Section: General Medicine

Original Research Article

CORRELATION OF CLINICAL SCORES AND CT SCAN IN ACUTE STROKE

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Abstract

Background: A stroke is defined by abrupt onset of neurological deficit due to focal vascular cause. It is important to distinguish between cerebral haemorrhage and infarction, since the management differs substantially. The most accurate method is Computed Tomography. In resource poor settings, scores like Guy's hospital score and Siriraj score can be used as a simple diagnostic to distinguish the types, the utility of which is being tested in this study. **Materials and Methods:** A hospital-based study was conducted at the Department of Medicine, DY Patil Hospital, Navi Mumbai. A total pf 50 suspected stroke patients coming to the hospital fulfilling the eligibility criteria were included. A detailed history and clinical examination performed. Siriraj stroke score and Guy's hospital stroke score were evaluated at admission and at the end of 24 hours respectively. All patients were subjected to CT scan head within 24 hours of admission which was used as final diagnosis for comparison. **Result:** The sensitivity of Siriraj score for ischemic stroke - 84.6%, specificity- 92.90% while the positive predictive value - 91.7% and negative predictive value - 86.7% with overall accuracy of 88.9%. For haemorrhagic stroke, sensitivity – 92.9%, specificity – 84.6% PPV – 86.7% NPV – 91.7% with overall accuracy of 88.9%. The sensitivity, specificity, PPV and NPV of Guy hospital score for both haemorrhagic and ischemic stroke was 100% after excluding equivocal cases. **Conclusion:** Present study observed that both Siriraj and Guy hospital score are not sufficiently accurate for use in distinguishing and clinical management of patients with stroke. It is unlikely that any score will replace brain imaging, which is current gold standard for diagnosing stroke patients, but, in places where CT is unavailable and the treatment of stroke is therefore limited, these scores can be used to some extent to differentiate stroke subtypes.

INTRODUCTION

Stroke or cerebrovascular accident is defined by the abrupt onset of a neurologic deficit that is attributable to a focal vascular cause. The definition of stroke is clinical, and laboratory studies including brain imaging are used to support the diagnosis. The clinical manifestations of stroke are highly variable because of the complex anatomy of brain and its vasculature. Cerebral ischemia is caused by a reduction in blood flow that lasts longer than several seconds. Neurologic symptoms manifest within seconds because neurons lack glycogen, so energy failure is rapid. If the cessation of blood flow lasts more than a few minutes, infarction, or death of brain tissue results. When blood flow is quickly restored, brain tissue can recover fully and the patient's symptoms are only transient, this is called a Transient Ischemic Attack (TIA). A generalized reduction in cerebral blood flow due to systemic hypotension (e.g. cardiac arrhythmia, myocardial infarction, or hemorrhagic shock) usually produces syncope. Focal ischemia or infarction, conversely, is caused by thrombosis of the cerebral vessels themselves or by emboli from a proximal arterial source or the heart. Intracranial hemorrhage is caused by bleeding directly into or around the brain, it produces neurologic symptoms by producing a mass effect on neural structures, from the toxic effects of blood itself, or by increasing intracranial pressure.[1-3]

The effects of stroke can vary enormously, depending on the area of brain that has been damaged and the extent of damage. Clinical features vary from paralysis, communication difficulties (speaking, reading, writing and understanding) and also difficulties with learning, concentration and memory. Some patients can present with visual disturbances,

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urinary incontinence, swallowing difficulties and emotional problems.[4,5]

It is important for clinicians to distinguish between cerebral hemorrhage and infarction in cases of acute stroke, since management of these two disorders differ substantially. The most accurate method of distinguishing cerebral hemorrhage from infarction is Computed Tomography (CT). In 1984, the Guy's Hospital score was developed as a clinical diagnostic tool for intracranial hemorrhage. The calculations involved in Guy's scoring system were too complex for bedside application, hence another simpler scoring system was evolved at the Siriraj hospital of Thailand which found greater acceptance. Till such time these scoring systems have been fully evaluated and endorsed it is necessary to test them against the gold standard if CT scan.[6]

The present study was an attempt to test the utility of the Guy's Hospital score and Siriraj stroke score in the diagnosis of acute stroke.

