Updates on Dysphagia Management

Maine Speech Language Hearing Association
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Learning Objectives

Upon completion of this course, participants will be able to...

1. Distinguish between normal aging impacts on swallowing and dysphagia
2. Choose exercise and sensory swallow interventions that are targeted to specific swallow impairments
3. Discuss risks and benefits of dietary modifications for individuals with pharyngeal dysphagia

Challenges in Dysphagia Management

Large amounts of information, sometimes conflicting

- Wide variety of sources - websites, journals, fellow clinicians
- Myths vs. anecdotal info vs. evidence

And…It's Complicated

- >25 muscle pairs
- 6 cranial nerves
- Cortical structures
- Subcortical structures
- Brainstem functions
- Assessment of sensory input
- Coordination with respiration, cough functions

Resulting in…

Rapid coordinated, sequenced activity in approximately one second!

Practice patterns of SLPs

Case review by 254 SLPs (internet survey)

- 47 different interventions recommended
- No single combination of therapies was repeated exactly across respondents
- Only 3.9% of respondents reported choosing their recommendations based on *physiologic abnormality*
- **58% of recommendations did not match specific dysphagia symptoms**

Carnaby and Harenberg, 2013

Identification of Swallowing Impairments

Online survey; review of videofluoroscopic swallow studies

Respondents were asked to identify physiological impairments; cases ranged in complexity from easy to complex

- SLP's were able to identify the primary impairment with 67% accuracy for the "easy" case, 6% accuracy for the "moderate" case, and 6% accuracy for the "complex" case

Vose, et al, 2018

And…

- On average, SLP's ***mistakenly identified 8 impairments*** that were actually WNL
- Treatment recommendations varied widely
- Rationales for treatment were generally not related to physiological impairments

Our Study

Survey of school-based speech-language pathologists

Case review of school aged-child with dysphagia

- 57% of respondents opted for direct intervention
- 29 unique treatment plans
- No two respondents recommended the same diet modifications and safe swallow strategies

Felicetti et al, 2020

What's getting in our way?

- Insufficient training in re: normal swallow variability
- Focus/training on bolus flow rather than impairments
- Lack of access to instrumental assessment
- Evidence base is emerging, not well established
- ***WADITWay!*** ("We've always done it this way")

Implementation Science

It takes an average of 17 years for research findings to be adapted into everyday practice!

Balas and Boren, 2000; Green et al, 2009; Bauer et al, 2015

Field of implementation science evolved to facilitate the spread of EBP

Implementation Science can help us answer:

- Is the intervention appropriate to the purpose, context?
- Has it been operationalized in a way that allows for implementation?
- Do those responsible for implementation have the necessary competencies?
- What are the organizational barriers? Supports?

Easterling, 2016

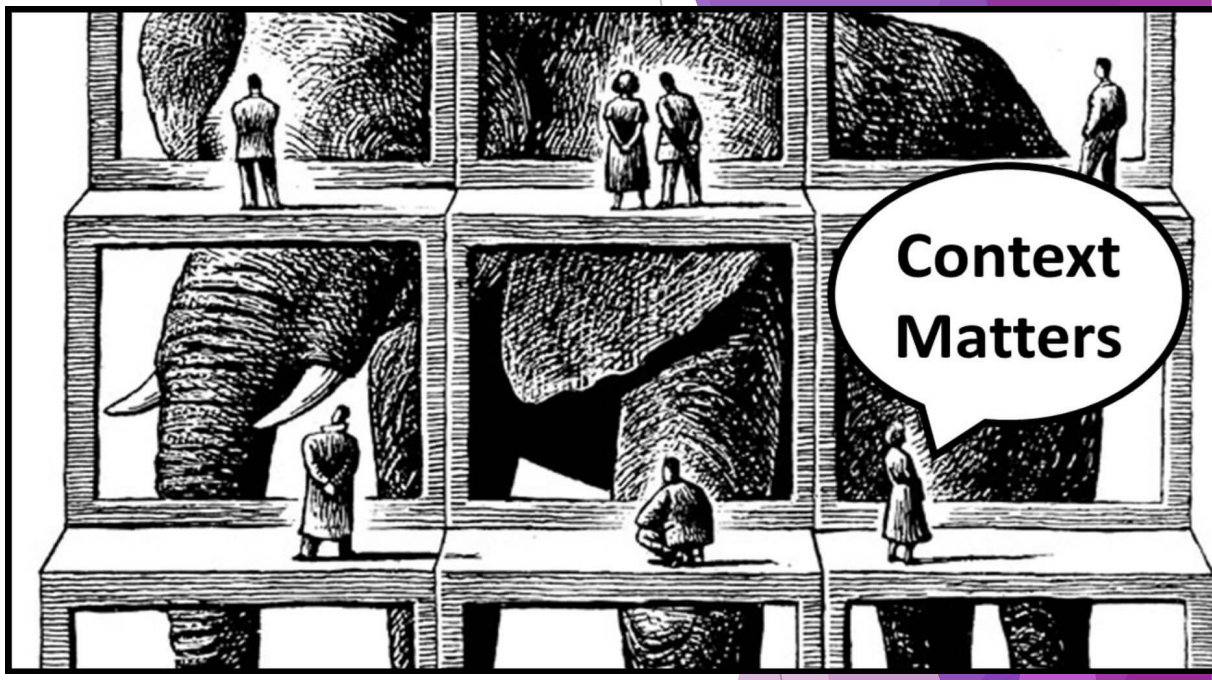
And Context Matters...

Patient characteristics

- Medical diagnosis – i.e. what is the ***cause*** of the dysphagia?
- Comorbidities – especially those that impact respiratory, renal, immune, GI system function
- General health – mobility, oral health, degree of dependence/disability

Aspirate characteristics

- Acidity?
- Amount?
- Weight/Viscosity?

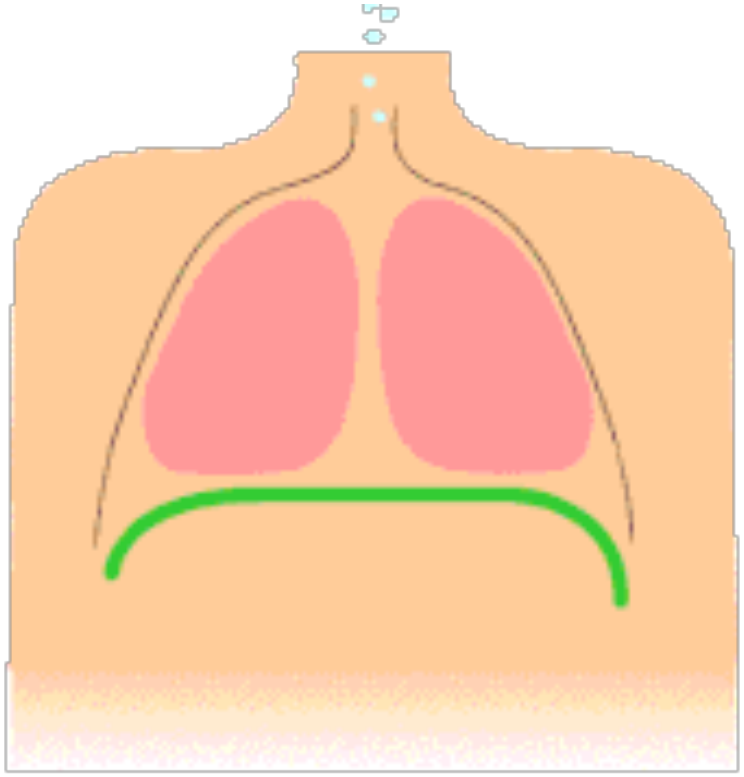


Questions for This Workshop (And For Our Field)

- How can we widen our perspective to consider the whole person? (**What happens in one part of the body, impacts what happens in other parts of the body…)**
- What are the benefits ***and risks*** of our dietary interventions? Who is actually appropriate for dietary intervention and who is not? And who decides?
- Which interventions (exercise, sensory interventions, compensatory strategies) are appropriate for ***which underlying impairments***? In other words, how can we avoid "everything and the kitchen sink"?

If You Can’t Breathe, You Can’t Swallow…

Dysphagia in Respiratory Diseases



Breathing-Swallow Coordination

1. Respiratory-Swallow Patterning (exhale-swallow-exhale)
2. Lung Volume Initiation (low-middle to middle lung ranges or 42-55% of vital capacity)
3. Respiratory Pause Duration (0.5 to 1.5 seconds)

Curtis and Troche, 2020

What Do We Know About COPD?

- ***Obstructive*** lung disease
- CO-2 retention
- Hyper-inflated lung – lower laryngeal resting position
- Oxygen, ventilation support?
- High respiratory rates; low oxygen saturation
- Impaired laryngeal sensation
- GERD

And…

Dysphagia and aspiration can be contributing factors to Acute Exacerbations of COPD (AECOPD)

Cvejic et al, 2021; Terada, 2010; Lin and Shune, 2020; Kobayashi et al, 2007

Dysphagia and COPD

151 patients with stable COPD underwent swallow studies – self paced swallowing and fast paced serial swallows:

- 19.9% demonstrated ***aspiration***
- 13.2% demonstrated ***pharyngeal retention***
- 20.5% demonstrated ***esophageal retention*** (in absence of obstruction)

Cvejic et al, 2021

COPD - Why Dysphagia?

- Decreased laryngeal sensitivity
- Impaired breathing/swallow coordination
- Laryngeal resting posture/movement
- Fatigue and sarcopenia
- Gastro-Esophageal Reflux Disease (GERD)

Impaired Laryngeal Sensation

Patients with COPD had significantly higher threshold for triggering Laryngeal Adductor Reflex (LAR)

Clayton et al, 2012

Impaired laryngeal sensation resulted in increased frequency of pooled secretions in pharynx

Borowsky da Rosa et al, 2021

WHY?

- Inhaled steroids?
- Xerostomia?
- GERD? (*More on this later*)

Q2

Impaired Respiratory-Swallow Coordination

Patients with COPD:

- More likely to demonstrate post-swallow inhalation pattern - especially with boluses requiring oral management (semi solids, solids)
- More likely to swallow at lower lung volumes
- Higher respiratory rates

Gross et al, 2009; Cassiani et al, 2015, Epiu et al, 2021; Drulia et al, 2021

Is It All About Volumes?

