

Assessment and Management of Stroke

In the United States, stroke is the fifth leading cause of death and the leading cause of disability (Centers for Disease Control and Prevention [CDC], 2023). Early identification, evaluation and treatment of stroke reduces motor and cognitive deficits and lowers mortality. Use this nursing pocket card to assist in the identification and treatment of stroke.

Types of Stroke and Risk Factors

There are two types of stroke, both of which result in a reduction of oxygen delivered to the brain.

- **Ischemic Stroke** – Occurs when blood supply to part of the brain is blocked by a thrombus (blood clot) or by a narrowing of the artery from atherosclerosis. Major causes include arterial thrombus, venous emboli that migrate, atrial fibrillation, arteritis, and patent foramen ovale. Less commonly, ischemic stroke can occur from severe hypotension and hypoperfusion caused by left ventricular dysfunction, large loss of blood, and refractory septic shock.
- **Hemorrhagic Stroke** – Occurs when there is bleeding into the brain tissue (intracerebral hemorrhage) or bleeding between the inner and outer layers of tissue covering the brain (subarachnoid hemorrhage). Intracerebral hemorrhages (ICH) are typically caused by a rupture of the vessels due to long-term atherosclerotic damage and arterial hypertension. Other mechanisms include bleeding diatheses, iatrogenic anticoagulation, cerebral amyloidosis, and cocaine abuse.
- **Transient Ischemic Attack (TIA)** or “mini-stroke” occurs when there is a temporary disruption of blood flow to the brain that causes a brief episode of neurologic dysfunction. The symptoms typically last less than one hour and mimic those of a stroke, including slurred speech, visual changes, extremity weakness, or changes in level of consciousness (LOC).

Common Risk Factors for Stroke (National Institute for Health, 2023)

- High blood pressure
- Diabetes
- Coronary artery disease, atrial fibrillation, heart valve disease, and carotid artery disease
- High low-density lipoprotein (LDL) cholesterol levels
- History of TIA, previous stroke, or myocardial infarction
- Smoking
- Brain aneurysm or arteriovenous malformations (AVMs)
- Infections or conditions that cause inflammation such as lupus or rheumatoid arthritis
- Age – risk increases with age
- Ethnicity (Black, Hispanic, Alaska Native, American Indian)
- Substance abuse or alcoholism
- Gender (men more at risk at younger age, but women have higher lifetime risk)
- Family history and genetics

Signs and Symptoms of Stroke

Cardinal signs of stroke such as sudden motor and sensory deficits include:

- Facial droop
- Hemiparesis
- Unilateral extremity weakness
- Slurred speech

Additional signs and symptoms:

- Sudden-onset dizziness (vertigo)
- Loss of coordination or balance
- Gait disturbances
- Vision loss in one or both eyes
- Expressive or receptive aphasia
- Visuospatial neglect: inability to report, respond, or orient to stimuli, generally on the opposite side of the lesion

Signs of thrombosis of the basilar artery:

- Acute onset quadriparesis (muscle weakness of all four limbs)
- Loss of consciousness
- Respiratory failure

Stroke Assessment Tools

The National Institute of Neurological Disorders and Stroke (NINDS) recommends using a specific stroke assessment tool. Examples include:

- **Cincinnati Prehospital Stroke Scale (CPSS)** – commonly used by emergency medical services (EMS) and paramedics. The American Hospital Association (AHA) and the NINDS promote educating the community on these symptoms and to notify emergency services (FAST).
 - **F**acial droop: one side of the face does not move at all
 - **A**rm drift: one arm drifts compared with the other
 - **S**peech: the patient uses slurred or inappropriate words, or is mute
 - **T**ime to call 911
- **National Institutes of Health Stroke Scale (NIHSS)** – the preferred assessment tool, the NIHSS identifies the severity of ischemic stroke by assessing 11 areas including LOC, eye gaze, visual fields, facial palsy, motor arm (drift), motor leg (drift), limb ataxia, sensation, language, aphasia/dysarthria, and inattention. An NIH stroke scale should be administered and scored when stroke is suspected, 24 hours after fibrinolytic therapy, 7 days post-stroke, and 30 days post-stroke. The NIHSS is the preferred stroke scale and the total score (0 to 42) correlates to stroke outcome (Filho & Mullen, 2022):
 - Less than 5: mild
 - Between 5 and 9: moderate
 - Greater than or equal to 10: severe

Emergency Department (ED) Triage

When a stroke is suspected, early interventions are critical to improving outcomes.

