Cerebrovascular Disorders

Blood, Brain, and Energy
- 20% of body's oxygen usage
- No oxygen/glucose reserves
- Hypoxia - reduced oxygen
- Anoxia - Absence of oxygen supply
- Cell death can occur in as little as 4 minutes without oxygen
  - Hippocampus is particularly susceptible

Blood Supply to the Brain
Middle Cerebral

Regional Distribution of Cerebral Arterial System

Stroke

- aka, Cerebrovascular Accident (CVA)
- A focal neurological disorder of abrupt development due to a pathological process in blood vessels (Walton, 1994)
CVA Facts

- Third leading cause of death in US
- 700,000 strokes per year in US
- 500,000 new, 200,000 recurrent
- Someone has a stroke every 45 secs.
- Women > Men, Blacks > other ethnicities
- Stroke rate INCREASING since 1993
- Stroke death rate DECREASING since 1993

CVA

- Three sources of deficits
  - Hypoxia / anoxia
  - Intracranial pressure if hemorrhage occurs
  - Blood can be toxic to the cerebral tissue

CVA Course

- Reduced/blocked blood flow
- Increased heart rate
- Arterial dilation
- Increased oxygen extraction ratio
- If none of the above help, cell death
Blood Supply and Stroke

Types of CVA
- Ischemia - most common
  - Insufficient blood flow to an area
- Infarction
  - Sufficient disruption of blood flow to cause significant cell death
- Hemorrhage
  - Rupture of a blood vessel
  - Most severe form of CVA

Transient Ischemic Attack (TIA)
- Temporary blockage of vessels
- Symptoms similar to stroke
  - Anterior circulation (motor, speech)
  - Posterior circulation (vision, sensory, memory)
- Last several minutes; no more than 24hrs
- Considered a warning:
  - ~33% will have a stroke
78 y.o. man with TIAs

Source: Hesselink

Infarction
- Cell death resulting from ischemia
- 2 primary sources
  - Thrombosis
    - Most common type
    - Associated with atherosclerosis
    - Major junctures: ICA, VBA
  - Embolism
    - Associated with atrial fibrillation

Thrombosis

Blood Clot - Thrombus

A blood clot forms when blood cells and platelets sticking together it is called a thrombus.
Thrombosis Effects

- 75% of strokes
- Tend to be large
- ICA most common site
- Develop slowly; TIA's common
- Right hemisphere lesions - greater functional impairment
- Left hemisphere lesions - aphasia

Embolism

Embolism Effects

- 20% of strokes
- Tend to be further “downstream”
  - Smaller lesions
- Tend to occur in younger individuals
- Often abrupt onset without headache or TIA
Left Hemisphere Deficits

- Aphasia
- Apraxia
- Agraphia / dysgraphia
- Right hemiplegia / hemiparesis
- Verbal memory problems
- Right visual field loss
- Local processing deficits
- Depression

Right Hemisphere Deficits

- Visual-perceptual processing
- Left hemiplegia / hemiparesis
- Nonverbal communication
- Prosopagnosia
- Visual memory
- Left neglect
- Anosagnosia or euphoria

Predict the Deficits

- 86 year old man
- Atrial fibrillation and diabetes mellitus
- Notice the swelling of infarcted tissue and the distortion of surrounding tissue.
Predict the Deficits

- 45 year old woman

Hemorrhagic Stroke

- Rupture of blood vessel within the brain
- Hematoma: Pooling of blood in the brain
  - Intracranial
    - Within the cerebrum
  - Subarachnoid/Subdural
    - Bleeding into the meningeal spaces
Intracranial Hemorrhage
- 49-yo AA woman
- HTN, DM
- c/o numbness and tingling in left leg

Hemorrhagic Stroke
- 38-yo woman
- Sudden onset HA and mental confusion

Subdural Hematoma

Source: Hesselink
Subarachnoid Hemorrhage

“Worst headache of my life”

Stroke Subtype Prevalence

<table>
<thead>
<tr>
<th>Stroke Subtype</th>
<th>Prevalence</th>
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<tbody>
<tr>
<td>Lacunar</td>
<td>19%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
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<tr>
<td>ICH</td>
<td>13%</td>
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<tr>
<td>SAH</td>
<td>13%</td>
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<tr>
<td>Thromboembolic</td>
<td>6%</td>
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<tr>
<td>Cardioembolic</td>
<td>14%</td>
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<tr>
<td>Unknown</td>
<td>32%</td>
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</table>

Stroke Risk Factors

- Age
- Prior history of stroke
- Ethnicity (AA have highest rate)
- Coronary artery disease (CAD)
- Hypertension (HTN)
- Hypercholesterolemia (LDL)
- Diabetes
- Smoking
- Obesity
Aneurysm

- Weakened blood vessel wall
- Ballooning
- Risk of rupture

MCA Aneurysm

ACoA Aneurysm
Arteriovenous Malformation (AVM)
- Abnormal communication between arteries and veins
- "steals" blood from other areas
- High leak potential

34-yo man
- h/o headache
- Single seizure

Vascular Dementia (VaD)
- Cognitive decline secondary to cerebrovascular disease
- Definition challenges
- Multiple types
- "Probable VaD"
  - Dementia
  - 2 or more ischemic strokes by history or 1 correlated with cognition
  - At least 1 outside the cerebellum
Neuropsychology of VaD

- Relationship to Alzheimer's disease
- Cognitive symptoms
  - Less pronounced memory disturbance
  - Psychomotor slowing / gate disturbance
  - Greater lateralization (focal signs)
  - More pronounced executive system dysfunction
  - Psychiatric symptoms (esp. depression)
  - Stepwise deterioration (?)

Vascular Dementia

81yo Female

76yo Female
Binswanger’s Disease
- Diffuse white matter hyperintensities
- Focused in the centrum semiovale and periventricular white matter

Neuropsychology and Cerebrovascular disorders
- Deficits vary with site of lesion
- Serial testing to establish recovery
- Must consider:
  - Age / medical history
  - Time to treatment
  - Nature of stroke (hemorrhage vs infarct)
  - Size of stroke
  - Localized vs diffuse deficits