Current Thinking on Aspiration Pneumonitis

Michael Rieker, DNP, CRNA
Director, Nurse Anesthesia Program
Wake Forest University Baptist Medical Center
Winston-Salem, NC

Definitions
- Aspiration
- Aspiration Pneumonitis
- Aspiration Pneumonia

Components of aspiration pneumonitis and pneumonia
- Regurgitation
- Aspiration
- Composition of Material

Pathophysiology of pneumonitis
- Immediate irritation
- Atelectasis
- Inflammation
- Infiltration

Sequelae of Aspiration


Clinical Presentation
- Hypoxemia
- Inc PIP
- Dyspnea, bronchospasm, laryngospasm
- Adventitious lung sounds
- CXR: Infiltrates in dependent lobes
- Differential: PE, allergic bronchospasm, mechanical ETT obstruction
Patients at Risk for Aspiration

- Debilitated
- Morbid Obesity
- Gastroparesis
- Hiatal Hernia
- Narcotics
- GI Obstruction
- Esophageal Disorder
- Pregnant
- Decreased LOC
- Difficult Airway

Don’t see the forest for the trees

Why is it a problem under anesthesia?

- Unconsciousness impairs protective reflexes
- Both lower and upper esophageal sphincter tone reduced by anesthesia
- Upper airway reflexes continue to be significantly impaired for 2 hours after recovery from anesthesia.
- Electrolyte abnormalities and hyperglycemia impair gastric motility

Mendelson’s syndrome


"A survey of New York Lying-in Hospital records of patients that aspirated gastric contents during obstetric anesthesia revealed the following different diagnoses: meningitis, massive atelectasis, partial atelectasis, diaphragmatic hernia, aspiration pneumonia, bronchopneumonia, lobar pneumonia, virus pneumonia, atypical pneumonia, tuberculosis, pneumonia, meningitis, pneumoconiosis, pneumothorax, foreign body aspiration, pulmonary embolism, and pernicious anemia.

Risk Factors - Mendelson’s

- Gastric pH < 2.5
- Gastric volume > 25ml or 0.4 ml/kg

Problem-based prevention

- Barrier pressure reduction
  LES pressure is raised by succinylcholine, metoclopramide, cholinergic drugs
  LES pressure reduced by anticholinergics, ganglion blockers, theophylline, thiopental, opioids, cricoid pressure, and beta-adrenergic agonists.
Have we been following the correct procedures?

- Cricoid pressure?!!!
- “Although the use of cricoid pressure seems to make intuitive sense, its scientific basis is weak at best and lacking at worst.”

Have we been following the correct procedures?

- Sellick’s 1961 article
- How applicable?
  - Patients in head-down tilt
  - Did not control for quality of induction
  - No qualitative data on amount of force applied
  - Not randomized
  - Published under “preliminary communications”

Have we been following the correct procedures?

- Upper esophageal sphincter tone decreases after induction
- Cricoid pressure reduces tone of lower esophageal sphincter

Have we been following the correct procedures?

- Problems applying concept of cricoid pressure
  - Distorts anatomy and displaces esophagus
  - Can make laryngoscopy difficult
  - 10% of clinicians have experienced regurgitation in spite of pressure (Anaesthesia 38:457. 1983)
  - 25% of aspiration claims in ASA database had cricoid pressure applied (Engelhart & Webster Pulmonary aspiration of gastric contents. Br / Anaes 1998 63:455-460.
  - Procedure incorrectly applied in 50% of cases (Anaesthesia 38:457. 1983)

A continuing controversy

- “New Explanation for Controversial Old Patient-Care Technique to Prevent Regurgitation”
  - Anes-Anal 11/09
Does the endotracheal tube really protect the airway?

- Cuff may become more effective during positive-pressure breath, but less effective between breaths.
- Cuff pressure ideally maintained 20-30 cm H2O.
- CPAP and PEEP help reduce fluid movement past cuff.

