

Dysphagia Management with the Patient who is acutely or critically ill

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Objectives

1. Describe common disorders of the cardiopulmonary, endocrine, neurological and digestive systems often seen in patients with dysphagia.
2. State types of data obtained from monitoring instruments.
3. Discuss the importance of a variety of types of information found in a medical record.
4. Describe life-saving/life-supporting treatments used in acute care hospitals.
5. How we assess dysphagia in the acute care hospital.
6. Apply information presented to case studies.

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Acute care setting

- SLPs providing services in acute care settings may encounter patients with any number of diagnoses
- 70-90% of elderly patients (without known neuro disease) have some degree of swallowing impairment
- Incidence of dysphagia in critical care units may be increased related to intubation (more later), use of sedativ
- Hospital-acquired pneumonias (nosocomial) have high rate of mortality (? Are some of these aspiration pneumonia?)

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Challenges in acute care setting

- Definitive diagnosis may not be made at the time you see the patient
- Multiple physicians may be involved in the case, with lack of coordination
- Compete with many other services to get to the patient
- Patients only stay a short period of time...so it's all about diagnosis and case management

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Challenges in acute care setting

- Patients often medically fragile
- Condition can change unexpectedly
 - Especially when in intensive care
 - This may mean the recommendations you made yesterday are no longer appropriate

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Why should we know about medical status/conditions?

- You then treat from a more informed perspective
- You are a better member of the health care team
- You can discuss the case more effectively with physicians and nurses

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Systems we'll discuss

- Cardiopulmonary
- Endocrine
- Neurological
- Digestive

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Cardiopulmonary

- Proper functioning of the cardiopulmonary system is essential for a human being to survive.

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Respiratory System Functions

Ventilation

- Transfer of oxygen rich air into lungs
- Transfer of oxygen depleted/waste air out of lungs

Respiration

- Transfer of oxygen to circulatory system, then to working organs
- Removal of some waste from working organs, via circulatory system

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Respiratory status

■ Lung sounds

- Rhonchi: coarse, secretions in bronchial tubes
- Rale: abnormal breath sound may indicate fluid in the alveoli
- Wheeze: whistling breath sound



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Respiratory status by radiograph

- Chest x-rays
 - Infiltrate location dependent on position of patient at time of aspiration
 - If recumbent, posterior segments of upper lobes
 - If upright, involvement of basal segments of lower lobes
 - Der Sahakian et al 2007; Mark, 2001

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Relationship of respiration and swallowing

- Breath phase at which swallow is initiated determines volume of the swallow
 - Near end of inspiratory-expiratory phase = largest volumes
 - That is, large swallows are found when lungs remain inflated at end of tidal breath
 - Allows more oxygen reserves to be available for blood O₂ saturation (Paydarfar, et al 1995)

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Relationship of respiration and swallowing

- Swallow breathing pattern can be altered by either swallowing or breathing (Martin-Harris, 2005)
 - E.g. Increase in ventilatory drive during hypercapnia (increased CO₂) decreases swallowing frequency
 - Swallow during hypercapnia associated with increased incidence of aspiration and laryngeal irritation (Nishino et al 1998)

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Relationship of respiration and swallowing

- Swallowing can alter breathing
 - E.g. During repetitive swallowing, there are greater inspiratory-expiratory times, yet tidal volume and minute ventilation are maintained
 - Issa & Porostocky 1994)

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Relationship of respiration and swallowing

- Swallow breathing pattern can be volitionally modified
 - Subjects instructed to breathe out to residual volume and then swallow – overall duration of swallow was prolonged (slower swallows)
 - Swallows at total lung capacity were shorter in duration (faster swallows)
 - Gross et al 2008

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Diseases of cardiopulmonary system

- Cardiac disease
- CABG
- Obstructive lung disease
- Restrictive airway disease
- Pneumonia

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Cardiac-related conditions

- In large study (N=1340) re: FEEST, largest patient subgroup was stroke
- 2nd largest (22%) was cardiac-related
 - Most following open-heart surgery (almost 60% of cases)
 - Heart attack
 - Congestive heart failure
 - Newly diagnosed arrhythmias
- Large percentage of these patients had significant vagal nerve sensory dysfunctions
- Hypothesized they were then at risk for silent aspiration

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Post cardiac surgery

■ Other side effects include:

- Discomfort or itching from healing incisions
- Swelling of the area where an artery or vein was taken for grafting
- Muscle pain or tightness in the shoulders and upper back
- Fatigue (tiredness), mood swings, or depression
- Difficulty sleeping or **loss of appetite**
- Constipation

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Pneumonia

- **Pneumonia is not a single illness but rather many different ones, each caused by a different microscopic organism—whether it is a bacterium, virus, fungus**
- Where pneumonia is acquired is often part of the description:
 - Hospital-acquired
 - Community acquired
 - Ventilator-associated

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Medical status - pneumonia

- Relationship between pneumonia and aspiration not clear
- Not everyone who aspirates gets aspiration pneumonia

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Medical status - pneumonia

- Feinberg (1990) - patients who aspirated thin liquids on fluoroscopy got no more pneumonia than patients who did not aspirate (unless they were tube fed)
- Corghan et al (1994) - no difference in number of patients who got pneumonia when comparing known aspirators to those who did not

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Medical status - pneumonia

- Schmidt et al (1994) - patients were 7.6 X more likely to develop pneumonia if they aspirated on fluoroscopy
- Non-compliers with dysphagia recommendations had more hospital admissions because of chest infections or aspiration pneumonia
 - Low et al 2001

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Medical status - pneumonia

- Who will get pneumonia?
- How much is aspirated?
- Are lungs able to clear material?
- What was baseline pulmonary status?

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Risk factors for developing pneumonia (patients:OP, acute care, nursing home)

- Langmore (1998)
 - dependent for feeding
 - multiple medical diagnoses
 - current smoker
 - tube fed
 - dependent for oral care
 - number of decayed teeth
 - number of meds

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Risk factors for chest infection in acute stroke

Dunnett et al 2007

- 412 patients admitted in UK
- Subjects who developed pneumonia were:
 - Older
 - Had higher NIHSS scores
 - History of chronic obstructive pulmonary disease
 - Lower AMT (Abbrev. Mental Test) scores
 - Higher Oral Cavity Score
 - Greater proportion with positive bacterial culture from oral swabs
- Independent predictors of pneumonia were:
 - Age >65
 - Dysarthria or no speech due to aphasia
 - Modified Rankin Scale score >4
 - AMT <8
 - Failed water swallow test

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Aspiration pneumonia

- Highest mortality rate of any infection
- Among hospitalized elderly, development of pneumonia is associated with 43% mortality rate
- Pneumonia 2nd most common infection in nursing homes
- Up to 80% of nosocomial pneumonia may be aspiration pneumonia

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Aspiration pneumonia

- Kasprisin (1989) - compared two groups of treated patients with group of untreated patients
- Both treated groups had significantly less aspiration pneumonia than the untreated group

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Aspiration pneumonia

- Kasprisin conclusions
 - Even mildly dysphagic patients are at risk for the development of aspiration pneumonia
 - Severely dysphagic patients responded to management of their swallowing problems

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High incidence of respiratory infections in NPO stroke patients

Langdon et al 2007

- 369 acute stroke patients – Perth Australia
- 51 respiratory infections in 330 survivors
- Dysphagia at 48 hours and 7 days was strongly associated with respiratory infection
- Survivors NPO at 48 hours and 7 days were significantly more likely than survivors fed orally to develop respiratory infection
- 75% of survivors fed by NG or PEG were treated with antibiotics for infections
- Oral factors found to be significant in predicting respiratory infections
- Subjects who had poor oral hygiene and were NPO 48 hours post stroke had risk ratio of respiratory infection of 18.39

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Aspiration considered as possible cause for Community Acquired Pneumonia (CAP)

- Review article discusses implications of community-acquired pneumonia
- Concludes that elderly patients with clinical signs suggestive of dysphagia and/or who have CAP should be referred for swallow evaluation

■ Marik & Kaplan,
2003

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Atelectasis

- **Atelectasis is a condition in which all or part of a lung becomes airless and collapses.**
- Blockage of the bronchial tubes is a common cause of atelectasis.
- Shortness of breath is the only symptom that atelectasis itself causes.
- Chest x-ray is used to confirm the diagnosis.
- **Common cause of atelectasis is a blockage of one of the bronchi**
- **The blockage may be caused by something inside the bronchus, such as a plug of mucus, a tumor, or an inhaled foreign object (such as a coin, piece of food, or a toy).**
- **Alternatively, the bronchus may be blocked by something pressing from the outside, such as a tumor or enlarged lymph nodes.**

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Endocrine system

- The endocrine system is one of the body's main systems for communicating, controlling and coordinating the body's work.
- It works with the nervous system, reproductive system and other organs to help maintain and control the following: body energy level, reproduction, growth and development, responses to surroundings, stress, and injury.

