

Guidelines for management of Acute Ischemic Stroke

These guidelines are taken from the American Stroke Association for the management of acute ischemic stroke and are adapted for our use at the Alaska Native Medical Center. [1]

Definition

The American Stroke Association has recently reviewed the definitions of stroke and TIA and made the following recommendation. [2]

TIA: a transient episode of neurological dysfunction caused by focal brain, spinal cord, or retinal ischemia, without acute infarction.

Ischemic Stroke: infarction of central nervous system tissue.

These new definitions of stroke and TIA take into consideration findings on imaging that suggest the arbitrary definitions of symptoms lasting less than 24 hours are TIA and symptoms lasting more than 24 hours stroke, are not accurate. Often in patients with symptoms lasting more than an hour but less than 24 hours have increased signal on MRI DWI suggesting the presence of infarction. Therefore, in patients presenting to the hospital beyond the 4.5 hour time window to use tPA, MRI is the preferred imaging modality. CT should still be used for patients being considered for tPA treatment.

TIA

The ABCD² score is a risk assessment tool designed to improve the prediction of short-term stroke risk after a transient ischemic attack (TIA). The score is optimized to predict the risk of stroke within 2 days after a TIA, but also predicts stroke risk within 90 days. The ABCD² score is calculated by summing up points for five independent factors.

Risk Factor	Points
Age ≥ 60 years	1
Blood pressure Systolic BP ≥ 140 mm Hg OR Diastolic ≥ 90 mm Hg	1
Clinical features of TIA (choose one) Unilateral weakness with or without speech impairment OR Speech impairment without unilateral weakness	2 1
Duration TIA duration ≥ 60 minutes TIA duration 10-59 minutes	2 1
Diabetes	1
Total ABCD ² Score	0-7

Higher ABCD² scores are associated with greater risk of stroke during the 2, 7, 30, and 90 days after a TIA (Figure). The authors of the ABCD² score made the following recommendations for hospital observation: [3]

ABCD ² Score	2-day Stroke Risk	Comment
0-3	1.0%	Hospital observation may be unnecessary without another indication (e.g. new atrial fibrillation)
4-5	4.1%	Hospital observation justified in most situations
6-7	8.1%	Hospital observation worthwhile

Evaluation

- Initial Evaluation: Prompt initial evaluation (within 12h); evaluation completed within 48 hours
- Hospitalization: Should be considered to facilitate early therapy and secondary prevention
- Lab testing: Full blood count, serum electrolytes and creatinine; fasting blood glucose and lipids
- Electrocardiography: Recommended within 48 hours
- Brain imaging study: CT or MRI within 48 hours
- Vascular imaging: Carotid imaging, CT or MR angiography, or transcranial Doppler within 48 hours

Medical Management

- Antithrombotic Therapy
 - Atherothrombotic TIA: Daily long-term antiplatelet therapy: combination extended-release dipyridamole plus aspirin (reasonable as first choice), clopidogrel, or aspirin alone. Anticoagulation is not recommended
 - Cardioembolic TIA: Long-term anticoagulation for atrial fibrillation (continuous or paroxysmal). If patient intolerant to anticoagulation, aspirin 325 mg daily; clopidogrel 75 mg daily if intolerant to aspirin.
- Hypertension: Lower blood pressure to <140/90 mm Hg or <130/80 mm Hg for diabetics, with an ACE inhibitor alone or in combination with a diuretic, or with an angiotensin-receptor blocker
- Lipids: Initiate a daily statin. Goal LDL-cholesterol level <2.59 mmol/l (<100mg/dl)
- Smoking: Initiate a cessation program
- Diabetes: Fasting blood glucose goal <126mg/dl
- Physical activity: Recommend ≥10 min of exercise such as walking, bicycling, running, or swimming ≥3 times/week

Surgical Management

- Carotid endarterectomy: Preferably within 2 weeks of cerebral or retinal TIA in those with TIA attributed to a high-grade internal carotid artery stenosis:
 - 70-99% internal carotid artery stenosis: Recommended
 - 50-69% stenosis: Recommended for certain patients
 - <50% stenosis: Not recommended
- Bypass surgery: Not recommended

Stroke

1. Stroke patients should be treated as a critically ill patient. This does not imply that every stroke patient should be admitted to the intensive care unit. Patients who are awake with mild symptoms can be managed appropriately in an acute care bed. The following should be considered in each patient with an acute ischemic stroke:

- Stabilize ABC's
- Secondary assessment of neurologic deficits & co-morbidities
- Consider stroke mimics:

Conversion Disorder	Lack of cranial nerve findings, neuro findings in non-vascular distribution, inconsistent exam
Hypertensive Encephalopathy	Headache, delirium, significant hypertension, symmetric cerebral edema.
Hypoglycemia	History of Diabetes Mellitus, low serum glucose, diminished level of consciousness.
Complex Migraine	History of similar events, preceding aura, headache.
Seizure	History of seizures, witnessed seizure, postictal period.

