Cerebrovascular anatomy for speech-language pathologists

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Outline & Objectives

1. Explain why cerebrovascular anatomy is important

2. Identify the major arteries supplying the brain, including their origin and what parts of the brain they supply
   - Circle of Willis & the major cerebral arteries
   - Cerebellar arteries and small vessels
   - Branches of MCA & PCA

3. Explain the pathophysiology of stroke and how it relates to cerebrovascular anatomy
   - Pathophysiology & angiography of ischemic stroke (thrombotic & embolic)
   - Pathophysiology of hemorrhagic stroke (subarachnoid & intracerebral hemorrhage)
Perfusing the brain is critical

- The brain:
  - Receives 15-20% of the blood pumped by the heart (cardiac output)
  - Accounts for ~20% of the energy used by the entire body
  - Is only ~2% of the total body mass
- Vulnerable neurons begin to die ~5 minutes after ischemia onset
  - Compare to 20+ minutes for cardiomyocytes or hepatic cells
- So ensuring that blood constantly gets to the brain is really important
Overview of cerebrovascular system
Cerebral arteries & Circle of Willis

- **Circle of Willis** – redundancy!
  - If part of CoW is obstructed, can still get some flow through alternate routes
- Major cerebral arteries (MCA, PCA, ACA) come off of Circle of Willis
  - Cover most of the cortex

Source: physio-pedia.com
Source: lecturio.com
Cerebral arteries & Circle of Willis

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  - If part of CoW is obstructed, can still get some flow through alternate routes
- Major cerebral arteries (MCA, PCA, ACA) come off of Circle of Willis
  - Cover most of the cortex
- But what about subcortical structures, cerebellum?

Source: John Lynch via Wikimedia
Cerebellar arteries and small vessels

Source: Netter's Atlas of Neuroscience

Source: Neuroanatomy: An Illustrated Colour Text
Branches of MCA and PCA
Overview of cerebrovascular system

Source: Netter's Atlas of Neuroscience
Overview of cerebrovascular system

Source: Netter's Atlas of Neuroscience
Clinical correlates: Pathophysiology of stroke
Ischemic stroke – how does a clot form?
Thrombotic ischemic stroke

- Occurs when a clot forms in a blood vessel that supplies the brain

- Occurs most commonly in places where blood vessels bifurcate/split off
  - Turbulent flow

- Atherosclerosis is the most common cause of thrombotic stroke
  - Hyperlipidemia → plaque formation
  - Plaque ruptures → inflammatory response, clot formed
Embolic ischemic stroke

- Occurs when a clot (or other occlusion) forms upstream and is carried through circulation into the cerebral arteries

- Atrial fibrillation (AFib) is a common cause of cardioembolic stroke
  - Heart arrhythmia – discoordinated contraction of atria due to “faulty wiring”
Embolic ischemic stroke

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- Results in atrial blood stasis (pooling) → triggers thrombosis (clotting)
  ○ Embolized clot can then be passed through left ventricle → aorta → straight to brain
Angiography and ischemic stroke
Hemorrhagic stroke

Subarachnoid hemorrhage (ruptured aneurysm)

Intracerebral hemorrhage (hypertensive)

Source: Netter’s Atlas of Neuroscience
Intracerebral hemorrhage (ICH)

- Roughly 2-3x as common as subarachnoid hemorrhage (SAH)
  - About 10% of all strokes in the U.S.

- Primary ICH caused by:
  1. High blood pressure (hypertension)
     - Associated with hemorrhage deeper in the brain
  2. Amyloid deposition (cerebral amyloid angiopathy, CAA)
     - Associated with more superficial hemorrhage
Aneurysm and subarachnoid hemorrhage (SAH)

- Constitutes ~5% of all strokes; high chance of poor outcome or mortality
- Most commonly results from ruptured saccular [“berry”] aneurysm
  - Outpouching of artery formed by high pressure and turbulent flow
- Saccular aneurysm most frequently occurs in anterior circulation (85%), particularly in ACA and at bifurcation of MCA
**Summary**
Thank you!

Questions?