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Diabetes

- Peripheral neuropathy can result in oropharyngeal dysphagia
- Gastroparesis is a disorder affecting people with both type 1 and type 2 diabetes, where the stomach takes too long to empty its contents. It happens when nerves to the stomach are damaged or stop working.
 - Signs and symptoms of gastroparesis (delayed gastric emptying) are:
 - heartburn
 - nausea
 - vomiting of undigested food
 - an early feeling of fullness when eating
 - weight loss
 - abdominal bloating
 - erratic blood glucose (sugar) levels
 - lack of appetite
 - gastroesophageal reflux
 - spasms of the stomach wall

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Complications of gastroparesis

- Gastroparesis can make diabetes worse by making it more difficult to manage blood glucose.
 - When food that has been delayed in the stomach finally enters the small intestine and is absorbed, blood glucose levels rise.
- If food stays too long in the stomach, it can cause problems like bacterial overgrowth because the food has fermented.
 - Also, the food can harden into solid masses called bezoars that may cause nausea, vomiting, and obstruction in the stomach. Bezoars can be dangerous if they block the passage of food into the small intestine.

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Diseases of neurological system (a few examples)

- CVA, TIA, hemorrhage
- Progressive disorders (MS, Parkinson's)
- Dementia

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Converging evidence about neurology of swallowing

- Common sites of involvement are evident
- Distributed neural network
 - Both cerebral hemispheres and subcortical structures
 - Involvement of multiple levels
 - May induce more severe or protracted dysphagia

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Dysphagia and Stroke: Demographics

- 2000 people per million worldwide
- 700,000 individuals annually in U.S.
- Dysphagia occurs in about 55% of patients with acute stroke
- 40% demonstrate aspiration on videofluoroscopic evaluation
- 40%-70% demonstrate silent aspiration

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Neuroanatomy of swallowing lesions

- Dysphagia may result from bilateral hemispheric and brainstem strokes
 - Horner et al 1990
 - Kim et al 2000
- Dysphagia may result from unilateral strokes of either cerebral hemisphere
 - Robbins et al 1993

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Neuroanatomy of swallowing lesions

- There are contradictory findings concerning swallowing lateralization
 - Dysmotility pattern and aspiration risk may be related to the hemisphere lesioned
 - Robbins et al, 1993, 1988; Smithard et al 1997
 - Hemisphere may not discriminate dysmotility pattern or risk of aspiration
 - Daniels & Foundas, 1999; Alberts et al 1992

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Neuroanatomy of swallowing lesions

- Swallowing behavior differs in left and right hemispheric stroke (Robbins et al)
 - Left hemisphere stroke
 - Oral dysmotility
 - Right hemisphere stroke
 - Pharyngeal dysfunction
 - Aspiration
- Swallowing behavior does not differ in left and right hemisphere strokes
 - Daniels et al 1999

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Neuroanatomy of swallowing lesions

- Hemispatial neglect significantly associated with initial non-oral intake
- Aphasia not associated with swallowing outcome (Schroder, et al 2006)

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Parkinson's Disease

- Progressive degenerative disorder
 - Loss of striatal dopamine
- Related impairments include:
 - Cognitive impairment
 - Drooling
 - Jaw rigidity
 - Head and neck posture
 - Upper extremity limited mobility
 - Impulsive feeding behavior

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Parkinson's Disease

- Oral phase problems
 - Impaired lingual movement for transfer of bolus (rocking or pumping)
 - Incomplete oral clearance
 - Premature loss over back of tongue

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Parkinson's Disease

- Pharyngoesophageal
 - Delayed onset pharyngeal response
 - Abnormal pharyngeal wall movement
 - Impaired bolus transport
 - Residue
 - Decreased hyolaryngeal movement
 - Incomplete UES and LES opening
 - GER
 - Tertiary contractions
 - Esophageal stasis

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Dementia

- Changes throughout the course of the degenerative disease process.
- In the early stage, the individual with dementia may forget to eat, may become depressed and not want to eat, or may become distracted and leave the table without eating.
- In the middle stage, the individual with dementia may be unable to sit long enough to eat, yet at this stage may require an additional 600 calories per day because of wandering and motor restlessness.
- In the late stage, the individual with dementia does not have intact oral motor skills for chewing and swallowing, thus becoming subject to malnourishment and "wasting away."

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Dementia

- Estimated that 45% of institutionalized patients with dementia have dysphagia (Easterling & Robbins, 2008)
- Two independent predictor factors for development of pneumococcal infections are dementia and seizure disorders (Lipsky et al 1986)

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Digestive system

- Digestion involves mixing food with digestive juices, moving it through the digestive tract, and breaking down large molecules of food into smaller molecules.
- Digestion begins in the mouth, when you chew and swallow, and is completed in the small intestine.

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Digestive system tied closely to endocrine system

- **Hormone Regulators**
- The major hormones that control the functions of the digestive system are produced and released by cells in the mucosa of the stomach and small intestine.
- These hormones are released into the blood of the digestive tract, travel back to the heart and through the arteries, and return to the digestive system where they stimulate digestive juices and cause organ movement.
- The main hormones that control digestion are gastrin, secretin, and cholecystokinin (CCK)

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Diseases of digestive system

- The list is almost endless
 - Celiac
 - Crohn's
 - Irritable bowel syndrome
 - Lactose intolerance
 - Ulcers

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Esophageal disorders

- GERD/LPR
- GERD and LPR are implicated in the development of a variety of respiratory tract diseases, including:
 - Chronic laryngitis (Johnson, 2000)
 - Hoarseness (Weiner et al 1989)
 - Laryngeal cancer (Freije et al 1996)
 - Globus (feeling of knot or tightness in chest) (Halstead 1999)
 - Cough and Paradoxical Vocal Fold Motion (Altman et al 2002)
 - Laryngeal stenosis and laryngomalacia (Halstead 1999)
 - Sleep disturbance (Penzel et al 1999)
 - Chronic rhinosinusitis (Contencin et al 1991)

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Common structural problems of esophagus

- *Peptic stricture* is the most common stricture of the esophagus. About 10% of patients with severe reflux disease have such a stricture of the LES. However, the stricture can also occur in proximal esophagus, causing aspiration and choking.
- *Esophageal rings and webs* can occur proximally (such as in Plummer-Vinson or Paterson-Brown-Kelly syndrome) and cause aspiration. These proximal webs may be associated with Zenker's diverticulum.
 - Distal rings are located at the LES and are usually accompanied by a hiatal hernia. Dysphagia is intermittent and usually related to solid foods. These are called Schatzki's rings. (Shaker, 2003).

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Common motility problems of the esophagus

- *Esophageal dysmotility* is a decrease in the primary contraction wave of the esophagus
- *Achalasia* is the best characterized esophageal motility disorder and affects swallowing of liquid and solids. The patient may complain of a burning sensation or pain behind the sternum. It is chronic and gets worse gradually. When assessed manometrically, it is characterized by lack of esophageal peristalsis and lower esophageal sphincter relaxation.
 - The view on fluoroscopy is described as a bird's beak because the esophagus is dilated and full of food, no squeezing is occurring and because the LES doesn't relax the column of food in the esophagus ends in a point looking like a bird's beak.

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Other esophageal

- The esophagus may also be affected in *collagen vascular* diseases such as dermatomyositis/polymyositis and progressive systemic sclerosis. Effects may range from GERD to reduced UES opening. (Shaker, 2003).
- In instances of true *cricopharyngeal dysfunction*, the upper esophageal sphincter fails to relax.