2. History

- Document time of symptom onset and description of symptoms. In the case a patient wakes with symptoms, time of onset is assumed when patient woke, but patient is not to be considered for tPA.
- Document vascular risk factors: Prior stroke, TIA, coronary artery disease, hypertension, diabetes mellitus, hyperlipidemia, use of tobacco, alcohol and family history of stroke or heart disease.
- Document NIH Stroke Scale

3. Diagnostic studies for all patients:

- Blood sugar, electrolytes, CBC including platelet count, PT and PTT
- ECG
- Non-contrast CT if patient arrives within 4 hours of symptom onset, otherwise non-contrast MRI.

4. Diagnostic studies for select patients:

- Markers for cardiac ischemia (symptoms of angina or abnormal ECG)
- Hepatic function tests
- Toxicology screen

- Blood alcohol level
- Pregnancy test
- ABG if hypoxia is suspected
- Chest X-ray if lung disease is suspected
- Lumbar puncture if SAH is suspected and CT scan is negative for blood
- EEG if seizure is suspected

General Management

- Airway support and ventilator assistance for patients with decreased consciousness or bulbar dysfunction causing compromised airway.
- Oxygen for hypoxic patients to keep O2 saturation $\geq 92\%$.
- Treat fever
- Cardiac monitoring to (screen for atrial fibrillation) for 24 hours
- Cautious management of sustained hypertension (systolic BP > 185, diastolic BP > 110).
- Correct hypovolemia with normal saline. Avoid IV fluid containing glucose.
- Maintain normoglycemia.

NIH Stroke Scale [4]

Item	Score	Response
1.a. Level of Consciousness	0 1 2 3	<ul style="list-style-type: none"> • Alert, keenly responsive • Not alert, arousable by minor stimulation to obey, answer, respond • Not alert, requires repeated or painful stimulation to attend • Responds only with reflex motor or autonomic effects, or totally unresponsive, flaccid, areflexic
1.b. LOC Questions	0 1 2	<ul style="list-style-type: none"> • Answers both correctly • Answers one correctly • Incorrect
1.c. LOC Commands	0 1 2	<ul style="list-style-type: none"> • Obeys both correctly • Obeys one correctly • Incorrect
2. Best Gaze	0 1 2	<ul style="list-style-type: none"> • Normal • Partial gaze palsy. Gaze abnormal in one or both eyes, but forced deviation or total gaze paresis not present • Forced deviation or total gaze paresis not overcome by oculocephalic maneuver
3. Best Visual	0 1 2 3	<ul style="list-style-type: none"> • No vision loss • Partial hemianopia • Complete hemianopia • Bilateral hemianopia (blind, including cortical blindness)
4. Facial Palsy	0 1 2 3	<ul style="list-style-type: none"> • Normal symmetrical movement • Minor paralysis (flattened NLF, asymmetry on smiling) • Partial paralysis (total or near-total paralysis of lower face) • Complete (absence of movement in upper and lower face)
5. Best Motor Arm	0 1 2 3 4 U	<ul style="list-style-type: none"> • No drift, limb holds 90° (or 45°) for full 10 seconds • Drift; limb holds 90° (or 45°) but drifts down before full 10 seconds; does not hit bed or other support • Some effort against gravity; limb cannot get to or maintain (if cued) 90° (or 45°), drifts down to bed • No effort against gravity; limb falls • No movement • Amputation, joint fusion (Unstable)
6. Other Arm	0-4	(Use same scale as above)
7. Best Motor Leg	0 1	<ul style="list-style-type: none"> • No drift, limb holds 90° (or 45°) for full 10 seconds • Drift; limb holds 90° (or 45°) but drifts down before full 10 seconds; does not

