Neuroanatomy and neurophysiology

Rebecca Burke PhD, CCC-SLP
Washington Speech Language and Hearing Association
October 2014

Overview

• Our ability to form new memories is dependent upon the brain’s plasticity which is the ability to form new connections
• We can provide patients with experiences and adapt their environment to recruit this plasticity for regaining functional abilities
• Understanding the underlying anatomy and physiology of the brain is an important foundation for our work
• We can take advantage of the brain’s ability to change over time in our daily therapy—learning creates new synapses
• Evidence based practice can guide us to provide appropriate treatments

Outline

• Neural anatomy review
  – Neuron function, surface anatomy, fibers and tracts, higher level processing, subcortex, brainstem
• Cranial nerves, testing and neurological assessment
• Neural plasticity
  – Principles, general treatment approaches, neurobiology, aging brain and brain plasticity
• Treatment approaches and neural plasticity across disciplines
  – Etiologies, functional therapy, treatment approaches
Learner objectives

1. Learners will review neural anatomy and be able to state the divisions and functions of neurons, surface anatomy, fibers and tracts, higher level processing, subcortex and brainstem
2. Learners will be able to state the 12 cranial nerves, name and test their function
3. Learners will be able to complete a neurological assessment

4. Learners will be familiar with the neural plasticity principles and will relate these principles to clinical recommendations across disciplines of occupational, physical and speech therapy
5. Learners will be able to recognize and identify clinical applications of neural plasticity

Section 1: Neural anatomy review:

Overview slide

• Neuron function
• Spinal column
• Landmarks of cerebrum
• Fibers and tracts
• Higher level processing- lobes of the brain
• Subcortex: basal ganglia, diencephalon, cerebellum
• Brainstem
Neuron function

- Neuron - Communicating:
  - Soma
  - Axons
  - Dendrites
- Glial cells - support

Neuron function

- Communication between nerves
  - Neuron response can be excitation or inhibition
  - If neuron is sufficiently stimulated then discharge occurs then axon discharges
  - Occurs at the synapses with release of neurotransmitters
Neuron function
Horn et al. 2013

- A new study from the Montreal Neurological Institute -- The Neuro, McGill University, reveals that DCC, the receptor for a crucial protein in the nervous system known as netrin, plays a key role in regulating the plasticity of nerve cell connections in the brain.
- The absence of DCC would lead to profound memory loss such as HM-memory loss after having his hippocampus removed.

HM- Henry Molaison

- At age of 27 years had his hippocampus removed due to epileptic seizures
- Resulted in global amnesia and retrograde amnesia for 11 years before his surgery
- He lost verbal memory and could not recall from moment to moment but was able to retain some new motor skills

Spinal column segment

![Spinal column segment diagram](image)
Spinal column segment

- Ventral root
- Dorsal root

Neuron function

- Muscle spindles and Golgi tendon organs
- Brainstem reflexes
Brainstem reflexes

• Chewing reflex
• Sucking and rooting
• Palatal reflex
• Gag reflex
• Vomit
• Cough

Spinal column

• Cervical- neck/ arms
• Thoracic- hand/ trunk
• Lumbar - legs
• Sacral- foot/ toe

Surface anatomy

• Meningeal linings- protection and nutritive function
Speech means using both sides of the brain (Cogan et al. 2014)

- Past - left hemisphere - language
- Right hemisphere - cognitive functions
- New research identifies sensory - motor transformations for speech occur bilaterally
- Research used electrodes directly on the brain surface with patients with epilepsy using new imaging techniques
- Patients repeated 2 non-words

Landmarks of cerebrum

- Lobes
  - Frontal
  - Parietal

Landmarks of cerebrum

- Frontal lobe
  - Planning, initiate and inhibit voluntary motion
  - Executive functions
  - Motor strip
  - Broca’s area

- Parietal lobe
  - Postcentral gyrus - reception for body sensation
Landmarks of cerebrum

- **Temporal lobe**
  - Auditory reception and receptive language processing
  - Superior temporal gyrus
    - Heschl's gyrus
    - Wernicke's area
- **Occipital lobe**
  - Receives and processes visual stimulation