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Cardiac monitors

- **Cardiac or heart monitors:** Cardiac monitors are used to monitor the electrical activity of the heart. The monitor looks like a computer screen with lines, or tracings, moving across the screen. The monitor has electrodes that are attached to the patient's chest with sticky pads.
- 60-80 normal
 - 100-200 tachycardia
 - 40-50 bradycardia

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Pulse Oximetry

- Colodny (2000)
- 181 subjects
- 104 with dysphagia
- Aspirators had lower SpO₂ levels before, during and after feeding
- Solid aspirators most compromised
- No relation found between SpO₂ levels and aspiration
- Conclusion: Individuals with dysphagia have compromised pulmonary systems

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Pulse Oximetry (Leder, 2000)

FEES with monitoring of arterial oxygen saturation, heart rate and blood pressure

No significant differences in SpO₂ levels based on aspiration status or oxygen requirements

Higher heart rate during and 5 minutes post

Higher blood pressure during and lower post

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Swan-Ganz

- **Swan-Ganz catheter:** A Swan-Ganz, or pulmonary artery catheter, is used to measure the amount of fluid filling the heart as well as to determine how the heart is functioning.
- It is inserted through the large vessels of the neck or upper chest and threaded into the heart.
- <http://www.pulmonologychannel.com/icu/equipment.shtml>

<http://www.nlm.nih.gov/medlineplus/ency/imagepages/18087.htm>
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Arterial lines

- Also called intra-arterial lines, art lines, A-lines
- Placement of an arterial line is indicated for continuous monitoring of arterial pressure and direct arterial blood sampling.
- Typically placed in radial artery

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Tubes and catheters

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Central Venous catheter

- **Central venous catheter (CVC):** This type of catheter is a soft, pliable tube that is inserted into a large vessel (vein) in the neck (internal jugular vein), in the upper chest (subclavian vein), or in the groin area (femoral vein).
- Ends up in vena cava or atrium of heart
 - Peripherally inserted Central Catheter PICC line goes into arm
- Patients are sedated and receive a local anesthetic prior to insertion. Sutures secure the CVC, which can be left in place for days or weeks.

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Central Venous catheters

CVCs are used:

- to administer frequent or continuous medication;
- to administer large multiple IV products that do not fit in one line; and
- to measure central venous pressure (the amount of fluid in the vessels).
- CVCs carry some risk of bloodstream infection and thrombosis (tenderness and abnormal fluid collection in tissues, impaired movement, and engorged veins).

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Intravenous (IV):

- An IV is a plastic catheter (tube) that is inserted into the veins (peripheral IV) or a larger size catheter inserted into the larger veins of the neck. Fluids, medications, nutrition preparations, and blood products are administered through IV catheters. Patients in ICU often have multiple IVs.

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Chest tubes

- Chest tubes are inserted through the chest wall into the space around the lung to drain fluid or air that has accumulated and prevent the lung from being able to expand.
- http://davezanni.com/blog/wp-content/uploads/2007/12/chest_tubes.jpg

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Urinary catheter

- Urinary catheters (Foley catheters)
- inserted through the urethra into the bladder.
- Kept in place by a balloon, which is inflated, at the end of the catheter.
- Urinary catheters continuously drain the bladder and allow for accurate measurement of urinary output, which is extremely important in fluid management and in assessing kidney function.
- <http://www.malecare.com/nr551580.jpg>

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Interpreting data from medical record

- Laboratory values
 - Blood gas values
- Nutritional values
- Pharmacological information – what different drugs do
- Physician consults (neuro, gastro, radiology)

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Lab values

- Russell “Hank” Mills
- John Ashford
 - Department of Veterans Affairs Directive 2006-32
 - “Management of Patients with Swallowing (Dysphagia) and Feeding Disorders
- *Summarized in Perspectives 17 (128-134) December 2008*

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What can lab values tell us?

- 43% to 54% of patients with acute CVA will aspirate
- Of patients who do not aspirate, 37% will develop pneumonia and 63% will not
 - WHY?

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Mills & Ashford Health Status Model

- Relationship between dysphagia and the organism
- Oral, pharyngeal and esophageal components of swallow at core
- Surrounding that are six areas of health status:
 - RBC indices
 - Hydration
 - Renal function
 - Nutrition
 - Immune system status
 - Presence of infection

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Lab values as indicator of health status

- Blood tests assembled into panels:
 - Complete Blood Count (CBC)
 - Complete Metabolic Panel (CMP)
 - See Appendix for Reference Ranges of most helpful tests from the panel
- Using a finding from a single test is an over-simplification

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CBC

- Three red blood cell indices
 - Red Blood Cell Count (RBC)
 - Hematocrit (HCT)
 - Hemoglobin (Hgb)
 - Responsible for transporting oxygen molecules throughout all parts of organism
 - Depressed values may indicate anemia
 - Common symptoms of anemia include fatigue, loss of energy, SOB, difficulty concentrating and dizziness

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CBC

- Total white blood cell count (WBC)
 - Total number of leukocytes present
 - Lymphocytes
 - Neutrophils
 - Basophiles
 - Eosinophils
 - Monocytes
 - All have differing functions related to the immune system

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CMP

- Includes electrolytes: sodium, potassium, chloride
- Indicators of hydration status
- Under-hydration and over-hydration can take several forms
 - Not all are reflected in “out of reference range”

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CMP – Forms of dehydration

- **Hypernatremia**
 - Greater water loss from the body than sodium
 - Causes profuse sweating, severe diarrhea, vomiting
- **Hypovolemia**
 - Equal losses of fluid and electrolytes

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CMP

- **Blood Urea Nitrogen (BUN) and Creatinine** are waste products of metabolism
 - Elevated values may indicate renal impairment
 - Renal impairment = decreased urine output, dry mouth, loss of appetite, nausea, vomiting, dehydration

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CMP

- **Albumin** is measure of protein stores
 - Used as measure of nutritional status
- **Low albumin** may indicate body has been depleted of protein and that the patient is malnourished
 - Without intervention for low albumin levels, hospitalized elderly consumed only 14.5% of their estimated energy requirements
 - Byrnes, Statton & Wright (1998)

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CMP

- **Weaknesses to albumin measurements**
 - **Hydration sensitive**
 - Dehydrated patient may have artificially elevated albumin levels
 - Reflects protein status over last 18-21 days
 - Pre-albumin reflects last 1-2 days, so that test will show if a treatment is working

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CMP

- Albumin value important b/c nutritional status tied to strength of immune system
- So, aspiration in normally hydrated patient with low albumin level (e.g. 2.0 gm/dl) should indicate extreme caution in treatment planning, as immune system compromised

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The immune system

- Body's ability to fight infection in patients with dysphagia is critical
- Two subsystems combine to seek out and destroy pathogenic microorganisms
 - Specialized immunoglobulins & complement proteins
 - Specialized white blood cells (WBC), called leukocytes
 - Lymphocytes (B- & T-)
 - Phagocytes
 - Granulocytes (these include neutrophils)

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The immune system: neutrophils

- Bacteria fighters first to arrive at site of infection
- Neutrophil count expressed in two ways:
- Total percent – 40%-70% of WBC
- Absolute Neutrophil Count (ANC) – 1500/mm³ or >

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Immune system- Neutrophils

- Patients with values of 500 to 1500/mm³ have reduced number of neutrophils = mild neutropenia and at minimum risk to develop infection
- ANC values less than 500/mm³ = moderate to severe neutropenia and at increased risk for developing infection
- ANC values > 7500/mm³ or neutrophil counts > 70% = neutrophilia and this may indicate acute bacterial infection

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Illness and immune system

- Serious illness (e.g. CVA, surgery) may result in temporary neutropenia
 - Coupled with aspiration of over-colonized oropharyngeal bacteria may result in pneumonia
- Elevated WBC values indicate presence of peripheral inflammatory response (and that infection is bacterial in nature)

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Immune system and the mouth

- Neutrophils trap and degrade bacteria in oral cavity
- Onset of stress from serious illness (e.g. CVA, surgery) may alter the regulation of the immune system
 - Reduced protection allows oral pathogens to increase
 - If aspirated into immune-compromised lower respiratory system, could trigger pneumonia

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Lab values: Arterial blood gases

- Essential part of diagnosing and managing patient's oxygenation status and acid-base balance
- Acid-base balance
 - pH is measure of acidity or alkalinity of blood
 - Normal pH range 7.35 to 7.45
 - Too low = acidic Too high = alkalotic
 - Normal range has to be maintained for normal metabolism to take place

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Lab values: Arterial blood gases

- | | |
|---|--|
| ■ Acidic state | ■ Alkalotic state |
| ■ Decrease in force of cardiac contractions | ■ Interferes with tissue oxygenation |
| ■ Decrease in vascular response to catecholamines | ■ Interferes with normal neurological and muscular functioning |
| ■ Diminished response to effects of certain meds | |