MATERIALS AND METHODS

This was a hospital-based screening test study conducted in Department of Medicine, DY Patil Hospital, Navi Mumbai. Patients with measurable neurological deficit lasting for more than 24 hours (clinical diagnosis of stroke as defined by WHO definition), all adult males and females (above 18 years) presenting within 48 hours of onset of neurological deficit, those who consented for the study were included. Whereas those patients with previous history of stroke, subarachnoid hemorrhage, with clinical picture suggestive of postictal paralysis, bacterial/viral/tubercular meningitis and history of trauma were excluded from this study.

The sample size was calculated using following formulae:

$$n = \frac{\left(Z_{\frac{\alpha}{2}}\right)^2 * Sensitivity\,(1-Sensitivity)}{L^2 * Prevalence}$$

n = Sample size

Z = Z value at 5% error (1.96)

Sensitivity of Sriraj score = taken as 68% as per observations by Weir et al.

Q = 1-P

L = Desired precision (taken as 20% of Sensitivity i.e. 0.136)

n = (1.96)2 * (0.68 * 0.32)

(0.136)2

n = 45 (approx.)

So, by rounding off, we took 50 diagnosed stroke patients coming to our hospital in this study.

Acute stroke as per WHO criteria is "rapidly developing signs of focal or global disturbances of cerebral function with symptoms lasting 24 hours or longer, with no apparent cause other than of vascular origin.

A detailed history, thorough clinical examination was performed at admission and at the end of 24 hours. Siriraj stroke score and Guy's hospital stroke score were evaluated at admission and at 24 hours respectively. All patients were subjected to CT scan (head) within 24 hours of admission. The final diagnosis of stroke was based on findings on CT head, taken as gold standard for comparison.

The Siriraj Stroke Score was calculated at admission using the following variables shown in the table below:

Level of consciousness	Alert Drowsy/Stupor Semi coma/Coma	0 1 2
Headache (within 2 hours)	Absent Present	0 1
Vomiting	Absent Present	0 1
Diastolic BP		
Atheroma markers	None One or more	0 1
Diabetes Mellitus		
Angina Pectoris		
Intermittent claudication		

The Siriraj stroke score is calculated as (2.5x level of consciousness) + (2x vomiting) + (2x headache) + (0.1x Diastolic BP) – (3x Atheroma markers) -12.

A score of less than -1 was considered as infarction and a score of more than +1 was considered as hemorrhage. Scores between -1 and +1 were considered as equivocal.

The Guy's Hospital stroke score was calculated at the end of 24 hours of admission using 13 variables as shown in table below. The score of <4 was considered as infarction and a score of >24 was considered hemorrhage. Scores between 4 and 24 were considered as equivocal.

Variables	**Clinical feature**	**Score**
Apoplectic onset Loss of consciousness Headache within two hours Vomiting Neck stiffness	None or one Two or more	0 +21.9
Level of consciousness (24 hours after admission)	Alert Drowsy Unconscious	0 +7.3 +14.6
Plantar responses	Both flexor or single extensor Both extensor	0 +7.1
Diastolic blood pressure (24 hours after admission) (x0.17)		BP x 0.17
Atheroma markers Diabètes mellites, Angina, intermittent claudication	None One or more	0 -3.7
History of hypertension	Not present Present	0 -4.1
Previous event (stroke or TIA)	None Any number	0 -6.7
Heart disease	None Aortic/mitral murmur Cardiac failure Cardiomyopathy Atrial fibrillation Cardiomegaly	0 -4.3 -4.3 -4.3 -4.3 -4.3

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	Myocardial infarction within 6 months	-4.3
Constant		-12.6

Interpretation of score:
-30 to 0 = 95% probability of infarction
25 to 50 = 95% probability of hemorrhage

Statistical Analysis

All the collected data was entered in Microsoft Excel Sheet. The data was then transferred and analyzed using SPSS ver. 29. Quantitative variables were presented as mean +/- SD while qualitative variables were presented as frequency with percentages,
Sensitivity, Specificity, PPV and NPV of the Siriraj Score and Guy's Hospital stroke score was done using standard formulae, taking CT findings as gold standard.

RESULTS

A total of 50 consecutive clinically diagnosed stroke patients coming to our hospital were included in this study. The mean age of the study subjects was 57.8 years with 42% of cases being above 60 years of age. Male preponderance was seen with 62% males and 38% females. Most common associated risk factors were Hypertension (62%) and history of alcoholism (46%) and smoking (44%). Other risk factors include hypercholesterolemia (26%), diabetes (16%) and history of CVD (12%).

