JMBR: A Peer-review Journal of Biomedical Sciences
June 2017, Vol. 16 No. 1 pp 35-46

PROSPECTIVE STUDY TO ASSESS NATIONAL INSTITUTES OF HEALTH STROKE SCALE AS PREDICTOR OF FUNCTIONAL OUTCOME IN STROKE PATIENTS IN BENIN CITY

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ABSTRACT

BACKGROUND

Stroke is a leading cause of disability and predicting functional outcome early at presentation would guide treatment and rehabilitation plans. The aim of this study was to assess baseline National Institute of Health Stroke Scale (NIHSS) score as predictor of functional outcome.

METHODS

Ninety consecutive patients with stroke were evaluated at presentation. The patient's demographics, clinical features, risk factors for stroke and NIHSS were tested as potential predictors of functional outcome in a multiple regression analysis. The Barthel index was used to measure functional outcome at 28days.

RESULTS

Significant predictors on univariate analysis were; age, gender, random blood glucose on admission, atrial fibrillation, mean packed cell volume, stroke type and NIHSS score. On multivariate regression analysis the NIHSS score was the only independent predictor of functional outcome (B = , $P < 0.05$).

CONCLUSION

NIHSS score is an important predictor of functional outcome and should be utilized in stroke care.

INTRODUCTION

Stroke is a leading cause of disability[1] necessitating the expenditure of huge financial resources towards the rehabilitation of the stroke patient[2.3]. The essence of rehabilitation is to ensure recovery of function[4]. Functional recovery is regarded as the ability to perform activities of daily living including eating, dressing, grooming and ambulation following stroke[5].

Reliable and accurate early predictors of functional recovery are desirable in view of the rising cost of stroke care, the marked difference in stroke manifestation and recovery[6].

Predicting functional outcome at presentation of stroke victims would guide management plans, prognostication and rehabilitation. It would ensure realistic communication to relatives of stroke victims, appropriate scares financial resources to attainable treatment goals, facilitate discharge planning and home care[7].

Previous researches have demonstrated that neurologic impairments are strongly associated with functional recovery.[8.9.10.11.12.13.14.15.16] In addition several clinical variables have been identified including age, gender, neuro-radiologic findings, infarct volume, diabetes mellitus, hypertension, cognitive

KEYWORDS: UME, Post-UME-Screening test, MBBS, Medical Students

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impairment, urinary incontinence and cardiac disease to individually or in combination to predict functional outcome[8.10.12.13.14.15.17].

A baseline stroke impairment scale can be used to assess severity and to adequately predict functional outcome.

The National Institute of Health Stroke scale (NIHSS) is one of the most reliable and valid instrument of clinical measurement in stroke[16.18.19]. It is widely used in the initial assessment of the severity of neurological impairment and deficit of stroke patients. Baseline NIHSS score at presentation is recognized as a strong predictor of functional outcome in stroke[20.21.22.23]. It is a 15-item scale that standardizes and quantifies the basic neurological examination. It evaluates the effects of acute stroke on the level of consciousness, language, neglect, visual field, loss of extra-ocular movement, motor strength, ataxia, dysarthria and sensory loss. The scale is designed to be a simple tool that can be administered by physicians, nurses or therapist. The NIHSS is scored from 0 to a maximum score of 42. Higher score are indicative of sever impairment, Table II.

We are not aware of any study in the south –south region of Nigeria that assesses the NIHSS score as a predictor of functional recovery following an acute stroke. Local studies nationally have had varying primary end point of mortality[24.26] and other stroke scales as outcome measure [25]. We tested the ability of NIHSS at presentation to predicting the functional outcome of stroke as measured by the Barthel Index at 28days.

The Barthel Index (BI) is the most commonly used functional measure in stroke rehabilitation settings[27.28.29] and it assists in discharge planning from long-stay wards. It is a scoring technique that measures the patient's performance in ten activities of daily living (ADL). The items are grouped into those related to self-care (feeding, grooming, bathing, dressing, bowel and bladder care) and another related to mobility (ambulation, transfer and stair climbing). The BI scoring of the individual is related to the independence in each task, with a higher score indicating greater independence. The range of BI score depends on the version. The instrument is easy to administer, and does not need formal training or certification[30]