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Acid base disorders

- Respiratory acidosis (any condition with hypoventilation can cause)
 - CNS depression related to CHI, meds
 - Impaired respiratory muscle function (spinal cord injury, neuromuscular diseases)
 - Pulmonary disorders (pneumonia, atelectasis, etc)
 - Massive pulmonary embolus
- Respiratory alkalosis (any condition that causes hyperventilation)
 - Psychological responses (fear, anxiety)
 - Pain
 - Increased metabolic demands (fever, sepsis)
 - Meds (resp stimulants)
 - CNS lesions

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Arterial blood gases

- Blood pH changes according to level of CO₂ present
 - Triggers lungs to > or < rate and depth of ventilation
- The kidneys excrete or retain bicarbonate to maintain the pH

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Metabolic disorders

- Metabolic acidosis
 - Bicarb level < 22 and pH < 7.35
- Causes of increased acids:
 - Renal failure
 - Diabetic ketoacidosis
 - Starvation
 - Salicylate intoxication
- Symptoms in CNS, cardiovascular, pulmonary and GI systems
- Metabolic alkalosis
 - Bicarb > 26 with pH > 7.45
- Symptoms
 - Neurological
 - Musculoskeletal

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Nutrition

- Current diet
 - Amount eaten
 - Restrictions
- Alternate method of feeding
- Oral health/dentures affecting?

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Nutrition-tips from a Chief Dietitian

- Tests used in surveys of “healthy” populations to suggest nutritional status are often affected by disease processes and may be useless in acute care or in chronic disease
 - E.g. hemoglobin
 - Serum albumin

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Nutrition-tips from a Chief Dietitian

- Look for anemia
 - Low hemoglobin and other factors may indicate macrocytic anemia due to folate or vitamin B12 deficiency
 - Tests for serum B12 and folate may indicate “nutritional” anemia and can be addressed with supplementation
- Anemia
 - If problem is B12 and problem is prolonged, permanent damage to nerve cells can result

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Nutrition-tips from a Chief Dietitian

- Albumin
 - Possible protein status indicator
- Look at the body
 - Measure various circumferences or skin fold thickness to assess relative leanness, muscle wasting or obesity

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Nutrition-tips from a Chief Dietitian

- Nitrogen balance study to compare amount of nitrogen in the protein going into the body (oral, enteral or parenteral)
- With nitrogen exiting the body in urine (urinary urea nitrogen) and add to that fecal material, sweat, skin sloughing
- Comparison of nitrogen in/out can indicate if body is in:
 - Catabolic (traumatized)
 - Anabolic (growing or healing)
 - Maintaining

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Nutrition-tips from a Chief Dietitian

- Serum glucose or Hemoglobin A1C for glucose tolerance/diabetes care
- Blood urea nitrogen, serum creatinine, serum potassium, serum phosphorus to assess nutritional implications for kidney disease
- Serum sodium and chloride as rough indicators of fluid status (retention vs. dehydration)
- Serum phosphorus, magnesium and potassium when “re-feeding” – may have to slow process

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Malnutrition

- Patients following stroke at high risk for malnutrition
- May be as high as 56% during a 3-week hospital stay
- Protein calorie malnutrition (PCM) most common type
- PCM fatigues muscles, alters neuromuscular function, thus increasing severity of dysphagia

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Dehydration

- Dehydration is the excessive loss of body water.
- Number of causes of dehydration including heat exposure, prolonged vigorous exercise, and some diseases of the gastrointestinal tract.

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Dehydration

- The majority of the body is made up of water, with up to 75% of the body's weight due to H₂O.
- Most of the water is found within the cells of the body (intracellular space).
- The rest is found in the so-called extracellular space, which consists of the blood vessels (intravascular space) and the spaces between cells (interstitial space).

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Complications of dehydration

- **Cerebral edema**
- **Seizures**
- **Hypovolemic shock** -low blood volume causes a drop in blood pressure and a corresponding reduction in the amount of oxygen reaching your tissues.
 - If untreated, severe hypovolemic shock can cause death in a matter of minutes.
- **Kidney failure.** Occurs when the kidneys are no longer able to remove excess fluids and waste from your blood.

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Medications

- Drugs that cause change in mental status, confusion, sedation
 - Anticholinergics
 - Analgesics
 - Psychotropics
 - Anti-epileptics
 - Sedatives
 - Antibiotics

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Meds: Anticholinergics

- **Anticholinergic** means blocking the effects of the neurotransmitter acetylcholine. Since acetylcholine is involved with learning and memory, glands and involuntary muscles, an anticholinergic drug can cause:
 - Dry mouth
 - Decrease in perspiration
 - Increased heart rate
 - Constipation
 - Increase in blood pressure
 - Blurred vision
 - Memory problems
 - Loss of coordination (ataxia)
 - Sensitivity to heat

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What are anticholinergics?

- Drugs that have anticholinergic effects include but are not limited to:
 - **Tricyclic antidepressants**
 - **Antipsychotics**
 - **SSRI antidepressants (Prozac, Zoloft, Paxil)**
 - Diphenhydramine (Benadryl, other generic antihistamines)

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Meds: Neuroleptics

- Antidepressants
 - E.g. Elavil
- Result in drying of mucosa, drowsiness
- Antipsychotics
 - E.g. Haldol, Thorazine
 - Can cause Tardive Dyskinesia

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Meds: Barbituates

- Treatment of insomnia
 - E.g. Phenobarbitol, Nembutal
- CNS depressant (drowsiness causing decompensation of patients with cognitive deficits)

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Meds: Antihistamines

- For relief of nasal congestion and cough
 - E.g. cold and cough preparations
- Drying mucosa, sedative effects

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Meds: Diuretics

- Treatment of edema (e.g. associated with CHF)
 - E.g. Lasix
- Signs of chronic dehydration (dryness of mouth, thirst, weakness, drowsiness)

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Meds: Antihypertensives

- Used to treat high blood pressure
- Most have some degree of parasympathomimetic effect
 - Dry mucosa

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Meds to treat disorders

- Moving from meds to treat “unrelated” disorders that have an impact on swallowing
TO
- Meds that are designed to treat the disorder causing the dysphagia

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CVA-Tissue Plasminogen Activator (tPA)

- Tissue plasminogen activator (tPA) is a thrombolytic agent (clot-busting drug).
- Approved for use in certain patients having a heart attack or stroke.
- The drug can dissolve blood clots, which cause most heart attacks and strokes.
- tPA is the only drug approved by the U.S. Food and Drug Administration for the acute (urgent) treatment of ischemic stroke.

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Intra-arterial tPA

Neurovascular specialist inserts a thin, flexible catheter into an artery (usually in the groin area) and steers it up to the area of the clot then administers the tPA through the catheter.

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Medications to treat disorder

- Parkinson's: one case study reported improvement in swallowing with adjustment in timing of medication (Sinemet most effective one hour post administration) (Fonda et al 1995)

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Impact of dopaminergic stimulation on swallowing

- Small study (15 patients)
- Withheld meds and performed MBS
- Found *some* changes in more automatic, non-voluntary components of the swallow (e.g. pharyngeal phase time)
- "Unlike the cardinal motor features of Parkinson's Disease, swallowing dysfunction is predominantly resistant to dopaminergic stimulation" Hamer et al 1997
- Small study (12 patients)
- MBS before and after administering meds
- 50% showed objective improvement after levodopa treatment
 - Jong-Ling, et al 1997

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Medications to treat disorder

- Myasthenia Gravis
 - Mestinon peak effectiveness two hours after administration

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Medications to treat disorder: GERD

- Antacids
- Histamine-2 receptor antagonists (Zantac, Pepcid, Tagamet)
- Proton pump inhibitors (Omeprazole, Prilosec, Protonix)
- Motility drugs – prokinetic (Propulsid)

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Other treatments

- Mechanical ventilation
- Non-invasive ventilation
- Other modes of oxygen delivery
- Dialysis
 - Peritoneal
 - Regular
- Tube feeding
- Chemoradiation

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Instruments and devices

- Ventilators
 - Medical device that ventilates a patient
 - Ventilation: process of moving gases into and out of the lungs
 - Respiration: actual exchange of gases between air breathed in and cells of the body

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Why are patients placed on ventilators?

- Experiencing periods of apnea
- In acute ventilatory failure
- Impending ventilatory failure
- Need hyperventilation for intracranial pressure control

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Positive pressure ventilators

- Push air into the airways to inflate the alveoli
- Pressure ventilation is set on the ventilator and the exhaled volume will vary based on lung compliance
- Volume ventilation is set to a desired volume and the required pressure varies based on lung compliance.

