in the acute phase and managing them where possible can help improve the cognitive profile of stroke survivors. Considering the stroke increasing incidence in low to middle-income countries including DRC, the current study aims to evaluate the neuropsychological profile of patients 3 months after their stroke as well as the determinants of cognitive disorders occurring within the same period.

2. Methodology

2.1. Study Design and Setting

A prospective cohort study is conducted with a single group. The city of Kinshasa Province was chosen to carry out our study. This choice was motivated by the fact that Kinshasa is not only a city in full demographic growth with a consequent increase in cases of stroke in their multiple forms but also it remains to this day the only city in the DRC with advanced neuroimaging tools, including CT and

Magnetic Resonance Imaging. The various hospitals including Saint Joseph Hospital, the Congolese Sino Friendship Hospital (HASC), and the Kinshasa General Reference Hospital (HGRK) were selected based on their geographical position, placing them at the crossroads of high-density municipalities and thus promoting massive accessibility for patients, including stroke patients. Indeed, this study was conducted during different study periods respectively October 2016 to June 2017, July 2017 to February 2018, and October 2017 to March 2018.

2.2. Study Population

The study population consisted of stroke patients who met the following criteria: being adult patients aged at least 18 years old with a diagnosis of stroke documented by medical imaging, having an educational level to answer the questionnaire, not having a disability that could interfere with the progress of the assessment such as severe aphasia, paralysis, and no history of brain damage other than stroke. Patients with severe aphasia were excluded from the study.

2.3. Sample Size

During the study period, 247 patients had been identified and certified as having had a stroke. Only eighty-six (86) were selected for our study according to the selection criteria: thirty-six (36) for Saint Joseph, thirty-seven (37) for HGRK and thirteen (13) for HASC.

2.4. Sampling Technic

A purposive sampling was applied to select hospitals. The three hospitals were selected according to their location at the crossroads of municipalities with a high population density. The Saint Joseph Hospital located on Boulevard Lumumba is an access point for the inhabitants of the communes of Limete, Lemba, and Kingabwa. The HGRK is the affluent point of the inhabitants of the communes of Kinshasa, Lingwala, Gombe and even Barumbu. The HASC receives the inhabitants of the N'Djili, Masina, and Kimbanseke communes.

2.5. Data Collection

Interviews with a structured questionnaire were used to collect data from the patients selected. Training sessions were organized for interviewers recruited by the investigator. These sessions covered the objectives of the study, variables of interest, the methodology of the study, and the pilot checking tool's consistency. The questionnaire covered all sociodemographic, clinical, and paraclinical information and neuropsychological characteristics. For data collection, four interviewers were recruited to ensure data collection. All data were sent to the investigator for checking and feedback for improvements.

2.6. Variables of Interest

Socio-demographic characteristics such as age, sex, education, and occupation

were collected. Level of education was defined as the highest level of education attained by the patient. Occupation was assessed by seeking the exercise of a public or private professional activity. Those with no activity were classified as non-active subjects and those with occupational activity were classified as active patients.

Clinically, the patient's state of consciousness was measured. Consciousness was retained when the patient or caregiver did not report altered consciousness during the stroke; It is said to be impaired when the patient reported a disturbance of consciousness at the time of stroke either in a coma situation or in confusion. In addition, a history of high blood pressure, diabetes mellitus, alcohol, and tobacco were sought. Neuroradiological data: took into account the type of stroke, hemispheric and corticosteroid or subcortical location, vascular territory, and lesions associated with stroke.

Cognitive functions were explored by the MOCA version 7.1 or Montreal Cognitive Assessment. This test was designed with the main objective of screening for mild neurocognitive impairment. It is a short-answer questionnaire that lasts 5 to 10 minutes. The elements assessed are grouped into 6 subsections: short-term memory, visuospatial skills, executive functions, attention, concentration, working memory, and temporospatial orientation. The maximum score is 30 points. Patients were grouped into 5 classes: pathological (<26), normal (26 - 30), mild cognitive impairment (18 - 25), moderate cognitive impairment (10 - 17) and severe cognitive impairment (<10). A correction was made according to the level of education, it is necessary to add a point if the patient's schooling is 12 years or less [10].