Other endotracheal tube options

- Silver-coated tubes reduce biofilm formation
- Polyurethane cuff

Example of how tapered cuff reduces channeling

Does the endotracheal tube really protect the airway?

"ETT cuff as protective as you think?"

How about the LMA?
- Would you use the LMA on a ventilated patient?
- Would you use a LMA for a tonsillectomy?

Does the LMA do anything to protect the airway?

Problem-based prevention
- Gastric dysmotility
  The use of alcohol, anticholinergics, or opioids can increase the risk of regurgitation by reducing gastric motility.

Problem-based prevention
- Medication Effects
  LES tone is reduced by: nicotine, caffeine, alcohol, theophylline, beta-adrenergic agonists, thiopental, calcium-channel blockers, and nitrates. Drugs which reduce the formation of bicarbonate-rich saliva indirectly contribute to gastric acidity. These drugs include some antihypertensives, antihistamines, anti-depressants, and anticholinergics.

Problem-based prevention
- Reduced protective reflexes
  Avoid opioids where risk of obtundation exists prior to securing airway

  Increase attention to residual relaxation post-op

Xerostomia- Drugs

<table>
<thead>
<tr>
<th>ANTIHYPERTENSIVE</th>
<th>ANTI DEPRESSANT</th>
<th>ANTI CONVULSANT</th>
<th>ANTI ANXIETY</th>
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<td>Xanax</td>
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Problem-based prevention

- Regurgitation Risk
  - airway difficulties, obesity, pregnancy, and lithotomy or prone positioning
  - Pregnant patient risks: Mechanical and hormonal
    - increase in gastric acid production
    - decrease in LES tone
    - epidural opioids reduce gastric emptying time

Pharmacologic Prophylaxis

- Various Modalities:
  - Diminish gastric acid volume
  - NPO status
  - Clear liquids up to 2 hours pre-op does not increase gastric contents or acidity

NPO Guidelines

Preoperative Fasting Guidelines for various foods

- Clear Liquid
- Breast Milk
- Light Meal
- Animal Milk
- Infant Formula
- Fatty Meal

Minimum Hours Preoperatively

H2 Blockers- Important Facts

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<thead>
<tr>
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<th>Dosage IV</th>
<th>Dosage PO</th>
<th>Duration (IV)</th>
<th>Pregnancy Cat.</th>
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<td>20 mg</td>
<td>12 hour</td>
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<tr>
<td>Ranitidine</td>
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<td>150 mg</td>
<td>8 hour</td>
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<td>Cimetidine</td>
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<td>Nizatidine</td>
<td>150 mg</td>
<td></td>
<td>12 hour (PO)</td>
<td>C</td>
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Pediatric Dosages

*Note: H2 Blockers are not FDA approved for pediatric use.

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<tr>
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<th>Dosage PO</th>
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<tr>
<td>Famotidine</td>
<td>0.4 mg/kg/dose q12h</td>
<td>0.4 mg/kg/dose q12h 0 mg</td>
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<tr>
<td>Ranitidine</td>
<td>1.5 mg/kg/dose q6h</td>
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<tr>
<td>Cimetidine</td>
<td>5-10 mg/kg/dose q6h</td>
<td>5-10 mg/kg/dose q 6</td>
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H2 Blockers - Other considerations

- **Cimetidine**: inhibits the cytochrome P-450 potential for interactions with theophylline, warfarin, lidocaine, and phenytoin
- **Famotidine**: no drug interactions, less adverse effects, long duration, less cost
- **Ranitidine**: thrombocytopenia possible with prolonged use

Proton Pump Inhibitors

- **Directly reduce acid output from parietal cells**
- **Omeprazole**: 
  - *Prilosec*
- **Lansoprazole**: 
  - *Prevacid*
- **Pantoprazole**: 
  - *Protonix*
- **Esomeprazole**: 
  - *Nexium*
- **Rabeprazole**: 
  - *Acifex*

