Minor ischemic stroke

Triaging, disposition, and outcome

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Abstract

Background: Two-thirds of patients with stroke have mild deficits. The optimal triaging of these patients remains unclear. It is crucial to stratify patients based on who needs inpatient vs outpatient evaluation in a cost-effective manner. **Methods:** We reviewed the current literature (randomized trials, retrospective studies, case series, and case reports) on minor ischemic stroke and extrapolated evidence-based opinions and future directions on the management of minor ischemic stroke. **Results:** We provide evidence-based opinions and future directions on the approach to triaging patients with mild deficits based on the early risk of stroke recurrence, feasibility of outpatient diagnostic evaluation, and disabling deficits needing inpatient evaluation by physical and occupational therapy.

Conclusions: Outpatient evaluation of patients with nondisabling minor stroke is potentially cost-effective after excluding large artery atherosclerosis and ensuring a rapid access outpatient evaluation. Larger studies on the cost-effectiveness and safety of this approach are necessary. *Neurol Clin Pract* 2016;6:157-163

In population- and hospital-based studies, approximately two-thirds of ischemic stroke patients are found to have mild deficits.¹ With the exception of being younger, patients with minor stroke have similar demographic characteristics as patients with moderate to severe stroke.¹ On the other hand, the prevalence of TIA increases with age, ranging from 0.4% in adults between the ages of 45 and 64 years to 4.1% in those between 75 and 79 years. While the age, blood pressure, clinical, diabetes, duration (ABCD2) score is used to prognosticate risk of subsequent stroke and thereby triage patients with TIAs, the use of this score and others to triage patients with minor ischemic stroke is not validated. This review aims to provide an overview on the definition and outcome of patients with minor ischemic stroke with a focus on triaging and disposition.

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Approximately 30% of patients with minor strokes who are excluded from thrombolytic therapy for mild symptoms have poor outcomes.

Data acquisition

We performed a nonsystematic review of the literature on minor ischemic stroke that included randomized trials, retrospective studies, case series, and case reports. The literature was interpreted to provide evidence-based conclusions and future directions on minor ischemic stroke with a focus on triaging and disposition.

What is a minor stroke?

There is no standard definition used for a stroke that qualifies as minor. A stroke was defined as minor in the National Institutes of Neurological Diseases and Stroke IV recombinant tissue plasminogen activator trials when the symptoms were believed at the discretion of the local investigator to be mild and cause very minimal or no disability.² Since extensive functional and cognitive testing could not be routinely performed in the acute setting, most definitions used for minor stroke in analyses of outcomes are based on structured neurologic examinations, such as the itemized NIH Stroke Scale (NIHSS).³ Most definitions used in prior studies of minor stroke did not include the effect on the patient's ability to perform functional and cognitive tasks. A notable exception is the definition used in the ongoing Phase IIIB, Double-Blind, Multicenter Study to Evaluate the Efficacy and Safety of Alteplase in Patients with Mild Stroke: Rapidly Improving Symptoms and Neurologic Deficits (PRISMS) study which, in addition to requiring an NIHSS of 5 or less, requires the consideration of the patient's ability to perform activities of daily living and return to work based on the observed deficits. Due to the lack of a standard definition for minor stroke, treating physicians tend to make treatment decisions based on whether they consider the deficits disabling to a particular patient, an approach that is highly subjective.⁴ While the NIHSS score is an adequate tool to assess stroke severity, it has several drawbacks in patients with mild deficits. The NIHSS score fails to capture some important deficits that could affect functional outcomes in patients such as hand strength and dexterity, gait, and subtle nondominant hemisphere and executive functioning cognitive abnormalities. These measures are included in a comprehensive neurologic examination performed at the bedside that takes a considerable amount of time to complete and must be weighed against the clear data on improved outcomes for acute ischemic stroke with shorter door-to-needle times. The standardized assessment tools for stroke, on the other hand, have a distinct advantage in that they can be completed quickly by any health care professional and have formal certification available. More subtle measures of neurologic impairment may be necessary as part of standardized stroke assessment tools in order to detect mild but potentially disabling symptoms. The definition of minor stroke is likely to be further clouded by the 2009 change in definition of TIA, which required the absence of infarction on neuroimaging.⁵ It is crucial for both clinical and research purposes to have a standard definition for minor stroke that takes into account the type and severity of deficits, the individual patient, and the potential for stroke recovery.