2.7. Exposure and Outcome

In this study, stroke was considered the exposure. Its measurement was made based on the patient's clinical picture and the cerebroscannographic confirmation. Impairment of cognitive function assessed by MOCA was the main variable of interest.

2.8. Follow-Up

As the cohort was open-label, each stroke patient was followed for a period of 3 months. Patients were identified as soon as they were admitted to the emergency department. Consent to participate in the study was obtained either from the accompanying person or from the patient himself. The first neurocognitive assessment was performed within the first 30 days after the stroke and the second assessment at month three post-stroke using MOCA. Tests were performed by appointment either in a hospital or at home. Potential confounders such as age, gender, socioeconomic level, occupation, and educational attainment were measured.

A total of 86 adults with a diagnosis of stroke had to fulfill the neurological and neuroimaging criteria for the disease and were subjected to neuropsychological testing using the MOCA for cognition in the first month following the stroke. All risk factors of cognitive decline were collected. After baseline information was collected, subjects in a prospective cohort study approach were then followed longi-

tudinally, in the third month after the stroke. All study participants fulfilled the following inclusion criteria: post-stroke adult with a computerized diagnosis, education level that enables him to answer the questionnaire, no carrier of a disability that should interfere with the progress of the assessment such as severe aphasia or paralysis, and no history of brain damage other than stroke.

2.9. Statistical Analysis

Data were collected and coded according to the categories whether they were open-ended or closed-ended questions. Encoded and unencoded data was entered on the computer using Microsoft Excel. After quality control, the data were transferred to the SPSS software version 20.0 for various analyses. The proportions were used to determine the extent of cognitive impairment in the stroke patient.

The quantitative variables were summarized on average and the standard deviation. Proportion was used to summarize qualitative variables. The Z-test for the difference in proportions; the Student-test for the comparison of means; and the chi-square to look for the association between cognitive function disorders and the different risk factors for cognitive disorders. Relative risk was calculated to confirm associations. Results were considered significant when p was ≤ 0.05.

2.10. Ethics

The proposal received ethical approval from the ethics committees of the Kinshasa School of Public Health (ESP/CE/01B/2018). Participation was voluntary. All participants provided written informed consent after a full explanation of the nature, purpose, and procedures used in the study. The participants were informed that responses would be anonymous and that they were free to withdraw from the interview or discussion at any time.

3. Results

A total of 86 patients were selected for our study. The average age was 58.5 (49 - 67), the male gender was more representative, sociodemographic, and para-clinical variables had been searched (Table 1).

Indeed, three-quarters of patients had an occupation (76.7%) and nearly nine out of ten patients had at least 7 years of study (91.9). With regard to clinical and para-clinical history, Table 1 shows that at least one patient in five had smoked in the past (18.6%), and nearly seven patients had a history of alcohol intake (69.8%). In addition, at the time of admission to the emergency room, at least five out of ten patients had chronic hypertension (54.7%), and nearly six out of ten diseases had an altered state of consciousness (61.6%Ischemic stroke was the most common form (70.9%). Finally, the analysis of CT images of stroke patients revealed that the subcortical region was the most affected (66.3%). The left hemispheric localization was the most encountered (72.1%) and involvement of the basivertebral territory was found in one patient in five (20.6%).

The study showed that cognitive disorders in survivors were observed in 79.1% of cases in the 1st month after stroke, and their proportions were reduced

Table 1. Sociodemographic and clinical characteristics of stroke survivors.

