CVA

Cerebrovascular Accident
Stroke
Brain Attack

Stroke

• ...is defined as sudden onset of neurological dysfunction resulting from abnormality in cerebral circulation (ischemic or hemorrhagic lesions in the brain)

Terminology

• Paralysis: unable to move or feel (or both), all or part of the body
• Hemiplegia: paralysis on one side of the body
• Hemiparesis: weakness on one side of the body
• Paresthesias: a sensation on the skin, like tingling, prickling, creeping
CVA Categories

- **Etiologic**
  - thrombosis, embolus, hemorrhage

- **Management**
  - transient ischemic attack (TIA), minor stroke, major stroke, etc

- **Anatomic**
  - specific vascular area

Thrombus vs. Embolus

- DO NOT OVERTHINK this

- **Thrombus** originates in the body part that is damaged (i.e. cerebral artery)

- **Embolus** had to travel to get to the body part that is damaged

Epidemiology

- CVA is the third leading cause of death in the U.S.
- And the most common cause of adult disability
Epidemiology

- Incidence increases dramatically with age
- Only 20% of CVAs occur in individuals under the age 65
- Incidence has declined steadily over the past 30 years

Etiologic Categories

- Ischemic
- Hemorrhagic

Etiologic Categories: Ischemic

- Lack of blood flow & oxygen to the brain
- Can be caused by
  - (1) Cerebral thrombosis: blood clot (thrombus) within the cerebral arteries or their branches
    - Lead to ischemia with resulting infarction (tissue death)
Etiologic Categories

- **(2) Cerebral embolus:** bits of matter (thrombi, fat, air) that travel through the bloodstream to the cerebral arteries where they produce an occlusion and infarction
  - associated with CV disease

Etiologic Categories: Hemorrhagic

- **Hemorrhage:** abnormal bleeding due to a ruptured vessel. Tissue death results from both ischemic and mechanical injury.
  - intracerebral hemorrhage, subarachnoid hemorrhage

Hemorrhagic Stroke
Hemorrhagic Stroke

Risk Factors for Stroke

- Hypertension
- Heart disease
- Diabetes
**Stroke Prevention**

- Preventable with modifiable risk factors
  - Regulate blood pressure
  - Dietary adjustments
  - Cessation of smoking
  - Exercise and weight control
  - Control of diabetes and heart disease
  - Improving public awareness of early warning signs of stroke

**Signs & Symptoms**

![SPOT A STROKE](image)

**Beyond F.A.S.T. – Other Symptoms You Should Know**

- Sudden numbness or weakness of the leg, arm or face
- Sudden confusion or trouble understanding
- Sudden trouble seeing in one or both eyes
- Sudden trouble walking, dizziness, loss of balance or coordination
- Sudden severe headache with no known cause
Anatomy of Blood Flow

- Internal carotids divide into the
  - anterior cerebral artery via anterior communicating artery
  - middle cerebral artery via posterior communicating artery

Anatomy of Blood Flow

- Vertebral arteries join together to form the Basilar artery
- Basilar artery divides into
  - posterior cerebral artery
  - cerebellar arteries (3 pairs)
Anatomy of Blood Flow

- Circle of Willis: comprised of
  - anterior, middle, and posterior cerebral arteries
  - anterior and posterior communicating arteries

Clinical relevance: the artery involved determines the area of infarct…

which results in the variety of signs and symptoms associated with CVAs
  - Martin & Kessler p 284, Table 10-1
Transient Ischemic Attack (TIA)
- often labeled “mini-stroke”
- more accurately characterized as a “warning stroke:
- Should be taken very seriously

Stroke Syndromes
- **Anterior Cerebral Artery Syndrome**
  - contralateral weakness and sensory loss, primarily in LE’s
  - aphasia
  - Incontinence
  - May have significant memory deficits, loss of behavioral inhibition
  - May see neglect, aphasia, apraxia & agraphia

Stroke Syndromes
- **Middle Cerebral Artery Occlusion**
  - most common
  - contralateral sensory loss and weakness in face and UE, less in LE
  - Spastic hemiparesis
  - homonymous hemianopsia
  - Perceptual deficits: unilateral neglect, apraxia, and spatial disorganization
  - Wernicke’s aphasia in dominant hemisphere
  - Flat affect in right hemisphere
  - Impaired body schema (next slide)
Impaired Body Schema

- The term Body Scheme refers to a postural model of the body, including the relationship of body parts to each other and the relationship of the body to the environment.
- This body awareness relies on tactile & proprioceptive sensations.
- It is considered one of the essential foundations for the performance of all purposeful motor behavior.
- Unilateral neglect, somatoagnosia, finger agnosia, anosognosia.

