Accuracy of clinical scores in differentiating stroke subtypes in Mosul

Hakki Mohammed Majdal*, Khalid Gh. Hameed Al-Abachi, Mahmood Mal-Allah*****
*** Neurologist, ** Interventional cardiologist, *** Consultant Cardiologist, Ibn-Sina Teaching Hospital.**

(Ann. Coll. Med. Mosul 2010; 36 (1 & 2): 49-55).
Received: 17th Nov 2009; Accepted: 9th Feb 2011.

ABSTRACT

Objectives: To study the validity of clinical scores in differentiating intracerebral hemorrhage and ischemic stroke and to see which of them is more applicable in our hospitals.
Methods: A prospective study of 100 consecutive patients with acute neurological deficit admitted as inpatient to the neurological unit in Ibn-Sina Teaching Hospital in the city of Mosul, evaluated with computed tomography and Allen and Siriraj scores to determine the pathological type of stroke during the period from September 15th 2008 and January 28th 2009.
Results: The prevalence of hemorrhage (diagnosed with computed tomography) was 19%. Allen scores were "uncertain" in 13 cases and Siriraj scores in 17 cases; Sensitivity, specificity, positive and negative predictive values, for haemorrhage were 0.53, 0.96, 0.77 and 0.90, for Allen scores and 0.79, 0.97, 0.88, and 0.95 for Siriraj scores; such values for infarction were 0.91, 0.89, 0.97, and 0.71 for Allen scores and 0.80, 0.95, 0.98 and 0.53 for Siriraj scores.
Conclusion: When CT-Scan is not immediately available and the clinician wishes to start antithrombotic treatment, the Siriraj score (and possibly the Allen score) can be useful to identify patients at low risk of intracerebral hemorrhage and The Siriraj score is simple, cheap, reliable and practical method which can be used immediately after the stroke.

Keywords*:* Ischemic stroke IS, intracerebral hemorrhage ICH, computerized tomography (CT-Scan), Allen Hospital score (AS), Siriraj stroke Score (SS).

الخلاصة

الهدف من البحث: لدراسة مصداقية المقاييس السريرية في التفريق بين السكتة الدماغية التعطشية والنزف داخل المخ، ومعرفة أي من المقاييس أكثر عملية للتطبيق في مستشفياتنا.
الوسائل: الدراسة شملت ١٠٠ مريض كانوا يعانون من خلل عصبي حاد، أدخلوا وحدة الإمراض العصبية في مستشفى ابن سينا التعليمي في الموصل للفترة من ٢٠٠٨/٩/٢٥م – ٢٠٠٩/١/٢٨م، وأجري لهم فحص مفراس الدماغ وقيمت حالاتهم بواسطة كلا المقياسين ألين وسيريراج لتحديد نوع السكتة الدماغية أهي تعطشية أم نزف داخل المخ.
النتائج: نسبة حدوث النزف داخل المخ (المشخص بواسطة جهاز المفراس) كانت ١٩%. مقياس ألين كان غير واضح في ١٣% من الحالات، بينما مقياس سيريراج كان غير واضح في ١٧% من الحالات بينما كانت الحساسية والدقة والقيمة التنبؤية الموجبة لحالات النزف داخل المخ حسب مقياس ألين هي (٠,٥٣) (٠,٩٦) (٠,٧٧) على التعاقب، بينما كانت حسب مقياس سيريراج هي (٠,٧٩) (٠,٩٧) (٠,٨٨). أما لحالات السكتة الدماغية التعطشية فكانت (٠,٩١) (٠,٨٩) (٠,٩٧) حسب مقياس ألين على التعاقب وكانت حسب مقياس سيريراج (٠,٨٠) (٠,٩٥) (٠,٩٨) على التعاقب.
الاستنتاجات: في حالة عدم التمكن من إجراء فحص المفراس بصورة فورية للمرضى وعند رغبة الطبيب المعالج بإعطاء علاج مانع التخثر، مقياس سيريراج (ومن الممكن أيضا مقياس ألين) يمكن أن يكون مفيدا لتحديد المرضى ذو الخطورة

الأقل للإصابة بنزف داخل المخ. مقياس سيريراج هو مقياس بسيط، غير مكلف، عملي ومن السهل استعماله مباشرة بعد حصول السكتة الدماغية .