As per Siriraj score variables, common observation in cases of infarction was drowsiness (54.5%) and atheroma markers (12.1%) while in cases of hemorrhage, it was drowsiness (54.5%) associated with vomiting (52.9%) and headache (47.1%).

As per Guy's Hospital score variables, common observation in cases of infarction was drowsiness (54.5%) and h/o hypertension (54.5%) while in cases of hemorrhage, it was drowsiness (94.1%) associated with apoplectic onset (58.8%) and presence of bilateral plantar extensor (76.5%). Hypertension was observed in 76.5% of hemorrhagic stroke cases while history of heart diseases was given in 18.2% of infarction cases.

Out of total 50 cases as per CT findings, infarction was seen in 66% while hemorrhagic stroke was observed in 34% of the total cases. Mortality rate in cases of infarction was 12.1% while it was 29.4% in hemorrhagic stroke.

The sensitivity of Siriraj score for ischemic stroke was 84.6%, specificity was 92.90% while positive and negative predictive value was 91.7% and 86.7% respectively with overall accuracy of 88.9%. For hemorrhagic stroke, sensitivity of Siriraj score was 92.9%, specificity was 84.6% while positive and negative predictive value was 86.7% and 91.7% respectively with overall accuracy of 88.9%.

On inclusion of equivocal cases, the sensitivity and specificity of the Siriraj score for infarction was 33.3% and 94.1% while for that of hemorrhagic stroke was 76.5% and 93.9% respectively. The score had a good positive predictive value for both infarction (91.7%) and hemorrhage (86.7%).

The sensitivity, specificity, PPV and NPV of Guy hospital score for both hemorrhagic and ischemic stroke was 100% after excluding equivocal cases.

On inclusion of equivocal cases, the sensitivity and specificity of Guy Hospital score for infarction was 30.3% and 100% respectively while that for hemorrhagic stroke was 64.7% and 100% respectively. The score had good positive predictive value for both infarction (100%) and hemorrhage (100%).

Table 1: Distribution of stroke cases as per Age group.

Age group (yrs.)	N	%
</= 40	7	14.0%
41-50	8	16.0%
51-60	14	28.0%
61-70	18	36.0%
>70	3	6.0%
Total	50	100.0%
Mean age = 57.8 +/- 16.23 yrs.		

Table 2: Distribution of cases as per Risk factors

Risk factors for Stroke	N	%
Hypertension	31	62.0%
CVD	6	12.0%
DM	8	16.0%
Hypercholesterolemia	13	26.0%
Smoking	22	44.0%
Alcohol	23	46.0%

Table 3: Association of Guy's hospital score variables with Type of stroke

Guy Hospital Score variables	CT Diagnosis		Total (n-50)
	Infarction (n-33)	Hemorrhage (n-17)	
Apoplectic onset (loss of consciousness, headache within 2 hours, vomiting, neck stiffness)	0.0%	58.8%	20.0%
Drowsy/Comatose	54.5%	94.1%	68.0%
B/L Planter Extensor	0.0%	76.5%	26.0%

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Atheroma markers (Diabetes Mellitus, Angina pectoris, Intermittent claudication)	12.1%	17.6%	14.0%
H/o Hypertension	54.5%	76.5%	62.0%
Heart Disease	18.2%	0.0%	12.0%

Table 4: Diagnostic accuracy of Siriraj Score

Parameters*	Infarction	Hemorrhage
Sensitivity	84.6%	92.9%
Specificity	92.9%	84.6%
PPV	91.7%	86.7%
NPV	86.7%	91.7%
Accuracy	88.9%	88.9%

Table 5: Diagnostic accuracy of Guy's Hospital score

Parameters*	Infarction	Hemorrhage
Sensitivity	100.0%	100.0%
Specificity	100.0%	100.0%
PPV	100.0%	100.0%
NPV	100.0%	100.0%
Accuracy	100.0%	100.0%

*Excluding equivocal cases.

The sensitivity for Infarction was more in Guy's score (100%) as compared to Siriraj score (84.6%) and the same was for hemorrhagic stroke (100% vs 92%) when equivocal cases were excluded.

The overall comparability of Siriraj stroke score and Guy's hospital stroke score was substantial (Kappa ~ 0.612, p<0.0.5).

