Speech and Language Disorders

BROCA'S, WERNICKE'S... ETC.

DEX ARNOLD
PGY-2 UNIVERSITY OF CALGARY NEUROLOGY
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SEVERAL GRAPHICAL SLIDES ADAPTED FROM DR. DARYL WILE’S 2011 PRESENTATION
Basic Concepts

- Language ≠ Speech
- Speech is merely the auditory expression of language
- Language encompasses reading, writing, speech, and motor gestures, and is a means of transmitting ideas or feelings through symbols
- The production of sounds and articulation are the result of vocal cord, tongue, and pharyngeal/laryngeal muscle activity. These are controlled chiefly by the brainstem and upper cervical spine.
- Language is the domain of the cerebral cortex.
Basic Concepts

- Two major neurologic disorders covered here:
  1. Dysarthria (and Dysphonia)
  2. Aphasia
- Differentiating between them is critical!
Dysarthria and Dysphonia

THE CONTENT IS RIGHT. THE DELIVERY IS OFF.
Localizing

- Muscle
- Neuromuscular Junction
- Lower Motor Neuron (cranial nerves or upper cervical nerves)
- Brainstem nuclei
- Cerebellum
- Basal Ganglia
- Cortex/Subcortex

Generally, dysarthria is difficult to localize.
Brainstem Innervation

- CN V: muscles of mastication, opening and closing the mouth
- CN VII: controls facial expression and adjusts lip shape via orbicularis oris and other facial muscles
- CN IX & X: movement of the soft palate, pharynx and larynx
- CN XII: tongue movement
The Brainstem’s Contribution

- Vocalization is the result of coordinated respiratory muscle activity, the tension and length of the vocal cords, the size and shape of the glottis, pharynx, and mouth, and the positioning of the tongue, palate, and lips.
- In trached patients, speech is still possible due to the esophagus.
  - Swallowed air is slowly released through the GE junction, and resonates in the esophagus and pharynx to be molded by the mouth and lips into words.
Exam Pearls

- Labial (lip) sounds - CN VII: b, p, m
- Lingual (tongue) sounds - CN XII: t, d, l, n
- Velar (pharyngeal) sounds – CN IX/X: k, g
- Combine with “pataka”
- Test for dysarthria with consonant-loaded phrases
  - E.g. “baby hippopotamus”, “third riding artillery brigade”, and “voluntary retribution”

- Conditions like myaesthenia – fatigable speech. Ask the patient to count to 100
- Cerebellar dysfunction – ataxic speech – lurching, breaking, wavering, explosive speech
- Hoarse or weak voice – think about recurrent laryngeal nerve, larynx mass or pathology, vocal cord paralysis, injury, or dysfunction
- Nasal-sounding voice – pharyngeal muscle dysfunction or CN X lesion – the nasopharynx cannot be sealed off
- Vocal tremor may be seen with cerebellar disorders, essential tremor, and Parkinsonism. Hypophonia (soft, monotonous speech) is a hallmark of Parkinson’s

- Note that pronunciation is influenced by level of education, cultural background, first language, and individual factors. Ask family what is normal.
<table>
<thead>
<tr>
<th>Type</th>
<th>Localization</th>
<th>Auditory Signs</th>
<th>Characteristic Disease(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flaccid</td>
<td>Lower motor neuron</td>
<td>Breathy, nasal voice, imprecise consonants</td>
<td>Stroke, myasthenia gravis</td>
</tr>
<tr>
<td>Spastic</td>
<td>Bilateral motor neuron</td>
<td>Strain-strangle, harsh voice; slow rate; imprecise consonants</td>
<td>Bilateral strokes, tumors, primary lateral sclerosis</td>
</tr>
<tr>
<td></td>
<td>Unilateral upper motor neuron</td>
<td>Consonant imprecision, slow rate, harsh voice quality</td>
<td>Stroke, tumor</td>
</tr>
<tr>
<td>Ataxic</td>
<td>Cerebellum</td>
<td>Irregular articulatory breakdowns, excessive and equal stress</td>
<td>Stroke, degenerative disease</td>
</tr>
<tr>
<td>Hypokinetic</td>
<td>Extrapyramidal</td>
<td>Rapid rate, reduced loudness, monopitch and monoloudness</td>
<td>PD</td>
</tr>
<tr>
<td>Hyperkinetic</td>
<td>Extrapyramidal</td>
<td>Prolonged phonemes, variable rate, inappropriate silences, voice stoppages</td>
<td>Dystonia, HD</td>
</tr>
<tr>
<td>Spastic and flaccid</td>
<td>Upper and lower motor neuron</td>
<td>Hypernasality, strain-strangle, harsh voice, slow rate, imprecise consonants</td>
<td>ALS, multiple strokes</td>
</tr>
</tbody>
</table>


