Annals of African Medicine
Vol. 8, No. 1; 2009: 14 - 18

ORIGINAL ARTICLE

COMPARISON OF TWO HOSPITAL STROKE SCORES WITH COMPUTERIZED TOMOGRAPHY IN ASCERTAINING STROKE TYPE AMONG NIGERIANS

[1]F. Salawu, [2]I. Umar and [3]A. Danburam

[1]Department of Medicine, State Specialist Hospital Maiduguri, Nigeria
[2]Department of Radiology, University of Maiduguri Teaching Hospital, Maiduguri, Nigeria
[3]Department of Medicine, Federal Medical Centre, Yola, Nigeria
Reprint requests to: Dr Fatai Salawu, Department of Medicine, Federal Medical Centre, Yola 640001, Adamawa State, Nigeria. E-mail: dr_abdulsalawu@yahoo.com
Accepted: 17th August 2008

Abstract

Background: Stroke, a major cause of morbidity and mortality is on the increase in Nigeria, routine Computerized Tomography (CT) for all Nigerians with stroke is not available to most doctors, and this poses management problems. We compared two available clinical scores with brain CT for the differential diagnosis of cerebral ischemia and hemorrhage among adult Nigerians with first-ever acute stroke.

Methods: The study was conducted at the State Specialist Hospital Maiduguri. Ninety-five adult Nigerians presenting with first-ever acute stroke onset within 48 hours were evaluated with the Siriraj Hospital Stroke (SHS) score on presentation and the Guy's Hospital Stroke (GHS) score 24 hours after admission. CT brain scan was considered as gold standard. These two stroke scores were compared with the results of CT brain and sensitivity, specificity; positive predictive and negative values were calculated.

Results: Applying the recommended optimum cut-off points for the 2 scores, diagnoses were classified by the Guy's Hospital Stroke and Siriraj Hospital Stroke score as probable hemorrhagic strokes (49% and 25% respectively) and probable ischemic (40% and 65% respectively). The remainder were classified as "uncertain." The prevalence of hemorrhage diagnosed by gold standard (CT) was 29.5% while the prevalence of ischemic stroke diagnosed by CT was 54.7%. The CT brain was normal in 15.8%. Sensitivity, specificity, positive predictive value and negative predictive value for cerebral hemorrhage was 0.64, 0.48, 0.4 and 0.71 for Guy's Hospital Stroke score and 0.35, 0.73, 0.4 and 0.68 for Siriraj Hospital Stroke score.

Conclusion: It is evident from the study that these clinical scoring systems alone are not sufficient and one has to employ the use of computerized tomography scan in establishing stroke type in Nigerians with stroke.

Key words: *Stroke, score, type computed tomography*

Résumé

Fond: La course, une cause importante de la morbidité et la mortalité est en augmentation du Nigéria, la tomographie automatisée par routine (CT) pour tous les nigériens avec la course n'est pas à la disposition de la plupart des médecins, et ceci pose des problèmes de gestion. Nous avons comparé deux points cliniques disponibles au cerveau CT pour le diagnostic différentiel de l'ischémie et de l'hémorragie cérébrales parmi des nigériens d'adulte avec la première course aiguë.

Méthodes: L'étude a été entreprise à l'hôpital Maiduguri de spécialiste en état. Quatre-vingt-quinze nigériens d'adulte se présentant avec le premier début aigu de course dans un délai de 48 heures ont été évalués avec les points de la course d'hôpital de Siriraj (SHS) sur la présentation et les points de la course de l'hôpital du type (GHS) 24 heures après admission. Le balayage de cerveau de CT a été considéré comme étalon or or. Ces points de deux courses ont été comparés aux résultats du cerveau de CT et de la sensibilité, spécificité ; des valeurs prédictives et négatives positives ont été calculées.

Résultats: Appliquant les points optima recommandés de coupure pour les 2 points, des diagnostics ont été classifiés par les points de course de l'hôpital du type et de course d'hôpital de Siriraj en tant que les courses hémorragiques probables (49% et 25% respectivement) et ischémique probable (40% et 65% respectivement). Le reste ont été classifiés comme « incertain. » La prédominance de l'hémorragie diagnostiquée par l'étalon or or (CT) était 29.5% tandis que la prédominance de la course ischémique diagnostiquée par CT était 54.7%. Le cerveau de CT était normal dans 15.8%. La sensibilité, la spécificité, la valeur prédictive positive et la valeur prédictive négative pour l'hémorragie cérébrale étaient 0.64, 0.48, 0.4 et 0.71 pour les points de course de l'hôpital du type et 0.35, 0.73, 0.4 et 0.68 pour des points de course d'hôpital de Siriraj.