- Ensure medical stability with airway, breathing, and circulation.
- Determine if signs and symptoms are consistent with stroke and if onset of symptoms is within the 3-hour timeframe for treatment with alteplase [intravenous tissue plasminogen activator (tPA)].
 - Time of onset is defined as the time the patient was last known to be neurologically normal.
 - In a select group of patients, the treatment window may be extended to 3-4.5 hours of last known neurologically normal time.

The Golden Hour

The AHA and American Stroke Association (ASA) developed the 60-minute or less stroke protocol with a goal of intervention within 60 minutes upon arrival to the ED.

Time	Plan
Time Zero	Arrival to the Emergency Department (ED).
10 Minutes	Patient seen by ED physician for initial assessment.
15 Minutes	Patient seen by stroke team.
25 Minutes	Non-contrast computed tomography (CT) scan performed.
45 Minutes	CT scan results available to stroke team and decision made for treatment.
60 Minutes	Door-To-Needle (DTN): Fibrinolytic therapy initiated within 3 hours of time last known well, unless contraindicated (up to 4.5 hours in selected patients) <ul style="list-style-type: none"> ● Administer IV fibrinolytic therapy in eligible patients. ● Carefully lower blood pressure (BP) below 185/110 mm Hg before IV fibrinolytic therapy.

Physical Exam

In addition to a thorough neurological assessment and use of stroke assessment tools, important components of the physical exam include:

- Inspect chest wall movement and observe the respiratory rate, respiratory effort, and skin color for cyanosis.
- Inspect head and extremities for signs of trauma.
- Auscultate heart for irregular rhythm and abnormal rate and murmurs.
- Auscultate carotid arteries for bruits.
- Auscultate lungs for adventitious breath sounds.
- Inspect skin for ecchymoses and evidence of surgery or other invasive procedures.

Diagnostic Studies

Laboratory and diagnostic tests should NOT delay the initiation of fibrinolytic therapy if stroke is suspected (Powers et al., 2018).

Test	Indication
Non-contrast Head CT	<ul style="list-style-type: none"> ● Preferred study at most centers due to widespread availability and rapid scan times ● Rule out intracranial hemorrhage or non-stroke lesions. Identify the degree of ischemic brain injury. ● Identify the vascular lesion responsible for the ischemic attack.
CT Angiography (CTA) Head CT Perfusion	<ul style="list-style-type: none"> ● Identify patients with large vessel occlusion who may benefit from endovascular intervention ● Can be obtained concurrently with non-contrast head CT
MRI with diffusion weighted imaging	<ul style="list-style-type: none"> ● Superior to non-contrast CT for the very early detection of acute ischemia and the exclusion of some conditions that mimic stroke. ● MRI can be used as the only imaging method in select centers with sufficient MRI availability for the evaluation of suspected stroke patients who do not have MRI contraindications. ● Limitations: Not readily available at most centers for the acute evaluation of patients with stroke; MRI in practice is more limited by patient contraindications or intolerance than CT; MRI is a longer study and may delay the administration of alteplase. ● There is no data to show that MRI is superior to CT for selecting patients who could be treated with intravenous thrombolysis.
Oxygen saturation (O2 sat)	<ul style="list-style-type: none"> ● Rule out acute ischemic stroke associated with hypoxemia.
Fingerstick blood glucose	<ul style="list-style-type: none"> ● Rule out hypoglycemia and hyperglycemia. <i>Serum glucose is the only lab test that must be measured before IV fibrinolytic therapy is started unless there is strong clinical suspicion for contraindication.</i>
Complete blood count (CBC)*	<ul style="list-style-type: none"> ● Check red blood cells (RBC), white blood cells (WBC), and platelets.
Coagulation studies*	<ul style="list-style-type: none"> ● Check prothrombin time (PT), activated partial thromboplastin time (aPTT), international normalized ratio (INR), Ecarin clotting time (ECT), thrombin time, direct factor Xa assay.

