

CORRELATION OF CLINICAL SCORES AND CT SCAN IN PATIENTS OF ACUTE STROKE

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Background. In India, stroke is associated with high morbidity and mortality. It is important to distinguish between cerebral infarction and hemorrhage in cases of acute stroke since the management of both differ substantially.

Aim. To assess the Siriraj stroke score and Guy's Hospital stroke score in the clinical diagnosis of acute stroke. Study also designed to differentiate cerebral hemorrhage from infarction using the Guy's Hospital score and Siriraj stroke score and to correlate clinical scores with CT brain.

Materials and methods. The study was conducted on 70 patients admitted with acute stroke over a period of 1 year. Siriraj Stroke Score was calculated on admission and Guys's Hospital Score was calculated at and 24 hrs after admission. All patients were subjected to CT scan within 72hrs of admission. The sensitivity, specificity, positive predictive value were calculated for both the scores. These scores were correlated with CT scan of brain using Chi-square test.

Results. Of the 70 patients admitted with acute stroke CT scan of brain showed infarction in 30 patients and hemorrhage in 40 patients. The sensitivity, specificity and PPV for Siriraj Stroke Score were 83.33%, 97.44%, 83.33% for infarction and 97.22%, 85.71%, 94.59% for haemorrhage respectively whereas the corresponding figures for Guys's Hospital Score were 100%, 97.30%, 75% for infarction and 96.97%, 100%, 100% for hemorrhage respectively. The comparability for Siriraj Stroke Score and Guy's Hospital Score was substantial.

Conclusion. CT brain is an accurate, safe and non-invasive procedure for differentiating between cerebral infarction and hemorrhage. However when CT scan facilities are not available, we suggest Siriraj Stroke Score as a simple method of screening patients for Intracerebral hemorrhage, as it is easier to use at bedside and has greater accuracy in diagnosing hemorrhage than Guys's Hospital Score. Guy's Hospital Score is not useful because it can be assessed only after 24hrs of onset of stroke.

Keywords: stroke, Siriraj Stroke Score, Guys's Hospital Score, Computed Tomography.

Background. Stroke is defined as "rapidly developing clinical symptoms and/or signs of focal and at times global (applied to patients in deep coma and those with SAH) loss of cerebral function with symptoms lasting for more than 24hrs or leading to death, with no apparent cause other than that of vascular origin" [1].

Stroke is one among the leading cause of death worldwide. Globally 1 in 4 adults over the age of 25 will have a stroke in their lifetime and this number has increased 50% over the past 17 years [2]. 12.2 million People worldwide will have their first stroke per year one in every three seconds, and 6.5 million will die as a result. The incidence of stroke increases with age, however over 60% of strokes happen to people under the age of 70 yrs[2]. The WHO collaborative study showed that

both in developed and developing countries nearly 1/3rd of stroke patients died within 3 month and 48% died within 1 year [3]. Metabolic risks (high systolic blood pressure (SBP), high body-mass index (BMI), high fasting plasma glucose (FPG), high total cholesterol, and low glomerular filtration rate) account for 71% (64.6–77.1) of stroke burden. Behavioural factors (smoking, poor diet, and low physical activity) account for 47% [41.3 to 54.4] of stroke burden and environmental risks (air pollution and lead exposure) 37.8% [35.0 to 41.0] [4].

It is important to differentiate cerebral infarction and hemorrhage since both differ substantially in their management. The most accurate method of distinguishing cerebral infarction from hemorrhage is CT scan.

In 1984, the Guy's Hospital score was developed as a clinical diagnostic tool for Intracerebral Hemorrhage [5]. The calculations involved in this score were too complex for bedside application. Hence, another score was designed at Siriraj Hospital in Thailand and had a greater acceptance. Till these scoring systems fully evolve it is necessary to test them against the gold standard test i.e. CT scan.

In Thailand, a stroke score known as the Siriraj Stroke Score was developed and has been in use throughout Thailand since 1986 [5]. Daga et al did a comparison of Siriraj and Guy's Hospital score in 160 patients admitted with acute stroke [6]. Celani et al compared the Guy's Hospital stroke score and Siriraj stroke score among 231 consecutive patients and have concluded that when computed tomography is not immediately available and the clinician wishes to start anti-thrombotic treatment, the Siriraj stroke score and Guy's Hospital score can be useful to identify patients at low risk of intracerebral hemorrhage [7].

