ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 12, pp. 22734-22738, December, 2017

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

ACCURACY OF SIRIRAJ STROKE SCORE IN DISTINGUISHING HAEMORRHAGIC FROM ISCHEMIC STROKE IN AN INDIAN POPULATION

Indranil Sen[1]., Atanu Chandra[2]., Sampurna Chowdhury[3]., Atreyo Chakraborty[4]., Swayang Prakas Chowdhury[5] and Rishan Singh Nongbet[6]

[1]RMO Cum Clinical Tutor, Calcutta National Medical College & Hospital
[2]RMO Cum Clinical Tutor, Midnapur Medical College & Hospital
[3]Burdwan Medical College & Hospital
[4, 5,6]Calcutta National Medical College & Hospital

DOI: http://dx.doi.org/10.24327/ijrsr.2017.0812.1327

ARTICLE INFO

Article History:

Received 15th September, 2017
Received in revised form 25th October, 2017
Accepted 23rd November, 2017
Published online 28th December, 2017

Key Words:

Siriraj Stroke Score, haemorrhagic stroke, sensitivity, specificity

ABSTRACT

Background: The burden of stroke in India is already high and likely to increase, but few patients with stroke particularly in rural setting have access to brain imaging. Distinguishing pathologic stroke types is relevant both for clinical management and epidemiologic studies. So in resource limited settings scoring system based on discriminant analysis technique and multivariate logistic regression have been developed to distinguish cerebral haemorrhage from cerebral infarction.

Aims & Objectives: In this study we aimed to establish the accuracy of Siriraj Stroke Score in the bedside diagnosis of types of stroke in comparison with a neuroimaging technique usually CT scan.

Methods: This is a cross-sectional observational study conducted for seven months from April to November 2017. Patients who met the inclusion criteria were inquired about variables of Siriraj Stroke Score and scored accordingly. Results were compared with the findings of CT scan. Sensitivity and specificity of the score for haemorrhagic and ischemic stroke was tested against computed CT of brain as a gold standard. Sensitivity and specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for diagnostic accuracy in distinguishing stroke subtypes taking CT scan as gold standard.

Results: Total 1000 patients were included in the study. Sensitivity, Specificity, Positive Predictive Value, and Negative Predictive Value of Siriraj Stroke Score for haemorrhagic stroke was 85%, 82%, 92% and 68% respectively. Overall accuracy for haemorrhagic stroke was found to be 84%. In cases of ischemic stroke the Sensitivity, Specificity and Positive predictive Value was 82%, 92% and 67% respectively. There was no significant statistical correlation between the variables and stroke subtypes.

Conclusion: Siriraj Stroke Score had higher sensitivity for haemorrhagic stroke and is more sensitive in Asian population, but still not accurate enough to replace CT scan as investigation of choice particularly where definitive therapy like anticoagulation or thrombolysis is considered but can plays a role to avoid delay in the management where CT scan is delayed or not available.

INTRODUCTION

Stroke is defined by the World Health Organization as "rapidly developing clinical symptoms and or signs of focal and at times global (applied to patients in deep coma) loss of cerebral function, with symptoms lasting more than 24 hours or until death, with no apparent non-vascular cause" [1]. After coronary heart disease (CHD) and cancer of all types, stroke is the third commonest cause of death worldwide. However unlike the Caucasians, Asians have a lower rate of CHD and a higher prevalence of stroke. [2] The disparity between the stroke and CHD incidence rates is usually attributed to high prevalence of hypertension and low levels of blood lipids among the Orientals. Hypertension was related to high salt intake and perhaps to genetic factors and low serum lipid was due to low levels of animal fats and protein in oriental diet. In the early

Corresponding author:* **Indranil Sen
RMO CUM Clinical Tutor, Calcutta National Medical College & Hospital

1980s the prevalence rates of stroke were around 500-700 per 100,000 in the Western countries and 900 per 100,000 in Asia. [2, 3] There were limited data available on stroke related mortality in India. Although medical certification of the cause of death is a legal requirement, only 13.5% of all deaths in India were medically certified in 1994.[4] Therefore ascertainment of the cause of death was grossly inadequate in India. However, it was estimated that stroke represented 1.2 % of the total deaths in the country, when all ages were included. [5] The proportion of stroke death increased with age, and in the oldest group (> 70 years of age) stroke contributed to 2.4% of all deaths.