Proton Pump Inhibitors

- Generally more effective than H2 blockers
- Slower ramp up to max. effect.
  - At least 2 hours to full effect
  - 3 days for max effect in chronic use

H2 Blockers vs. PPIs

- **Placebo**
- **Famotidine 20 mg**
- **Omeprazole 10 mg**
- **Ranitidine 50 mg**

PPIs - Other considerations

- Yet another controversy
- Gastric acid inhibits bacterial growth
- ICU patients on pantoprazole showed 3x rate of pneumonia vs. those on ranitidine
- (834 patients reviewed - Miano et. al. *Chest* 2009)
- Consider benefits of short-term (perioperative) vs. long-term use.

Direct Antacids

- **Sodium Citrate**
- **Sodium Citrate + Citric Acid (Bicitra)**

Gastric Prokinetics

- Metoclopramide (Reglan)
- Cisapride (Propulsid) - off market

Novel Approaches

- Lidocaine immediately before or after acid aspiration attenuated lung injury
  (Nishina, K., Mikawa, K., Takao, Y., Ohga, M., Hashawa, K., Odaka, H. Anesthesiology. 88(5):1300-8, 1998 May)
- Hyperoxia worsens lung damage after acid aspiration
- Erythromycin 200mg/day as effective as metoclopramide as gastric stimulant

Cellular response- helpful?

- Neutrophils, humoral mediators respond to treat, but cause much of damage

Pneumonitis Treatment

- Therapy depends upon severity of symptoms
- Initial course is prognostic
- Majority do not require treatment beyond supportive care
- Even with fever, leukocytosis, & infiltrate, antibiotics are not always indicated
**Pneumonitis Treatment**

- ORAL suctioning
- Oxygen as needed (enough, but not too much)
- If ventilation required, include PEEP
- Bronchodilators
- Neutrophil aggregation inhibitors
- Antibiotics - many regimens, tailor to situation

**Pneumonitis Treatment - What not to do**

- Tracheal/bronchial suctioning
- Overzealous oxygen administration
- High dose volatiles as bronchodilators

**Experimental/emerging treatments**

- Pentoxifylline administration shortly after acid instillation results in significant alleviation of impaired oxygenation, stabilization of BP with higher heart rates, and improved survival after 6 h.
- JTE-607 can inhibit the production of inflammatory cytokines such as tumor necrosis factor-α, interleukin-6 and cytokine-induced neutrophil chemoattractant and attenuate acid-induced lung injury in rats.
- Sivelestat at 1 mg/kg/h inhibits neutrophil elastase. 20% more patients off ventilator at 20 days out.

**Antibiotic Recommendations**

- Pneumonitis symptoms > 48 hours?
  - Yes
    - Levofoxacin 500 mg/day OR Ceftriaxone 1-2 gm/day
  - No
    - Risk factors for pneumonia or documented pneumonia?
      - Yes
        - An aerobiotic coverage needed?
          - Yes
            - Piperacillin/Tazobactam 3.375 gm q6h OR Ceftazidime 2 gm q8h
          - No
            - Supportive care
      - No
        - Levofloxacin 400 mg bid OR Piperacillin/Tazobactam 3.375 gm q6h OR Ceftriaxone 1-2 gm/day

- CXR of patient following GI bleed and witnessed aspiration.
  - 2nd film 2 days later.
Summary

- Aspiration pneumonitis - chemical irritation of lung, usually caused by gastric acid
- Variety of medical conditions predispose; don’t focus on Mendelson’s
- Prevention focuses on one or all 3 components
  - Regurgitation
  - Aspiration
  - Caustic composition of material

- Majority are asymptomatic - 2 hours to “out of the woods”
- Conservative treatment usually indicated
  - No benefit to tracheal suctioning for non-particulate aspirates
  - Lido as neutrophil inhibitor
  - Antibiotics only if indicated
  - No steroids
  - Oxygen only as needed