Outcome in minor stroke

Approximately 30% of patients with minor strokes who are excluded from thrombolytic therapy for mild symptoms have poor outcomes: disability at 90 days (modified Rankin Scale [mRS] 2–6), discharge other than to home, and lack of independent ambulation at discharge.⁶ A consistent predictor of outcome in patients with minor deficits is evidence of large vessel

An important principle in the rapid triage and assessment of TIA patients is that care should be provided by specialist stroke services within 24 hours without barriers to care.

occlusion on imaging, but considerable disability is seen even in those without visualized large vessel occlusions.⁷ Physicians tend to rely on the type of deficits to judge whether a minor stroke symptom will be disabling in an individual context and therefore worth the risk of thrombolysis.³ While one study showed that the types of deficits do not predict outcome in minor stroke,⁸ other studies showed that distal hand weakness,⁹ gait disorder,⁹ language,⁹ leg weakness,¹⁰ and neglect¹⁰ predict poor outcome in patients with mild deficits; this likely reflects individual patient circumstances, variable recovery patterns, and unmeasured cognitive effects. Furthermore, outcome measures assessed in prior studies such as mRS may be skewed towards motor deficits and underestimate certain functional aspects, cognitive deficits, and poststroke fatigue that have been described in patients with mild deficits.

Stroke risk after TIA and minor stroke

Another factor influencing outcome in patients with minor deficits is recurrent stroke. The risk in a recent clinical trial of minor stroke and TIA in China was 8.2% in the dual antiplatelet arm vs 11.7% in the aspirin arm at 90 days.¹¹ The bulk of studies examining clinical events after minor stroke or TIA have focused on the risk of stroke after TIA, and most were derived before the definition of TIA was changed to exclude infarction on imaging. Several scores have been derived using retrospective data to predict the early risk of stroke after a TIA (table); the most widely used is the ABCD2 score, with more contemporary scores also including parenchymal and vascular imaging.¹² Incorporating vascular imaging into prediction of stroke after TIA provides the most important information that can be used to alter initial clinical management. The data on risk of recurrent stroke after a minor stroke are more sparse, though it is notable that the Stenting vs Aggressive Medical Management for Preventing Recurrent Stroke in Intracranial Stenosis (SAMMPRIS) trial excluded patients with major disabling strokes. In this trial, the risk of recurrent stroke with aggressive medical treatment was 5.8% at 30 days.¹³ Neurologic deterioration may also occur in patients with lacunar stroke,¹⁴ which could possibly be the result of substenotic intracranial atherosclerosis.¹⁵ However, the overall incidence is rare¹⁴ and the optimal treatment remains unknown.

Triaging and discharge disposition

In patients with minor stroke who arrive within a time window for thrombolysis, urgent brain imaging with a noncontrast head CT or MRI is necessary to rule out intracerebral hemorrhage (figure). In patients with disabling deficits, thrombolytic therapy and endovascular therapy in certain patients may be indicated and in patients with deficits that are not clearly disabling, enrollment in clinical trials may be considered (figure). In the nonthrombolysis scenario, CT or MRI may be appropriate, depending on the local availability of imaging (figure). If hemorrhage is ruled out, an urgent diagnostic evaluation to rule out conditions associated with high risk of early stroke recurrence is of paramount importance. This approach allows for early implementation of appropriate clinical care and improves resource utilization and cost utilization. Since the diagnostic evaluation of patients with minor stroke and TIA potentially can be performed in 24 hours, hospital admission occurs frequently for rapid diagnostic testing alone. The cost-effectiveness of this approach is unclear. In addition, inpatient evaluation may be challenging in these patients given the new Centers for Medicare Services rule of not paying for hospital admissions with stays less than 2 nights duration and limited

