

Zero on the NIHSS Does Not Equal the Absence of Stroke

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Study objective: The National Institutes of Health Stroke Scale (NIHSS) measures deficits caused by a stroke, but not all stroke signs are captured on the NIHSS. We determine the symptoms and stroke localization of patients with brain infarction and an NIHSS score of 0.

Methods: We studied all patients who presented with acute neurologic symptoms to our stroke center from 2004 to 2008 and had persistent symptoms at the evaluation in the emergency department, an NIHSS score of 0, and an infarct on diffusion-weighted imaging. We characterized the symptoms, signs, lesion location, demographics, and stroke causes.

Results: Twenty patients met inclusion criteria. Symptoms frequently experienced were headache, vertigo, and nausea. The posterior circulation was commonly infarcted in this group. Truncal ataxia was the most common neurologic sign.

Conclusion: Ischemic stroke may cause symptoms that are associated with no deficits on the NIHSS score. [Ann Emerg Med. 2011;57:42-45.]

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0196-0644/\$-see front matter

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doi:10.1016/j.annemergmed.2010.06.564

INTRODUCTION

The National Institutes of Health Stroke Scale (NIHSS) is a valid, reproducible scale that measures neurologic deficits and is the most frequently used scoring system in stroke intervention trials.^{1,2} Physicians rely on the NIHSS to evaluate patients with suspected acute stroke and to make decisions about acute treatment.¹ The NIHSS correlates with infarct size, clinical severity, and long-term outcome.^{3,4}

However, not all signs caused by a stroke are captured as deficits on the NIHSS. The scale is highly weighted toward deficits caused by anterior circulation strokes, whereas deficits caused by posterior circulation strokes receive fewer points.^{1,5,6} Within the anterior circulation, the scale underestimates the degree of right versus left hemisphere injury.^{7,8} These studies indicate that the NIHSS performs unequally in the detection of stroke, depending on lesion location, and it is therefore possible that some patients with persistent symptoms on arrival to the emergency department (ED) and an NIHSS score of 0 still have an infarct.

In this study, we characterize the persistent symptoms and the stroke location of patients who present to the ED with an acute cerebrovascular syndrome and an NIHSS score of 0; we

hypothesize that such patients with persistent symptoms have more strokes in the posterior circulation, causing deficits not detectable on the NIHSS.

MATERIALS AND METHODS

All patients with suspected acute cerebral ischemia admitted to our stroke service are initially evaluated by an NIHSS-certified member of our stroke team (vascular neurology fellow or stroke faculty member) in the ED. Unless contraindicated, all patients with suspected acute cerebral ischemia undergo multimodal magnetic resonance imaging of the brain and magnetic resonance angiography of the intracranial and extracranial vessels within 24 hours of hospital presentation. The initial NIHSS examination is performed before the patient undergoes magnetic resonance imaging. We studied all patients who presented to our stroke center from 2004 to 2008 with suspected acute cerebral ischemia and an NIHSS score of 0 at hospital presentation. The inclusion criteria for this study were admission to the stroke service, NIHSS score of 0 while symptomatic, and magnetic resonance imaging of the brain performed after initial NIHSS examination, demonstrating an

Editor's Capsule Summary

What is already known on this topic

Some patients with acute ischemic stroke whose symptoms are mild or nonspecific can score 0 on the National Institutes of Health Stroke Scale (NIHSS).

What question this study addressed

How often do stroke patients score 0 on the NIHSS, and what are their characteristics?

What this study adds to our knowledge

In 2,618 patients admitted with acute ischemic stroke, 20 had a NIHSS score of 0 in the emergency department. Posterior circulation stroke; symptoms of headache, vertigo, and nausea; and signs of truncal ataxia were common.

How this is relevant to clinical practices

These data reinforce that the NIHSS cannot replace history, thorough examination, and clinical acumen to diagnose stroke in patients with mild or nonspecific signs and symptoms.

acute infarction. These patients received a label of "NIHSS 0 stroke."