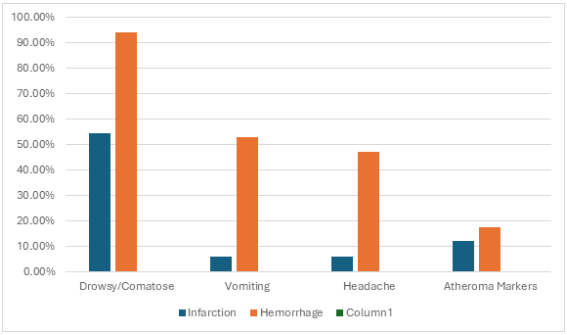

Figure 1: Association of Siriraj score variables with Type of Stroke

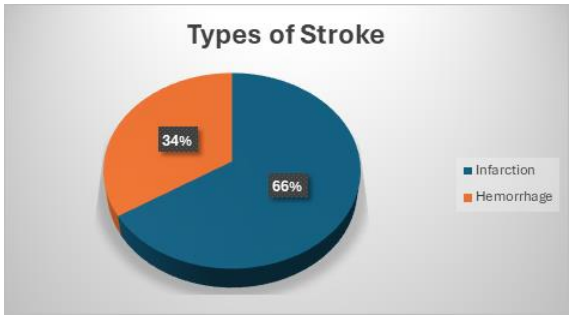

Figure 2: Distribution of cases as per type of stroke on CT scan

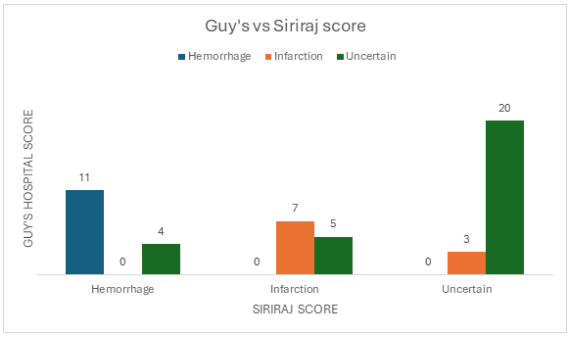

Figure 3: Agreement between Guy's Hospital and Siriraj Score

DISCUSSION

The aim of present study was evaluation of acute stroke on basis of two scores:

Siriraj stroke score and Guy's hospital stroke score and to assess the accuracy of these scores to differentiate cerebral hemorrhage from infarction. A total of 50 consecutive diagnosed stroke patients coming to our hospital were included in the study.

Demography

Mean age of the study subjects were 57.8 years with 70% of the patients being over 50 years of age and 42% being over 60 years of age. Male preponderance was seen in the study group with 62% males and 38% females.

Various studies have shown that prevalence of stroke increases with advancing age. However regarding gender differentiation, different studies showed varied results. In a study by Pavan MR et al. out of total 100 patients, 50 were males and 50 were females. The mean age of stroke patients was 61.01 ± 14.1 years. Somasundaran et al. in their study observed that out of total 464 patients, 207 (44.6%) were females and 257 (55.4%) were males with mean age of 64.3 years. In another study by Chukwuonye et al. mean age of subjects was 66.5± 2.6 years with 58% females and 42% males.

Risk Factors

Most common associated risk factors were Hypertension (62%) and history of alcoholism (46%)

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and smoking (44%). Other risk factors include Hypercholesterolemia (26%), Diabetes (16%) and history pf CVD (8%).

In a study conducted in South India conducted on 109 patients of stroke in age group of 15-45 years, there were 76 (69.7%) smokers, 53 alcoholics (48.6%), 59 diabetics (54.1%) and 79 hypertensives (72.5%). A retrospective review was done of the medical records of 177 patients seen in a tertiary referral center in Thiruvananthapuram, Kerala. Hypertension, Smoking, Alcohol and Hyperlipidemia were significantly more prevalent in cases of stroke. Another study in Taiwan explored the etiology of stroke. The 4 most common risk factors were Hyperlipidemia (53.1%), Smoking (49.8%), Hypertension (45.8%), and family history of Stroke (29.3%). Strong et al. also eliminated that hypertension was the most common risk factor for stroke, which was present in 54% of the cases in their study. In a similar study by Pavan et al. risk factors associated with stroke patients were Hypertension (37%), smoking (26%), Diabetes (18%), Alcohol (13%) and history of TIA (11%) and CVD (5%). Bansal BC et al. have observed that more than one-third of stroke cases had hypertension, cardiovascular diseases were seen in 42.8%, 51% were smokers, 18.9% were Diabetics and Hyperlipidemia was seen in 16.3% of total. Sridharan SE et al. observed that Hypertension was the most frequent risk factor, seen in 83.2% patients. Half of the patients had Diabetes and 26% had Dyslipidemia.