	2	hit bed or other support
	3	• Some effort against gravity; limb cannot get to or maintain (if cued) 90° (or 45°), drifts down to bed
	4	• No effort against gravity; limb falls
	U	• No movement • Amputation, joint fusion (Untestable)
8. Other Leg	0-4	(Use same scale as above)
9. Limb Ataxia	0	• Absent
	1	• Present in 1 limb
	2	• Present in 2 limbs
10. Sensory	0	• Normal; no sensory loss
	1	• Mild to moderate sensory loss; patient feels pinprick is less sharp or is dull on the affected side; or loss of spervicial pain but patient is aware of being touched
	2	• Severe to total sensory loss; patient is not aware of being touched
11. Neglect	0	• No neglect
	1	• Visual, tactile, auditory, spatial or personal inattention or extinction to bilateral simultaneous stimulation in 1 of the sensory modalities
	2	• Profound hemi-inattention or hmi-inattention to >1 modality. Does not recognize own hand or orients to only 1 side of space
12. Dysarthria	0	• Normal
	1	• Mild to moderate; patient slurs at least some words and, at worst, can be understood with some difficulty
	2	• Sever; patient's speech is so slurred as to be unintelligible in the absence of or out of propotion to any dysphasia, or is mute/anarthric
	U	• Intubated or other physical barrier (Untestable)
13. Best Language	0	• No aphasia, normal
	1	• Mild to moderate aphasia; some obvious loss of fluency or facility of comprehension, without significant limitation on ideas epressed or form of expression. Reduction of speech and/or comprehension, however, makes conversation about provided material difficult or impossible.
	2	• Severe aphasia; all comunication is through fragmentary expression; great need for inference, questioning, and guessing by the listener. Range of information that can be exchanged is limited; listener carries burden of communication. Examiner cannot identify materials provided from patient's response.
	3	• Mute, global aphasia; no usable speech or auditory comprehension

Other Considerations

Intravenous Thrombolysis

Using IV thrombolytics for ischemic stroke is controversial. The NINDS study suggested that 8/18 stroke patients who receive tPA according to a strict protocol will recover by 3 months with minimal disability. This is compared with 6/18 who receive no therapy. However, 1/18 patients bled into the brain, and when this happened, almost half of them died. The drug has been studied and is FDA approved for administration within 3 hours of symptom onset. Some centers are starting to use tPA between 3-4.5 hours in certain populations. Favorable outcome is better in patients with mild to moderate strokes (NIHSS < 22) and age less than 75 years. Risk of symptomatic hemorrhage is 6.4%

Inclusion Criteria

- Diagnosis of ischemic stroke causing measurable neurological deficit
- The neurological signs should not be clearing spontaneously
- The neurologic signs should not be minor and isolated, i.e. NIHSS < 4
- Caution should be used in treating a patient with major deficits, i.e. NIHSS >22

- Symptoms of stroke should not be suggestive of subarachnoid hemorrhage
- Onset of symptoms <3 hours before beginning treatment, though tPA administration can be considered up to 4.5 hours in select cases with these additional exclusions:
 - age <80 years old
 - not on anticoagulants
 - no history of stroke and diabetes
- No head trauma or prior stroke in previous 3 months
- No myocardial infarction in the previous 3 months
- No GI or urinary tract hemorrhage in previous 21 days
- No major surgery in the previous 14 days
- No arterial puncture at a noncompressible site in the previous 7 days
- No history of previous intracranial hemorrhage
- Blood pressure <185 mm Hg systolic and <110 mm Hg diastolic
- No evidence of active bleeding or acute trauma (fracture) on examination
- If taking anticoagulant (warfarin), INR ≥ 1.7
- If heparin received in the past 48 hours, aPTT must be in normal range.
- Platelet count $\geq 100,000$ mm³
- Blood glucose ≥ 50 mg/dl
- No seizure with postictal residual neurological impairments
- CT does not show a multilobar infarction (hypodensity is $> 1/3$ cerebral hemisphere)
- The patient or family members understand the potential risks and benefits from treatment (consent is not required as this treatment is the standard of care for acute ischemic stroke).

tPA Protocol

- Infuse 0.9 mg/kg (max dose 90 mg) over 60 minutes with 10% of the dose given as a bolus over 1 minute.
- Admit to patient to the ICU for monitoring
- Neuro checks every 15 minutes during the infusion and every 30 minutes thereafter for the next 6 hours, then hourly until 24 hours after treatment.
- If the patient develops severe headache, acute hypertension, nausea, or vomiting, discontinue tPA infusion (if still being infused) and obtain an emergency CT scan.
- Measure blood pressure every 15 minutes for the first 2 hours and subsequently every 30 minutes for the next 6 hours, then hourly until 24 hours after treatment.
- Increase the frequency of blood pressure measurements if a systolic blood pressure is ≥ 180 mm Hg or if a diastolic blood pressure is ≥ 105 mm Hg: administer antihypertensive medications to maintain blood pressure at or below these levels.
- Delay placement of nasogastric tubes, indwelling bladder catheters, or intr-arterial pressure catheters.

- Obtain a follow-up CT scan at 24 hours before starting anticoagulants or antiplatelet agents.