Case study: Broca’s aphasia

- 64 year old male
- Left middle cerebral artery cut off
- Receptive language better than expressive
- Right facial droop, right sided weakness
- At baseline independent with all IADLs

Treatment

- **Occupational therapy**
  - Upper body dressing, toileting
- **Physical therapy**
  - Transfers, electrical stimulation, home safety eval
- **Speech therapy**
  - Regular with thin liquids (from initial tube feeding)
  - AAC strategies of pain scale, yes/no card, VOCAs
  - Speech- melodic intonation therapy
Landmarks of cerebrum

• Insula
  – Deep to the area of the cerebrum known as operculum
  – Operculum underlies areas of the temporal, partial and frontal lobe

• Limbic system
  – Not anatomically distinct
  – Functionally distinct - motivation, sex drive, emotional behavior and affect

Limbic system

Medial surface of the cortex

• Corpus callosum
  – Information Superhighway
  • Connects right and left hemispheres
Inferior surface

- Olfactory sulcus
  - Relays smell
- Hippocampal formation
  - Memory

Fibers and tracts

- Projection fibers
  - Tracts from cortex to brainstem and spinal cord
- Association fibers
  - Communication between regions in the same hemisphere
  - Short and long
  - Arcuate fasciculus - connect Broca’s and Wernicke’s areas
- Commissural fibers
  - Connections from one location on a hemisphere to the other hemisphere

Fibers and tracts

- Corona radiata - an example of a projection fiber which connects the cortex from distant locations
Ventricles

- Lateral ventricles
- Third ventricle
- Fourth ventricle

Role of sleep and possible brain damage

- Glia cells are the brain’s non-neuronal cells that transport waste from the CSF
- Studies of mice expand this by 60%
- Neurological diseases are associated with lack of sleep
- Lack of sleep could cause byproducts to build up and cause brain damage

Role of sleep and memory

- Sleep is important to memory
  - Newly formed memories stick better after sleep
  - True for both declarative (facts) and procedural knowledge (how to do things)
  - The brain rehashes new information when resting
  - Some controversy as to how:
    - Either activity during sleep strengthens neural connections
    - Synaptic weakening brings the brain back to baseline—it reboots to get ready for new information
Higher level processing

- Vision
- Audition
- Somatic sense
  - touch
- Motor

Subcortex

- Basal ganglia
  - Group of cell bodies related to movement and background of movement
    - Caudate nucleus
    - Amygdala
    - Globus pallidus
    - Putamen

Case study: Basal ganglia CVA

- 57 year old female
- Multiple CVAs some affecting basal ganglia
- Cognitively: disorientation, difficulty initiating activity, decreased insight into deficits
- Difficulty with swallowing due to not initiating
- Poor trunk control with difficulty with sitting balance
- Motor apraxia of limb movements
Treatment

• Medically
  – Placement and then revision of a shunt

• Speech therapy:
  – Environmental cues including calendars, maps
  – Dysphagia treatment: vital stimulation, deep pharyngeal neuromuscular stimulation

• Occupational therapy
  – Visual perceptual tasks, motor control and activities of daily living including dressing, hygiene and grooming

• Physical therapy
  – Transfers, sitting balance, ambulation

Subcortex

• Diencephalon
  – Thalamus
  – Subthalamus
  – Hypothalamus

  – Pictured right: Structures of the hypothalamus viewed from inferior view

Subcortex

• Cerebellum
  – Function- coordinating motor commands with sensory input to control movement; communicates with the brainstem
  – 2 hemispheres with 3 lobes
  – Deep structures:
    • Cerebellar cortex: 3 layers
    • 5 tracts
Subcortex

- Cerebellum 5 tracts:
  - Dorsal spinocerebellar tract
  - Anterior spinocerebellar tract
  - Cuneocerebellar
  - Rostral spinocerebellar
  - Oliveocerebellar

Cerebellum

- Sagittal section and from beneath

Brainstem

- Site of all the cranial nerves
- 3 levels:
  - Medulla
  - Pons
  - Midbrain
### Brainstem stroke

- 39 year old female
- Non-verbal
- Use of motorized wheelchair with use of joystick for control
- Used lightwriter-type to speech output device
- Working on treatment for speech using lingual stretches, labial exercises
- Physical therapy-stretches for mobility and overcoming tone