Stroke Syndromes

- **Vertebral-Basilar Artery occlusion**
  - Loss of consciousness
  - Hemiplegia or tetraplegia
  - Headache, dizziness, ataxia
  - Cranial nerve involvement
  - Locked in syndrome
    - Inability to speak
    - Alert
    - Vertical eye movement intact

Treating Locked In Syndrome

- There is no cure for locked-in syndrome, nor is there a standard course of treatment.
- Neuromuscular stimulation may help activate some paralyzed muscles.
- Several devices to help communication are available.
- Other treatment is symptomatic and supportive.
Stroke Syndromes

- **Posterior Cerebral Artery occlusion**
  - contralateral sensory loss
  - thalamic pain syndrome
  - memory deficit
  - homonymous hemianopsia
  - visual agnosia
  - cortical blindness

- **Lacunar Infarct**
  - deep region of the brain
  - common in diabetes and hypertension
  - results in a cystic cavity after the infarct
  - sensory loss
  - ataxia
  - dysarthria

Other Stroke Syndromes

- **Thalamic pain syndrome**
  - Intolerable burning pain and sensory perseveration

- **Pusher syndrome** (R CVA/ L hemiplegia)
  - Absent/impaired tactile & kinesthetic awareness
  - Visual deficits
  - Truncal asymmetries
  - Increased weight bearing on the Left
  - Difficulties with transfers (pushing away with the uninvolved side)
  - [http://www.youtube.com/watch?v=HO8BT6vznLU](http://www.youtube.com/watch?v=HO8BT6vznLU)
Left Hemispheric Specialization

- Language
- process verbal language
- understand language
- produce written/spoken language
- Analytical
- controlled
- logical
- rational
- sequence and perform movements
- math calculations
- express positive emotion

Characteristics of CVA
Left Hemisphere Involvement

- Weakness, paralysis of right side
- Increased frustration
- Decreased processing
- Possible aphasia
- Possible dysphagia
- Possible motor apraxia
- Decreased discrimination between R & L
- Right hemianopsia

Right Hemispheric Specialization

- Nonverbal processing
- process info holistically
- artistic
- General concept comprehension
- Hand-eye coord
- spatial skills
- kinesthetic awareness
- understands music
- nonverbal commun
- body image
- express negative emotion
Characteristics of CVA
Right Hemisphere Involvement

- Weakness, paralysis of left side
- Decreased attention span
- Left hemianopsia
- Decreased awareness & judgment
- Left inattention
- Emotional lability
- Impulsive behaviors
- Decreased spatial orientation
- Memory deficits

Direct Impairments

- **Sensation**: frequently impaired, rarely absent.
- Type and extent of deficit depends on location and extent of the lesion.
- Proprioceptive loss common
- Profound hemisensory loss can lead to…

Direct Impairments

- **Pain**
  - CVA can result in severe headache, neck or face pain
  - Thalamic Pain Syndrome
  - Pain due to secondary impairments
Direct Impairments

Visual deficits
- homonymous hemianopsia: common; blindness on nasal half of one eye and temporal half of the other. Named by the side of the defect which corresponds to the affected side (R CVA = L hemianopsia, L hemiplegia)

Is Homonymous Hemianopsia reversible?
- Over the years it has become clear that patients may improve spontaneously.
- Visual field defects of vascular origin, the prognosis for spontaneous recovery is poor.
- Any recovery of a complete hemianopsia occurs in the first 10 days after which further recovery is unlikely.
- Recovery of a partial defect is usually maximal within the first 48 hours.
- Less than 10% of patients recover their full field, and a proportion of these will, nevertheless, continue to complain about their visual function because of coexisting parietal lobe involvement.
- Up to 50% show spontaneous regression of varying degrees.

