Physiology of Speech

*FUNCTIONS OF NERVOUS SYSTEM:

- Collection of sensory input
- Integration
- Motor output

Speech and Language :

- It is the highest function of the nervous system
- Involves understanding of spoken & printed words
- It is the ability to express ideas in speech & writing

*Function of the Brain in Communication-Language Input and Language Output :

- 1. Sensory Aspects of Communication.
- 2. Integration.
- 3. Motor Aspects of Communication.
- 4. Articulation.

*Brain Areas Concerned with Language :

1- Wernick's Area.
2- Broca'a Area.
3- Speech articulation Area in Insula.
4- Motor Cortex.
5- Angular Gyrus.
6- Auditory Association Areas.

*ASSOCIATION AREAS:

These areas receive and analyze signals simultaneously from multiple regions of both the <u>motor</u> and <u>sensory cortices</u> as well as from <u>subcortical structures</u>.

The most important association areas are :

(1) Parieto-occipitotemporal association area.
(2) prefrontal association area.
(3) limbic association area.

Broca's Area:

- **A special region in the frontal cortex, called Broca's area, provides the neural circuitry for <u>word formation</u>.**
- **This area, is located partly in the posterior lateral prefrontal cortex and partly in the premotor area.**
- **It is here that plans and motor patterns for expressing individual words or even short phrases are initiated and executed.**

- **This area also works in close association with Wernicke's language comprehension center in the temporal association cortex**

*PARIETO-OCCIPITOTEMPORAL ASSOCIATION AREAS :

1. **Analysis of the Spatial Coordinates of the Body.**
2. **Area for Language Comprehension.**
3. **Area for Initial Processing of Visual Language (Reading).**

4. Area for Naming Objects.

PARIETO-OCCIPITOTEMPORAL ASSOCIATION AREAS

AREA	SITE	FUNCTION
Analysis of the Spatial Coordinates of the Body. 1	beginning in the posterior parietal cortex and extending into the superior occipital cortex	computes the coordinates of the visual, auditory, and body surroundings.
Area for Language Comprehension 2	Wernicke's area, lies behind the primary auditory cortex in the posterior part of the superior gyrus of the temporal lobe.	higher intellectual function
Area for Initial Processing of Visual Language (Reading). 3	angular gyrus area	make meaning out of the visually perceived words (Dyslexia or Word Blindess)
Area for Naming Objects. 4	In the most lateral portions of the anterior occipital lobe and posterior temporal lobe	naming objects.

FASCIAL RECOGNITION AREAS

***One wonders why so much of the cerebral cortex should be reserved for the simple task of face recognition.**

- Most of our daily tasks involve associations with other people, and one can see the importance ofthis intellectual function.
- The occipital portion of this facial recognition area is contiguous with the visual cortex, and the temporal portion is closely associated with the limbic system that has to do with emotions, brain activation, and control of one's behavioral response to the environment.

prosophenosia = is inability to recognize faces.

This occurs in people who have extensive damage on the medial undersides of both occipital lobes and along the medioventral surfaces of the temporal lobes Loss of these face recognition areas, strangely enough, results in little other abnormality of brain function.

1- "Wernicke's Area" :

Comprehensive Interpretative Function of the Posterior Superior Temporal Lobe, also called /
General Interpretative Area, Gnostic area, the Knowing area and the Tertiary association area.

- The somatic, visual and auditory association areas, which can actually be called interpretative area, all meet one another in the posterior part of the angular gyrus where the temporal, parietal and occipital lobes all come together.

- **At the posterior end of the superior temporal gyrus**
- **Closely associated with 1 & 2 auditory areas**
- **Responsible about comprehension of auditory & visual information, then project it to Broca`s area via arcuat fasiculus**
- **Interpretations of sensory experience**
- **Formation of thought in response to sensory experience**
- **Choice of words to express thoughts**

- After severe damage in Wernicke's area, a person might hear perfectly well and even recognize different words but still be unable to arrange these words into a coherent thought.

AREA	LESION FAETURES
Auditory association areas	Word deafness auditory aphasia: an impairment in understanding spoken language that is not attributable to hearing loss
Visual association areas	Word blindness called dyslexia
Wernicke's Aphasia	Unable to interpret the thought also known as fluent aphasia, or sensory aphasia .
Broca's Area Causes	Motor Aphasia
Global Aphasia	Unable to interpret the thought Motor Aphasia The symptoms of global aphasia are those of severe Broca's aphasia and Wernicke's aphasia combined

Visual Language (Reading).

