GERD and Aspiration in the Child and Infant
Diagnosis and Treatment

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Grand Rounds Presentation
February 2005
Anatomy and Physiology

- Swallowing reflex begins at 16 weeks gestation
- Can suckle by 2nd to 3rd trimester
- 34 weeks, infant can suckle and feed normally
- Pharyngeal phase earlier developed
- Oral preparatory phase maldeveloped in premature infants
Anatomy and Physiology

- Infant larynx at C2-C3
- Adult larynx at C5-C7
- At 4 months, enlargement of oropharynx, descent of larynx causes dysphagia
- Chewing begins at 6 months
- 40% efficacy of chewing at 6 years
Anatomy and Physiology

- Swallow divided into 4 phases
  - Oral preparatory phase
  - Oral transport phase
  - Pharyngeal phase
  - Esophageal phase
Anatomy and Physiology

- Oral preparatory phase
  - Suckle in infant, mastication in child and adult
  - Soft palate meets base of tongue and epiglottis allowing breathing during suckle

- Oral transport phase
  - Anterior tongue propels bolus back to oropharynx
Anatomy and Physiology

Pharyngeal phase

- Vocal folds close
- Arytenoid cartilages tilt up and forward
- Base of tongue moves posteriorly
- Epiglottis moves posteriorly
- Soft palate closes off nasopharynx
- Larynx elevates, cricopharyngeal muscle relaxes
Anatomy and Physiology

- Esophageal phase
  - Peristalsis moves food to stomach
  - Lower esophageal sphincter relaxes
  - Upper esophageal sphincter, Lower esophageal sphincter constrict preventing reflux
Anatomy and Physiology

- Cough reflex
  - Present in 25% of children less than 5 days old
  - Tactile receptors present at highest concentrations at larynx and bifurcations of airway
  - C-fiber receptors respond to chemical stimuli
  - Stretch receptors present in bronchioles
Gastroesophageal Reflux Disease
Gastroesophageal Reflux Disease

Gastroesophageal Reflux (GER)
- Reflux of gastric contents into esophagus
- Normal physiologic process
- 50% of infants 0-3 months of age
- 25% of infants 3-6 months of age
- 5% of infants 10-12 months of age
- 20% of pH probe reflux episodes are visible reflux
- Result of Transient LES relaxations
Gastroesophageal Reflux Disease

- Symptoms
  - Weight loss or poor weight gain
  - Irritability
  - Frequent regurgitation
  - Heartburn or Chest pain
  - Hematemesis
  - Dysphagia
Gastroesophageal Reflux Disease

- Symptoms
  - Feeding refusal
  - Apnea
  - Wheezing or stridor
  - Hoarseness
  - Cough
  - Abnormal Neck posturing (Sandifer syndrome)
    often confused with seizures
Gastroesophageal Reflux Disease

Findings

- Esophagitis
- Esophageal stricture
- Barrett’s esophagus
- Laryngitis
- Hypoproteinemina
- Anemia
Gastroesophageal Reflux Disease

- Associations
  - Reactive airway disease
  - Recurrent stridor
  - Chronic cough
  - Recurrent pneumonia
  - ALTE
  - SIDS
Gastroesophageal Reflux Disease

- **Diagnosis**
  - **History and physical**
    - No studies comparing H&P to diagnostic tests.
    - Two pediatric studies – no relationship between symptoms and the presence of esophagitis
    - Still recognized by all as the first line in diagnosis
Gastroesophageal Reflux Disease

- Barium Swallow
  - Useful to detect anatomic abnormalities
  - Not sensitive (31-86%), not specific (21-83%) when compared to pH probe monitoring
  - Not physiologic
  - Snapshot of time (High false positive, false negative)
Gastroesophageal Reflux Disease

- Scintigraphy
  - Technetium-labeled formula or food
  - Stomach, esophagus, lungs scanned
  - Good for gastric emptying, aspiration
  - Scan for 1 hour, then 24 hours later
  - Sensitivity 15% to 59%, specificity 83% to 100% when compared to pH probe monitoring
  - Role in diagnosis of GERD is unclear
Gastroesophageal Reflux Disease

