DYSPHAGIA IN PARKINSON’S DISEASE

- Bulbar dysfunction may be equally or more disabling than cardinal features
- Impacts QOL and general health
  (Plowman-Prine et al., 2009, Leow et al., 2010)
- More than 80% of PwPD will also have dysphagia
  (Kaff et al., 2011)
- Pneumonia: a leading cause of mortality
  (Fall et al., 2003; Morgante et al., 2000)
- Lacking restorative treatments specific to the behavior of swallowing

ASSESSMENT: CLINICAL SIGNS OF DYSPHAGIA

- bradykinesia and rigidity of the tongue
- aberrant lingual movements:
  - rocking, rolling, and lingual pumping;
- increased number of swallows per bolus;
- uncontrolled loss of bolus from the oral cavity;
- incomplete cricopharyngeal relaxation and reduced opening;
- oral and vallecular residue;
- reduced lingual elevation;
- delayed swallow initiation; and
- impaired swallow-breath coordination
  (Bajers & Speyer, 2009; Bird et al., 1994; Blonsky et al., 1975; Gross et al., 2008;
  Logold & Kagel, 1997; Logemann, 1993; Nagaya et al., 1998).
THE TONGUE

- Greatest contributor to bolus propulsion through lingual-palatal pressure generation (Dodds, 1989; Robbins et al., 2005)
- Propagate: antero-posterior dimension (Ono, Hori, & Nobukubi, 2004)

CONTRIBUTIONS OF LINGUAL DYSFUNCTION TO PD-RELATED DYSPHAGIA

- Logemann et al. (1973) have suggested that "lingual disability" in PD may progress from the posterior to the anterior lingual regions; however, this theory has yet to be documented in pressure generation.
- Insufficient lingual elevation along the length of the tongue during swallowing (Blonsky et al., 1975).
- Inconsistencies in documenting tongue weakness in PD (Solomon et al., 1995, 2000).

ASSESSMENT: LINGUAL STRENGTH AND RESERVE

[Graph showing reserve and swallowing pressure]
SUPPLEMENTING ASSESSMENT:
LINGUAL STRENGTH AND FUNCTION

- Lingual weakness beyond natural aging may be present in PD
  - Related to diet modification
- Percentage of strength employed during swallowing
  - Implications for fatigue during mealtimes
- Lingual weakness is not addressed by dopaminergic medication alone
  (De Letter et al., 2003)

DRUG CLASSES

- Dopaminergic agents
  - Levodopa/carbidopa (Sinemet®, generics, Parcopa® orally disintegrating tablet), Sinemet CR
- Dopamine agonists
  - Apomorphine (Apokyn®), Bromocriptine (Parlodel®), Cabergoline (Not approved in the US), Lisuride (Not approved in the US), Pergolide (Permax®; withdrawn from US market March 2007), Pramipexole (Mirapex®), Ropinirole (Requip®), Rotigotine (Neupro® patch)
- COMT Inhibitors
  - Entacapone (Comtan®, Stalevo®), Tolcapone (Tasmar®)
- MAO-B Inhibitors
  - Rasagiline (Azilect®), Selegiline (Eldepryl® orally swallowed pill, Zelapar® orally disintegrating tablet)
- Anticholinergics
  - Trihexyphenidyl (Artane®), Benztropine, Ethopropazine
- Amantadine (Symmetrel®, generics)

DOPAMINERGIC INFLUENCE ON SWALLOWING

- The "off-on" phenomenon (Wajsbort, 1997)
- Lack of conclusive evidence for improvement in swallowing biokinemetics secondary to levadopa treatment
  (Nóbrega et al., 2013; Melo & Monteiro et al., 2012; Sutton, 2013)
- May change cortical pharyngeal excitability and brainstem reflexes (Michou, Harris, & Hamdy, 2013)
- Calculation of Levodopa Equivalence Dosage (LED)
EXAMPLE OF LED CALCULATION

<table>
<thead>
<tr>
<th>Actual oral dose (mg)</th>
<th>Conversion factor</th>
<th>Oral LED (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate release capsules</td>
<td>1</td>
<td>164</td>
</tr>
<tr>
<td>Controlled release capsules</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Entacapone (or Sinemet)</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Dopamine</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Parkinson’s (on off)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Resting</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Surgery type</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other factors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total LED</td>
<td>208</td>
<td>208</td>
</tr>
</tbody>
</table>

Note: The oral LED is the daily dose that is multiplied by 0.15 to give the oral LED for entacapone; this will then be added to the total oral and other oral LED(s) to give the total LED.

EFFECT OF DBS ON SWALLOWING FUNCTION

Lack of evidence for significant physiologic changes following DBS

Troche et al., 2013: systematic review (9 studies)
- 3 studies: timing of pharyngeal phase may be sensitive to STN stimulation; however, multiple factors such as medication, stimulation or surgery type were not controlled
- 2 studies: improved patient reported outcomes (PROs) without congruent physiologic data
- No conclusions regarding differences between STN and GPi stimulation

STN-DBS had longer survival (p = .002) and reduced admittance to a residential care home (p < .001; Ngoga et al. 2013)

PATIENT REPORTED SWALLOWING BEHAVIORS

- SWAL-QOL
  - (Leow et al., 2010; Plowman-Prine et al., 2009)
- Swallowing Disturbance Questionnaire
  - (Manor et al., 2007)
- Sydney Swallow Questionnaire (SSQ)
- Clinical Questions
SUPPLEMENTING ASSESSMENT WITH COUGH AND AIRWAY SOMATOSENSORY THRESHOLDS

- Cough measures: Expiratory Phase Peak Flow
  - EPPF: peak airflow during voluntary cough
  - Cue: “Take a deep breath and cough hard”
    (Pitts et al., 2010)

- Airway Somatosensory Function:
  - Higher thresholds
  - More oropharyngeal residue
  - Self-reported swallow severity equal to controls
    (Hammer et al., 2013)

INSTRUMENTAL ASSESSMENT: VIDEOFLUOROSCOPY

Investigate the occurrence & cause of aspiration and the effectiveness of compensatory strategies when trialed online during Modified Barium Swallow (MBS) evaluations.