Characteristics	N(%)
Age (Median/P35-P75)	58.5 (49 - 67)
Gender	
Male	59 (68.6)
Female	27 (31.4)
Occupation	
Active	66 (76.7)
Not-active	20 (23.3)
Level of study	
≤7	7 (8.1)
>7	79 (91.9)
Tobacco	
Yes	16 (18.6)
No	70 (81.4)
Alcohol	
Yes	60 (69.8)
No	26 (30.2)
Type alcohol consumption	
Not excessive	36 (60)
Excessive	24 (40)
Chronic hypertension	
Yes	47 (54.7)
No	39 (45.3)
State of consciousness	
Preserved	53 (61.6)
Disturbed	33 (38.4)
Stroke type	
Ischemic	61 (70.9)
Hemorrhagic	25 (29.1)
Region	
Cortical	29 (33.7)
Sub-cortical	57 (66.3)
Localization	
Left hemispheric	62 (72.1)
Right hemispheric	21 (24.4)
Bi-hemispheric	3 (3.5)

Continued

Vascular territory	
Carotid	68 (79.1)
Basilar vertebro	18 (20.9)
Lipid profil	
Pathological	44 (51.2)
Normal	42 (48.8)

3 months later to 54.7% (Table 2). The severity of cognitive impairment decreased from 16.3% to 4.7% from the 1st to 3rd month after stroke (Table 3).

Furthermore, Table 4 summarizes the analysis of the homogeneity of explanatory variables in patient groups. It shows that the distribution of explanatory variables such as age, sex, and schooling was not homogeneous in the two groups ($p > 0.05$). On the other hand, only chronic hypertension, alcohol consumption, and MOCA impairment in the first month at admission were homogeneously distributed in both groups ($p < 0.01$) (Table 4).

PSCI predictors are shown in Table 5. Female patients and patients with chronic hypertension had respectively 86 times (ORA = 86.3; IC 2.8 - 2643.7; $p = 0.01$) and 36 times (ORA = 26.8; $CI_{95\%}$ 2.55 - 282.55; $p < 0.01$) at risk of developing PSCI. Patients with pathological lipid profile and pathological MOCA in the first month were respectively 8 times (ORA = 8.7; $CI_{95\%}$ 1.10 - 68.82; $p < 0.01$) and 41 times (ORA = 41.2; $CI_{95\%}$ 8.13 - 2134.8; $p = 0.021$) more exposed to PSCI (Table 5).

4. Discussion

This study presented an evaluation of cognitive performance using MOCA among post-stroke survivors in the first and third months after stroke. Our results showed that post-stroke cognitive impairment was common in many survivors, especially in the first moments after stroke, with proportions of impaired patients varying from 79.1% in the first month to 54.7% in the third month after stroke, as reported by Rasquin *et al.* during the same period [5]. This high prevalence is due, on the one hand to the acute neuroanatomic lesions underlying the stroke, including cerebral hypoperfusion, cytotoxic and vasogenic edema, brain neurotransmission disturbances, hyperglycemia, and neuroinflammation, and on the other to patient pre-existing specific factors, including (age, high blood pressure, diabetic…). Three months after the stroke, cognitive disorders decreased from 79.1% to 54.7% slightly higher than the findings of some authors among which Akinyemi *et al.* [8] and Tu *et al.* [11] but lower than Yu *et al.* [12]. This decrease in PSCI is probably related to the effects of early management or functionally dynamic factors in the acute phase of the stroke mentioned above.

Table 2. Evolving of PSCI from the 1st month and to the 3rd month after stroke.

Period	%
1st month	79.1
3rd month	54.7
Proportion (%) of cognitive impairment	

Table 3. Evolving cognitive impairment severity from the 1st to the 3rd month after stroke.

Type of Cognitive Impairment	1st Month	3rd Month
Mild	37.2	38.4
Moderate	25.6	11.6
Severe	16.3	4.7
Proportion (%) of cognitive impairment		

Table 4. Differences in clinical neuroimaging and neuropsychological characteristics of stroke survivors with and without cognitive impairment.