### Section 2 overview:
**Cranial nerves and testing**

- Cranial nerves: Classification and function
- Cranial nerves: Testing
- Neurological examination

### Cranial nerves

<table>
<thead>
<tr>
<th>I. Olfactory</th>
<th>VII. Facial</th>
</tr>
</thead>
<tbody>
<tr>
<td>II. Optic</td>
<td>VIII. Auditory</td>
</tr>
<tr>
<td>III. Oculomotor</td>
<td>IX. Glossopharyngeal</td>
</tr>
<tr>
<td>IV. Trochlear</td>
<td>X. Vagus</td>
</tr>
<tr>
<td>V. Trigeminal</td>
<td>XI. Spinal accessory</td>
</tr>
<tr>
<td>VI. Abducens</td>
<td>XII. Hypoglossal</td>
</tr>
</tbody>
</table>
Cranial nerves

- On Old Olympus’ Towering Top A Finn And German Viewed Some Hops

- Oh, oh, oh to touch and feel very good velvet, such heaven

Cranial nerves

- Classification: sensory vs. motor

- Some say men marry but my brother says be brave my man

Cranial nerves

I. Olfactory- S
II. Optic- S
III. Oculomotor- M
IV. Trochlear- M
V. Trigeminal- B
VI. Abducens- M

VII. Facial- B
VIII. Auditory- S
IX. Glossopharyngeal- B
X. Vagus- B
XI. Spinal accessory- M
XII. Hypoglossal- M
I. Olfactory nerve

- Sensory
- Sense of smell
- Damage:
  - Ansmia
  - Loss of sense of smell

II. Optic nerve

- Vision

II. Optic nerve - damage

- Four quadrants
- Left homonymous hemianopsia - damage to R optic tract results in losing L half of both eyes
- Heteronymous bitemporal hemianopsia - lesion at chiasm - R eye lose R visual field and L eye lose L visual field
- Field cut vs. visual neglect - can compensate for a neglect
III. Oculomotor nerve

• Motor for eye:
  – Up and out
  – Inward
  – Down and out

• Schematic of:
  – III. Oculomotor
  – IV. Trochlear
  – VI. Abducens

III. Oculomotor, IV. Trochlear and VI. Abducens damage

• Extreme coordination of the 2 eyes:
  – Convergence- bringing eyes together
  – Conjugate movements- moving eyes together to look toward the same side

• Hemisphere damage affecting ocular movements results in contralateral involvement- e.g. upper motor neuron (UMN) damage in right hemisphere damage will result in inability to turn eyes to left side – patients “look towards the lesion”

III. Oculomotor, IV. Trochlear and VI. Abducens damage

• Divergent strabismus- inability of eye to turn out
• Ptosis- drooping eyelid
• Mydriasis- abnormal dilation of pupil
IV. Trochlear

• Motor
• Turns eyes down and slightly out

• Damage:
  – Lower motor neuron (LMN) damage to trochlear –
    difficulty pulling eye down

V. Trigeminal

• Motor and sensory with 3 branches:
• Ophthalmic- sensory for upper face
• Maxillary- sensory- mid-face
• Mandibular- sensory and motor
  – Sensory for mandibular (jaw) region
  – Lingual nerve- sensation for anterior 2/3 of tongue
  – Motor- muscle of mastication (chewing)
Ophthalmic, maxillary, and mandibular branches of V. trigeminal nerve

V. Trigeminal nerve damage

- UMN (upper motor neuron) damage - minimal motor deficit due to bilateral innervation
  - Jaw jerk reflex increased
- LMN (lower motor neuron) damage - atrophy (muscle wasting) and weakness of affected side
  - Jaw hanging open, hypernasality, difficulty chewing
- Damage to sensory component of those areas
- Trigeminal neuralgia (tic douloureux) - severe sharp shooting pain

VI. Abducens nerve

- Motor
- Innervates the lateral rectus ocular muscle
  - Rotates the eye out

- LMN (lower motor neuron) lesion - internal strabismus - eye rotated in
- Diplopia - double vision - inability to fuse visual images from both eyes
VII. Facial nerve

- Motor and sensory for facial muscles and taste
- Upper face muscles: bilateral cortical input; lower face: contralateral innervation (opposite side)
- E.g. left hemisphere damage: right facial paralysis but able to wrinkle forehead, close eyes, etc.

