Original Article

Utility of stroke scores in correctly diagnosing stroke subtype and starting low risk antithromotic therapy in areas without imaging facilities

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Abstract

Background and Objective: Stroke burden in India and all over the world is already high and is increasing, but limited patients with stroke have access to brain imaging. Distinguishing pathologic stroke types is relevant both for clinical management and epidemiologic studies. We assessed the accuracy of two stroke scores which are based on clinicians assessment of patient in distinguishing stroke subtypes and compared them with the computed tomography brain scanning as the "gold standard." **Methodology**: This comparative, analytical study was conducted at Shri. V.N. Govt. Medical College, from December 2012 to July 2015. Study included 150 consecutive patients of acute stroke admitted to our hospital. ASS and SSS were calculated for each patient and compared with the results of CT scan(sensitivity, specificity, positive predictive value, likelihood ratio, kappa statistics). **Results**: Out of 150 patients, 105 had CI and 45 had CH. The overall comparability of ASS and SSS was good (Kappa=0.728). SSS was equivocal in 5 cases. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of SSS was 87.62%; 84.44%; 92.93% and74.51% respectively for CI and 82..22%, 87.62%, 74% and 92% respectively for CH. The sensitivity, specificity, PPV and NPV of ASS was 87.62%, 73.33%, 88.46% and 71.74% respectively for CI and 73.33%, 87.62%, 71.74% and 88.46% respectively for CH. **Conclusion**: Although, SSS simple to calculate and being more accurate is better than ASS, both these scores lack sufficient validity to be used for exclusion of intracerebral hemorrhage so cannot be used to offer high risk thrombolytic therapy.

Key Words: Stroke, Cerebral Infarction, Cerebral Hemorrhage, Allen Stroke Score, Siriraj Stroke Score.

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INTRODUCTION

Though 45 years have passed since the discovery of CT scan by Sir. Godfrey N. Hounsefield, which is a safe and noninvasive procedure for differentiating between cerebral infarction and hemorrhage. However in India and in most of the developing countries, the availability of CT scan facilities, particularly in the rural and peripheral centers is very low. Moreover the cost of scanning precludes its routine usage by the poorer sections of society. In view of the above constraints, different scoring systems have been developed taking into consideration the most commonly occurring clinical variables for differentiating between cerebral infarction and hemorrhage. It was hoped that these scoring systems would help the physician to predict the diagnosis with a greater degree of confidence using simple clinical parameters and thereby discourage the nonselective use of modern diagnostic technology. We cannot directly extrapolate the results from validation studies undertaken outside our area because scores used to distinguish pathologic stroke subtypes use "atheroma markers" such as angina, intermittent claudication, diabetes, and myocardial infarction. Although three small studies have compared Allens and siriraj stroke scores in India, they

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have been undertaken in urban area at Mumbai, Bikaner and Indore cities.{Wadhwani, 2002, Nature of lesion in cerebrovascular stroke patients: clinical stroke score and computed tomography scan brain correlation}Our population belonging to tribal district of Vidarbha region in India does not have a high prevalence of extracranial atherosclerotic disease either in the general population or in patients with stroke. Also prevalence of intracerebral hemorrhage may be very different in our population. This study attempts to differentiate between ischemic and hemorrhagic strokes by applying the Siriraj and Allen stroke scores and confirms their accuracy with CT scan diagnosis in rural population. We are trying to verify the diagnostic accuracy of all available clinical information that is easily obtainable to clinicians at the bedside—initial patient interview, physical examination which has been combined in different stroke scores and to verify if any of these parameters combined in these scores might be of value to correctly identify patients of stroke as infarct or hemorrhage so that ischemic stroke patient can be started on early aspirin therapy in resource limited setting.

MATERIALS AND METHODS

Source of Data

Patients of acute stroke admitted to our hospital within 72 hours of onset of symptoms.

Method of Collection of Data

The data for this study was collected by detailed history, patient evaluation, clinical examination and investigation.

Study Design

Observational study of acute stroke during the year 2012 - 2015.

Inclusion Criteria

- Patients who come to SVNGMC hospital with stroke. Stroke is defined as the rapid on set off ocalor global disturbance of cerebral function lasting more than 24 hours (WHO criteria for acute stroke syndrome).
- Patients presenting within 72 hours of onset of symptoms.