Compared volunteers with COPD and healthy elderly (n= 9, 10 respectively)

- COPD patients swallowed at lower lung volumes...But...
- When lung volumes were increased (using biofeedback), there was less frequent post-swallow inhalation

Why? Volume alone? Fb from stretch receptors? Something else?

Drulia et al, 2021

Laryngeal Resting Posture

- Hyperinflation creates traction effect on larynx
- Elevation to epiglottis takes longer, is less efficient
- Laryngeal position mid-swallow is lower than in normal

Mokhlesi et al, 2002

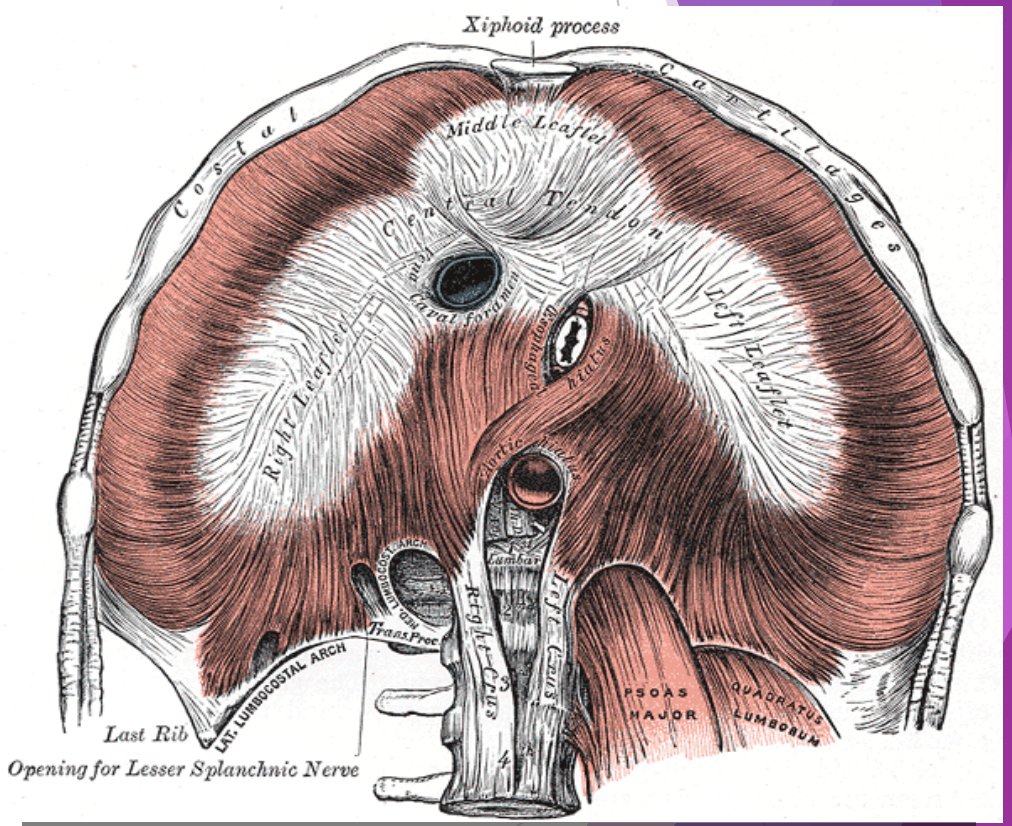
Sarcopenia and Fatigue

- Dyspnea, increased work of breathing
- Chronic hyperinflation causes rapid fatigue
- Decreased food intake due to early satiety
- Higher respiratory rates
- Impaired lingual pressures, tongue strength (maybe – evidence is equivocal)

Lin & Shune, 2020; Sugiya et al, 2021; Gonzalez & Lindh et al, 2021

COPD and GERD

- Flattened diaphragm in COPD results in decreased abdominal pressure (muscle lowers to a lesser degree) and increased lung volume – LES is misaligned
- Hyperinflated lung compresses esophagus, stomach
- ***Aspiration of reflux*** triggers COPD exacerbations



Henry Vandyke Carter,Public domain, via Wikimedia Commons

COPD and GERD

And…

- Increased WOB slows stomach emptying
- Bronchodilators lower the tone in the LES
- Chronic hypoxia deoxygenates gastric mucosa, alters pH; impairs integrity of the mucosa
- Reductions in airflow, increased coughing lower tone in LES
- Stress of dyspnea triggers reflux episode

Significant link between COPD and Reflux-related complications (esophagitis; stricture; esophageal cancer; Barrett's esophagus)

Wang et al 2023

Q1

COPD and Dysphagia
What Should We Look For?

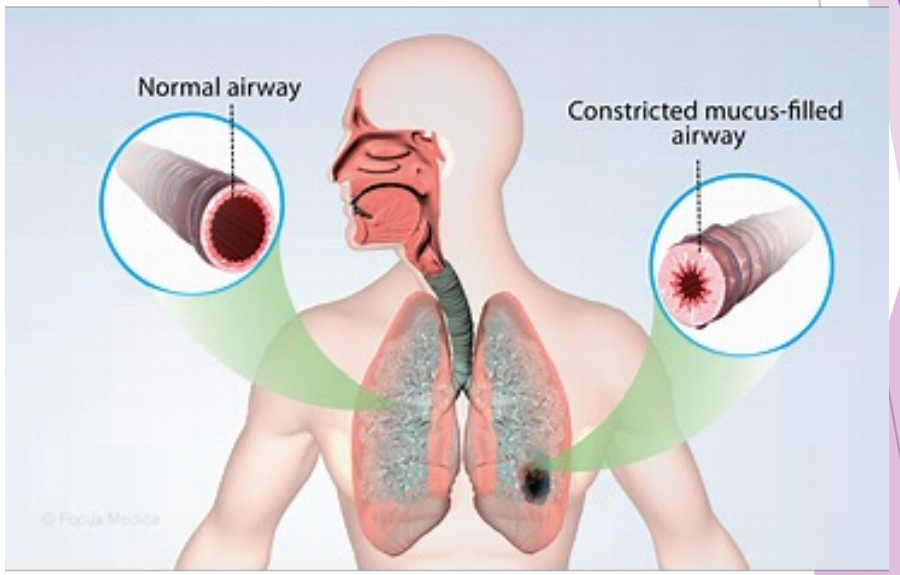
Systematic review of swallow function and COPD:

- Longer oral and pharyngeal transit times
- Delayed swallow response
- Decreased laryngeal elevation
- Longer duration laryngeal vestibule closure
- Pharyngeal residue
- Laryngeal penetration and aspiration
- Impaired breathing/swallow coordination
- More likely to swallow at low lung volume
- Voluntary use of longer laryngeal closure times

Ghannouchi et al 2016

What Do We Know About Asthma?

- *Chronic* airway inflammation with mucous production, airway narrowing
- Symptoms include wheezing, dyspnea, chest tightness, cough
- Exacerbations or “attacks” may be triggered by allergens, cold, exercise



Asthma and Dysphagia

Is there a connection?

- Asthma results in reduced lung volumes and dyspnea
- Often overlaps with COPD, GERD

But...dysphagia not well studied in this population

Why Dysphagia in Asthma?

Again, not well studied but possibilities include...

- Impaired respiratory-swallow coordination
- Sensory alteration secondary to use of inhaled steroids
- GERD with resulting acid exposure to larynx, pharynx

Dysphagia and Asthma
What Should We Look For?

- Lingual weakness, discoordination
- Pharyngeal residue
- Multiple swallows per bolus
- Prolonged pharyngeal transit times

Scarpel et al, 2021

What Do We Know About Obstructive Sleep Apnea (OSA)?

Repeated complete or partial episodes of pharyngeal collapse during sleep

- Upper airway dysfunction
- Repetitive airway obstruction
- Upper airway resistance
- Apnea, hypoxemia
- Snoring

OSA Results in...

- Reduced blood oxygenation
- Excessive daytime sleepiness
- Fatigue
- Headache

And...

- May be implicated in the development and/or exacerbation of CAD, arrhythmias, DM, hypertension

OSA and Dysphagia

Recent systematic reviews:

- Dysphagia prevalence in patients with OSA ranges from 16 – 78%

  Bhutada et al, 2020

- No relationship between OSA severity and likelihood of dysphagia but snoring patients are at higher risk

  Ghannouchi et al, 2016

Why Dysphagia in OSA?

Unclear..

- Chronic hypoxia?
- Sensory changes?
- Neural injury?
- GERD?

May resolve with CPAP treatment

Is Sleep-Time Dysphagia the Problem?

Two patients with recurrent aspiration pneumonias and normal swallow function (while awake)

- Assessment of respiration - swallowing ***during sleep*** revealed more frequent post-swallow inhalation

Sato et al, 2021

OSA: Post-Surgery

Uvulopalatopharyngoplasty; coblation channeling of tongue; radiofrequency ablation of tongue base, soft palate

- Odynophagia
- Laryngeal penetration
- Reduced hypopharyngeal pressures; increased stasis
- Reduced UES opening
- Globus
- GER

Kato et al, 2017; Schar et al, 2018; Corradi et al, 2018

Nocturnal GER

It happens to all of us...

- UES pressure decreases during sleep
- Swallow frequency decreases in sleep which decreases primary peristalsis frequency
- Secondary peristalsis decreases in deep sleep as well

Meta-analysis revealed a significant correlation between OSA and GERD (Wu et al, 2019)

Incidence of LPR in individuals with OSA = 45% (Magliulo et al, 2018)

OSA and GERD

Comparison of patients with OSA and healthy controls during sleep

Both groups had similar non-acidic GER episodes

But...Patients with OSA:

- More acidic GER
- Prolonged acid clearance

Xiao et al, 2012

What's the mechanism? Possibly *negative intrathoracic pressure* related to increased respiratory effort?

OSA and Dysphagia
What Should We Look For?

- Delayed swallow response
- Longer respiratory pause
- Increased dwell times and pharyngeal stasis
- Premature oral spill into pharynx with liquids

Wang, et al, 2016; Shah et al, 2018, Caparroz, et al, 2019; Campanholo et al, 2021; Pizzorni et al, 2021; Valbuza et al, 2011

What Do We Know About COVID-19?

- Novel strain of ***coronavirus***
- Gains entry to cells via angiotensin-converting enzyme-related carboxypeptidase (ACE2) which are mostly in ***cardiopulmonary*** tissue – but also in white blood cells and brain neurons
- Infects mucosa of ***upper airway***
- Dysphonia, dysphagia, laryngeal hyper-sensitivity frequent sequalae (Shah et al, 2023)

Why Dysphagia in COVID-19?

