Clinical Localization of Stroke to Vascular Territories in the Brain

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Cerebral Vascular Distribution

Classification of Cerebral Cortical Function

• Cytoarchitecture of the brain
• Emerged in 1909; developed by Korbinian Brodmann, German neurologist
• System is incomplete, yet offers a method to label and localize physiology
• Both discreet and indiscreet functional boundaries are detailed

"Vergleichende Lokalisationslehre der Großhirnrinde in ihren Prinzipien dargestellt auf Grund des Zellenbaues" (Comparative Localization Studies in the Brain Cortex, Its Fundamentals Represented on the Basis of its Cellular Architecture); 1909.

The Frontal Lobe

• Primary functions:
  • Voluntary motor function
  • Higher intellectual function
  • Language expression

Brodmann's Area 4
• Last portion of the frontal lobe on the pre-central gyrus
• Superior aspects = ACA, but primarily MCA territory

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Localizing Findings to the Frontal Cortex

- Clinical Findings with sudden onset:
  - Arm and facial weakness
  - Pure leg weakness (rare)
  - Arm, face, leg weakness
  - Loss of language fluency
  - Cognitive change

Neurovascular Territory to "Consider:"
- Contralateral MCA
- Contralateral ACA
- Contralateral distal ICA or proximal MCA
- MCA (usually left)
- ACA

Note: Cortical sensory findings in the parietal lobe will commonly be associated with motor findings in the same extremity contralateral to the neurovascular territory implicated.

The Parietal Lobe

- Primary sensory lobe
  - Receives sensory information from sensory receptors in the skin and joints
  - Information is relayed to the parietal lobe by way of the thalamus
  - True discrimination:
    - Position of body in space
    - Size, shape and texture
    - Intensity and locality

The Occipital Lobe

- Primary visual lobe
  - Receives input from the optic nerves and special nuclei of the thalamus to visually interprets findings
  - PCA territory

The Course of Visual Stimuli

1. Confrontation must be used in patients with poor attention, cognitive limitations that affect cooperation, or in cases of altered consciousness
2. Defects of one eye (monocular) = retina or optic nerve
3. Defects of both eyes (binocular) = chiasm or beyond
4. There is greater similarity between each eye’s defects (congruity) with more posteriorly located lesions
5. Homonymous hemianopias are always beyond the chiasm
Visual Field Localization
6. Large parietal infarcts may result in complete homonymous hemianopia
7. Medial occipital lesions produced by PCA infarct cause complete homonymous hemianopia
   a. Patients with purely occipital infarction are usually aware of their field defect, while those with more anterior involvement affecting the parietal lobe may remain unaware of visual loss
8. Diplopia is almost always caused by lesions affecting the ocular movement system in the brainstem

The Subcortex
- The subcortex is packed with ascending sensory fibers and descending motor fibers, and the basal nuclei
- Lesions affecting the subcortical region commonly result in either:
  - Pure sensory deficits
  - Pure motor deficits
  - Combined sensori-motor deficits

The Cerebellum
- Represents 10% of total brain volume
- 2 lateral hemispheres connected by the vermis
- Functions:
  - Fine coordination of muscle movements
  - Maintenance of muscle tone and posture
  - Impulses from the vestibular apparatus in the inner ear are continually delivered and processed to maintain equilibrium

Cerebellar Dysfunction
- Alterations in equilibrium and coordination
- Ataxia – Inability coordinate motor function
  - Loss of gross motor coordination
  - Loss of fine motor coordination
- Cerebellar findings are ipsilateral and often associated with brainstem findings

Localizing Findings to the Cerebellum
- Pure cerebellar stroke:
  - Vertigo
  - No loss of motor strength
- Commonly occurs in association with brainstem stroke; presentation includes findings of cerebellar stroke along with any of the following:
  - Motor weakness
  - Sensory loss
  - Alterations in consciousness
  - Cranial nerve palsies

The Brainstem
- Major control centers:
  - Level of consciousness
  - Cardiac
  - Respiratory
  - Vasomotor
  - Vomiting
  - Sneezing
  - Sensory (ascending) and motor (descending) pathways
  - Cranial nerves III-XII
Basilar Artery Thrombosis

• Most commonly misdiagnosed of all ischemic infarction presentations
• Findings may include any/all of the following:
  – Vertigo
  – Motor/sensory loss
  – Cranial nerve palsies
  – Hiccups
  – Shivering

• Most severe symptoms include:
  ✓ Tetraparesis
  ✓ Respiratory failure
  ✓ Altered LOC including coma
  ✓ Locked-in syndrome
  ✓ Cortical blindness with bilateral PCA occlusions (top of the basilar syndrome)

Differentiating Brainstem Findings

• Rules:
  – Loss of sensory and/or motor loss that is all on the same side involving the face and extremities indicates a lesion in the cortex, subcortex, thalamus or upper brainstem.
  – Cardinal brainstem stroke findings = Bilaterality; cranial nerve deficit on the same side as the infarct with opposite side extremity weakness and/or sensory loss.
  – Uncommon stroke findings may indicate a brainstem lesion: Auditory loss; vertigo; ocular motor dysfunction.
  – Sudden loss of consciousness in non-hemorrhagic stroke may indicate brainstem stroke.