Exclusion Criteria

- Stroke due to Tumours, Trauma and Infection.
- Patients presenting after 72 hours of onset
- Patient dying or leaving the hospital within 24 hours of admission

Protocol of the study

For all patients who fulfilled the inclusion and exclusion criteria, detailed history, clinical examination findings and the results of investigations were recorded. The two clinical scores, that is the Siriraj and Allens stroke scores were calculated for each patient. Whenever asymptom was not clear, it was recorded as absent. The scores were calculated as follows:

Statistical analysis

Statistical analysis was done using statistical package SPSS version 11.5. The Siriraj stroke score was compared with the results of CT brain and sensitivity, specificity; positive predictive and negative predictive values were calculated. Siriraj stroke score was calculated using variables shown in {table 1}

Table 1: Siriraj Stroke Score

Variable	Clinicalfeature	Score
1. Consciousness	Alert	0
	Drowsy, stupor	1
	semicoma, coma	2
2. Vomiting	No	0
	Yes	1
3. Headache (within 2hrs of onset)	No	0
	Yes	1
4. Diastolic BP	-	In mm of Hg
5. Atheromamarkers (DM, Angina, Intermittent claudication)	None	0
	≥1	1

Calculation

SSS = (2.5 X level of consciousness) + (2X headache) +(2 X vomiting) + (0.1X Diastolic BP) – (3 X atheroma markers) – 12[constant]

- A score >+1 indicates hemorrhage.
- A score < -1 indicates infarction.
- A score between +1 and–1 is taken as equivocal and will require imaging to decide the diagnosis.

Allens stroke score

Allens stroke score was calculated using variables shown in{table 2}{Wadhwani, 2002, Nature of lesion in cerebrovascular stroke patients: clinical stroke score and computed tomography scan brain correlation}

Table 2

Variable	Clinical feature	Score
1. Level of consciousness (24 hrs after admission)	Drowsy	+7.3
	Unarousable	+14.6
2. Plantar responses	Both flexor or single extensor	0
	Bilateral extensor	+7.1
3. Apoplectic onset		
a) Loss of consciousness		
b) Headache within 2 hrs	None or one	0
c) Vomiting	Two or more	+21.9
d) Neck stiffness		
Diastolic Blood pressure (24 hrs after admission)		+BP X 0.17
Atheroma markers (DM, Angina, Claudication)	None	0
	One or more	-3.7
H/O HT	Not present	0
	Present	-4.1
Previous event (TIA/ stroke)	None	0
	Any number	-6.7
Heart disease	None	0
	Aortic or mitral murmur Cardiac	-4.3
	failure Cardiomyopathy	-4.3
	Atrial fibrillation	-4.3
	Cardiomegaly	-4.3
	MI within 6 months	-4.3
		-4.3
Constant		-12.6

Interpretation of score

> +14----------Hemorrhage

< +14----------Infarction

Both scores were calculated by obtaining details of each clinical variable. If any variable was not available e.g. if patient is aphasic or unconscious, information from a valid surrogate respondent was taken[spouse/relative aware of patients medical history].We tried to record BP and conscious level of every patient at baseline and at 24 hours after admission. If due to any reason the reading at 24 hours was not available, then the nearest reading recorded was taken for calculation of Allens stroke score. History of hypertension was taken from patient himself or relatives of patient or patients previous medical records if available. Patients were assumed to be fully conscious if they had a score of >13 on the Glasgow Coma Scale (GCS), drowsy if they had a GCS score of 8–13 and unconscious if they scored <7 Diabetes mellitus was considered when patient or his attendants confirmed the history DM or use of insulin or oral hypoglycemic agents or if patient had a random blood sugar level of 11.1 mmol /L or more. History of intermittent claudication was taken from patient or his attendant by considering following criteria :calf pain which is atherosclerotic in origin, induced by exercise and relieved within 10 minutes by rest. Atrial fibrillation was confirmed by ECG recording at arrival. Cardiomegaly was considered if cardiothoracic ratio was more than 0.5 on chest x-ray. Allpatients were subjected to CT scan brain to identify intracranial hemorrhage. Repeat CT scan was done after 48 hours, in patients whose scans failed to show any evidence of cerebral infarction. Every CT scan was reported by consultant radiologist who was blinded to both scores. Every patient was subjected to CT Brain preferably within 24-72 hours of admission.