Type of Stroke

Out of the total 50 cases, as per CT findings, Infarction was seen in 66% while Hemorrhagic stroke was observed in 34% cases.

In a study by Somasundaran A et al., out of the total 108 cases, 72.2% were ischemic strokes and rest were hemorrhagic strokes as confirmed by CT brain. Reviewing the Indian stroke epidemiological data, the Mumbai registry has recorded 80.2% ischemic stroke and 17.7% hemorrhagic strokes. Data from Kerala state were obtained from Trivandrum Stroke Registry where 83.6% were ischemic strokes and 16.4% were hemorrhagic stroke. Pavan et al. in a similar study observed 71% ischemic and 29% hemorrhagic stroke cases.

Correlation Between Siriraj Score and Guy's Hospital Stroke Score

The overall comparability of Siriraj stroke score and Guy's Hospital Stroke Score was substantial (kappa - 0.67, $p<0.05$)

This finding was consistent with the results of a study which was done by Pavan et al. who used Mc Nemar test to compare the results of Siriraj stroke score and the Guy's hospital stroke score and observed no difference between the two scores. Celani et al. also did not find a significant difference between the two scores. Badam et al. also observed similar results with good agreement between the two scores after exclusion of equivocal score results (kappa = 0.93).

Our findings thus agree with others who suggested that the stroke scores are sufficiently accurate for use in the clinical management of patients with stroke. On comparing between the scores, both scores showed good agreement, but Guy's hospital score had a better diagnostic accuracy than Siriraj score.

But Siriraj and Guy's hospital scores failed to classify the strokes into different groups. Thus it is unlikely that any score will replace brain imaging and we should encourage investment in imaging modalities. But still, in placed where this is impossible and the treatment of stroke is therefore limited, these scores can be reliably used to differentiate stroke subtypes.

CONCLUSION

Present study of both Siriraj Score and Guy Hospital score for use in clinical differentiation between subtypes of stroke, where CT scan is not available, concluded the following :

•The scores had good positive and negative predictive value and could be used as "rule out" instead of "rule in" and exclude hemorrhage in poor resources area and early initiation of antiplatelet only to some extent.

•On comparing between the scores, both scores showed good agreement, but Guy's hospital score has a better diagnostic accuracy than Siriraj score both in hemorrhagic stroke and infarct. But Siriraj score is relatively easier to calculate.

•However, a large number of equivocal cases marred the diagnostic ability of these scores that is, they are not sensitive enough. It is thus unlikely that any of these scores will replace brain imaging, which is the current gold standard for diagnosing stroke patients.

•Limitation of the study represents only hospitalized stroke patients, and does not consider those who did not get referred or died at home.

•Therefore further studies are required to exclude the variables of low discriminate value and include new variables in the scoring system like seizures etc. and increase the accuracy of the score by reducing equivocal cases.

REFERENCES

1. Global Health Estimates Technical Paper WHO/HIS/HIS/GHE/2013.3. WHO methods and data sources for global causes of death 2000-2011.
2. Alvin C.Powers. Harrison's Principles of Internal Medicine. Diabetes mellites. The McGraw-Hill Companies, Maryland, Baltimore,20th edition.
3. Das SK, Banerjee TK, Biswas A, et al. A prospective community-based study of stroke in Kolkata, India.
4. Allen CM. Predicting the outcome of acute stroke: a prognostic score. Journal of neurology, Neurosurgery and Psychiatry.
5. Poungvarin N, Viriyavejakul A, Komontri C. Siriraj stroke score and validation study to distinguish supratentorial cerebral hemorrhage from infarction
6. Badam PR, Solao VA, Pai MA, Kalantri SP. Poor accuracy of the Siriraj and Guy's stroke score in distinguishing hemorrhagic from ischemic stroke in a rural, tertiary care hospital. National Medical Journal of India. 2003 Jan 1

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