Reflux and Aspiration
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Outline

- Incidence
- Impact of Obesity
- Reflux
- GERD pathophysiology
- NPO Status
- Aspiration
- Airway Devices

G.E.R.D.

Gastroesophageal Reflux Disease
Chart Review

- 100 Patients
- General surgical procedures
- 1 of 2 general surgeons at B.M.C. in 1993
- Pre-Anesthesia review and/or H&P
- Diagnosis = G.E.R.D. or Heartburn
- Findings: data from 93 patients
  - GERD = 1
  - Heartburn = 2
- Overall Incidence ~ 3.2%
- No mention as pertinent negative

Chart Review - Part II

- 100 Patients
- General surgical procedures
- Same two surgeons at BMC in 2003
- Findings: data from 98 patients
  - G.E.R.D. = 19
  - Heartburn = 9
- Overall incidence of 28.5%
- Almost a 10 fold increase in 10 years!
- G.E.R.D. as pertinent negative = 23

G.E.R.D. Incidence

- Szarka, Mayo Clinic Proceedings 2001;76:97-101
  - Overall incidence of 18%
- Voutilainen, et. al.: Digestion 2000;61:6-13
  - Overall incidence of 22%
- DiPalma, J Clinical Gastroenterol 2001;32:19-26
  - Overall incidence of 35%
Obesity & G.E.R.D.

Relationship between body mass and gastro-esophageal reflux symptoms:
The Bristol Helicobacter Project.

"Obese people are almost three times as likely to experience these symptoms as those of normal weight."


Prevalence of Obesity

✓ 26% of U.S. population has BMI > 30 Kg/m²

National Center for Health Statistics – 1999
www.cdc.gov/nchs/products/pubs/obese

\[ B.M.I. = \frac{Wt (Kg)}{Ht (Meters)^2} \]
**Prevalence of Obesity**

- **Overweight adults** (B.M.I. > 25)
  - 55.9% to 64.5%
- **Obesity** (B.M.I. > 30)
  - 22.9% to 30.5%

Flegal: JAMA 2002; 288; 1723-7

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**Anesthetic Implications**

- 51 y/o m for elective knee arthroscopy
- PMHx: + G.E.R.D.
- PSHx: None
- PE:
  - Ht 5'11" Wt 84 Kg BMI = 26.6
  - Airway: Mallampatti I / IV
  - Otherwise Unremarkable

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**The Anesthetic Plan?**

- If GA is the plan
- How many would intubate?
**G.E.R.D.**

- An increasing common diagnosis in patients presenting for anesthesia
- Inconsistent approach to airway / anesthetic management

**G.E.R.D. Definitions/Concepts**

- Reflux: the movement of stomach acid into the distal esophagus
- Reflux Disease: any symptomatic condition or histopathologic alteration resulting from reflux
- Acid Clearance Time (ACT): The percentage of time that the esophageal mucosa remains acidified to a pH < 4
- ACT > 4.0 % = Reflux Disease
- Some reflux is physiologic and "normal"

Kahrilas & Pandolfi: Chapter 33 GE Reflux Disease
Sleisenger & Fordtran’s, Gastrointestinal & Liver Disease

**Pathophysiology of Reflux**

- Transient L.E.S. Relaxations (TLESR)
  - Without anatomic abnormality
  - Not accompanied by swallowing / peristalsis
- L.E.S. Hypotension
  - Without anatomic abnormality
  - Neuromuscular disorders
- Anatomic abnormality of the GE Junction
  - Hiatal Hernia
Protective Mechanisms

- Peristalsis
- Swallowing
- Saliva production

Reflux Symptoms

- Often occur when the ability of protective mechanisms to clear acid is exceeded:
  - Heartburn (retro-sternal burning sensation)
  - Regurgitation (sour taste in the mouth)
  - Excess salivation (water brash)
  - Dysphagia (difficulty in swallowing)
  - Globus (sensation of a lump in the throat)
- Exacerbation
  - After eating
  - Positional