RESULTS

Analysis of date of a total 150 patients recruited in our study showed that there were 105cases with cerebral infarction (CI) and 45cases with cerebral haemorrhage(ICH).79 were males and 71 females. We found no significant difference in the sex distribution. On evaluating the cases with the Siriraj stroke score, out of 150 cases 99 had is chemicinfarcts and 46 had hemorrhagicinfarcts. Five patients had a score between +1 and –1 and were considered to be equivocal. Siriraj Stroke Score diagnosed 99 cases to be ischemic strokes. The diagnosis was correct in 92 cases and incorrect in 7. 46 cases were diagnosed as hemorrhage. The diagnosis was correct in 37 patients and erroneousin9.3 patients had a score between+1and–1and were taken as equivocal. Sensitivity for infarction by Siriraj stroke scoreis87.62% while for hemorrhage is 82.22%. Specificity for infarction by Siriraj stroke score is 84.44% and for hemorrhage is 87.62%. The positive and negative predictive values for infarction 92.93 and 74.51 and for hemorrhage were 74% and 92% respectively{Table 3}.

Table 3: Validation Study of Siriraj and Allens Stroke Score

Parameter	Siriraj Stroke Score		Allens Stroke Score	
	Infarct	Hemorrhage	Infarct	Hemorrhage
Sensitivity	87.62	82.22	87.62	73.33
Specificity	84.44	87.62	73.33	87.62
PPV	92.93	74.00	88.46	71.74
NPV	74.51	92.00	71.74	88.46

Allens stroke Score diagnosed infarctionin 104 cases with correct correlation in 92 cases. Of the 46 cases diagnosed as hemorrhage, the diagnosis was correct in 33 cases and incorrect in 13 cases. Sensitivity for infarction by Allen's stroke score is 87.62% while for hemorrhage is 73.33%. Specificity for infarction by Allens stroke score is 73.33% and for hemorrhage is 87.62%. The positive and negative predictive values for infarction 88.46 and 71.74 and for

hemorrhage were 71.74 and 88.46 percent respectively {Table 3}. SSS is superior to ASS as an early screening tool is also augmented by the ROC curve analysis in which the AUC for SSS is significantly higher than ASS.{ fig1}

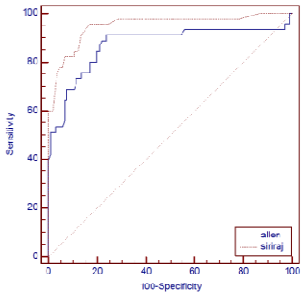

Figure 1: Pairwise comparison of ROC curves

Table 6: Difference between auc areas

Difference between areas	0.0796
Standard Error[c]	0.0344
95% Confidence Interval	0.0122 to 0.147

DISCUSSION

Diagnosis of the acute stroke syndrome is relatively easy, but diagnosis of stroke subtype in the acute setting without imaging facilities is certainly difficult. The sample in this study was restricted to cases of definite stroke. The practical utilization of these scoring systems as screening tests would be to exclude cerebral haemorrhage in patients acute stroke, in order to offer any thrombolytic or antithrombotic treatment in settings where CT is not vaialable. In order to exclude CH, the clinical score should have a high sensitivity for cerebral hemorrhage. The Siriraj Stroke Score and the Allen's stroke score considers the onset of symptoms, the level of consciousness, history of vomiting and history of headache and were given different scores. Both scores consider the diastolic blood pressure of the patients in their scoring systems. Both scores consider theather omamarkers like diabetes, angina and intermittent claudication in their scores showing their importance in differential diagnosis of acute stroke. Allen's stroke score also considers the history of hypertension, previous history of transient ischemic attack or stroke and history of heart disease. 150 consecutive cases of stroke fulfilling our inclusion and exclusion criteria were taken up for the study. Even though there was no selection bias, there was near equal representation of both sexes, as was the case in Poungvarin *et al* study from Thailand[1] and Jyoti Wadwani *et al* study from India[2]. In the present study, sensitivity of Siriraj stroke score in diagnosing infarction was 87.62% and that indiagnosing hemorrhage is 82.22%. In comparison to sensitivity of previous validations tudies, sensitivity of infarction in study by Celani *et al*[3] by Siriraj Score was 93.3% and for hemorrhage was 61%. Sensitivity for infarction by Siriraj Stroke Score validation study was 93.2% and for hemorrhage was 89.3%. Sensitivity for infarction by Hung L Y*et al*[4] for infarction was 90% and for hemorrhage was 85% by Siriraj Stroke Score. In one study conducted in India by Jyothi Wadhwani *et al*[2], sensitivity for infarction was 92.54% and for hemorrhage was 87% by Siriraj Stroke Score.