Direct Impairments

Motor Deficits: several considerations:
- Sequential recovery stages:
  - Initial flaccid stage
  - Stage of spasticity
  - Stage of relative recovery
Direct Impairments

- **Motor Deficits**
- **Alterations in tone:**
  - flaccidity: usually present immediately after the CVA and short-lived
  - spasticity: emerges in 90% of the cases and occur typically in predictable patterns

Direct Impairments

- **Motor Deficits**
- **Abnormal Synergy patterns:**
  stereotypical movement patterns associated with spasticity
  - The patient is unable to move an isolated segment of a limb without producing movements in the remainder of the limb
  - 2 distinct abnormal synergy patterns have been described for each extremity

Direct Impairments

- **Motor Deficits**
- **Reflexes:** become altered and depend on the stage of recovery
  - initially, hyporeflexive
  - middle stages of recovery (spasticity/synergy), hyperreflexive
  - Primitive reflexes may re-emerge
  - Associated Reactions may be present
Direct Impairments

- **Motor Deficits**
  - Paresis: common finding. Varies considerably

Direct Impairments

- **Motor Deficits**
  - Motor programming deficits: more likely seen in patients with ____ CVA (___ hemiplegia)
    - L hemisphere responsible for sequencing movements; so L CVA results in apraxia
    - R hemisphere has a role in sustaining a movement or posture; R CVA may demonstrate an inability to sustain a movement or posture

Direct Impairments

- **Motor Deficits**
  - Postural Control & Balance Deficits
    - Balance is frequently impaired following CVA
    - Patients demo increased postural sway in standing
    - Patients with hemiplegia typically fall in the direction of weakness
Direct Impairments

- **Motor Deficits**

- **Speech and language disorders**
  - **aphasia**: general term indicating an acquired communication disorder caused by brain damage and characterized by an impairment of language comprehension, formulation, and use.
  - Occurs in up to 40% of all patients with CVAs
  - many types
  - http://www.youtube.com/watch?v=0DpflY_M

- **Dysphagia**
  - Swallowing difficulty
  - Usually delayed swallowing reflex
  - Aspiration occurs in 1/3 of patients with dysphagia

Direct Impairments

- **Motor Deficits**

- **Dysphagia**
  - Swallowing difficulty
  - Usually delayed swallowing reflex
  - Aspiration occurs in 1/3 of patients with dysphagia

Direct Impairments

- **Motor Deficits**

- **Perceptual deficits**: includes
  - visuospatial distortions: difficulty judging distance, size, position, rate of movement, form
  - disturbances in body image: distorted mental and visual images of one’s body that includes feelings about one’s body
  - unilateral neglect: patients are unaware of what happens on the hemiplegic side
Direct Impairments

- **Motor Deficits**
- **Affective Disorders**
  - Lesions in Right hemisphere
    - Impaired emotional function
  - Lesions in Left hemisphere
    - May experience frequent and severe depression

Direct Impairments

- **Motor Deficits**
- **Behavioral changes**: vary widely
  - **L CVA**: difficulty processing information in a sequential, linear manner.
    - Negative, anxious, depressed; more cautious, insecure, and uncertain
    - Realistic in appraisal of the existing problem
  - **R CVA**: difficulty in grasping the whole idea and spatial-perceptual tasks
    - Indifferent, quick, impulsive, euphoric
    - Overestimate their ability while minimizing (or denying) their problem = SAFETY CONCERNS

Secondary Impairments

- DVT
- Skin Breakdown
- Decreased flexibility
- Complex Regional Pain Syndrome (CRPS)
- Deconditioning
- Shoulder subluxation & pain
Recovery

- Fastest in the first few weeks after onset
- Most measurable neurologic recovery (90%) occurs during the first 3 months
- Functional gains continue for up to 6 months or longer (at reduced rate)
- Rates of improvement vary greatly depending on the management category (minor vs. severe)

Acute Rehabilitation

- Begins as soon as the patient is stable
- General goals:
  - maintain ROM and prevent deformity
  - Promote awareness, active movement and use of the affected side
  - improve trunk control, symmetry, and balance
  - improve functional mobility
  - initiate self-care activities
  - monitor changes associated with recovery

Acute Rehabilitation

- **Positioning:** want to stimulate the patient to turn toward and engage the affected side
  - ex. place bed so affected side faces main part of the room
  - assume upright postures ASAP
  - turning in bed to prevent pressure decubiti
Acute Rehabilitation

- **AVOID** these positions:
  - lateral flexion to the affected side
  - scapular depression & retraction, IR & add of the UE, elbow flex, FA pronation, wrist & finger flexion
  - hip retraction & elevation, hip & knee extension with hip adduction; or hip & knee flexion with hip abduction; ankle plantarflexion

