At this time, both Olga Kaminski and Althea Wagman-Bolster are employed at Brigham & Women’s Hospital, Boston MA.

We have no relevant financial or non-financial relationships to disclose.

### Goals of TBI Dysphagia Therapy

- Prevent respiratory complications
- Prevent malnutrition, dehydration
- Improve swallow function
- Improve cognition

### Incidence of Dysphagia in TBI

- Impaired swallowing is a frequent complication in traumatic brain injury.
- Incidence rates as high as 93% in patients with severe TBI (Mackay, Morgan & Bernstein, 1999)
- Incidence verified by MBS as high as 61% in patients with severe TBI (Mackay, Morgan & Bernstein, 1999)
- Less than 33% of TBI patients are able to eat independently (Buchanan et al., 2003)
- Overall incidence for dysphagia in patients with TBI, regardless of severity, ranges from 38-65% (Terre & Mearin, 2009)

### Early Aspiration Risk Factors

- Loss of consciousness causes inability to protect airway
- Many patients may have full stomachs at the time of injury
- Patients intubated at scene at greater risk for early onset pneumonia (3-7 days post)
- Persons with early onset pneumonia have higher incidence of swallowing disorders as compared with late onset (68% vs. 42.9%) (Morgan & Mackay, 1999)

### Medical Factors that Impact Swallowing

- Multiple surgeries
- Prolonged disuse of swallowing muscles
- Medications that may impair swallowing function
- Injuries during emergent intubation
- Prolonged intubation/tracheostomy placement (Morgan & Mackay, 1999)
Primary vs. Secondary Injury

- Primary Injury – the event
  - Ex: DAI, SAH, SDH
  - Treatment of primary injury (ex: burr hole, craniotomy)
- Secondary Injury – metabolic alteration
  - Inflammatory cascade
  - Cell swelling and disintegration of cells
  - Causing cerebral edema, brain cell metabolic function and cell death

(Cook, Peppard & Magnuson, 2008)

Metabolic Alterations in Brain Injury

- May cause hormonal changes
- Catecholamines support blood pressure and cardiac output which helps cerebral perfusion but also increases:
  - Basal metabolism
  - Oxygen consumption
  - Glycogenolysis
  - Hyperglycemia
  - Proteolysis
  - Muscle wasting

Nutritional Concerns and TBI

- Overall increased resting metabolic expenditure
- Abnormal tone and posturing
  - Spasticity, decorticate or decerebrate posturing
  - Hypermetabolic state increases metabolic needs and protein loss
- Periodic sympathetic discharges “storming”
- Early enteral nutrition within 48 hours
  - Forestalls breakdown of protein and fat stores
  - Promotes immune system

(Cook, Peppard & Magnuson, 2008)

Challenges of Enteral Feeding

- Acute BI often causes impaired gastric emptying:
  - Vagus nerve damage
  - Elevated levels of endogeneous opioids and endorphins
  - Medications
    - Pentobarbital
    - Narcotics
  - Elevated intracranial pressure
- Start slow, usually 50% can be tolerated at Day 2, full calories at Day 7

Medications and Nutrition Interactions

- Fentanyl/Morphine (paralytic) – decrease GI motility
- Phenytoin (anticonvulsant) – absorption reduced by enteral feeding
- Ciprofloxacin (antibiotic) – absorption decreased by 44% secondary to chelation
- Other drug interactions may affect concentrations of nutrients and electrolytes

(Cook, Peppard and Magnuson, 2008)

Clinical Signs of Feeding Intolerance

- Abdominal distension
- Aspiration pneumonitis
- Diarrhea
  - Not caused by enteral feeding
  - Sorbitol used in liquid medications often causes cramping and diarrhea
  - Hypoalbuminemia causes bowel edema and impaired absorption
Hazards of Inadequate Nutritional Support

- Increased difficulties in function and mobility
- Development of medical complications
  - Decubitus ulcers
  - UTI
  - Venous thromboembolism
  - Pneumonia

Factors Impacting Aspiration Risk

- Aspiration occurred in approx 38-41% of patients
  (Lazarus & Logemann, 1987)

  - Delayed/absent swallow reflex: 81%
  - Reduced lingual control: 50%
  - Reduced peristalsis: 33%
  - Loss of bolus control: 79%
  - Decreased base of tongue retraction: 61%