	<i>Note: INR, aPTT, and platelets may be needed if coagulopathy is suspected, however fibrinolytic therapy should not be delayed while waiting for results.</i>
Cardiac biomarker*	<ul style="list-style-type: none"> ● Check troponin level to rule out myocardial infarction (MI).
Electrocardiogram (ECG)*	<ul style="list-style-type: none"> ● Rule out acute MI and atrial fibrillation.
Basic metabolic panel [†]	<ul style="list-style-type: none"> ● Check serum electrolytes, blood urea nitrogen (BUN), and creatinine.
Blood alcohol & toxicology [†]	<ul style="list-style-type: none"> ● Include liver panel for patients with suspicion of alcohol intoxication.
Arterial blood gas (ABG) [†]	<ul style="list-style-type: none"> ● Assess for hypoxemia.
Pregnancy test [†]	<ul style="list-style-type: none"> ● Assess women of child-bearing potential.
Chest X-ray [†]	<ul style="list-style-type: none"> ● Assess for suspected lung disease or injury.
Electroencephalogram [†]	<ul style="list-style-type: none"> ● Rule out ongoing seizures.
Lumbar puncture [†]	<ul style="list-style-type: none"> ● Rule out suspected subarachnoid hemorrhage when brain imaging is negative (lumbar puncture will preclude IV fibrinolytic therapy, which should not be given if there is a suspicion for subarachnoid hemorrhage).
Urinalysis [†]	<ul style="list-style-type: none"> ● Indicated if fever is present to check for infectious source.
Blood cultures [†]	<ul style="list-style-type: none"> ● Indicated if fever is present to check for infectious source.
Type and cross match [†]	<ul style="list-style-type: none"> ● Perform as needed if transfusion of blood products is anticipated.

*Should NOT delay fibrinolytic therapy.

[†]May be appropriate for select patients (Filho & Mullen, 2022)

Medications

Alteplase

- A tissue plasminogen activator [tPA], which is a natural enzyme that initiates fibrinolysis (breaks down thrombus). [See [NursingCenter Pocket Card: Alteplase Injection for Acute Ischemic Events](#)] (Powers et al., 2019)
- Used in patients who can be treated within 3-4.5 hours of ischemic stroke symptom onset or last known baseline state.
- 0.9 mg/kg (not to exceed 90 mg) by IV infusion over 60 minutes with 10% of total dose given as initial bolus over 1 minute.
- Benefit of therapy is time-dependent; treatment should be initiated as quickly as possible and not delayed for additional multimodal neuroimaging, such as CT and MRI perfusion imaging.
- Patients with mild, nondisabling stroke symptoms (NIHSS score 0-5) should not receive IV alteplase.
- Patients who are eligible for IV alteplase should receive it even if mechanical thrombectomy is being considered.

Tenecteplase (Powers et al., 2019)

- Single IV bolus of 0.25 mg/kg, maximum 25 mg may be a reasonable alternative to IV alteplase for patients eligible for mechanical thrombectomy who have no contraindications.
- Single IV bolus of 0.4 mg/kg may be considered as an alternative to alteplase in patients with minor neurological impairment and no major intracranial occlusion.

Heparin

- Used for an acute stroke during mechanical thrombectomy, when administering intraarterial alteplase, and in the presence of large, intraluminal thrombotic or embolic filling defect of the major cerebral arteries.

Furosemide (Lasix)

- Loop diuretic used to reduce intracranial fluid volume in hemorrhagic stroke and to decrease the risk of herniation.

Mannitol

- Osmotic diuretic used to decrease cerebral edema, tissue damage and reduce the risk of herniation.

Fosphenytoin

- Antiepileptic drug that stabilizes neuronal membranes and decreases seizure activity.

Phenytoin

- Antiepileptic drug used to inhibit the spread of seizure activity in the cerebral motor cortex and brainstem centers responsible for the tonic phase of grand mal seizures.

Antiplatelet treatment (Powers et al., 2019):

- Administer aspirin within 24 to 48 hours after stroke onset. For patients that have been treated with alteplase, delay aspirin until 24 hours following therapy after repeat CT head without contrast is performed and negative for acute hemorrhage.
- In patients with minor non-cardioembolic ischemic stroke (NIHSS score is 3 or less) who do not receive IV fibrinolytic therapy, aspirin plus clopidogrel, started within 24 hours after symptom onset and continued for 21 days, can reduce recurrent ischemic stroke risk for up to 90 days.
- Aspirin is **not** recommended as a substitute for acute stroke treatment in patients who are eligible for IV fibrinolytics or mechanical thrombectomy.
- Abciximab (IV glycoprotein IIb/IIIa inhibitor) as a treatment for AIS may be harmful and should be avoided.
- Ticagrelor is **not** recommended over aspirin to treat minor acute stroke.