It’s Complicated...

- Sensory changes
- Neuronal injury
- Cytokine storm
- Proning
- Respiratory-Swallow Discoordination
- Respiratory Failure; Post-extubation dysphagia
- GI dysmotility

Neuronal Injury

SARS CoV particles have been found in human brain neurons

- May travel along vagus nerve, to nucleus ambiguous (would explain loss of smell, taste)
- Entry to brain via olfactory bulb?
- Infected leukocytes enter brain?

COVID 19 and CVA

- Often otherwise asymptomatic; some develop COVID symptoms later
- Most commonly large-vessel ischemic strokes but small asymptomatic infarcts have been identified on MRI
- Often patients <50

WHY?

- Hypercoagulation?
- Release of microparticles?
- Afib? Direct cardiac injury?
- Blood vessel injury?
- Inflammation destabilizes carotid plaque?

Cytokine Release Syndrome

- Cytokines: Small **peptides**; produced by a number of cells including **white blood cells**; facilitate **communication between cells**, particularly in the immune system
- In the presence of infection, immune system releases cytokines to **coordinate the immune response**
- Very high levels of cytokines are released resulting in:
- Hypotension
- Mental status changes
- Dysphagia
- Acute kidney injury
- ARDS
- Multi-organ failure

And/Or…

Bradykinin Storm

- Bradykinins are peptides that fight infection by promoting inflammation
- In COVID 19 patients, bradykinins may flood multiple systems resulting in…
  - Arrythmias, heart failure, hypotension
  - Pulmonary edema, “hydrogel”
  - Encephalopathy, headache, cognitive changes
  - Ischemia
  - Myalgia

Proning

- COVID 19 patients with severe illness may have difficulty maintain oxygen saturation despite mechanical ventilation
- For these patients, 12-18 hours of prone position is often recommended – “Swimmer’s position”
- Also utilized with non-ventilated patients successfully
- Facilitates alveolar recruitment; less pressure required to open alveoli
- Reduces the weight of the body on the lung
- Facilitates fluid drainage
- Decreases work of breathing by decreasing pressure on lungs from abdominal organs

Damarla et al, 2020; Taboada et al, 2020; Matthews et al, 2021

But…

- Increases likelihood of saliva aspiration
- Makes oral hygiene difficult
- Increases likelihood of airway injury

Potential for:

- Facial wounds
- UE weakness, shoulder injury
- Pressure injuries – knees, breasts, iliac crest
- Oropharyngeal edema due to hyperextension of neck
- ET tube obstruction

Munshi et al, 2017 ; Le et al, 2020

GI Issues

Esophageal and Gastric Dysmotility common in critically ill patients – why?

- Reduced salivary clearance
- Sedating medications
- Supine body position
- Sepsis and hypoventilation lower LES pressure

So…aspiration of gastric contents not uncommon

Ladopoulos et al, 2018

But…

Some evidence to suggest that PPIs may increase COVID risk

Almario et al, 2020

COVID 19 and Dysphagia
What Should We Look For?

- Impaired Respiration-Swallow Coordination
- Frequent post-swallow inhalation
- Dyspnea with swallowing
- Swallow response delay
- Pharyngeal weakness
- Fatigue, fatigue, fatigue!

It’s Not Over When It’s Over...

“Long” or Post-Acute COVID

- Not well defined but increasingly reported
- Generally considered to indicate symptoms that persist or occur 3-4 weeks post initial onset of COVID
- Pathogenesis is undefined at this time – crosses age groups and severity levels

Korompoki et al, 2021

What Do We Know About Acute Respiratory Distress Syndrome (ARDS)?

Serious, widespread lung injury; fluid accumulation in alveoli with resulting hypoxemia

Treated with:

- Oxygen and *ventilation*
- Prone positioning
- Medication for pain, fluid mgt.
- Other treatments specific to underlying cause(s)

Post-Extubation Dysphagia

Aspiration risk increases immediately post extubation

- Residual effects of sedating meds; delirium; decreased level of alertness
- Alteration in airway sensitivity
- Potential for glottic injury
- Disuse atrophy
- Weakness
- GERD secondary to medication, supine position, NG tube
- Reduced breathing-swallow coordination

Post-Extubation Dysphagia (PED)

- Prolonged duration (>48 hours)*
- Age > 55
- Poor pre-morbid functional status
- Increased duration ICU stay
- Repeated intubations
- Upper GI dysfunction
- Kidney disease, CHF
- COVID; proning

May increase aspiration risk

*Durations <12 hours result in reduced risk and risk increases for each additional 24 hour period

Why Dysphagia in ARDS/PED?

Usually more than one issue…

- Underlying illness
- Weakness
- Medications
- Breathing-swallow discoordination
- Post-intubation changes – laryngeal trauma, impaired sensation

When “Acute” Becomes Chronic

Tracheostomy

- Long term vent dependence (“long” is relative...)
- Secretion management
- Airway obstruction

Tracheostomy Benefits

- Decreases work of breathing
- Reduction of sedation associated with endotracheal tube
- Improved oral care (as compared to ET tube)
- Options for mobility
- Options for communication
- Facilitates weaning
- Reduced risk of laryngeal trauma
- More comfortable
- Easily replaced

AND:

- Return to oral feeding

Timing of Conversion

Does it matter when ET tube is converted to trach?

No agreement as to what “early” or “late” means

Large RCT; patients randomized to trach at day 4 vs day 10 (Young et al, 2013)

- No difference in mortality
- <half of the “late” group actually needed trach at day 10

How do we know who is going to need prolonged ventilation?

Timing of Conversion

Rumbak et al, 2004 reported ***lower mortality rates*** and ***lower pneumonia rates*** in patients who converted early (within 48 hours)

Siempos et al, 2015 reported ***lower pneumonia rates*** but ***no impact on mortality*** in patients who converted within 7 days of intubation

Review by Andriolo et al, 2015 identified some evidence to suggest ***lower mortality rates*** in patients with early tracheostomy (</= 10 days) but no guidance re: specific patient populations

Filice et al, 2021 completed large retrospective (but not randomized review) and found patients with early trach (</= 7 days) has ***shorter LOS***, ***lower mortality***, and ***higher likelihood of d/c to home***

Here's What We Do Know...

Issue re: early v late outcomes is unresolved as to ***overall*** outcomes but...

*Fewer intubation days improves **dysphagia** outcomes:*

- Intubation durations <12 hours result in reduced risk of dysphagia

AND

- Risk increases significantly after 48 hours and continues to increase as intubation becomes more prolonged (Skoretz et al, 2014; Kwok et al, 2013)

Does Tracheostomy Cause Dysphagia?

- 7-100% of pts with trachs demonstrate aspiration; may be higher in older patients
- Aspiration is often silent
- Risk may decrease when trach has been in place 3 weeks or more

Do trachs cause dysphagia and aspiration?

Let's look at the evidence...

Do Trachs Cause Dysphagia?

Comparison of patients in three conditions:

- Tracheotomy tube in and open with a 5-cc air-inflated cuff; tracheotomy tube in and capped with deflated cuff; and tracheotomy tube out (decannulated)
- ***No differences*** in laryngeal elevation or hyoid displacement

Terk et al, 2007

Swallow studies pre-post decannulation in patients with brain injury

- No differences in laryngeal elevation, aspiration, or pharyngeal transit
- But...decannulation did improve pharyngeal residue and upper esophageal sphincter opening

Kim et al, 2015

Patients with HNC

- Compared closed trach tube to decannulation
- ***No differences*** in swallow function parameters

Galli et al, 2020

But…

All of these studies necessarily involved patients ready for decannulation

Who actually is the “trach patient”?

Trauma? Head/Neck Cancer? Stroke? Respiratory Disease? Neuromuscular Disease?

So what do we know?

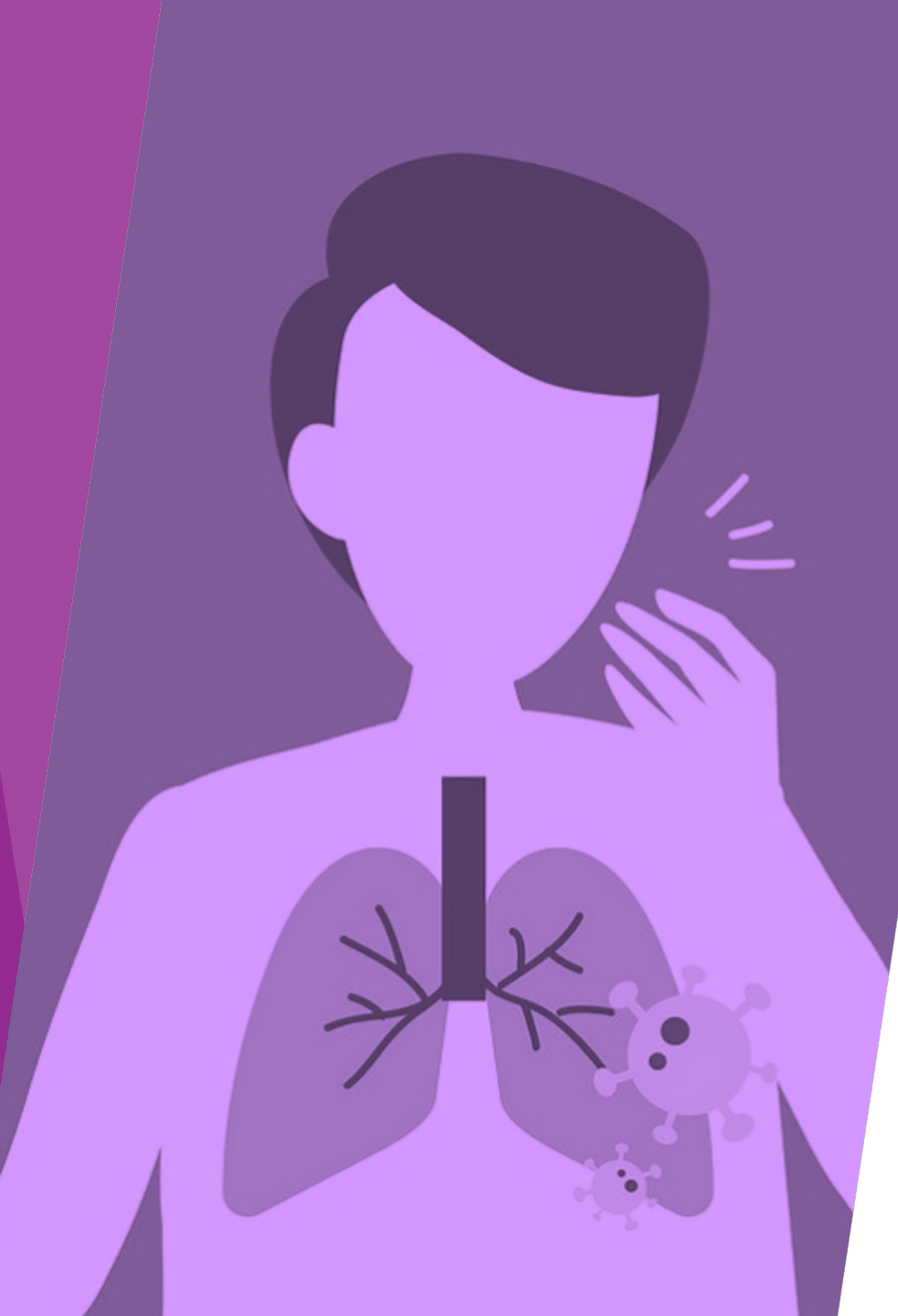
Swallow outcomes are highly variable (Skoretz et al, 2020)