Stroke was defined as rapidly developing clinical signs of focal disturbance of cerebral function, lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin (WHO definition [1]).

It is not possible for all stroke patients in Iraq to have a computed tomography scan (CT scan) immediately, (even sometimes not obtainable at all), for two reasons: first, lack of this tool in most of our hospitals; second - especially at the time being - transporting patients between hospitals may be hazardous or not allowed because of curfew. The ability to classify stroke would improve understanding of the nature of stroke and provide clues to its etiology which would be useful for potential interventions in the acute stage. In such situations, the clinical diagnosis is often the only way to differentiate between hemorrhagic and ischemic stroke. Considering the unreliability of clinical assessment in diagnosing the type of stroke. [2-5], scoring systems were devised to assist physicians without easy access to CT scanning facilities to improve the accuracy of the clinical diagnosis of acute stroke.

The two scoring protocols produced by Allen[6] (also known as Guy's Hospital score (AS)) in 1983 and Poungvarin et al (Siriraj Stroke Score (SS)) in 1991[7] are the common ones that are currently used in clinical practice and have been validated against both postmortem and CT scan results. They are designed to give an objective score based on clinical variables shown to be significantly different between hemorrhagic and ischemic strokes. [8](Appendix)

These two scores require the least testing and investigation and appear to be simple to use. The SS only requires a history and clinical examination, whereas the AS requires a chest x-ray and electrocardiogram in a addition.

The aim of this study is to validate the above mentioned clinical scores in acute stroke patients, and to compare their applicability in our practice.

Patients and methods

This study was approved by ethical committee in the Local Health Authority. A prospective study which included 129 consecutive patients with an acute neurologic deficit studied during the period between September 15th 2008 and January 28th 2009. The patients were admitted as inpatients to neurology unit in Ibn Sina Teaching Hospital in Mosul. Consent was taken from all patients and their relatives after explanation.

Patient's assessment included careful history and thorough physical and neurological examination including proper evaluation by a cardiologist.

The following investigations were made for each patient: CBP and ESR, FBS, renal and liver function tests, serum electrolytes, serum lipid profile, ECG, CXR, and echocardiography. Both scores were calculated for each patient. The final clinical diagnosis was determined before any imaging is made. CT scans taken were within 15 days of the event were included in the study to eliminate the possible misdiagnosis of resolving intra cerebral hemorrhage as ischemic stroke[9].

Twenty nine patients were excluded from the study; 25 of them, due to inability to perform a CT-scan (3 of them died before doing CT scan), two proved to have brain tumor, one found to have focal deficit due to hypoglycemia and another one due to brucellosis. We combined subarachnoid hemorrhage (SAH) and cerebral hemorrhage as “intracerebral hemorrhage[8,10].

The scores were compared in terms of "certain" results (i.e. percentages of cases in which the scores predicted ischemia or hemorrhage, according to the cut offs suggested in the original papers[6,7]). A result was considered to be certain when the Allen score was <4 or >24 or the Siriraj score was <-

1 or >1. The two scores were compared with the results of computed tomography, and sensitivity, specificity, positive predictive value, negative predictive value, and likelihood ratio were calculated using standard formulas and significances determined by using z-test of two proportion[11].

We included the "uncertain" results, i.e. The results that did not yield a definite answer of ICH or IS, in the analysis, as negative because both sensitivity and specificity may be increased by excluding these results [8].

Results

A wide range of ages was found (32 to 88 years), with a mean age for all patients of 64.3 years ± 10.43 (men, 63 years ± 11.35; women, 65.5 ± 9.25 years); male (58 cases) to female(42 cases) ratio was 1.38.

CT scan showed IS in 81% of cases, and ICH in 19% of patients (2 cases had SAH).

In comparison with the CT scan result, applying the recommended optimum cutoff points for each scale, the cases with definitive diagnoses were classified by the AS and SS scales as probable ICH (13% and 17%, respectively) or probable IS (76% and 66%, respectively). The remainder were classified as uncertain as seen in (table1).

As seen in table 2, after excluding uncertain cases, percentage of true infarction for both scores were more than 97% in comparison to brain CT scan result and differences in the diagnosis made by the above two methods (between scores and CT scan) was insignificant.

