Aspiration Pneumonia And The Role Of The Speech-Language Pathologist: Using Evidence To Determine Risks Associated With Oral Feeding

SPEAKER:
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Dysphagia Practice: Aspiration Pneumonia and the Role of the Speech-Language Pathologist

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Outline

• 8:00–8:30 Anatomy and Physiology of the Respiratory System R/T Dysphagia
• 8:30–9:30 Pneumonia Types; Differential Diagnosis of Aspiration Pneumonia
• 9:30–9:45 Break
• 9:45–11:15 Differential Diagnosis of AP (continued)
• 11:15–12:15 Lunch (on your own)
• 12:15–1:00 Non-Dysphagia Pneumonia Risk Factors: Attributing Risk With Logic
• 1:00–1:45 Pulmonary Function Tests and Treatments for Respiratory Diseases
• 1:45–2:00 Break
• 2:00–2:45 Dysphagia Interventions and Aspiration: Thick Liquids, Water Protocols, (Tubes), and Common Sense
• 2:45–3:45 Case Studies

Dysphagia is Not a Disease

Disease, Condition:
Neurologic
Traumatic
Neoplastic
Structural
Iatrogenic
“Deconditioning”
Pulmonary
Others

Dysphagia

Aging

Disease, Condition:
Pulmonary
Nutritional
Community-Acquired
Social
Psychological
Others
Medical SLP

- Role of Modern Medical SLP
  - What is the nature of the patient's dysphagia?
  - How likely is current disease related to dysphagia?
  - What is risk of future disease due to dysphagia?
  - Can that risk be lowered?
  - How?
  - These questions are far less commonly asked by referring physicians, of other professionals

Medical SLP

- Adverse outcomes in our patients
  - Pulmonary diseases
  - Malnutrition, dehydration
  - Blood glucose management
  - Airway obstruction
  - Social isolation, depression
  - All are costly (economic cost)
  - Most can cause premature death (human cost)

Essential Knowledge

- Anatomy, physiology respiratory system
- Pathophysiology of common conditions
- Natural history of common conditions
- Effects and side effects of common medications
- What do test results mean
  - Imaging, laboratory, bacteriology, PFT, etc.
- What is considered “normal” swallowing function?
Pre-test

- Where does diaphragm’s innervation originate?
- What cranial nerve supplies facial sensation?
- What about tongue sensation?
- All pneumonias are technically aspiration pneumonias. True or false?
- Feeding tubes prevent aspiration. True or false?
- Eliminating dysphagia is the best way to reduce aspiration pneumonia risk. True or False?

Aerodigestive tract anatomy

Digestive:
Digestive System

- Esophagus - Transports food to digestive system
- Stomach - Breaks down proteins
- Duodenum - Breaks down fats, carbohydrates
- Jejunum - Absorbs carbohydrates and proteins
- Ileum – Absorbs fats
- Colon: transport waste, absorb water
  - Cecum, ascending, transverse, sigmoid, rectum...

Digestive System

- Esophagus
  - Muscular tube
  - Sphincters
  - Pierces diaphragm
  - Bolus transit

Digestive System

- Esophagus
  - Muscular tube
  - Sphincters
  - Pierces diaphragm
  - Bolus transit
Digestive System

- Stomach
  - GE junction
  - Fundus, body, pylorus
  - Pyloric sphincter
  - Mucosa secretes:
    - HCl
    - Proteolytics
    - Hormones
    - Mucus

Digestive System

- Duodenum

Digestive System

- Jejunum
  - Villi absorb dissolved nutrients
  - Nutrients transported in blood to target organs
**Digestive System**

- Large intestine
  - Removes water from remaining waste
  - Eliminates waste

**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 metabolic waste from working organs, via circulatory system
Ventilation

Airways CONDUCT air to alveoli... NO GAS EXCHANGE

Respiratory Gross Anatomy

Parietal pleura
Visceral pleura

P=atm rib
Ventilation Principles

- Lungs (alveoli) have a tendency to collapse
  - Elastance (or surface tension)
- Chest wall has a tendency to expand
  - Elastance
- Chest wall is connected to lungs, which
  - Maintains lungs partially inflated at rest
  - Maintains chest wall partially collapsed at rest

Major Events in Ventilation

- Phrenic nerve activates diaphragm
- Diaphragm contracts, pulling on lung and pushing on viscera
- Alveolar inertia overcome, lung volume increases
- Intra-alveolar pressure decreases (Boyle's Law)
- Atmospheric air fills pressure void in lungs
- Alveolar volume decreases, pressure increases
- Compressed viscera, stretched alveoli, recoil
- Elasticity of viscera, alveoli are now unopposed
- Alveolar are "pushed" out to atmosphere
- Phrenic nerve impulses cease, diaphragm relaxes

Ventilation-Rest

- P_{n} = Patm
- P_{a} = Patm
- nb
- rb
- Lung
- Diaphragm
- Pleural linkage
Respiration

- Physiologic requirements
  - Eliminate accumulated waste
  - Acquire nutrients
  - Oxygen and Carbon Dioxide concentrations are balanced by the respiratory system

- Medullary, peripheral centers sensitive to pH changes
  - Rate, depth of ventilation quickly altered by response to pH

Circulation & Respiration

- Lungs
- External Respiration (Blood ↔ Atmosphere)
- Working Tissues & Organs
- Internal Respiration (Blood ↔ Organs)
External Respiration

Alveoli exchange with blood

Breathing and Swallowing

Respiration and Deglutition

- Upper aerodigestive tract is shared
- Ventilation stops with swallowing (apnea)
  - Larynx closes "bottom to top"

Charbonneau et al., 2005; Hiss et al., 2003; Perlman et al., 2005

Aspiration Pneumonia and the SLP
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Normal Spirometry

- IRV: Inspiration (expansion)
- TV
- ERV: Expiration (collapse)
- RV

Respiration and Deglutition

- In Normals...
  - Exhale → Swallow → Exhale; Young and Old¹
  - Respiratory rate (young) is about 16/min.²
  - " " (elderly) " " 20/min.
  - Total Swallow Duration, Swallow Apnea Duration³
    - Increase with age
    - Decrease with lower lung volumes

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Normal Respiratory Rate-swallow on expiration

Total Swallow Duration=1.5 – 2.5 seconds

- Respiratory Rate = 16/min
Exhalation begins Swallow begins Swallow ends, exhalation resumes

Respiration and Deglutition

- Subglottic pressure

Inhalation: pressure above atmospheric
Exhalation: pressure below atmospheric

Rest breathing

UES Post. Phar. wall

C7 C6 C5 Post. Phar. wall
Breathing and swallowing

- Abnormalities
  - Stroke: volumes, duration, airflow direction
    - Shorter cycle duration at rest*
    - Direction of airflow after swallow**
      - Normals: 96% expiration after swallow
      - Stroke: 60% expiration after swallow (p<.01)
  - Laryngectomy***
    - Evidence of maintained pattern in laryngectomy

*,**Leslie et al., 2002 a,b
***Charbonneau et al., 2005
Breathing and swallowing
- Abnormalities
  - Cheyne Stokes respiratory pattern
  - Periodic apnea

Breathing and swallowing
Abnormalities: Tachypnea

Swallow-apnea
1.5 – 2.5 seconds

Pneumonia and Respiratory Diseases
Aging and Disease

- 2005: 20 million chronic-disease deaths
  - Cardiovascular 30%
  - Cancer 13%
  - Chronic respiratory 7%
  - Diabetes mellitus 2%
- Devastating events and comorbidity
  - Stroke, neurodegenerative disease PLUS above

Pneumonia

- Most frequent infectious cause of death*
- 2nd most common nosocomial infection (UTI) in hospitals***
- 33%-48% of all Nursing Home Infections
- 63,000 deaths in 2003**
- 40% higher incidence in elderly
- Case fatality rate
  - 55% (elderly)


What is Pneumonia?

