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Original Research Article

TOAST CLASSIFICATION AND NIHSS SCORE IN ACUTE ISCHAEMIC STROKE IN A TERTIARY CARE HOSPITAL – A PROSPECTIVE STUDY

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Abstract

Background: Stroke is a heterogeneous disease with more than 150 known causes. Categorization of subtypes of ischemic stroke has considerable study, but definitions are hard to formulate and their application for diagnosis in an individual patient is often problematic. Advances in diagnostic technology have allowed us to identify the potential underlying causes of stroke in patients. The fundamental goals of ischemic stroke classification are to make a correct diagnosis, enable prompt treatment, and predict future risks in subgroups of certain discrete features. **Materials and Methods:** It is a prospective observational study to assess the categorisation of acute ischemic stroke patients treated at the Neurology Department of Madurai Medical College, Madurai, from October 2021 to September 2022. **Result:** In our study, 250 ischemic stroke patients were consecutively included and classified according to TOAST. The assessment was supplemented with cerebral small vessel disease (SVD) score, based on Magnetic Resonance Imaging (MRI). Markers of small and large vessel disease were present in all TOAST groups. Carotid stenosis and atrial fibrillation were associated with their respective TOAST groups (p = 0.023 and p < 0.001, respectively). We found no association between the SVD score and the small vessel occlusion TOAST group (p = 0.59). NIHSS score compared among patients with TOAST and severity has been assessed. An operational classification that contains quantification of each vascular pathophysiology in the individual patient is pivotal for future research and development of personalized medicine. **Conclusion:** Cerebral SVD were present across all TOAST groups and objective measures of large and small vessel disease (carotid atherosclerosis) were not associated to specific TOAST groups. Only strokes in patients with ipsilateral carotid stenosis _ 50% and atrial fibrillation were associated with TOAST.

INTRODUCTION

Stroke is a heterogeneous disease with more than 150 known causes. Categorization of subtypes of ischemic stroke has considerable study, but definitions are hard to formulate and their application for diagnosis in an individual patient is often problematic. In the past, classifications have been based primarily on risk factor profiles, clinical features of the stroke, and the findings on brain imaging studies (computed tomography [CT] or magnetic resonance imaging [MRI]).[1] Most registries have failed to identify a definite cause in 25–39% of patients, depending on the quality, completeness, and rapidity of the work-up. This group of strokes of unknown causes (the so-called 'cryptogenic strokes', a term popular among neurologists but perhaps unnecessarily cryptic to students, patients, and most nonstroke physicians) should be a major focus for future clinical research. Advances in diagnostic technology have allowed us to identify the potential underlying causes of stroke in stroke patients. The fundamental goals of ischemic stroke classification are to make a correct diagnosis, enable prompt treatment, and predict future risks in subgroups of certain discrete features.[2,3]

Etiological classification is essential in stroke-related research, and accuracy of ischemic stroke assignment is important in clinical studies.[4,5]

Aims and objectives

The aim of this study is to assess the percentage of patients who have been categorised according to TOAST on the basis of NIHSS score.

MATERIALS AND METHODS

It is a prospective observational study to assess the categorization of acute ischemic stroke patients treated at the Neurology Department of Madurai Medical College, Madurai, from October 2021 to September 2022. Ethical approval was obtained from the institution, and verbal informed consent was taken from all participants or their relatives for obtaining information from admission to follow-up. Inclusion criteria for the study is ,Patients of age more than 18yrs, all male and female cases of acute stroke, and patients having clinical signs of focal or global cerebral dysfunction that lasting more than 24 hours, with no other than vascular cause .

Exclusion criteria for the study, age less than 18yrs, hemorrhagic stroke, secondary focal neurological deficit, Transient ischemic attacks and Subdural/Epidural haematomas.

Study Design: Patients diagnosed to have stroke by CT/DW MRI, NIHSS scoring is done on the day of admission.