Siriraj and Guy's Hospital scores can be used to identify patients at a low risk of intracerebral hemorrhage, in randomizing patients in clinical trials of low-risk treatment for the secondary prevention of stroke (in whom CT scanning is not feasible).

This study attempts to test the utility of both these scores in the diagnosis of acute stroke and compare it with CT scan.

Aim: to assess the Siriraj stroke score and Guy's Hospital stroke score in the clinical diagnosis of acute stroke. Study also designed to differentiate cerebral hemorrhage from infarction using the Guy's Hospital score and Siriraj stroke score and to correlate clinical scores with CT brain.

MATERIALS AND METHODS

The study was done in department of Medicine, Apollo Institute of Medical Sciences and Research. 70 cases of acute stroke admitted to medical wards were studied for a duration of one year from January 2021 to January 2022. This was a prospective study.

Method of collection of Data

Sampling procedure-purposive sampling

Sample size – 70 cases.

Inclusion Criteria:

The study group consisted of patients admitted to medical wards with a clinical diagnosis of acute stroke (stroke as defined by WHO definition). A detailed history, thorough clinical examination were performed at admission and at end of 24 hours. Siriraj stroke score and Guy's Hospital stroke score were evaluated. All patients were subjected to CT scan head within 72 hours of admission.

Exclusion Criteria:

- Previous history of stroke.

Table 1

Variables of Siriraj Stroke Score

Variables	Clinical features	Score
Level of consciousness	Alert	0
	Drowsy/stupor	1
	Semiconscious/coma	2
Headache (within 2 hrs)	Absent	0
	Present	1
Vomiting	Absent	0
	Present	1
Diastolic blood pressure		
Atheroma markers-	None	0
Diabetes mellitus/angina pectoris/intermittent claudication	One or more present	1

- Subarachnoid haemorrhage.
- Patients with clinical picture suggestive of post-ictal paralysis.
- Patients with history of trauma.

The Siriraj stroke score is calculated as (2.5x level of consciousness) + (2 x vomiting) + (2 x headache) + (0.1 x diastolic B.P.) – (3 x atheroma

markers) -12. A score of less than -1 was considered as infarction more than +1 as hemorrhage, between -1 and +1 were considered as equivocal.

The Guy's Hospital stroke score was calculated at end of 24 hours of admission using thirteen variables.

Table 2

Variables of Guy's Score

Variables	Clinical features	Score
Level of consciousness (24 hours after admission)	Alert	0
	Drowsy	+7.3
	Unconscious	+14.6
Apoplectic onset Loss of consciousness Headache within two hours Vomiting Neck stiffness	None or one	0
	Two or more	+21.9
Plantar responses	Both flexor or single extensor	0
	Both extensor	+7.1
Diastolic blood pressure (24 hours after admission) (x0.17)		BP x 0.17
Atheroma markers Diabetes, angina, intermittent claudication	None	0
	One or more	-3.7
History of hypertension	Not present	0
	present	-4.1
Previous event None Transient ischaemic attack	None	0
	Any number of previous events	-6.7
Heart diseases	None	0
	Aortic or mitral murmur	-4.3
	Cardiac failure	-4.3
	Cardiomyopathy	-4.3
	Atrial fibrillation	-4.3
	Cardiomegaly	-4.3
	MI within 6 months	-4.3
Constant		-12.6

RESULTS AND DISCUSSION

Seventy cases of acute stroke admitted to Department of Medicine Apollo institute of medical sciences and research were studied. Siriraj

stroke score and Guy's Hospital stroke score were calculated and correlated with CT scan.

The maximum incidence was between 60-70 yrs (32%) in both infarction and hemorrhage groups. There was 1 patient who was in the age group < 30yrs (Table 1). Males accounts higher than females (67.14% vs 32.85%).

