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Correlation of Clinical Findings with Radiological Imaging of Brain in Acute Stroke Patients

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Abstract **Original Research Article**

Introduction: Stroke is the most common neurological emergency [1]. It is a medical emergency that occurs when the blood flow to the brain is suddenly disrupted, resulting in the death of brain cells. A stroke can cause long-term disability or death if not treated quickly. It is important to recognize the signs and symptoms of stroke and seek immediate medical attention. ***Aim of the Study:*** The aim of the study was to find out the correlation of clinical findings with radiological imaging of the brain in acute stroke patients. ***Methods:*** This descriptive type of cross-sectional study was conducted at the Department of Medicine of Sir Salim Ullah Medical College & Mitford Hospital; Bangladesh. The study period was Six (6) months, starting from 1st January; 2018 to 31st June 2018 A total of 100 patients with a stroke, aged 30 years and older, in whom a CT scan or MRI of the brain was done, were included in this study. ***Results:*** Out of 100 patients, 65% were male and 35% were female, with the majority of patients aged 61 to 70. Most of the admitted stroke patients were businessmen (26%), and most belonged to the lower-income group (43%). HTN was associated with 72% of ischemic stroke patients and 80% of hemorrhagic stroke patients. DM was present in 64% of ischemic stroke patients and 44 % of hemorrhagic stroke patients. Dyslipidemia was associated with 45% of ischemic stroke patients and 40% of hemorrhagic stroke patients. CT/MRI of the brain revealed 75% ischemic stroke, 22% intracerebral hemorrhage, and 3% SAH. Infarction in the MCA territory was most common (74.6%), followed by the PCA territory (10.6%) and ACA territory (9.3%). The most common site for hemorrhage was the basal ganglion region (45.45%). The positive predictive value of the Siriraj score for the clinical diagnosis of ischemic and hemorrhagic stroke was 88% and 84%, respectively, and the specificity of the Siriraj score for the diagnosis of hemorrhagic stroke was 95.8%. ***Conclusion:*** In this study, an attempt was made to find out the correlation between clinical diagnosis of types of strokes based on the Siriraj Stroke Score and radiological imaging of the brain in an acute stroke patient. Siriraj's Stroke Score was found to be more sensitive in an Asian population, but still not accurate enough to replace a CT scan/ MRI of the brain as an investigation of choice but can play a role to avoid delay in the management where CT scan/MRI is delayed or unavailable.

Keywords: Brain, Stroke, Radiology.

INTRODUCTION

Stroke is the most common neurological emergency [1]. The term "stroke" defines a focal (or at times global) neurological impairment of sudden onset, lasting more than 24 hours (or leading to death), and of presumed vascular origin [2]. Stroke is the third most common cause of death in developed nations after ischemic heart diseases and cancer [3]. The incidence of stroke increases day by day and in many developing countries, the incidence is rising because of adaptation to unhealthy lifestyles and lack of awareness [3]. The AHA estimates that 780000 strokes occur each year; 60000 of these are new strokes and 180000 are

recurrent strokes [4]. Eighty-five percent are ischemic strokes, 10% are intracerebral hemorrhage (ICH) and 5% are subarachnoid hemorrhage (SAH) [5]. In 2007, the overall mortality rate from stroke was 273000 which makes stroke the third leading cause of death in the United States [4]. Between 1979 and 2005, the annual number of hospital discharges with stroke as the diagnosis was 900000 [4]. Direct and indirect costs associated with stroke are estimated to be approximately $65.5 billion [4]. Strokes caused by blocked blood vessels in the brain, or ischemic strokes, lead to cerebral infarction, whereas hemorrhagic strokes caused by ruptured vessels in and around the brain lead to intracerebral hemorrhage (ICH) and subarachnoid hemorrhage (SAH) [6]. Ischemic strokes are commonly caused by atherosclerotic disease of extracranial or intracranial vessels that circulate blood to the brain and Hemorrhagic stroke is commonly due to either primary ICH or SAH. Another very important risk factor for stroke is diabetes [4, 6]. A brain imaging study is necessary to determine if the cause of stroke is ischemia or hemorrhage [7]. Noncontract CT scanning of the brain is often the initial imaging study performed for an acute stroke patient [8]. The distinction between ischemic and hemorrhagic stroke is readily made by CT [8]. MRI of the brain is often the favored imaging modality in non-acute stroke patients or when a stroke is presumed to be of the posterior circulation [8], It is impossible for all stroke patients can't have a CT scan of the brain immediately after admission because of lack of facilities and limited access due to cost or distance, especially in rural areas in the developing countries such as Bangladesh. Hemorrhagic and ischemic stroke cannot be distinguished clinically which is why the use of weighted clinical scores has been proposed to differentiate hemorrhagic from ischemic stroke. The two European-recognized clinical scores are Allen's or Guys Hospital score and Siriraj Hospital score [9, 10]. Siriraj Stroke Score was developed in Thailand (Siriraj Hospital) by Poungvarin *et al.,* in 1991 [11]. Studies comparing the two scores have concluded that Siriraj score is better than Guy's hospital score [12, 13]. Results of most of the studies have concluded that [14] Siriraj's score is better than Allen's score, especially in the diagnosis of cerebral hemorrhage, and has the utility of being used within 24 hours of acute stroke [13, 15].