ALS, Amyotrophic lateral sclerosis; HD, Huntington disease; PD, Parkinson disease.
Aphasia

Domains of language, anatomy, a house around which to build an understanding, and patterns
Anatomy

- Usually in the left hemisphere
- The main circuit consists of Wernicke’s area on the superior temporal gyrus, the arcuate fasciculus, and Broca’s area in the inferior frontal lobe.
- In essence, a C-shaped area of brain around the sylvian fissure.

Source: Blumenfeld’s Neuroanatomy through Clinical Cases
HANDEDNESS

LEFT    RIGHT

60-70% LH dominance
May be co-dominant

>95% LH dominance
Vascular Anatomy

- Perisylvian language areas perfused by the MCA
- Broca’s area = superior division
- Wernicke’s area = inferior division
- Proximal MCA occlusions = more global aphasia

- Exact localization, matching of symptoms to anatomy is difficult. Inter-individual variability is significant. Generally, the bigger the lesion, the more global the problem.

- Key Point: The most important and common cause of aphasia is left MCA ischemia!
The Exam

- Demographics (including handedness)
- Assess the remainder of the mental status
- Full language exam involves assessing the following domains:
  1. Fluency
  2. Naming
  3. Comprehension
  4. Repetition
  5. Reading
  6. Writing
Types of Aphasias
Classifying Aphasia

- Expressive and receptive terms, while learned in medical school, are tough as all aphasic patients have trouble expressing themselves
- DeJong’s proposes Fluent and Nonfluent as a general approach (helps to classify 60-80% of acute aphasias)
Aphasia syndromes

Fluent?

Comprehends?

Repeats?

- N
  - Global aphasia
  - Mixed transcortical aphasia

- Y
  - Broca’s aphasia
  - Transcortical motor aphasia

Y

- N
  - Wernicke’s aphasia
  - Transcortical sensory aphasia

- Y
  - Conduction aphasia
  - Anomic aphasia

Source: Blumenfeld’s Neuroanatomy through Clinical Cases
Broca’s

- The most common non-fluent aphasia
- Decreased linguistic output, with relatively preserved comprehension
- Speech may consist of nouns and major verbs produced with great effort
- Patient are aware and frustrated
- Impaired repetition, reading aloud, naming
- Superior MCA occlusion
Wernicke’s

- Impaired comprehension, but fluent speech
- Speech, while of normal or increased rate, is devoid of meaningful content – flowing gibberish
- Agrammatism, neologisms, and paraphasias abound
- Patient is often unaware of the deficit
- Hearing intact, and patients will recognize voices, but content is incomprehensible
- Inferior MCA occlusion
Global

- Exactly as it sounds. Nonfluent as well as severe comprehension impairment.
- In vascular etiologies, cause is usually proximal MCA occlusion or ICA occlusion.
Conduction

- Lesion is in the supramarginal gyrus, usually involving the arcuate fasciculus, the white matter highway connecting Wernicke’s to Broca’s
- Clinically, intact fluency and comprehension, but with impaired repetition
- May see word-finding difficulty
- Vascular cause is usually an MCA terminal branch occlusion
Anomic

- Pretty much all aphasias come with naming difficulty, or recover to a point of mild naming impairment
- If naming is the chief issue throughout the course, dubbed anomic aphasia
- Localizes to the lower temporal lobe
- If accompanied by Gerstmann syndrome (dysgraphia, dyscalculia, finger agnosia, left-right disorientation), lesion localizes to the dominant angular gyrus (temporal-parietal junction)
Transcortical Aphasia

- Perisylvian language areas are intact, but they become an island cut off from the rest of the brain.
- Usual etiology is watershed infarct.
- Repetition is intact (the hallmark) as the arcuate fasciculus connects intact Broca’s and Wernicke’s areas.
- Transcortical motor aphasia is like Broca’s, but with repetition > spontaneous speech.
- Transcortical sensory is similar to Wernicke’s, but with repetition > comprehension.
Other Aphasias

- Subcortical aphasias – often resemble transcortical aphasias
- Non-dominant lesions – the usual of domains of language will be intact, but patients may lose an understanding for the emotional undertones of speech, or lose the ability to instill emotion (prosody) into their own speech
Aphasia syndromes