- Effects of UMN and LMN damage on facial muscle function

Warning signs of stroke- FAST
National Stroke Association

- Face: Ask the person to smile- does one side of their face droop?
- Arms: Ask the person to raise their arms- does one arm drift downward?
- Speech: Ask the person to repeat a simple phrase. Is their speech slurred or strange?
- Time: If you observe any of these signs, call 911
General course of the VII facial nerve

VII. Facial nerve damage

- Unilateral UMN damage
  - Not result in upper face paralysis
  - Paralyze all facial muscles below eyes affecting articulatory (sound production) function, swallowing

- LMN damage - upper and lower face paralysis on side of the lesion
  - Inability to close eyelid, muscle sagging, loss of tone, reduction of wrinkling

VII. Facial nerve damage

- Bell’s palsy - result from compression of VII nerve - paralysis of facial muscles which usually remits in a few months
VIII. Auditory/ vestibulocochlear nerve

- Motor and sensory
- Motor for damping output of hair cells
- Sensory for hearing and balance
- Acoustic and vestibular branches
- Auditory pathway - primarily crossed with a small ipsilateral (same side) component retained

VIII. Auditory nerve damage

- Damage to the VIII nerve:
  - Ipsilateral (same side) hearing loss
  - Vestibular system - disturbances in equilibrium due to loss of information about position in space
- Temporal bone fractures
  - Sensorineural hearing loss
  - Vertigo - dizziness
IX. Glossopharyngeal nerve

• Sensory and motor
• Sensation for taste, touch, pain and temperature of posterior 1/3 of tongue
• Sensory for ear canal
• Motor for stylopharyngeus (elevates and opens pharynx during swallowing) and superior constrictor muscle (closes VP)
• Innervates parotid gland- saliva production

• IX in relation to X vagus and XI spinal accessory nerves

IX. Glossopharyngeal nerve damage

• Paralysis of stylopharyngeus
• Loss of sensation for posterior tongue and throat
• Reduced or absent gag reflex
X. Vagus

- Sensory and motor
- Parasympathetic motor (counteracts affect of sympathetic or fight and flight system)
  - Intestines, pancreas, stomach, esophagus, trachea, kidneys, liver and the heart
- Motor for larynx, most pharyngeal and palatal muscles
- Sensory for pain, touch and temp of ear drum; pain for lower pharynx, larynx, thoracic and abdominal viscera, esophagus and bronchi
- Hunger and nausea

X. Vagus

- Maintenance of heartbeat, blood pressure, respiration and digestion
- Taste sense from epiglottis
- 4 branches including:
  - Auricular branch
  - Pharyngeal
  - Recurrent laryngeal
    - Right recurrent laryngeal
    - Left recurrent laryngeal nerve- loops under aortic arch to ascend between trachea and esophagus
  - Superior laryngeal

X. Vagus lesion

- Pharyngeal branch
  - Difficulty swallowing, potential loss gag reflex
  - Hypernasality
  - Unilateral damage- difficulty elevating soft palate
  - Bilateral damage- absent or reduced soft palate movement, hypernasality, nasal regurgitation, dysphagia and pharyngeal muscular paralysis
- Superior laryngeal
  - Loss of sensation for upper larynx, paralysis cricothyroid muscle (tensor of the vocal folds)
X. Vagus lesion

- Recurrent nerve damage
  - Alter sensation below level of vocal folds
  - Unilateral- flaccid vocal fold- hoarse and breathy
  - Bilateral- may paralyze vocal folds, laryngeal stridor (if adducted), breathy and hoarse (paramedian position), adducted position- life threatening but rare

XI. Spinal accessory nerve

- Motor –
  - Sternocleidomastoid and trapezius muscle
  - Works with vagus to innervate intrinsic muscles of larynx, pharynx and soft palate

- Spinal accessory nerve origin
XI. Spinal accessory nerve damage

- **Damage**
  - Unilateral affecting sternocleidomastoid- difficulty turning head away from side of lesion
  - Trapezius- restrict ability to elevate arm and drooping shoulder on the side of the lesion