- Causes
  - Microbiological etiology
    - Pneumococcal, Legionnaire’s, RSV, bacterial
- Location (site)
  - Bronchoalveolar, lobular, lobar
- Type
  - Primary (inhale or aspirate pathogen)
  - Secondary (opportunistic pathogen infects damaged epithelium)
What is Pneumonia?

- Setting of onset
  - Community acquired pneumonia
  - Health care associated (nosocomial) pneumonia

- Predisposing factors
  - Ventilator associated pneumonia
  - Aspiration pneumonia

What is Pneumonia?

- An inflammation of pulmonary parenchyma (alveoli, airways, both)...
  - ...Caused by infectious pathogens

- Treatment:
  - Infection must be treated
  - Respiratory distress, failure must be treated

What is Pneumonia?

- Phase 1: Edema
  - Pathogen infiltrates, infects alveoli
    - Draws nourishment from alveolar epithelium
    - Damaging alveolar epithelium
    - Producing metabolic byproducts (toxins)
    - Irritants to alveoli
    - Inflammation

Illustration: Patrick J. Lynch

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Aspiration Pneumonia and the SLP
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What is Pneumonia?

- Phase 2: Red hepatization phase.
  - Alveoli become excessively permeable
    - Red blood cells “leak” from capillaries
  - Immunological response
    - Inflammation of the lung = Pneumonitis

What is Pneumonia?

- Alveoli fill with RBC, WBC, serum, infectious debris
- Respiratory surface area is reduced by infiltrate
  - Dyspnea, hypoxemia
- Epithelium thickens
  - Surfactant production is diminished
    - Reduces compliance of lung
      - Further source of dyspnea
- Can spread with cough

Infiltrates

Thickened epithelium
What is Pneumonia?

- Phase 3: Gray hepatization phase
  - RBC’s destroyed
  - Infection contained
    - Bacteria absent
    - Infiltrates diminish
- Phase 4: Resolution
  - Immunological “clean-up”
  - Epithelium “heals”, surfactant restored

Types of Pneumonia

- All Pneumonia
  - Bacterial, viral, Legionella, RSV, etc.
- CAP
- Nosocomial Pneumonia
- Aspiration Pneumonia
  - Typical
  - Atypical
- VAP
- Non-VAP

Types of Pneumonia

- Community Acquired Pneumonia (CAP)
  - Pneumonia not acquired in a health care facility
  - 4-5 million cases per year**
  - 600,000 hospitalizations, 45,000 deaths**
  - Incidence**
    - 12 per 1000 persons
    - 20 per 1000 elderly persons (60% greater)

*Niederman, 2002; **Mandell & Wunderink, 2007
C.A.P.

- Pathogens responsible
  - Typical: Streptococcus, Klebsiella pneumoniae
  - Atypical *: H. influenzae, RSV, Legionella, E. coli, Staph. aureus, others

*El-Soh, et al., 2000; CDC guidelines

Cost of CAP

- Human Costs of Community Acquired Pneumonia
- Pneumonia after stroke*
  - 26.3% mortality, vs. 4.4% in stroke w/o pneumonia
- Economic Costs of Community Acquired Pneumonia
- Cost of pneumonia: $8-10 billion (1998)** ***

*Katzan, et al., 2003; **Niederman, et al., 1998; Mandell & Wunderink, 2007

Types of Pneumonia

- Nosocomial Pneumonias: Ventilator Associated, Nursing Home Acquired Pneumonia
- Pathogens:
  - Pseudomonas aeruginosa, Proteus species, Staph. Aureus

MRSA, Pseudobacteria
Types of Pneumonia

- Ventilator Associated Pneumonia
  - Exposure to mechanical ventilation
  - Contaminated respiratory circuits
  - Contaminated suction, bronchoscopic equipment
  - Gastroesophageal reflux common in Ventilation
  - Early, late onset
    - Early: typically CAP pathogens
    - Late: MRSA, other drug-resistant pathogens

Aspiration Pneumonia (AP)

- Aspiration
  - Foreign matter enters the respiratory system
- Pneumonia
  - Infectious acute inflammation
  - Reaction to pathogen
- Aspiration Pneumonia
  - Pulmonary infection caused by aspiration of colonized matter

Aspiration Pneumonia

- Aspiration pneumonia
  - CAP
  - Nosocomial

  - AP can originate in the community or in a hospital/HCF
  - Has reached epidemic proportions in the US*

*Baine, Yu, & Summe, 2001
Aspiration Pneumonia

- Human Costs of Aspiration Pneumonia
- AP admissions highest case-fatality rate
  - 23.1% during hospitalization*
- Is fatal in 20%-50% of confirmed cases
- Annual mortality (1998 numbers)
  - >25,000 annual deaths due to AP
- Economic Costs of Aspiration Pneumonia
  - $1.5 billion

*Baine et al, 2001;

Importance:

- If we reduce the incidence of AP by a modest 20%
  - 5,000 saved lives each year
- If we reduce the admissions or length of stay for AP by a modest 20%
  - $300 million saved

Data extrapolated from Mandell & Wunderink, 2007; Baine et al, 2001

What is Dysphagia-Related Aspiration Pneumonia (DAP)?

- Patient with dysphagia
- ...and other risk factors favoring pneumonia
- ...aspirates colonized oral secretions
- ...causing infection of airways and/or alveoli

- Where do these pathogens come from?
Oral biofilm development

How Does DAP Develop?

- Host Risk Factors
  - Mental status, immunological health, oral condition, upper GI obstruction, etc.
- What was aspirated?
  - And what is its pathogen load?
- Iatrogenic Risk Factors (institutionalized)
  - Feeding tube, postoperative impairments, medications, etc.

Where Does DAP Develop?

- Site of occurrence:
  - Can occur in a health care facility (HCF)
  - Nosocomial Aspiration Pneumonia
  - Can occur outside of the HCF
  - Community Acquired Aspiration Pneumonia
Aspiration Pneumonitis

- Non-Infectious
  - Acute Lung Injury caused by aspiration of caustic or particulate matter
  - Inflammation of alveoli by effects of irritants
    - No infection (sterile/non-pathogenic material)
    - Inflammatory edema reduces surface area
- Gastric contents
  - Sterile, acidic, caustic
  - Damage to airways, alveoli

A new source of AP?

- Gastric contents are normally sterile
  - pH: 2-3* (nothing can survive)
- However....
  - When stomach is de-acidified, and patient exhibits GE reflux or emesis, aspirated, colonized gastric contents can produce pneumonia
- Increased use of acid suppressing drugs**
  - Raise gastric pH to 4.0 to 6.0*

A new source of AP?