Tracheostomy Impacts

- ***Subglottic pressure*** changes
- ***Loss of expiratory airflow*** – cough, sensation, taste, smell, voice
- ***Decreased PEEP*** secondary to open valve – decreases potential for oxygenation
- ***Cuff issues*** – esophageal impingement can result in reflux, trauma, decreased transit
- ***Inability to Valsalva*** – toileting, exercise, equilibrium

ARDS/PED/Tracheostomy and Dysphagia What Should We Look For?

- Impaired respiratory-swallow coordination
- Impaired laryngeal sensation – silent aspiration
- Weak cough
- Delays in swallow response
- Oral/pharyngeal muscle weakness; disuse atrophy
- Generalized weakness, fatigue



Impaired Cough Predicts Impaired Swallow

Cough Development

- In vitro and early infancy: rapid swallows; laryngeal constriction; apnea
- Cough response develops later (6 mos +)

Reflexive Cough

Reflexive Cough Components

- *Inspiration Phase* (diaphragm contracts – lung volume increases)
- *Compression Phase* (vocal folds adduct; respiratory muscles contract)
- *Expiratory Phase* (vocal folds abduct; high expiratory flow; bronchi narrow to increase force generation)

A great deal of variation exists, however

Cough epoch – successive coughs after a single inspiration

Multiple coughs – successive coughs separated by inspirations

Also

Expiratory reflex – closure of the glottis without prior inspiration

But...this is dependent on sufficient lung capacity (most swallows occur at middle range of lung volumes...which is sufficient for expiratory reflex to occur)

Widdicombe and Fontana, 2006

Glottal Closure reflex/Laryngeal Adductor reflex:

Bilateral thyroarytenoid muscle response to mechanical or chemical irritation of the laryngeal mucosa

Domer et al, 2013

Cough

Reflexive cough is dependent on "urge to cough"

In subjects who can estimate their urge to cough..

- Urge increases
- Cough intensity increases
- Voluntary control increase

Davenport, 2008, 2009

So…perhaps we should be asking clients about this?

Neurophysiology of Cough

- Airway ***sensory nerve activation***
- ***Cough receptors*** in larynx, traches, bronchi (also pericardium, esophagus, diaphragm, stomach)
- Cough receptors in airways are both ***chemical and mechanical***
- ***Pulmonary stretch receptors*** – appear to regulate duration and magnitude of inspiration and expiration during cough
- ***Medullary and cerebellar control*** – reflexive cough; cortical control – voluntary cough
- Activation of ***vagus, phrenic, and spinal motor nerves*** – relaxes diaphragm, activates expiratory and accessory muscles

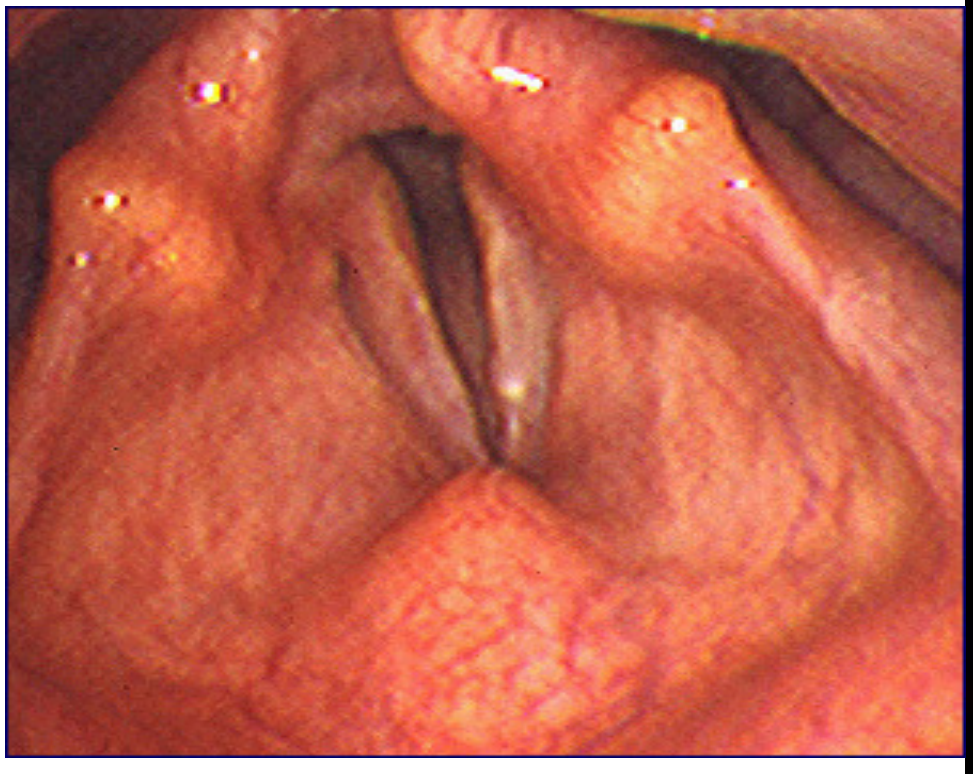
Cough motor output is dependent on type of irritant, volume of irritant, duration of irritant, and lung volume at cough initiation

Troche et al, 2014

Reflexive Cough

- Medullary “cough center”
- Variation in neurological mediation - vagus, peripheral nerves
- Evidence to suggest that different irritants produce cough along different neural pathways
- In Larynx/Trachea triggered largely by mechanical stimulation
- Bronchial cough generally triggered by mucus, edema
- Laryngeal enervation not necessarily needed to trigger

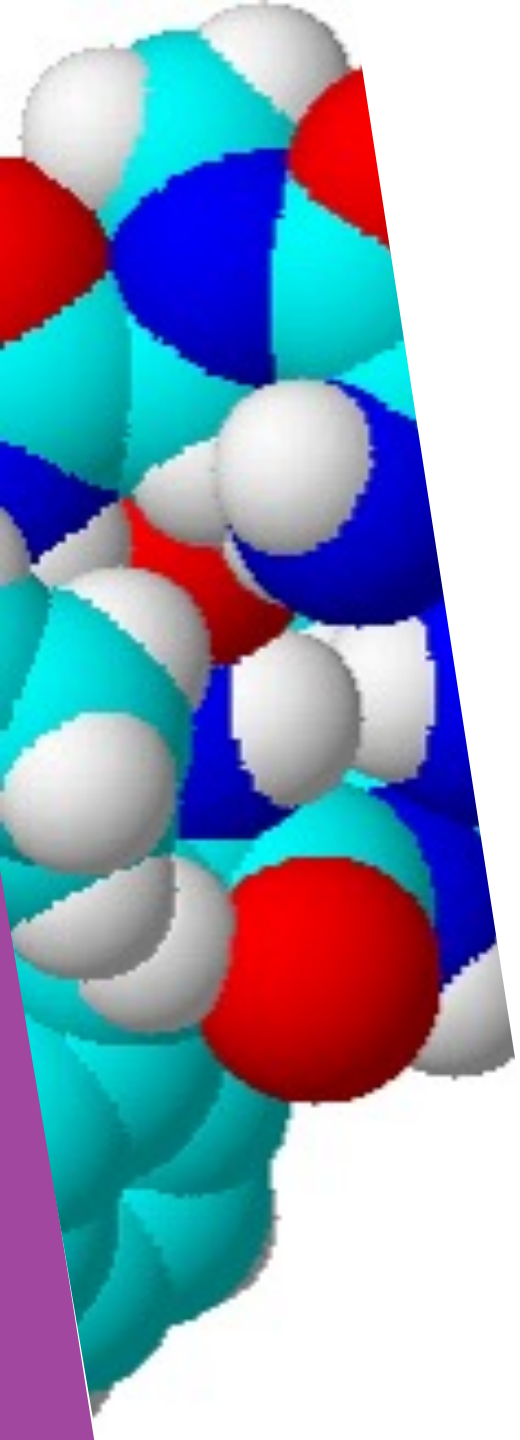
Cough



Cough

Cough and angiotensin-converting-enzyme (ACE) inhibitors

- Used to treat HTN, CHF (e.g. Capoten/captopril, Vasotec/enalapril, Altace/ramipril)
- Reduce tension in blood vessels, reduce blood flow
- Increase cough sensitivity; lower cough threshold; i.e. people who take them cough with less stimulation
- Some evidence to suggest that they could prevent aspiration and aspiration pneumonia (Marik, 2003)



Substance P

Peptide that transmits signals from sensory nerves to CNS. Important for pain transmission, emotional responses, ***cough and swallow***

- Reduced in patients with dysphagia (Kishida et al, 2013)
- Low Substance P in stroke patients correlated with low frequency of spontaneous swallowing (Niimi et al, 2018)
- Beta blockers may increase Substance P levels and protect against dysphagia (Miarons et al, 2018)
- Pharyngeal e-stim increased Substance P levels in stroke patients and improved swallow outcomes (Muhle et al, 2017)

Cough Assessment

Reflex cough testing via irritant

- **Tartaric acid** dissolved in water and nebulized - Pneumoflex (Addington, et al 2005)
- **Citric acid** mist via nebulizer (Wakasugi, et al, 2008; 2012; Guillen-Solla et al, 2015; Lee et al, 2014)
- **Capsaicin** via nebulizer compared to aerosolized water (Hegland, et al, 2016)

Variable outcomes overall...