- **Endoscopy and biopsy**
  - Can identify esophagitis, stricture, Barrett’s esophagus, Crohn’s disease, webs, infectious esophagitis
  - 40% of normal appearing biopsy sites show signs of esophagitis
  - Eosinophils and neutrophils not present in esophageal epithelium of children, and their presence suggests inflammation.
Gastroesophageal Reflux Disease

- Esophageal pH Monitoring
  - Transnasal placement of electrode into distal esophagus, +/- proximal esophagus, +/- above the UES
  - Acid reflux episode pH < 4 for 15-30 seconds
  - 12-24 hour studies recommended
Gastroesophageal Reflux Disease

- Esophageal pH Monitoring
  - Normal reflux in 0-11 month old children
    - 31 reflux episode +/- 21, 73 upper limit
    - Reflux greater than 5 minutes 9.7 infants, 6.8 children, 3.2 in adults
    - Reflux index (% time spent below pH of 4) 11.7% in infants, 5.4% in children, 6% in adults
  - Symptom index > 0.5 abnormal (Number of symptoms with reflux/number of reflux episodes)
Gastroesophageal Reflux Disease

- **Esophageal pH Monitoring**
  - 60% of patients with poorly controlled asthma have abnormal pH probe studies
  - Correlate well with esophageal biopsies
  - Considered gold standard
  - Unclear whether proximal and distal probes more effective than one distal probe
Gastroesophageal Reflux Disease

- Treatment Goals
  - Relieve patient’s symptoms
  - Promote normal weight gain and growth
  - Heal inflammation
  - Prevent respiratory symptoms
  - Prevent complications
Gastroesophageal Reflux Disease

- Lifestyle changes
  - Children with milk allergy benefit from hypoallergenic formula (1-2 week trial)
  - Thickening does not change number of reflux episodes, does decrease vomiting
  - Studies show decreased numbers of reflux episodes in prone position at night 8%-24%
  - Conflicting evidence regarding reflux in children placed prone 30 degrees vs. prone flat
Gastroesophageal Reflux Disease

- **Prone vs. Supine**
  - Several studies have shown increased incidence of SIDS with prone position (Relative risk 13.9, 4.4/1000 vs. 0.1/1000)
  - Prone positioning postprandial period while awake
  - Prone positioning when child with life threatening complications of GERD
  - Otherwise, supine positioning
Gastroesophageal Reflux Disease

- Medical treatment
  - H2 receptor blockers
    - Numerous studies in adults showing superiority over placebo
    - Several studies in children showing superior improvement of pathology over placebo
    - Side effects include rash, dizziness, nausea, vomiting, blood dyscrasias
    - No clear superior agent in class
Gastroesophageal Reflux Disease

- **Proton pump inhibitors**
  - Best if given ½ hour prior to breakfast, ½ hour before evening meal
  - Takes several days for a steady state acid suppression
  - One study showed similar efficacy of omeprazole and high dose ranitidine in children
  - One study showed increased efficacy of omeprazole over ranitidine in severe esophagitis
  - Prevacid FDA approved for 1 - 17 years old
Gastroesophageal Reflux Disease

- Antacids
  - Neutralize gastric acid
  - Magnesium hydroxide and aluminum hydroxide as effective as cimetidine in treatment of esophagitis
  - High doses lead to near toxic aluminum levels
  - Not recommended for treatment over 2 weeks
Prokinetic Therapy

- Increase LES pressure, no effect on transient relaxations
- Double blind single drug studies for cisapride, metoclopramide, bethanecol, and domperidone have been done, with cisapride the only agent better than placebo
- Cisapride off market due to potential cardiac arrhythmias. Available only for severe cases
Gastroesophageal Reflux Disease