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Modes of ventilation

- Assist control
 - Every breath delivered to the patient is at a set volume but does allow the patient to have spontaneous effort at the pre set volume.
- Synchronized Intermittent Mandatory (SIMV)
 - Waits for patient to breathe as deeply and quickly as they want; gives breath with patient's effort
- Mandatory control
 - Does not rely on patient to start the breath this is only if the patient is so sedated that there is no spontaneous respiratory effort. *Not used much anymore*
- Spontaneous
 - Just assists the patient with end expiratory pressure called PEEP, may add pressure support if necessary

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Augmentative modes

- Positive End Expiratory Pressure (PEEP)
- Gives added pressure to maintain oxygenation
 - Used with any mode of ventilation to increase oxygenation
- Continuous Positive Airway Pressure (CPAP)
- Mode used during weaning

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Non-invasive ventilators: CPAP

- Continuous positive airway pressure (CPAP) refers to a medical device used primarily for the treatment of **sleep apnea**, although it may also be employed to transition patients in hospitals from breathing tubes, or *intubation*, to regular breathing.
- Those with **chronic obstructive pulmonary disorder** or other breathing disorders may also use a CPAP or a BiPap unit at night

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Non-invasive ventilators: BiPAP

- BiPAP stands for *Bi-level Positive Airway Pressure*. It is a breathing device that delivers a pressure during inhalation called pressure support and allows a PEEP during exhalation.
- Created in the 1990s, it developed out of the C-PAP, which stands for *Continuous Positive Airway Pressure*

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BiPap

- Air delivered through a mask can be set at one pressure for inhaling and another for exhaling.
- This makes BiPAP much easier for users to adapt to and also allows neuromuscular disease sufferers to use the device.
- Because of these dual settings, BiPAP allows people to get more air in and out of the lungs without the natural muscular effort needed to do so.

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Other oxygen devices

- Non-Rebreather
 - allows high percentage of oxygen to be delivered by not allowing the patient to re-breathe exhaled gases.

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Oxygen therapy

- Mode of delivery
 - Face mask
 - Nasal cannula

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Intubation and Tracheotomy tubes

- Endotracheal tube
 - Regular ETT
 - Hi-lo evac tube
 - Silver ETT
- Nasotracheal tube

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Oral or nasal intubation

- How long is too long?
- de Larminat (1995) - marked impairment in sensitivity of swallowing response after as short a time as 24 hours
- Colice (1989,1992) described the kind of damage as mucosal lacerations along posterior-medial aspects of both cords and edema

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Oral or nasal intubation

- Leder et al. (1998)
- Intubated at least 48 hours
- FEES about 24 hours after extubation
- Aspiration in 45%, and 44% of those were silent aspirators
- 89% of aspirators resumed oral diet 2-10 days after extubation
- Your evaluation may prevent aspiration

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Recovery of feeding following intubation

Barker et al 2007

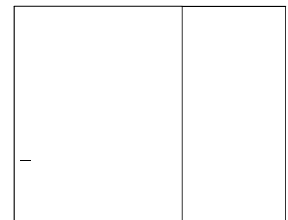
- Retrospective review of 254 patients
- Intubated 48 hours or longer
- Dysphagia identified in 51%
- Incremental factors predicting risk for developing post-extubation dysphagia included:
 - Longer duration of endotracheal intubation
 - Occurrence of peri-operative stroke
 - Presence of peri-operative sepsis
- Occurrence of dysphagia and duration of endotracheal intubation were only independent factors predicting delayed return to normal enteral feeding and delayed discharge

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Trach tubes

- Tracheostomy tube
 - outer flange
 - outer cannula
 - inner cannula
 - obturator
 - universal hub
 - cuff
 - fenestrations



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Effects of trach on swallowing

- Bonnano (1971) - limited laryngeal elevation and limited anterior rotation of the larynx
- Trach tube seems to act as anchor

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Effects of trach on swallowing

- May be some loss of protective reflexes
- Shaker et al. (1995) - vocal cords close completely, duration of closure shorter for patients with trachs
- Timing of apnea related to vocal cord closure also altered

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Incidence of dysphagia with trachs

- Between 65% and 87%
- Patients who are orally intubated and then trached - double deficit
- DeVita et al. (1990) - Mean of six deficits per patient (from list of 11)
- Delayed triggering and pharyngeal pooling
- Some patients' deficits continued after tube removed

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Incidence of dysphagia with trachs

- Tolep et al (1996) - MBS studies abnormal in 83% of patients
- Laryngoscopy revealed decreased sensation of the cords, pooled secretions above the cords, limited vocal cord movement, and edema of the arytenoids
- Elpern et al (1994) - 50% of their patients aspirated (77% silently)

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What about cuffs on trach tubes?

- Generally preferable that cuff be deflated
- Elpern et al. (1987)- inflated cuffs did NOT prevent aspiration.
- Aspiration occurred with greater frequency when cuffs inflated to occlusion than when slight leak present

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Speaking valves and swallowing

- Advantage to wearing speaking valve during eating - allows patient to communicate
- However, disagreement whether the valve really helps swallowing

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Speaking valves and swallowing

- Eibling and Gross (1996)
- Supports role of subglottic pressure in swallowing efficiency
- 11 patients known to aspirate on MBS
- Significant decrease or elimination of aspiration with Passy-Muir Valve on.

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Speaking valves and swallowing

- Leder (1996; 1998)
- Occlusion of trach tube had no effect on prevalence of aspiration
- No trends related to bolus consistency, type of tube, presence/absence of NG
- Leder (1999)
- Incidence of aspiration not affected by one-way trach valve
- Authors concluded that patients with trach tubes often have risk factors other than the tube that predisposes them to aspirate

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Cuff deflation and one-way speaking valve and swallowing

- 14 non-ventilator dependent patients had VFSS under three conditions (cuff up, down, valve on)
- Scores on penetration-aspiration scale not significantly affected by cuff status
- One-way valve placement significantly reduced scores on penetration-aspiration scale for liquid bolus
 - Suiter, et al 2003

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Suctioning

- Nasotracheal
- Endotracheal
- Trach

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Suctioning - if SLP wants to do it

- Scope of Practice - does not list it, but does not exclude it. Not a new area of practice, but a tool
- Code of Ethics - assure that you have demonstrated competence
- Position Statement of Multiskilled Personnel (1996) - "cross-training of basic patient care skills is a reasonable option"

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Dialysis

- End stage kidney failure
- When about 85 to 90 percent of kidney function has been lost

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Hemodialysis

- Artificial kidney (hemodialyzer) is used to remove waste and extra chemicals and fluid from the blood.
- Surgical placement to make an access (entrance) into the blood vessels.
 - Sometimes, an access is made by joining an artery to a vein under the skin to make a bigger blood vessel called a fistula.
 - May use a soft plastic tube to join an artery and a vein under the skin (graft)
 - A narrow plastic tube, called a catheter, which is inserted into a large vein in the neck. This type of access may be temporary, but is sometimes used for long-term treatment.

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Peritoneal dialysis

- Blood is cleaned inside the body.
- Catheter in abdomen to make an access.
- During the treatment, the abdominal area (the peritoneal cavity) is slowly filled with dialysate through the catheter.
- The blood stays in the arteries and veins that line the peritoneal cavity.
 - Extra fluid and waste products are drawn out of the blood and into the dialysate.

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Two major kinds of peritoneal dialysis.

- | | |
|---|---|
| <ul style="list-style-type: none">■ Continuous Ambulatory Peritoneal Dialysis (CAPD)<ul style="list-style-type: none">■ done without machines■ Patient puts a bag of dialysate (about two quarts) into the peritoneal cavity through the catheter. | <ul style="list-style-type: none">■ Continuous Cycling Peritoneal Dialysis (CCPD).<ul style="list-style-type: none">■ machine called a cyclor.■ Each cycle usually lasts 1-1/2 hours |
|---|---|

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Nutrition for NPO: Tube feeding

- | | |
|--|---|
| <ul style="list-style-type: none">■ NG■ NJ■ ND | <ul style="list-style-type: none">■ PEG■ PEJ |
|--|---|

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PEG vs. PEJ

- Meta-analysis of 11 clinical trials
 - Gastric feeding instead of postpyloric feeding did not increase the risk of aspiration or pneumonia or hospital mortality (Ho, Dobb & Wedd 2006)
- PEJ associated with lower complication rates, but does not eliminate risk of aspiration Shike, et al 1996

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PEG and pneumonia

- Aspiration pneumonia occurred in 52% of patients up to a month after PEG placement (Kitamura et al 2007)
- However, patients with PEG often have clinical conditions predisposing to the direct aspiration of oropharyngeal contents and GE reflux

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Does feeding tube affect aspiration on FEES Leder 2007

- Prospective study 1,260 consecutive peds and adult patients with variety of diagnoses
- Some with (61% small bore; 39% large bore) NG and some without
- Presence of NG Tube did not affect incidence of aspiration for either liquid or puree consistencies during FEES®

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Nutrition for NPO

- Total Parenteral Nutrition (TPN)
- IV directly into bloodstream
- Central line inserted into large vein (often under collar bone)

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Who gets TPN?