- **PROMOTE** these positions:
  - supine positioning: small pillow under scapula (promotes protraction), support UE on pillow (promotes extension), pillow under pelvis (promotes anterior pelvic tilt), pillow under knee (prevents hyperextension)

- **PROMOTE** these positions:
  - lying on the sound (uninvolved) side: trunk straight; pillow under rib cage (elongates affected side); pillow under the affected UE (promotes scap protraction, elbow extension, forearm neutral or supinated); pillow under the affected LE (pelvis protracted, hip extended, knee flexed, neutral rotation)
Acute Rehabilitation

- PROMOTE these positions:
  - lying on the affected side: trunk straight; scapula protracted (with the UE well forward), elbow extended, forearm supinated; hip extended with knee flexed (alternate position: slight hip and knee flexion with pelvic protraction)

Acute Rehabilitation

- PROMOTE these positions:
  - sitting: head/trunk in midline; symmetrical WB on buttocks; hips/knees flexed to 90 degrees, feet flat; UEs resting on pillows, arm/lap board with scapula protracted and wrist/fingers in extended in a functional open position

Acute Rehabilitation

- ROM and prevention of limb trauma:
  - ROM:
    - UE: can be supported in a sling during the flaccid stage, preventing joint trauma; contraindicated in the spastic stage
    - LE: stretch plantarflexors/activate weak dorsiflexors
Acute Rehabilitation

- **Functional mobility activities:**
  - promote use of both sides rather than just the sound side
  - focus on:
    - rolling (both directions)
    - sitting up (both directions)
    - bridging
    - sitting
    - Standing
    - walking
    - and transfers

Study #1 UE TE in Acute Phase

- Single-blind RCT with 100 patients put in either a control group or the experimental group
- Experimental group received 5 days/week for 6 weeks for 30 minutes: patient in rocking chair with inflatable splint to support affected arm, shoulder in 80° flexion & slight abd, elbow ext

Study #1 UE TE in Acute Phase

- Distal splint fixed with 2 straps in a gutter. Patient rocked for 30 minutes, using affected arm to actively push backward. This contained 3 elements:
  - Motor Stimulation
  - Sensory Stimulation
  - Placement opposite of synergistic pattern
Study #1 UE TE in Acute Phase

- **Control group**: sat in rocking chair and rocked for 30 minutes with arm on cushion in lap with fake short wave therapy on the shoulder.
- **Results**: experimental group did better on Brunnstrom-Fugl-Meyer (impairment test) with statistically significant differences at follow up. No effect on tests of disability level.
- Adding the specific intervention during the acute phase s/p CVA improved motor recovery.

Postacute Rehabilitation

- Continue and modify (if necessary) the treatment activities begun in the acute phase.
- Important to monitor CV status as activities and challenges increase so as not to over-exert the patient.

Postacute Rehabilitation

- **Goals**:
  - prevent/minimize secondary complications
  - compensate for sensory and perceptual loss
  - improve postural control and balance
  - develop independent functional mobility skills
  - develop independent ADLs
  - endurance
  - encourage socialization and motivation
Postacute Rehabilitation

**Motor control training**: stress selective (out of synergy) movement patterns that allow success in functional tasks (feeding, dressing, gait)
- Stress holding or eccentric contractions before concentric ones (generates more tension; ↑muscle fiber recruitment)
- Weak muscles should be activated, first in unidirectional patterns, then progressed to slow reciprocal movements (balanced agonist/antagonist interaction is crucial for normal coordination & function)

**Postacute Rehabilitation**

- **NDT**: the patient learns to control tone & movement through the use of patterns that promote “normal” movements (out of synergy)

- **PNF**: PNF patterns are chosen and used while avoiding synergistic patterns. Emphasizes practice, repetition, and visual guidance.