The results for the AS score as shown in table 3 had a sensitivity of 53% and a specificity of 96% for ICH. The positive predictive value for ICH was 77%). For IS, the AS score had a sensitivity of 80%, a specificity of 96%, and a positive predictive value of 99%. The results for ICH in SS score had a sensitivity of 79%, a specificity of 98%, and a positive predictive value of 88%. For ischemic stroke, the SS score had a sensitivity of 80%, a specificity of 90%, and a positive predictive value of 97%.

Table (1): Predicting ICH and IS With the AS and SS in comparison with CT scan.

	Infarction	Hemorrhage	Uncertain
SS	66 (66%)	17 (17%)	17 (17%)
AS	76 (66%)	13 (17%)	11 (17%)
CT result	81 (81%)	19 (19%)	

Table (2): Percentage of true and false result in both methods of certain cases only compared with CT scan.

	True IS	False IS	CT Results	p-value	True ICH	False ICH	CT Results	p-value
AS	74 (97.6%)	2 (2.6%)	76	=0.155*	10 (76.9%)	3 (23.1%)	13	=0.066*
SS	65 (98.5%)	1 (1.5%)	66	=0.315*	15 (88.2%)	2 (11.7%)	17	=0.145*

* = insignificant

Table (3): Performance of the SS and AS in diagnosing Intracranial hemorrhage compared with the brain imaging.

	sensitivity	specificity	positive predictive value	negative predictive value	Positive likelihood ratio	negative likelihood ratio
ICH (AS)	0.53	0.96	0.77	0.90	13.2	0.5
ICH (SS)	0.79	0.97	0.88	0.95	31.6	0.05
IS (AS)	0.91	0.89	0.97	0.71	9	0.1
IS (SS)	0.80	0.95	0.98	0.53	15	0.2

Discussion

The conventional bedside diagnosis of stroke subtypes is said to be inaccurate[11]. It raised a lot of conflicts. Aring and Merrit, Dalsgaad Nielson, Heasman and Lipworth, Schaafsma, and Harrison all reported conflicting results about the clinical features that distinguish cerebral hemorrhage from infarction[12-16]. On the other hand the scoring methods are said to be more accurate[6] but our study as others shows that these scores do not diagnose the cases as being certain infarction or certain hemorrhage. Since missing diagnosis of ICH has more grave consequences than that of infarction in acute treatment of stroke (first of all do not harm the patient) [8]. Using both scores may slightly increase the accuracy, however the Allen score can be calculated only after 24 hours.

The findings suggest that these two commonly used, validated clinical scoring systems have sufficient sensitivity to allow classification of stroke into the two main types, hemorrhagic or ischemic, although the sensitivities for the detection of hemorrhage were 53% and 79% for the GHS and SHS scores, respectively.

The SS performed marginally better than the GHS and had a much higher sensitivity for detecting ICH. Reversely GHS more sensitive in diagnosing IS (91% vs 80%).

We have compared our findings with those found in other regions of the world [7,8,11,17-26] and values were similar to the results of the some studies but differed from others. A higher sensitivity, specificity, and positive predictive value for the SS in detecting intracranial hemorrhage was shown in the study than was found in most of other population. This was despite the high proportions of intracranial hemorrhage especially in those studies from Africa (47% , 59%,32%)[17,18,26], compared with our study (17%). This probably reflects patient selection and the limitations of a retrospective study design rather than a true difference in the performance of the SS, where missing variables in the calculations were adjusted to zero and score will over diagnose infarction. The other reason may relate to that the scoring systems are for epidemiological classification (as occur in retrospective study) or for clinical trials in which the intention is to eliminate hemorrhagic strokes. Exclusion of "uncertain" cases as seen in studies from Thailand[7] and Hong Kong (China) [23], they have better sensitivity than our study because both sensitivity and specificity will increase by excluding these results [8].

The most appropriate studies for comparison with our study are those from Malaysia[24] and SouthAfrica[26]. They were also prospective studies that included "uncertain" results in the analysis. We found the SS had a higher sensitivity and positive predictive values for detecting intracranial hemorrhage from both of them, but the specificity were nearly similar in above mentioned two studies.