- Patient whose gut is non-functional
 - Severe persistent diarrhea
 - Lymphoma
 - Motility disorders of esophagus and GI tract
 - Colorectal CA

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Chemoradiation

- ACUTE EFFECTS
 - Due to effects on mucosa, taste buds, salivary glands
- LATE EFFECTS
 - 5-10 years post
 - Injury to salivary glands = xerostomia
 - Damage to connective tissue (fibrosis) resulting in trismus and pharyngeal dysphagia

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Assessment of dysphagia

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How can we identify dysphagia?

- Screening
- Clinical evaluation by SLP
- Instrumental evaluation by SLP
- Incidence of dysphagia per type of procedure:
 - Screening 37-45%
 - Clinical exam by SLP 51-55%
 - Instrumental testing 64-78%
 - Martino et al 2005

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Bedside evaluation or screening?

- Screening does not identify the nature of the problem
 - But the bedside exam can identify the nature of the oral dysphagia
- Screening identifies who is at risk for significant dysphagia
 - We're getting better at this, but even predicting who will aspirate does not tell us why
- Rosenbek indicates screening is pre-symptomatic testing with aim of early diagnosis
- Therefore, the bedside is not a screening according to those criteria

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Bedside evaluation

- Usually the first step in assessing a patient
- This evaluation yields important information about the oral phase of the swallow and..
- Provides clues about the pharyngeal phase

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Bedside evaluation

- If treatment for suspected pharyngeal disorder is based solely on bedside evaluation, patient is placed at risk
- Aspiration cannot be confirmed or ruled out
- Up to 65% of patients may be silent aspirators

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Purposes of clinical exam

Clinical Indicators for Instrumental Assessment of Dysphagia: ASHA 2000

- Integrate info from interview, case hx, medical records, protocols, collaboration
- Observe and assess oral motor function
- Characteristics of dysphagia
- Determine need for instrumental
- Determine if patient appropriate candidate for tx
- Recommend route of nutritional mgt
- Recommend interventions
- Counsel and educate

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Efficacy of clinical/bedside evaluation

- Logemann et al
- McCullough et al
- Mann 2002
- All lead to a likelihood ratio
- If patient has certain signs, symptoms, history what is the increased likelihood of dysphagia or aspiration?



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Risk ratio example (Logemann, et al 1999)

- Identified variables that were able to classify patients correctly as having or not having:
 - Aspiration 71%
 - Oral stage disorder 69%
 - Pharyngeal delay 72%
 - Pharyngeal problem 70%

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How accurate are bedside evaluations?

- Logemann et al concluded:
 - “Even if screening procedures become 100% accurate in defining the presence of aspiration or the presence of problems in the oral stage of the swallow, the pharyngeal triggering, or the pharyngeal stage of the swallow, in-depth diagnosis is still needed to define the anatomic and/physiologic nature of the problem and the effects of treatment strategies....”

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How accurate are bedside evaluations?

- McCullough et al (2000)
- Fewer than 50% of the measures clinicians typically employ are rated with sufficient inter- and intra-judge reliability

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McCullough (2000)

- Best history measure: pneumonia
- Best oral motor measure: jaw strength
- Best voice: wet and dysphonia

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Risk ratio example (Mann & Hankey, 2001)

- Clinical items as independent predictors of *dysphagia* (measured radiographically)
- Age > 70
- Male
- Disabling Stroke (Barthel < 60)
- Palatal weakness or asymmetry
- Incomplete oral clearance
- Impaired pharyngeal response (cough/gurgle)

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Risk ratio example (Mann & Hankey, 2001)

- Clinical predictors of *aspiration*
- Delayed oral transit
- Incomplete oral clearance

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Mann Assessment of Swallowing Ability (MASA)^{Delmar}

- Yields probabilities of presence of dysphagia and of aspiration on instrumental exam
- 5 and 10 point scaling of 24 items
- 200 points maximum
- Definite, probable, possible or unlikely dysphagia OR of aspiration on VFSE

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Reliability of MASA

- 41 first ever stroke patients assessed within 36 hours of admit with MASA and FEES
- Prevalance of dysphagia
 - 73% MASA 68% FEES
- Prevalance aspiration
 - 65% MASA 43% FEES

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MASA

- Sensitivity of MASA for dysphagia was 96% and specificity 75%
- Positive predictive value 89%
- Negative predictive value 90%
- Sensitivity of MASA for aspiration was 87% sensitive and 51% specific
- Positive predictive value 57%
- Negative predictive value 85%

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Procedures sometimes used with/instead of bedside

- 3 oz. Water swallow test
- Timed Test of Swallowing
- Cervical auscultation
- Blue Dye Test
- Pulse Oximetry
- Reflex Cough Test

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3 oz. Water Swallow Test

- DePippo et al (1992)
- Stroke rehab patients
- Abnormal response considered to be:
 - Inability to complete task
 - coughing during or for one minute after
 - wet-hoarse vocal quality
- Patients then underwent MBS (not clear when this occurred)

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3 Ounce Water Swallow Test

- Contribution of 3 ounce water test to detection of aspiration during clinical (bedside) swallow screening has been reported, but no clear consensus because of inadequate statistical power due to small sample sizes and varying methodologies

(DePippo, 1992; Garon, 1995; Mari, 1997; McCullough et al., *J Comm Dis*, 34:55-72, 2001; Rosenbek et al., *J Comm Dis*, 37:437-50, 2004)

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3 Ounce Water Swallow Test

- Clinical utility of 3 ounce water swallow test focused primarily on adults with neurological disease, i.e., stroke
 - (DePippo, 1992; Garon, 1995; Mari, 1997; McCullough et al., 2001; Rosenbek et al., 2004)
- Variable sensitivity and specificity ranging from sensitivity as high as 0.86 but with specificity as low as 0.50
 - (Rosenbek et al., 2004)

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3 Ounce Water Swallow Test

- The clinical usefulness of the 3 ounce water swallow test in more heterogeneous patient populations is unknown

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Clinical Utility of the 3 Ounce Water Swallow Test

- Steven B. Leder, Ph.D.
Yale University School of Medicine
- Debra M. Suiter, Ph.D.
University of Memphis

Dysphagia (2008) 23: 244-250

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3 Ounce Water Swallow Test

Purpose

- Examine the clinical usefulness of the 3 ounce water swallow test for determining aspiration status and oral feeding recommendations in a large and heterogeneous population sample

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3 Ounce Water Swallow Test

3 Research Questions Asked:

1. Does the 3 ounce water swallow test ID patients who aspirate thin liquids?
2. Does a failed 3 ounce water swallow test ID pts. who are also unsafe for oral alimentation based on results of instrumental evaluation?
3. Does a successfully passed 3 ounce water swallow test permit specific diet rec. to be made without further objective assessment?

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3 Ounce Water Swallow Test

Methods

- All FEES performed from Dec. 1999-Sept. 2006
- All patients allowed to swallow spontaneously, i.e., without verbal command
- Food Challenge:
 - 3 boluses of puree then
 - 3 boluses of liquid
- Safe Swallow: No aspiration during FEES

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3 Ounce Water Swallow Test

Methods

- Immediately after FEES, each patient given 3 ounces of water and asked to drink without interruption
- Criteria for Test Failure:
 - Inability to complete task
 - Coughing or choking
 - Post-swallow wet/horse vocal quality

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3 Ounce Water Swallow Test

Statistics

- Diagnostic value of a test expressed by means of its:
 - Sensitivity: Probability that a Diagnostic sign will be positive given that disease (aspiration) is truly present
 - Specificity: Probability that a Diagnostic sign will *not* be positive given that a disease is truly *not* present

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3 Ounce Water Swallow Test

Statistics

- Predictive Value: The chance that persons with a certain test score actually have the disease
- Positive Predictive Value: Which part of persons under study with a positive test score actually have the disease
- Negative Predictive Value: Which part of persons under study with a negative test score are healthy

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3 Ounce Water Swallow Test

Statistics

- True Positive: + asp. FEES/Failed 3 ounce test
- True Negative: - asp. FEES/Passed 3 ounce test
- False Positive: - asp. FEES/Failed 3 ounce test
- False Negative: + asp. FEES/Passed 3 ounce test

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Does the 3 ounce water swallow test ID patients who aspirate thin liquids?