2- BROCA'S AREA

Located at the base of the precentral gyrus, in the left hemisphere 44 (the lower end of premotor area)

- **Process information received from W. area into detailed & co-ordinated pattern for vocalization.**
- **Then project it to motor cortex to initiate the appropriate movement of the lips & larynx to produces speech.**
- **Damage to this area causes inability to say words properly**

- **In adult who learn second language during adulthood. The MRI shows portion of Broca`s area concerned with it is adjacent to but separate from area concerned with the native language.**
- **But in children who learn second language early in life there is only single area involved for both languages.**

3- Angular Gyrus

Leis behind Wernikes area fused posteriorly into the visual cortex
Function: interpretation of information obtained from reading from visual cortex

Sequence of events in speech production :

- **W. area receive information from both auditory & visual areas**
- **Project it to B. areas via arcuat fasiculus**
- **Broca`s area process information received into co-ordinated pattern of vocalization & then project that pattern to the motor area**
- **Initiation of movement of muscle of speech in tongue, larynx & lips.**

If writing is concerned:

- **then information received from W. area is processed in the area of hand skills**
- **»» co-ordinated pattern of muscle movement projected to the arms & hand region of the motor cortex**
- **»» initiation of necessary muscle movement in the hand & arms required for writing a particular word**

ARTICULATION

- **Means the muscular movements of the mouth, tongue, larynx, vocal cords.**
- **Responsible for the intonations, timing, and rapid changes in intensities of the sequential sounds.**
- **The facial and laryngeal regions of the motor cortex activate these muscles, and the cerebellum, basal ganglia, and sensory cortex all help to control the sequences and intensities of muscle contractions.**

SPEECH DISORDERS:

APHASIA	DYSARTHRIA
aphasia is loss of or defective language from damage to the speech centres within the left hemisphere.	dysarthria simply means disordered articulation - slurred speech. language is intact, cf. aphasia.

REMEMBER THAT:

in aphasia there is no damage to vision, hearing or motor paralysis.the damage is in speech centers in categorical hemispheres.

Aphasia :

- **Abnormality of language function due to injury of language centres in cerebral cortex. Comprehension or expression of words will be affected**
- **Due to thrombus or embolism of cerebral vessels, trauma**

Types of Aphasia

1-Expressive.

2-Receptive.

BROCA'S APHASIA = (EXPRESSIVE APHASIA, ANTERIOR APHASIA)

- Damage in the left frontal lobe causes reduced speech fluency with comprehension preserved.

- The patient makes great efforts to initiate language, which becomes reduced to a few disjointed words. There is failure to construct sentences.

- In some cases speech may be limited to 2-3 words

- Patients who recover from this form of aphasia say they knew what they wanted to say, but 'could not get the words out'.

WERNICKE'S APHASIA = (RECEPTIVE APHASIA, POSTERIOR APHASIA)

- Left temporo-parietal damage leaves language that is fluent but the words themselves are incorrect. This varies from insertion of a few incorrect or nonexistent words into fluent speech to a profuse outpouring of jargon (that is, rubbish with wholly nonexistent words). Severe jargon aphasia may be bizarre - and confused with psychotic behaviour.
- Impaired comprehension
- Loss of intellectual function
- Failure to interprets meaning of written or spoken words
- Meaningless & excessive talk (in sever cases)
- Patients who have recovered from Wernicke's aphasia say that when aphasic they found speech, both their own and others', like a wholly unintelligible foreign language. They could neither stop themselves, nor understand themselves and others.

Conductive aphasia *(fluent):*

- **Lesion of nerve fibres of arcuate fasiculus**
- **Patient understand speech of others but can not repeat it**
- **Meaningless speech**

Anomic aphasia:

- **Lesion of angular gyrus, thus B. & W. are intact**
- **Speech & auditory comprehension is normal but visual comprehension is abnormal, due to visual information is not processed & not transmitted to W. area**
- **Dyslexia (word blindness) interruption in the flow of visual experience into W. area from visual area**

GLOBAL APHASIA = (CENTRAL APHASIA)

- This means the combination of the expressive problems of Broca's aphasia and the loss of comprehension of Wernicke's.
- The patient can neither speak nor understand language.
- It is due to widespread damage to speech areas and is the commonest aphasia after a severe left hemisphere infarct. Writing and reading are also affected.

DYSARTHRIA = Slurred speech.

-Language is intact, cf. aphasia.
-Paralysis, slowing or incoordination of muscles of articulation or local discomfort causes various different patterns of dysarthria.

DISORDERED ARTICULATION
Examples

•speech of upper motor neurone lesions of lower cranial nerves = (gravelly) .
• speech of cerebellar lesions = jerky, ataxic speech (Scannimg Speech).
•the monotone of Parkinson's disease = (Slurred).
•speech in myasthenia = that fatigues and dies away.

Many aphasic patients are also somewhat dysarthric.

*STUTTERING (التأتأة)

• Have <u>right cerebral dominance</u> and widespread overactivity in the cerebral cortex and cerebellum.
•This includes increased activity of the <u>supplementary motor area</u>.

The non-dominant hemisphere = representational hemisphere

- Understanding and interpreting music.
- Nonverbal visual experiences (especially visual patterns).
- Spatial relations between the person and their surroundings.
- The significance of "body language"
- Intonations of people's voices.
- and probably Many somatic experiences related to use of the limbs and hands eg; dressing or constructional apraxia

In 95% of people :

Right Hemisphere is (the representational hemisphere)

- The right hemisphere controls the left side of the body
- Temporal and spatial relationships
- Analyzing nonverbal information
- Communicating emotion

Left Hemisphere is (the categorical hemisphere)

- The left hemisphere controls the right side of the body
- Produce and understand language

Terms to Remember

- Dysarthria
- Broca's aphasia
- Wernicke's aphasia
- Conduction aphasia
- Anomic aphasia
- Global aphasia
- Dyslexia
- Acalculia
- Prosopagnosia
- Achromatopsia
- Stuttering

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