CEREBROVASCULAR ACCIDENT (CVA)

(STROKE, BRAIN ATTACK)

Stroke, **CVA**, or **brain attack** is the onset & persistence of neurologic dysfunction lasting > 24 hours & result from disruption of blood supply to brain & indicates infarction than ischemia. Strokes are classified as **ischemic** (> 70% of strokes) or **hemorrhagic** (associated with greater morbidity & mortality). About 14% of strokes in USA are of ***cardiac origin***. About 60% of hemorrhagic strokes result of ***hypertension***. Stroke is the leading cause of long-term disability and the 3rd leading cause of death in the USA, with an annual incidence of 700,000.

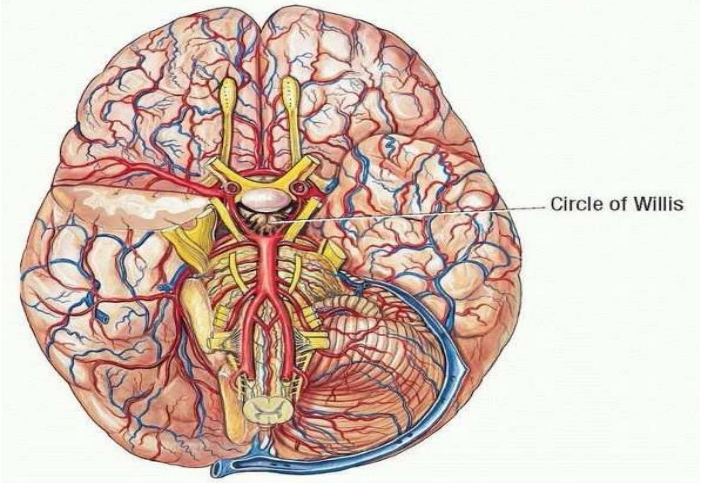


FIGURE (1) The Circle of Willis as seen at the base of a brain removed from the skull.

Pathophysiology and Etiology

A. Ischemic Stroke

- **Partial or complete occlusion** of a cerebral blood flow to an area of the brain due to:
  - **Thrombus** (most common): due to arteriosclerotic plaque in a cerebral artery.
  - **Embolus**: a moving clot of cardiac origin or from a carotid artery that travels quickly to the brain and lodges in a small artery; occurs suddenly.
- **Area of brain affected** is related to the occluded vascular territory. Subtle decrease in blood flow may allow brain cells to maintain minimal function, but as blood flow decreases, focal areas of ischemia occur, followed by infarction.
- An area of injury includes edema, tissue breakdown, and small arterial vessel damage. The small arterial vessel damage poses a risk of hemorrhage.
- **Ischemic strokes** are not activity dependent; may occur at rest.

NURSING ALERT: Early detection of warning signs promotes early diagnosis and intervention aimed at lessening mortality and morbidity.

B. Hemorrhagic Stroke

- Leakage of blood from a blood vessel and hemorrhage into brain tissue, causing ***edema***, ***compression of brain tissue***, and ***spasm of adjacent blood vessels***.
- May occur (**extradural**), (**subdural**), or within the brain substance (**intracerebral**).

- **Causal** mechanisms include:
  - **Increased pressure** due to hypertension.
  - **Head trauma** causing dissection or rupture or vessel.
  - **Deterioration of vessel wall** from chronic hypertension, DM, or cocaine use.
  - **Congenital weakening of blood vessel wall** with aneurysm or malformation.
- **The intracranial hemorrhage** becomes a space-occupying lesion within the skull and **compromises brain function**.
  - The mass effect causes **pressure on brain tissue**.
  - The hemorrhage irritates local brain tissue leading to surrounding **focal edema**.
  - SAH or hemorrhage into a ventricle **can block normal CSF flow ➔ hydrocephalus**.
- Hemorrhage commonly occurs suddenly while a person is active.