METHOD

This was a prospective cohort study of patients admitted to the hospital with a diagnosis of stroke. Ninety patients were consecutively recruited from the University of Benin Teaching Hospital and the Central Hospital Benin in a fifteen month period, from 4 June 2014 to 18 September 2015. The diagnosis of stroke was made by the authors in their respective centers, based on the clinical features and computerized tomography scan of brain evidence of stroke. Patients who had serious accompanying illnesses including cancers, gastrointestinal hemorrhage, kidney failure, liver failure, osteoarthritis, mental disorders and dementia where excluded. We interviewed patients that are able to co-operate or close relations about their demographic characteristics using a structured questionnaire. The age, gender, occupation, ethnic group, educational status, time of presentation, risk factors for stroke and symptoms at presentation were determined. Stroke risk factors were based on participants self-reporting, that they were hypertensive or diabetic and are currently on treatment. Significant alcohol intake also relied on participants self reporting of having more than 3 drinks a day for males and more than 2 drinks a day for females. Using the address of each

patient, the distance from home and the hospital of admission was determined from the ministry of lands and survey. Routine investigations were done including fasting blood sugar, full blood count and erythrocytes sedimentation rate, fasting lipid profile, electrocardiogram and electrolytes and urea. The patients all had standard care using the neurology unit protocol adopted from existing international guideline on the management of stroke, but the ischemic stroke cases did not receive recombinant tissue plasminogen activator.

Each participant had an evaluation of neurological impairment using the National Institute of Health Stroke scale (NIHSS) on admission, within the first 3days after stroke onset and 28days later had a functional outcome measure using the Barthel Index. We used the 0 to 20 version of the BI[31] where a total minimum score of 0 corresponds to complete dependency while a maximum score of 20 corresponds to complete independency. These measurements were conducted by the authors and two senior neurology residents. The protocol was approved by the Ethics and Research Committee of Central Hospital Benin.

Descriptive and comparative statistical analyses were performed using SPSS, version 21. Means, standard deviation, medians, range, were presented for continuous variable, with comparison using the two-tailed T-test statistics. Categorical data were presented as frequency and percentages, with comparison based on the chi-square test. Univariate analysis were performed to detect associations between the Barthel Index and various independent parameters including, age, gender, marital status, occupational status, ethnicity, educational status, NIHSS, hypertension, diabetes mellitus, alcohol history, previous stroke, atrial fibrillation, packed cell volume, random blood sugar on admission, types of stroke. Variables reaching statistical significance in the univariate analysis were included in the final multiple regression model. The number of independent predictor variables in the final regression model was limited to 8 on the basis of the sample size. Statistical significance was assigned at the level of $P < 0.05$

RESULTS

98 patients were recruited for the study, but two declined assessment, three had incomplete data, while three died before the 28th day on admission. 90 patients were actually analyzed. 48 of the participants from the university of Benin Teaching hospital and 42 from the Central Hospital Benin City. The mean age of the cohort was 61.1(s.d.12.7) years, with sixty one (67.8%) of the patients between the ages of 51 to 70years. Thirty seven (41.1%) of participants were females. Sixty eight (75.5%) had ischemic stroke, while twenty three (25.6%) have had a repeat stroke. The mean NIHSS score at presentation was 10.1(s.d.5) while the median Barthel index score at 28days was 8(IQR7). The median time of stroke onset and presentation was 2days (IQR3days). Forty eight (53.3%) 0f the participants were of the Bini ethnic group. Seventy four (82.2%) of participants were married, while thirty one (34.4%) had tertiary level of education. Seventy four (82.2%) of the participants were hypertensive while forty (44.4%) had social risk factors, alcohol and smoking. Twenty four (26.6%) were diabetic with mean admission blood sugar of 189(s.d.40)mg%. sixty two (68.9%) had a hemiparesis as the presenting complaint while fourteen (15.6%) had atrial fibrillation. The mean PCV on admission was 32.6 (s.d.6.4)%,Table I. Age, gender, random blood sugar on admission, atrial

TABLE I: The demographics and clinical characteristics of stroke cohort (no=90)

Variables	Mean±s.d., Median(IQR), no(%)
Age, years	61.1±12.7
Male	53(58.9%)
Ischemic stroke,	68(75.5%)
Intracerebral hemorrhage	16(17.8%)
Subarachnoid hemorrhage	6(6.7%)
Recurrent stroke	23(25.6%)
Married	74 (82.2%)
Widow	9(10%)
Single	7(7.8%)
Hypertension	74(82.2%)
Diabetes mellitus	24(26.6%)
Atrial fibrillation	14(15.6%)
Alcoholics	29(32.2%)
Smoking	11(12.2%)
Admission random blood sugar,mg/dl	189.2±40.6
Admission packed cell volume	32.6±6.4
Glasgocoma coma score	12.6±3.5
Distance from hospital, km	4.7(5.2)
Baseline admission NIHSS score	10.1±5.0
Barthel index(0 to 20) at 28^{th} day	8(7)