Table 3

Age distribution of study group

AGE group	Infarction		Hemorrhage		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<30 Yrs	1	3.33%	0	0%	1	1.42%
31-40 Yrs	0	0%	4	10%	4	5.71%
41-50 Yrs	3	10%	4	10%	7	10%
51-60 Yrs	3	10%	6	15%	9	12.85%
61-70 Yrs	22	73.33%	23	57.5%	45	64.28%
>71 Yrs	1	3.33%	3	7.5%	4	5.71%
Total	30	100%	40	100%	70	100%

90% of patient in hemorrhage group and 70% in infarction group had altered consciousness at admission (P = 0.033). 70% of patients in hemorrhage group and 10% in infarction group had vomiting on presentation (P<0.001). 70% of hemorrhage group and 16.66% of infarction group had headache on presentation (P<0.001). 12.5% of hemorrhage and 10% of infarction group had atheroma markers (Diabetes mellitus, angina, intermittent claudication) (P=0.744).

Table 4

Comparison of Siriraj Stroke score variables in haemorrhage and infarction group

Variables	Infarction		Haemorrhage		Total		Chi sq	P value
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage		
1.Loss of consciousness								
Alert	9	30	4	10	13	18.57	4.53	0.033*
Drowsy/coma	21	70	36	90	57	81.42		
2.Vomitings								
Present	3	10	28	70	31	44.28	25.0	<0.001**
Absent	27	90	12	30	39	55.71		
3.Headache								
Present	5	16.66	28	70	33	47.14	19.5	<0.001**
Absent	25	83.33	12	30	37	52.85		
4.Atheroma markers								
Present	3	10	5	12.5	8	11.4	0.10	0.744 ns
Absent	27	90	35	87.5	62	88.57		

NS – not significant (p>0.05), * – Significant (p<0.05), ** – Highly significant (p<0.001).

Variables of guy's hospital stroke score:

80% of patients in hemorrhage group had apoplectic onset whereas no patient in infarction group had apoplectic onset ($P<0.001$). 80% of patients in hemorrhage group were drowsy / unconscious as compared to 66.66% in infarction group ($P=0.001$). 100% patients in infarction had bilateral extensor plantar response while 77.5% of patients in hemorrhage group had bilateral extensor plantar response ($P=0.023$) (Table 3).

Risk factors for stroke:

History of hypertension was present in 40% of stroke patients ($P=0.801$). Alcohol consumption was the most common risk factor (52.85%) especially in hemorrhage group (70%) ($P=<0.001$). Smoking was next common risk factor for stroke (48.57%) ($P=0.097$). Associated cardiovascular disease was present in 14.28% of stroke patients ($P=0.263$). Diabetes mellitus was present in 27.14% of stroke patients ($P=0.005$) and hypercholesterolemia in 17.14% of stroke patients ($P=0.542$).

Table 5

Comparison of guy's Hospital stroke score variables in hemorrhage and infarction group

Variables	Infarction		Hemorrhage		Total		Chi sq	P value
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage		
1.Apoplectic onset								
Present	0	0%	32	80%	32	45.7 1%	41.3	<0.001 **
Absent	30	100%	8	20%	38	54.2 8%		
2. Level of consciousness								
Alert	10	33.33%	2	20%	12	17.14%	9.68	0.001*
Drowsy/unconscious	20	66.6 6%	38	80%	58	82.8 5%		
3.Plantar								
Flexion	0	0%	9	22.5 %	9	12.8 5%	5.14	0.023*
B/L Extension	30	100%	31	77.5 %	61	87.1 4%		
4.Atheroma markers								
Present	2	6.66 %	2	20%	4	5.71 %	0.08	0.766 NS
Absent	28	93.3 3%	38	80%	66	94.2 8%		
5.H/O hypertension								
Present	8	26.6 6%	19	47.5 %	27	38.5 %	4.19 –	0.040* –
Absent	22	73.3 3%	21	52.5 %	43	61.4 2%		
Yes	0	0%	0	0%	0	0%		
No	30	100%	40	100	70	100%		
7.Heart disease								
Present	6	20%	4	10%	10	14.2 8%	1.40	0.236 ns
Absent	24	80%	36	90%	60	85.7 1%		

NS – not significant ($p>0.05$), * – Significant ($p<0.05$), ** – Highly significant ($p<0.001$).

