NURS 821 Neurological Disorders

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Lecture 11

Part 1 Disorders of the Central Nervous System:Cerebrovascular Disease

The Central Nervous System

- The portion of the nervous system consisting of the brain and spinal cord.

The Central Nervous System

- Alterations are caused by :
  - Traumatic injury
  - Vascular disorders
  - Tumor growth
  - Infectious and inflammatory processes
  - Metabolic derangements
  - Degenerative processes

Cerebrovascular Disease

- Definition: diseases pertaining to the brain vasculature
- Brain abnormalities induced by CVD are:
  - Ischemic, with or without infarction
  - ***or***
  - Hemorrhagic
- Both result in a Cerebral Vascular Accident (CVA, stroke)

Cerebrovascular Attack (CVA): Brain Attack

- U.S. annual cost is $43 billion/yr
- Definition-Anoxic damage to the brain causing necrosis and permanent deficits due to a sudden or prolonged disruption of cerebral blood flow.
- Prognosis depends on etiology, severity, and duration of attack. Ischemic penumbra are those cells at risk for death but may survive if prompt intervention.
- Anoxia under 15 minutes, better prognosis
- Manifestations depend on area of brain affected.

Cerebral Vascular Accident

- 3rd leading cause of death in the United States
- Occur mainly in persons over 65
- Tend to run in families
- F>M
- Recurrent CVA-25% within next 5 years
- Greater incidence in blacks than whites (? related to increased incidence of HTN in blacks)

CVA Manifestations

- Sudden numbness, weakness, face, arm, leg, usually unilateral
- Sudden confusion, trouble talking, or comprehending
- Sudden difficulty seeing in one or both eyes
- Sudden trouble walking, dizziness, loss of balance or coordination
- Sudden severe HA without cause (NINDS, 2000)

Major types of CVAs

Classified according to pathophysiology:

- **Ischemic-occlusive disease-80%**
  - Thrombotic 32%
  - Embolic 32%
  - Lucunar 18%
- Hemorrhagic-intracerebral, subarrachnoid, or AVM bleeding into brain parenchyma or spaces; 20% of CVAs. Usually caused by aneurysm or AVM.

Ratio of infarcts to hemorrhages is 4:1 and emboli accounts for approx. 1/3 of all strokes

Source: Mohr (1998). Harvard Stroke Series

Cerebral Vascular Accident

- Etiology: Most attributed to artherosclerosis and chronic HTN
- Mechanism:

  Atherosclerosis ⇨ reduces resilience of large arteries ⇨induces HTN ⇨ worsens atherosclerosis ⇨ damages small branch vessels ⇨vessels impregnated with hyaline-lipid material (lipohyalinosis) ⇨…

Cerebral Vascular Accident - Pathology

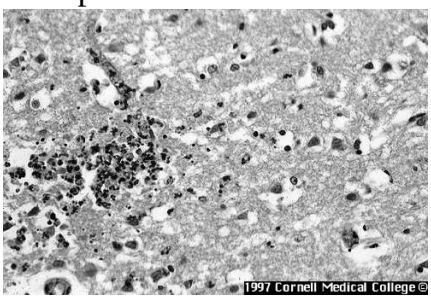
At this point one of two scenarios can occur…

#1) results in thrombosis formation in arteries ⇨ ischemic event

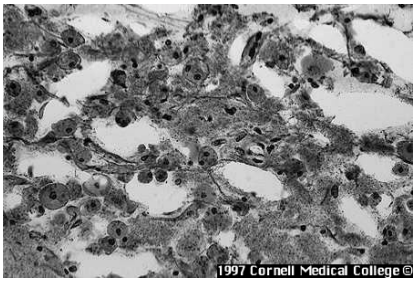
OR

#2) weakens vessel wall⇨ formation of small dissecting aneurysm ⇨ which can result in a brain hemorrhage

Neutrophilia in Acute CVA



Macrophage Activity in CVA



Thrombotic Stroke

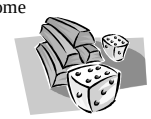
- Occurs when arteries supplying the brain or the intracranial vessels are occluded by thrombi ⇨ ischemia ⇨ infarction of brain tissue

Thrombotic Stroke Risk factors

- Atherosclerosis and its risk factors:
  - HTN
  - Smoking
  - Diabetes
  - High cholesterol
- Hypothyroidism
- Sedentary lifestyle

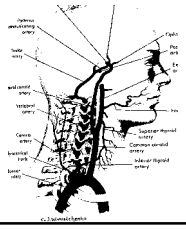
Thrombotic Stroke Risk Factors

- Conditions causing inadequate cerebral perfusion:
  - Coagulation disorders, sickle cell disease
  - Dehydration, hypotension
  - Prolonged vasoconstriction from malignant HTN
  - Arteritis, subclavian steal syndrome
  - Oral contraceptives
  - Chronic hypoxia



Pathophysiology

- Atheromatous plaques typically form at branches and curves in the cerebral circulation



Thrombotic Stroke

- Plaques may grow silently for 20+ years
- Gradually, the artery occludes
- Plaques may ulcerate and a clot forms
- Thrombotic strokes occur when parts of a clot break off and travel upstream

Clinical Features

- Evolution of a thrombotic CVA is more variable than embolic or hemorrhagic stroke
- In 35 – 50% of patients who have a CVA, it was preceded by minor signs of one or more transient ischemic attacks (TIAs)

