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Internal Medicine

"Validity of Siriraj Stroke Score in Differentiating Acute Ischemic and Hemorrhagic Stroke"

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Abstract **Original Research Article**

Computed tomography (CT) scan is the gold standard investigation used to distinguish cerebral infarction and hemorrhage. However early access to CT is not always feasible. In the past many Investigators have proposed various scoring systems to differentiate cerebral infarct and hemorrhage based on clinical findings. Siriraj Stroke Score (SSS) is one of the commonly used clinical stroke score. The aim of our study was to validate sensitivity, specificity and accuracy of SSS in differentiating cerebral infarct and hemorrhage in comparison with CT brain findings. 100 cases of acute stroke were included in the study. SSS for these patients was calculated at the time of admission. Sensitivity and specificity of SSS for infarction and hemorrhage were tested against CT brain. Findings recorded and statistically analyzed. Statistical Package for Social Sciences (SPSS) version 20 was used for statistical analysis. Among 100 patients, CT brain showed cerebral infarction in 75 and hemorrhage in 25 patients. The sensitivity of SSS for infarction was 84.75% and specificity was 95.24% and the sensitivity for hemorrhage was 95.24% and specificity was 84.75%. The overall accuracy of SSS was 87.5%. This study showed that SSS is fairly reliable in differentiating acute ischemic stroke from acute hemorrhagic stroke, but efforts should be made to make neuroimaging available and affordable in resource poor settings, as critical decisions cannot be made in acute stroke without imaging. In our study SSS showed good sensitivity and specificity and a good predictive accuracy, however as the results are not comparable with gold standard test (Neuroimaging), SSS cannot be used as a diagnostic tool. However as it has good sensitivity and specificity, it can be used as a screening tool to classify patients into stroke subtypes. It can be used for epidemiological purposes and as a bedside tool to differentiate type of stroke.

Keywords: Stroke; Siriraj stroke score; CT scan; Sensitivity; Specificity.

INTRODUCTION

Stroke is defined as an abrupt onset of neurological deficit that is attributable to a focal vascular cause (lasting for more than 24hour). Stroke is a major global public health problem. It is the second leading cause of death worldwide accounting for 6.2million deaths in 2011 [1]. In India Incidence of stroke is 105-152/100000 persons/year and Prevalence is 44.29 to 559/100000 persons [2]. Computed tomography (CT) is the most commonly used reliable and gold standard investigation in differentiating ischemic and hemorrhagic stroke. However, In India due to cost and availability constraint, it is not always accessible. Various clinical scores have been developed to classify stroke clinically. Siriraj Stroke Score (SSS) (TABLE 1) is one of the most commonly used bedside tools to differentiate between ischemic and hemorrhagic stroke.

Siriraj Stroke Score= (2.5×level of consciousness) + (2×Vomiting) + (2×headache) + (0.1×DBP) - (3×atheroma markers) -12

Other clinical stroke scores used to differentiate cerebral infarction and hemorrhage are Greek stroke score and Allen stroke score. Studies have been done to assess validity of Siriraj stroke score on various populations, results of the studies were found to vary from place to place. This study is being done to determine the sensitivity and specificity of Siriraj Stroke Score.

METHODS

Patients with acute stroke, Age >18 years, whose focal neurological deficit lasted for more than 24 hours who are willing to give written informed consent were included for the study. Patients with causes of focal neurological deficits other than stroke (tuberculosis, tumor, trauma, transient ischemic attack)

were excluded from the study. Also patients with sub-arachnoid hemorrhage, and in whom CT scan could not be done, patients on anticoagulation therapy, and duration of stroke >14 days (because of risk of missing intracerebral hemorrhage) and Age < 18 years were excluded. Study was conducted on 100 patients with acute stroke who satisfy inclusion criteria. It is a Cross Sectional study conducted in a tertiary care center. Sample Size was calculated by using statistical formula

$$N = \frac{Z\alpha^2 pq}{d^2}$$

Where, N=Sample size, Zα2 at 95% confidence interval = 1.96 (Based on previously conducted study by Rajan *et al.* and statistical formula). 100 patients with acute stroke were classified into ischemic and hemorrhagic stroke by using Siriraj stroke score (SSS). Patients with SSS <-1 were classified as Ischemic stroke, SSS -1 to +1 were classified as equivocal and those with SSS >+1 were classified as hemorrhagic stroke. Plain Computed Tomography was done all study subjects. SSS was compared with CT scan.

Statistical Analysis was done by SPSS (Statistical Package for Social Sciences) version 20. [IBM SPASS statistics (IBM corp. Armonk, NY, USA released 2011)]. Data was entered in the excel spread sheet. Descriptive statistics was analyzed by mean and standard deviation for quantitative variable. Frequency and proportions were used for qualitative variables. Inferential statistics was done by Chi square test to assess significance between qualitative variables. Unpaired t test – was used to assess statistical difference between two quantitative variables. The level of significance was set at 5%.