XII. Hypoglossal

- **Motor- tongue**
  - All extrinsic muscles except palatoglossus (via XI)

- **Damage**
  - Left UMN damage – right tongue weakness due to contralateral corticobulbar tract
  - LMN damage- ipsilateral deficit (same side)
  - Tongue protrudes and points to side of paralyzed muscles because of posterior tongue muscle

- **XI. Hypoglossal nerve damage**

  - Profound impact on articulation and speech intelligibility
  - Fasciculations- abnormal involuntary twitching of muscles before atrophy
Cranial Nerve 0: Terminal Nerve

• First discovered in sharks in twentieth century
• Mediates pheromones for sexual partner selection and identification
• Debate on if it is functionally in humans
• Found in almost half of humans
• May be subconsciously used for mate selection

Cranial Nerves: Testing

I. Olfactory nerve - sense of smell
   - Smell something - soap and coffee

II. Optic nerve - vision
   - Acuity - read name badge or chart
   - Color - Ishihara plate
   - Field - track your finger
   - Fundoscopy - see back of the eye

Cranial nerves: Testing

III. Oculomotor nerve - eye movements
    - Pupil size, where the eyelids fall

IV. Trochlear - eye movement
    - Follow your finger down toward their nose
    - Check for double vision (diplopia)
Cranial nerve: Testing

V. Trigeminal nerve- sensory to the face and motor to the muscles of mastication
   – Light touch
     • Ophthalmic, maxillary, mandibular and corneal
   – Motor
     • Clench teeth and feel masseter and temporalis
     • Jaw jerk

Cranial nerve: Testing

VI. Abducens- eye movement
   – Look toward each ear, follow your field through six fields of gaze- draw a big X in the air and a horizontal line through
   – Monitor for nystagmus or twitching

VII. Facial- motor branches of facial expression
   – Wrinkle forehead
   – Close eyes against resistance
   – Puff out cheeks
   – Show your teeth

Cranial nerve: Testing

VIII. Auditory (vestibulocochlear) – innervation to the ear
   – Rub your fingers together by each ear
   – Rinne test- placing a tuning fork against the mastoid process and beside the ear; normally next to the ear is louder
   – Weber test- place a tuning fork base down the center of the forehead; should sound the same to both ears

IX. Glossopharyngeal- sensory supply to the palate
   – Gag reflex or touching the arches of the palate
   – Sense of taste on the back of the tongue
Cranial nerve: Testing

X. Vagus - motor supply to the pharynx
   - Observe handling swallow of secretions
   - Speaking, say “aah” and watch the uvula move

XI. Spinal Accessory - motor supply to the sternocleidomastoid and trapezius
   - Shrug your shoulders against resistance
   - Turn your head against resistance

Cranial nerves: Testing

XII. Hypoglossal - motor supply to the tongue muscles
   - Stick out your tongue
   - Problems with swallowing, and speaking
   - Watch for signs of lingual (tongue) wasting or fasciculations

Neurological assessment

- Neurological checks will be completed every 15 minutes x 4, every 30 min x 4, every hour x 4, followed by 4 hours x 4, then every shift for 72 hours
- Level of consciousness
  - Alert, drowsy, stuporous, or comatose
Neurological Assessment

• Pupil response
  – PERL- pupils equal and reactive to light, brisk, sluggish, nonreactive, pinpoint, dilated, or fixed

• Motor response
  – Hand grasps- equal, right greater than left, left grasp greater than right, unable to follow commands, or absent
  – Extremities- moves all extremities, moves right arm, left arm, right leg, left leg, unable to follow commands, or absent

• Pain response
  – Appropriate pain response, inappropriate, no response

• Vitals
  – Blood pressure, temp, pulse and respiration

• Observations
  – e.g. seizures, headaches, vomiting, paralysis

Section III Overview: Neuroplasticity

• 15 principles of neural plasticity and general treatment approaches

• Neurobiology and changes in the hippocampus

• Aging and brain plasticity
Neuroplasticity

• The capacity for continuous alteration of the neural pathways and synapses of the living brain and nervous system in response to experience or injury that involves the formation of new pathways and synapses and the elimination or modification of existing ones
  - Merriam Webster's Medical Dictionary