Cough Assessment

What about voluntary cough?

"Modest" relationship between *voluntary* cough and aspiration/penetration in patients with PD

Pitts, et al, 2008

Reduced peak expiratory flow in voluntary cough differentiated ALS patients with and without dysphagia

Plowman, et al, 2016

Impaired Cough Predicts Impaired Swallow

Reductions in Peak Expiratory Flow Rate (PEFR) have been demonstrated to predict aspiration, dysphagia severity

Pitts et al, 2008

Pitts et al, 2010

Hegland et al, 2014

Silverman et al, 2016

Impaired Cough Predicts Impaired Swallow

Acute Stroke patients:

Measured pharyngeal residue via VFSS; assessed cough via peak flow meter

- Weak cough correlated with increased pharyngeal residue

Lee et al, 2015

Measuring Peak Flow

<200 lpm likely to be ineffective

Bianchi et al, 2012; Silverman et al, 2014; Sakai, et al, 2019

Cough Assessment

“Urge to Cough”

Perception of cough stimuli and need to cough

UTC distinguished between PD patients with mild and severe dysphagia (Troche, et al, 2016)

Patient rating may be useful.

Please rate your **urge to cough**:

0 None at all

1 Very slight

2 Slight

3 Moderate

4 Somewhat severe

5 Severe

6

7 Very, very severe

8

9

10 Very, very, very severe (almost maximal)

Curtis and Troche, 2020

Improving Cough via EMST

10 patients with PD and some degree of restrictive lung disease

EMST resulted in:

- Increases in ***maximum expiratory pressures***
- Increases in ***cough volume acceleration***

Functionally, increased cough acceleration improves shearing forces and ability to remove material from the airway

- As a result, ***decreased aspiration/penetration*** (as measured by PA scale)

Pitts et al, 2009

And…

- ACE inhibitors?
- Increasing Substance P?
- Medication changes?

- Oral care? (Watando et al, 2004)

Aggressive daily oral care for 30 days increased cough sensitivity

Thick Liquids and Cough Response

180 inpatients referred for FEES due to question of dysphagia; varying diagnoses

Compared thin and thick (mildly thick) fluids

Thicker fluids decreased aspiration likelihood, particularly at small volumes

But...

Higher likelihood of silent aspiration with thick fluids

Miles et al, 2018

Presbyphagia, Frailty, and Sarcopenia: Dysphagia and Aging

- Photo: US National Archives

Normal Aging

Presbyphagia: Changes in swallow function in otherwise healthy aging adults

Not dysphagia!

So, what does it look like?

Normal Aging

Presbyphagia:

- Decreased lingual pressures
- Slower swallow response
- Longer swallow apnea duration
- Reduced tension in UES
- Cricopharyngeal noncompliance – stiffening – results in narrowing of UES
- Decreased sensation
- Sarcopenia (decreased muscle mass)
- Decreased efficiency of nutrient absorption
- Reduced functional reserve

Normal Aging

Which results in…

- Slower transit times
- Longer dwell times
- Increased laryngeal penetration
- Slowed esophageal motility; gastric emptying
- Increased nutritional need (due to decreased absorption)

Defining Some Terms

Sarcopenia:

Progressive, generalized loss of muscle mass and function

Frailty: (this one is trickier – no agreed upon definition)

- Accumulation of abnormalities
- Reduced potential for compensation

Eventually a critical point is met which negatively impacts the entire system

Frailty and Dysphagia

Growing evidence to suggest that frailty associated with

- Dysphagia
- Aspiration
- Malnutrition

Wakabayashi, et al, 2015; Hathaway, et al 2014; Takeuchi, et al, 2014; Banda et al, 2021; Sella-Weiss, 2021, Bahat et al, 2019

Frailty and Dysphagia

Recent review of records from Healthcare Cost and Utilization Project National Inpatient Sample

Data from 6 million hospital discharges patients 50+ years of age from 2014-2015 (excluding accident/injury, maternity, substance abuse)

Dysphagia prevalence 4% overall

Dysphagia rate in frail individuals: 11%

Cohen et al, 2020

Frailty and Dysphagia

Assessment of 45 frail elderly patients via VFSS

- 63% demonstrated oro-pharyngeal residue
- 57% demonstrated laryngeal penetration
- 17% demonstrated aspiration

Physiological deficits included reduced lingual propulsion and impaired hyo-laryngeal excursion

Rofes et al, 2010

Frailty and Dysphagia

VFSS Studies of 190 patients with frailty/deconditioning and dysphagia not attributed to another cause

Followed for three months

- Pneumonia rate in the group was approx. 25%
- PAS scores 3, 7 and 8 had highest likelihood of pneumonia

Chang and Kwak, 2021

Hip Fracture Population

Assessed post surgery for dysphagia in three studies:

- Dysphagia found in 34%; 54%; 55% of population
- Risk factors = pre-existing neuro and resp co-morbidities, delirium, age, living in a residential facility prior to admission, impaired ADLs prior to surgery

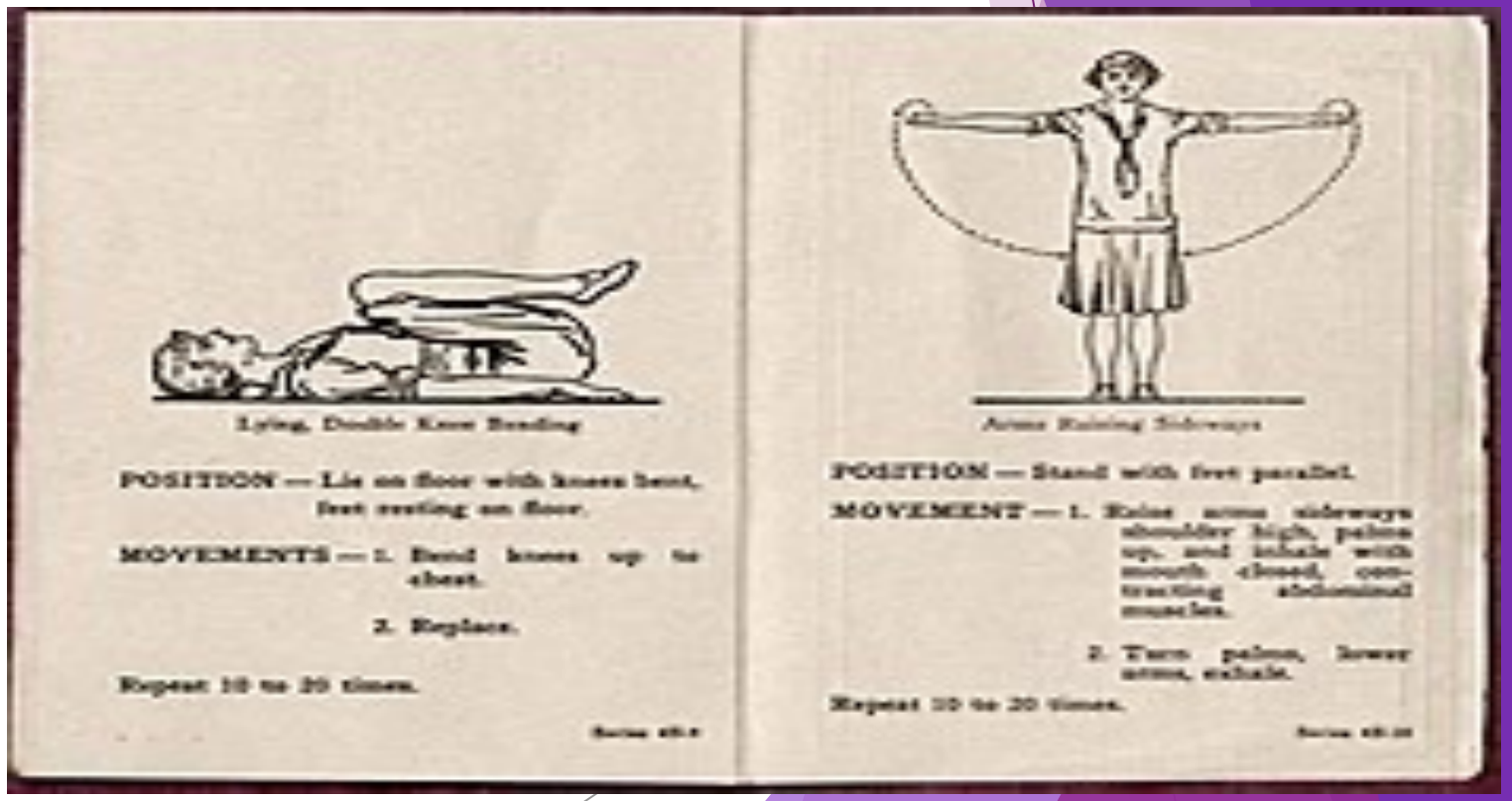
Love, et al, 2013; Madsen et al, 2020; Mateos-Nozal, et al, 2021

Assessment Considerations

- Endurance – assess over time
- Fluctuations in performance – assess at different times of the day
- Strength – assess with hard to chew foods
- Consult with PT, OT – strength? Mobility? Falls?

Choosing Targeted Interventions

First, a Few Words about Exercise



Lying, Double Knee Bending

POSITION — Lie on floor with knees bent, feet resting on floor.

MOVEMENTS — 1. Bend knees up to chest.

2. Replace.

Repeat 10 to 20 times.

Arms Raising Sideways

POSITION — Stand with feet parallel.

MOVEMENT — 1. Raise arms sideways shoulder high, palms up, and inhale with mouth closed, contracting abdominal muscles.

2. Turn palms, lower arms, exhale.

Repeat 10 to 20 times.

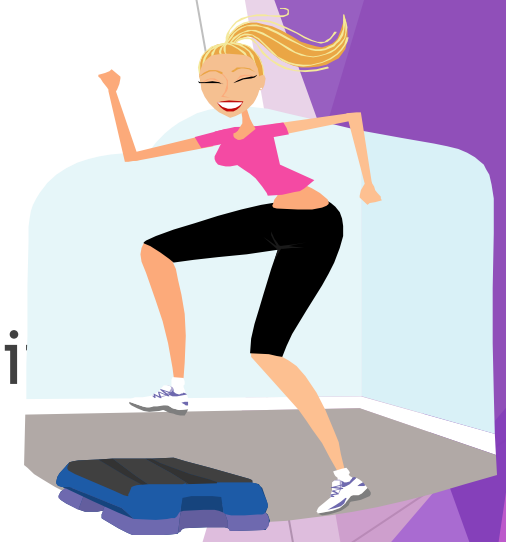
Exercise Principles

Intensity

Load – must exceed the typical demand

Exercise Frequency - # of training sessions per uni
of time

Progression: Systematic increase in resistance, contraction velocity, duration



Exercise Principles

Targets?