Conclusion: Il est évident de l'étude que ces seuls systèmes de notation cliniques ne sont pas suffisants et on doit utiliser l'utilisation du balayage automatisé de tomographie en établissant la course saisissent des nigériens avec la course.

Mots clés: *Course, points, type tomographie calculée*

Acute stroke is increasingly recognized as one of the leading causes of morbidity and mortality worldwide. Therapeutic decisions regarding management of stroke requires accurate diagnosis of stroke types[1] and exclusion of mimics. CT scanning allows the accurate distinction of hemorrhagic from ischemic lesions in patients presenting with acute stroke.[2-6] Despite the growing burden of stroke, the majority of such patients continue to be managed by physicians who do not have easy access to this facility.[7] It is well known that some clinical data may suggest a hemorrhagic or ischemic stroke even though no data are specific enough to allow a reliable diagnosis. Scoring systems based on clinical data determining the relative likelihood of infarction or hemorrhage have been formulated and tested.[8,9] Although the clinical diagnoses made using these scores seem more accurate than those made by physicians,[8] they present several problems.[10]

The Allen's score otherwise known as the Guy's Hospital Stroke score requires data collected 24 hours after admission, such as level of consciousness and diastolic blood pressure, and must be calculated using a handheld calculator. Furthermore, the Siriraj stroke score, which also includes the level of consciousness and the diastolic blood pressure, and the Guy's Hospital Stroke score do not achieve a diagnosis with a positive predictive value of close to 100%. These two scoring protocols are the only ones currently available that have been validated against both post-mortem and CT scan results. They are designed to give an objective score based on clinical variables shown to be significantly different for hemorrhagic and ischemic strokes.

Because of the shortage of brain imaging in the country, we therefore evaluated the accuracy of the Siriraj Hospital Stroke score and the Guy's Hospital Stroke score among Nigerians with first-ever acute stroke in differentiation of pathological stroke types.

Materials and Methods

This Prospective observational study was carried out at the Department of Medicine of the State Specialist Hospital Maiduguri. We defined stroke according to the World Health Organization clinical criteria as a "rapidly developing clinical syndrome of focal (or global in the case of subarachnoid haemorrhage) disturbance of cerebral function lasting longer than 24 hours (unless interrupted by surgery or death), presumably of vascular origin.[11] It does not include subdural or extradural haemorrhage, brain tumour, trauma, or transient ischemic attack. On admission detailed history and thorough clinical examination including neurological assessment was carried out. Other parameters recorded included: patients' age, dates of admission and discharge, presence of headache and vomiting, level of consciousness, blood pressure, history of hypertension, transient ischaemic attack, diabetes mellitus, obesity, presence of history suggestive of angina pectoris, intermittent claudication.

Ninety-five consecutive patients that presented at the study centre between January 2005 and May 2006 with clinical diagnosis of stroke were included in the study. Inclusion criteria included black Nigerians of 18 years or above with sudden weakness of one-half of the body of supratentorial origin and sufficient data available to calculate the stroke scores and had undergone CT within 15 days of onset of their stroke. The exclusion criteria were patients below the age of 18 years, patients with stroke duration of more than 14 days because of the possibility of missing an intracerebral haemorrhage, causes of focal neurological deficit other than stroke or stroke-like syndromes, repeat or recurrent stroke and those who refused CT scan or informed consent from caregivers or relation. CT brain scan was considered as gold standard. Before being scanned, each patient was evaluated by one of the authors, who completed a proforma containing the variables of each stroke score[8, 9] (answering yes or no to each question and reporting of blood pressure) but did not calculate the stroke score. The proforma were sent to an independent physician for calculation and comparisons with the reports of CT, after the study was completed. Only CT scans taken within 15 days of the ictus were included to eliminate possible misdiagnosis of resolving intracerebral haemorrhage as ischaemic stroke.[12] There was no CT scanner in our hospital, and patients had to be taken to the University of Maiduguri Teaching Hospital (24-hour access to CT) about 5-6km from study centre. No Magnetic Resonance Imaging was available.