Table Risk scores for predicting a stroke after a TIA

Score	Components	Population derived from	7-day risk of stroke	Includes vessel imaging
ABCD2	Age: <60 years (0 points); ≥60 years (1 point)	Emergency room diagnosis of TIA	0-3: 1.2%	No
	Blood pressure: <140/90 mm Hg (0 points); ≥140/90 mm Hg (1 point)		4-5: 5.9%	
	Clinical features: Weakness (2 points), speech impairment (1 point), neither (0 points)		6-7: 11.7%	
	Duration of symptoms: <10 minutes (0 points), 10-59 minutes (1 point), ≥60 minutes (2 points)			
	History of diabetes: No (0 points), yes (1 point)			
ABCD3	Age: <60 years (0 points); ≥60 years (1 point)	Stroke neurologist diagnosis of TIA	0-3: 0%	No
	Blood pressure: <140/90 (0 points); ≥140/90 (1 point)		4-5: 2.5%	
	Clinical features: Weakness (2 points), speech impairment (1 point), neither (0 points)		6-9: 4.3%	
	Duration of symptoms: <10 minutes (0 points), 10-59 minutes (1 point), ≥60 minutes (2 points)			
	History of diabetes: No (0 points), yes (1 point)			
ABCD3-I	Age: <60 years (0 points); ≥60 years (1 point)	Stroke neurologist diagnosis of TIA	0-7: 0.5%	Yes
	Blood pressure: <140/90 mm Hg (0 points); ≥140/90 mm Hg (1 point)		8-13: 4.1%	
	Clinical features: Weakness (2 points), speech impairment (1 point), neither (0 points)			
	Duration of symptoms: <10 minutes (0 points), 10-59 minutes (1 point), ≥60 minutes (2 points)			
	History of diabetes: No (0 points), yes (1 point)			
	Dual symptoms within 1 week: No (0 points), yes (2 points)			
	Imaging:			
	MRI DWI positive: No (0 points), yes (2 points)			
	CT angiography with ipsilateral ≥50% ipsilateral stenosis: No (0 points), yes (2 points)			

Abbreviations: ABCD2 = age, blood pressure, clinical, diabetes, duration; DWI = diffusion-weighted imaging.

availability of observation units.¹⁶ The principles of rapid triaging these patients also consists of identifying those with disabling deficits who cannot be safely discharged to their current living environment, and those whose diagnostic evaluation cannot be performed as an out-patient. An important principle in the rapid triage and assessment of TIA patients is that care should be provided by specialist stroke services within 24 hours without barriers to care. A transient ischemic stroke clinic with round-the-clock access (SOS-TIA) study demonstrated the feasibility of rapid access TIA clinics with a 90-day stroke risk of only 1.24% (95% confidence interval 0.72–2.12), whereas the rate predicted by the ABCD2 score was 5.96%.¹⁷

Figure Algorithm to triage patients with mild stroke

Rapid assessment within a specialized TIA clinic is feasible and can significantly reduce the risk of recurrent stroke, an effect that appears to be driven mainly by detection of atrial fibrillation and major arterial stenosis.

Some reports suggest that stroke education and patient compliance with treatment may be improved with inpatient hospitalization. However, instituting systems in the emergency room such as dispensing medications in the hospital and patient education performed by emergency room staff¹⁸ can also improve patient compliance with medications and reduce readmission rates. In addition, a discussion with the patient about the new stroke diagnosis, stroke recurrence risk, and outpatient vs inpatient diagnostic evaluation may further help triage patients with nondisabling deficits.