Skill - acquisition and/or refinement of movement sequences – (via combinations of motor sequences)

Strength – Increased force capacity – (via resistance)

Endurance – Capacity for continuous motor output – (via repetition)

Exercise Principles

Specificity - Exercise does not generalize

- Target the muscles exhibiting the weakness
- Target movements related to feeding, swallowing

But…

Is some transference possible?

- Unilateral strength training in upper and lower extremities has been shown to improve strength in the ***opposite, untrained*** limb

Munn, et al, 2005; Lee, et al, 2009; Kidgell, et al, 2011

Exercise Principles

Detraining

- Occurs more rapidly than training
- Atrophy; decreased mass
- Muscle fiber shift to fast fatiguing
- Neuroplasticity implications
- Prevention?

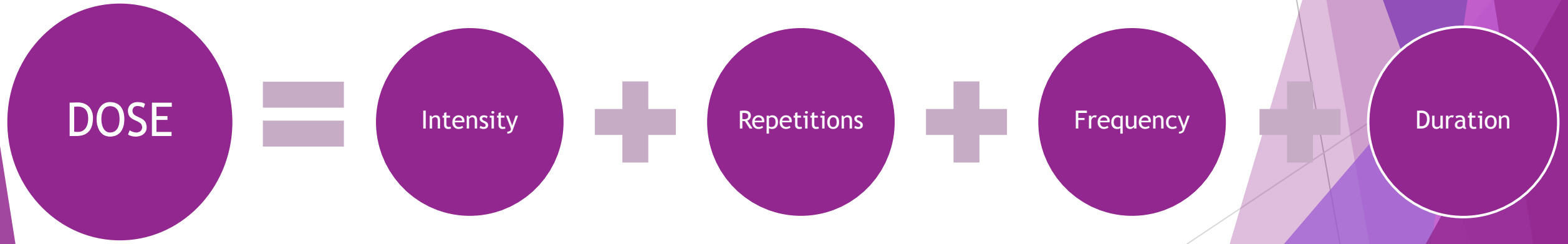
So…Who is a Candidate for Exercise?

- Weakness, low endurance – consider underlying etiology – is this reversable?
- Exercise for maintenance – appropriate in early stages of degenerative conditions
- Is this a condition that is exacerbated by fatigue?
- Potential to complete activities with ***high frequency and intensity***
- Potential for ***progression***

What's Your Number?

Exercise Dose

Well studied in limbs, trunk musculature; limited information for head/neck muscles



Dose

Limited agreement dose reported in the literature but *most commonly reported* as follows:

EMST = 5 sets of 5 repetitions 5 days/week (at 60-75% of capacity generally)

Lingual exercise = 30 repetitions 3 x/day x 7 days/week

Shaker/CTAR = 30 repetitions 3x/day x 7 days/week x 6 weeks

Choy et al, 2023; Krekeler et al, 2021

Dose

General Recommendations (Krekeler et al, 2021)

Resistance exercise

- Frequency: 2-4x/day; 2-3x/week
- Repetition: 8-12; increase # as patients age; increase # if endurance is goal (rather than strength)
- Intensity: 70-80% of capacity; reduce to 50% for endurance training
- Duration: 8-12 weeks

Flexibility/Stretching

- Frequency: 2-4x/day; 2-3x/week; may increase to 7days/week if needed
- Repetition: 10-30 seconds stretch each stretch; may increase to 60 seconds if needed
- Intensity: stretch to point of slight discomfort
- Duration: not specified

A Change in Thinking About Exercise

Focus on ***Skill Training*** rather than strengthening

- "Acquisition of skill through repetition and refinement of movement patterns" (Huckabee and Burnip, 2018)
- Goal = acquisition (or re-acquisition) of a specific skill (or skills)
- Incorporates principles of motor learning
- Biofeedback is an essential part of the process to ensure accurate task performance and subsequent retention of motor pattern(s)
- More stable over time than strengthening – can continue to access even after a period of no practice.

Motor Learning Principles

Healthy swallow systems are flexible and adaptable...so how do we re-develop those qualities?

- *Attention and Motivation* - external rather than internal focus (i.e. focus on residue clearance rather than on tongue movements)
- Specificity – focus on entirety of task rather than components
- *Structured practice* – but with some variability
- Repetition at high intensity
- Increasing challenge for *refinement of task*
- *Feedback* – again, focus on fb re: task completion

Similar to exercise physiology, right? *But focus is on motor planning rather than strengthening….* **Cortical** *learning is the goal*

Practice (Makes Perfect)

Blocked Practice **-** practicing the same skill under the same conditions repeatedly (e.g. effortful swallow with saliva)

- More rapid improvement
- Slower transfer to other conditions

Random Practice – practicing a skill (or a variety of skills) under a variety of conditions (e.g. effortful swallow with a variety of foods, liquids)

- Slower improvement
- Facilitates transfer to other conditions
- Requires more adaptation

Ideally, incorporate both into your plan

Also…

Adaptation

- Motor learning that occurs in a short time frame
- Adjustment of movements through trial and error in presence of new demand

Error Based Learning

- Brain makes calibrations to predict consequence of movements and to prevent errors

What About *Mental* Practice?

Principles borrowed from sports medicine

May be beneficial for...

- Patients at high aspiration risk
- Patients with very low endurance, who fatigue quickly
- Patients with movement disorders

Completed in isolation and/or in conjunction with physical movement or exercise

See Braun et al, 2008 and Caldas et al, 2018 for reviews

Effects of lingual exercise may be enhanced by addition of mental practice

Synkiewicz et al, 2021

Mental imagery of swallowing results in activation of cortical and subcortical swallow network

Kober and Wood, 2014; Kober et al, 2019

When the Target Is...

Breathing-Swallow Coordination

Expiratory Muscle Strength Training

www.emst150.com

EMST by Population

- **MS** – increased cough effectiveness in patients with moderate levels of disability; no research in re: swallow efficiency
- **Elderly** – improved cough pressures, effectiveness
- **PD** – improved swallow safety (changes in PAS scores); improved hyolaryngeal movement; improved cough effectiveness
- **COPD** – decreased dyspnea; reduced WOB
- **CVA** – improved urge to cough; cough effectiveness
- **ALS** – improved MEP; improved DIGEST scores (Plowman et al, 2019)

See Troche, 2015, Hegland et al, 2016 and Xie et al, 2021 for reviews

EMST Contra-Indications

- *Untreated* hypertension
- *Untreated* GERD
- Hiatal hernia

COPD/ALS – Lower resistance than other populations (recommendation is generally 50% of load)

Post-Swallow Exhalation – Can We Re-Train It?

- Patients with persistent dysphagia
- Visual feedback (illustrations; computerized fb)
- All subjects achieved mastery of post-swallow exhalation
- Improved laryngeal closure, reduced pharyngeal residue; reduced aspiration per MBS studies

Martin-Harris, et al, 2015; Tran et al, 2018; Curtis et al, 2020

When the Target is…

Cough

Improving Cough

As discussed, EMST improves cough response in:

- Elderly subjects
- Individuals with PD
- Individuals with MS
- CVA survivors

Cough Skill Training

Subjects with movement disorders

- Used peak flow meter to measure “hard coughs” with biofeedback
- Variable practice – 25% above and 25% below PEFR
- Results: increased mPEP and PEFR

Sevitz et al, 2022

Subjects – individuals with PD and normal aging adults

- Used spirometry to measure “hard coughs”; biofeedback
- Results: increased PEFR in both groups

Brandimore et al, 2017

Sensori-Motor Training for Airway Protection (smTAP)

- ***Strength + Skill Based program***
- Subthreshold dose of capsaicin – subject assesses urge to cough
- Initiates voluntary “hard cough” with biofeedback
- Target = 25% > PEFR
- Resulted in ***improved PEFR*** in patients with Progressive Supranuclear Palsy (Borders et al, 2022) and ***improved PEFR and reflexive cough*** response in patients with PD (Troche et al, 2023)

Photo:

Borders et al, 2022

When the Target is...

Tongue Strength and Bolus Management

Lingual Strengthening

Iowa Oral Performance Instrument

- Progressive resistance
- As isometric pressure increased, oral pressures during swallowing also improved
- Increased ***bolus transit***, decreased aspiration

See Smaoui et al 2020 for review

www.IOPImedical.com

Lingual Strengthening

Tongue press to palate

- Improved ***anterior and posterior tongue strength*** in healthy adults (Lin et al, 2020)
- Improved ***oral and pharyngeal efficiency*** in individuals with dysphagia after stroke when combined with effortful swallow and Shaker exercise (Cho et al, 2017)

