Swallowing is considered a patterned response (Ioana and Gabriela, 2014).

Initiation of swallowing needs activation of thermo, touch, pressure and/or chemo-receptors and sensory fibers of the oropharynx, which send taste and sensory information to five pairs of cranial nerves (V, VII, IX, and fibers shared by X and XI).

This information is then transferred to groups of nuclei in the brainstem: nucleus tractus solitarius (NTS), nucleus ambiguus (NA) and the area located in the surrounding reticular formation.

The nuclei then need supramedullary input to enable initiation of motor commands. These commands are sent through six pairs of cranial nerves (V, VII, IX, fibers shared by X and XI, and XII) to the end organs—e.g., the oropharyngeal muscles.

Pharyngeal components of swallowing are controlled mainly by subcortical networks. Oral phases, which are voluntary, are under cortical control.
Single-event-related fMRIs have identified multiple regions of cerebral activation associated with the volitionally triggered swallow (Hamdy et. al., 1999)

The most pronounced were in the anterior cingulate cortex, caudal sensorimotor cortex, premotor cortex, insular and frontal opercular cortex, and temporal cortex, with differing levels of cerebral lateralization.

HOW DO WE DEFINE DYSPHAGIA?

Many definitions exist

- Any disruption of bolus flow from the lips through the upper esophageal sphincter.
- Any abnormal physiology of the oropharyngeal swallow, regardless of aspiration
- Aspiration

STATISTICS

- Between 23-50% of patients experience dysphagia following a CVA (Sing & Hamdy 2006)
- Methods and timing of studies likely account for such a wide discrepancy
- How we describe “dysphagia” is also critically important Martino, Pron & Diamant (2000)
- Aspiration as a consequence of dysphagia vs aspiration as a requirement to have “dysphagia”
There is a high incidence for both dysphagia and pneumonia after CVA.

The pneumonia risk is greatest in stroke patients with aspiration. (Martino et al., 2005)

In the post stroke population, dysphagia carries a sevenfold increased risk of aspiration pneumonia. (Singh & Hamdy, 2006)

Dysphagia is an independent predictor of mortality after stroke. (Singh & Hamdy, 2006)

Dysphagia is typically transient (Smithard et al., 1997)

- typically resolved within the first 7 days
- 22% of patients were found to have aspiration under fluoroscopy (video fluoroscopic swallow study or VFSS completed typically on day 2)
- Repeat VFSS at 1 month: 15% were still aspirating

Any food, liquid, or substance that pass below the true vocal folds
ASPIRATION PNEUMONIA

- Seminole study: Langmore et al., 1998
- The best predictors for the development of aspiration pneumonia were: dependence for feeding, dependence for oral care, number of decayed teeth, tube feeding status, more than one medical diagnosis, number of medications, and smoking status
- They concluded that dysphagia was an important risk factor for aspiration pneumonia, but because aspiration alone does not predict pneumonia, other risk factors also play a role.

ASPIRATION PNEUMONIA CONT.

- Risk factors for developing aspiration pneumonia:
  - Poor oral hygiene, the overuse of sedative medications, impaired immunity, reduced mucociliary transport, and depressed lung function due to aging (Komiya, Ishii, & Kadota 2015)
  - Sputum suctioning, deterioration of swallowing function (last 3 months), dehydration, and dementia. (Manabe, Teramoto, Tamiya, Okochi, & Hizawa, 2015)

MALNUTRITION

- Abnormal nutritional status is common following a CVA.
  - Dávalos et al (1996) found that 16% of patients at the onset of the study (immediately following CVA) were malnourished
  - After the first week after admission this jumped to 26%
  - After the second week it climbed to 35%
  - This was despite early, aggressive enteral nutrition in patients with dysphagia in the acute phase
MALNUTRITION CONT.