Table 4: Comparison of sensitivity for SIRIRAJ STROKE SCORE

Study	Siriraj Stroke Score	
	Infarct	Hemorrhage
Poungvarin *et al* study (1991)[1]	93.2%	89.3%
Weir C J *et al* study (1994)[7]		68%
Celani M J *et al* study (1994)[3]		61%
JyotiWadhwani *et al* study (2002)[2]	92.54%	87%
HungLY*et al*[7]	90%	85%
Present Study	87.62%	82.22%

The positive predictive value of Siriraj Stroke Score in diagnosing infarctionis 92.93% and for diagnosing hemorrhageis 74%. Instudyby Celanietal[3], positive pre dictive value of Siriraj Score in diagnosing infarctionis 93% and hemorrhageis 63%. In Siriraj Stroke Score validation study, positive predictive value for infarction is 73.92% and for hemorrhage is 91.27%. Compared to previous studies, positive predictive value for both infarction and hemorrhage by Siriraj Stroke Score is similar in the present study. The sensitivity of Allen's score in diagnos inginfarction in the present study is 87.62% and that of hemorrhage is 73.33%. In study by Celani *et al*, sensitivity of Allen's score for infarction is 91%. In study by P.A. Sandercock *et al*[5], sensitivity of Allen's score for infarctionis 78%. In another study conducted in India by Jyothi Wadhwani *et al*, sensitivity of Allen's score for infarction was 93.42% and for hemorrhage was 66.66%.

Table 5: Comparision of sensitivity of the present study with other validation studies on Allen's stroke score

Study	Infarction (%)	Hemorrhage (%)
Celani *et al*[3]	91.00%	--
Sandercock PA *et al*[5]	78.00%	--
JyothiWadhwani *et al*[2]	93.42%	66.6%
		50%
AamodSoman *et al*[8]	--	5
		5
Weir *et al*[7]		70%
Present study	87.62%	73.33%

The predictive value of a positive test it the present study for infarction by Allen's score is 88.46% and that of hemorrhage is 71.74%. In the study by PAS and ercock *et al*, the positive predictive value in the diagnosis of

infarction by Allen's score is 78%. In the study conducted by Celanietal, the positive predictive value in the diagnosis of infarction by Allen's score was 93%. The superiority of the SS over the Allen score is related to its better discrimination, evident in statistical analysis, simplicity in application, and the fact that the score can be applied at presentation of the patient unlike that for ASS which requires 24 Hours to be calculated. The fact that SSS is superior to ASS as an early screening tool is also augmented by the ROC curve analysis in which the AUC for SSS is significantly higher than ASS. Both the scores are based mainly on clinical symptomatology. In this study all patients shown to have a large infarct (ischemic stroke) by CT scan, but who were predicted by clinical cores to have hemorrhage due to their severe symptoms and there for ehighapolectic onset scores. On the other way, patients with a small hemorrhage as detected by CT scan had clinical score favoring infarction because of their minimal symptoms and therefore incorrectly diagnosed as infarctionby clinical scores. Another fallacy is that both scores lack formal definitions for some variables. The main problem relates to the level of consciousness because it is an important weighing factors in both scoring protocols. In large infarcts cerebral edemaleadstomidline shift, brainstem compression, alterationin the level of consciousness and gives false interpretation of hemorrhage. In general both scoring methods tend to classify severe strokes as hemorrhagic strokes and strokes of less severity as ischemicregard less of their etiology, therefore both scoring methods needs modifications in their variables. When computerized tomographyis not immediately available and the doctors wish to start anti platelet therapy, Siriraj stroke score can be applied for the differential diagnosis of hemorrhage and infarction as the sensitivity and predictive value of a positive test for hemorrhage were higher when compared to that of Allen's score. Recent analysis of the data of Chinese Acute Stroke Trial and International Stroke Trial to analyze the potential impact of aspirin on outcome at hospital discharge after acute stroke in resource-limited settings without access to neuroimaging to distinguish ischemic stroke from intracerebral hemorrhage (ICH) has concluded that Aspirin treatment for the period of initial hospitalization after acute stroke of undetermined etiology is predicted to decrease acute stroke-related mortality and in-hospital stroke recurrence even at the highest reported proportion of acute strokes due to ICH[6].

CONCLUSION

we will require large scale clinical trials and modifications in scores for better accuracy before the scores can be used to initiate high risk clinical procedures like thrombolysis though they can be used to start low risk treatment like antiplatelets in present condition.

Limitations

- The score may give erroneous results incase of mild or very severe strokes.
- The scores cannot be used before initiating high-risk strategies like thrombolysis.

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