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Differentiating Ischemic and Haemorrhagic Strokes Using Clinical Stroke Scores and Their Correlation with Imaging Studies

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Original Research Article

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Abstract: The study aimed to determine the accuracy of the stroke scores (Allen's score, Siriraj score and Greek score) to differentiate between ischemic and haemorrhagic strokes. 100 patients of acute stroke that were admitted to Dr.D.Y.patil hospital, Kolhapur were included in the study. The patients were examined clinically and all the variables included in the three stroke scores were carefully evaluated before subjecting the patients to brain imaging. Out of 100 patients, 73 had cerebral ischemia and 27 had cerebral haemorrhage by brain imaging. Out of 73 patients with Ischemia Allen's score diagnosed 58 patients, Siriraj score diagnosed 65 patients and Greek score diagnosed 49 patients correctly to have Ischemia. Out of 27 patients with Haemorrhage Allen's score diagnosed 21 patients, Siriaj score diagnosed 22 patients and Greek score diagnosed 17 patients correctly to have cerebral haemorrhage. The overall sensitivity (%), specificity (%), positive predictive value (%) and negative predictive value (%) of Allen's score for Ischemia is 79.4, 92.5, 96 and 62.5, Allen's score for haemorrhage is 77.7, 95.8, 87.5 and 92 respectively. With Siriraj score for Ischemia it is 89, 96.2, 98.4 and 74.4, for haemorrhage it is 81.4, 97.2, 91.6 and 93.4 respectively. With Greek score for ischemia it is 67.1, 85.1, 92.4 and 48.9, and for haemorrhage it is 62.9, 97.2, 89.4 and 87.6 respectively. Siriraj score is better among all the three scores in terms of application and results. It is simpler and easier to calculate and time required to diagnose is less compared to Allen's score, while Greek score is not a reliable score for diagnosis. Whenever a clinician wishes to start patient on antithrombotic measures while waiting for imaging results or when Imaging facilities are not available, Siriraj score is the single best score for diagnosis.
Keywords: Cerebral Ischemia, Cerebral haemorrhage, Allen's score, Siriraj score, Greek score.

INTRODUCTION

It is commonest life threatening, neurological disease requiring hospitalization and stands out as one of the most important causes of severe disability. Stroke is 3rd commonest cause of death in developed countries.

In developing countries like ours, the diagnostic facilities are insufficient and also if available; due to economic burden to family and various other circumstances - utilization of such facilities are delayed. But in contrary it is well established that management and prognosis of patients with acute stroke syndrome needs timely differentiation between Ischemic and haemorrhagic subtypes of stroke. If stroke patients are to derive benefit from thrombolytic therapy and anti-platelet drugs, cerebral infarction needs to be diagnosed quickly and correctly [1].

CT scan is the gold standard for distinguishing stroke sub-types. It is still expensive and inaccessible in many heath care centres and institutions. There is paucity of the specialists in the field of neurology with a large number of hospitals lacking a specialised stroke unit. Most patients with stroke are inadequately diagnosed, resulting in poor outcomes [2].

To overcome these difficulties and to enhance clinical bedside diagnosis, clinical stroke scores have been developed. This stroke could potentially differentiate between ischemic and haemorrhagic strokes clinically and they have been widely studied, are under trials and are even validated in a few countries. There are many stroke scores which can direct the treating physician in clinical distinction of haemorrhagic and ischemic stroke.

Allen's stroke score also called as Guy's hospital score [3]. This score has been validated in various countries. Siriraj stroke score [4] is widely used in Thailand and is much easier to determine.

Comparison studies of Allen's and Siriraj score has been done in many countries. Allen's and Sirias score are considered as 'poor man's C.T. Scan' in terms of reliability [7]. Recently, a new score proposed by a team from Athens called 'Greek score' claimed the sensitivity, specificity to be much better as compared to the previous scores [5]. This study aims to determine the capability of the stroke scores to differentiate between ischemic and haemorrhagic strokes.