- Laheij et al., 2004*
  - 365,000 patients
  - Users and non-users of acid suppression drugs
    - Some were prior users
  - 5,551 patients developed pneumonia
    - PPI users were twice as likely to develop pneumonia
      - OR = 1.94-2.28
    - H2 receptor agonist users
      - OR = 1.36-1.64
  - AND...Eurich, et al., 2010; Herzig, et al., 2009

Distinguishing AP, Aspiration Pneumonitis, Other Pneumonias

- The Medical Record contains important clues
  - HISTORY OF ONSET
  - The course and progression of the disease
  - Presence/absence of underlying source/cause of aspiration
  - Results of lab, radiographic tests
Differential Diagnosis

- Dysphagia-related Aspiration Pneumonia (DAP)
- Non-dysphagia-related Aspiration Pneumonia (NDAP)
- Other pneumonias

DAP
- Associated with dysphagia
- Non-dysphagia related Aspiration Pneumonia
  - Aspiration does not occur because of dysphagia
    - Safely swallowed material
    - Gastroesophageal reflux or emesis (colonized)
      - Deacidified gastric contents

DAP vs. other Pneumonias

1. Location of chest infiltrates
   - DAP: typically gravity dependent segments
     - Lower lobes an segments
   - Position while aspirating
Radiographic evidence

- Infiltrates
  - Chest x-ray shows “shadows” at sites of infection-induced inflammation
    - Advanced pneumonia may involve entire lobes
      - Infection can spread
      - Aspiration Pneumonitis - Does not spread...

Aspiration Related Infiltrates

- Basilar infiltrates
- Upper & middle lobe infiltrates

Aspiration produces pneumonitis or pneumonia in gravity dependent portions of lung(s). "Dependence" depends on posture when aspiration occurs, density & volume aspirated.

DAP vs. other Pneumonias

- 1. Location of chest infiltrates
  - CAP, VAP, Nosocomial Pneumonia:
    - Diffuse
    - VAP: often well distributed
RRUL and RML infiltrates in patient with pneumonia

Aspiration Pneumonia

Aspiration pneumonia
Multilobar community acquired pneumonia

- **DAP vs. other Pneumonias**
  - **2. Signs and symptoms**
    - DAP, CAP, Nosocomial Pneumonia: *similar*,
      - Dyspnea
      - Hypoxemia
      - Malaise
      - Fever
      - Productive cough
      - Purulent sputum
      - Leukocytosis

- **Bacteriology**
  - DAP: oral pathogens/oral flora
  - CAP: Strep. pneumoniae, Klebsiella pneumoniae, H. influenzae, RSV, Legionella, E. coli, Staph. aureus
  - VAP: pseudomonas, proteus species, Staph. Aureus
    - Typically multiple organisms
  - Nosocomial pneumonia: pseudomonas, proteus species, Staph. aureus
  - Leukocytosis (elevated WBC)
    - Normal: 4.5 – 10.5 k cells/microliter
DAP vs. other Pneumonias

4. History
- DAP: Dysphagia! Dysphagia-producing disease, Symptom onset following oral intake; position during oral intake; esophageal dysmotility
  - Dependent for feeding/oral care, oral biofilm

DAP vs. other Pneumonias

4. History
- CAP: pt. not institutionalized; insidious onset
- Nosocomial Pneumonia: institutionalized patient, insidious onset
- VAP: mechanically ventilated patient; typically NPO at onset

Examination data collection

5. Course of Pneumonia
- What you see on assessment is not baseline
  - Elevated respiratory rate
  - Mental status
  - Cough is present in background
    - Count coughing before, during, and after oral trials
Examination data collection

<table>
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<tr>
<th>Time</th>
<th>Duration</th>
<th>Cough</th>
<th>Throat</th>
<th>Swallow trials A</th>
<th>Swallow trials B</th>
<th>Post-swallow trials</th>
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Summary-pneumonia

- Knowledge of normal and abnormal function is essential
  - Not just swallowing function...
- Elderly possess many risk factors for pneumonia that are unique to the elderly
- There are many clues pointing to, or away from, a diagnosis of DAP

Summary-pneumonia

- Things to remember
  - Aspiration can occur without dysphagia
  - Aspiration is one potential source of pneumonia pathogens
  - All respiratory illnesses are NOT dysphagia related
  - ALL PNEUMONIAS ARE NOT ASPIRATION RELATED
  - Patient appearance with pneumonia is NOT baseline
  - History, course, physical signs are data for the SLP
Respiratory System & Diseases

- The structures involved
- The respiratory conditions seen in the elderly
  - Are they suspicious for a dysphagia etiology?

Aging and Disease

- Obstructive Diseases
  - Inspired air is obstructed from the respiratory membrane
  - Obstructed gas exchange
  - Respiratory pump works
- Restrictive Diseases
  - Airflow or volume is mechanically restricted
  - Gas exchange is intact
  - Patient cannot inhale sufficient volume

Aging and Disease

- Chronic respiratory conditions
  - COPD
    - Progressive airway/alveolar destruction (emphysema)
    - Chronic bronchitis
  - Congestive Heart Failure
    - Hypertension
    - Right heart, left heart
    - Pulmonary Edema, Pleural Effusions
  - Pulmonary Fibrosis
  - Asthma
Aging and Disease

- Acute respiratory conditions
  - Pneumonia
  - Pneumothorax
    - Atelectasis
  - ARDS
    - Other acute pneumonitis

Respiratory Disease-obstructive

- Obstructive diseases
  - Air is "obstructed" from contact with respiratory membrane
  - Reduced oxygen supply
  - Reduced waste elimination
    - Acidosis
  - Increased respiratory rate
    - Overlap with swallow

Respiratory Disease-obstructive

- Airway Obstruction
  - Caused by dysphagia?
    - Very possible
  - Causes dysphagia?
    - No
Respiratory Disease-obstructive

- COPD
  - Chronic bronchitis
    - chronic mucus...obstruction
  - Emphysema
    - Alveoli and capillary destruction,
  - Resistance to blood flow into lungs
    - Can cause heart failure
  - Increased rate
  - Decreased cough effort
  - Reduced mucociliary clearance

Obstructive Pulmonary Disease

Respiratory membrane
surface area is destroyed
- emphysema

Respiratory membrane
surface area is obstructed
- Chronic bronchitis

Respiratory Disease-obstructive

- COPD: Caused by dysphagia?
  - Rarely but possible...
  - Chronic aspiration can produce
    - Alveolar destruction
    - Airway disease
    - Asthmatic bronchitis
    - Chronic irritation due to chronic aspiration
1. “Bottlenecked” Pulmonary Circulation → (R) Ventricle Fails

2. “Bottlenecked” Systemic Circulation → (L) Ventricle Fails

Hypertension and Edema: Normal Fluid “Balancing”
Hydrostatic pressure pushes water into interstitial space around organs.

Interstitial Fluid

Plasma

Na+ Na+

Cells/Organs

Hypertension

Hypertension and Edema: Abnormal Fluid "Balancing"

Obstructive Pulmonary Disease

Pulmonary Edema

- Common in CHF
- Hypertension
- Caustic ingestion
- Increased capillary permeability
- Pneumonitis
- Increased rate / reduced inspiratory capacity

Respiratory Disease-Restrictive

- Restrictive Diseases
- Limit amount of air that can be inhaled
- Mechanical
- Pain, paralysis, fibrosis
- Poor compliance
Restrictive Pulmonary Disease

- Asthma
  - A. Allergic/reactive
    - bronchial smooth muscle spasm
    - narrow airway, increased resistance, reduced flow
  - B. Asthmatic bronchitis
    - Mucus production
    - Obstructive component

Respiratory Disease-Restrictive

- Asthma
  - Dysphagia related? Maybe. Chronic aspiration can cause asthmatic bronchitis
  - Cause of dysphagia? Short-term/acute, maybe

Restrictive Pulmonary Disease

- Mechanically restrictive disease
  - Disable complete expansion of thoracic cavity
    - Kyphosis
    - Abnormally flexed thoracic spine, compressed thorax
  - Pulmonary fibrosis
    - Tough, leathery segments tether adjacent segments
  - Paralysis
Restrictive Pulmonary Disease