Clinical Manifestations

- Clinical manifestations vary depending on the vessel affected and the cerebral territories it perfuses. Symptoms are usually multifocal. Headache may be a sign of impending cerebral hemorrhage or infarction; however, it is not always present.
- **Common clinical manifestations** related to vascular territory (Table 15-5, page 507).
  - Numbness (paresthesia), weakness (paresis), or loss of motor ability (plegia) on one side of the body.
  - Difficulty in swallowing (dysphagia).
  - Aphasia (nonfluent, fluent, global).
  - Visual difficulties of inattention or neglect (lack of acknowledgment of one side of sensory field), loss of half of visual field (hemianopsia), double vision, photophobia.
  - Altered cognitive abilities and psychological affect.
  - Self-care deficits.

Diagnostic Evaluation

- **Carotid ultrasound**: to detect carotid stenosis in ischemic stroke.
- **CT scan**: determine cause, location & type of stroke, ischemic versus hemorrhagic.
- **MRA or CT angiogram**: noninvasive evaluation of cerebrovascular structures.
- **Cerebral angiography**: invasive evaluation cerebrovasculature to determine the extent of cerebrovascular injury/insufficiency & to evaluate structural abnormalities.
- **PET, MRI with DWIs**: to localize ischemic damage in ischemic stroke.
- **TCD**: noninvasive to evaluate cerebral perfusion. Useful in bedside evaluation and to provide a means for ongoing monitoring of cerebral blood flow.

TABLE (1) Stroke Deficits Related to Vascular Territory

CEREBRAL ARTERY	BRAIN AREA INVOLVED	SIGNS AND SYMPTOMS*
Anterior cerebral	Infarction of medial aspect of one frontal lobe if lesion is distal to communicating artery;	Paralysis of contralateral foot or leg; impaired gait; paresis of contralateral arm; contralateral sensory loss over toes, foot, & leg; problems making decisions or

	bilateral frontal infarction if flow in other anterior cerebral artery is inadequate	performing acts voluntarily; lack of spontaneity, easily distracted; slowness of thought; urinary incontinence; cognitive and affective disorders
Middle cerebral	Massive infarction of most of lateral hemisphere & deeper structures of the frontal, parietal, and temporal lobes; internal capsule; basal ganglia	Contralateral **hemiplegia** (face & arm); contralateral sensory impairment; aphasia; homonymous hemiplegia; altered consciousness (confusion to coma); inability to turn eyes toward paralyzed side; denial of paralyzed side or limb (hemiattention); possible acalculia, alexia (visual aphasia), finger agnosia & left-right confusion; vasomotor paresis & instability
Posterior cerebral	Occipital lobe; anterior and medial portion of temporal lobe	Homonymous hemianopia and other visual defects, such as color blindness, loss of central vision, & visual hallucinations; memory deficits; perseveration (repeated performance of verbal or motor response)
	Thalamus involvement	Loss of all sensory modalities; spontaneous pain; intentional tremor; mild hemiparesis; aphasia
	Cerebral peduncle involvement	Oculomotor nerve palsy with contralateral hemiplegia
Basilar & vertebral	Cerebellum and brain stem	Visual disturbance such as diplopia, dystaxia, vertigo, dysphagia, dysphonia
* Dependent on hemisphere involved and adequacy of collaterals.		

Management

Acute Treatment

Ischemic Stroke

- ★ **Support of vital functions**—maintain airway, breathing, oxygenation, circulation.
  - ☆ Maintain pulse oximetry greater than 92%. Utilize oxygen therapy as needed.
  - ☆ Arrythmias are common. Telemetry may be indicated to monitor. Atrial fibrillation most common arrythmias in stroke population.
- ★ **Astute neurologic assessment** utilizing the National Institute of Health Stroke Scale (www.ninds.nih.gov/doctors/nih/ stroke scale booklet.pdf) & management of ⇧ICP (see page 492).
- ★ **I.V. fluids** (normal saline) at maintenance until able to tolerate oral diet. Colloids and volume expanders (albumin) may be used for reperfusion and hemodilution.
- ★ **Maintain BP** within prescribed parameters. Limit BP fluctuations.
  - ☆ Management of **systemic hypertension** with **labetalol**, nicardipine, or alternative I.V. antihypertensive agents **to keep systolic BP (SBP) less than 200 mm Hg**. Goal is to promote adequate cerebral perfusion to prevent further ischemia. **Avoid lowering BP greater than 25%** within ***first 24 hours***. Hyperglycemia and BP fluctuations or rapid increases in BP increase the risk of hemorrhagic conversion.
  - ☆ **Management of hypotension**: SBP goal > 100. Vasopressor agents to maintain SBP within prescribed range.
  - ☆ **Pretreatment** with **tissue plasminogen (tPA)**: unable to receive tPA if SBP > 185 mm Hg or diastolic BP > 110 mm Hg.
  - ☆ **Post-tPA**: maintain SBP < 180 mm Hg or diastolic BP < 105 mm Hg.