  (Mackay, Morgan & Bernstein, 1999)

Glasgow Coma Scale

<table>
<thead>
<tr>
<th>Glasgow Coma Score</th>
<th>Eye Opening (E)</th>
<th>Verbal Response (V)</th>
<th>Motor Response (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4=Spontaneous</td>
<td>5=Normal conversation</td>
<td>6=Normal</td>
</tr>
<tr>
<td></td>
<td>3=To voice</td>
<td>4=Disoriented conversation</td>
<td>5=Localizes to pain</td>
</tr>
<tr>
<td></td>
<td>2=To pain</td>
<td>3=No words……only sounds</td>
<td>4=Withdraws to pain</td>
</tr>
<tr>
<td></td>
<td>1=None</td>
<td>2=Deorticulate posture</td>
<td>3=Deorticulate posture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1= None</td>
<td>1= None</td>
</tr>
</tbody>
</table>

Total = E+V+M

Correlation Between GCS Scores and Dysphagia

- Lower GCS Score at admission
  - Patients with lower scores (more severe TBI) took approximately twice as long to initiate oral feeding
  - Lower score also a significant factor in risk of aspiration
  - GCS 3-5 (severe) resulted in approx twice as many swallowing abnormalities on VFSS as compared to GCS 6-8

  (Mackay, Morgan & Bernstein, 1999)

Most Common Problems Affecting Oral Feeding in Severe TBI

- Prolonged oral transit time: 87.5%
- Delayed swallow initiation: 87.5%
- Vallecular residue: 62.5%
- Pyriform sinus residue: 62.5%

  (Mackay, Morgan & Bernstein, 1999)

Ranchos Lost Amigos Levels

- Level I – No response
- Level II – Generalized Response
- Level III – Localized Response
- Level IV – Confused and Agitated
- Level V – Confused, Inappropriate, Non-Agitated
- Level VI – Confused, Appropriate
- Level VII – Automatic, Appropriate
- Level VIII – Purposeful, Appropriate
Correlation Between RLAS Scores and Dysphagia

- Lower RLA Levels at admission
  - Higher percentage of abnormal swallowing
  - 2-2.5 times longer to achieve total oral feeding.
  - Admitting scores of RLA level II had more than twice as many swallowing abnormalities than admitting RLA levels III-IV.
- **RLA is the most important independent predictor of days to achievement of total oral feeding.**
  (Mackay, Morgan & Bernstein, 1999)

Effect of Ventilation on Dysphagia

- Increased ventilation time results in increased dysphagia incidence
- Patients with 8-14 days ventilation had more than twice as many swallowing abnormalities as patients with less than 7 days ventilation.
- Patients with greater than 15 days ventilation had an average 4.5 swallowing abnormalities.
  (Mackay, Morgan & Bernstein, 1999)

Severity of Brain Injury

- More severe CT scans initially
  - Midline shift, brainstem pathology, operative procedures
  - The greater the severity of the injury, the greater percentage of dysphagia and aspiration.
  - Twice as many swallowing abnormalities identified on MBS.
  (Mackay, Morgan & Bernstein, 1999)

Factors Predictive of Return to Total Oral Feeding

- Association between severity of BI and chance of reaching unrestricted PO intake before D/C.
  - 93% of patients w/ difficulty eating/drinking at admit
  - 64% reached unrestricted diet before discharge
  - GCS, RLAS, FIM and FOIS scores were found to predict time to recovery of functional oral intake.
    - RLAS I-II: 24% chance of reaching unrestricted diet
    - RLAS III or higher: 77% chance
    - GCS 3-8 took longer time to initiate oral diet
  (Hansen, Engberg & Larsen, 2008)

Patterns of Swallowing Resolution

- Median no. of day to first swallow assessment: 8
  - 50.4% of patients still had a tracheostomy
  - 50.4% of patients were safe for some oral intake and immediately commenced oral trials
- Median no. of days to initiation of oral feeding: 10
  - Majority of patients initially on thickened liquids
- Median no. of days to return to normal intake: 22
  - 83% of patients managing thin fluids
  - 47% resolved to normal “house” diet
  - Less than 18% needed supplementation
  (Ward, Green & Morton, 2007)

When does recovery occur?