Neuroplasticity

• Short term changes in neuronal synaptic efficiency to long term changes in the structure of the nervous system (Muir & Jones, 2009)
• Based on imaging studies, use of repetitive, functional task specific practice brings about a change in cortical areas - plasticity occurs with repetition and learning

Neuroplasticity

• Areas in the opposite hemisphere and adjacent areas of the cortical lesion may take over functioning
• There is the potential for the brain to change with recovery and how you challenge the brain is critical to that change - that is a powerful motivator for recovery
• The mature brain remains plastic during the course of a lifetime (Carey, 2010)
15 principles of neural plasticity across the disciplines (Kleim & Jones, 2008)

1. Use it or lose it
   – Using neural structures strengthens them

2. Use it and improve it
   – Active exercising of a motor system improves the motor and linguistic function

3. Specificity
   – Train what you want to improve, build on the abilities the patient already has

4. Repetition matters
   – Need a lot of repetitions to make changes, mass repetitions help

5. Intensity matters
   – High intensity stimulation induces long-term learning

6. Time matters
   – Early training after a stroke is important with the caveat that intense therapy too early can cause physiological damage

7. Salience matters
   – Salience requires attention to the target, needs to be relevant to our client, you can reward a response to make it salient

8. Age matters
   – Change is slower when the individual is older

9. Transference
   – Working on one area can cause a neural response to spread to adjacent areas
15 principles of neural plasticity across the disciplines (Kleim & Jones, 2008; Robey, 1998)

10. Interference
   – Too much non-target stimulation can undo the learning process

11. Treatment matters
   – Treatment improves patient function

12. Treatment duration matters
   – At least 2 hours / week

15 principles of neural plasticity across the disciplines (Robey, 1998)

13. Repetition matters
   – Our clients want to work, repetition does not bore them, redundancy matters

14. Therapists matter
   – You are critical to the recovery process

15. Patients, families, and caregivers matter!

Neurobiology and changes in the hippocampus (Burke & Barnes, 2007)

• Animal and human studies on a cellular level
• Cognitive functions that rely on the medial temporal lobe and prefrontal cortex are subject to age related changes
   – Learning, memory and executive function
• The hippocampus is vulnerable to age changes
   – There may be therapeutic approaches in the future to change hippocampal neurophysiology
Aging and brain plasticity (Johansson, 2004)

- Brain plasticity
  - Neuronal circuits can be modified by experience, learning and in response to brain lesions

- Evidence
  - Neuroimaging in vivo – important impact
  - Cortical reorganization in children who are blind or deaf

Aging and brain plasticity (Johansson, 2004)

- Elderly people activate more regions than younger people for motor tasks
  - Based on functional Magnetic Resonance Imaging (fMRI) and Positron Emission Tomography (PET) scans
  - Adaptable and plastic motor response network

- Effect of practice and cognitive changes
  - Individuals age at different rates

Aging and brain plasticity (Johansson, 2004)

- Finnish study found possible link between identification with age and physical and psychological well being

- Anecdotal accounts of musicians and conductors leading long and active lives
Aging and brain plasticity
(Johansson, 2004)

- Adult brain retains the capacity for structural and functional reorganization that was underestimated
  - Huntington's disease- possible environmental interaction
  - Rehabilitation after stroke and trauma
  - Sensory retraining for hand dystonia
  - Sensory re-education after hand surgery
  - Stimulating activities is associated with reduced cognitive decline during aging

Brain plasticity

- Alzheimer’s disease
  - Lessons from the Nun’s study
  - Participation in cognitively stimulating activities is associated with a reduced risk for Alzheimer’s disease
- Exercise training increases the size of the hippocampus and improves memory
  (Erickson et al, 2011)
  - Randomized controlled study of 120 older adults had less volume loss of the hippocampus

Aging brain strategies

- Delaying cognitive changes
  - High level of education
  - Exercise
  - Staying intellectually engage
  - Social and friendship networks
  - Healthy diet, antioxidants and omega 3 fatty acids
  - Vitamin E
- DCC – the receptor for a crucial protein in the nervous system (netrin) regulates the plasticity of nerve cell connections in the brain (Horn et al, 2013)
Section IV Overview:
Treatment applications across the disciplines