Extra-esophageal Symptoms

- Can occur alone or in combination with esophageal symptoms:
  - Laryngeal
  - Otologic
  - Atypical Chest Pain
  - Asthma
  - Sleep apnea / SIDS
**Histopathology of Reflux**

- None
- Reactive hyperplasia
- Inflammation (esophagitis)
- Ulceration
- Peptic stricture
- Barrett's esophagus
- Adenocarcinoma
- Perforation
- Fistulization
- Extra-esophageal

**Correlation of Symptoms**

- Histopathology may be very disproportionate to the symptoms:
  - Asymptomatic patients can present with Barrett’s Esophagus & / or adenocarcinoma
  - Patients with severe symptoms often have no findings on endoscopy
- Many authors agree that histopathology is rare in patients under the age of 50

**Defining Normal**

- Normal healthy volunteers
  - Computer aided H&P
  - Upper endoscopy
  - Esophageal manometry
  - 24-h esophageal pH monitoring
- Average ACT was 1.16 % (0.2 – 12.7)
- 95th percentile was 6.0 %
- Average ~ 18 reflux episodes / day (3 – 74)
- 95th percentile was 55 episodes / day

Stal, Scand J Gastroenterol 1999;34:121-128
**Defining Normal**

“Mild, intermittent reflux may be considered a normal physiologic phenomenon”

“85% of reflux episodes are symptom-free”

“There is a poor correlation between the symptoms and endoscopic findings in reflux patients”

Stal. Scand J Gastroenterol 1999;34:121-128

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**Non Erosive Reflux Disease**

✓ N.E.R.D.
✓ Significant symptoms without pathology
✓ May be part of a spectrum of disease - a precursor to G.E.R.D.
✓ Over sensitivity to normal physiology - esophageal equivalent of I.B.S.

Non-erosive reflux disease: part of the spectrum of gastroesophageal reflux disease, a component of functional dyspepsia, or both? Locke, Gastroenterol Clin North Am. 2002 Dec;31:S59-66

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**Sensitivity and Specificity**

✓ Heartburn + Regurgitation
  » Specificity 70 – 89%
  » Sensitivity 6 – 38%

✓ Positive predictive value for GERD ~ 60%
**Diagnosis**

- Heartburn on 2 or more days / week sufficient to make diagnosis
- Chronic G.E.R.D. can lead to:
  - Erosive esophagitis
  - Barrett's esophagus
  - Adenocarcinoma
- A trial with a proton pump inhibitor (PPI) is the quickest and most cost-effective way to diagnose G.E.R.D.

Howden & Chey J Family Practice 2003: 53; 240-247

**Hiatal Hernia**

- Hiatal hernia is a frequent asymptomatic finding (21%)
- The prevalence increases with age
- Hiatal hernia patients have more acid reflux

Stal, Scand J Gastroenterol 1999; 34: 924-926
The Anesthetic Conundrum

Symptom evaluation alone may not be satisfactory for accurately making the diagnosis ...

... Yet, we are seeing an increasing number of patients in whom the diagnosis is based solely on symptoms.

G.E.R.D. and Aspiration

- Does reflux make aspiration more likely?
  - Maybe?
  - Normal sleep reduces acid clearance mechanisms
    - Swallowing
    - Saliva production
    - Peristalsis
  - Anesthesia likely similar or even worse
  - Blunts airway protective reflexes


Morbidity Worsened by:

- Volume
- pH
- Particulate
The Prepared Stomach - NPO

- Critical Gastric Fluid Volume > 0.4 mL / Kg
- Citra raises pH

Roberts & Shirley - Anesth Analg 1974;53:859-68

The Prepared Stomach - NPO

- Gastric volume does not equal aspirated volume
- One does not aspirate the entire gastric volume
- Cats – GFV for spontaneous regurgitation was 20.8 mL / Kg

Ng - Anesth Analg 2001;93:494-513
The Prepared Stomach - NPO

- 50% NPO patients have either GFV > 0.4 mL/kg, or pH < 2.5
- >2 hours NPO clear liquids no difference

Ingebo J Pediatr 1997;131:155-158

The Prepared Stomach - NPO

- “(GFV) has failed to prove its relevancy to outcomes (i.e., aspiration) that matter to patients.”

