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A Sensory Approach to Dysphagia Treatment: After the Cranial Nerve Exam

Presenter: Tiffani Wallace, M.A., CCC-SLP, BCS-S

Moderated by:
Amy Natho, M.S., CCC-SLP, CEU Administrator, SpeechPathology.com

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Cranial Nerve Review

Terminology

- CNS (Central Nervous System): brain and spinal cord
- PNS (Peripheral Nervous System): made up of Somatic Function (cranial nerves and spinal nerves) and Autonomic Function (involuntary smooth muscle, cardiac muscle and glands, both sympathetic and parasympathetic)

Terminology

- Afferent (sensory): impulses from peripheral tissues toward CNS
- Efferent (motor): impulses from CNS to muscles and/or glands

Terminology

- Nucleus Tractus Solitarius (NTS): Where sensory input is recognized.
- Programs the swallow in the nucleus ambiguus where sensory leads to motor.

Swallowing

- "The act of swallowing is a synergistic motor response to stimulation of afferent receptors." (Martin-Harris et al, 2008))
- Stimulation of afferent receptors leads to:
  - 1. Propulsion of the bolus
  - 2. Protection of the airway.

Swallowing

- Vision, smell, taste, touch/pressure and temperature are among the influences on normal and abnormal swallowing physiology. (Rosenbek)

CN V-Trigeminal

- Sensory (tactile facial sensation)
  - Position bolus in the mouth
  - Pocketing
  - Facial sensation
- Motor (muscles of mastication)
  - Mastication
  - Hyoid Elevation
  - Velar Elevation
- Main sensory swallowing nerve-bare nerve endings

CN V-Trigeminal

- Reflexes
  - Jaw Jerk Reflex

CN VII-Facial

- Parasympathetic (salivation)
  - Submandibular
  - Sublingual
- Sensory (taste anterior 2/3 tongue)
  - Taste
- Motor (movement of facial muscles)
  - Tone/movement cheeks
  - Lip closure
  - Hyoid Elevation

CN IX-Glossopharyngeal

- Parasympathetic
  - Parotid
- Sensory
  - Senses arrival of the bolus at the palate
  - Taste (posterior 1/3 tongue and oral pharynx)
  - Gag Reflex
- Motor
  - Pharyngeal constriction and shortening (stylopharyngeus)
  - Elevation of palate

CN IX-Glossopharyngeal

- Reflex
  - Gag (along with CN X)

CN X-Vagus

- Sensory (90%)
- Pharyngeal Plexus-General sensory
  - Taste in oropharynx (epiglottis/pharynx)
  - Sensation of residue in pharynx, larynx, esophagus

CN X-Vagus

- Motor
  - Velopharyngeal Closure
  - Vocal Fold Approximation
  - Middle/inferior pharyngeal constriction
  - Pharyngoesophageal Segment Relaxation
  - Esophageal Peristalsis
  - Gag Reflex

CN X-Vagus

- Superior Laryngeal Nerve
  - Sensation and motor above the vocal cords
  - Reflex response to material entering the space above the vocal cords is a swallow.

CN X-Vagus

- Recurrent Laryngeal Nerve
  - Sensation and motor at and below the vocal cords
  - Reflex response to material entering space is to cough.

CN XI-Spinal Accessory Nerve

- Motor Function
  - Assists with velopharyngeal closure
  - Innervates the sternocleidomastoid muscle for head turn

CN XII-Hypoglossus

- Motor ONLY
  - Power source for the tongue muscles
  - Hyoid-Thyroid Approximation
  - Hyoid Anterior Movement

CN XII-Hypoglossus

- Reflexes
  - Tongue Base Retraction
  - Lingual Groove
  - Protective Retraction

Neural Plasticity

- The ability of the brain to change

The 10 Principles of Neural Plasticity

1. Use it or lose it
2. Use it and improve it
3. Experience specific
4. Repetition matters
5. Intensity matters

The 10 Principles of Neural Plasticity

6. Time matters
7. Salience matters
8. Age matters
9. Transference
10. Interference

Sensory

Sensory Input

- Sensory input is vital to the oral, pharyngeal and esophageal phases (Steele and Miller, 2010)

Sensory Input

- Modifies esophageal swallow intensity
- Synaptically influences multiple pathways
- Triggers pharyngeal swallow response

Sensory Input

- Saliva is important to sensory; water-specific receptors in the pharynx.

What is a sensory experience?

- Sight
- Smell
- Taste
- Texture
- Temperature
- Viscosity
- Volume
- Chemesthesis

Sight

- Cranial Nerves: II, III, IV, VI
- Part of the anticipation

Smell

- Cranial Nerve I (Olfactory)
- Part of anticipation
- In Alzheimer's, Parkinson's, MS, ALS: taste not as affected as smell. (Logemann)
- Food flavors depend on smell and not on taste.