- ★ **Thrombolytic therapy** (see Box 15-2, page 508).
  - ☆ **I.V. recombinant tPA** is the only FDA-approved treatment for acute ischemic stroke. **Dosing**: I.V. 0.9 mg/kg ***within 3 hours*** of onset of symptoms.
  - ☆ **Transarterial tPA** within **6 hours** of onset of symptoms.

    Advantages include:
    - ✓ Higher concentration delivered to clot
    - ✓ Can be performed in conjunction with mechanical disruption of clot
    - ✓ Provides precise imaging of pathology and evaluation of collateral circulation
    - ✓ Defines extent of injury and recanalization

    Disadvantages include:
    - ✓ Risk of hemorrhage related to catheter manipulation
    - ✓ Dislodgement of clot
    - ✓ Delay in thrombolytic therapy due to access delays
    - ✓ Limited facility-based accessibility
  - ☆ **Additional treatment options** (transarterial or endovascular)
    - ✓ ***Abciximab*** (RePro): antiplatelet agent delivered intra-arterially
    - ✓ ***Verapamil***: potent vasodilator injected intracranial vessel to treat acute spasm
    - ✓ ***Clot retrieval*** or manipulation of clot.
    - ✓ ***Angioplasty & stenting*** utilized in acute dissection, though data are limited
- ★ **Maintain normal glucose** levels ➔ hyperglycemia is associated with a poor outcome. Insulin drip should be given to maintain blood sugar at 80-140 mg/dL.
- ★ **Maintain normothermia**: Studies in animal models have demonstrated that ***mild hypothermia*** is neuroprotective through reduction of focal hypoxia.
- ★ **Deep vein thrombosis prophylaxis**: stockings & low dose heparin should be utilized.
- ★ Focus on **early rehabilitation**.

Inclusion and Exclusion Criteria for tPA Therapy

INCLUSION

- ★ Onset of symptoms (- Within 3 hours I.V. tPA - Within 6 hours I.A. tPA)
- ★ Ischemic stroke with measurable deficits using the NIH stroke scale (see page 507)
- ★ No hemorrhage noted on CT scan of brain
- ★ Clearly defined time of symptom onset

EXCLUSION

- ★ Head CT demonstrates early signs of infarction or hemorrhage
- ★ Uncontrolled hypertensive nonresponsive to I.V. or oral agent (SBP >185 or DBP >110)
- ★ Glucose level > 400 mg/dL
- ★ Coagulopathy (- Heparin within past 48 hours - Patient on warfarin)
- ★ History of previous intracranial hemorrhage, head trauma, or stroke in past 3 months
- ★ GI or genitourinary tract hemorrhage in the past 3 weeks
- ★ History of major surgery in the past 2 weeks