Source: Blumenfeld’s Neuroanatomy through Clinical Cases
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<tr>
<th></th>
<th>Broca’s</th>
<th>Wernicke’s</th>
<th>Trans cortical motor</th>
<th>Trans cortical Sensory</th>
<th>Conduction</th>
<th>Global</th>
<th>Anomic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency</td>
<td>non-fluent</td>
<td>fluent</td>
<td>non-fluent</td>
<td>fluent</td>
<td>fluent</td>
<td>non-fluent</td>
<td>fluent</td>
</tr>
<tr>
<td>Naming</td>
<td>poor</td>
<td>poor</td>
<td>poor</td>
<td>poor</td>
<td>poor</td>
<td>poor</td>
<td>poor</td>
</tr>
<tr>
<td>Repetition</td>
<td>poor</td>
<td>poor</td>
<td>intact</td>
<td>intact</td>
<td>poor</td>
<td>poor</td>
<td>intact</td>
</tr>
<tr>
<td>Comprehension</td>
<td>intact</td>
<td>poor</td>
<td>good</td>
<td>absent</td>
<td>intact</td>
<td>poor</td>
<td>intact</td>
</tr>
</tbody>
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Video Links

- **Broca’s Aphasia**
  - [https://www.youtube.com/watch?v=f2IiMEbMnPM](https://www.youtube.com/watch?v=f2IiMEbMnPM)

- **Wernicke’s Aphasia**
  - [https://www.youtube.com/watch?v=3oef68YabDo](https://www.youtube.com/watch?v=3oef68YabDo)
Differential Diagnosis

**Broadly:**

1. **Aphasia** – think vascular, isolated language deficit +/- hemiparesis and other stroke syndrome features
2. **Dysarthria** – slurred speech, but normal syntax/idea construction, and no other language domains affected
3. **Delirium** – fluctuating inattention/level of consciousness
4. **Dementia** – progressive over time, affects memory, visuospatial function (other cognitive domains)
5. **Psychosis** – usually, sentence structure and word form is intact. Associated with agitation, hallucinations, delusions, etc.
Etiologies

1. Vascular, Vascular, Vascular (hemorrhagic and ischemic)
2. Trauma (particularly to the left hemisphere)
3. Tumours
4. Abscesses
5. Focal dyscognitive seizures
6. CNS infections – particularly HSV, HIV, syphilis, tuberculosis
7. Degenerative – Primary Progressive Aphasia. Also seen in FTD, AD, and PD.
Cases

TIME TO PRACTICE
Case 1

- 81 yo RHD female, history of HTN. Sudden onset of nonsensical speech. On exam, irregular S1/S2. Rest of general exam normal. Language exam – fluent, normal prosody and grammatical constructs, however meaningless content with frequent paraphasic errors and repetition. Unable to follow commands other than “close your eyes”. Unable to repeat simple words and called a pen “red rains” and a watch “round thing”. Nonsensical writing and unable to read. Oblivious to deficits.
Case 1


- Localization?
  - Wernicke’s Aphasia in the posterior/superior temporal region and inferior parietal region. As RHD, most likely in left hemisphere.

- Etiology?
  - Vascular
Case 2

- 64 yo RHD female with one week progressive issues with vision and reading. History of colon cancer with liver metastases. Exam normal except unable to read written words, mild short-term verbal memory impairment, and right homonymous hemianopia. Writing intact. Mild dysnomia.

Source: Blumenfeld’s Neuroanatomy through Clinical Cases
Case 2

- **Localization**
  - Patient has alexia without agraphia. Mild language dysfunction, but mostly intact. Mainly thinking about damaged connections between the primary visual cortex in the occipital lobe and the language circuits in the perisylvian area. With right homonymous hemianopia, left optic radiation affected.

- **Etiology?**
  - With history of cancer and progressive course, consider metastasis. Also on DDx would be slowly evolving PCA infarct or ICH, abscess, or primary CNS neoplasm

Source: Blumenfeld’s Neuroanatomy through Clinical Cases
Summary

- Language is not the same as dysarthria
- Language is housed chiefly in the inferior frontal lobe and superior temporal lobe (Broca’s and Wernicke’s areas), usually on the left
- Left MCA occlusions or hemorrhages in this territory are clinically very important causes of aphasia
- Aphasias can be broadly clumped into fluent and nonfluent categories. Think about the anatomy and correlate it with the patient’s symptoms to localize the lesion.
   - Kirshner, H. Chapter 12B: Language and Speech Disorders, Motor Speech Disorders, Dysarthria and Apraxia of Speech. 149-152.