Question #1: YES

The 3 ounce water swallow test is:

- Sensitive for ID aspiration of thin liquids: 96% who aspirated on FEES also failed 3 ounce test
- Also, 3 ounce test had high negative predictive value (98%), i.e., if passed also no aspiration on FEES
- Therefore, passing 3 ounce test = good predictor to safely tolerate thin liquids

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Does a failed 3 ounce water swallow test ID pts. who are also unsafe for oral alimentation based on results of instrumental evaluation?

Question #2: NO (over-identifies)

However, failure on 3 ounce test often does not indicate *inability* to tolerate safely thin liquids

- Specificity for determining liquid aspiration during FEES = low, 50%, and false positive rate high (50%), i.e., half of patients who failed the 3 ounce test did not aspirate during FEES

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3 Ounce Water Swallow Test

Discussion

- The combination of low specificity with a high false positive rate results in approximately 50% of screened pts. referred unnecessarily for further testing
- 3 ounce test fails as a screening tool because it over-refers and unnecessarily restricts liquid intake for almost 50% of patients tested

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Does a successfully passed 3 ounce water swallow test permit specific diet rec. to be made without further objective assessment?

Question #3: Yes, but.....

- For the first time with objective data, if the 3 ounce water swallow test was passed, patients can have an oral diet without further diagnostic dysphagia testing.
 - Puree diet if edentulous
 - Soft/Regular diet if dentate

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3 Ounce Water Swallow Test

BUT.... nearly 71% of pts. who failed the 3 ounce test were deemed safe for some form of oral intake based on FEES

- *Failure on the 3 ounce water swallow test did not accurately reflect true oral feeding status.*

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3 Ounce Water Swallow Test

Discussion

- Clinical Judgment and Experience
- Although 98.3% of patients who passed the 3 ounce test were successful with an oral diet, other patient-specific factors are important for an oral diet to be safe and successful

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3 Ounce Water Swallow Test

Discussion

- For ex.:
 - Dementia: Following directions, self-feeding
 - Stroke: Assess neglect, limb apraxia, hemiplegia
 - TBI: Impulsivity and task attentiveness
 - De-Conditioned: Diet modifications and assistance with eating

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3 Ounce Water Swallow Test

Discussion

- All patients with dysphagia benefit from encouragement and monitoring as work towards the goal of normal eating progresses
- Dysphagia specialist must synthesize objective, subjective, and behavioral data on an individual basis to promote safe and successful eating

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3 Ounce Water Swallow Test

Conclusions

- Caveat: Due to high false positive rate and low specificity, the 3 ounce test is not an efficient screening tool
- However, over-referral, although conservative, is not in and of itself a negative, as it allows greater objective ID of aspiration and the potential to determine diet rec. and Rx to promote safe eating

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Methodological weaknesses

- Examiner and order bias
- Patients not randomized
- Criteria for passing FEES® different than for passing 3 ounce water swallow

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Cervical Auscultation

- Cardiac Analogy Hypothesis:
 - Pharynx contains valves and pumps that produce reverberations with the pharynx to generate swallowing sounds
 - Heart sounds are propagated via vibration of muscles and valves
 - Limit of Dx Potential-Cause of swallowing sounds
 - Cichero & Murdoch, 1998

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Cervical Auscultation

- Methodology:
 - Spectra of sounds of swallowing transduced with an accelerometer, demonstrate important frequency sensitivity in higher rangel
- Conclusion:
 - Two stethoscope models have superior transmission characteristics for use in cervical auscultation of swallowing sounds
 - Hamlet, Penney, Formolo, 1994

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Cervical Auscultation

Aim of Study:

- Study symmetry and reproducibility of swallowing sounds from bilateral cervical auscultation

Conclusions:

- No significant differences for any parameters in both time and frequency domain analyses between swallowing sounds detected bilaterally

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Cervical Auscultation

Conclusion (continued)

- Support for use of unilateral site for detection of swallowing sounds
- Reproducibility suggest that evaluation of acoustic characteristics of swallowing sounds should be from repeated swallows vs. single swallow
 - Takahashi, Groher, Michi, 1994

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Cervical Auscultation

■ Investigate:

- n=14 normal subjects
- Type of acoustic detector unit suited to an acoustic analysis of pharyngeal swallow
- Type of adhesive suited for attachment of the detector
- Optimal site for sound detection of pharyngeal swallow

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Cervical Auscultation

■ Conclusion:

- Site over lateral border of the trachea immediately inferior to cricoid cartilage is the optimal site for detection of swallowing sounds (Greatest signal to noise ratio with smallest variance)

■ Takahashi, Groher, Michi, 1994

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Cervical Auscultation

- Growing clinical use as compliment
- Lack of randomized controlled studies
- How do dysphagic swallow sounds differ from normal swallow sounds?
 - Study of normal swallow
 - Acoustic signals differed for variables: age and bolus volume
 - Cichero & Murdoch, 2002

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Cervical Auscultation

- Benchmark methodology
 - Acoustic detector unit sensitive to swallowing sounds
 - Best placement
 - Takahashi et al, 1994
 - New instrumental standards
 - Microphone vs. accelerometer
 - Placement consistent with Takahashi
 - Cichero & Murdoch, 2002

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Cervical Auscultation

- Growing clinical use as compliment
- Lack of randomized controlled studies
- How do dysphagic swallow sounds differ from normal swallow sounds?
 - Study of normal swallow
 - Acoustic signals differed for variables: age and bolus volume
 - Cichero & Murdoch, 2002

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Cervical auscultation

- Recorded sounds of swallow
- Rated by 19 SLPs
- Compared to radiographically defined aspiration 66% specificity and 62% sensitivity
- Reliability of individual judges varied widely
- Those raters with good intra-rater reliability made good predictions
- Group consensus(17 of 20)was good
- So...in 'principle' use of swallow sounds should be reliable

Leslie, et al 2004
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Cervical Auscultation used to study post swallow respiratory sounds Cichero et al 2003

- Non-dysphagic individuals (18-60+)
- Called it the 'glottal release sound'
- Found to occur consistently in close proximity following the swallowing sound
- Sound has distinct features and these change depending on volume and viscosity of bolus swallowed
- Further research required

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Inter- and intra-rater reliability w/ cervical auscultation to detect aspiration

Stroud et al 2002

- Swallowing sounds recorded simultaneously with videofluoroscopy
- 5 SLPs listened to the sounds in isolation
- SLPs could not reliably classify swallows into those with or without aspiration
- Over detected aspiration

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Cervical Auscultation

- Cervical auscultation is at present an imprecise tool and information gained should be used cautiously

- Cichero & Murdoch, 1998
- Hamlet et al, 1994
- Takahashi et al, 1994
- Zenner et al, 1995

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Use of blue dye

- Issues:
 - 1.) Is it a reliable way to detect aspiration using the Modified Evans Blue Dye Test ?
 - 2.) If used in MEBDT or FEES®, is blue dye safe?