- Most significant reduction in aspiration occurs within 3 months following severe TBI.
- Greatest improvement in swallowing function occurs during the first 6 months after TBI.
- Improvements between 6 months and 1 year are slower and less dramatic but do continue slowly.
  (Terre & Mearin, 2009)
Basic Cognition and Impact on Dysphagia

- Odds of aspiration on thin liquids were 31% greater for patients who were not oriented to person, place and time as compared to those who were oriented.
  - Results were not significant for aspiration of puree.
  - Odds of being deemed unsafe for any oral intake were not greater.
- Odds of aspiration on thin liquids were 57% greater for patients who were unable to follow 1-step commands as compared to those who were.
  - Odds of aspiration on puree were 48% greater.
  - Odds of being deemed unsafe for any oral intake were 69% greater.
- When a patient is disoriented and/or unable to follow basic commands, a clinician should be alerted to potential increased odds of aspiration. (Leder & Suiter, 2009)

Importance of Objective Exam

- Clinical “bedside” swallowing assessments are not able to diagnose silent aspiration or provide pathophysiological diagnosis of swallowing dysfunction.
- Approximately half patients with severe TBI are silent aspirators.
- In order to plan rational therapeutic approach objective exam is essential.
  - Consider MBS versus FEES
  (Terre and Mearin, 2007)

Cognitive Deficits: Impacting the Swallow

- Cognitive-Communicative Deficits:
  - Sensory reception/perception
  - Attention
  - Memory
  - Problem solving/judgment
  - Executive Functioning/Organization
- Behavior Management
  - Agitation
  - Impulsivity/Disinhibition
  - Apathy
  (Halper et al., 1999)

Sensory Reception and Perception

- The process of receiving sensory information and actively integrating these stimuli into meaningful units.
  - Includes stimuli that is:
    - Tactile
    - Visual
    - Auditory
    - Gustatory
    - Olfactory
    - Kinesthetic

Sensory Impairments and Dysphagia

- Reduced recognition of food
  - Smells
  - Textures
  - Tastes
- Reduced appetite
- Reduced desire to participate in self-feeding tasks
- Texture defensive

Suggestions for Treatment

- Work closely with occupational therapist on compensatory self-feeding strategies
  - Consider tactile defensiveness:
    - Metal utensils vs. plastic utensils
    - Hot vs. cold foods
    - Hard vs. soft foods
- Consider eating environment:
  - Over-stimulation: multiple options, increased sound, bright lights, environmental surroundings
  - Under-stimulation: change in position (bed vs. chair), lighting, sound
Memory

- Ability to encode, store and retrieve information
  - Immediate memory
  - Short term memory
  - Functional carryover
  - Prospective memory
  - Procedural memory

Memory Impairments and Dysphagia

- Decreased comprehension and retention of instructions
  - Increased difficulty with lengthy information
  - Increased difficulty with novel, complex information
- Difficulty retaining and learning new safe swallowing strategies
- Poor utilization of strategies in absence of supervision because of poor carryover

Treatment Suggestions

- May need to consider level of supervision at meals
  - 1:1 supervision
  - Close supervision
  - Intermittent supervision
- Provide compensatory strategies in written format
  - Cue card on eating surface or posted on wall
- Review compensatory strategies before each meal; focus on patient demonstrating recall.

Attention

- Ranges from ability to maintain arousal/wakefulness to being able to divide attention between multiple tasks
  - Focused attention
  - Sustained attention
  - Selective attention
  - Alternating attention
  - Divided attention
  - Prolonged concentration

Attention Impairments and Dysphagia

- Reduced arousal may preclude oral intake
- Patient may be unaware of presence of food and/or unaware of the need to swallow food once placed into mouth
- Meal times may be prolonged because of distractibility from external/internal stimuli
- Poor attention may result in inconsistent use of safe swallowing strategies

Treatment Strategies

- Consider medications to increase wakefulness/arousal (discuss with MD)
- Over-stimulation versus under-stimulation
- Place one food item and one drink item in front of patient versus whole tray
- Remove decorative tray liner as appropriate
- Reduce conversations during meal times
- Reduce number of visitors during meal times
- Provide intermittent cues for strategy use (“Are you remembering to use your safe swallowing strategies?”)
Executive Functioning and High Level Cog Processes