Anticoagulant

- Urgent anticoagulation, with the goal to prevent recurrent stroke or neurological worsening after AIS, is **not** recommended.
- The following have **not** been proven safe or useful to treat AIS (Powers et al., 2019):
 - Short-term anticoagulation for nonocclusive extracranial intraluminal thrombus in the setting of AIS
 - Argatroban, dabigatran, or other thrombin inhibitors
 - Oral factor Xa inhibitors

Surgical Procedures

For acute ischemic stroke

Endovascular thrombectomy: mechanical removal of the thrombus to reestablish blood flow

- Can be performed up to 24 hours after symptom onset (Filho & Mullen, 2022)
- Treats thrombus in minutes versus alteplase which may take hours to dissolve the clot
- Effective in large cerebral vessels, but not in smaller arterial cerebral vessels
- Do not delay mechanical thrombectomy to observe a clinical response after IV fibrinolytics
- Maintain BP less than or equal to 180/110 mmHg during and for 24 hours after the procedure (Powers et al., 2019)

For hemorrhagic stroke

- Superficial temporal artery to middle cerebral artery bypass graft: the graft bypasses the cerebral vessel that has the thrombus or unruptured aneurysm (may also treat ischemic stroke)
- Guglielmi detachable coils: small platinum coils are used to occlude an inoperable, ruptured, or unruptured aneurysm
- Aneurysm clipping: surgical clips may be placed to seal bleeding from a fusiform aneurysm (ruptured or unruptured) or multiple small vessel aneurysms

Nursing Interventions for the Stroke Patient (Powers et al., 2018)

- Support airway, breathing, and circulation
 - Provide supplemental oxygen to maintain oxygen saturation greater than 94% in hypoxic patients; not recommended in nonhypoxic patients.
 - Ventilator support for respiratory depression, fatigue, decreased consciousness, or a compromised airway (GCS less than 8)
- Monitor vital signs at least every 15 minutes initially, as directed by your facility.
- Head of bed flat in ischemic stroke as tolerated for 24 hours.
- Neurologic assessments should be performed hourly and as needed.
 - Monitor for signs of brain stem herniation (increased intracranial pressure, decreased strength in extremities, focal or global seizure activity, or asymmetrical pupils.)
 - Monitor for seizure activity and implement seizure precautions.
 - Do not administer anti-seizure medication prophylactically unless indicated.
- Treat hyperthermia (temperature greater than 38 degrees Celsius) with antipyretic medications.
- Treat hyperglycemia to keep blood glucose levels between 140-180 mg/dL and treat hypoglycemia (blood glucose less than 60 mg/dL), as directed by your facility.
- Hypotension and hypovolemia should be corrected to support organ function (Powers et al., 2019) and to prevent secondary brain injury.
 - Administer fluids for volume depletion; individualize for patients' cardiovascular status, electrolyte disturbances, and other conditions that may disturb fluid balance (Filho & Mullen, 2022).
 - Isotonic saline without dextrose is recommended, (normal saline preferred)
 - Hypotonic fluids may exacerbate cerebral edema as they may cause hyponatremia
 - Fluids containing dextrose may aggravate hyperglycemia.
 - High-dose albumin is not recommended to treat AIS.
 - The following are **not** recommended to treat AIS (Powers et al., 2019):
 - Vasodilatory agents, such as pentoxifylline
 - Devices to mechanically augment cerebral blood flow
- Treat hypertension early when comorbid conditions are present, such as concomitant acute coronary event, acute heart failure, aortic dissection, postfibrinolysis subarachnoid hemorrhage (SAH), or preeclampsia/eclampsia (Powers et al., 2019).
 - If BP greater than or equal to 220/120 mm Hg in patients who did not receive IV fibrinolytics or mechanical thrombectomy and with no comorbid conditions requiring urgent treatment, lower BP by 15% during the first 24 hours after onset of stroke (Powers et al., 2019).
 - Post fibrinolytic treatment, BP should be maintained below 180/105 mm Hg for at least the first 24 hours.
 - Avoid hypertension in patients with hemorrhagic stroke to prevent expansion of intracranial bleeding.
 - Avoid rapidly lowering BP which can lead to worsening ischemia.
- If surgery is performed, assess the patient for the following and if present, notify the

health care team immediately:

- Surgical puncture site hematoma or signs of infection, such as localized edema and erythema.
- Change in vital signs such as tachycardia, hypo- or hypertension, and elevated temperature.
- Neurologic changes (decreased LOC, visual changes, new-onset weakness), which may indicate extension of the stroke area, cerebral vasospasm, or cerebral brainstem herniation.