- Dysphagia related?
  - Kyphosis, no
  - Pulmonary fibrosis? Maybe
    - Chronic aspiration
  - Effects on respiration/swallow
    - Increased rate / reduced inspiratory capacity

Restrictive Pulmonary Disease

- Pneumothorax
  - Perforation caused by empyema/abscess
    - Chronic aspiration

Restrictive Pulmonary Disease

- Atelectasis
  - Areas of collapsed alveoli
Restrictive Pulmonary Disease

Pleural Effusion

CHF (transudative), Inflammatory (exudative)

Aspiration and Lung Damage

- Idiopathic Pulmonary Fibrosis (IPF)
  - Fibrosis: toughening
  - Idiopathic: from an unknown cause/etiology

Aspiration Pneumonitis

- Acute Lung Injury caused by aspiration of caustic or particulate matter
- Restrictive Plus Obstructive
  - Restrictive
    - Inflammation of alveoli by effects of irritants
  - No infection
    - Pulmonary edema
  - Obstructive
    - Fluid filled alveoli
Aspiration Pneumonitis

- Gastric Contents: Massive Acute Inflammation
  - Sterile, acidic
  - Airways, respiratory membrane damage
    - Opportunistic secondary infection
  - ARDS

ARDS

Iatrogenic causes of respiratory conditions

- Iatrogenic condition: a disease cause by treatment of another disease
  - Sedation (restrictive)
  - CNS depression
  - Disruption of pleural linkage (restrictive)
    - Cardiothoracic surgery
  - Phrenic nerve injury (restrictive)
    - Cardiothoracic surgery
Respiratory Swallow Tactics

- Effects on interventions
  - Mainly on behavioral interventions
    - Timing of airway closure
  - Consider added fatigue of “eating and drinking”
    - Increase respiratory rate even more?
    - Mitigating rate increases with supplemental O2
      - ...because we can’t pull off more CO2.

Summary

- Pulmonary disease affects swallow/breathing coordination
- Pulmonary disease can cause, or be caused by, dysphagia
  - Mainly characterized by disruption of swallow-respiratory coordination

Next – Risk Factors Favoring Pathogenesis of Pneumonia (Besides Dysphagia!)
**Risk Factors for Pneumonia**

- **Host Risk Factors**
  - Something about the host (patient) predisposing them to an adverse outcome
    - Oral colonization, aging, dependence, underlying pulmonary, neurological or digestive disease

- **Iatrogenic Risk Factors**
  - Increased risk for an adverse event caused by treatment of another condition
    - Medications, intraoperative injury, artificial airway

**Dysphagia—a host risk factor**

- Little disagreement regarding dysphagia
  - Aspiration obstructs airways
  - Enables secondary infection
  - Stroke, neurological diseases, cause dysphagia

- But pneumonia is always multifactorial...
  - We often CANNOT eliminate dysphagia

- What else can we do to mitigate pneumonia risk?

**Non-Dysphagia Risk Factors**

- Langmore, et al., 1998
  - 189 institutionalized males (non-ICU)
  - CSE, VFS, 3 scintigraphic exams (GE reflux, esophageal motility)
    - Half also had FEES test
    - VFS repeated if dysphagia suspected
  - Dental exam, salivary flow measurement, saliva and throat cultures, interview (repeated annually)
  - Outcome: pneumonia
    - SBC >12,000 + fever >100.5F + new infiltrate on CXR
Non-Dysphagia Risk Factors

- Patients who developed pneumonia had significantly more:
  - Feeding tubes in place
  - COPD, CHF, GI diagnoses
  - Decayed teeth, periodontitis, did not brush teeth
  - Multiple medical diagnoses, multiple medications
  - Dependent for oral care and feeding
  - Reduced activity
- What is the evidence in these areas?

Feeding Tubes - iatrogenic

- Feeding tubes as pneumonia risk factor
  - Bacterial contamination of stomach and mouth*
    - 44% PEG, 54% NG
    - E. coli, Proteus, multi-organism: NG > PEG (p<.001)
  - Feeding tube reservoirs contaminated**
    - 44% stroke patients with NG develop pneumonia***
      - ...without worsening dysphagia****

Segal, et al., 2006; **Wagner, et al., 1994; ***Dzeiwas et al., 2004; Dzeiwas et al., 2008

Feeding Tubes

- Pneumonia incidence is high *, **, ***, ****
  - Short-term, long-term
  - Other complications
    - Agitation and self extubation*
  - Do not improve risk of death or poor outcome *

*Ciocon, et al., 1988; Dzeiwas et al., 2004; Finucane, et al., 1996; Gomes et al., 2004
# Lindeboom, 2005
Pulmonary Disease-host risk

- COPD
  - Alters swallow physiology
    - Inspiration following swallow more frequent*
  - Damaged mucociliary clearance
    - Reduced ability to clear contaminants
  - Impaired cough

*Gross et al., 2009;

Pulmonary Disease

- CHF
  - Increased respiratory rate due to
    - Pleural effusion, pulmonary edema

- COPD and CHF: present significantly more in patients diagnosed with pneumonia *, **

Langmore et al., 1998; Langmore et al., 2002

Pulmonary Disease

- Active smoking
  - 4.1 times higher pneumonia risk *
  - Pharyngeal and glottic protective reflexes are attenuated by active smoking**

Langmore et al., 1998; Dua et al., 2002
Medications - iatrogenic

- Antipsychotics*
  - 60% increase pneumonia risk in a case-control study of elderly patients
  - Risk in first week of treatment: 450% increase
  - Subsides (does not disappear) over time
  - Most events with atypical antipsychotics
  - Clozapine, Abilify, Risperdal
  - Extrapyramidal effects, sedation
  - Typical drugs: sedation (haloperidol, chlorpromazine)

*Knoj et al., 2008;

Medications

- Multiple medications
  - Increase risk of pneumonia 15% *
- Medications that reduce LES tone
  - Cholecystokinin, secretin, progesterone, glucagon, neurotensin, dopamine, atropine, butylscopolamine, theophylline, nitrates, alcohol, fat, chocolate
  - Barbiturate, cigarettes, benzo., Ca channel blockers (cardizem), caffeine, anticholinergics

*Langmore et al., 1998;

Medications

- Acid suppression medications
  - Administered for stress ulcer prophylaxis in ICU
  - 3 studies show increased incidence of pneumonia in patients taking acid suppressing drugs
  - Proton pump inhibitors (omeprazole, etc.)
  - H2 receptor antagonists (ranitidine, etc.)
  - Increased pneumonia risk (discussed earlier)
  - Enables survival of pathogens in stomach
**Medications**

- LaHeij et al., 2004 (>300,000 OP subjects)
  - Treated patients who developed pneumonia were matched to up to 10 age/gender/lifestyle
  - Currently using PPI: 89% higher pneumonia risk over those who stopped using PPI
  - H2 antagonists: 63% higher pneumonia risk
- Herzig et al., 2009 (>60,000 IP subjects)
  - 52% inpatients treated
  - 5% treated patients, 2% untreated, → pneumonia
    - 30% higher risk of pneumonia (adjusted)

**Medications**

- Eurich et al., 2010
  - 248 patients post-pneumonia admission, compared to 2500 patients with no pneumonia hx.
  - 5.4 years average follow up
    - Some continued, some stopped PPI use
  - Acid suppression (current/past): 12% incidence
    - Current users: all of the incidence was with current
  - Non-acid suppression: 8% incidence

**Medications**

- Interesting contrast
  - SDD (selective decontamination of the digestive tract (sterilizes gastric contents without acid suppression)
  - Reduced pneumonia incidence in CVA patients*

---

*Gosney et al., 2006*
Medications

- There is evidence that acid suppression therapy may increase pneumonia risk
  - ...and that the stomach is a reservoir for pathogens