Schreiner Anesth Analg 1998;87:754-756
The Prepared Stomach - NPO

- GFV may be important, however the critical volume is uncertain.
- It likely is much greater than 0.4 mL / Kg
- Do patients with G.E.R.D. have a greater GFV than patients without G.E.R.D.?

G.E.R.D. and NPO Status

- 248 pediatric patients for elective endoscopy
- Grouped by presenting GI symptom
- Fasted per institutional guidelines
- Following anesthetic induction, GFV measured by endoscopist under direct vision
- Gastric pH also measured

**G.E.R.D. and NPO Status**

- Average GFV 0.35 +/- 0.45 mL / Kg
- 33% had GFV > 0.4 mL / Kg

**G.E.R.D. group** (n=35)
- Average GFV 0.29 +/- 0.47 mL / Kg
- 20% had GFV > 0.4 mL / Kg
- Not statistically different

- Neither age nor weight correlated with GFV
- GI Medications (n=13), no significant difference

Schwartz - Anesth & Analg 1998;87:757-760

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**Adults**

- No similar studies performed in adults!
**Review Article**

- Aspiration incidence has decreased
- Breast milk vs cow milk
- Medications to decrease GFV and increase pH...number needed to treat (NNT) would be enormous
- No evidence to support routine use
- Routine use not in ASA guidelines
- OB guidelines
- Most "evidence" is opinion based

Ng Anesth Analg 2001; 93: 494-513

**Summary**

The risk of aspiration, in otherwise healthy elective surgery patients, with the diagnosis of GERD, is likely no different.

**Incidence of Aspiration**

<table>
<thead>
<tr>
<th>Patient Group</th>
<th>Number of Anesthetics</th>
<th>Number of Aspirations</th>
<th>Per 10,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olsson, 1986</td>
<td>185,358</td>
<td>87</td>
<td>4.7</td>
</tr>
<tr>
<td>Warner, 1993</td>
<td>215,488</td>
<td>67</td>
<td>3.1</td>
</tr>
<tr>
<td>Brimacombe, 1995</td>
<td>12,901</td>
<td>3</td>
<td>2.3</td>
</tr>
<tr>
<td>Mellin-Olsen, 1996</td>
<td>85,594</td>
<td>25</td>
<td>2.9</td>
</tr>
<tr>
<td>Borland, 1998</td>
<td>50,880</td>
<td>52</td>
<td>10.2</td>
</tr>
<tr>
<td>Ezri, 2000</td>
<td>1,870</td>
<td>1</td>
<td>5.3</td>
</tr>
<tr>
<td>Warner, 1999</td>
<td>63,180</td>
<td>24</td>
<td>3.8</td>
</tr>
<tr>
<td>Lockey, 2000</td>
<td>53</td>
<td>18</td>
<td>3396.2</td>
</tr>
</tbody>
</table>
Overall Risk of Aspiration

- 0.04% or 4.2 / 10,000
- Perhaps slightly lower in adults than children
- Perhaps lower in the United States

- Significantly higher in:
  - Patients with gastric or bowel obstruction
  - Emergency / trauma patients

Aspiration Morbidity

- 215,488 anesthetics
- Significant clinical effects
  - New cough or wheeze
  - SaO₂ 10% < pre-op value
  - A-a gradient > 300 mmHg in intubated patients
  - Xray abnormality within 2 hrs of aspiration

Warner Anesthesiology 1993; 78: 56-62
Aspiration Morbidity

- 67 aspirations / 215,488 anesthetics
- 43 (64 %) – no sequelae
- 24 (36 %) – required treatment
- 13 (20 %) – ventilation > 6 hours
- 6 (9 %) – ventilation > 24 hours
- Of those, 50% mortality

Warner Anesthesiology 1993; 78: 56-62

Aspiration Morbidity

- No correlation with:
  - Age
  - Gender
  - Pregnancy
  - NPO time > 3 hours
  - Obesity - BMI > 35
  - Individual co morbidity
  - Type of anesthetic
  - Type of surgery