Therefore the concept of outpatient clinical evaluation and vessel imaging can be achieved with collaborative effort of health care providers in the emergency department along with the outpatient neurologists or vascular neurologists who will facilitate evaluating patients with minor stroke on an urgent basis.

Triaging based on symptoms

It is essential to perform a full neurologic examination in patients with minor stroke to identify those with disabling deficits not captured on the NIHSS that may influence the ability to be safely discharged home with expedited (<24-hour) stroke diagnostic workup. Those with ataxia and gait imbalance may benefit from admission and evaluation by rehabilitation services to assess ambulation and appropriateness for inpatient vs outpatient rehabilitation. In addition, patients who have dysphagia require an inpatient swallowing evaluation by a speech pathologist to ensure their swallowing mechanism is intact.

Triaging based on risk of neurologic deterioration

The ABCD2 score is used to risk stratify patients with TIA into 3 categories: low risk (0–3), intermediate risk (4–5), and high risk (6–7). This has been shown to predict the early risk of

stroke in patients with TIA and perhaps determine who may benefit from inpatient evaluation and who may potentially undergo an outpatient evaluation. The cost-effectiveness of this approach is uncertain. Moreover, the ABCD2 fails to identify patients with symptomatic severe carotid stenosis¹⁹ where early carotid endarterectomy or carotid artery stenting is the mainstay of treatment. These scores have not been widely studied in patients with minor stroke and thus the risk factors of early stroke recurrence and neurologic deterioration in this patient population are not as well known. However, given that the early risk of stroke and neurologic deterioration is highest in patients with large artery atherosclerosis, patients with minor stroke should be evaluated with extracranial and intracranial vascular imaging with ultrasound, CT angiography, or magnetic resonance angiography within 24 hours to exclude such conditions.^{20,21} Inpatient hospitalization for a diagnostic evaluation and initiation of stroke prevention strategies may be considered under these conditions: imaging reveals intracranial or extracranial atherosclerosis $\geq 50\%$ stenosis accounting for the patient's symptoms, the patient's deficits are fluctuating, or if the diagnostic evaluation cannot be done rapidly as an outpatient. If vessel imaging does not reveal a symptomatic vascular stenosis, and the patient is otherwise medically stable to be discharged, a rapid access clinical evaluation by a neurologist or 24-hour stay in an observation unit to complete the diagnostic evaluation may be considered.

Is an urgent outpatient evaluation cost-effective?

In patients with TIA, there is evidence to support the cost-effectiveness of outpatient evaluation. In one study, hospitalization of patients with TIA yielded only an additional 0.00026 quality-adjusted life-years (QALYs) with an additional cost of \$5,573 per patient and \$21,434,615/QALY²²; $< \$50,000/\text{QALY}$ is considered cost-effective. Another study demonstrated that inpatient treatment of patients with TIA and a 24-hour risk of recurrent stroke of more than 5% was a cost-effective approach yielding $< \$50,000/\text{QALY}$.²³ These studies, however, included patients with TIA for whom thrombolytic therapy could be offered in cases of early recurrent events. Thrombolytic therapy is not routinely offered for an early recurrent stroke after a minor stroke (based on the potential/debatable contraindication of recent ischemic stroke). In addition, measures to improve cerebral perfusion such as blood pressure augmentation with IV fluids or pressors in certain patients and hyperacute endovascular treatment could be performed if neurologic deterioration occurs that may help improve the outcome of patients. The cost-effectiveness of inpatient hospitalization of minor stroke remains uncertain.

CONCLUSION

Outpatient evaluation of patients with nondisabling minor stroke may reduce the inpatient hospitalization cost after excluding large artery atherosclerosis and ensuring a rapid access outpatient evaluation. Larger studies on the cost-effectiveness and safety of this approach are necessary.

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Shadi Yaghi: literature review, planning, and manuscript preparation. Joshua Willey: literature review, planning, and manuscript critique. Pooja Khatri: manuscript critique, planning, and supervision.

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