Although the AS has shown a high specificity and a fair positive predictive value in the diagnosis of intracranial hemorrhage, the sensitivity was low. Together with studies from Italy[19] , SouthAfrica[26] and New Zealand [8] they found the lowest sensitivity (0.31, 0.34 to 0.38) respectively for detecting intracranial hemorrhage using the AS. It has been suggested that the AS was developed with relatively young patients with stroke (under the age of 76 years) and therefore AS had low sensitivity in a population with a higher prevalence of intracranial hemorrhage[8].

In our study, the SS was more accurate at diagnosing IS than in Nigeria[17], Ethiopia[18] and New Zealand [8]. Our findings for sensitivity, specificity, and positive predictive value are remarkably consistent with those found in studies from Pakistan, India, and Hong Kong.

The accuracy of the AS in diagnosing ischemic stroke in our study was good when compared with previous studies. The AS score places far more emphasis on measures of atherosclerosis than the SS does. Perhaps it performs better in populations in which atherosclerosis is an important cause of ischemic stroke.

The limitations of the scoring system should be understood. If a patient or his relatives cannot give a clear description of the symptoms of the ictus, the score will tend to

overestimate the likelihood of infarction. Many of the symptoms used in the score as being in favor of ICH (loss of consciousness at onset, early headache, vomiting) may develop later in IS due to brain edema. If the time onset of such symptoms was not accurate, patients with IS wrongly diagnosed as ICN [8]. Also patients with brainstem infarction tend to have symptoms which may suggest hemorrhage [8].

On the other hand patients with small deep hematomas may present under the clinical guise of cerebral infarction[8]. This occur in 2 cases of our study.

In conclusion, for great areas of Iraq, thrombolytic and anticoagulation are available only for few patients. A score that excluded significant intracranial hemorrhage would encourage doctors in remote areas to initiate aspirin therapy early. 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, scoring system is the second best means (after CT or MRI) in differentiating cerebral hemorrhage from infarction in Iraqi patients. The Siriraj score is simple, cheap, reliable and practical method, and can be used immediately after the stroke, (but the Allen score can be calculated only after 24 hours) and has a 98% positive predictive value for ischemia. When clinicians wish to start antiplatelet antithrombotic treatment (aspirin or heparin) while waiting for the scan results, they can rely on the Siriraj score.

References

1. 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.
2. Anderson C, Stewart-Wynne T. Stroke: clinical presentations of stroke—the classic and the less obvious. Aust Fam Physician. 1991; 20:1565-1573.
3. Bamford J. Clinical examination in diagnosis and sub classification of stroke. Lancet. 1992;339:400-402.
4. Harrison MJG. Clinical distinction of cerebral hemorrhage and cerebral infarction. Postgrad J Med. 1980; 56:629-632.
5. von Arbin M, Britton M, deFaire U, Helmers C, Miah K, Murray V. Accuracy of bedside diagnosis of stroke. Stroke. 1981;12:288-293.
6. Allen CMC. Clinical diagnosis of the acute stroke syndrome. Q J Med. 1983; 52:515-523.
7. Poungvarin N, Viriyavejakul A, Komontri C. Siriraj stroke score and validation study to distinguish supratentorial intra cerebral hemorrhage from infarction. Br Med J. 1991;302:1565-1567.
8. Glen C. Hawkins, Ruth Bonita, Joanna B, Neil E. Anderson. Inadequacy of Clinical Scoring Systems to Differentiate Stroke Subtypes in Population-Based Studies. Stroke. 1995; 26:1338-1342.
9. Dennis MS, Bamford JM, Molyneux AJ, Warlow CP. Rapid resolution of signs of primary intra cerebral hemorrhage in computed tomograms of the brain. Br Med J. 1987;295:379-381.
10. Sandercock PA, Allen CM, Corston RN, Harrison MJ, Warlow CP. Clinical Diagnosis of intracranial hemorrhage using Guy's Hospital score.BMJ (Clin Res Ed). 1985;291:1675–1677.
11. Beaglehole R, Bonita R, Kjellström T. Basic Epidemiology. Geneva, Switzerland: World Health Organization; 1993.
12. Aring GCD, Merrit MH. Differential diagnosis between cerebral hemorrhage and thrombosis. Arch Intern Med 1935; 56: 435-456.
13. Dalsgaard,Nielson T.Survey of 1000 cases of apoplexia cerebri. Acta Neurol Scand 1956; 30:160-185.
14. Heasman MA, Lipworth L. Accuracy of Certification of Causes of Death. London: HMSO,1966.
15. SchaafsmaS.On the Differential diagnosis between cerebral hemorrhage and infarction Neurol Sci 1968;7:83-95.
16. Harrison MJG. Clinical distinction of cerebral hemorrhage and cerebral infarction. Postgrad Med J 1980; 629-623.