Acute Treatment

Hemorrhagic Stroke

- ★ **Support of vital functions**: maintain airway, breathing, oxygenation, circulation.
  - ☆ Maintain pulse oximetry greater than 92%. Utilize oxygen therapy as needed.
  - ☆ Arrythmias are common. Telemetry may be indicated to monitor.
  - ☆ I.V. fluids (normal saline) at maintenance until able to tolerate oral diet.
- ★ **Neurologic assessment**: use NIHSS or general neurologic assessment tool is adequate. Notify physician of clinical deterioration related to rebleed or cerebral edema
- ★ **Reversal of coagulopathies**:
  - ☆ ***Obtain patient's medication history***, concerned Medications include warfarin, aspirin, clopidogrel (Plavix), ticlopidine (Ticlid) & dipyridamole/aspirin (Aggrenox).
  - ☆ Obtain International Normalized Ratio (***INR) & platelet function analyzer*** (PFA-100). Elevated INR is associated with warfarin use. PFA epinephrine > 164 denotes platelet dysfunction related to aspirin use and PFA adenosine diphosphate > 116 denotes nonaspirin platelet dysfunction.
  - ☆ As ordered, treat with platelets, cryoprecipitate, or vitamin K to reverse coagulopathy. Novo 7 (factor VII) may used for rapid reversal.
- ★ **Management of BP within prescribed parameters**: maintain SBP < 160 to reduce vessel wall stressors. Goal is to prevent rebleeding while promoting adequate cerebral perfusion. Labetalol, nicardipine, or alternative I.V. antihypertensive agents may used.
- ★ **Neurosurgical consultation** for possible evacuation of intracerebral hemorrhage.
- ★ **Prophylactic treatment of seizures** with phenytoin (Dilantin). Seizures commonly occur within the first 24 hours of intracerebral hemorrhage.
- ★ **Maintain normal glucose level** because hyperglycemia is associated with a poor outcome. Insulin drip should be given to ***maintain blood sugar at 80 to140 mg/dL***.
- ★ **Maintain normothermia:** hyperthermia ➔ poor neurologic outcome. Studies in animal demonstrated mild hypothermia is neuroprotective (reduce of focal hypoxia).
- ★ **Deep vein thrombosis prophylaxis**: stockings & low-dose heparin should be utilized.
- ★ **Focus on early rehabilitation.**

Subsequent Treatment

- ★ **Anticoagulation**: instituted after hemorrhage is ruled out. Anticoagulation is **contraindicated** for the **first 24 hours** in patients who **received tPA**.
- ★ **Aspirin**: is ***recommended within 24 - 48 hours poststroke***. Alternative antiplatelet agents include ticlopidine, dipyridamole/aspirin 200/25, and clopidogrel.
- ★ **Antispasmodic agents** can be used for ***spastic paralysis***.
- ★ **A rehabilitation program**, including ***physical therapy***, ***occupational therapy***, and ***speech therapy*** (as soon as stable), and ***counseling as needed***.
- ★ **Depression:** early initiation of antidepressants, as serotonin reuptake inhibitors.

Complications

1. Dysphagia in 25% to 50% of patients after stroke	2. Aspiration pneumonia
3. Deep vein thrombosis, pulmonary embolism	4. Spasticity, contractures
5. Brain stem herniation	6. Poststroke depression

Nursing Assessment

- ★ ***Maintain neurologic flow sheet*** (Modified Rankin scale or NIH Stroke Scale).
- ★ ***Assess for voluntary or involuntary movements***, tone of muscles, presence of deep tendon reflexes (reflex return signals end of flaccid period and return of muscle tone).
- ★ Also assess mental status, cranial nerve function, sensation/proprioception.
- ★ Monitor bowel and bladder function/control.
- ★ Monitor effectiveness of anticoagulation therapy.
- ★ Frequently assess level of function and psychosocial response to condition.
  - ☆ Assess for skin breakdown, contractures, and other complications of immobility.

DRUG ALERT: Oral anticoagulants are adjusted to maintain an INR at 2 to 3 to prevent associated with atrial fibrillation. Monitor for potential complications of intracranial & subdural hemorrhage. Report INRs that are elevated to reduce risk of bleeding or ↓ levels.

Nursing Diagnoses

1. **Risk for Injury** RT neurologic deficits
2. **Impaired Physical Mobility** RT motor deficits
3. **Disturbed Thought Processes** RT brain injury
4. **Impaired Verbal Communication** RT brain injury
5. **Self-Care Deficit**: Bathing, Dressing, Toileting RT hemiparesis/paralysis
6. **Imbalanced Nutrition**: Less Than Body Requirements RT impaired self-feeding, chewing, swallowing
7. **Impaired Urinary Elimination** RT motor/sensory deficits
8. **Disabled Family Coping** RT, cognitive & behavioral sequelae of stroke & care burden

NURSING ALERT: Case management models of care foster interdisciplinary utilization, timeliness of referrals, patient education, satisfaction, & efficient use of health care resources. Nurse role in recovery integrates therapeutic aspects of coordinating, maintaining, & training.