METHODOLOGY

This is a cross-sectional observational study that included 100 patients of acute stroke admitted to D.Y.Patil hospital and research centre, Kolhapur.

For all the patients included in the study we recorded the following information: Age, gender, history of previous stroke, TIA, IHD, Rheumatic heart disease, peripheral arterial disease, hypertension, diabetes, smoking, alcohol consumption, hyperlipidaemia, clinical signs, and symptoms (onset of deficit, headache, vomiting, blood pressure, Glasgow Coma Scale, pupil and plantar response, neck stiffness, level of consciousness, neurological deterioration within the first 24 hours) and basic laboratory data (ECG, WBC count).

We intend to calculate stroke scores based on patient's data with the use of score tables after carefully evaluating each variable present in the score table of all the three scores. Patient will be then subjected to brain imaging to look for the type of stroke.

Allen's stroke score	Apoplectic onset: Loss of consciousness Headache 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 response	flexors or single extensor Both extensor	0 +7.1
	Diastolic BP(24hours after admission)	DBP	DBP x 0.17
	Atheroma markers: Diabetes Angina Intermittent claudication	None One or more	0 -3.7
	History of Hypertension	No Yes	0 -4.1
	Previous event of Stroke/TIA	Absent Present	0 -6.7
	Heart diseases	None Aortic or mitral murmur Cardiac failure Cardiomyopathy AF Cardiomegaly MI within past 6 months	0 -4.3 -4.3 -4.3 -4.3 -4.3 -4.3 -12.6
	Constant	-12.6	

<4 = cerebral ischemia, >24= cerebral haemorrhage, 4 to 24=equivocal

Siriraj stroke score	Consciousness	-Alert -Drowsy, stupor -Coma	0 x 2.5 1 x 2.5 2 x 2.5
	Vomiting	No Yes	0 x 2 1 x 2
	Headache(within 2 hours)	No Yes	0 x 2 1 x 2
	Diastolic BP	…….mm Hg	DBP x 0.1
	Atheroma markers (DM, Angina, Intermittent claudication)	-None -One or more	0 x 3 -1 x 3
	Constant	----------	-12

<-1 = Cerebral ischemia, >+ = Cerebral haemorrhage, -1 to +1 =equivocal

Greek stroke score	Neurological deterioration within 3 hours of admission	6
	Vomiting	4
	TLC in peripheral blood	4
	Decreased level of consciousness at admission	3

<3 = Ischemia, >11 = Haemorrhage, 3 to 11 = equivocal

RESULTS

Out of 100 cases included in the study, 73 were proven to be infarction and 27 were proven to be haemorrhage by imaging studies (CT/MRI). 61 were males and 39 were females among 100 patients. Average Age in years was 59.4±14.6, range being 18 to 90 years. Among 27 patients with haemorrhage, the highest percentage belonged to age group of >61 years (48.13%). Among 73 patients with infarction, the highest percentage belonged to the age group between 41-60 years (49.33%).

Mean DBP in mm of Hg among Haemorrhagic group was 105.58 ± 16.71 and among infarct group was 85.2± 10.28. Figure no. 01 shows prevalence of risk factors and other parameters among the two subtypes of stroke. History of diabetes was present in 22.22% of patients with haemorrhage and 34.24% of patients with infarction. Hypertension was present in 59.25% of the patients with Haemorrhage and 50.6% of the patients with Infarction. History of previous Stroke or TIA was present in 11.11% of the patients with Haemorrhage and 31.5% of the patients with Infarction. History of Heart diseases was present in 33.33% of the patients with haemorrhage and 26.02% of the patients with Infarction.