Strategies to Minimize Post-Procedure Complications

- Ensure the patient remains NPO to prevent aspiration immediately post-procedure.
- Implement oral hygiene protocols to reduce the risk of pneumonia after stroke.
- Unless contraindicated, keep the head of bed elevated to 30 degrees for patients at risk for increased intracranial pressure, aspiration, cardiopulmonary decompensation, or oxygen desaturation.
- Start or restart antihypertensive therapy during hospitalization in neurologically stable patients with BP greater than 140/90 mmHg to improve long-term BP control, unless contraindicated.

Nutrition (Powers et al., 2019)

- Start enteral feedings within 7 days of admission after an acute stroke.
- Screen for dysphagia with speech therapy consultation before the patient begins eating, drinking, or receiving oral medications to identify risk for aspiration.
- For patients with dysphagia, use nasogastric tubes for feeding in early phase of stroke (first 7 days); percutaneous gastrostomy tube may be needed if unable to swallow safely for longer than 2-3 weeks.
- Consider nutritional supplements for patients who are at risk for malnourishment.

Venous thromboembolism (VTE) Prophylaxis (Isida, 2024)

- The approach to VTE prophylaxis differs according to the type of stroke involved.
 - Acute ischemic stroke approach
 - If treated with thrombolytic therapy, intermittent pneumatic compression (IPC) should be started on admission but delay anticoagulation until 24 hours after IV thrombolysis
 - If not treated with thrombolytic therapy, start IPC on admission and low-dose heparin (low molecular weight or unfractionated) if not being treated with dual antiplatelet therapy (DAPT).
 - If on DAPT use IPC alone and avoid pharmacologic VTE prophylaxis.
 - If on oral anticoagulation, use IPC alone and avoid pharmacologic VTE prophylaxis unless during an interval when oral anticoagulation has been stopped.
 - Intracerebral hemorrhage stroke approach
 - IPC alone is recommended and should be started on admission
 - Subarachnoid hemorrhage stroke approach

- IPC should be started on admission
- Low-molecular-weight or unfractionated heparin may be added after aneurysm has been treated if patient remains immobile.

Additional Recommendations (Powers et al., 2018)

- Screen for post-stroke depression and administer antidepressants if not contraindicated.
- Avoid routine use of indwelling bladder catheters to prevent catheter-associated urinary tract infections.
- Perform regular skin assessments during hospitalization and inpatient rehabilitation. Minimize skin friction and pressure; provide support surfaces; avoid excessive moisture; and maintain nutrition and hydration to prevent skin breakdown. Regular turning, good skin hygiene, special mattresses, wheelchair cushions, and seating should be used until mobility returns.
- Antithrombotic treatment
 - In non-embolic stroke, use antiplatelet agent in place of oral anticoagulation to reduce risk of recurrent stroke.
 - For most patients with atrial fibrillation and stroke, it is reasonable to begin oral anticoagulation within 4-14 days after onset of neurological symptoms.
 - For patients with extracranial carotid or vertebral artery dissection, it is reasonable to treat with antiplatelet or anticoagulant therapy for 3 to 6 months.
- Continue statin therapy for patients taking statins or initiate in-hospital high-intensity statin therapy for patients who qualify.
- Routine use of prophylactic antibiotics is not beneficial (Powers et al., 2019).
- Initiate early rehabilitation for hospitalized stroke patients; facilitate and prioritize physical and occupational therapy evaluations and assist with implementation of treatment plans
 - Encourage family participation in occupational and physical therapy sessions at therapist discretion
- High-dose, very early mobilization within 24- hours of stroke onset should **not** be performed as it may impact outcomes at 3 months.
- When revascularization is indicated for secondary prevention in patients with minor, non-disabling stroke, the procedure may be performed between 48 hours and 7 days after the stroke.
- Advise every patient to quit smoking and provide counseling and high-intensity behavioral therapies in-hospital.
- Provide patients with stroke education, information, and the opportunity to talk about the impact of illness on their lives.
- Refer patients and families to palliative care resources as needed.

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