Nursing Interventions

1)Preventing fall and Other Injuries

1. ***Bed rest*** during (1st 24-48 hours), ***elevate head of bed*** slightly & ***side rails*** in place.
2. ***Administer oxygen, as ordered***, during acute phase to maximize cerebral oxygenation.
3. Frequently ***assess respiratory status***, ***vital signs***, ***HR & rhythm***, and ***urine output***.
4. ***Maintain frequent vigilance*** & ***interactions*** to orient, assess, & meeting patient needs.
5. ***Calm reassurance*** and ***presence*** to ***allay confusion*** and ***agitation***.
6. ***Assess patient for risk for fall status***.

2)Preventing Complications of Immobility

Functional recovery requires patient's active participation & repetitive training. Functional demand and intensive training trigger CNS reorganization & recovery after stroke.

a. Maintain functional position of all extremities.

1. Apply a ***trochanter roll*** from ilium crest to midthigh to prevent hip external rotation.
2. Place ***pillow in affected side axilla*** to keep arm away & prevent shoulder adduction.
3. Place ***affected upper extremity slightly flexed*** on pillow with each joint positioned higher than preceding one to prevent edema & fibrosis; alternate elbow extension.
4. Place the ***hand in slight supination*** with ***fingers slightly flexion***.
5. Avoid excessive pressure on ball of foot after spasticity develops.
6. ***Do not allow top bedding*** to pull affected foot into plantar flexion (use tennis shoes)
7. Put patient in ***prone position for 15 - 30 minutes daily*** & avoid long sitting in chair.
8. Encourage ***neutral positioning of affected limbs*** to promote relaxation and to limit abnormal increases in muscular tone to enhance functional recovery.
9. ***"Forced use"*** to overcome nonuse of hemiparetic upper extremity.
10. ***"Constraint-induced movement therapy"*** restricts contralateral upper extremity in effort to force use of the affected arm.

b. Apply splints and braces, as indicated, to support flaccid extremities or on spastic extremities to decrease stretch stimulation and reduce spasticity.

1. Volar splint to support functional position of wrist
2. Sling to prevent shoulder subluxation of flaccid arm
3. High-top sneaker for ankle and foot support

c. **Exercise affected extremities passively through ROM 4-5 times daily to maintain joint mobility & enhance circulation; encourage active ROM exercise.**

d. Teach patient to use unaffected extremity to move affected one.

e. Assist with ambulation, as needed, with help of physical therapy as indicated.

1. ***Check for orthostatic hypotension***	**2.** Assess patient for ***excessive exertion***.
3. ***Gradually position patient*** (***reclining ➔head elevated ➔ dangle legs)*** before ***transferring*** out of bed or ***ambulating***; assess **sitting balance in bed**.	
4. Have patient ***wear walking*** or tennis ***shoes***.	**5.** ***Provide rest periods*** (tire easily).
6. ***Assess standing balance***, and have patient ***practice standing***.	
7. Begin ambulating when standing balance is achieved; ensure safety with waist belt.	

3)Optimizing Cognitive Abilities

1. Be aware of patient's cognitive alterations & ***adjust interaction & environment***
2. Participate in cognitive retraining program—***reality orientation***, ***visual imagery***, ***cueing procedures***—as outlined by rehabilitation nurse or therapist.
3. ***Use pictures of family members***, ***clock***, ***calendar***; ***post schedule of daily activities***.
4. ***Focus on patient's strengths***, and give ***positive feedback***.
5. Be aware of depression, include psychotherapy & early antidepressant initiation

4)Facilitating Communication

1. ***Speak slowly***, ***using visual cues*** & ***gestures***; be consistent, & repeat as necessary.
2. ***Speak directly to the patient while facing him***.
3. Give plenty of time for response, and reinforce attempts as well as correct responses.
4. Minimize distractions.
5. Use alternative methods of communication as ***written words***, ***gestures***, or ***pictures***.

5)Fostering Independence

1. ***Teach use nonaffected side*** for activities of daily living, ***do not neglect affected side***.
2. **Adjust** environment ***to awareness side***; **approach** patient ***from uninvolved side***.
3. Teach the patient to scan environment if visual deficits are present.
4. Provide ***clothing size larger than patient wears***, with ***front closures***, stretch fabric
5. Keep personal care items ***nearby*** (urinal & commode), ***provide assistance as needed***.
6. Be aware that ADLs require ***anticipatory*** (automatic coordination of multiple muscle in anticipation of specific movement) & ***reactive*** (adjustment of posture to stimuli).
7. Patients usually have goals to functional abilities, against which all success & forward progress will be measured; ***help them set realistic short- & long-term goals***.