Thrombotic Stroke

- The typical development of thrombotic stroke is known as stroke-in-evolution
  - Symptoms may abruptly develop but tend to progress slowly and progressively over hours
- When a CVA has reached its maximum destruction it is called a completed stroke
  - (NINDSD, 2000)

Transient Ischemia Attack (TIA)

- Definition-Temporary neurologic dysfunction resulting from diminished blood supply to a specific area of the brain
- Etiology-Usually related to ASCVD or thrombosis
- Attacks last no longer than 15 minutes, but manifestations may last 24 hours
- Any cerebral artery may be involved with associated manifestations
  - Minor focal deficits-contralateral weakness of legs, arms, face; hemiparesthesias; visual impairments
  - Major deficits causing loss of consciousness

Transient Ischemic Attack (TIA)

- Approx. 2/3 of all patients with TIAs are men or hypertensive or both
- Lasts from a few seconds to 24 hours
- Usually, the duration is 2 – 15 minutes
- May be few or several hundred TIAs
- In a true TIA, neurologic deficits are completely clear within 24 hours, leaving no residual dysfunction

TIA

- If the blockage occurs in the carotid and middle cerebral artery, the TIA can present as:
  - Monocular blindness
  - Hemiplegia, hemianesthesia
  - Disturbances of speech and language
  - Confusion

TIA

- If the blockage occurs in the vetebrobasilar system, the prodromal spells most often take the form of:
  - Episodes of dizziness
  - Diplopia or impaired vision in one or both visual fields
  - Numbness
  - Dysarthria

Transient Ischemia Attack

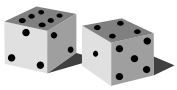
Embolic Stroke

- Involves fragments breaking from a thrombus formed outside of the brain (like the heart, aorta, or common carotid)
- Embolus usually involves small vessels and obstructs at a bifurcation (usually the middle cerebral artery) or other narrowing leading to ischemia or brain tissue

Embolic Stroke

- Embolus may completely block lumen and/or break into fragments and move up the vessel
- Usually, a second stroke follows, because the source of emboli continues to exist

Embolic Stroke



- Risk factors:
  - Afib (most common cause)
  - MI
  - Endocarditis
  - Rheumatic heart disease
  - Valvular prosthesis
  - Atrial-septal defects
  - Disorders of carotids, aorta, vertebral-basilar circulation

(75% of cardiogenic emboli lodge in the brain)

Embolic Stroke

- Clinical features:
  - Develop most rapidly
  - Full blown picture evolves within seconds
  - With rare exceptions, no warning (no TIA)
  - Can strike anytime, but getting up to go to the bathroom has been found to be a “danger time”
  - Neurological picture depends on site of obstruction

Hemorrhagic Stroke

- An intracranial hemorrhage is the third most frequent cause of CVA
- Common etiology includes:
  - HTN (most common)
  - Ruptured aneurysms
  - Arteriovenous malformation
  - Hemorrhage associated with bleeding disorders

Hemorrhagic Stroke

- Average age is lower than in thrombotic infarction
- M=F
- African Americans > whites. Recently, incidence among Asians have increased
- Usually occurs when patient is up and active

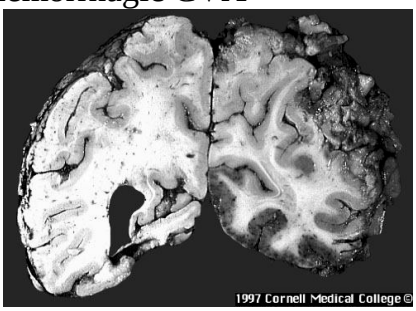
Hemorrhagic Stroke

- Most common site for HTN hemorrhages:
  - Putamen of the basal ganglia - 55%
- Remainder occur:
  - Thalamus - 10%
  - Cortex and subcortex - 15 %
  - Pons - 10%
  - Cerebellar spheres - 10%

Hemorrhagic Stroke

- Pathology:
  - Blood leaks from vessel (usually a small artery) directly into the brain ⇨ forms a hematoma in the brain substance ⇨spreads to the ventricles ⇨ spreads to subarachnoid space ⇨ increasing intracranial pressure ⇨ destruction of surrounding brain tissue

Hemorrhagic CVA



Hemorrhagic Stroke

- Once bleeding stops, absorbed over weeks to months.
  - The neurological deficit is never transitory.
  - Rapid improvement is not expected.

Hemorrhagic Stroke

- The classic historic description is:

  "an obese, plethoric, hypertensive male who, while sane and sound, falls senseless to the ground – impervious to shouts, shaking, and pinching – breathes stertorously, and dies in a few hours."

Hemorrhagic Stroke

- Clinical features:

  Of all CVAs, brain hemorrhage is the most "dramatic"

  It has even been given its own name, "apoplexy" (Greek)

- Cardinal features:

  Headache and vomiting

  Usually no prodromal syndromes (TIA's)

Lacunar Stroke

- < 1 cm in diameter
- Involves small penetrating branches of the cerebral arteries.
- As arteries occlude, tiny infarcts occur.
- Softened tissue is removed, leaving a small cavity, or lacune.
- Resulting infarcts may be so small they may cause no symptoms.

Lacunar Stroke

- Strong correlation in patients with combined HTN and atherosclerosis, and to lesser extent diabetes
- Predominantly occur in basal ganglia, internal capsules, and brainstem

Lacunar Stroke

- Clinical features:
  - Because of the subcortical location and small area of infarction, these strokes may have:
    - Pure motor deficits
    - Pure sensory deficits
    - No deficits