The Guy's Hospital Stroke (GHS) score has been validated in different European settings, and has a reasonably good (90%) accuracy when the suggested cut-offs (<4 for ischaemic and >24 for haemorrhage) are used; however, it cannot be used until 24 hours after the stroke. According to the cut-offs suggested by the original paper, a result was considered to be certain when the Siriraj Hospital Stroke (SHS) score was <-1 or >1. All patients were evaluated with the SHS score on presentation and the GHS score 24 hours after admission. If a patient was unable to communicate, clinical details required for the GHS[8] score and SHS[9] score were obtained from a close relative or friend. When the value for diastolic blood pressure at 24 hours after admission was not available, the nearest recording at less than 24 hours was used. Patients were assumed to be fully conscious if they had a value of greater than 13 in the Glasgow coma scale (GCS), [13] or if it was reported that the patient had not lost consciousness within the first two hours (for the SHS score) or at 24 hours (for the GHS). Patients were defined as drowsy if they had a GCS of 8 to 13 inclusive, and patients with GCS of 7 or less were assumed to have been unconscious unless it was reported that the patient had lost consciousness in the specified period.

Data was analysed using statistical software for social sciences version (12.0 www.spss.com) and EPI Info version 6.03. Group differences by gender were tested by independent *t*-test for age, kappa statistics for comparability and Chi square for categorical variables. P value of <.05 was taken as statistically significant. The two scores were compared with the results of CT brain and sensitivity, specificity; positive predictive and negative values were calculated using standard formula.[14] Ethical approval for the study was granted by the State Specialist Hospital Human Ethics Research Committee.

Results

The mean age and sex distribution of patients studied are shown in Table 1. There was statistically significant difference in age between 62 males (mean age 58.75+14.24 years (range 26-84 years) and 33 females (mean age 52.1+9.97 years (range 29-69 years) *P*=.0187. Applying the recommended optimum cut-off for the two clinical scores, diagnoses were classified by the GHS and SHS as probable hemorrhagic strokes (49% and 25% respectively) and probable ischemic stroke (40% and 65% respectively). The remainder were classified as "uncertain."

The overall comparability of the GHS and SHS was poor (k=0.041, *P*=.284) (Table 2). The GHS was uncertain in ten cases while the SHS was uncertain in nine *(P*=.59, McNemar's test), however, the kappa statistic showed a worse comparability between the two scores in terms of certain results (k=-0.111, *P*=.59) (Table 3). When only results within the diagnostic range with both hospital scores (76 cases) are considered, agreement in diagnosing infarction and hemorrhage was higher (k=0.757) (Table 4).

The prevalence of intracerebral hemorrhage diagnosed by CT was 29.5% (28 of 95) while the prevalence of cerebral ischemia diagnosed by CT was 54.7% (52 of 95). Apparently, CT brain was normal in15.8% of study population. Tables 5 and 6 show the sensitivity, specificity, positive and negative predictive values when computerized tomography scan results are used as standard. For the Guy's Hospital Stroke score, the sensitivity and specificity for intracerebral hemorrhage were 64.3% and 48.1% respectively, the positive and negative predictive values were 40% and 71% respectively. Sensitivity and specificity for ischemic stroke were 48.1% and 62.1% respectively, the positive and negative predictive values were 71% and 40%. For the Siriraj Hospital stroke score, the sensitivity and specificity for intracerebral hemorrhage were 35.7% and 73% respectively, and, positive and negative predictive values were 42% and 68% respectively. Sensitivity and specificity for ischemic stroke were 73% and 35.7% respectively, and, positive and negative predictive values were 68% and 42% respectively.

Table 1. Age and sex distribution of first-ever acute stroke patients

Age (years)	M (%)	F (%)	Total (%)
20 - 29	2 (3.2)	1 (3.1)	3 (3.2)
30 – 39	6 (9.7)	3 (9.1)	9 (9.5)
40 – 49	8 (13.0)	7 (21.2)	15 (15.8)
50 – 59	11 (17.7)	14 (42.5)	25 (26.3)
60 – 69	22 (35.5)	8 (24.2)	30 (31.5)
70 – 79	11 (17.7)	-	11 (11.6)
80+	2 (3.2)	-	2 (2.1)
Total	62 (100)	33 (100)	95 (100)

Mean age (SD) for males: 58.75±14.24; Mean age (SD) for females: 52.1±9.97; p=.0187

Table 2. Comparison of Guy's hospital stroke score and Siriraj hospital stroke score

Guy's hospital stroke score	Siriraj hospital stroke score		
	Hemorrhage	Ischaemia	Uncertain
Hemorrhage	12	28	7
Ischaemia	8	28	2
Uncertain	4	6	0