RESULTS

100 cases of acute stroke were included in the study. Out of the total 100 patients, 75 patients (75%) had infarct and 25 patients (25%) had bleed. Among 100 study participants, 64 patients were male and 36 patients were female. The mean age of male patients was 57.69 years and that of female patients was 67.67 years. Variables of SSS were cross-tabulated against type of stroke as classified by SSS (Table 2), which showed that poor GCS with GCS score <8 were seen in 16 patients out of 100 study participants. Vomiting and headache were seen more in patients with bleed i.e 9 patients and 13 patients respectively as compared to infarct, where vomiting and headache were seen in 3 patients and 0 patients respectively. DBP >100mmHg was seen in patients with bleed i.e 16 patients when compared to patients with infarct (1 Patient). Atheroma markers were present in 27 patients with infarct as compared to 8 patients with bleed. These results were statistically significant with P value <0.05. Siriraj stroke score showed unequivocal result in 80 cases. According to SSS, 51 patients were classified as probable infarct and 29 patients as probable hemorrhagic stroke. It wrongly diagnosed 1 case of hemorrhage as infarction and 9 cases of infarct as hemorrhage.

The sensitivity of SSS for detecting infarction was 84.75% and specificity, positive predictive value and negative predictive value were 95.24%, 98.04% and 68.97% respectively (Table 3 and 4). The sensitivity of SSS for detecting hemorrhage was 95.24% and specificity, Positive predictive value and negative predictive value were 84.75%, 68.97% and 98.04% respectively (Table 5). The overall accuracy of SSS was 87.5%.

Table-1: Siriraj stroke score

Variable	Clinical Features	Score
Consciousness	Alert	+0×2.5
	Stupor/Drowsy/Semi coma	+1×2.5
	Coma	+2×2.5
Vomiting	No	+0×2
	Yes	+1×2
Headache within two hours	No	+0×2
	Yes	+1×2
Diastolic blood pressure (DBP)	mmHg	+DBP(×0.1)
Atheroma markers	None	-0×3
(Diabetes, Angina, Intermittent Claudication)	One or more	-1×3
Constant		-12

Table-2: Cross-tabulation of variables of siriraj stroke score with type of stroke as per siriraj stroke score

Variable of Siriraj stroke score		Type of stroke based on Siriraj stroke score			Total	Chi square	P value
		Infarct	Bleed	Equivocal			
Gender	Female	19	11	6	36	0.394	0.821
	Male	32	18	14	64		
	Total	51	29	20	100		
GCS Score	< 8	16	0	2	18	33.60	0.00*
	8-14	32	14	16	62		
	>14	3	15	2	20		
	Total	51	29	20	100		
Vomiting	Absent	48	20	17	85	9.17	0.010*
	Present	3	9	3	15		
	Total	51	29	20	100		
Headache	Absent	51	11	18	80	46.07	0.00*
	Present	0	18	2	20		
	Total	51	29	20	100		
DBP	<100mmHg	50	13	17	80	33.10	0.00*
	>100mmHg	1	16	3	20		
	Total	51	29	20	100		
Atheroma markers	Absent	24	21	15	60	7.29	0.026*
	Present	27	8	5	40		
	Total	51	29	20	100		

*Significant

Table-3: Cross-tabulation of ct score and siriraj stroke score

CT SCORE		Type of stroke based on Siriraj stroke score			Total
		Infarct	Bleed	Equivocal	
Infarct	Count	50	9	16	75
	% of Total	50.0%	9.0%	16.0%	75.0%
Bleed	Count	1	20	4	25
	% of Total	1.0%	20.0%	4.0%	25.0%
Total	Count	51	29	20	100
	% of Total	51.0%	29.0%	20.0%	100.0%
Chi-square value- 44.60					
P value- 0.00*					

*significant

Table-4: Cross tabulation of type of stroke based on sss versus ct scan in evaluating infacrt

SSS	CT scan		Total
	Infarct	Non infarct	
<-1	50	1	51
>+1	9	20	29
	59	21	80

Table-5: Cross tabulation of type of stroke based on sss versus ct scan in evaluating hemorrhage