- Mechanism: alteration of gastric pH
  (normally 2-3) allows bacterial survival and colonization

Colonization-host risk or iatrogenic

- Gastric colonization
  - Discussed previously

- Oral colonization
  - Systematic review
    - Good evidence that aggressive oral care/hygiene reduces pneumonia in high risk adults
    - Relative risk reduction=34%-83%
  - Causes: oral, dental disease, xerostomia, medications

Colonization

- Oral Colonization (cont’d)
  - Worsened with*:  
    - Antibiotic use
    - Oral disease
    - Xerostomia
    - Malnutrition
    - Presence of teeth! **

*Gomes et al., 2003; **Wan et al., 2003
Colonization

- Oral colonization (cont’d)
  - Up to 1/3 of stroke patients cultured, found to have:
    - aerobic* (pseudomonas, e.g.)
    - and anaerobic** (E. coli, e.g.)
    - ...pathogens in mouth
  - Combine oral colonization with the fact that all normals aspirate at times ***

G.E. Reflux

- Regurgitation of gastric contents → aspiration
  - If colonized → pneumonia
  - If not colonized → ? Pulmonary fibrosis*
    - 24 hour pH probe
    - Compared IPF to ILD patients
    - Significant incidence of pH <4 in top, bottom of esophagus in IPF, not in ILD

*Tobin et al., 1998

Aging

- Senescent sensorimotor changes
- Reduced physiologic reserve

Baseline →
Healthy
Not Healthy
Young Middle Aged Old Very Old

Non Well-Being Physiologic Reserve

Stroke
Aging

- Diminished esophageal motility
- Reduced cricopharyngeal compliance
- Reduced intrabolus pressure generation (swallowing)
- Immune system degradation

Other iatrogenic risk factors

- Postoperative sensorimotor impairments
  - Predispose to dysphagia
  - Anterior cervical fusion*
  - Esophagectomy**
  - Thyroidectomy, carotid endarterectomy
  - Aortic repairs
  - Phrenic, vagus n.

*Krislovich, et al., 2000; **Atkins, et al., 2007

Other iatrogenic risk factors

- Airway manipulation
  - Mechanical ventilation
  - Endotracheal intubation
  - Tracheostomy
  - All raise the patient's pneumonia risk (VAP)
Mechanical Ventilation

- Complications of PPV
  - Barotrauma (alveolar damage, excessive pressure)
  - Pneumothorax
  - Diffuse alveolar damage
  - Atelectasis (alveolar collapse, insufficient PA)
  - Infection
    - ETT, tracheostomy: direct pathogen route
      - Nosocomial pathogens \(\rightarrow\) VAP
    - Respiratory deconditioning
    - Alveolar hypo-hyperventilation
    - Hypotension

Endotracheal Intubation

- Complications
  - malfunction, mucus plug, leak, position
  - Self extubation
  - Mucosal necrosis
  - Pneumonia
  - Laryngeal edema
  - Tracheal erosion

Prolonged Intubation

- Definition
  - Generally, \(>24-48\) hours
    - Dependent on other host risk factors
      - Age, method of intubation, underlying disease
    - \(>24\) hours (frail elderly)
Prolonged Intubation

- Evidence
  - Ajemian et al., 2001
    - 48 patients > 48 hours intubation, < 48 hours extubated
    - 27/48 (56%) aspirated, 12/27 (44%) silent aspiration
    - 19/27 thin liquid aspirators, 9/27 puree

- ElSohl et al., 2003
  - 42 elderly, 42 nonelderly; all > 48 hours intubation
  - FEES at 2 days post-extubation, and 5, 9, 14 days (aspirators)
  - 22/42 elderly, 15/42 non-elderly, aspiration
  - 13% elderly persistent dysphagia after 2 weeks
    - 0% non-elderly

Tracheostomy

- Open pathway for pathogens to colonize lung
Respiratory System Testing and Treatments

Testing the Respiratory System

Pulmonary Function Parameters

- FVC = forced vital capacity
- VC = vital capacity
- FEV₁ = forced expiratory volume in 1 second
- TLC = total lung capacity
- Reduced in restrictive disease
- RV = residual volume

Aspiration Pneumonia and the SLP
James L. Coyle, Ph.D., CCC-SLP, BRS-S
Normal Resting Spirometry

Spirometry Subtests

- Post-bronchodilator FEV₁
- FEV₁/FVC
- Rate of decline
- Body plethysmography
- Exhaled CO (carbon monoxide)
  - Confirms current smoking status

Imaging of the Chest

- Chest x-ray
- Chest CT
Chest x-ray

- Shadows
  - X-rays penetrate air filled areas and strike film
  - X-rays are absorbed by denser tissue
  - Differences in grayscale color indicate areas of "more solid" matter
  - Cases a shadow on the film

Right lung

Left lung
Chest x-ray: AP & lateral

Chest x-ray reports

- Terms
  - Consolidation, density, opacity:
    - "I see a shadow."
    - Does not indicate nature of "more solid" matter
  - Infiltrates:
    - More solid matter has infiltrated a space
    - Alveolar, airway
  - Edema: Fluid saturating area
    - Alveolar, interstitial
  - Effusion: fluid fills a body cavity (pleural)

Chest x-ray reports

- Terms
  - Atelectasis: collapsed alveoli
    - Obstructive
      - Blocked airways; gas within alveoli absorbed into blood
    - Non-obstructive
      - Compressive
        - Alveoli pressed closed – extrinsic
      - Dependent
        - Pt. position prevents inflation of alveoli; poor inspiration
      - Adhesive: lack of surfactant cause collapse
      - Passive: widened pleural space enables collapse
Chest x-ray reports

- Terms
  - Pulmonary vascular congestion
    - NOT airway congestion
    - Blood back-up in pulmonary vessels
    - Poor perfusion, (R) heart failure
    - pulmonary artery congestion
    - Arterial hypertenion, (L) heart failure
    - pulmonary vein congestion
  - Alveolar infiltrates are inside alveoli!
  - The rest of these are NOT alveolar infiltrates.

Pneumothorax

ARDS (bilaterally) with (R) Pneumothorax
Pulmonary edema (before, after)

Left lung mass; patchy (R) infiltrates

ARDS – Massive pneumonitis

Aspiration Pneumonia and the SLP
James L. Coyle, Ph.D., CCC-SLP, BRS-S
Pleural Effusions (R>L)

Chest CT

- Slices of body part are looked at

Plane film would look like this

Aspiration Pneumonia and the SLP
James L. Coyle, Ph.D., CCC-SLP, BRS-S
Chest CT

COPD

Reduced parenchyma

Emphysematous “holes”

Loss of alveolar surface area

Other tests

- Exercise tolerance
  - Treadmill test, 6 minute
- Resting SpO₂
  - After 10 minutes rest
- Biomarkers
  - Sputum, exhaled gas condensate, metabolites
  - DNA; Markers for surfactant, etc.
- Questionnaires
  - Depression, QOL, fatigue, dyspnea

Other tests

- Body Plethysmography: TLC and RV
- Inhalation Challenge Tests: allergen
- Exercise stress test
- Gas diffusion
  - ABG →
Blood Gases

• Reading Blood Gas Data (ABG)
  - p = partial pressure (mm/Hg)
  - a = arterial
  - v = venous (blood gases from venous sample)
  - O₂ = oxygen, CO₂ = carbon dioxide
  - S = saturation
  - H = hydrogen ion
  - Index of acidity