K=0.041, one-tailed P=.284

Table 3. Certain and uncertain results with Guy's hospital stroke score and Siriraj hospital stroke score

Siriraj hospital stroke score	Guy's hospital stroke score	
	Certain	Uncertain
Certain	76	10
Uncertain	9	0

P=.590; k=-0.1108

Table 4. Diagnostic agreement of Guy's hospital stroke score

Siriraj hospital stroke score	Guy's hospital stroke score	
	Hemorrhage	Ischaemia
Hemorrhage	12	8
Ischaemia	28	28

k=0.0757; P=.26

Table 5. Comparison of Guy's hospital stroke score with results of computerized tomography

Guy's hospital stroke score	Computerised tomography	
	Hemorrhage	Ischaemia
Hemorrhage	8	27
Ischaemia	10	25

χ^2=0.68; P=.408

Table 6. Comparison of Siriraj hospital stroke score with results of computerized tomography

Siriraj hospital stroke score	Computerised tomography	
	Hemorrhage	Ischaemia
Hemorrhage	10	14
Ischaemia	18	38

χ^2=0.32; P=.573

Discussion

We found that the GHS and SHS did not perform well in diagnosing the pathological stroke type in Nigerians with stroke. They did not diagnose the same case as being certain infarction or certain hemorrhage. This study is the first prospective study of scores to distinguish pathological stroke type among black Nigerians in northern Nigeria. There have been retrospective assessments of SHS and World Health Organization criteria for the acute stroke syndrome from southwest Nigeria and Ethiopia.[15-17] We found a lower sensitivity and positive predictive value for the SHS in detecting intracerebral hemorrhage than was found in southwest Nigeria and Ethiopia. The GHS performed marginally better than the SHS and had a slightly higher sensitivity for detecting intracranial hemorrhage. In our study, the SHS was more accurate at diagnosing ischemic stroke than in southwest Nigeria and Ethiopia. Both scores did not achieve a diagnosis with a positive predictive value close to 100%. The scores should be considered comparable only when both show certainty and point and point to the same side of the scale. Using both scales may slightly increase the accuracy, but the GHS can be calculated only after 24 hours, so the combined use should be restricted to few patients; furthermore, the variables used in the SHS are all present in the GHS making an additional effect unlikely. However, this time consuming double procedure does not seem clinically sound. Correct diagnosis is important because treatments for ischemic stroke may be contraindicated in intracerebral hemorrhage; hence, diagnosis requires imaging of the brain.

Computerized tomography is practical, quick (a few minutes to scan a brain), easy to use in ill patients, although not widely available in Nigeria. It accurately identifies intracerebral hemorrhage as soon as it has occurred, but the technique has limitations. Intracerebral hemorrhage will be misinterpreted as ischemic stroke if computerized tomography is not done within 10 to 14 days after stroke.[18] A study compared the GHS and SHS on a group of 1059 patients with CT proven stroke admitted to the acute stroke unit at the Western Infirmary, Glasgow with suspected stroke. The GHS had a sensitivity of 70% for the diagnosis of hemorrhage and specificity of 64%. The corresponding figures for SHS were 68% sensitivity and 64% specificity. This validation study concluded that neither score is useful for exclusion of hemorrhage before anticoagulant treatment is initiated or as a diagnostic screening procedure for trials of low-risk treatments such as aspirin.[10] Similar findings were reported by Hawkins and coworkers in a study conducted in New Zealand.[19] The SHS and GHS were tested by Badam and coworkers[20] in an Indian setting found both scores not sufficiently accurate to identify infarct from hemorrhage.

The GHS and SHS did not confidently discriminate between stroke subtypes in a study in Brazil. [12]

A study by Besson and coworkers[22] showed that these clinical scoring systems do not exhibit enough accuracy to be applied safely if the use of antithrombotic treatment is to be considered and their use can only be limited to clinically to classify strokes for academic purpose where CT scan facility is not available. While many studies have suggested the inaccuracies of both clinical scoring systems, Celani and coworkers[22] Ozeren and coworkers[23] have recommended their use in epidemiological studies as well as diagnostic tools in clinics. Our findings agree with others who have suggested that stroke scores are not sufficiently accurate for use in clinical management of patients with stroke at present. Only CT or magnetic resonance imaging will do. However, it is unlikely that any score will replace brain imaging and we would encourage investment in CT scanners. Where this is impossible and the treatment of stroke therefore limited, health services should emphasize strategies to reduce the risk of stroke in our population.