- **Surface agents**
  - Sodium alginate - forms surface gel that decreases reflux and protects mucosa. Conflicting results from studies, not available in US
  - Sucralfate - adheres to peptic lesions. One study available states as effective as cimetidine for treatment of esophagitis. Aluminum compound...toxicity
Gastroesophageal Reflux Disease

- Surgical Options
  - Nissen fundoplication +/- pyloroplasty
  - Success rates from 57%-92% reported
  - Complications from 2.2%-45%
    - Breakdown of wrap, small bowel obstruction, infection, atelectasis, pneumonia, perforation, esophageal obstruction
  - No difference in laparoscopic vs. open except in length of stay
Gastroesophageal Reflux Disease

- **Surgical**
  - Consider when maximal medical therapy fails
  - Should be combined with G-tube when aspiration a concern
  - Most effective treatment
  - Highest risk
Aspiration

- Penetration of secretions below the level of the true vocal cords
- Direct aspiration – oral secretions, feeding
- Indirect aspiration – from refluxed contents
- Most commonly a result of neurological compromise
Aspiration

- Risk factors
  - CNS disease
  - Prematurity
  - Mechanical factors (NG tube, endotracheal tube, tracheostomy tube)
  - Anatomical defects (esophageal atresia, stricture, vascular rings, TE fistula)
  - Intestinal motility disorders
Aspiration

- Complications
  - Tracheitis
  - Bronchitis
  - Bronchospasm
  - Reactive airway disease
  - Pneumonia
  - Pulmonary abscess
  - SIDS?
Aspiration

- Cerebral palsy, epilepsy, intestinal motility disorders high risk for aspiration pneumonia (41%, 36%, 15%)

- Nasopharyngeal reflux associated with aspiration
  - 83% of children with ALTE’s had evidence of Nasopharyngeal reflux (Kohda)
Aspiration

- **Symptoms**
  - Cough or choking during feeds
  - Vomiting with choke
  - Nocturnal cough
  - Recurrent stridor
  - Hoarseness
  - Multiple apneas
Aspiration

- Signs
  - Dysmorphic features
  - Hoarse or weak cry
  - Wheezing
  - Pooling of secretions in piriforms, valleculae
  - Other Head and neck anomalies
Aspiration

- **Diagnosis**
  - Upper GI series
  - Scintigraphy
  - 24 hour pH probe
  - Dual pH probe measurements
  - Endoscopy (TE fistula, laryngeal cleft, signs of reflux, other anomalies)
Aspiration

- Lipid-laden alveolar macrophage
  - BAL obtained during bronchoscopy
  - 100 macrophages stained with oil red to identify intracellular lipid
  - Score greater than 70 diagnostic of aspiration
  - Sensitivity and Specificity of 80 and 85%
Aspiration

- Modified barium swallow
  - Identifies anatomic anomalies
  - Identifies NP reflux, laryngeal penetration
  - Speech pathologist can evaluate different food consistencies
- Expensive equipment
- Cannot do bedside exams
Aspiration

- Functional Endoscopic Evaluation of Swallowing (FEES)
  - Evaluation of swallowing with scope just above larynx
  - Different foods stained
  - Look for penetration, pooling
  - May test different consistencies
  - Good test when visualization of larynx necessary
Aspiration

- FEES vs. MBS
  - Similar costs
  - Similar efficacy in children and adults
  - Most studies showed no difference in outcome when either modality chosen
  - Use FEES when upper aerodigestive anomaly suspected
  - Use MBS when esophageal anomaly suspected
  - Use MBS in children 3-8
Aspiration

- Treatment
  - Maximal treatment of GERD 1st line, both medical and surgical
  - Vocal cord paralysis treated with medialization
  - Tracheostomy for pulmonary toilet
    - Pulmonary toilet vs. increased aspiration
Aspiration

- **Major surgical options**
  - Epiglottic flap closure
  - Glottic closure
  - Narrow field laryngectomy (rarely indicated)
  - Tracheoesophageal diversion
  - Laryngotracheal separation
Glottic Closure
Tracheoesophageal Diversion and Laryngotracheal Separation