We collected symptoms, signs, lesion location, patient demographics, stroke causes, and early outcome at discharge. The symptoms were those that the patients described to the stroke team member at the evaluation in the ED and were abstracted from the initial consultation note in the ED. The physical examination findings were abstracted from the initial consultation note, but in cases in which the NIHSS was the only examination performed, additional signs on the neurologic examination were collected from the attending physician's note. The stroke attending physician at our institution performs a neurologic examination while the patient is still in the ED or the next day when the patient is admitted to the hospital. The attending physician's note was used if there were instances of conflicting findings. The retrospective chart review was approved by the institutional review board at the University of Texas–Houston.

RESULTS

The Figure provides a flow chart of how many patients were treated in our ED in the study period by the stroke team and admitted to the stroke service. Twenty patients met inclusion criteria for this study. Of the total population of 2,618 patients with acute cerebral ischemia whom our stroke service admitted during the same period, the NIHSS 0 stroke group represented 0.76%. We report the demographics, causes, symptoms, and outcome with respect to their discharge modified Rankin Scale

(mRS) or disposition (Table 1). The distributions of infarcts in the anterior and posterior circulation are presented in Table 2, and the physical examination findings of these patients are shown in Table 3.

There was a higher percentage of posterior circulation compared with anterior circulation strokes. Headache, vertigo, and nausea occurred more frequently than motor and sensory symptoms (Table 1). The most common neurologic finding was truncal ataxia (Table 3). There were 2 cases of agitated confusion and single cases of memory impairment, Horner's syndrome, etc. In 2 cases, no neurologic deficits were found (right temporal infarct and a left pontine infarct) (Table 3).

LIMITATIONS

Our study is limited by small sample size, single-center experience, and the interrater variability in performing the NIHSS. In addition, we studied only admitted patients and therefore do not provide information on how many patients during the study period were discharged from the ED with an NIHSS score of 0. Therefore, there is a possibility that patients with undetected posterior circulation strokes misdiagnosed as a peripheral vestibulopathy, for example, were missed by our methodology. However, the findings from this report support the idea that the NIHSS should not substitute for a thorough neurologic examination, including a formal gait evaluation, when a patient is evaluated for suspected stroke.

DISCUSSION

Patients with suspected acute cerebral ischemia presenting to the ED with persistent symptoms who have an NIHSS score of 0 compose a small but important population that has not been previously characterized, to our knowledge. Our findings suggest that the NIHSS sometimes does not capture some ischemic strokes, more often within the posterior compared with the anterior circulation. There are several possible reasons why the NIHSS failed to detect strokes in our symptomatic patients. First, patients in the NIHSS 0 stroke group most commonly presented with nausea, vomiting, and headache, all of which are associated with posterior circulation ischemia.⁹ This type of ischemia occurred more frequently in this group and, depending on infarct location, may not be associated with detectable deficits on the NIHSS. Second, midline lesions of the cerebellum cause truncal ataxia, which is not part of the NIHSS and is not routinely tested in our center in the hyperacute setting. Truncal ataxia was the most common neurologic finding in this patient population.

Our findings indicate that the NIHSS alone cannot be used to rule out a stroke in patients with acute persistent symptoms. The NIHSS does not substitute for a comprehensive neurologic examination. Truncal ataxia, decreased visual acuity, Horner's syndrome, and memory impairments are neurologic deficits that were detected in this patient population and which the NIHSS does not capture. In addition, subtle limb weakness (4/5) in an

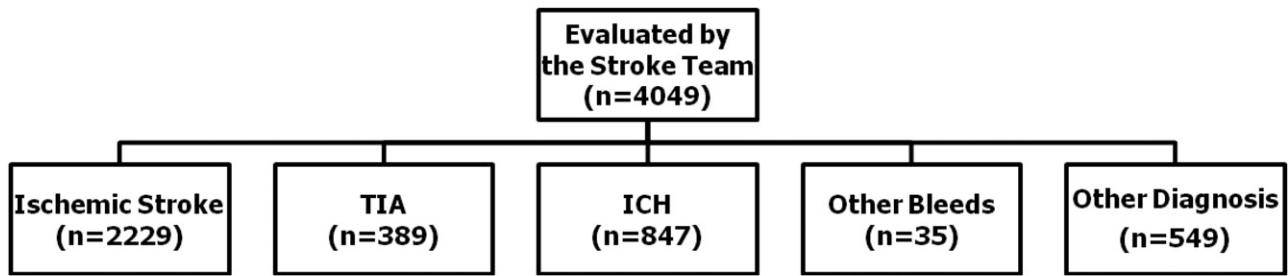


Figure. Stroke patients presenting to the ED from July 2004 to December 2008. *TIA*, Transient ischemic attack; *ICH*, intracerebral hemorrhage.