Blood Gases

• Arterial blood gases & normal ranges
  - paCO₂ = partial pressure of CO₂
    - 38-45 mmHg
  - paO₂ = partial pressure of O₂
    - 85-100 mmHg
  - pH: acidity
    - ~7.4
  - SaO₂ = % hemoglobin O₂ saturation
    - 90-100%

Pulmonary Disease Treatment

• ...and adapting the SLP evaluation to accommodate them...
**Treatment of Respiratory Conditions**

- Bronchodilators
  - Nebulizer
  - Metered Dose Inhaler (MDI)

**Pulmonary Disease Treatment**

- Oxygen monitoring
  - ABG
  - Pulse oximetry
    - Continuous
    - Intermittent

**Pulmonary Disease Treatment**

- Hyperinflation therapy
  - Patient generated
    - Incentive spirometry (IS)
  - Positive pressure
    - "Mechanical bronchodilator"
    - CPAP
      - One level
      - Bipap-2 level
    - IPPB
Pulmonary Disease Treatment

- Bronchopulmonary Hygiene
  - Percussion and postural drainage

- Suctioning

- Supplemental oxygen
  - Nasal cannula
  - Facemask
  - Non-rebreather
    - Prevents inspiration of
      - Room air
      - Exhaled air
    - Delivery parameter = LPM flow

- Adaptations?
  - Facemask: can pt. use cannula/oximeter?

- Venturi mask
  - Mixes room air with O2 to a fixed FiO2
  - Delivery parameter = FiO2, not flow (LPM)
Pulmonary Disease Treatment

- Observe all important vital signs
  - Respiratory rate in context of...
    - Oxygen saturation
      - Pulse oximetry does not help with dysphagia assessment; identifies hypoxemia over longer periods
    - Endurance/fatigue
      - Speaking, feeding, etc.
      - Overall mental status
    - Can the rate be brought down, temporarily?
      - i.e. the duration of a "meal"

Examination considerations

- Medication timing and the evaluation
  - Assess patient functions r/t recent medications
  - Bronchodilators, sedating medications, anxiolytics
  - Timing of "breathing treatments"
- Duration of endurance
  - Can influence meal duration/frequency
    - Patient who is "safe" for short periods
- Mix and match
  - The above parameters can be flexibly manipulated

Tracheostomy Management

- Acute Illness Requiring Mechanical Ventilation
  - Patient Survives Acute Illness/Disease
  - Patient Fails to Wean from Mechanical Ventilation
  - Tracheostomy is Placed
  - Patient Successfully Weans from Mechanical Ventilation
  - Patient is Decannulated
- Tolerance of Cuff Deflation
  - Screening for Aspiration of Oropharyngeal Secretions
  - Establishment of Oral-Nasal Airflow
  - Tolerance of Expiratory Occlusion; Speech
  - Clinical/Instrumental Evaluation of Swallowing
  - Tolerance of Inspiratory and Expiratory Occlusion

*Heffner & Zamora, 1991; Holevar et al., 2008*
High End Life Support

- ECMO
  - Extracorporeal membrane oxygenation

Extracorporeal Life Support

After Mechanical Ventilation

- Weaning
- Prolonged endotracheal intubation
- Ventilator associated pneumonia
- Clinical evaluation of tracheostomy patients
- Instrumental Testing

Dysphagia Interventions
Interventions

- Designed to
  - Prevent adverse events
    - Biomechanical
      - Aspiration, bolus misdirection, etc.
    - Global health outcomes
      - Pneumonia, malnutrition, dehydration
    - Psychosocial impairments
      - Isolation etc.

Interventions

- Topics
  - Thickening of liquids for dysphagia management
  - "Free water" protocols
  - Enteral feeding tubes in dysphagic patients

- Common theme:
  - Hydration/nutrition vs. aspiration...
  - Choosing the better of 2 or more bad choices

Water

- Main fluid medium of all cells (except fat)
  - 75-80% cell volume = water
  - Necessary for normal cellular functions
    - Other chemicals dissolved, suspended
    - Concentrations at cell membrane
Water

- Intake of water: ~2300 mL per day
  - 2100 mL through intake
  - 200 mL synthesized by body (CHO metabolism)

- Variations in water intake
  - Climate, habits, physical activity

Water

- Loss of water: ~2300 mL per day
  - Evaporation: 700 mL per day
  - Respiratory system (300 mL), through skin (400 mL)
    - Not sweating
  - Urine: 1400 mL
  - Sweat: 100 mL
  - Feces: 100 mL
Dehydration
- Kidneys constantly excrete fluid
  - Elimination of excess solutes
    - Ingested or metabolic byproducts
  - + Evaporation
  - = dehydration
- Sodium concentration rises
  - Hypernatremia with loss of extracellular fluid

Dehydration
- Hypernatremia
  - ADH increases fluid conservation by kidneys
  - Threshold for drinking
    - AKA Thirst!
  - Heart, kidney, neuron, other organs do not function
    - Cellular activity depends on concentration of sodium and other ions in plasma, cells.

Thick liquids
Pneumonia and aspiration

- Thin liquids aspirated most frequently
  - Compared to other viscosities
  - Spawned experimentation with thick liquids

Thickened liquids

- Theory for dysphagia use:
  - Slowing the flow
    - Compensates for mistimed airway closure
- What do we know about them?

Thickened liquids

- Use in SNF's
  - 11 companies that own 20% of all SNF's in US
  - Randomly selected facilities to avoid bias
  - 252 facilities in 41 states (~29000 beds)
  - Analyzed by CMS region

Castellanos et al., 2004)
• Results by facilities
  • Use in SNF: 0% to 100%
  • Facilities that use thickened water: 91.6%

• Results by patients
  • 8.3% patients receive thick liquids
  • Nectar (60%), Honey (33%), Pudding (6%)
  • Assessed with instrumentation: 45% (0-100%)

Thickened liquids

• Reduces aspiration of thin liquids
  • Kuhlemeier et al., 2001; Logemann et al., 2008
  • Does not increase pharyngeal residue
  • Bogaardt, et al., 2007.
  • Swallow apnea later/longer with thick liquids
  • Hiss et al., 2004; Butler et al., 2004
  • More effort needed to clear thick
  • Nicosia et al., 2001

Thickened liquids

• Patients do not like thick liquids
  • Garcia, 2005: prepackaged vs. mixed
    • Prepackaged better: Whelan, 2001
  • Great variability in thick liquids
    • Prepackaged & mixed: UW/VA Swallowing Research Lab, 1999
    • Prepackaged: Garcia, et al., 2005; Steele, 2005
    • Mixed by clinician: Glassburn & Deem, 1998
Thickened liquids

- And...
  - Mixed vs. packaged thick liquids
    - Not same viscosity
- And...
  - Barium mixtures vs. packaged thick drinks:
    - Not same viscosity
- Other properties make up “thickness”
  - ...not just viscosity

Thickened liquids

Add liquid to cylinder
 Remove cylinder
 Spread distance over time (50 mm)

Line Spread Test vs.
Brookfield Viscometer

Dysphagia Treatment Methods

**LST: Similar Viscosity**

**Fluids**

<table>
<thead>
<tr>
<th>Material</th>
<th>Viscosity</th>
<th>Line Spread -50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-thickened honey 1</td>
<td>675</td>
<td>9</td>
</tr>
<tr>
<td>Pre-thickened honey 2</td>
<td>832</td>
<td>8.75</td>
</tr>
<tr>
<td>Pre-thickened honey 3</td>
<td>909</td>
<td>10.42</td>
</tr>
<tr>
<td>Pre-thickened honey 4</td>
<td>1117</td>
<td>9.33</td>
</tr>
<tr>
<td>Honey thick barium</td>
<td>710</td>
<td>18.75</td>
</tr>
<tr>
<td>Karo syrup (93%)</td>
<td>1038</td>
<td>13.6</td>
</tr>
<tr>
<td>Pre-thickened nectar 1</td>
<td>260</td>
<td>12.8</td>
</tr>
<tr>
<td>Pre-thickened nectar 2</td>
<td>300</td>
<td>13</td>
</tr>
<tr>
<td>Pre-thickened nectar 3</td>
<td>264</td>
<td>11.7</td>
</tr>
<tr>
<td>Nectar thick barium</td>
<td>200</td>
<td>17.2</td>
</tr>
</tbody>
</table>