References

1. Vuadens P, Bougoussalavsky J. Diagnosis as a guide to stroke therapy. Lancet. 1998; 352:5-9.
2. Sandercock P, Molyneux A, Warlow C. Value of CT in patients with stroke. Oxfordshire Community stroke project. BMJ. 1985; 290:193-197.
3. Sotaniemi KA, Pyktinen J, Myllyia VV. Correlation of clinical and computerized tomographic findings in stroke patients. Stroke. 1990; 21:1562-1566.
4. Wintermark M, Bougoucclavsky J. Imaging of acute ischaemic brain injury; the return of computed tomography. Curr Opin Neurol. 2003; 16:59-63.
5. Wardlaw JM. Is routine CT in stroke unnecessary? BMJ. 1994; 309:1498-1499.
6. Wadhwani J, Hussain R, Rahman PH. Clinical Stroke Score and CT Scan Brain Correlation. J Assoc Physicians India. 2002; 50:777-781.
7. El Khamlichi A. African neurosurgery: current situation, priorities, and needs. Neurosurgery. 2001; 48:1344-1347.
8. Allen CMC. Clinical diagnosis of the acute stroke syndrome. Q J Med. 1983; 52:515-523.
9. Poungvarin N, Viriyavejakul A, Komoutri C. Siriraj stroke score and validation study to distinguish supratentorial intracerebral haemorrhage from infarction. BMJ. 1991; 302:1565-1567.
10. Weir CJ, Murray GD, Adams FG, Muir KW, Grosset DG, Lees KR. Poor accuracy of stroke scoring systems for differential clinical diagnosis of intracranial haemorrhage and infarction. Lancet. 1994; 344:999-1002.
11. The WHO. MONICA Project Principal Investigators. The World Health Organization MONICA Project (monitoring trends and determinants in cardiovascular disease): a major international collaboration. J Clin Epidemiol. 1988; 41:171-184.
12. Dennis MS, Bamford JM, Molyneux AJ, Warlow CP. Rapid resolution of signs of primary intracerebral haemorrhage in computed tomograms of the brain. BMJ. 1987; 295:379-381.
13. Teasdale G, Jennett B. Assessment of coma and impaired consciousness. Lancet. 1974; 2:81-83.
14. Beagle hole R, Bonita R, Kjellstrom T. Basic Epidemiology. Geneva, Switzerland: World Health Organization 1993.
15. Ogun SA, Oluwole O, Fatade B, Ogunseyinde AO, Ojini FO, Odusote KA. Comparison of Siriraj Stroke Score and the WHO criteria in the clinical classification of stroke subtypes. Afr J Med Med Sci. 2002; 31:13-16.
16. Zenebe G, Asmera J, Alemayehu M. How accurate is Siriraj Stroke Score among Ethiopians? A brief communication. Ethiop Med J. 2005; 43:35-38.
17. Ogun SA, Oluwole SOA, Oluremi A, Fatade AO, Ojini F, Odusote KA. Accuracy of the Siriraj Stroke score in differentiating cerebral haemorrhage and infarction in African Nigerians. African Journal of Neurological Sciences. 2001; 20:21-26.
18. Wardlaw JM, Keir SL, Dennis MS. The impact of delays in computed tomography of the brain on the accuracy of diagnosis and subsequent management in patients with minor stroke. J Neurol Neurosurg Psychiatry. 2003; 74:77-81.
19. Hawkins GC, Bonita R, Broad JB, Anderson NE. Inadequacy of clinical scoring systems to differentiate stroke subtypes in population based studies. Stroke. 1995; 26:1338-1342.
20. Badam P, Solao V, Pai M, Kalantri SP. Poor accuracy of Siriraj and Guy’s Hospital stroke scores in distinguishing haemorrhage from ischaemic stroke in a rural tertiary care hospital. Natl Med J India. 2003; 16:8-12.
21. Gomes Mda M, Costa MF, Andre C, Gomes R, Novis SA. Emergency physician’s diagnosis of stroke subtype. An accuracy study. Arq Neuropsiquiatr. 1998; 56(3B):523-527.
22. Celani MG, Righetti E, Migliacci R, et al. Comparability and validity of two clinical scores in the early differential diagnosis of acute stroke. BMJ. 1994; 308:1674-1676.
23. Ozeren A, Bicakci S, Burgut R, Sarica Y, Bozdemir H. Accuracy of bedside diagnosis versus Allen and Siriraj stroke scores in Turkish patients. Eur J Neurol. 2006; 13:611-615.