Table 1. Demographics, causes, and outcome of stroke patients with NIHSS score 0.

	%
Demographics	
Age, y, mean (SD)	54.1
Sex, female	35.0
Ethnicity	
Black	35.0
White	50.0
Hispanic	15.0
Asian	0
Symptoms	
Headache	45.0
Vertigo	30.0
Nausea	30.0
Ataxia	25.0
Confusion	20.0
Blurred vision	20.0
Sensory disturbance	15.0
Limb weakness	10.0
Double vision	5.0
Risk factors	
Glucose, mg/dl, median (range)	128
Treated with intravenous tPA	5.0
History of Afib	6.3
History of CAD	16.7
History of DM	50.0
History of HTN	77.8
TOAST classification	
Cardioembolic	30.0
Large vessel	15.0
Small vessel	20.0
Cryptogenic	20.0
Other	15.0
Disposition	
Home	75.0
Inpatient rehabilitation	10.0
Skilled nursing	10.0
Other	5.0
mRS at discharge	
0	35.0
1	30.0
2	10.0
3	15.0
4	5.0
5	5.0
6	0
LOS, median (range)	4.5

tPA, Tissue plasminogen activator; *Afib*, atrial fibrillation; *CAD*, coronary artery disease; *DM*, diabetes mellitus; *HTN*, hypertension; *TOAST*, Trial of 10172 in Acute Stroke Treatment; *LOS*, length of stay.

Table 2. Distribution of infarct location in patients with NIHSS score 0.

	%
Anterior circulation	
Frontal lobe	0
Temporal lobe	5.3
Parietal lobe	5.3
Insula	5.3
Multiterritory	5.3
Cortical and subcortical	0
Subcortical	21.1
Posterior circulation	
Occipital lobe	15.8
Multiterritory	0
Cerebellum	31.6
Pons	5.3
Medulla	5.3

Table 3. Neurologic signs of patients with NIHSS score 0.

Neurologic Signs	%
Truncal ataxia	45
Agitated confusion	10
Normal examination result	10
Nystagmus*	5
Limb weakness	5
Memory impairment	5
Horner's syndrome	5
Slow to respond	5
Reduced visual acuity without field cut	5
Tandem gait abnormality	5

*Not specified further in the medical chart.

upper motor neuron pattern (extensors of the arms or flexors of the legs) may not be observed on the motor component of the NIHSS. However, in 2 cases, no neurologic deficits were found on a comprehensive neurologic examination. Therefore, it should also be acknowledged that strokes may rarely cause symptoms not associated with deficits on a more thorough clinical evaluation. Even in the absence of examination findings, the pattern of symptoms in some patients should still prompt brain imaging with a focus on those posterior circulation strokes that have been missed by clinicians in the past, such as cerebellar strokes.⁹

The consequences of missing a stroke in a patient with NIHSS score 0 are unknown. Fortunately, the median discharge mRS score

was 1, and 75% of these patients were discharged home. However, the detection of stroke in these patients presents an opportunity to implement preventive measures. Thirty percent of the NIHSS 0 stroke group had cardioembolic causes, which might prompt consideration for anticoagulation.

Supervising editor: Robert Silbergleit, MD

Author contributions: SM-S and SIS conceived and designed the study. JCG and SS supervised the conduct of the study and data collection. JT and VP abstracted the data and participated in quality control. KCA provided statistical advice and analyzed the data. SM-S drafted the article, and KCA, EBJ, JCG, and SIS contributed substantially to its revision. SIS takes responsibility for the paper as a whole.

Funding and support: By *Annals* policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article that might create any potential conflict of interest. See the Manuscript Submission Agreement in this issue for examples of specific conflicts covered by this statement. This work was supported by the Howard Hughes Medical Institute, NIH training grant T32NS04712, and P50NS044227.

Publication dates: Received for publication March 14, 2010. Revision received June 12, 2010. Accepted for publication June 25, 2010. Available online September 15, 2010.

Presented as a poster at the International Stroke Conference, February 2010, San Antonio, TX.

Reprints not available from the authors.

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