TABLE II: National Institute of Health Stroke Scale

ITEM	SCORE
(1a) LEVEL OF CONSCIOUSNESS, RESPONSIVENESS	
Alert; Keenly responsive	= 0
Not Alert; but arousable by minor stimulation to obey, answer, or respond	= 1
Not Alert; requires repeated stimulation to attend, or is obtunded and require Strong or painful stimulation to make movements (not stereotyped)	= 2
Responds only with reflex motor or autonomic effects or totally unresponsive, Flaccid, and areflexic	= 3
(1b) Level of consciousness, questions. Patient is verbally asked his or her age and for the name of the current month.	
Correctly answers both questions	= 0
Correctly answers one question	= 1
Does not correctly answer either question	= 2
(1c) Level of consciousness, command. The patient is instructed to first open and close his or her eyes and then grip and release his or her hand.	
Correctly performs both task	= 0
Correctly performs one task	= 1
Does not correctly perform either task	= 2
(2) BEST GAZE, horizontal eye movement	
Normal	**= 0**
Partial gaze palsy; gaze is abnormal in one or both eyes, but forced deviation or total gaze paresis not present.	= 1
Forced deviation, or total gaze paresis not overcome by the oculocephalic maneuver.	= 2
(3) VISUAL, visual field test	
No visual loss	**= 0**
Partial hemianopia	= 1
Complete hemianopia	= 2
Bilateral hemianopia (blind including cortical blindness)	= 3

(4) FACIAL PALSY:

Normal symmetrical movements	=	0
Minor paralysis (flattened nasolabial fold, asymmetry or smiling)	=	1
Partial paralysis (total to near-total paralysis of lower face)	=	2
Complete paralysis of one or both sides (absence of facial movement in the upper and lower face)	=	3

(5) MOTOR ARM:

No drift; limb holds 90 (or 45) degrees for full 10 seconds	=	0
Drift; limb holds 90 (or 45) degrees, but drift down before full 10 seconds; does not hit bed or other support	=	1
Some effort against gravity; limb cannot get to or maintain (if cured) 90 (or 45) degrees, drifts down to bed, but has some effort against gravity.	=	2
No effort against gravity, limb falls	=	3
No movement	=	4

Amputation or joint fusion, explain:_____

5a. Left Arm ☐

5b. Right Arm ☐

(6.) MOTOR LEG

No drift; Leg holds 30-degree position for full 5 seconds	=	0
Drift; leg falls by the end of the 5-seconds period but does not hit bed	=	1
Some effort against gravity; let falls to bed by 5-seconds, but has some effort against gravity	=	2
No effort against gravity; Let falls to bed by 5-seconds, but has some effort against gravity; leg falls to bed immediately	=	3
No Movement	=	4

Amputation or joint fusion, explain:_____

6a. Left Leg ☐

6b. Right Leg ☐

(7.) LIMB ATAXIA:

Absent = 0
Present in one limb = 1
Present in two limbs = 2
Amputation or joint fusion, explain:_____

(8.) SENSORY:

Normal; no sensory loss = 0

Mild-to-moderate sensory loss; patient feels pinprick is less sharp or is dull on he affected side, or there is a loss of superficial pain with pinprick, but patient is aware of being touched. = 1

Severe to total sensory loss; patient is not aware of being touched in the face, arm, and leg = 2

(9) BEST LANGUAGE:

No aphasia, normal = 0

Mild-to-moderate aphasia; some obvious loss of fluency of facility of Comprehension, without significant limitation on ideas expressed or form of expression. Reduction of speech and/or comprehension, however, makes conversation about provided materials difficult or impossible. For example, in conversion about provided materials, examiner can identify picture or naming card content from patient's response. = 1

Severe aphasia; all communication is through fragmentary expression; Great need for interference, questioning, and guessing by the listener. Range of information that can be exchange is limited; listener carries burden of communication. Examiner cannot indentify materials provided from patient response. = 2

Mute, global aphasia; no usable speech or auditory comprehension = 3

(10.) DYSARTHRIA:

Normal = 0

Mild-to-moderate dysarthria; patient slurs at least some words and, at Worst, can be understood with some difficulty = 1

Severe dysarthria; patient's speech is so slurred as to be unintelligible in the absence of or out of proportion to any dysphasia, or is mute/anarthric = 2
Intubated or other physical barrier, explain:_____

(11.) EXTINCTION AND INATTENTION (FORMERLY NEGLECT):

No abnormality	=	0
Visual, tractile, auditory, spatial, or personal inattention or extinction to bilateral simulation in one of the sensory modalities.	=	1
Profound hemi-inattention or extinction to more than one modality; does not recognize own hand or orients to only one side of space	=	2

TABLE III: Predictors of functional disability (Barthel index) in a cohort of 90 stroke subjects using multiple regression model.