METHODS

This descriptive type of cross-sectional study was conducted at the Department of Medicine of Sir Salim Ullah Medical College & Mitford Hospital, Bangladesh. The study period was Six (6) months, starting from 1st January;2018 to 31st June 2018 A total of 100 patients with a stroke aged 30 years and above in whom CT scan/ MRI of the brain was done, were included in this study. Patients were selected by consecutive convenient purposive sampling methods. The results were shown in tables, figures, diagrams, etc.

Inclusion Criteria

- Patient admitted with a clinical diagnosis of acute stroke and CT scan or MRI of the brain done within 5 days of onset of symptoms.
- Age ≥ 30 years.
- Sex – Both male and female.

Exclusion Criteria

- Patients in critical stages are not able to give history without an attendant.
- Patients having h/o previous stroke.

RESULTS

Table 1: Distribution of patients concerning age and sex group

Age groups (years)	Sex of the patient		Total number
	Male	Female	
30-40	3	1	4
41-50	5	2	7
51-60	15	10	25
61-70	16	10	26
71-80	10	6	16
81-90	9	4	13
91-100	6	2	8
100+	1	0	1
Total	**65**	**35**	**100**

Among these cases, a maximum number of patients (N=26) were in 61–70-year age group. The second highest number (N=25) were in the 51–60-year age group

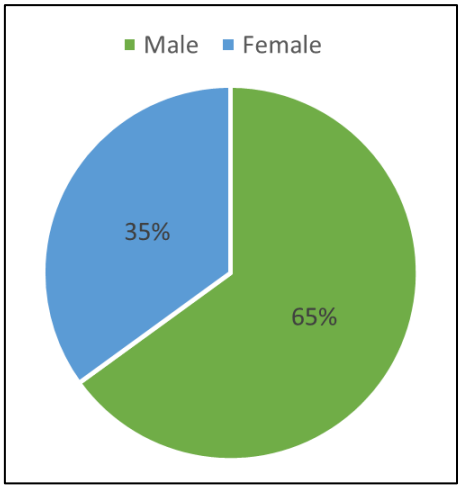

Figure 1: Distribution of the patient concerning sex

This chart shows that the maximum number of stroke patients were male n=65 and the rest of the patients are female n=35.

Table 2: Economic status of the patients

Income status	Number of patients	Percentage
Low Income (<60,000 taka/year)	43	43%

Middle income (60,000-1,80,000 taka/year)	27	27%
High income (>1,80,000 taka/year)	30	30%
Total	**100**	**100%**

Among the cases, most of the stroke patients were within a low-income group (n=43); followed by a high-income group (n=30).