There are two types of stroke the more common ischemic and haemorrhagic types. Accurate distinction between these two types is crucial as the management protocol differs considerably.

The clinical accuracy of distinction of stroke from non-stroke has a sensitivity of up to 95% [6, 7] and specificity between 66 to 97% [8, 9]. However, this accuracy drops significantly when stroke subtypes have to be distinguished, with sensitivity of 68% and specificity of 67% [10, 11, and 12]. So stroke patients are subjected to a computerised tomography (CT scan) for confirmation of the diagnosis and determination of the subtypes. However in India a vast majority of patients do not have access to brain imaging due to cost and inaccessibility at least at the onset of presentation. So to aid in diagnosis and initial management scoring systems based on multivariate logistic regression analysis and discriminant analysis technique have been developed, such as the Guy's hospital score (also known as the Allen score) and the Siriraj Stroke Score (SSS) [13]. These have been used in many studies particularly in developing nations with validation with the index study at Bangkok with conflicting results as regarding accuracy. So with the aim to validate the Siriraj Stroke Score in Indian context this study was carried out in a tertiary care centre in Eastern India. This study aimed to determine the sensitivity, specificity and accuracy of Siriraj scoring system in distinguishing between stroke pathological types in patients confirmed by CT scan. To the best of our knowledge this is the largest single centre study in India regarding diagnostic accuracy of Siriraj Stroke Score with a registry of 1000 patients.

METHODOLOGY

This cross-sectional observational study was carried out in the department of General Medicine in Calcutta National Medical College & Hospital which is one of the tertiary care centres in West Bengal. Prior to the study a favourable ethical clearance was taken from the Institutional Ethical Committee.

Study subjects

Patients selected by non probability consecutive sampling that presented with focal or global neurological deficit in the emergency and outpatient department and were subsequently admitted were initially selected. They were evaluated clinically and the patients aged 18 years and above fulfilling the WHO definition for stroke were recruited in the study. The time gap between the culpable ictus and the first neuroimaging was considered to be 14 days and those presenting with a CT scan later than that were excluded. The other exclusion criteria were:-

1. Repeat or recurrent stroke
2. Subjects on anticoagulant therapy prior to the episode of stroke
3. Bilateral motor weakness
4. CT scan evidence of subarachnoid haemorrhage
5. Patients who died or left the hospital in less than 24 hours after admission
6. Stroke due to tumour, encephalitis, tubercular arteritis or head injury
7. Patients refusing CT scan or consent
8. Patients who had insufficient data to calculate

After fulfilling all these criteria the study was conducted with a sample size of 1000 patients in the period from April 2107 to November 2017.

Data calculation

A preformed and pretested proforma was prepared and the relevant data was collected from the patients and in case of comatose or confused patients from relatives. Demographic data in form of patient's age, sex, duration of symptoms before presentation, and whether the patient is a known diabetic or hypertensive was recorded. Then general physical and neurological examination was done in all cases. The variables of Siriraj stroke scale namely the first recorded blood pressure from onset of the stroke, consciousness level based on Glasgow Coma Scale, presence of atheroma marker, and the presence of headache or vomiting within 2 hours of onset were documented. Patients were categorized as conscious having Glasgow Coma Scale (GCS) > 13 score 0, drowsy having GCS 8 to 12 assigned score 1 and unconscious having GCS < 08 with a score 2. History of headache within two hours of onset and history of vomiting after onset each was given1 point. Atheroma markers were classified as a history of diabetes, angina, transient ischemic attack or intermittent claudication. The patient scored 1 point if he or she had one or more atheroma markers. If any variable was not measured than the score was adjusted as zero. A previous history of diabetes or a fasting plasma glucose of 126 mg/dL or more, mg/dL or glycosylated haemoglobin >6.5 or higher was classified as diabetes mellitus. Patients presenting with systolic blood pressure 140 mmHg and above or diastolic blood pressure 90 mmHg and above or who had normal blood pressure but were pharmacologically being treated for hypertension were categorized as hypertensive. A zero score was assigned in the absence of any history or physical findings of the listed variables. Whenever the occurrence of a symptom was not clear it was recorded as absent and scored zero.