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. Zenebe G, Asmera J, Alemayehu M. How accurate is Siriraj Stroke Score among Ethiopians? A brief communication. Ethiop Med J. 2005;43:35–38.
19. Celani MG, Righetti E, Migliacci R, Zampolini M, Antoniutti L, Grandi FC, Ricci S. Comparability and validity of two clinical scores in the early differential diagnosis of acute stroke. BMJ. 1994;308:1674–1676.
20. Badam P, Solao V, Pai M, Kalantri SP. Poor accuracy of the Siriraj and Guy's Hospital stroke scores in distinguishing haemorrhagic from ischaemic stroke in a rural, tertiary care hospital. Natl Med J India. 2003;16:8–12
21. Kochar DK, Joshi A, Agarwal N, Aseri S, Sharma BV, Agarwal TD. Poor diagnostic accuracy and applicability of Siriraj Stroke Score, Allen score and their combination in differentiating acute haemorrhagic and thrombotic stroke. J Assoc Physicians India. 2000;48:584–588.
22. Shah FU, Salih M, Saeed MA, Tariq M. Validaty of Siriraj Stroke Scoring. J Coll Physicians Surg Pak. 2003;13:391–393.
23. Hui AC, Wu B, Tang AS, Kay R. Lack of clinical utility of the Siriraj Stroke Score. Intern Med J. 2002;32:311–314.
24. Kan CH, Lee SK, Low CS, Velusamy SS, Cheong I. A validation study of the Siriraj Stroke Score. Int J Clin Pract. 2000; 54: 645–646.
25. Akpunonu BE, Mutgi AB, Lee L, Khuder S, Federman DJ, Roberts C. Can a clinical score aid in early diagnosis and treatment of various stroke syndromes? Am J Med Sci. 1998;315:194–198.
26. Connor D, Modi G, Charles P. Accuracy of the Siriraj and Guy's Hospital Stroke Scores in Urban South Africans. Stroke 2007; 38;62-68.

Appendix

Calculation of Siriraj score

*Consciousness (x2.5) (Alert 0, Drowsy or stupor 1, Semicoma or coma 2)
*Vomiting (x2) (No 0, Yes 1)
*Headache within two hours (x2)(No 0,Yes 1)
*Diastolic blood pressure (x0.1)
*Atheroma markers (x3) Diabetes, angina, intermittent claudication(None 0, One or more 1
*Constant -12

Hemorrhage (>89% certainty), score greater than +1; ischemic stroke (>93% certainty), score less than -1; and uncertain, score of -1 to +1.

Calculation of Allen score

*Apoplectic onset: Loss of consciousness, Headache within two hours, Vomiting Neck stiffness (None or one 0, Two or more 21.9)
*Level of consciousness (24 hours after admission)
(Alert 0, Drowsy 7.3, Unconscious 14.6)
*Plantar responses Both flexor or single extensor 0, Both extensor 7.1
*Diastolic blood pressure(x0.17)
*Atheroma markers Diabetes, angina, intermittent claudication(None 0,One or more-3.7)
*History of hypertension Not present 0, Present -4.1
*Previous event TIA (None 0 , Any number of previous events -6.7)
*Heart disease None O, Aortic or mitral murmur -4.3 , Cardiac failure -4.3, Cardiomyopathy -4.3, Atrial fibrillation -4.3, Cardiomegaly -4.3, Myocardial infarct within six months -4.3)
*Constant -12

Hemorrhage (>90% certainty), score greater than +24; ischemic stroke (>90% certainty), score less than +4; and uncertain, score of +4 to +24.