Warner Anesthesiology 1993; 78: 56-62

Aspiration Morbidity

- Direct correlation with:
  - Emergency surgery – 1:343 c/w Lockey et al.
  - Increasing A.S.A. physical status

- 119,351 elective cases, A.S.A I and II
- 1: 8,000 anesthetics
- 0: morbidity / mortality
- Even in patients with co-morbid disease

Warner Anesthesiology 1993; 78: 56-62
Aspiration Morbidity

- GI Prophylaxis did not alter morbidity
  - 52% without
  - 48% with
  - No difference outcome
- Suggest that the cost/benefit ratio of giving these medications is very high
- The majority of aspirations (68.8%) occurred in conjunction with laryngoscopy and intubation or extubation

Warner Anesthesiology 1993; 78: 56-62

Anesthesia Closed Claims: Aspiration

- Aspiration 3.5% of claims (158 / 4,459)
- 42% occurred on induction
- Reflux was mentioned in 4 cases
- Conclusions:
  - Reflux does not lead to severe aspiration
  - Aspiration is not a major liability hazard
  - Aspiration is not a source of major morbidity

Cheney. Anesth Analg 2000; 96: 5-6

Endotracheal Intubation

- Does E.T. Intubation really protect against aspiration under G/A?
  - Not 100%
- Micro-aspiration around folds in the E.T. tube cuff is a commonly documented occurrence using methylene blue dye techniques.

Leakage of fluid past the tracheal tube cuff in a benchtop model:
Young Br J Anesth 1987; 78: 587-62

Prevention of tracheal aspiration using the pressure-limited tracheal tube cuff
Young Br J Anesth 1988; 54: 889-93
E.T. Intubation & Morbidity

Incidence of voice dysfunction, hoarseness:
- May be as high as 50%.
- Varies with intubating conditions.

Mencke Anesthesiology 2003; 99: 1049 – 1056

Hoarseness in 57 / 167 (34 %)
- May last longer than appreciated.
- Average 7 days, longest 89 days.

Jones Anesthesia 1992; 47: 213-216

3 % persisted more than 6 months
Kark BJM 1984; 289: 1412-1415
E.T. Intubation & Morbidity

- Elaborate study
- Patients otherwise asymptomatic
- Laryngeal edema increased after intubation
- Did not occur after with LMA

Tanaka Anesthesiology 2003;99:252-258

Anesthesia Closed Claims: Intubation
Anesthesia Closed Claims: Intubation

Most Common Complications in the ASA Closed Claims Project Database

- Death: 32%
- Airway Trauma: 6%
- Other: 18%

Other Complications:
- No Injury: 5%
- Eye Injury: 4%
- Herniated Injury: 3%
- Perinatal: 3%
- Mastache: 3%
- Stroke: 3%
- Miscellaneous: 18%

- 6% (266) of closed claims
- Does not include dental injury
- 87% involved larynx
  - Vocal Cord Paralysis
  - Granulomas
  - Arytenoid dislocation
  - Hematoma
- 80% routine (non-difficult) intubation
- Most (85%) with short term intubation

Domino 1989; 91: 1703-1711

Pharyngeal Injury  n = 51  (19%)
- Perforation  n = 19
- Mortality = 5

Esophageal Injury  n = 48  (18%)
- Perforation  n = 43
- Mortality = 9
E.T. Intubation & Morbidity

- Tracheal Injury n = 39 (15 %)
  - Perforation n = 13 (33 %)
  - Mortality = 15 (38 %)
- TMJ Injury n = 22 (8%)
  - 100 % with routine intubation

On Balance

- Risk of ET Intubation
  - Minor morbidity
    - Sore throat
    - Laryngeal edema
    - Hoarseness
    - Dental injury
  - Major morbidity
    - 8 % of closed claims
    - Mortality
      - 81 of 299 airway claims
- Risk of Aspiration
  - Minor morbidity
    - Oxygen
    - Ventilation support
  - Major morbidity
    - 3.5 % of closed claims
    - Mortality
    - 6.0 % of 158 aspiration claims