Table 6

Risk Factors for Stroke

	Infarction		Hemorrhage		Total		Chi sq	P value
	N	%	N	%	N	%		
1.H/O hypertension	12	40%	16	40%	28	40	0.060	0.801 NS
2.Smoking	18	60%	16	40%	34	48.57	2.745	0.097 NS
3.Cardiovascular disease	6	20%	4	10%	10	14.28	1.400	0.263 NS
4.Alcohol Cosumption	9	30%	28	70%	37	52.85	11	<0.001**
5.Diabetes Mellitus	3	10%	16	40%	19	27.14	7.801	0.005*
6.Hypercholest erolemia	4	13.3	8	2%	12	17.14	0.370	0.542 NS

NS – not significant ($p > 0.05$), * – Significant ($p < 0.05$), ** – Highly significant ($p < 0.001$).

Mortality from stroke: Overall mortality of stroke patients included in the study was 27.14% with 40% in haemorrhagic group and 10% in ischemic group ($P = 0.005$) (Table 7).

Table 7

Mortality from Stroke

Infarction (n=30)	Hemorrhage(n=40)	Total (n=70)
3 (10%)	16(40%)	19(27.14%)
Chi sq	7.801	P =0.005*

*-Significant ($p < 0.05$).

Siriraj score and CT correlation: Out of 40 patients diagnosed as hemorrhage by CT scan head Siriraj stroke score was suggestive of hemorrhage in 35 cases. In 4 cases it was equivocal and it wrongly diagnosed 1 case of hemorrhage as infarction. The sensitivity of Siriraj score for hemorrhage is 97.22%, specificity is 85.71% and positive predictive value of 94.59%.

Table 8

Siriraj stroke score and CT correlation for haemorrhagic stroke

Siriraj Stroke Score	CT Scan diagnosis	
	Hemorrhage	Infarction
>+1	35	2
-1 to +1	4	16
<-1	1	12
Total	40	30
Chi sq	45.438	P <0.001**

Out of 30 patients diagnosed as infarction by CT scan head, Siriraj stroke score was suggestive of infarction in 12 cases, 16 cases were equivocal and it wrongly diagnosed 2 cases of infarction as haemorrhage. The sensitivity of Siriraj score for ischemic stroke is 85.71% specificity is 97.22% and positive predictive value of 92.31% (Table 9).

Table 9

Correlation of infarction in siriraj score and CT scan

Siriraj Stroke Score	CT Scan Diagnosis	
	Infarction	Hemorrhage
<-1	12	1
-1 to +1	16	4
>+1	2	35
Total	30	40
Chi sq	49.221	P <0.001**

**Highly significant.

Out of 30 patients diagnosed as infarction by CT scan head Guy's hospital stroke score was suggestive of infarction in 3 cases. In 27 cases the score was equivocal. The sensitivity for ischemic stroke is 100%, specificity is 97.30% and positive predictive value of 75%.

Table 10

Guy's Hospital Stroke score and CT correlation for ischemic stroke

Guy's Score	CT Scan Diagnosis	
	Infarction	Hemorrhage
<4	3	1
>4 to <24	27	3
>24	0	36
Total	30	40
Chi Sq	51.981	P <0.001**

**Highly significant.

Out of 40 patients diagnosed as hemorrhage by CT scan head Guy's hospital stroke score was suggestive of hemorrhage in 36 cases. In 3 cases the score was equivocal and it wrongly diagnosed 1 case of hemorrhage as infarction. The sensitivity of Guy's score for hemorrhagic stroke is 97.30%, specificity is 100% and positive predictive value is 100%.

Table 11

Guy's hospital stroke score and CT correlation for haemorrhagic stroke

Guy's score	CT scan diagnosis	
	Hemorrhage	Infarction
>24	36	0
>4 and <24	3	27
<4	1	3
Total	40	30
Chi sq	47.221	P <0.001**

**Highly significant.

Seventy cases of acute stroke admitted to Apollo Institute of Medical College were studied. Both Siriraj stroke score and Guy's Hospital stroke score were calculated and correlated with CT scan.