Based on the NIHSS score severity is assessed at the time of admission, 1-4 indicates minor stroke, 5-15 indicates moderate stroke, 16-20 indicates moderate to severe stroke, 21-42 indicates severe stroke. Estimation of Complete hemogram, Urine routine, Renal function test, ECG, Chest X-ray, RBS, HbA1C and 2D Echo,CT/MRI scan done ,carotid angiogram done at the time of admission.

Sample Size: With 95% confidence level and margin of error of _7.5%, a sample size of 250 subjects will allow the study to determine the predictive value of NIHSS in association with TOAST classification in acute ischaemic stroke patients.

Statistical Analysis: $n = \dfrac{z2p(1-p)}{d2}$

where

   _Z= z statistic at 5% level of significance
   _ d is margin of error
   _ p is anticipated prevalence rate

All characteristics will be summarized descriptively. For continuous variables, the summary statistics of N, mean, standard deviation (SD) will be used. For categorical data, the number and percentage will be used in the data summaries and data will be analyzed by Chi square test for association, comparison of means using t test, ANOVA and diagrammatic presentation.

NIHSS: National Institutes of Health Stroke Scale (NIHSS): NIHSS was National found to be helpful both in diagnosis of stroke and in stratifying patients, so that outcome could be predicted and also to decide for acute intervention. Among various stroke scales, NIHSS has been studied extensively and its reliability and validity are well documented in scientific literature.

Scores ≥20 have been associated with symptomatic intracerebral hemorrhage when compared with other stroke scales (e.g., the Scandinavian, Mathew, and Orgogozo scales), the NIHSS was the most sensitive in detecting changes in stroke signs.

TOAST: The purpose of the TOAST (the Trial of ORG 10172) classification system was to better categorize stroke patients for the purpose of investigating any potential efficacy of the anticoagulant danaparoid for treatment of various types of ischemic strokes (10-13). This system was primarily based on clinical features plus any information from neuroimaging, echocardiography, neurosonography, and cerebral angiography.

A system for classifying ischemic stroke subtypes mainly based on etiology has been developed for the Trial of Org 10172 in Acute Stroke Treatment (**TOAST**)

TOAST classification identifies five subtypes of stroke:

1. Large-artery atherosclerosis (LAA)
2. Cardioembolic stroke (CE)
3. Small-vessel disease (SVD) / penetrating artery disease (PAD)
4. A stroke of other determined cause
5. A stroke of undetermined cause (cryptogenic stroke).

Diagnosis is based on clinical features and data obtained from brain imaging (CT/MRI), vessel imaging (CTA/MRA, neurosonology, DSA), cardiac imaging, and laboratory tests.

Examinations: The standard workup included medical history, registration of medication and functional status (modified Rankin Scale, mRS), neurological examination including stroke severity (National Institutes of Health Stroke Scale, NIHSS), computed tomography (CT) or magnetic resonance imaging (MRI) of the brain (described below), chest X-ray, electrocardiogram, carotid ultrasound (described below . Some patients also underwent echocardiography, CT or MR angiography, and extended blood examination if the basic examinations could not reveal an etiology for the stroke.[6,7]

Magnetic Resonance Imaging: Patients without contraindications such as magnetic implants and severe claustrophobia were offered an MRI scan. MRI was performed with a Siemens Avanto 1.5 T scanner with a standard protocol including sagittal T2, axial T2, axial fluid attenuation inversion recovery, 3D T1, susceptibility-weighted imaging, and diffusion-weighted imaging. A blinded neuroradiologist provided a description of the intracerebral lesion(s) according to the Standards for Reporting Vascular Changes on Neuroimaging (STRIVE) [8,9]. The J. Pers. Med. **2022**, 12, 496 3 of 11 total SVD score was calculated with one point for each of the following: lacuna, deep and periventricular white matter hyperintensity (Fazekas

score 2–3), microbleeds, and enlarged perivascular spaces (EPV) in the basal ganglia.[10]