• Etiologies

• Functional therapy

• Treatment techniques:

Etiologies

• Stroke- often focus of plasticity literature
  – Left hemisphere
    • Hemiparesis on right side, possibly aphasia, dysarthria and apraxia
  – Right hemisphere
    • Hemiparesis on left side, generally able to communicate but cognitive impairments, left visual neglect and decreased insight into deficits

• Traumatic brain injury
  – Diffuse damage if severe often resulting in initial coma
  – Frontal lobe syndrome- difficulty with executive functions including problem solving, initiation
  – Rancho levels of cognitive functioning I-XIII

Etiologies

• Traumatic brain injury- Rancho levels
  – I coma
  – II generalized response
  – III localized response
  – IV confused
  – V confused and appropriate
  – VII automatic and appropriate
  – VIII purposeful and appropriate
Etiologies

• Dementia - progressive decline in function over time
  – Alzheimers is most common type but also Pik's disease, frontotemporal dementia, and vascular dementias
  – Mild neurocognitive disease
• Other neurological diseases
  – Huntington's disease, Parkinsons, amyotrophic lateral sclerosis
• Other medical conditions
  – Cancer, cognitive deficits following surgical procedures, urinary tract infections, etc.

Functional therapy

• Establish the goals of the client and their caregivers
• Determine the baseline
  – Typically daily routine
• What is the discharge plan?
  – Contacting family members at or near evaluation
  – Care conferences

Functional therapy

• Barrier accommodations
  – Physical barriers
  – Caregiver needs at discharge
  – Medical co-morbidities
  – Motivation
  – Device use
Functional therapy

- Patient strengths
  - Family and caregiver support
  - Cognition / language skills
  - High prior level of function
  - Motivation
    - Establish rapport with your clients and empathy
    - Clients need to be motivated and engaged to achieve learning dependent plasticity
    - Focus on learning how to learn (Carey, 2010)

- Injury prevention and re-education
  - Training of caregivers
  - Taking care of the caregivers including ourselves
  - Seat belt use
  - Fall prevention programs
  - Home safety evaluations
  - Follow up with physicians
  - Appropriate referrals
    - Home health services, geriatric psychology, audiology, denturists, and ophthalmology

Speech therapy functional screenings

- Cognition
  - Mini mental status examination
    - Orientation, naming, 3 item delayed recall, basic writing, verbal 3 step and written 1 step direction, writing sentence and copying design
  - St Louis University Mental Status examination
    - Orientation, naming item in 1 min, digit reversal, clock drawing, 5 item recall, story recall
  - Montreal Cognitive Assessment
    - Copying design, clock drawing, 5 item delayed recall, naming animals, repetition tasks, counting backward from 100
Speech therapy functional screenings

• Dysphagia
  – Mann Assessment of Swallowing Ability
    • Respiration, tongue and lip movements, bolus control

• Miscellaneous
  – Vital signs
  – Depression: Caregiver grief inventory

Treatment techniques specific to speech therapy

• Dysphagia:
  – Swallow exercises
    • Effortful swallow, masako, supraglottic swallow, shaker
  – Vital stimulation
    • Use of electrodes on the anterior neck for muscle strengthening and contraction during oral intake
  – Deep pharyngeal neuromuscular stimulation
    • Use of iced lemon glycerin swabs in the oral and pharyngeal cavity with the client swallowing after each presentation

Treatment techniques specific to speech therapy
(Kurland, Pulvermuller, Silva, Burke & Andrianopoulos, 2012)

• Aphasia
  – Constraint induced therapy
  – Used fMRI to compare PACE w/ constraint induced for individuals with moderate aphasia/ apraxia
  – Improving naming
  – 2 participants made more progress using constraint induced treatment
Treatment techniques specific to speech therapy

• Constraint induced therapy
  – Make it difficult for client to communicate actions without using spoken language