In our study, the maximum incidence of stroke was between 60 to 70 years of age (64.28%). There were 47 males and 23 females in the study group. Alcohol consumption was the most common risk factor (52.85%) especially in hemorrhage group (70%). 40% of patients were hypertensives. 48.57% of patients were smokers. 27.14% of patients had history of diabetes mellitus, 17.14% had hypercholesterolemia, and 14.28% of patients had associated cardiovascular disease. The risk factor found in the study group were alcohol consumption, smoking, hypertension, diabetes mellitus, hypercholesterolemia, cardiovascular disease in decreasing order of frequency.

In a ICMR study, hypertension, smoking, diabetes mellitus and low hemoglobin were identified as risk factor for stroke in Indian patients.⁸ A study have observed that more than one third of stroke cases had hypertension, cardiovascular disease was seen in 42.8%, 51% were smokers, 18.9% were diabetics and hyperlipidemia was seen in 16.3% [9].

Mortality: 3 patients in infarction group (10%) and 16 in hemorrhage group (40%) expired. The mortality in the study group was more in hemorrhage group than in ischemic group ($P < 0.005$). Nilamadhav Kar et al observed 30% mortality in stroke population of which 38% were due to non-neurological causes [10].

Siriraj stroke score and CT correlation:

CT scan showed cerebral infarction in 30 cases and cerebral hemorrhage in 40 cases in our study.

Table 12

Comparison of sensitivity of Siriraj score, predictive value of a positive test, Sensitivity of Guy's Hospital Stroke score, Positive predictive value of Guy's Hospital Stroke score in the diagnosis of infarction and hemorrhage

Comparison of sensitivity of Siriraj score		
STUDY	INFARCTION	HEMORRHAGE
Kehinde et al [11]	71%	79%
Qaiser et al [12]	71.4%	78%
Singh et al [13]	92.5%	83.33%
Present Study	85.71%	97.22%
Comparison of predictive value of a positive test		
STUDY	INFARCTION	HEMORRHAGE
Kehinde et al	91%	63%
Qaiser et al	87%	83%
Singh et al	81.2%	86.9%
Present study	92.31%	94.59%
Comparison of Sensitivity of Guy's Hospital Stroke score in the diagnosis of infarction and hemorrhage		
STUDY	INFARCTION	HEMORRHAGE
Pavan et al [14]	94.54%	80%
Yungandhar et al [15]	90%	94.46%
Present study	100%	97.30%
Comparison of Positive predictive value of Guy's Hospital Stroke score in the diagnosis of infarction and hemorrhage		
STUDY	INFARCTION	HEMORRHAGE
Pavan et al	92.85%	84.21%
Yugandhar et al [15]	100%	95.24%
Present study	75%	100%

The sensitivity of Siriraj stroke score in diagnosing infarction was 85.71% and that in diagnosing hemorrhage was 97.22%. The positive predictive accuracy of Siriraj stroke score for cerebral infarction and hemorrhage was 92.31% and 94.59% respectively. Sensitivity was 85.71% for infarction and 97.22% for hemorrhage ($P < 0.001$).

Guy's hospital score and CT correlation:

The sensitivity of Guy's Hospital stroke score in diagnosing infarction in the present study is 100% and that for hemorrhage is 97.30% ($P < 0.001$). The positive predictive accuracy of Guy's Hospital stroke score for cerebral infarction and hemorrhage was 75% and 100% respectively. The sensitivity for infarction was more in Guy's Hospital score (100%) as compared to Siriraj stroke score (85.71%) Siriraj stroke score and Guy's hospital score had an almost equal sensitivity for hemorrhage (97.22% vs 97.30%) (Table 12).

The Siriraj stroke score is much simpler, easier to calculate and time needed to calculate is much less than Guy's Hospital score, which is difficult to calculate, needs detailed evaluation and at least monitoring for 24 hours. When clinician wishes to start antithrombotic treatment while waiting for CT scan results, they can rely on Siriraj stroke score as the sensitivity to detect hemorrhage is equal to Guy's Hospital score.

Prospects for future research

Further validation studies requiring large number of participants are needed before wide

acceptance of Siriraj stroke score as and Guy's Hospital stroke score as screening tools in clinical diagnosis of acute stroke.