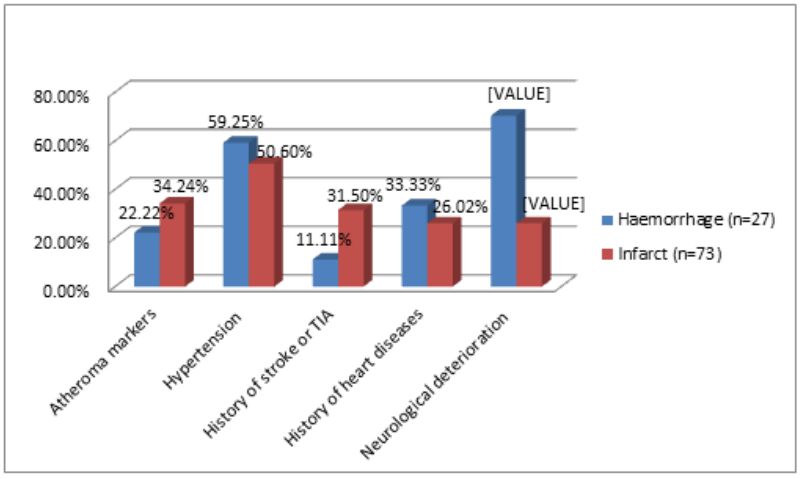

Fig-1: Prevalence of various parameters among the study population

Out of 27 patients who were diagnosed to have haemorrhage by imaging studies, Allen's score correctly predicted 21 patients (77.78%) to have haemorrhaged, 2 patients (7.41%) were diagnosed as Infarct and 4 patients (14.81%) were equivocal. Siriraj score correctly predicted 22 patients (81.48%) to have haemorrhaged, 1 patient (3.70%) was diagnosed as Infarct and 4 patients (14.82%) were equivocal. Greek score correctly predicted 17 patients (62.96%) to have haemorrhaged, 4 patients (14.82%) were diagnosed as Infarct and 6 patients (22.22%) were equivocal.

Out of 73 patients who were diagnosed as Infarct by imaging studies, Allen's score correctly diagnosed 58 patients (79.45%) to have Infarction, 3 patients (4.11%) were diagnosed as haemorrhage and 12 patients (16.44%) were equivocal. Siriraj score correctly diagnosed 65 patients (89.04%) to have Infarction, 2 patients (2.74%) were diagnosed as haemorrhage and 6 patients (8.22%) were equivocal. Greek score correctly diagnosed 49 patients (67.12%) to have Infarction, 2 patients (2.74%) were diagnosed as haemorrhage and 22 patients (30.13%) were equivocal.

Table-1: Allen's score among haemorrhagic and infarct cases

Allen score	Hemorrhage (n=27)		Infarct (n=73)	
	Frequency	Percentage	Frequency	Percentage
Equivoval	4	14.81%	12	16.44%
Infarct	2	7.41%	58	79.45%
Bleed	21	77.78%	3	4.11%
Total	27	100%	73	100%

Table-2: Siriraj score among haemorrhagic and infarct cases

Siriraj score	Hemorrhage (n=27)		Infarct (n=73)	
	Frequency	Percentage	Frequency	Percentage
Equivocal	4	14.82%	6	8.22%
Infarct	1	3.70%	65	89.04%
Bleed	22	81.48%	2	2.74%
Total	27	100%	73	100%

Table-3: Greek score among haemorrhagic and infarct cases

Greek score	Hemorrhage (n=27)		Infarct (n=73)	
	Frequency	Percentage	Frequency	Percentage
0	6	22.22%	22	30.13%
1	4	14.82%	49	67.12%
2	17	62.96%	2	2.74%
Total	27	100%	73	100%

Table-4: Comparison of all the three scores

Score	**Sensitivity%**	**Specificity%**	**PPV%**	**NPV%**
Allen's score				
Haemorrhage	77.7	95.89	87.5	92
Infarction	79.4	92.59	96.66	62.5
Siriraj score				
Haemorrhage	81.48	97.26	91.66	93.42
Infarction	89.04	96.29	98.48	74.47
Greek score				
Haemorrhage	62.96	97.26	89.47	87.65
Infarction	67.12	85.18	92.45	48.93