**Postacute Rehabilitation**

- **Tone reduction**: many techniques
  - Elongation of spastic muscles & positioning techniques
  - Prolonged pressure
  - Slow rocking movements
  - Air splints

  - Once inhibition & ROM are achieved…
Postacute Rehabilitation

**UE Control**
- FIRST: pelvic/trunk/scapular alignment
- Early mob/ROM/positioning
- UE WBing
- Scapular protraction/elbow, finger, wrist ext
- Emphasize wrist/finger movements independent of shoulder/elbow motions

Postacute Rehabilitation

**LE Control:**
- Prepares patient for gait
- Pregait mat activities should be out of synergy and promote normal gait
- Pelvic control

Postacute Rehabilitation

**Balance**
- Once initial stability control is achieved in upright postures...
Balance study #1: sit to stand

- **RCT**: 32 subjects
- Subjects in both groups received 30 minutes of general PT 3X/week X 4 weeks.
- Subjects in experimental group received an additional 15 minutes of sit-to-stand training each time.

Results: significant improvements in directional control anteriorly and hip extensor strength for the experimental group.

Additional sit to stand training is encouraged due to effects on dynamic balance and extensor muscle strength in subjects with stroke


Balance Study #2: late after CVA

- **RCT**: 41 subjects with hemiparesis mean time after stroke (6 months)
- **Control group**: conventional stroke inpatient rehab
- **Experimental group**: 15 sessions of balance training in addition to the conventional program
Balance Study #2: late after CVA

- 3D computerized gait analysis system one week before and after the program
- Control group did not show any significant difference re: gait
- Experimental group: significant improvement in pelvic excursion in frontal plane and vertical ground reaction force

Balance Study #2: late after CVA

- Balance training using force platform biofeedback in additional to conventional stroke rehab is beneficial in improving postural control and weight bearing on the paretic side while walking late after stroke.

Postacute Rehabilitation

- **Gait training**: walking is initiated early
- Early Walking prevents…

- Movement deficiencies will vary…
Postacute Rehabilitation

- practice forward, backwards, sideways, braiding
- elevation activities
- different surfaces
- orthoses may be necessary

Gait

- If someone has UE flexor synergy, what types of A.D. would be most appropriate?

Study #1: Walking after Stroke

- A single-blind RCT with 97 participants recruited within 6 weeks of stroke onset. All participants received conventional rehab. Those randomly assigned to the control group also received overground gait training only and those assigned to the experimental group received gait training with body weight support on a treadmill.
Study #1: Walking after Stroke

- Outcomes measures used to assess the difference between the 2 groups: Motricity Index, Trunk Control Test, Barthel Index, Functional Ambulation Categories, 10-meter and 6-minute walk tests, and Walking Handicap Scale.
- Assessments done at baseline, after 20 treatment sessions, 2 weeks after treatment and 6 months after stroke.

After treatment, all patients were able to walk.
- Both groups showed improvement in all outcome measures.
- No differences were seen between the 2 groups before, during or after treatment and follow up.
  – Franceschini et al, 2009

Study #2: Walking After Stroke

- RCT: 25 subjects recruited within 90 days of stroke onset
- Both subjects received PT 5 days/week based on Bobath X 3 weeks.
- Gait training for control group: ambulate on floor surface at comfortable speed using AD, assistance and rest periods as needed.
Study #2: Walking After Stroke

- Gait training for experimental group: ambulating on treadmill, which was adjusted to the subject’s comfortable walking speed. Subjects held horizontal bar in front or at side with the PT standing next to them assisting with hip flexion and foot placement as needed.

Study #2: Walking After Stroke

- Results: treadmill training may be more effective than conventional gait training for improving some gait parameters such as functional ambulation, stride length, percentage of paretic single stance period and gastrocnemius muscle activity.
  – Laufer et al (2001)

Postacute Rehabilitation

- Functional training: variety of activities and postures can be utilized
  – getting down and up from the floor
  – varying the environment is important to ensure adaptability and generalizability
  – training in ADL is usually directed by the OT
    • must maintain open lines of communications between team members to direct the plan of care
Postacute Rehabilitation

– optimum motor learning can be achieved through:
  • demonstration at the ideal performance speed
  • manually guiding the patient through the movement
  • encouraging early active participation (affected side)

• practicing the movement on the unaffected side first
  • simultaneous practice of similar movements on both sides
  • visualization

Patient and Family Education

- Provide accurate, factual information; counsel family about the patient’s capabilities and limitations; avoid predictions
- Give only as much information as needed; be consistent and repeat information
Patient and Family Education

- Provide a forum for open discussion and communication
- Be supportive, sensitive, and maintain a hopeful manner

Discharge Planning

- Family members should know the HEP, and proper performance of exercises
- Home visits
- Trial stays at home
- OP or home care may continue treatment

REFERENCES

REFERENCES continued
