Neuroimaging for the Speech-Language Pathologist – Part II

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Disclosures

• Employed by Georgetown University
• Affiliated with MedStar National Rehabilitation Network
• Grants from NIDCD, NINDS, NCATS, Doris Duke Charitable Foundation
Goals and Plan for this Talk

- Review the differences between neuroimaging modalities and the clinical indications for each type
- Learn some basics of how to look at brain images and what to look for
Review of Part I
CT vs. MRI

- **CT Clinical indications:** a very quick (1 minute) scan to find acute hemorrhages or major issues in the brain (e.g., hydrocephalus, herniation)
  - Not very sensitive to hyperacute ischemic strokes or any small stroke
- **MRI Clinical Indications:** Any time you want a detailed picture and don’t need it super fast
  - Ischemic stroke
  - Brain atrophy (neurodegeneration)
  - Older damage to white matter (“chronic small vessel ischemic disease”)
  - To assess the brain stem or cerebellum (difficult to see on CT)
  - Old bleeds
  - TBI
  - MS or other inflammatory diseases
  - Infection (meningitis, encephalitis)
  - Tumors
Main Types of MRI Scans

- **T1-Weighted**: standard anatomical scan used to assess structure and atrophy
- **T2-Weighted**: good for assessing white matter damage; better for assessing the brainstem than FLAIR
- **Fluid-Attenuated Inversion Recovery (FLAIR)**: also good for assessing white matter damage, particularly the areas around the ventricles
- **Diffusion-Weighted (DWI)**: primarily used to detect acute ischemic stroke
- **Gradient Echo (GRE) or Susceptibility-Weighted (SWI)**: used to detect bleeding that has occurred at any time in a person’s life
CTA vs. MRA

- CTAs and MRAs are both used to assess blood vessels
  - Computed Tomography Angiography (CTA):
    • Requires IV contrast
    • Used during acute ischemic stroke to determine interventions such as tPA or thrombectomy
  - Magnetic Resonance Angiography (MRA):
    • Can be used without contrast
      - This is helpful if the person has a contrast allergy or renal issues
    • The picture can sometimes be less clear than a CTA if the person doesn’t stay still since this scan lasts longer
    • If acute treatment planning is not necessary, an MRA might be ordered instead, especially if a structural MRI is already being ordered
Answering Your Questions
Neuroplastic Changes

• Can you see neuroplastic changes/recovery in brain imaging?
  – Unfortunately, not yet on clinical scans
  – This is something we are looking at in our current study with:
    • Diffusion Tensor Imaging (DTI) scans – can trace white matter connections
    • Functional MRI – examines brain activity while doing a task and “functional connectivity”
  – Stay tuned for our upcoming lecture: Research Neuroimaging for the SLP!
CT or MRI?

- For a patient admitted with an ischemic stroke, if they develop new symptoms why is a CT ordered over an MRI?

- A CT is ordered first to check for hemorrhagic transformation or herniation
  - Much faster to get (<30 min from time of order)
  - As good as MRI for hemorrhage or herniation
Neuroimaging for COVID

• What is relevant neuroimaging phenomena to be aware of in non-stroke populations (dementias or long COVID in particular)?

• Neuroimaging in COVID patients: more studies are still needed, but a couple of studies have found:
  – White matter abnormality
  – Acute/subacute ischemic infarction
  – Leptomeningeal enhancement
  – Encephalitis

(Kremer et al, 2020; Kim et al, 2021)
What is relevant neuroimaging phenomena to be aware of in non-stroke populations (dementias or long COVID in particular)?

**Neurodegenerative Dementias:**
- Atrophy (look at T1 and T2 scans)
  - Big ventricles, big sulci
  - Pattern can be helpful (but isn’t diagnostic)
    - PPA = L > R atrophy, sometimes more specific
    - Alzheimer = hippocampi, parietal lobes
- Hypometabolism (on PET)
  - Ordered for Alzheimers vs. FTD
Lesion Location and Expected Impairments

• How can we use lesion location to determine expected speech, language, and swallowing deficits?
  – Stay tuned for our next round of lectures on Brain-Behavior Relationships!
How can SLP's recognize specific location of infarction or damaged tissue? (i.e. how to locate Broca's area, the motor cortex etc.)
  
  - Let’s look at some scans!
Let’s look at scans!

- Locating key structures on an MRI
- Computed Tomography Angiography (CTA)
- Magnetic Resonance Angiography (MRA)
Upcoming Lecture Topics

• Brain-Behavior Relationships
  – This will include multiple lectures covering gross anatomy, subcortical structures, the brainstem, the cerebral vascular system, and the cerebellum
  – We will focus on the functions of each region and the types of impairments you may see with damage

• Research Neuroimaging
  – Including Diffusion Tensor Imaging (DTI) and Functional MRI (fMRI)

• Neuroplasticity
  – What is it and how do you capitalize on it in therapy?

• And more...Please remember to answer our brief survey to help us plan future lectures!
Thank You!

Georgetown University, Cognitive Recovery Lab

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Funding Sources
The Vernon Family Trust