After calculating all the data the Siriraj Stroke Score was calculated for each patient according to the formula: (2.5× level of consciousness) + (2× headache) + (2× [vomiting] + [0.1× diastolic blood pressure] –12– [3× atheroma marker]). A score <–1 was taken to suggest infarction, a score >+1 was taken to suggest hemorrhage, while a score of -1 to +1 was considered indeterminate. [14] To obtain a definite diagnosis of haemorrhage or infarction all patients had a non-contrast computerised brain scan as early as possible and not later than 72 hours since the incident. The patients who had brought imaging from outside for this culpable event were also recorded. In inconclusive cases like posterior circulation

infarcts MRI of brain was done in selected cases. The computerised brain scanner was the Toshiba Alexion 16 slice/G-XL-16891.

Statistical analysis

Statistical analysis was performed using SPSS (IBM SPSS Statistics 20.0) software. Continuous variables (Age and diastolic blood pressure), were calculated by mean ± SD. Frequencies and percentages were calculated for gender, level of consciousness, vomiting, headache at onset. Sensitivity and specificity, Positive Predictive Value (PPV) and Negative predictive Value (NPV) were calculated for diagnostic accuracy of Siriraj score.

RESULTS

The cases were evaluated and documented. Among 1000 patients 663 patients were diagnosed to have haemorrhage according to Siriraj Score, 231 were infarct, and 106 were inconclusive. The data is shown in Table 1.

Table 1 Number of cases according to CT scan and Siriraj Stroke Score

		ct diagnosis	Total	
		Haemorrhage	Infarct	
SSSdiagnosis	haemorrhage	616	47	663
	inconclusive	51	55	106
	infarct	57	174	231
Total		724	276	1000

Then the CT reports of these patients were reported for definitive diagnosis. Among them 663 patients had haemorrhagic stroke and 337 had infarct. The sensitivity for haemorrhagic stroke is 85% and that of ischaemic stroke is 82%. The results are shown in table 2.

DISCUSSION

The result of our study was compared to other major studies in both developed and developing nation with different population demographics. The comparative analysis is shown in table 4.

In our study the sensitivity for diagnosing haemorrhagic stroke was 85%, specificity was 82% and positive predictive value was 92%. This was an impressive figure and it was similar to the data from studies in South East Asia with similar population characteristics. It has been suggested that the SSS has failed to impress in high-income white populations because it was developed in Thailand in a population with a high prevalence of cerebral haemorrhage. By including the inconclusive cases and assessing only the cases with a confirmed diagnosis by brain imaging our sensitivity was better than the studies in Western population. [24, 25 &26] In our study the sensitivity for diagnosing ischaemic stroke (infarct) is 82%, specificity is 92% and positive predictive value is 67%. Due to taking in account only patients with complete case records the sensitivity and specificity was quite high comparable with the index validation study in Bangkok, Thailand. The low prevalence of ischemic stroke in Indian population and the age group in which the study was done, mean age 51+/-4.3 years in which haemorrhagic stroke is commoner resulted in the low positive predictive value. Apart from the increased prevalence since our hospital was a referral hospital and most of the cases from districts and subdivisions were haemorrhagic cerebrovascular accidents there was this skewed proportion of patients. Overall in our study the sensitivity and specificity of Siriraj Stroke Score in differentiating pathological types of stroke was satisfactory.

Table 2 data showing specificity and sensitivity for haemorrhagic stroke

Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Positive likelihood ratio	Negative likelihood ratio	Likelihood ratio+/-	Percent agreement (%)
85	82	92	68	4.72	0.18	26.22	84

According to ANOVA Test vide table 3 there was no significant statistical correlation between the variables of Siriraj Score and the haemorrhage and infarct groups. Siriraj score was found to be more sensitive for the diagnosis of haemorrhagic stroke but still not accurate enough to replace the CT scan brain as investigation of choice.