Lingual Strengthening

Tongueometer

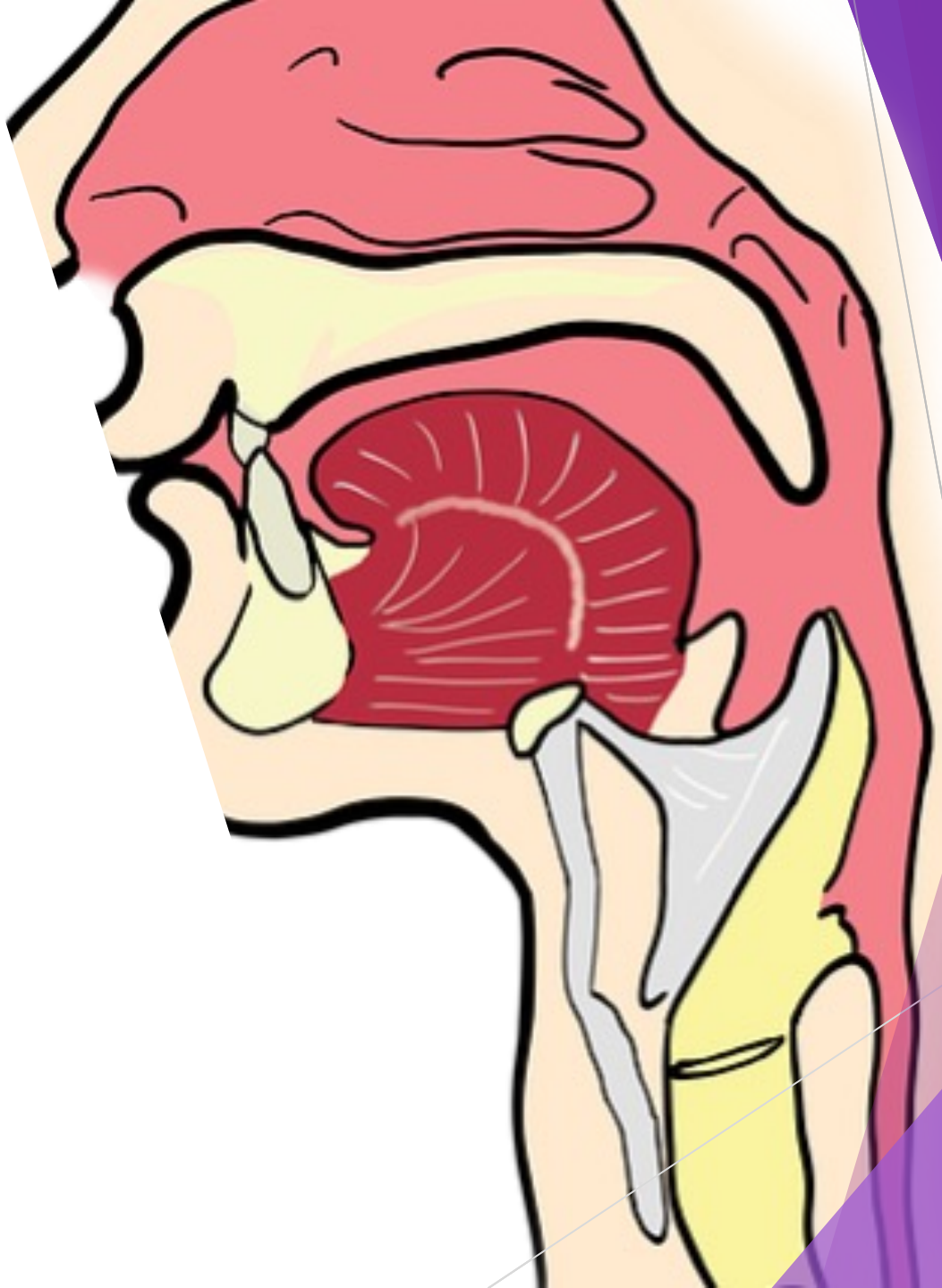
- Tongue strengthening device
- Substantial agreement in pressure when compared to IOPI (Curtis et al, 2023)
- https://www.craniorehab.com/Tongueometer

Effortful Swallow

- With or without bolus
- Increased **pressure generation** between tongue and palate; between tongue base and pharyngeal wall, in velopharyngeal region, and in UES region
- May be contra-indicated in cardiac patients (Gomes, et al, 2016)
- Emphasize tongue to palate squeeze (Huckabee et al, 2007; Park and Kim, 2016).
- Progression via increasing bolus size? Viscosity?

When the Target Is...

Hyo-laryngeal Excursion



Masako Maneuver/Tongue-Hold

- Increased muscular load; may strengthen pharyngeal constrictors

But…

- Resulted in *decreased* pharyngeal pressures and *reduced* UES opening in one study
- May place laryngeal vestibule in less protected position
- ***Must protrude tongue as far as possible for maximal impact***

Fujiu, 1996; Lazarus, 2002; Doeltgen et al, 2011; Doeltgen et al, 2017, Oh, 2019; Fujiwara, et al, 2018

Shaker Head Lift

Head lifts against gravity (skull is heavier than larynx – increases resistance)

Results in…

- Increased hyolaryngeal excursion
- Improved UES opening
- Increased strength in suprahyoid musculature
- Improved bolus clearance
- Reduced aspiration

Shaker, 2002; Easterling, et al, 2005; Mepani, et al, 2009; Park et al, 2017; Choi et al, 2017; Fujiki et al, 2019

But...perhaps not in HNC patients (Petersson et al, 2023)

Chin Tuck Against Resistance (CTAR)

Modification of Shaker

- Seated position -- Compression of an inflatable ball or device betwee and sternum

Compared to Shaker…

- Greater sEMG activation of supra-hyoid muscles
- Participants reported increased comfort

Improvements in…

- Pharyngeal residue
- Laryngeal elevation
- Overall airway protection

Kraaijenga, et al, 2015; Hughes and Watts, 2016; Park et al, 2018, Kilinc et al, 2020; Park and Hwang, 2021; Liu et al, 2023

Head Extension Exercise

Swallow saliva with head fully extended with “normal” or “effortful” swallow

- Provides resistance to **supra-hyoid muscles**

- Pilot study with healthy subjects resulted in increased muscle activation in “effortful” condition but not in “normal” (Oh, 2016)
- Eight week program with healthy elderly resulted in increased swallow pressures (Oh, 2018)

Jaw Opening Exercises

Goal = strengthening **suprahyoid muscles**

Mylohyoid, anterior belly of digastric and geniohyoid are involved in jaw lowering AND hyoid excursion

Wada, et al, 2012; Kraaijenga, et al, 2015

Against Resistance

- Elastic loops around head

Oh and Kwon, 2018

High Speed Jaw Opening

- Maximal jaw opening, as fast as possible; every 2 seconds
- 20 reps/set; 3 sets; 10 second break between sets; 2x/day x 4 w

Matsubara, et al, 2018

Results

Significant improvements in:

- Vertical hyoid movement
- UES opening
- Muscular strength, volume

Lee Silverman Voice Treatment (LSVT®)

Program to improve vocal intensity, speech intelligibility in Parkinson's Disease via high phonatory effort

- Improvements in **lingual lateralization, oral transit time, oral clearance, pharyngeal clearance in patients with PD** (El Sharkawi et al, 2002)
- Improved **UES opening**; increased **pharyngeal constriction**; in patients with PD (Miles et al, 2017)
- Improved timeliness of **UES opening** in patients with dysphagia without HNC (Nozaki et al, 2021)
- Improved **swallow efficiency** overall in patients with dysphagia and MSA or PD (Park et al, 2022)

When the Target Is... Endurance:

Physical therapy interventions (without specific swallow exercise) improved tongue strength and oral intake

Nagano et al, 2020

Whole body exercise has potential to improve swallow function

Pu and Yao, 2023

A New Look at Diet Modification

Empowering Patients (and ourselves) to..

- Weigh risks and benefits
- Make informed choices

Modified Texture Diets

+

- Reduced risk of choking
- Improved oral bolus management

−

- Low palatability may impact intake
- Higher caregiver burden
- Low nutrient density
- Potential for social isolation

The Case *for* Texture Modification

- Texture modification combined with supplementation and oral hygiene program ***reduced respiratory infections and hospital readmissions*** (Martin et al, *2018)*
- ***Improved energy intake and weight gain*** in patients with chronic dysphagia (Germain et al, 2006)
- Particles of >1.5 cm^2 (approx. ¼ in) may constitute a ***choking*** hazard for people with dysphagia (Steele et al, 2015)

The Case *Against* Diet Modification

In Skilled Nursing Facilities…

- 50%-70% of residents leave 25% or more of their food uneaten at most meals
- Both chart documentation of percent eaten and the MDS are notoriously inaccurate
- 60%-80% of residents have a physician or dietitian order to receive dietary supplements.
- 25% of residents experienced weight loss when research staff conducted standardized weighing procedures over time.

Dining Practice Standards, 2011

Potential for Nutritional Compromise

- Addition of fluids ***dilutes caloric and protein density***
- Pureed diets often ***do not provide adequate amounts of protein*** (Dahl, et al, 2007, Vucea et al, 2017)
- Texture modified meals and snacks often ***fail to provide adequate calories, protein*** (Bannerman and McDermott, 2011)
- Associated with ***low quality of life*** (Swan, et al, 2015)
- ***Inconsistent*** nutritional intervention for people with dysphagia (Eglseer et al, 2018)

Palatability

Interviews with clients eating texture modified diets:

- Lack of sensory appeal
- Food items indistinguishable from each other
- ***Percent reporting enjoyment of eating = 0%***

Keller and Duizer, 2014

- Strong association between texture modification and poor appetite

Shimizu et al, 2021

Thickened Liquids

Potential to decrease aspiration risk

May decrease coughing; increase comfort

Poor palatability; low intake

SIGNIFICANT DEHYDRATION RISK

Added cost

Increased caregiver burden

Potential for social isolation

Positive Impacts

- Reduces choking, coughing, discomfort and associated stress
- Increases comfort in end of life patients

Lippert et al, 2019

Literature Review:

- Potential for improved airway protection

Newman et al, 2016

BUT…

Thickening does ***not*** have a positive impact on QOL, hydration, lung health, death (Beck et al, 2018; Newman et al, 2016)

And…

Can increase pharyngeal residue in patients with dysphagia (Vilardell et al, 2016; Newman et al, 2016; Clave et al, 2008)

Can increase silent aspiration (Miles et al, 2018)

Impact on Quality of Life

What patients say:

- “awful” and “vile”
- “it was like wallpaper paste”
- “You had to keep stirring it or it would go into little balls and be terrible”
- “like poison”
- “It looked like frog spawn”