Characteristics	MOCA Impairment	Normal MOCA	P
Age (M ± SD)	60.4 ± 10.6	56.4 ± 11.8	0.103
MOCA (M ± SD)			<0.01
1st month	12.4 ± 6.9	24.4 ± 3.6	
3rd month	19.09 ± 6.5	27.9 ± 1.3	
Gender			
Male	33 (55.9)	26 (26.8)	0.724
Female	14 (51.9)	13 (48.1)	
Occupation status			0.292
Active	34 (51.5)	32 (48.5)	
Not-active	13 (65.0)	7 (35.0)	
Level of study			0.762
≤7	3 (42.9)	4 (57.1)	
>7	44 (55.7)	35 (44.3)	
Tobacco			
No	37 (52.9)	33 (47.1)	
Yes	10 (62.5)	6 (37.5)	0.486
Alcohol			
Yes	34 (56.7)	26 (43.3)	0.568
No	13 (50.0)	13 (50.0)	
Alcohol consumption			0.03
Not excessive	16 (44.4)	20 (55.6)	
Excessive	18 (75.0)	6 (25.0)	

Continued

Chronic hypertension			
Yes	40 (85.1)	7 (14.9)	<0.01
No	23 (58.9)	16 (41.1)	
State of consciousness			0.077
Preserved	25 (47.2)	28 (52.8)	
Disturbed	22 (66.7)	11 (33.3)	
Stroke type			0.111
Ischemic	30 (49.2)	31 (50.8)	
Hemorrhagic	17 (68.0)	8 (32.0)	
Region			0.697
Cortical	15 (51.7)	14 (48.3)	
Sub-corticale	32 (56.1)	25 (43.9)	
Localization			0.999
Left hemisphere	32 (51.6)	30 (48.4)	
Right hemisphere	13 (61.9)	8 (38.1)	
Bi-hemisphere	2 (66.7)	1 (33.3)	
Vascular territory			0.249
Carotid	35 (51.5)	33 (48.5)	
Basilar vertebro	12 (66.7)	6 (33.3)	
Lipid profil			0.087
Impaired	28 (63.6)	16 (36.4)	
Normal	19 (45.2)	23 (54.8)	
MOCA in the first month			<0.01
Impaired	47 (69.1)	21 (30.9)	
Normal	1 (5.5)	17 (94.5)	

Table 5. Clinical, neuroimaging and neuropsychological predictors of PSCI.

Characteristics	MOCA Impaired	Normal MOCA	COR	$CI_{95\%}$	AOR	$CI_{95\%}$	p
Age (M ± SD)	60.4 ± 10.6	56.4 ± 11.8					
MOCA (M ± SD)							
1st month	12.4 ± 6.9	24.4 ± 3.6	-	-			
3rd month	19.09 ± 6.5	27.9 ± 1.3					
Gender							
Male	33 (55.9)	26 (26.8)	1	-	1	-	
Female	14 (51.9)	13 (48.1)	0.85	[0.34 - 2.11]	86.3	[2.8 - 2643.7]	0.01*
Occupation status							
Active	34 (51.5)	32 (48.5)	1.75	[0.62 - 4.94]	4.03	[0.31 - 52.95]	0.288
No-active	13 (65.0)	7 (35.0)	1	-	1	-	

Continued

Level of study							
≤ 7 years	3 (42.9)	4 (57.1)	0.59	[0.12 - 2.84]	0.53	[0.09 - 3.04]	0.484
>7 years	44 (55.7)	35 (44.3)	1				
Tobacco consumption							
Yes	10 (62.5)	6 (375)	1.49	[0.49 - 4.53]	1.21	[0.07 - 19.02]	0.891
No	37 (52.9)	33 (47.1)	1				
Type alcohol consumption							
Yes	34 (56.7)	26 (43.3)	3.98	[1.42 - 11.08]	4.2	[0.46 - 38.17]	0.202
No	13 (50.0)	13 (50.0)	1	-	1	-	
Chronic hypertension							
Yes	40 (85.1)	7 (14.9)	3.9	[1.42 - 11.57]	26.8	[2.55 - 282.55]	0.006*
No	23 (58.9)	16 (41.1)	1	-	1	-	
State of consciousness							
Preserved	22 (66.7)	11 (33.3)	2.24	[0.91 - 5.52]	0.62	[0.07 - 5.26]	0.667
Disturbed	25 (47.2)	28 (52.8)	1	-	1	-	
Stroke type							
Hemorrhagic	17 (68.0)	8 (32.0)	2.19	[0.82 - 5.84]	7.6	[0.58 - 98.24]	0.120
Ischemical	30 (49.2)	31 (50.8)	1	-	1	-	
Region							
Sub-cortical	32 (56.1)	25 (43.9)	1.19	[0.48 - 2.98]	5.3	[0.53 - 53.86]	0.155
Cortical	15 (51.7)	14 (48.3)	1	-	1	-	
Vascular territory							
Carotid	35 (51.5)	33 (48.5)	1.19	[0.48 - 2.92]	6.2	[0.28 - 139.88]	0.247
Basilar vertebral	12 (66.7)	6 (33.3)	1	-	1	-	
Lipide profile							
Pathological	28 (63.6)	16 (36.4)	2.1	[0.89 - 5.02]	8.7	[1.10 - 68.82]	0.040*
Normal	19 (45.2)	23 (54.8)	1	-	1	-	
MOCA at the first month							
Pathological	47 (69.1)	21 (30.9)	36.5	[6.02 - 817.8]	41.2	[8.13 - 2134.8]	0.021*
Normal	1 (5.5)	17 (94.5)	1	-	1		