CONCOMITANT CONDITIONS MAY INCREASE ASPIRATION RISK

- Esophageal Cancer
- CVA
- Subdural Hemorrhage
- Alzheimer’s
- Anterior Cervical Discectomy and Fusion
- Recent intubation
- Sepsis
- Zenker’s
- AMS
- Oral Cancer with Jaw and Partial Tongue Resection
- SAH
- Graves’ Disease
- Meningitis
- Scleroderma
- Myocardial Infarction
- Acute toxic-metabolic encephalopathy
- Graves’ Disease
- Meningitis
- Scleroderma
- Myocardial Infarction
- Acute toxic-metabolic encephalopathy
CLINICAL IMPLICATIONS FOR ASSESSMENT

- Chart Review:
  - Note medications/dosages (LED) and concomitant conditions

- Potential Supplementation to the Bedside Evaluation:
  - Lingual strength and reserve
  - Cough strength
  - Airway Somatosensory Thresholds

- Emerging:
  Swallow Clinical Assessment Score
  (SCAS; Loureiro et al., 2013)

CLINICAL IMPLICATIONS FOR ASSESSMENT

Silent aspiration in PD may be higher than previously reported.

Need for MBS evaluations to include online interventions.

Multiple interventions were successful for single individuals.

Suggests online interventions during MBS provided valuable identification and documentation of effective and ineffective strategies to provide important directions for treatment and justify the use of clinical interventions outside the fluoroscopy suite.

TREATMENT: EXERCISE REGIMENS FOR PARKINSON’S DISEASE

Recent and growing evident for the benefit of intensive exercise (animal and human models):
  - Reduce parkinsonian motor symptoms
  - Arrest neurochemical loss and/or reverse disease progression
  - Improved motor performance
  - Normalization of corticomotor excitability
  - Decreased mortality rates
  (Allen et al., 2012; Ciucci & Conner, 2009; Fisher et al., 2008; Russell et al., 2010)
TREATMENT OF PD-RELATED DYSPHAGIA

- EMST improved measures of airway compromise (Pitts et al., 2009)
- LSVT improved oral and base of tongue movements during swallowing and overall swallowing efficiency (El Sharkawi et al., 2002)
- Intensive speech therapy improved swallowing response time (Robertson and Thomson, 1984)
- Transference may be due to central and peripheral neural overlap.

SINGLE SESSION: NAGAYA ET AL., 2000

- 10 subjects with PD and dysphagia (5 male, 5 females)
  - 4 aspirators
  - 7 with vallecular residue
  - 12 Healthy Controls (HC)

Findings:
- Initiation of swallow (measures as time between visual cue to swallow and onset of submental muscle activity per EMG) was longer in PD than HC
- Following 20 minutes of exercise (5 exercises), latency of swallow initiation was significantly reduced ($p = .0051$).


- Felix et al., 2008: 4 participants
  - 10 daily effortful swallowing sessions daily across two weeks
  - Improvements in clinical observation and anterior neck pressure measures
- Athukorala, 2012: 10 participants
  - 10 daily sessions skill training therapy across two week
  - Post-intervention assessment and retention assessment
- No instrumental visualization of the swallow (i.e., VFS or FEES)
Evaluation and Treatment of Dysphagia in Parkinson’s Disease

**SUBMENTAL ELECTRICAL STIMULATION**

**BAIJENS & SPEYER 2013**

- Controlled Trial- Quasi-randomized (n= 90)
- Diverse maneuvers, bolus modification, bolus trials, saliva swallows, and OMEs
- 3 Arms: 30 minute, 15 sessions
  - Dysphagia Therapy
  - Dysphagia Therapy with Submental Motor Stimulation
  - Dysphagia Therapy with Submental Sensory Stimulation
- No group differences in FEES or VFS measures
- Swallowing gains:
  - Piecemeal deglutition (VFS not FEES),
  - Preswallow posterior spill (FEES, not VFS),
  - Delayed initiation of pharyngeal reflex (FEES, not VFS)

**LINGUAL STRENGTHENING IN PD**

- Improvements in tongue strength, timing, and accuracy may occur in varying time courses
- Relation to oropharyngeal residue and penetration/aspiration
- Isometric Pressure versus Skilled Training
- Future research with large group designs is needed

**CLINICAL IMPLICATIONS FOR TREATMENT**

Recent evidence suggests exercise-based regimens specific to the act of swallowing may also be effective for persons with PD and dysphagia.

Future research should be directed towards evaluating the effectiveness and optimal dosage of exercise-based, swallowing-specific treatment protocols.
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Kristin A. Larsen, M.A., CCC-SLP

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Northwestern Memorial Hospital

Florida State University: School of CSD
Julie A.G. Stierwalt, Ph.D., CCC-SLP

Department of Communication Sciences and Disorders
Carlin F. Hageman, Ph.D., CCC-SLP