- Malnutrition after CVA has been identified in as much as 50% of patients entering a rehabilitation unit (Finestone, Greene-Finestone, Wilson, & Teasell, 1995).
- Dysphagia was highly correlated with malnutrition upon admission to Rehab.
- Despite high admission rates with malnutrition, malnutrition dropped significantly throughout rehab.
- This was thought to be due to the use of feeding tubes and declines in dysphagia with subsequent liberalization of diet recommendations.

SITE OF LESION PLAYS AN IMPORTANT ROLE

- Cola et al. (2010) found
  - Lesions to the left periventricular white matter may be more disruptive to swallowing behavior than similar lesions to the right PVWM.
  - Swallowing deficits involving oral control and transfer may be a marker of subcortical neural axis involvement.

SITE OF LESION CONT.

- According to Paciaroni et al. (2004)
  - Dysphagia was more frequent in patients with hemorrhagic stroke.
  - In patients with ischemic stroke, the arterial territory of the total middle cerebral artery was more frequently associated with dysphagia.
  - Regarding anatomical clinical correlation, the most important factor was the size of the lesion rather than a specific location.
EVALUATION

SCREENING FOR DYSPHAGIA

- Immediately following a CVA, early detection of dysphagia is important
- Screeners by RNs are often utilized to assess for potential dysphagia and prompt a more thorough evaluation
- “A bedside screening ought to be sensitive, specific, and easily administered without extensive training, and it needs to be time, as well as, cost-effective” (Kertscher, Speyer, Palmieri, and Plant, 2014).
- Identified 4 bedside screening tests
  - Volume-Viscosity Swallowing Test (V-VST)
  - Toronto Bedside Swallowing Screening Test (TOR-BSST)
  - 3 oz Water Swallowing Test
  - Cough Test (Mist of citric acid)

EVALUATING DYSPHAGIA

- Typically broken down into two categories
- Bedside or Clinical Swallow Evaluations
- Instrumental Swallowing Evaluations
  - Fiberoptic Endoscopic Examinations of Swallowing
  - Modified Barium Swallow Studies (videofluoroscopy)
THE CLINICAL SWALLOW EVALUATION

- Also known as the bedside swallow evaluation
- Typical components
  - detailed case history
  - an oral mechanism exam
  - initial PO trials to screen for potential difficulties requiring additional instrumental assessment

MODIFIED BARIUM SWALLOW STUDIES (MBSS)

- Aka videofluoscopy or videofluoroscopic swallow study
- Completed under fluoroscopy utilizing radio-opaque barium liquids
- Typically referred to as "the gold standard"

MBSS PROS AND CONS

- Pros
  - able to visualize the oral pharynx through the cervical esophagus
- Cons
  - exposes the patient to radiation (albeit a low dose) (Singh, 2006)
  - Conducted under "ideal" circumstances
  - Few trials are typically provided given time constraints
  - You have to utilize a barium contrast which limits foods you can attempt
FIBROPTIC ENDOSCOPIC EXAMINATIONS OF SWALLOWING (FEES)

- Completed utilizing a nasendoscope advanced through the nasopharynx into the pharynx allowing direct visualization of the larynx before and after the swallow
- can be completed in conjunction with an MD or completed independently by an SLP

FEES PROS AND CONS

Pros
- can be completed at the bedside
- no radiation exposure
- literally any food/liquid can be consumed allowing a broader ability to generalize findings or trouble shoot problem foods

Cons
- requires additional training
- requires special equipment which can be cost prohibitive in many settings
- cannot view the oral phase of the swallow
- has a “white out period”
- cannot visualize the cervical esophagus

IS THERE REALLY A GOLD STANDARD?

- lets see them both simultaneously
- https://www.youtube.com/watch?v=9JNAOxa3JvM
MBSS EXAMPLES

- Lateral plane, A-P plane, and Esophageal sweep
  - https://www.youtube.com/watch?v=T1WoZZYMWDc
- Aspiration
  - https://www.youtube.com/watch?v=i04vq_aYiBg

FEES EXAMPLE

- Normal 100 year old
  - https://www.youtube.com/watch?v=LuCwBqfYfYM
- Aspiration after the swallow
  - https://www.youtube.com/watch?v=j-iWVCbQquU

SO IS THERE REALLY A GOLD STANDARD?