PPV: Positive predictive value, NPV: Negative predictive value

The overall sensitivity, specificity, positive predictive value and negative predictive value of Allen's score for Ischemia is 79.4%, 92.5%, 96%, 62.5%, and for haemorrhage is 77.7%, 95.8%, 87.5% and 92% respectively. The same with Siriraj score for Ischemia is 89%, 96.2%, 98.4%, 74.4%, and for haemorrhage is 81.4%, 97.2%, 91.6% and 93.4% respectively. With Greek score it is 67.1%, 85.1%, 92.4% and 48.9% for ischemia, and 62.9%, 97.2%, 89.4% and 87.6% for haemorrhage respectively.

DISCUSSION

Appropriate treatment of stroke depends on differentiating between Infarction and haemorrhage. Computerized Tomography is simple, safe and accurate non-invasive procedure to distinguish between cerebral

ischemia and haemorrhage. Due to lack of proper health care system and paucity of health infrastructure in developing countries like ours, CT scan is not freely available especially in rural setup, and even if available, a large percentage of population cannot afford it[6]. Many attempts at differentiating stroke subtypes on clinical basis have failed in the past.

The risk factors for stroke are advanced age, male gender, History of hypertension, Long standing Diabetes and other atheroma markers, and Heart diseases like atrial fibrillation. It is well established that some of these risk factors are particular and specific to either Infarction or Cerebral haemorrhage [7]. Based on these risk factors and few other variables Clinical stroke scores were developed. Introduction of stroke scores led to hopes of bedside clinical differentiation between Ischemic and haemorrhagic stroke. Our study included three stroke scores, Allen's score, Siriraj score and Greek score with the objective to predict the accuracy of these scores to diagnose Infarct and haemorrhage.

The present study is carried out in 100 and the three stroke scores were calculated in all the patients and statistics were applied to predict the sensitivity, specificity, Positive predictive value and Accuracy. The Allen's score included variables that were included not just by history but also by clinical examination and X-rays. Some variables in the score like level of consciousness and Diastolic BP could be calculated only after 24 hours after stroke onset, and upon that calculating allen's score is not an easy task and requires accurate clinical acumen. The Siriraj score is much simpler compared to allen's score, involves fewer variables, much easier to apply and can be calculated immediately on bedside after stroke onset. The Greek score is a relatively new score and only a few studies have been done for its validation. It includes only 4 variables and is much simpler than Allen's and Siriraj scores.

When compared with each other in our study, Siriraj score had better accuracy, highest sensitivity and specificity for infarction at 89% and 96% respectively, with Allen's score coming at close second at 79% and 92%. Greek scores had least sensitivity compared to other scores at 67%, but had a relatively comparable specificity at 85%.

For Haemorrhage, Siriraj score again had better sensitivity and specificity at 81% and 97% with Allen score following closely at 77% and 95%. Greek score was at distant low at 62% sensitivity and had highest specificity at 97% at par with Siriraj score.

Though both Allen's score and Siriraj score had almost comparable sensitivity and specificity, Siriraj score is better among all the three scores in terms of application and results. In Allen's score a few variables can only be calculated after 24 hours after admission and onset of stroke hence it cannot be acute stroke management except in rare circumstances. Greek score although contains less variables has least sensitivity and cannot be reliable to differentiate stroke. Siriraj score being simple to calculate, easier to apply and with better results is the most reliable among all the three score to differentiate ischemic and haemorrhagic stroke.

CONCLUSION

The Siriraj stroke score is simpler and easier to calculate and time required to diagnose is less compared to Allen's score which requires 24 hours, needs detailed clinical evaluation and is difficult to calculate, while Greek score is not a reliable score for diagnosis.

Whenever a clinician wishes to start patient on antithrombotic measures while waiting for imaging results or when Imaging facilities are not available, Siriraj score is the single best score for diagnosis as the sensitivity to detect both Infarction and Haemorrhage is higher than other two scores. Further studies involving larger samples and different populace are required before validating Siriraj score for routine use.

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