Intubation Alternatives

- LMA now off patent
- Explosion of “Supralaryngeal” airways
- Three categories
Intubation Alternatives
Three Categories

- Oral-Pharyngeal balloon
- Esophageal balloon
- Supraglottic Airways

Pax Express Airway
Oro-Pharyngeal Balloons

- Pax Express and COBRA PLA
  - Minimal reported complications
  - Less experience
  - Refluxed fluid may be trapped in airway!
- COPA Mallinckrodt—no longer available

Intubation Alternatives

Three categories
- Oral-Pharyngeal balloon
  - Cobra
  - Pax Express
- Esophageal balloon
  - Combitube
  - Laryngeal Tube

Esophageal Balloon

- Laryngeal Tube Airway
  - King Systems
Combitube

- Combitube
  - Kendall - Sheridan

Esophageal Balloon

- Combitube - more clinical experience
  - Excessive cuff pressures
    - Mucosal ischemia
    - Edema of tongue
  - Increased incidence of esophageal injury
    - Lacerations 7.8%
  - Anecdotal reports of esophageal rupture
- I question its use in elective cases
  - Klein, Anesth Analg 1997; 85:938-939
Intubation Alternatives

- Three categories
  - Oral-Pharyngeal balloon
    - Cobra
    - Pax Express
  - Esophageal balloon
    - Combitube
    - Laryngeal Tube
  - Supraglottic Airways
    - LMA / Proseal
    - Portex soft seal LMA
    - Ambu Laryngeal Mask

- Meta-analysis--12,901 patients
- Clinical evidence of aspiration very rare
- Incidence not different with LMA vs ET Tube
  Brimacombe J Clin Anesth 1995; 7: 397-399

L.M.A.

- Meta-analysis--12,901 patients
- Clinical evidence of aspiration very rare
- Incidence not different with LMA vs ET Tube
  Brimacombe J Clin Anesth 1995; 7: 397-399
11,910 uses of LMA
- Conventional
- Non-Conventional Uses
- 44% with PPV

Overall incidence of aspiration 0.03%  
Verghese Anesth Analg 1996; 82: 129-133

Proseal L.M.A.
Proseal Advantages

- Gastric Drainage / Nasogastric Tube
- Better fit and higher airway seal pressure

Proseal L.M.A.

- Randomized, crossover, cadaver study
- Both LMA vs PLMA protect the glottis
- Measured Esophageal Leak Pressures
- "...a PLMA allows fluid in the esophagus to bypass the pharynx when the drainage tube is open."

Keller Anesth & Analg 2000; 91: 1017-1020
Proseal L.M.A.

- 60 patients x 2 cohorts
- Randomized crossover of airway seal pressure LMA vs PLMA
- PLMA demonstrated
  - 8 – 11 cm H₂O higher seal pressure
  - Consistent at all cuff volumes
- Better fit and higher pressure in females

Brimacombe Anesthesiology 2000; 93: 104 - 109
LMA and Proseal L.M.A.

- 200 patients for Laparoscopy
  - 104 LMA or PLMA
  - 105 ET intubation
  - All patients with NMB and PPV
  - Did not exclude patients with G.E.R.D.
- No aspirations
- No gastric distension difference

Maltby Can J Anesth 2003; 50: 74-77

Conclusions

Patients with the diagnosis of G.E.R.D. who present for elective general anesthesia are probably at no greater risk for aspiration than the general population.

Conclusions

The overall risk of aspiration is low; approximately 3.1 / 10,000, and the morbidity and mortality from aspiration are much lower than previously thought.
Conclusions

Endotracheal intubation carries more significant morbidity and mortality than is generally appreciated, and may often be the proximate cause of aspiration.

Conclusions

The Proseal may offer some important advantages in the management of patients with aspiration.

Review

- Incidence
- Impact of Obesity
- Reflux
- GERD pathophysiology
- NPO Status
- Aspiration
- Airway Devices