Anticoagulation

The results of the recent trials show that early administration of either heparin or a LMW heparin/danaparoid has not shown a benefit in reducing morbidity or mortality in acute ischemic stroke and is associated with an increased risk of bleeding complications. Anticoagulation should be reserved for cases of cardioembolic stroke, arterial wall dissection and hypercoagulable strokes. Anticoagulant therapy should also be avoided within 24 hours of treatment with tPA.

Antiplatelet Agents

The oral administration of aspirin (initial dose is 325 mg) within 24 to 48 hours after stroke is recommended for treatment of most patients.

Endovascular Interventions

The area of endovascular treatment of patients with acute ischemic stroke shows great promise. A number of techniques and devices are being studied. Already, the FDA has approved one device to extract a thrombus from an occluded intracranial artery. Other devices likely will be approved in the future. Emergency angioplasty also may achieve a role in management. As with the intra-arterial administration of thrombolytics, the use of these devices will be limited to those comprehensive stroke centers that have the resources and physician expertise to perform these procedures safely. Because of the relatively low population in Alaska, there is not sufficient volume of cases to maintain physician expertise here. Furthermore, transport of potential cases to a high volume center such as Swedish Neurosciences or Harborview Medical Center would delay this sort of treatment beyond the treatment widow. Therefore, endovascular interventions on our patients in Alaska are not recommended at this time.

Hospitalization and General Acute Treatment

Approximately 25% of patients may have neurological worsening during the first 24 to 48 hours after stroke. The goals of treatment after admission to the hospital are to:

1. Observe for changes in the patient's condition that might prompt initiation of medical or surgical interventions,
2. Facilitate medical or surgical measures aimed at improving outcome after stroke,
3. Begin measures to prevent subacute complications,
4. Plan for long-term therapies to prevent recurrent stroke,
5. Start efforts to restore neurologic function through rehabilitation and good supportive care.

This includes, but is not limited to:

- Use of stroke order sets on admission to improve general management,

- Early mobilization of less severely affected patients and measures to prevent subacute complications of stroke,
- Assessment of swallowing before starting eating or drinking,
- Treatment of suspected pneumonia or urinary tract infections with antibiotics,
- Subcutaneous administration of anticoagulants, or use of external compression devices for patients who cannot receive anticoagulants, in immobilized patients to prevent deep vein thrombosis,
- Treatment of concomitant medical diseases,
- Early institution of interventions to prevent recurrent stroke,
- Patients who cannot take food and fluids orally should receive nasogastric or PEG feedings to maintain hydration and nutrition while undergoing efforts to restore swallowing,
- If possible, the placement of indwelling bladder catheters should be avoided because of the associated risk of urinary tract infections.

Treatment of Acute Neurological Complications

Patients with major infarction affecting the cerebral hemisphere or cerebellum are at high risk for complicating brain edema and increased intracranial pressure. These patients should be monitored in the ICU for signs of neurological worsening during the first days after stroke. Patients with acute hydrocephalus secondary to an ischemic stroke most commonly affecting the cerebellum can be treated with placement of a ventricular drain. Decompressive surgical evacuation of a space-occupying cerebellar infarction is a potentially life-saving measure, and clinical recovery may be very good. Recurrent seizures after stroke should be treated with an anticonvulsant. Decompressive surgery for malignant edema of the cerebral hemisphere may be life-saving, but the impact of morbidity is unknown. Both the age of the patient and the side of the infarction may affect decisions about surgery. Medical measures may delay Decompressive surgery. Physicians should advise the patient's family about the potential outcomes, including survival with severe disability.

Palliative Care

Unfortunately, some patients with stroke have a fatal brain injury. These critically ill persons have profound neurological impairments such as a persistent vegetative state or evidence of unstable vital signs. Other patients with stroke have serious preexisting medical or neurological illnesses, such as dementia, that have caused severe impairments, and the new cerebrovascular event may add more disability. Despite the interventions that are described in this outline, the prognosis of such patients often is very poor. Many people would not want to survive if a devastating stroke would lead to a persistent vegetative state or other condition of devastating incapacity.

An increasing number of patients have advanced directive statements that provide instructions about emergency treatment in a situation such as a massive stroke. Physicians should honor those directives. In other circumstances, such

directives may not be available, and the patient's neurological status usually precludes decision making. Occasionally, a guardian with medical power of attorney can make the decision. Otherwise, the physician should involve family members. The physician should provide clear information about the nature of the stroke, the prognosis, and the treatment options. The family should be given the opportunity to select or withhold medical interventions. In such situation, the medical care may emphasize measures to keep the patient comfortable and to support the family during the terminal aspects of the stroke.

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