CONCLUSION

CT scan head is an accurate, safe and non-invasive procedure for differentiating between cerebral hemorrhage and infarction. However, when CT scan facilities are not available, we suggest Siriraj stroke score as a simple method of screening patients for intra cerebral haemorrhage, as it is easier to use at bedside and has similar accuracy in diagnosing hemorrhage as Guy's Hospital score. Guy's Hospital score is not useful because it can be assessed only after 24 hours of onset of stroke. This deprives the management to all thrombotic patients in speculated time window of modern management. These scores can also be used as screening in patients with low risk of stroke for secondary prevention of stroke in whom CT scan is not feasible.

Conflict of interest. The authors of this manuscript claim that there is no conflict of interest during the research and writing of the manuscript.

Sources of funding. The execution of this study and the writing of the manuscript were accomplished without external funding.

Table 13

Comparison of this study with previous studies on Guy's hospital and Siriraj stroke scores

Author	Infarction		Hemorrhage	
	Sensitivity	Specificity	sensitivity	Specificity
SIRIRAJ STROKE SCORE				
Clifford et al	69	83	65	88
Pavan MR et al	87.93	74	77.27	87.93
Hawkins et al [16]	61	85	48	85
Kochar et al [17]	73	92	85	73
Present study	85.71	97.22	97.22	85.71
GUY'S HOSPITAL SCORE				
Pavan MR et al	94.54	80		94.54
Hawkins et al	78	70		95

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КОРЕЛЯЦІЯ КЛІНІЧНИХ БАЛІВ І СКАНУВАННЯ ЗОРУ У ПАЦІЄНТІВ З ГОСТРИМ ІНСУЛЬТОМ

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Актуальність. В Індії інсульт пов'язаний з високою захворюваністю та смертністю. Важливо розрізнити церебральний інфаркт і крововилив у випадках гострого інсульту, оскільки лікування обох суттєво відрізняється.

Ціль: Оцінити Siriraj Stroke Score та Guys's Hospital Score у клінічній діагностиці гострого інсульту. Дослідження також було розроблено для того, щоб відрізнити церебральний крововилив від інфаркту за допомогою оцінки лікарні Гая та оцінки інсульту Сірайджа та співвіднести клінічні оцінки з КТ головного мозку.

Матеріали і методи. Дослідження проведено на 70 хворих, які поступили з гострим інсультом протягом 1 року. Оцінка Siriraj Stroke Score була розрахована під час надходження, а оцінка Guys's Hospital Score розрахована через 24 години після надходження. Усі пацієнти були піддані КТ протягом 72 годин після надходження. Чутливість, специфічність, позитивна прогностична цінність були розраховані для обох балів. Ці оцінки корелювали з КТ мозку за допомогою тесту Хі-квадрат.

Результати. Із 70 пацієнтів, які поступили з гострим інсультом, КТ головного мозку виявила інфаркт у 30 пацієнтів і крововилив у 40 пацієнтів. Чутливість, специфічність і PPV для шкали Siriraj Stroke Score становили 83,33%, 97,44%, 83,33% для інфаркту та 97,22%, 85,71%, 94,59% для кровотечі відповідно, тоді як відповідні показники для шкали Guys Hospital Score становили 100%, 97,30%, 75% для інфаркту та 96,97%, 100%, 100% для крововиливу відповідно. Порівнянність показників Siriraj Stroke Score і Guy Hospital Score була значною.

Висновок. КТ головного мозку є точною, безпечною та неінвазивною процедурою для диференціації інфаркту мозку від крововиливу. Однак, коли засоби комп'ютерної томографії недоступні, ми пропонуємо Siriraj Stroke Score як простий метод скринінгу пацієнтів на внутрішньомозковий крововилив, оскільки його легше використовувати біля ліжка та він має більшу точність у діагностиці кровотечі, ніж оцінка Guys's Hospital Score. Лікарняний бал Гая не є корисним, оскільки його можна оцінити лише через 24 години після початку інсульту.

Ключові слова: інсульт, шкала Siriraj Stroke Score, оцінка Guys Hospital, комп'ютерна томографія.