Taste

- Throw out the tongue map

Taste

- Combination of look, smell and sounds along with flavor.
- Papillae-taste buds-gustatory receptor cells-gustatory hair running through a taste pore-stimulates the cranial nerve fibers

Taste

- Five Flavors: Sweet, Sour, Salty, Bitter, Umami
- Bitter is the most diverse taste.
- CN VII, IX, X

Taste

- Strong, unpalatable sour bolus. (Pelletier & Dhanaraj, 2006)
- Moderate sucrose, high salt, high citric acid

Taste

- Sour Bolus = 50% water/50% ReaLemon at room temp (Palmer, et al 1992)
- Sour=more immediate swallow response.
- High Citrus was not effective with those with dementia. (Pelletier & Dhanaraj, 2006)

Taste

- Regardless of the type of sensory taste stim (sweet, sour, salty, bitter), the same 4 to 5 regions of the cortex are excited (Steele and Miller,2010)

Chemesthesis

- Not taste nor smell.....carbonation, hotness of a pepper, coolness of Menthol.
- Mediated by the Trigeminal Nerve; creates a trigeminal irritant.

Chemesthesis

- Pain
- Heat
- Coolness
- Tingling
- Tickle
- Itch

Chemesthesis

- Carbonation
  - No significant effect on oral transit time, pharyngeal transit time, initiation of pharyngeal swallow and pharyngeal retention. (Saravou & Walshe, 2012)
  - Did significantly decrease penetration/aspiration with 5 & 10 ml swallows.

Chemesthesis

- Carbonation
  - Drinks containing chemical ingredients that activate sour and heat receptors in the mouth alter swallowing physiology compared to water, and that greater stimulation may yield greater effect. (Krival & Bates, 2012).

Chemesthesis

- Carbonation
  - Carbonated thin liquid significantly decreased the incidence of spillover, delayed pharyngeal response and laryngeal penetration compared to non-carbonated thin liquids. (Newman et al, 2001)

Chemesthesis

- Carbonation
  - Likely that sour and carbonated beverages reflect a more organized activation of the submental muscles because of more effective afferent input to the NTS. (Miura et al)

Texture

- Food texture, hardness, cohesiveness and slipperiness are relevant for physiological behaviors and bolus flow patterns. (Steele)

Texture

- Systematic changes in bolus property indeed affected hyoid movement kinematics.
- Thickest material had the longest period of preswallow hyoid gestures.
- Larger volume=greater forward movement trajectory. (Chi-Fishman & Sonies)

Viscosity

- Changes in texture?
- Using texture as a therapeutic tool.

Changing the Bolus

- Chewy, texture, weighted bolus
- Create efferent drive and add resistance

Mastication

- There is an increased afferent drive with mastication of a bolus (Cranial Nerves V, VII)

Temperature

- Cold
- Cold + Sour + Metal (Sciortino et al)

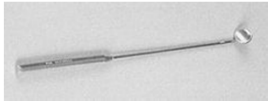
Temperature

- Cold may improve each swallow it accompanies (Steele & Miller, 2010)
- Also found the metal probes to warm to body temperature during arrival at the faucial pillars.

DPNS

- Deep Pharyngeal Neuromuscular Stimulation
- Has no published, peer-reviewed research
- Use of frozen lemon glycerin swabs, specific oropharyngeal points to elicit swallowing responses.

Thermal Tactile Stim



Thermal Tactile Stimulation

- "00" laryngeal mirror.
- Stimulate faucial arches 4-5x then assess speed of swallow.
- Repeat when swallow slows.
- Recommended dosage is 5x/day.

Thermal Tactile Stimulation

- Greatest effect when cold is combined with sour and a metal probe.

Ice Finger

- For "suck and swallow" technique; Suck 5-10 times then swallow.
- Can also fill the finger of a glove and freeze.

Volume

- Changes in volume can be therapeutic (Logemann)
- Larger bolus may be required to assist in opening the PES.

Effortful Swallow

- Increased sensory drive/motor output for:
  - Tongue base
  - Hyolaryngeal excursion
  - Pharyngeal contraction
  - Pharyngoesophageal (esophageal) opening

TheraSip

- During straw drinks, we create stronger lip seal, velopharyngeal closure, pharyngeal contraction and glossopharyngeal seal.
- Increased efferent drive with straws.

Expiratory Muscle Strength Training (EMST)

- Afferent stimulation to the brainstem swallowing centers through peripheral sensory receptors in the tongue and oropharynx, strengthening the oropharyngeal, laryngeal and supralaryngeal muscles.

Neuromuscular Electrical Stimulation (EStim)

- Increased afferent stimulation increases efferent drive.