• Three dimensions of constraint induced tx:
  – Material constraints- make task difficult with increasing task complexity- massed practice
  – Modeling and shaping constraints- encouraging increasing complexity of verbal responses- communication embedding
  – Reinforcement contingencies- positive feedback based on current performance level- guidance

Treatment techniques specific to speech therapy

• Constraint induced treatment
  – Studies have shown positive affects on
    • Length of utterance, confrontation naming, grammar, standardized tests, and functional outcomes
  – Brain reorganization
    • Spared areas of function, compensatory or alternate sub networks, or right hemisphere regions

Treatment techniques specific to speech therapy

• Aphasia
  – Melodic intonation therapy
    • Recruitment of the right hemisphere to augment speech
    • Tapping of the right hand and emphasizing supra-segmental aspects of speech
    • Initially in synchrony with model and then independent repetition
Treatment techniques specific to speech therapy

• Aphasia
  – Automatic language tasks
    • Counting, phrase completion, months of the year, songs, and the alphabet
  – Anomia
    • Retrieval strategies or circumlocutions such as word description to avoid communication breakdowns

Tx techniques specific to speech therapy- Mental practice (Page and Harnish, 2012)

• Cognitive rehearsal of physical movements in the absence of physical, voluntary attempts
• Stroke induced motor speech disorders - non-fluent aphasia and apraxia
• Repetitive, task specific functional practice brings about a change
• MP as an augment to traditional treatment, stand alone, or virtual treatment via internet

Tx techniques specific to speech therapy- Mental practice (Page and Harnish, 2012)

• Rehearse activities that simulate conversation in real-world communication situation
• Provide a list of words used in a typical conversation (e.g. hello, toilet, food)
• Patient would envision themselves saying these words
• Gradually increase complexity (rehearsing “Hello, how are you” and then adding response to “I’m fine. How are you today?”) and conversational settings (other partners, ordering at restaurant)
• Could be warm up to session, client needs to be able to visualize / imagine interactions
Treatment techniques specific to speech therapy

- Right hemisphere brain dysfunction
  - Orientation
  - Memory
  - Left visual neglect
  - Decreased insight into deficits

Treatment techniques specific to speech therapy

- Traumatic brain injury
  - Rancho Amigos scale
  - Orientation
  - Attention
  - Memory
  - Caregiver training
  - Higher level cognitive tasks

Treatment techniques specific to speech therapy

- Augmentative and alternative communication methods
  - Written choice communication
    - Writing question word and 3-4 answers in bullet format
    - Survivor points to desired word and you circle it
    - Scales such as the pain scale
  - Communication notebooks and photos
  - Voice output communication aides
  - Key word input
Treatment techniques specific to speech therapy

• Dysarthria
  – Lee Silverman Voice Treatment
    • Use of sustained ‘ah’ using “LOUD” and then progressing to phrases, sentences and conversation
  – Frenchay dysarthria assessment
    • Labial, lingual movements and speech intelligibility measure

• Apraxia
  – Speech practice with progressively longer utterances
  – Repetition, repetition, repetition
  – Oral apraxia

Treatment techniques specific to speech therapy

• Cognitive communication disorders
  – Medication management
  – Family and caregiver training
  – Parkinsons - deep brain stimulators
  – Orientation
    • MMSE, MOCA, SLUMs
  – Memory
    • Ross Information Processing Assessment
  – Environmental cues
    • Calendar, memory books, call light signs

Treatment techniques specific to speech therapy

• Higher level language and cognition
  – Focus on Function
    • Verbal, reading, writing, phone and numerical skills using functional tasks
  – Co-treatment with physical and occupational therapy
    • Advanced mobility tasks such as stairs
    • Cooking
Special acknowledgement for figures

• Thank you to Dr. Seikel for use of the figures which are from:

• Thank you to my rehabilitation team at Prestige Care and Rehabilitation especially Sheri Boles, my director of rehabilitation.

References


• BRIGGS (2012). *Neurological assessment flow sheet*. Des Moines, IA.


References

References


Resources- speech therapy

- Deep pharyngeal neuromuscular stimulation — www.speechteam.com/
- Lee Silverman Voice Treatment — www.lsvtglobal.com/
- Vital stimulation — www.vitalstim.com/
• Contact information:
  rebeccadailburke@yahoo.com