Our study confirms previous reports that female status is associated with PSCI [13] [14]. It should be noted that in many countries around the world women's literacy is not yet universally accepted, in sub-African countries where women have difficulty accessing higher education. This implies a fairly limited cognitive

reserve [15] which easily exposes them to cognitive decline in the face of a major brain attack such as a stroke.

As Jacquin *et al.* and Salvadori E *et al.* [1] [16] our study confirms that a poor MOCA score in the first month is one of the strongest predictors of PSCI in the 3rd month.

High blood pressure and cognitive function have long been the subject of several controversies. Seux *et al.* [17] highlighted the negative impact of chronic hypertension on intellectual abilities in a review. This impact may occur through micros infarctions or damage to white matter caused by hypertension. Our study showed a significant association between hypertension and poorer cognitive performance. As the most common risk factor for stroke, hypertension is associated with an increased risk of stroke and by extension stroke-related cognitive impairments. In addition to the severity of increased blood pressure, the duration of the hypertensive state would be an important determinant of cognitive impairment through micros infarctions or damage to white matter [18]. High serum LDL and Triglyceride levels were identified as cognitive impairment predictors in the 3rd month post-stroke, as reported in several studies [19]. The risk of cognitive disorders after acute ischemic stroke increases with increased cholesterol levels. Dyslipidemia is not only an independent and maybe the most important risk factor for ischemic stroke, which tends to cause hidden, progressive, and somatic organic damage, but also affects the cognitive function of patients with ischemic stroke through accelerating systemic atherosclerosis, and it is believed to be a risk factor inducing cognitive disorders, even dementia [20]. This study had some limitations, including not being able to specify in great detail the previous cognitive status of stroke survivors. Our sample was also small because of financial difficulties that did not allow us to perform all the examinations, especially those of an inflammatory nature (cytokines, CRP...) that could also justify post-stroke cognitive disorders.

5. Conclusion

In addition to the burden of the stroke itself, many burdens of stroke is due to its complications, including cognitive impairments. Cognitive disorders due to their high frequency, severity, and consequences should be sought as well as associated with stroke at the first moment to manage them early at best to prevent them.

Ethical Approval and Consent to Participate

Ethical clearance was obtained from the Ethics Committees of the Kinshasa School of Public Health (reference number: ESP/CE/01B/2018). Consent was obtained from each respondent during data collection. Privacy and confidentiality were maintained throughout the study.

Availability of Data and Materials

All data and supporting documents for this study are available at the Department

of Neurology, University of Kinshasa. They will be made available upon request to the leading author.

Authors' Contribution

Ken Mwamba designed the study, collected data, written and submitted a manuscript. Benito Kazenza wrote the statistical plane, cleaned, and analyzed the data. Benjamin Longo Mbenza reviewed and approved the manuscript. Tharcisse Kayembe Kalula reviewed and approved the manuscript. Marie Thérèse Sombo Ayanne reviewed and approved the manuscript. Guy Bumoko designed the study, supervised data collection, and reviewed, and approved the manuscript.

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Conflicts of Interest

The authors declare that they have no competing interests.

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