- When it comes to assessing dysphagia the gold standard is an instrumental assessment
- both FEES and MBSS have their advantages
- in our post stroke patients there are often times when completing both can provide valuable information
TREATMENT

NEUROPLASTICITY

- Has been defined as functional reorganization/compensation within residual neural tissue, mediated by changes in neural circuitry (Rothi, Musson, Rosenbek, & Sapienza, 2008)
- Return of swallowing after dysphagia inducing stroke has been shown to be associated with increased pharyngeal representation in the unaffected hemisphere. (Hamdy et. al., 1998)
  - Suggests a role for intact hemisphere reorganization in recovery.

PRINCIPLES OF NEUROPLASTICITY

- Langmore and Pisegna (2015)
  - Use it or loose it
  - Use it and improve it
  - Specificity
  - Transference
  - Intensity
  - (repetition and time?)
Compensatory Measures

- Many treatment approaches look to utilization of food and liquid thickeners to help make foods/liquids “safer” to swallow.
- However, no significant difference were found in the risk of pneumonia in aspirating patients who consumed thin liquids with safety strategies vs patients who consumed thickened liquids only. (Kaneoka et al., 2017)
  - Only for patients with low risk of pneumonia.

Swallowing maneuvers

- chin tuck
- head turn/tilt
- effortful swallow
- supraglottic swallow
- super supraglottic swallow
- valsalva

Use of enteral feeding often with the intent to “prevent” aspiration

- PEG tubes
- NG tubes
- J-Tubes

Remember feeding tube status is a better predictor of aspiration pneumonia than dysphagia.
COMPENSATE AND REHABILITATE CONT.

- Rehabilitation can be broken down into two major categories
  - Strengthening exercises
  - Skills based training

STRENGTHENING EXERCISES

- Expiratory and inspiratory muscle strength trainers
- IOPI (tongue bulb)
- Mendelsohn maneuver
- Effortful swallows
- Chin tuck against resistance
- Masako maneuver
- Shakers (isotonic and isometric)

SKILLS BASED TRAINING

- Huckabee and Macrae (2014)
- Three key ingredients for successful skill acquisition include:
  - specificity of practice
  - task challenge
  - feedback
SURFACE ELECTROMYOGRAPHY (SEMG)

- Biofeedback is provided during swallow attempts to assist the patient in maintaining the requested duration of each swallow attempt and to provide immediate information on the degree of effort associated with each swallow.
- Supra hyoid placement is typical, but electrodes can be placed in a variety of locations.
- After an average of 12 therapy sessions, 92% of post stroke patients showed improvement on the Functional Oral Intake Scale (FOIS) (Crary et al., 2004).

THE ROLE OF NEUROPLASTICITY WHEN CONSIDERING TX OPTIONS

- “Practicing” impaired swallowing through ingestion of a safely tolerated diet may facilitate pulmonary safety, but has no therapeutic benefits. However, systematically challenging the system in a controlled therapeutic environment may facilitate recovery. (Huckabee & Macrae 2014)

THE FUTURE OF TREATMENT

- Brain and peripheral neurostimulation is a rapidly developing area of research in dysphagia management (Hamdy 2010)
  - Repetitive Transcranial Magnetic Stimulation (rTMS)
  - Transcranial Direct Current Stimulation (tDCS)
  - Peripheral Stimulation
  - Intermittent Paired Associative Stimulation (IPAS)
IN SUMMARY

- Swallowing is a complex, patterned response involving both cortical and subcortical networks.
- An instrumental assessment is the only method of investigating dysphagia. Everything else is an educated guess, but a guess nonetheless.
- Utilizing the principles of neuroplasticity the best treatment for dysphagia is swallowing. In order to help reorganize the unaffected side, you must challenge the system by consuming a wide variety of foods and liquids.

REFERENCES


REFERENCES CONT.