Variable	coefficient	95% CI	p-value
NIHSS at admission*	-0.557	-0.895 to -0.22	0.002
Sex (male)	0.37	-2.921 to 3.662	0.823
Age	0.019	-0.126 to 0.164	0.792
RBS at admission**	0.014	-0.008 to 0.036	0.202
Atrial fibrillation	-2.226	-7.252 to 2.8	0.379
Packed cell volume	-0.015	-0.114 to 0.084	0.762
Ischemic stroke	1.084	-3.035 to 5.204	0.601

* NIHSS = National Institute of Health Stroke Scale

** RBS = Random Blood Sugar

fibrillation, packed cell volume, stroke type and NIHSS at presentation were significantly associated($p < 0.05$) with the Barthel index at 28days in the univariate analysis, and were then entered into the multivariate regression analysis. The NIHSS score at presentation while adjusting for the other variable in the final multiple regression model was significantly (< 0.002) associated with the Barthel index score at 28days, Table III.

DISCUSSION

Stroke represents a leading cause of disability in adults and an important consideration for stroke care and intervention is functional recovery[1.2.4.7].

The aim of this study was to evaluate baseline NIHSS measure of stroke impairment as predictor of functional outcome as assessed with the Barthel index. The study found that NIHSS measure on admission is an independent predictor of early functional outcome in stroke patients. The knowledge of possible outcome is fundamental to care of patients as it influences treatment plans, including rehabilitation early at presentation in addition to ensuring that family members are carried along[6.7.8]. Several studies have shown that baseline NIHSS score predicts outcome in stroke patient as assessed using BI[8.9.10.11.12.13.21.22.] Several impairment scale are available in clinical practice and research[32.33], but the NIHSS is probably the most used measure of stroke assessment on admission to asses baseline severity and to predict outcome[34.35]. In a study comparing the usefulness of baseline NIHSS, the Canadian neurologic scale, the middle cerebral artery neurologic score and the Guy's prognostic score the NIHSS was the best predictor at 12weeks[36].

We found that age had a relationship with functional outcome in the univariate analysis, but it was not an independent predictor of functional outcome in the final model. Researchers favor the explanation that older persons with stroke have less favorable outcome than younger persons. Several studies have identified age as independent predictor of functional outcome[8.10.11.12], although there are other earlier research works that had similar finding as in our work[39.40].

We did not find any relationship between gender and functional outcome in the final model; hence it was not an independent predictor of functional recovery. Adams et al while examining factors influencing functional recovery among 736 stroke cases found no association between sex, and age with functional recovery[41]. Kaste et al documenting functional recovery in patients with occlusion of middle cerebral artery found no relationship between sex, age and functional outcome in a mean time of 30 months[42]. Similar findings of no relationship between gender and outcome was also found by Jimenez et al[45], Kaplan et al[44] and Wade et al[43]

Atrial fibrillation is an important cardiac risk factor for stroke. We found no relationship with functional out come at 28days. The literature suggests that its presence increases stroke severity and late mortality[20.37.38], while its relationship with early functional outcome is not entirely clear[46]. Admission blood sugar and mean packed cell volume were both found to have a univariate relationship with outcome but no multivariable relationship with outcome. Lowered levels of packed cell volume and hyperglycemia at admission in non-diabetics patient have been found to predict early mortality but its impact on functional recovery is unclear[47. 48. 49. 50.] Stroke types were not identified as an independent predictor of functional outcome in our study. We suspect failure to distinguish localization of lesion, size

or extent of ischemic or hemorrhagic stroke and the small number of cases of recurrent could have accounted for this finding in our study.

The study limitations included not taking subtle differences in the care and rehabilitation in both centers as prognostic and not factoring the few complications in the course of care as possible cofounders. We relied on participant's self-reporting of alcohol intake, we did not assess their Mean Cell volume (MCV) or Liver Function Tests (LFT). We believe that the small sample size limited our power to demonstrate statistically significant relationship between some predictors and outcome

In summary this study found baseline NIHSS score on admission as the only independent predictor of functional outcome. Clinicians who desire to predict functional outcome early on admission can utilize NIHSS measure.

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