6)Promoting Adequate Oral Intake

1. Perform a bedside swallow screen. Follow institutional protocol. If any coughing or difficulties are noted, contact speech therapy for official consult.
2. Initiate ***referral for speech therapist*** for compromised level of consciousness (LOC), dyspraxic speech, or speech difficulties to evaluate swallowing radiographically or at bedside to demonstrate safe & functional swallowing mechanisms before oral diet.
3. Help the patient ***relearn swallowing sequence*** using compensatory techniques.
   - ☆ Place ice on tongue and encourage sucking.
   - ☆ Progress to ice pops and soft foods.
   - ☆ Make sure mechanical soft or pureed diet is provided, based on ability to chew.
4. Encourage small, frequent meals, & allow time to chew & swallow & consults dietician.
5. Remind the patient to ***chew on unaffected side***.
6. Encourage patient to ***drink small sips from a straw*** with ***chin tucked*** to the chest.
7. ***Inspect mouth for food collection*** & ***pocketing*** before entry of new bolus of food.
8. ***Inspect oral mucosa for injury*** from biting tongue or cheek.
9. Encourage ***frequent oral hygiene***.
10. Teach family how to assist the patient with meals to facilitate chewing and swallowing.

☆ Provide oral care before & after eating.	☆ Reduce environmental distractions.
☆ Position patient (sitting with 90^0 of flexion at hips & 45^0 of flexion at the neck.	
☆ Maintain position for 30-45 minutes after meals prevent regurgitation & aspiration.	

7)Attaining Bladder Control

1. Assist with standing or sitting to void (especially males).
2. Catheter in acute stage for accurate fluid management; remove as soon as possible.

3. Establish regular voiding schedule: every 2 - 3 hours. If unable to void, use intermittent catheterization. Bladder scan device is useful in monitoring bladder capacity.
4. See page 533 for bladder retraining program details.

8)Strengthening Family Coping

1. Encourage the family to maintain outside interests.
2. Teach stress management techniques, as relaxation exercises, use of support networks.
3. Encourage participation in support group for family respite program for caregivers.
4. Involve as many family and friends in care as possible.
5. Provide information about stroke and expected outcome.
6. Teach family that stroke survivors may show depression in first 3 months of recovery.

9)Community and Home Care Considerations

1. Hemiplegic complications resulting from stroke commonly include “frozen” shoulder; adduction and internal rotation of arm with flexion of elbow, wrist, and fingers; external rotation of the hip with flexion of the knee and plantar flexion of the ankle.
2. Perform & instruct patient & family on ROM exercises as well as proper positioning.
3. Reinforce that these muscle and ligament deformities resulting from stroke can be prevented with daily stretching and strengthening exercises.
4. Depression after stroke is a major problem because it can increase the morbidity. Monitor for signs of depression, such as difficulty sleeping, frequent crying, anorexia, feelings of guilt or sadness. Notify health provider for possible medication therapy.
5. Continue to support family at home or in long-term care for a long time. Six months after stroke, around 9% to 21% of survivors are disabled, and fully dependent.

10) Patient Education and Health Maintenance

1. Teach the patient and family to adapt home environment for safety and ease of use.
2. Instruct the patient of the need for rest periods throughout day.
3. Reassure family; stroke patients experience emotional lability & depression
4. Encourage consistency in the environment without distraction.
5. Assist the family to obtain self-help aids for the patient.
6. Instruct the family in management of aphasia.
7. Educate those at risk for stroke about lifestyle modifications and medication therapy.
8. Refer the patient and family for more information and support to such agencies.

Evaluation: Expected Outcomes

1. Maintains body alignment, no contractures	
2. No falls, vital signs stable	3. Oriented to person, place, & time
4. Family seeks help and assistance from others	5. Communicates appropriately
6. Voids on commode at 2-hour intervals	7. Feeds self two-thirds of meal
8. Brushes teeth, puts on shirt and pants independently	