Table 3 statistical significance between groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3344.655	1	3344.655	432.021	.000
Within Groups	7718.663	997	7.742		
Total	11063.318	998			

Table 4 Performance of Siriraj Stroke Score in diagnosing haemorrhage compared with Gold Standard (brain imaging/ autopsy) in different populations

Study	Study size	Design	Sensitivity	Specificity	Positive predictive value	Uncertain scores included/excluded/Not applicable
South africa[15]	222	prospective	0.60	0.88	0.70	included
Nigeria[16]	96	retrospective	0.50	0.63	0.55	included
Ethiopia[17]	41	retrospective	0.48	0.75	0.67	included
Thailand[13]	165	prospective	0.89	0.93	0.97	excluded
Italy[8]	193	prospective	0.61	0.94	0.63	excluded
India[18]	134	prospective	0.79	0.71	…..	N/A
India[19]	159	prospective	0.85	0.73	0.71	N/A
Pakistan[20]	100	prospective	0.73	0.90	0.83	N/A
Hong kong[21]	253	prospective	0.91	0.90	0.69	N/A
Malaysia[22]	160	prospective	0.50	0.91	0.66	included
USA[23]	254	retrospective	0.36	…….	0.77	excluded
New Zealand[24]	485	retrospective	0.48	0.85	0.59	included
UK[25]	482	retrospective	0.67	0.71	0.22	N/A

Table 5 Performance of Siriraj Stroke Score in diagnosing infarct compared with Gold Standard (brain imaging/ autopsy) in different populations

Study	Study size	Design	Sensitivity	Specificity	Positive predictive value	Uncertain scores YES/NO/NA
South Africa[15]	222	Prospective	0.70	0.84	0.91	YES
Nigeria[16]	96	Retrospective	0.58	0.55	0.63	YES for sensitivity NO for specificity, PPV
Etiopia[17]	41	Retrospective	0.40	0.86	0.73	YES
Thailand[13]	165	Prospective	0.93	0.89	0.76	NO
Pakistan[20]	100	Prospective	0.71	0.85	0.87	NA
India[19]	159	Prospective	0.73	0.85	0.85	NA
Hong Kong[21]	253	Prospective	0.78	0.80	0.93	NA
Malaysia[22]	160	Prospective	0.70	0.64	0.85	YES
New Zealand[24]	485	Retrospective	0.61	0.74	0.84	YES
USA[23]	254	Retrospective	0.90	……	0.61	NO

Further studies are required to improve the accuracy of Siriraj score by adding new variables of high discriminate values like neck stiffness, seizures that are more specific for haemorrhagic stroke and atrial fibrillation, Carotid Doppler and lipid profile which are more specific for ischemic stroke. So after assessment of stroke patients by the Siriraj Stroke Score differentiating between types of stroke is not full proof but at least initial management can be started and those suspected ischemic stroke patients who present within the golden hour can be promptly referred to higher centres for a diagnostic neuroimaging and thrombolysis or anticoagulation as and when necessary. So although the Siriraj Stroke Score may not be diagnostic it helps in triage of patients of cerebrovascular accident. Our recommendation is to improve diagnostic facilities in subdivisional and rural level and promote lifestyle modification to reduce the disease burden of stroke.

CONCLUSION

This study showed that Siriraj Stroke Score is fairly reliable in differentiating acute ischemic stroke from acute hemorrhagic stroke, but efforts should be given to make neuroimaging available and affordable in resource poor settings, as critical decisions cannot be made in acute stroke without imaging.

Disclosure

The authors report no conflicts of interest in this work.

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How to cite this article:

Indranil Sen *et al*.2017, Accuracy of Siriraj Stroke Score In Distinguishing Haemorrhagic From Ischemic Stroke In An Indian Population. *Int J Recent Sci Res.* 8(12), pp. 22734-22738. DOI: http://dx.doi.org/10.24327/ijrsr.2017.0812.1327

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