UW/VA Swallowing Research Lab, 1999
Thickened liquids

- Among 25 experienced SLP’s
  - Nectar: $r=+0.02$, Honey: $r=-0.03$
- Within subject (1st vs. second mixing of each consistency)
  - Nectar: $r=+0.26$ to $+0.33$
  - Honey: $r=+0.67$


---

**Thickened liquids**

- Hydration and thick liquids
  - Sharpe et al., 2007
    - Assessed water absorption
    - >95% water absorbed from thick mixtures
    - No difference between water, thick water
Thickened liquids

- Hydration and thick liquids
  - Reduced fluid intake when thick prescribed
    - Whelan, 2001
      - 24 stroke patients
      - Mean fluid intake = 455 mL/day

- Finestone, et al., 2001
  - 2 groups:
    - 1-enteral → diets with thick liquids (21 days)
    - 2-diets with thick liquids (21 days)
  - Both groups inadequate fluid intake with thick liquids
  - Reduced fluid intake as weaned from tube

- Large study data
  - Logemann et al., 2008; Robbins et al., 2008
    - 711 Patients with Parkinson disease, dementia
  - Aspiration on qualifying VFSS
  - Randomized order of presentation
    - Chin-down/thin, Nectar, Honey
  - Results...
Thickened liquids

- Part 1: eliminating liquid aspiration
  - Honey → nectar → chin down posture (all groups)
    - Overall aspiration: 53%, 63%, 68%
  - Half of patients aspirated on all 3
  - More aspiration on later trials
  - Patient preference:
    - Chin down posture, nectar, honey
- Part 2 →

Thickened liquids

- Protocol 201 Part 2 (515 patients)
  - Patients with aspiration on none or all:
    - ½ chin down posture with thin liquids (259)
    - ½ thick liquids (256)
      - ½ nectar, ½ honey (233, 123)
    - 3 month follow up
    - Pneumonia, hydration, other outcomes
- Results: →

Thickened liquids

- Results – Protocol 201 Part 2
  - 52/515 patients developed pneumonia (11%)
    - Much less than expected
  - Other adverse outcomes
    - More dehydration in thick liquids patients
      - 6% vs. 2%
    - More UTI in thick liquid patients
      - 6% vs. 3%
Thickened liquids

- Median hospital LOS with pneumonia
  - Honey (18 d.), nectar (4 d.), CDP (6 d.)

Thickened liquids

- Summary on thickened liquids
  - Reduces aspiration but is not preferred
  - Thick liquids do not dehydrate
    - Reduced intake of fluids
      - Probable source of dehydration
  - Test results do not match diet thickness
    - Anticipated results cannot be expected

Thickened liquids

- Summary on thickened liquids
  - Compliance
    - Patient preferences
    - Patient satisfaction
  - Aspiration of thick liquids may produce a worse pulmonary consequences than thin liquids
    - If treatment plan will not be implemented...
Evidence Summary for using Free Water Protocols

“Free Water” Protocols

- Frazier Rehab Institute Water Protocol
  - Kathy Panther, M.S., CCC, Louisville, Kentucky
  - “… Concern over patient and family non-compliance with thin liquid restrictions both within the facility and after discharge led us to alter our protocol in 1984. …oral intake of water became a major feature in both treatment and day to day hydration. Features of Frazier’s program …”

Free Water Protocols

- Literature search
  1. “Free Water”, + Deglutition Disorders
  2. Panther, K.
     - One citation on semantic relations in JSHD 1983
     - Perspectives article in 03/05 describing protocol
     - “Currently there is no published evidence that will give dysphagia clinicians a definitive scientific basis for the safe delivery of water to patients with dysphagia”
     - ASHA journal (pre “Leader”) piece in 1998
“Free Water” Protocol Principles

- Developers discuss
  - Safety of Water
  - Hydration
  - Compliance

1. “Safety of Water”
   - “Small amounts of water ... are quickly absorbed into the body pool.”
   - Large amounts are not.
   - “Water has a neutral pH...is free of bacteria ...”
   - “Aspiration of other liquids can lead to respiratory infections and pneumonia.”
- Cited evidence: animal studies, drowning case studies


Pneumonia and aspiration

- Drowning
  - Water fills air spaces
- Plasma is hypertonic
  - Meaning: it contains lower concentration of water
- At membrane, water flows into capillary

Effros, et al., 2000
**Pneumonia and aspiration**

- Example: seawater contains
  - High NaCL concentration
  - Is hypertonic
  - Compared to plasma
  - Seawater drowning
  - Plasma enters lung
  - Similar with aspiration of any hypertonic solution.

**“Free Water” Protocol Principles**

1. **“Safety of Water”**
   - “Water provides a safe means of assessing patients”
     - Opinion
   - “All patients (of any diagnosis) referred to Speech Pathology are screened for dysphagia with water.”
     - OK
   - “Water is safely utilized in daily treatment
     - “Swallow compensations can be practiced with thin liquid.”

2. **“Hydration”**
   - “Free water consumption is encouraged for all patients and makes a significant contribution in hydration for many.”
     - Evidence?
   - “The risk and cost of IV fluids should be decreased.
   - “Post-discharge surveys... indicate water often is the primary means of hydration.”

Retrieved on 01/20/09 from http://www.speech-languagepathologist.org/archives/chat/SLP/April212003.html
“Free Water” Protocol Principles

- 3. “Compliance”
  - "Patients reported thickened liquids did not quench thirst.
  - "...patient complaints are now much less"
  - "...patients object to thickened liquids.
  - "...patients appear more likely to comply with the thin liquids restriction.”

Retrieved on/using from:

---

“Free Water” Protocol Principles

- 3. “Compliance”
  - "...preparation of thickened liquids (is) burdensome.
  - "family may tire of patient complaints and abandon thickened liquids.
  - "Availability and cost of thickening may preclude compliance.
  - "Thick liquid preparation, ... can overwhelm many families.”

---

Free Water Protocols Evidence

- Bronchoalveolar lavage
- Whelan et al. (2001) reduced fluid intake in patients prescribed thick liquids
- Numerous citations on dehydration in dysphagia
- Animal studies of water aspiration
Free Water Protocols Evidence

- Garon et al., 1997
  - 20 aspiration-documented CVA patients
  - Aspirated liquid only on VFSS
  - Randomized to
    - (C): Thick liquids only at all times (10)
    - (E): All liquids thickened, AND free water (10)
  - Duration: treatment + 30 day follow up
- Small and underpowered study
  - Yet the main evidence for protocol

Garon et al., 1997

- Exclusion
  - “Severe cough” when aspirating
  - Cannot rinse and expectorate
  - Cannot self-feed
  - Pre-existing hydration concern
- 148 patients screened: 13% enrolled
  - 34 patients declined participation
  - 94 patients ineligible

Garon et al., 1997

- Water placed out of reach
- No water with meal or within 1 hour
- No compensatory swallow therapy
- Outcome variables
  - Pneumonia, hydration, time to no aspiration
  - Fluid intake
• Garon et al., 1997
  • Results
    • No patient in either group developed pneumonia, dehydration, complications
    • Intake of fluids comparable between groups
      • 1210 mL (C) - all thick
      • 1318 mL (E): 855mL thick, 463mL thin

Free Water Protocols Evidence

• Garon et al., 1997
  • Time to recovery of aspiration
    • Experimental: 19.1 days (range 7-35 days)
    • Control: 27.2 days (range: 8-64 days)
      • Control: 42% longer to recover
        - More severe aspirators in control so OK
        - Small sample
    • Time to pneumonia outcome: adequate?