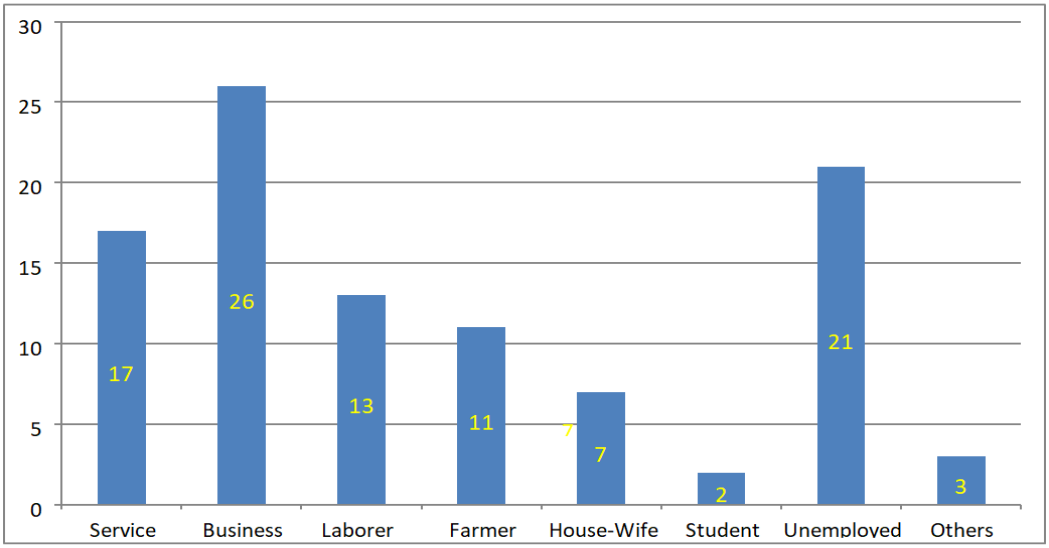

Figure 2: Distribution of the patients in the profession category

Among the cases, the majority of the stroke patients are Businessmen n=26 followed by unemployed people n=21.

Table 3: Association of different types of strokes

Type	Hemorrhage (25) n (%)	Ischemia (75) n (%)
Hypertension	20 (80.0)	54 (72.0)
Diabetes Mellitus	11 (44.0)	48 (64.0)
Dyslipidemia	10 (40.0)	34 (45.0)

Among these participants, hypertension was the most common risk factor associated with different types of strokes, with 72% in the case of ischemic stroke, 80% in the case of hemorrhagic stroke, and an overall association was 74%. Diabetes Mellitus was associated with 64% of ischemic stroke patients and 44% of patients with hemorrhagic stroke and an overall association of 59%. Dyslipidemia was associated with 45% of ischemic stroke patients and 40% of hemorrhagic stroke patients. The overall association was 44%.

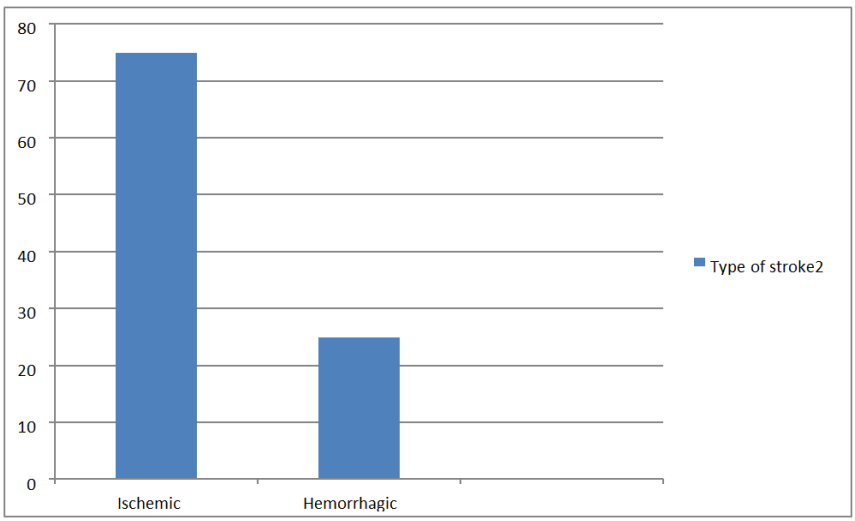

Figure 3: Types of strokes according to CT scan/MRI of the brain

Among the cases, radiologically total of 75 patients had ischemic stroke and 25 had a hemorrhagic stroke. Among the hemorrhagic stroke patients, 22 had an intracerebral hemorrhage and 3 had a subarachnoid hemorrhage.

Table 3: Distribution of infarcts in vascular territory according to brain imaging

Artery Territory	Number(n=75)	Percentage (%)
ACA territory	7	9.3
MCA territory	56	74.6
PCA territory	8	10.6
Multiple infarcts	4	5.33

(**ACA**- Anterior Cerebral Artery, **MCA**- Middle Cerebral Artery, **PCA**- Posterior Cerebral Artery)

Among the cases, infarction most commonly involved the middle cerebral artery territory (74.6%) followed by the posterior cerebral artery territory (10.6%).