McCurtin et al, 2018

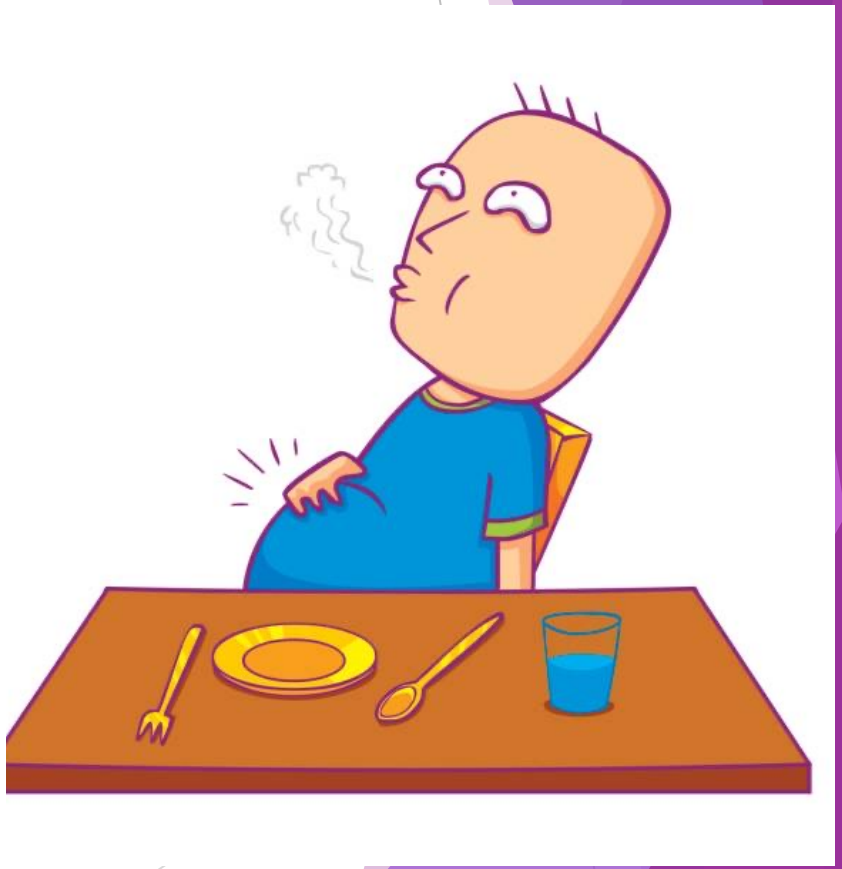
Adherence

May improve with addition of food flavoring

Vidal-Casariego et al, 2021

Thickeners and Satiety

- Added fiber adds to feeling of fullness
- Slower oral transit increases exposure to taste, texture receptors
- Liquids thickened with guar gum do not separate; digested more slowly
- Also slowed nutrient absorption, continuous satiety signals are generated



Cichero, J., 2013

Lung Impacts...In animals:

Rabbits' lungs instilled with water, corn starch thickened water, xanthum gum thickened water

- Survival rate of water group was 100%
- Survival rate of corn starch group was 12.5%
- Survival rate of xanthum gum group was 100% but...higher rate of pulmonary inflammation, interstitial congestion and alveolar edema than other groups

Nativ-Zeltzer et al, 2018

Thickening Impacts

Protocol 201

Randomized controlled study – three conditions: chin down, nectar liquids, honey liquids

Part I: What works immediately?

Part II: What are longer term implications?

Logemann, et al, 2008

Robbins, et al, 2008

Adverse Events Associated with Thick Liquids

Systematic Review Recent of 33 studies (Werden Abrams et al, 2023)

- Dehydration
- Pneumonia
- Death
- UTI
- Hospitalization
- Reduced quality of life
- Aspiration
- Reduced intake
- Increased residue
- Reduced medication bioavailability

What's Your Plan for Hydration?

- Offer liquids more frequently – fluid rounds, tea times or "happy hours"
- Choose foods with higher fluid content (fruits, vegetables, yogurt, e.g)
- Provide additional fluid with medication administration
- Consider carbonation
- Try different temperatures, flavors of liquids
- Consider naturally thick liquids or natural thickeners - e.g. potato flakes, quinoa flour (Baert et al, 2021)

NPO/Tube Feeding

Reduced risk of prandial aspiration	Swallow disuse atrophy
Potential to improve nutrition (depending on underlying diagnosis)	Medical complications – GERD, xerostomia, problems at tube site
	Increased cost of care; increased caregiver burden
	Social isolation

Diet Modification and QOL

Systematic Review of literature re: impact of bolus modification on quality of life in patients with dysphagia

Limited studies but...

As bolus modifications increased...quality of life decreased

Swan et al, 2015

Diet Modification in Elderly Individuals

Weigh risks and benefits of any diet modification

- Potential for further disuse atrophy?
- Potential impact on medication availability?
- Access? Need for assistance?
- Risk of dehydration, nutritional compromise related to decreased intake

The Clinician's Role

How can we facilitate autonomous decision making?

- Motivational interviewing
- Facilitating "hard" conversations
- Support for action planning
- Providing informational support

Motivational Interviewing

A “collaborative, conversational style of questioning and listening”

Goal is to identify the client’s motivation, readiness for change

Miller and Rollnick, 2013

- Allows clients to weight costs and benefits of health care choices
- Promotes active participation

Leslie et al, 2021

Tools include:

- Open-ended questions
- Clinician responses focus on positive change
- Acceptance and empathy
- Highlight discrepancies between past behaviors and future goals
- Support self-efficacy (highlight past successes

What's Hard About These Conversations?

Our own feelings – helplessness, failure, sadness, compassion fatigue

Our desire to "do something"; to be "the expert"

Our patient/family's feelings – anger, sadness, grief, mourning

Conflicts – patients disagree with the medical team; family members can't agree on best approach

Having the “Hard” Conversations

Address emotions before facts

“This must be hard to hear”

“You sound frustrated”

“It must be disappointing to hear this”

“You’ve gotten a lot of information – is it OK to start talking about next steps?”

Silence has power

- Listen with your full attention
- Don’t assume – “tell me more about...”
- Use “I wish” statements – “I wish I had better news” “I wish things were different” (Don’t follow up with “but”)

Ask (Don't Just Tell) to Give the Patient Control

ASK: Establish what the client/family member understands initially

"What is your understanding of the results of the swallow study?"

"How has the stroke affected your swallowing"

"What are you most afraid of? Worried about?"

ASK: Obtain permission to share info

"Some people want to know everything about their condition and others don't – how much would you like to know?"

"Would it be helpful if I shared my perspective?"

ASK: Check for understanding after the discussion

"What questions do you have for me?"

"What should we review again?"

"Can you tell me what you might tell your husband about our conversation?"

Facilitating Autonomy

Shared Decision Making

- Provide client/family with best available evidence
- Identify patient goals before discussing options
- Open discussion re: potential risks and benefits of ***all available options***; include potential real-life impacts
- Elicit patient's ideas, concerns, frustrations

Jovanovic et al, 2022

- ***Encourage self-appraisal***
- ***Allow self-pacing***
- ***Consider health literacy and provide appropriate learning materials***

Rogus-Pulia and Hind, 2015

“Eating with Acknowledged Risk”

Review of protocols for “eating and drinking with acknowledged risk”

Not well studied; impact on patient outcomes unclear

Increasing support for the concept, however

Soar, N. et al, 2020

But NOT with waivers

- Courts typically find waivers of liability unenforceable
- Patient does not have equal knowledge of risks, benefits
- Waivers are one-sided; ie patient gives up right to sue only to confirm his (already affirmed) right to refuse treatment

Horner et al, 2016

Food for Thought (Pun intended)

So…What is a true “Dysphagia” diet?

One that compensates...?

Or one that stimulates?

Let’s talk about Sensory Interventions...

Sensory Input and Swallowing

Taste perception and swallow response share pathways…

And…

Sensory information is utilized to shape swallow response

So…

Is there a role for sensory stimulation in improving swallow response?

Sour

(50/50 barium and lemon juice)

Resulted in…

- Increased swallow response
- Decreased aspiration

But…

- Low palatability

Logemann, et al, 1995.

Citric acid; healthy subjects

- Increased anterior lingual/palatal pressures
- Pressure increased with increased taste intensity

Pelletier and Steele, 2004

Sour

Patients with dysphagia

Sour and Sweet/Sour

- Sour reduced aspiration but was not palatable
- Sweet/Sour more palatable but no effect on swallowing

Pelletier and Lawless, 2003

Carbonation

Carbonation vs Non-Carbonated Liquids

Healthy young and elderly subjects (hospitalized but no dysphagia)

- No differences in young subjects
- In elderly…
- More timely swallows for carbonation
- More timely swallows for water ***following*** carbonation

Morishita, et al 2014

sEMG study of oral and pharyngeal muscles in healthy adults

- faster swallow onset times as carbonation increased
- Increased sEMG amplitudes as carbonation increased

Min et al, 2022

Carbonation

In patients with dysphagia…compared carbonated thin with nectar thick

- No effects on transit times
- Decreased aspiration

Sdravou, K., et al, 2012

In patients with Lewy Body dementia and PD, carbonation…

- Improved pharyngeal transit times

Larsson, et al, 2017

Carbonation

84 patients with dysphagia – diverse etiologies (included neuro, HNC, frailty)

Compared carbonated and non-carbonated water during FEES studies

With carbonation:

- Improved airway protection with less aspiration
- Improved pharyngeal clearance; less residue

Carbonation improved swallow function across diagnoses but effects were most significant in patients with frailty/deconditioning

Shapira-Galitz et al, 2021

29 subjects with neurogenic dysphagia; known to have deep penetration and/or aspiration

Compared carbonated thin with non-carbonated thin during VFSS

- With carbonation:
- Significant reduction in severity of penetration/aspiration
- Improved swallow efficiency overall
- No impact on pharyngeal transit

But...one subject had increased aspiration with carbonation

Turkington et al, 2019

Carbonation – Systematic Reviews

Nagano et al 2022:

- Improved swallow function
- Prevention of aspiration
- Increased duration of swallow apnea

Price et al, 2023

- Improved swallow safety
- Improved secretion management

But...both review note small subject populations and lack of consistency in study design

Cold

Some evidence to suggest that **cold** boluses improve swallow response

- In healthy subjects (Selcuk et al, 2007; Michou et al, 2012)
- In patients with stroke (Gatto et al, 2013)

And…

- Cold ***oral*** stimulation increased ***pharyngeal*** cortical activity (Magara et al, 2018); for as long as 30 minutes! (Magara et al, 2021)

Mixed Input?

- Increased lingual pressure (club soda)
- Increased further with carbonation + strong taste (ginger brew)

Cumulative effect of sensory input?

Krival, K., and Bates, C., 2012

Carbonation perceived to be more intense at lower temperatures

Cumulative effect of cold + carbonation on swallowing?

Newton Yau, and McDaniel, 1991

Bolus Volume Impacts

- Increased volume - CVA (Bisch, et al, 1994)
- Decreased volume – neurodegenerative disease; stable neuro patients (Clave, et al, 2006)

To Conclude...

- Consider the “whole body” – account for interactions between systems
- Choose interventions that are targeted to the patient’s specific impairment(s)
- Consider risks and benefits of every intervention – including dietary modification – and include patients and family members in decision making in a real way

Any Questions?