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Use of blue dye

- 20 consecutive simultaneous MEBDT and MBS
- 50% false negative rate
- MEBDT better at identifying aspiration in patients who aspirate more than a trace amount
 - Brady, Hildner & Hutchins (1999)

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Use of blue dye

- 15 consecutive simultaneous MEBDT and video nasal endoscopic exams
- 50% false negative rate
- MEBDT identified aspiration in 67% of patients who aspirated more than trace amounts
 - Donzelli, Brady, Wesling & Craney (2001)

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Simultaneous MBS and Blue Dye (BDT)

- Pilot study
- 50 simultaneous Blue Dye and MBS with trach patients
- Blue dye 80% sensitivity (Did not correctly identify 20% of patients who were aspirating)
- Blue dye 62% specificity (Thought 38% were aspirating when they were not)
- Certain trach conditions associated with more accurate BDT aspiration results:
 - Trach tube conditions:
 - cuff deflation
 - use of speaking valve
 - Food consistencies
 - Pureed solids
 - O'Neil, et al 2003

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Use of blue dye in tube feeding

- Patients experienced discolored serum, urine and skin from Blue Dye No. 1
- Several deaths reported
- Occurred in patients with gut permeability (sepsis, cardiac bypass, major vascular surgery, renal failure, AAA repair, cystic fibrosis, non-steroidal anti-inflammatory drug use)
 - Maloney, Ryan, Brasel, Binion, Johnson, Halbower, Frankel, Nyffeler & Moss, 2002)

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Use of blue dye in FEES®

- Amount differs from that used in tube feeding
- Reports of infection from opened and unopened bottles of blue dye
 - File, Tan & Thomson, 1995
 - Knoll, 1993

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Reflex cough test

- Reflex cough test (RCT)
- 20% tartaric acid
- Tube in mouth
- Pinched nose and inhaled
- Cough or no cough
 - Addington et al 1999

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Reflex cough test

- Compared two hospitals: RCT vs. standard
- RCT hospital 5/400 pneumonia
- Standard hospital 27/204 pneumonia
- Author's conclusion: Normal RCT after acute stroke indicated a neurologically intact laryngeal cough reflex, protected airway and low risk for developing pneumonia with PO

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RCT: An analysis

Murray et al 2002

- No inclusion/exclusion criteria
- No discussion site, type, size of lesion
- No attempt to determine if had pneumonia on admit
- More or less co-morbidities
- No control for differences in tx approaches

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RCT: An analysis

Murray et al 2002

- Binary decision of pass/fail
- No interjudge reliability for pass/fail
- "Pneumoflex"
- "Scientific validity and reliability of the RCT have not been demonstrated to date" (p.10)

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Clinical 'tests' to predict aspiration

- Researchers continue to search for non-instrumental methods for predicting aspiration
- Combination of three tests (water swallow; pudding swallow; still X-ray)
- Predicted aspiration on MBS with 90% sensitivity and 71% specificity
- Combination of two without the X-ray with 90 sensitivity and 56% specificity
 - Haruka, et al 2003

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Do we all do bedside the same?

- High degree of consistency on 11 of 19 components
- Inconsistencies in assessment of:
 - Sensory function
 - Gag
 - Cervical auscultation
 - Trial swallows with compensations
- Also inconsistent in what was recommended next after the clinical evaluation
 - Mathers-Schmidt 2003

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Instrumental Procedures

- Videofluoroscopy
- Endoscopy
- Endoscopy with sensory testing
- What you might choose based on where pt is

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Instrumental assessments for patients in ICU

- MBS
- Transporting patient to Radiology
- Nursing staff, respiratory care staff must accompany
- Still the best view for assessing efficacy of compensation techniques
- FEES
- Portable
- No patient transportation
- Can be repeated easily
- Don't "see" during complete swallow

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Efficacy of instrumental assessment

- The outcome of a videofluoroscopic evaluation can be immediate return to full or partial oral intake
 - Horner et al 1988
 - Logemann et al 1993
 - Rasley et al 1993
 - Swigert unpublished data

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Efficacy of the MBS

- Many studies have shown that the MBS allows the SLP to identify specific problems in anatomy/physiology and try appropriate treatment techniques
- Several studies that indicate MBS more accurate than bedside in identifying cause of aspiration

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Efficacy of the MBS

- Head and neck cancer patients assessed by MBS (vs. bedside) when planning treatment ultimately had better swallow times and more efficient swallows (Logemann et al 1992)

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Clinical Utility of MBS (Martin-Harris et al 2000)

- Database of nonrandom sample of 608 studies
- 10.4% normal
- 32.4% aspiration
- 57.2% swallowing abnormality
- 83% had change in at least one other variable:
 - 26.3% referral to specialist
 - 48.4% compensatory strategies
 - 37.2% swallowing therapy recommended
 - 31.4% change in mode of intake
 - 43.8% change in diet texture

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MBSImp (Martin-Harris et al 2008 Dysphagia)

- First standardized tool for the measurement of swallowing impairment based on judgments of structural movement relative to bolus flow from videofluoroscopic images using standardized bolus volumes and consistencies

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MBSImp

- The MBSImp is composed of 17 physiologic components ranging from lip closure to esophageal clearance.
- Each component is scored on 5-point Likert scale

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Identified physiologic components

- Lip Closure
- Hold Position/Tongue Control
- Bolus Preparation/Mastication
- Bolus Transport/Lingual Motion
- Initiation of Pharyngeal Swallow
- Soft Palate Elevation and Retraction
- Laryngeal Elevation
- Anterior Hyoid Excursion
- Epiglottic Movement
- Laryngeal Vestibular Closure – Height of Swallow
- Pharyngeal Stripping Wave
- Pharyngeal Contraction (*A/P VIEW ONLY*)
- Pharyngoesophageal Segment Opening
- Tongue Base Retraction
- Esophageal Clearance (upright)

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MBSImp

- Example of a five-point rating scale on the component “initiation of pharyngeal swallow” ranges from a score of “0” when the pharyngeal swallow initiates (onset superior-anterior hyoid movement) as the bolus head approximates the posterior ramus of the mandible to a “4” if there is no appreciable initiation of hyoid movement at any bolus location.

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MBSImp

- The study demonstrated that it was not necessary to score each swallow for every volume and consistency
- Rather, an overall impression (Overall Impression Score –OI) of the impaired components across all textures could be captured.

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MBSImp

- Oral and Pharyngeal Impairment scores were significantly associated with penetration-aspiration scores from the Penetration-Aspiration Scale (PAS) and this scale is used in conjunction with the MBSImp.
- However, there were many patients who exhibited swallowing impairment with nutritional and quality of life implications, but who did not penetrate or aspirate

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MBSImp

- Creating web-based training modules on the administration and scoring of the MBSImp tool. Each component will be represented by videofluoroscopic images across patient populations with corresponding 3-D animations.
- Prototypes ready for peer review in spring to mid-summer '09 and plans to offer ASHA CE credit for the training.

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Efficacy of FEES ®

- FEES® - Excess secretions visualized with FEES® have high predictive value for aspiration
- Murray et al 1996

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Murray's rating scale for secretions

- 0 = no visible secretions
- 1 = any secretions evident on entry or following a dry swallow in channels surrounding laryngeal vestibule bilaterally represented or deeply pooled. Includes transitions
- 2 = any secretions that changed from a 1 to a 3 during observation period
- 3 = Any secretions seen in the area defined as laryngeal vestibule

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Predicting aspiration from secretions

- All of hospitalized patients with secretions rating of 2 or above were observed to aspirate on FEES
- 0 = 21% aspirated
- 1 = 53% aspirated
- 2 = 100% aspirated
- 3 = 100% aspirated

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Comparison MBS & FEES(R)

- Oral phase observed
- Pharyngeal wall and tongue base movement during swallow
- Elevation and forward motion of larynx
- Opening of cricopharyngeus
- Tipping of epiglottis
- Movement of bolus during swallow
- Structures of the larynx and pharynx
- Amount and location of secretions
- Laryngeal sensation
- Closure of true cords
- Arytenoid movement
- Residue in lateral channels

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FEES and MBS comparisons

- Briani et al (1998): "videofluoroscopy most sensitive technique in identifying oropharyngeal alterations of swallowing"
- "videofluoroscopy also capable of detecting pre-clinical abnormalities in non-dysphagic patients who later developed dysphagia"

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How do the two studies compare?

- 34 patients with each, total agreement in 76.4% of patients for propulsion and 82.3% for aspiration (Perie et al 1998)
- 21 subjects, 75% of subjects who had penetration on FEES also had on MBS
- 88% of subjects who aspirated on FEES did so on MBS (within 48 hours) Langmore 1991

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FEES and MBS comparisons

- Langmore (1991)
- 75% of subjects who had penetration on FEES® also had penetration on MBS
- 88% who aspirated on FEES® also aspirated on MBS

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Reliability MBS (McCullough et al 2001)

- Intra-judge reliability on measures of:
 - Penetration-aspiration
 - Lingual function
 - Oral residue
 - Vallecular residue
 - Pyriform sinus residue
 - Hypopharyngeal residue
- Are acceptable
- Inter-judge reliability of most measures (with exception of aspiration yes/no) varies among clinicians
- Unacceptable

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Questions and case examples

- What questions do you have?
- Specific patient examples?

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