Table 4: Sites of intracerebral hemorrhage according to brain imaging

Site	Number (n=22)	Percentage (%)
Basal Ganglia	10	45.45
Lobes	6	27.27
Thalamus	3	13.64
Cerebellum	3	13.64

Among the cases, the most common sites of intracerebral hemorrhage were the basal ganglion region (45.45%) followed by cerebral lobes (27.27%).

Table 5: Clinical diagnosis of different types of strokes according to Siriraj score

Types	Number	Siriraj Score
Ischemic Stroke	78	≤1
Hemorrhagic Stroke	19	≥1
Indeterminate	3	-1 to +1

Among the cases, patients were categorized as alert with a Glasgow Coma Scale (GCS) > 13, drowsy with a GCS between 08 to 13, and unconscious with a GCS < 08. The Siriraj Score was calculated and compared with the CT scan and MRI findings of the patient on admission.

Table 6: Comparison of Siriraj Stroke score with Radiological Diagnosis of Stroke

Siriraj Stroke Score (SSS)	Hemorrhage (25) n (%)	Ischemia (75) n (%)	Total (100) n (%)
SSS > +1	16 (64.0)	3 (4.0)	19 (19.0)
SSS < -1	9 (36.0)	69 (92.0)	78 (78.0)
SSS = -1 to +1	0 (0.0)	3 (4.0)	3 (3.0)

Among the participants, 78 patients had a clinical diagnosis of infarction, infarction changes were found in 69 patients, and hemorrhage was seen in 9 patients. In 19 patients with a clinical diagnosis of hemorrhagic stroke, hemorrhage was seen in 16 patients and 3 showed infarction changes in CT scan.

Table 7: Screening Test for Siriraj Stroke score in Ischemic and Hemorrhagic stroke

Stroke Type	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Accuracy
Ischemic	95.83%	64.00 %	88.46%	84.21 %	87.63%
Hemorrhagic	64.00%	95.83 %	84.21%	88.46 %	87.63%

Among the participant's cases, the positive predictive values of the ischemic and hemorrhagic stroke scores of 88.46% and 84.21% respectively were recorded. Sensitivity was 95.83% and 64%, and specificity was 64.00% and 95.33%, respectively.

DISCUSSION

In this study, patients are grouped into 8 age groups. The majority of the patients are included between the 61-70 age group (26%); followed by the age group 51-60 (25%) and age group 71-80 (16%). The sex distribution of stroke patients shows 65% male and 35% female. In the age group distribution of males and females, there is no significant difference. The present study coincides with the study of Di Tullio MR *et al*., [16] and Adams HP Jr *et al*., [17] which showed that the frequency of stroke is 30% higher in the case of a male. Most stroke patient (43%) in this study belongs