Free Water Protocols Evidence

• Garon et al., 1997
  • “Much less water than expected” by investigators (“we were surprised...”)
  • Satisfaction: only one control patient was satisfied with thick liquid
    • “all study patients satisfied with water”
Free Water Protocols Evidence

  - Pneumonia-no difference
    - Thin liquids/chin-down posture: 10%
    - Thick liquids: 11%
  - Nectar: 8%, Honey: 15%
  - Dehydration: Thin: 2%, Thick: 6%
  - UTI: Thin: 3%, Thick: 6%
  - 3 times longer hospital stay in honey-thick who developed pneumonia

Free Water Protocols

- Two recent studies
  - Two presented at ASHA 2008
    - Becker et al., 2008. An oral water protocol in rehabilitation patients with dysphagia for liquids.

Free Water Protocols (#1)

- Bronson-Lowe, et al., 2008
  - 1. Retrospective study comparing patients with historical controls (via chart review)
    - Pneumonia, dehydration: no difference
    - Fluid intake greater in treatment group (p=.03)
  - 2. Sample of convenience concurrent comparison
    - Fewer pneumonia and more fluid intake
Authors’ discussion

- Authors could not determine whether results were influenced by:
  - Increased oral hygiene in the treatment group
  - Increased oral hydration in the treatment group
  - More compliance with aspiration precautions in treated patients
  - Hydration not affected by treatment/control assignment
- This needs to be replicated prospectively

Bronson-Lowe, et al., 2008

Free Water Protocols (#2)

- Randomization to water protocol or prescribed dietary fluid (26 patients)
- 17 patients requiring feeding assistance
  - 8 assigned to control, 9 to treatment
- 9 independent feeding patients
  - 3 assigned to control, 6 to treatment
- All received oral care four times per day

Becker, et al., 2008

Free Water Protocols (#2)

- Dependent Variables
  - Adverse events (pneumonia, UTI, death)
  - Objective measures not assigned by clinician/judges
  - FIM, FCM scores
  - not blinded, assigned by treating clinician/judges
  - Length of stay

Becker, et al., 2008
Free Water Protocols (#2)

- Results
  - Pneumonia: 1 patient in each group
  - UTI: 2 patients in each group
  - Death: 2 treatment deaths, no control deaths
  - FIM: no significant difference
  - FCM: no significant difference
  - Length of stay: 29.1 days (control) vs. 15.8 (tx)
    - Diet influence length of stay?

  Becker, et al., 2008

- Other findings:
  - Independent patients consumed significantly less fluid than dependent patients (p<.01), regardless of group

Free Water Protocols (#2)

![Box plot of average daily fluid intake by strata and treatment](256x256.png)

Becker, et al., 2008
Free Water Protocols (#2)

- **Discussion**
  - The presence of two deaths in the treatment group cannot be ignored
  - ...and may underscore the importance of clinical judgment in applying this and other treatments
  - Both patients that died had chronic pulmonary conditions

Becker, et al., 2008

Other issue – implied endorsement

“Free water protocols”

- **Summary**
  - 25 years experience by developers
  - No published, peer reviewed data
    - anecdote only
  - Minimal objective evidence
    - No pneumonia difference
    - Other differences seem to exist
“Free water protocols”

- Summary
  - Physiologic justification exists
  - But not for all patients
  - Severe pulmonary disease
  - One size does not fit all
  - Developers obligation to publish data

- Opinion here: there is no one protocol that is appropriate for every patient

Feeding tubes

- Indications
  - Artificial nutrition
  - Gastric decompression
  - Digestive system incompetence
    - Paralysis, obstruction, absorption disease
  - “Transfer dysphagia”
    - Oropharyngeal transfer disorder
  - Delivery:
    - Directly to gut → blood (enteral)
    - Directly to blood (parenteral)
Non-Oral Nutrition

- Enteral nutrition
  - Delivered to the gut
  - Utilizes digestive system
- Tube name \(\rightarrow\) entry, delivery
  - Naso-gastric (NG); gasatrojejunostomy (GJ)
- Depth: sphincters, absorption

Non-Oral Nutrition

- Parenteral nutrition
  - Bypasses the digestive system-intravenous
  - Central, peripheral
    - Percutaneous Intravenous Central Catheter
      - proteins, fats, carbohydrates, etc.
  - Peripheral vein – few nutrients can be delivered
  - TPN, PPN

Non-Oral Nutrition

- Nasopharyngeal entry
  - Fluoroscopic
  - Blind
Non-Oral Nutrition

- Surgical entry
  - Fluoroscopically guided
  - Endoscopically guided
  - PEG
  - Open surgical
- All involve opening abdominal wall so all are surgical

Non-Oral Nutrition

- PEG
Enteral Tube Indications

- Intractable aspiration
- Failed interventions
- Recurrent illness attributed to prandial aspiration
- Permanent → temporary
- Replacement/substitute for oral intake
- Supplement to oral intake
- Replacement for types of materials aspirated

Contraindications

- Ileus/Gastroparesis, SBO
  - Paralysis, obstruction
- Absorption Deficits
  - Default to parenteral nutrition
- Prior abdominal resections/anatomy diff.
  - Surgically inserted abdominal enteral tubes
- GER, severe.

Feeding Tubes

- Aspiration
  - Is not mitigated (25-40% in PEG)
    - Saliva production
    - May increase – new site (Metheny et al., 2006)
Complications

Feeding Tubes Evidence

Enteral Tube Feeding

- N= 70 tube fed patients, age 65-95, over 11 mo.
  - Indications
    - refusal to swallow 50%
    - dysphagia without obstruction 47%
    - esophageal obstruction 3%
  - Nutrition: weight, hgb, hct, serum albumin
    Ciocon et al, (1988)
Enteral Tube Feeding

• NGT complications in first two weeks
  • self-extubation (67%), AP (43%)
• GT complications in first two weeks
  • pneumonia (56%), dysfunction 50%
  • self-extubation 44%
• Late NGT complications
  • pneumonia (44%), self-extubation (39%)
• Late GT complications
  • pneumonia (56%), dysfunction 38%
  • self-extubation 0%
  • 40% died

Ciocon et al. (1988)

Enteral Tube Feeding

• Mortality in tube fed patients is high
  • Because they have multiple conditions
    • Dementia: 25-50% mortality
    • 14 dementia patients die in hospital following PEG placement (McClave & Chang, 2003)
  • Callahan et al., 2000 (150 PEG cases)
    • 7-14 days 16%
    • 30 day 22%, 1 year 50%

The SLP and the Feeding Tube

• 1. Patient education most important
  • Empower patient to ask questions
  • Neutral pro's and con's
• 2. Clinician personal opinion irrelevant
• 3. Clinician understanding of all the “ins and outs”
  • Our patients are sick
  • Balance of risks = medical care

Aspiration Pneumonia and the SLP
James L. Coyle, Ph.D., CCC-SLP, BRS-S
Thank you.

And now for some cases...
Coyle, Pneumonia Seminar

References


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