- Executive Function – Goal selection, planning, self-regulation, mental flexibility, anticipation, completion of intended activities
- Organization – Ability to sort, categorize, sequence, prioritize
- Reasoning – Ability to think abstractly and draw inferences and conclusions
- Problem solving – Ability to select, implement and evaluate effectiveness of a solution
- Insight – Ability to recognize areas of weakness

Higher Level Cognitive Impairments and Dysphagia

- Reduced use of compensatory strategies at appropriate times
- Limited independence in total feeding process (e.g. selecting appropriate diet consistencies, meal planning)
- Difficulty learning the sequence of steps necessary for specific compensatory strategy
- Difficult generalizing use of compensatory strategies to other settings
- Inability to select a technique appropriate for given situation and evaluating its success

Treatment Strategies

- Increase metacognitive process to encourage patient to “own” compensatory strategy use:
  - “What strategies will I use during this meal?”
  - “What happens if I don’t use my strategies?”
  - “If I find myself coughing, what should I do?”
  - “How did that meal go? Did I do a good job using my strategies with all food/drink items?”
- During cognitive therapy, plan grocery shopping trips and meal preparation activities.
- Co-treat with OT to cook a consistency-appropriate meal.

Treatment Strategies Cont.

- Allow patient to participate in dysphagia treatment groups to increase carryover of compensatory strategy use to social situations.
- Ask patient to explain compensatory strategies to caregivers (family, nursing staff, OT/PT) and to train these caregivers on how to use compensatory strategies.

Behavioral Impairments

- Apathy – lethargy; may demonstrate reduced initiation and lack of emotion
- Agitation – anxiety associated with severe motor restlessness; becomes easily annoyed and provoked to anger
- Impulsivity/Disinhibition – Acting without thinking about the consequences
### Behavioral Impairments and Dysphagia

- Disinterest and reduced participation in eating
- Reduced initiation of oral feeding and swallowing
- Extreme agitation may preclude oral intake
- Low tolerance level for oral stimulation, verbal or tactile cueing for compensatory strategies
- Chance of aspiration increased when behavioral outbursts occur during oral intake
- Intake of large amounts of food at rapid rate, resulting in increased risk of aspiration/choking

### Treatment Strategies

- Determining the underlying cause for a negative behavior should be the primary goal.
- Ex: Agitation occurs when speech therapy holds lunch meal until 12:30PM for training of compensatory strategies. Patient becomes agitated and aggressive with nursing staff at 12PM.
  - Consider...is the patient hungry and does not understand why others are eating while he is forced to wait for a speech therapist?
  - Does patient have low blood sugar because of a late lunch?
  - Does patient dislike having to eat with someone watching?

### Behavior Management Strategies

- Low tolerance for cueing:
  - Consider verbal versus tactile cues
  - Reduce frequency of cueing
  - Consider indirect cues versus commands
    - “Did that seem like an awfully large bite?” vs. “Take a smaller bite.”
- Pick your battles!
  - How important is it that a patient takes a sip after every bite? Is it worth increasing agitation, if cueing for a liquid wash every 2-3 bites is less frustrating?

### Behavior Management Strategies Cont.

- Consider dysphagia group therapy (“Lunch Bunch”) if appropriate:
  - Provide general structure and recommendations to the entire group versus signaling out one patient
    - “During this meal, I want everyone to try and remember to: eat slowly, take small bites, avoid talking before you’ve swallowed.”
  - Impulsivity reduction:
    - Train patient to put utensil down between each bite
    - Train patient to pace meal using clock/timer
    - 30 minute meal: 10 minutes = 1/3 of meal finished

### Use of Chin Tuck Strategy

- Chin tuck assisted in avoiding aspiration in:
  - 30% of patients with pharyngeal residue
  - 18% of patients with cricopharyngeal dysfunction
  - 54% of patients with pharyngeal delay
- Total of 55% of patients avoided aspiration with chin tuck.
  - Chin tuck effective 40% of time if aspiration occurred before swallow.
  - Chin tuck effective 60% of time if aspiration occurred during swallow.

(Terré & Mearin, 2011)

### Conclusions about Chin Tuck

- Given that the chin tuck has relatively low effectiveness in preventing aspiration, it must be assessed on MBS prior to recommendation.
- “While it is a simple physiological postural adjustment...for some patients...it is not a task that is simply performed but may require more physical strength, neuromotor control and cognitive skill than has been routinely appreciated.”

(Ashford et al., 2009)