to the low-income group (< 60,000 TK/year) followed by the high-income group (> 180,000 TK/year) 30%. Most of the stroke patients of nearby districts come to this tertiary care government hospital for treatment and a major portion of them belongs to low socio-economic status. Moreover, the local populations of this area, most of whom are solvent, also seek medical help in this hospital during their illness. The unique location of this hospital is the cause of these findings. In this study, the maximum number of stroke patients are businessmen (26%) followed by unemployed persons (21%). Service holders, laborers, and farmers are 17%, 13%, and 11% respectively. It contradicts the study done by MR Siddiqui *et al.,* [18] in the medical unit of BSMMU, BIRDEM, SSMCH, and DMCH where most of the stroke patients were unemployed. With the economic development of our country, the unemployment rate is reducing and more patients of various professions are seeking urgent medical attention. This factor may be contributory to the difference in findings between these two studies. Our study shows that 74 % of total stroke patients are hypertensive. Hypertension is more common in the hemorrhagic stroke group (80%) than in the ischemic stroke group (72%). The incidence of hypertension is significantly higher when compared to one study conducted on Chinese patients but is slightly lower than another study conducted in a hospital setting on Indian patients. Hypertension is the most common risk factor in all types of strokes. The incidence of diabetes is 59% in our study, which is significantly higher compared to the study conducted by Perera *et al.,* [19] on stroke patients in Sri Lanka which revealed 42.4% association of diabetes with stroke. And the association of dyslipidemia in stroke patients is 44% in this study which correlates well with the study by Perera *et al.,* [19] which showed an association of 40.2%. Lack of health education and adoption of sedentary lifestyles are the contributing factors to the development of diabetes and other risk factors in our population. CT scan of the head and MRI of brain findings of the studied patients show that majority of the patients are ischemic (75%) stroke patients, 22% have acute intracerebral hemorrhage and the rest 3% patients have a subarachnoid hemorrhage. Khan *et al.,* [20] conducted a study on 280 stroke patients at Ziauddin Hospital Karachi and observed 70.1% had cerebral infarction and 29% had cerebral hemorrhage. Hemorrhagic stroke accounts for 10-15% of all strokes and is associated with higher mortality rates than cerebral infarctions [21]. A higher rate of hemorrhagic stroke is also seen in several hospital series in Asian countries. The higher percentage of hemorrhagic stroke in the Asian population may be related to inadequate control of blood pressure. In patients of ischemic stroke, a middle cerebral artery is most commonly involved in 74.6% of patients; the posterior cerebral artery is involved in 10.6% of cases, and the anterior cerebral artery in 9.4% of cases in this study. The present study is correlated well with the study of Dr. A. Kanaka Mahalakshmi *et al.,* [22] in which 76.4%, 10.2%, and 7.4% involvement were found in the middle cerebral artery, posterior cerebral artery, and anterior cerebral artery respectively. In this study the sites of hemorrhage are basal ganglia 45.45%, cerebral lobes 27%, thalamus 14%, and cerebellum 14%. This finding also correlates with the study conducted by Dr. A. Kanaka Mahalakshmi *et al.,* [22] which showed most of the hemorrhage in the basal ganglia 45%, followed by cerebral lobes 32%, thalamus 14%, and cerebellum 10%. In the present study, the positive predictive value of Siriraj's score for clinical diagnosis of ischemic and hemorrhagic stroke is 88% and 84% respectively. Faridullah *et al.,* [23] carried out a study in 2003 at F.G Services Hospital and Pakistan Institute of Medical Sciences Islamabad, in which the positive predictive value of Siriraj's score for clinical diagnosis of ischemic stroke and hemorrhagic were 87% and 83% respectively. This finding of our study correlates well with that previous study. In our study specificity of Siriraj's score for diagnosis of hemorrhagic stroke is 95.8%. Sherin A *et al.,* [24] found a specificity of Siriraj score of 94.2% in hemorrhagic stroke in a study. It also correlates with the findings of our study. In this study sensitivity of Siriraj's score in hemorrhagic stroke is 64%. In a study conducted by Pavan *et al.,* in a south Indian hospital, the sensitivity of Siriraj score in intra-cerebral hemorrhage was 77.27%. The variation in results of different studies may be explained by different settings, the difference in patient ethnic background and prevalence of hemorrhagic stroke as well as methodological variations of various studies.

Limitations of the Study

This study is not free from limitations which should be considered during the implications of the findings of this study.

CONCLUSIONS

Developing countries like Bangladesh have been burdened not only with infectious diseases but also with non- communicable diseases such as diabetes mellitus, hypertension, heart disease, stroke, and cancer. The prevalence of stroke is rising in the community with an increase in life expectancy. Changes in lifestyles and food habits contribute to the comorbidity and risk factors of stroke. Mass awareness programs should be undertaken by the government to reduce the burden of stroke by reducing the comorbidities and risk factors. Proper management of acute stroke syndrome is based on the correct diagnosis of its pathological type. Computed tomography and magnetic resonance imaging are accurate, safe, and non-invasive procedures for differentiating between cerebral hemorrhage and infarction. In Bangladesh, these facilities are not available countrywide. Physicians in charge of acute stroke have therefore to resort to the usual routine procedures in conjunction with clinical features, which are unreliable. Siriraj's score is more sensitive for the diagnosis of types of strokes than other scoring systems

for the Asian population. But it is not accurate enough to replace radiological imaging of the brain as an investigation of choice.

RECOMMENDATIONS

Further studies are required to improve the accuracy of the Siriraj score by adding new variables of high discriminate values. More studies should be done to develop new clinical scores having more accurate for the diagnosis of different types of strokes. However, at present radiological imaging like CT scans and MRI of the brain are reliable investigations for distinguishing between hemorrhagic and ischemic stroke. So, these investigations should be made available and affordable throughout the country for better management of stroke patient.

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