SSS	CT scan		Total
	Hemorrhage	Non Hemorrhage	
>+1	20	9	29
<-1	1	50	51
	21	59	80

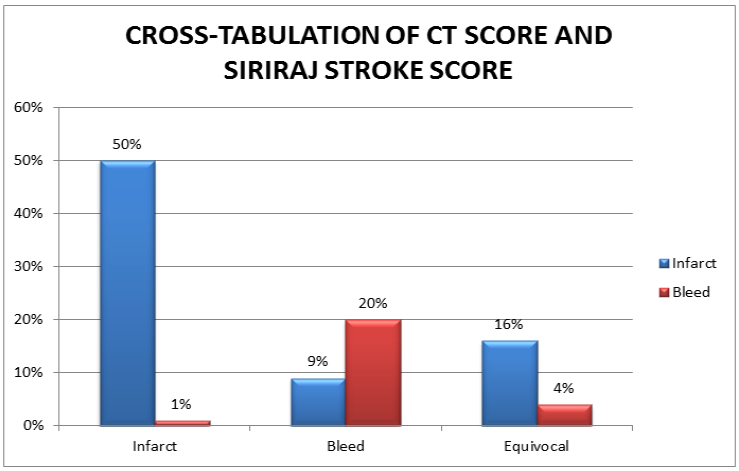

Fig-1

DISCUSSION

Stroke is one of the leading causes of morbidity and mortality worldwide. With changing lifestyle, the risk factors for stroke are increasing, so increasing trend has been noted in number of stroke cases. Neuroimaging techniques like computerized tomography (CT) scan or magnetic resonance imaging remain the most reliable tools for diagnosing stroke types. However in developing countries these imaging modalities are not readily available especially in rural communities, and when available, they are not easily affordable due to the prevailing poverty and high cost. The nonavailability of CT scan in rural hospitals, in addition to the prohibitive cost of the imaging makes the use of weighted clinical scoring systems in making a diagnosis of stroke types in the country.

Siriraj Stroke Score (SSS) is one of the most commonly used clinical scores worldwide to classify patients into ischemic and hemorrhagic stroke bedside. Variables in SSS like low level of consciousness, vomiting, headache, and high diastolic blood pressure are more indicative of hemorrhagic stroke. Atheroma markers like diabetes, angina, and intermittent clauducation are risk factors for thromboembolic events, hence more indicative of ischemic stroke. There are limited validation studies for stroke scores in South India.

Rajan S *et al*. studied 60 cases of stroke. In this study, Siriraj Score showed positive predictive value of 80.64% for ischemic stroke and negative predictive value of 78.57% for Haemorrhagic stroke and the P value is 0.015(Significant) [3].

Sreevani *et al*. studied 100 cases of acute stroke, out of which 69 were males and rest were females. According to Siriraj score 51 patients were classified as having cerebral infarct and 23 patients were having haemorrhage and 26 patients as equivocal. Out of 51 patients who were classified as infarct 49 had infarct and out of 23 patients classified as having hemorrhage, 16 patients showed cerebral haemorrhage on CT [4].

Priya Badam *et al*. studied 259 patients admitted for suspected stroke, 134 patients (73 men) underwent both clinical classification and CT scan. The siriraj score discriminated haemorrhage from infarction with a sensitivity of 78.5% and specificity of 71%. This study concluded that stroke score is not sufficiently accurate for distinguishing the type of stroke [5].

Wadhwani *et al*. studied 200 acute stroke patients, CT scan revealed cerebral infarction in 152(76%) patients and cerebral haemorrhage in 48(24%) patients. The sensitivity of Siriraj Stroke Score was 92.54% for infarction and 87% for haemorrhage (equivocal and infratentorial cases were excluded) and its overall accuracy was 91.11% [6].

Pavan *et al.* studied 100 patients of acute stroke. Sensitivity and specificity of SSS for infarction and haemorrhage was calculated. Out of 100 patients, Ct brain showed cerebral infarction in 71 patients and haemorrhage in 29 patients. The sensitivity of Siriraj score for detecting infarction was 87.93% and specificity was 77.27%.The sensitivity of Siriraj score for detecting haemorrhage was 77.27% and specificity was 87.93%.The overall accuracy of Siriraj stroke score was 85% [7].

Other clinical scores used to classify type of stroke are Allen score and Guy's score [8, 9]. Previously published studies on SSS reported variable conclusions [10-14], thus necessitating more studies and prompting us to take up this study to validate SSS in classifying patients into ischemic and hemorrhagic stroke.

The low use of CT scan by the stroke subjects points to its unaffordability by majority of the subjects. The higher percentage of subjects that presented within the first 24 hours from onset of stroke underlines the need for accurate diagnosis of the stroke type to enable

the use of appropriate treatment like thrombolytics. However, to facilitate accurate diagnosis of stroke, CT scan should be made available at affordable cost in most hospitals in India. This need cannot be overemphasized. The management of the tertiary and secondary hospitals, and the government should make every effort to have this facility in their hospitals at affordable cost.

This study showed that SSS is fairly reliable in differentiating acute ischemic stroke from acute hemorrhagic stroke, but efforts should be made to make neuroimaging available and affordable in resource poor settings, as critical decisions cannot be made in acute stroke without imaging. Neuroimaging remains the gold standard in diagnosing stroke types. In our study SSS showed good sensitivity and specificity and a good predictive accuracy, however as the results are not comparable with gold standard test (Neuroimaging), SSS cannot be used as a diagnostic tool. However as it has good sensitivity and specificity, it can be used as a screening tool to classify patients into stroke subtypes. It can be used for epidemiological purposes and as a bedside tool to differentiate type of stroke.

LIMITATIONS

- The sample size is relatively small. A larger sample size is desirable.
- As it is hospital based study, there are chances of missing stroke cases with less symptoms and validity of SSS may vary based on severity of symptoms. Population based studies to be done.

DECLARATIONS

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Conflict of interest: None declared
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