RESULTS

In this study, 10 patients had minor stroke, 130 patients had moderate stroke, 60 patients had moderate to severe stroke and 50 patients had severe stroke. [Table 1]

cerebral small vessel disease, expressed as the SVD score, was present in all TOAST groups. Two patients with OD etiology (internal carotid artery dissection), who both had an SVD score of zero. We found no association between SVD score and TOAST classification (p = 0.59), though 28% and 37.2 % of the SVO and and UD group had a SVD score of three or more, while this only accounted for 7.1% and 15.4% of the LAA and CE groups, and none had an SVD score of four. The SVO group had five (20%) patients with an SVD score of zero, as the acute lacunar infarct is not included in the SVD score. [Table 2]

Table 1: Distribution of cases according to NIHSS at admission

NIHSS at admission		N	%
1-4	Minor stroke	10	4
5-15	Moderate stroke	130	52
16-20	Moderate to severe stroke	60	24
21-42	Severe stroke	50	20
Total		250	100

Table 2: SVD score categorisation among TOAST

SVD score	All patient	Large artery atherosclerosis	Cardiac embolism	Small vessel occlusion	Other determined etiology	Undetermined etiology	P value
0	160	10	20	30	20	80	0.59
1	120	10	10	40	10	40	
2	100	15	15	20	10	30	
3	80	30	20	10	5	15	
4	50	15	20	5	5	5	

Graphical representation done comparing SVD score among TOAST classification in [Figure 1].
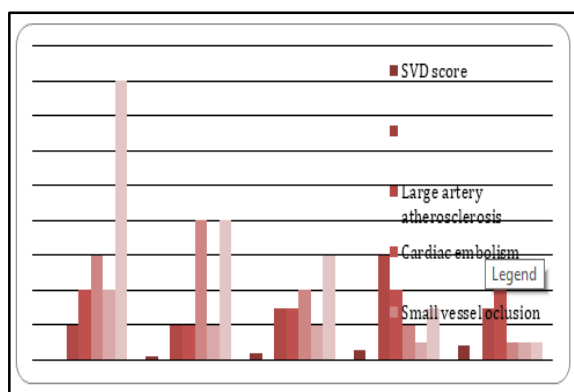

Figure 1: Graphical representation of categorization of SVD score among TOAST

DISCUSSION

Stroke is a global epidemic and an important cause of morbidity and mortality. It is the second most common cause of death and may soon become the leading cause of death worldwide.[8]

The National Institutes of Health Stroke Scale (NIHSS) is a well-validated, reliable scoring system for use specifically with stroke patients. The National Institutes of Health Stroke Scale (NIHSS) can be used as a standard measurement instrument by physicians to evaluate the severity of a patient and outcome.

Baseline NIHSS is a strong predictor of functional outcome 90 days after stroke. In this study, we replicated the association between TOAST and NIHSS score and assessed functional outcome. A study in a similar setting showed slightly lower incidence of lacunar stroke (40%), but slightly higher incidence of large-artery stroke (36%) and cardioembolic ischemic stroke (19%).[6] This study included patients only from ICU, where comparatively severe patients are treated, but we included patients from both ICU and neurology ward. In addition to this, patients with cardioembolic and large-artery stroke had greater severity based on baseline NIHSS score in our study.

The National Institutes of Health Stroke Scale (NIHSS) is a well-validated, reliable scoring system for use specifically with stroke patients. The National Institutes of Health Stroke Scale (NIHSS) can be used as a standard measurement instrument by physicians to evaluate the severity of a patient and outcome.[6,7]

We had expected the SVD score to be associated with the SVO group. Thus, inclusion of additional vascular markers did not improve the TOAST classification for the individual patient. As expected, ipsilateral carotid stenosis _ 50% and atrial fibrillation were associated with the TOAST classification.

The need for a classification system that includes all underlying pathophysiological mechanisms in the individual ischemic stroke patient has been raised in an Asia-specific context,[9] but this need is general, especially in terms of research (e.g., into genetics and biomarkers), choice of treatments, and further development of personalized medicine.[1,10]

CONCLUSION

Cerebral SVD were present across all TOAST groups and objective measures of large and small vessel disease (carotid atherosclerosis, ABI, RHI and eGFR) were not associated to specific TOAST groups. Only strokes in patients with ipsilateral carotid stenosis _ 50% and atrial fibrillation were associated with TOAST.

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