

Clinical Presentation

- Hypoxemia
- Inc PIP
- Dyspnea, bronchospasm, laryngospasm
- Adventitious lung sounds
- CXR: Infiltrates in dependent lobes
- Differential: PE, allergic bronchospasm, mechanical ETT obstruction

MYTH: SOME KEY INDICATORS MAKE IT EASY TO IDENTIFY PATIENTS AT RISK FOR ASPIRATION

Patients at Risk for Aspiration

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

MENDELSON, C. L.: The Aspiration of Stomach Contents into the Lungs During Obstetric Anesthesia. *Am. J. Obst. & Gynec.* 52: 191-205 (Aug.) 1946.


"A survey of New York Lying-In Hospital records of patients that aspirated gastric contents during obstetric anesthesia revealed the following different diagnoses: suffocation, massive atelectasis, partial atelectasis, disc atelectasis, pulmonary infarct, aspiration pneumonia, bronchopneumonia, lobar pneumonia, virus pneumonia, atypical pneumonia, tuberculous pneumonia, pulmonary tuberculosis, fungus infection, pulmonary metastasis, drowned lung, cardiac failure, pulmonary edema, and paroxysmal tachycardia. Obviously, a better understanding of

Risk Factors- Mendelson's

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




MYTH: CRICOID PRESSURE WILL PREVENT REGURGITATION.



Barrier pressure protection

LES pressure is raised by succinylcholine, metoclopramide, cholinergic drugs

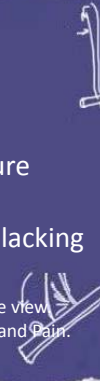
LES pressure reduced by anticholinergics, ganglion blockers, theophylline, thiopental, opioids, beta-adrenergic agonists, and cricoid pressure



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."

– Priebe, H. (2005) Cricoid Pressure? An alternative view. *Seminars in Anesthesia, Perioperative Medicine and Pain*. (24) 120-126.




Have we been following the correct procedures?

- Upper esophageal sphincter tone decreases after induction
 - Vanner, Pryle, O'Dwyer, Reynold. Upper oesophageal sphincter pressure and the intravenous induction of anaesthesia. *Anaesthesia* 1992; 47:371-5.
- Cricoid pressure reduces tone of lower esophageal sphincter
 - Chassard, Tournadre, Berrada, Bouletreau. Cricoid pressure decreases lower oesophageal sphincter tone in anaesthetized pigs. *Canadian Anaesthesia* 1996: 43:414-7.
 - Tournadre, Chassard, Berrada, Bouletreau. Ower oesophageal sphincter pressure during application of cricoid pressure in conscious volunteers. *Br J Anaes*. 1996: 76:A50



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"
- Priebe, H. (2005) Cricoid Pressure? An alternative view. *Seminars in Anesthesia, Perioperative Medicine and Pain*. (24) 120-126.





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 (Engelhardt & Webster Pulmonary aspiration of gastric contents. *Br J Anaes* 1999 83:453-460.)
 - Procedure incorrectly applied in 50% of cases (*Anaesthesia* 38:457, 1983)




Have we been following the correct procedures?

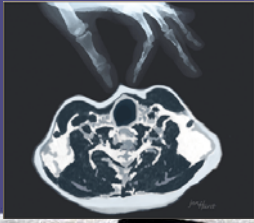
- “As a profession we invest a great deal of importance in a technique that is inadequately researched, poorly taught and badly performed.”
 - Haslam & Duggan (2004) Cricoid Pressure (letter). *Anaesthesia*. 59:91-2.

A continuing controversy

- “New Explanation for Controversial Old Patient-Care Technique to Prevent Regurgitation”

Rice MJ, et. al. Cricoid pressure results in compression of the postcricoid hypopharynx: the esophageal position is irrelevant. *Anesth Analg* 2009;109:1546-52



MYTH: THE PRIMARY DRIVER OF CONTINUED CRICOID PRESSURE MAY BE DEFENSIVE MEDICINE




ANESTHESIOLOGY NEWS

CLINICAL ANESTHESIOLOGY

ISSUE: OCTOBER 2010 | VOLUME: 39

Legal, Clinical Data Paint Conflicting Picture of Cricoid Pressure

Malpractice claims suggest no value, but new evidence points to effectiveness in right hands

Adam Marcus

Litigation involving aspiration almost twice as likely to involve death compared to other anesthesia malpractice claims



Cases involving cricoid pressure resulted in lower awards

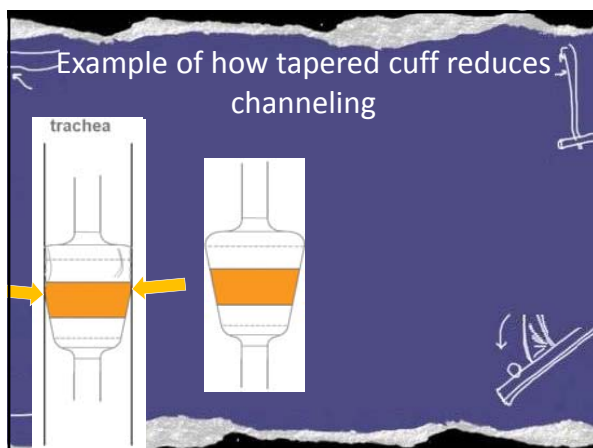
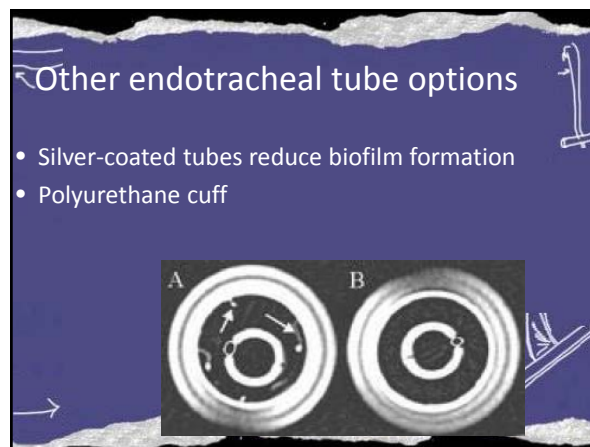
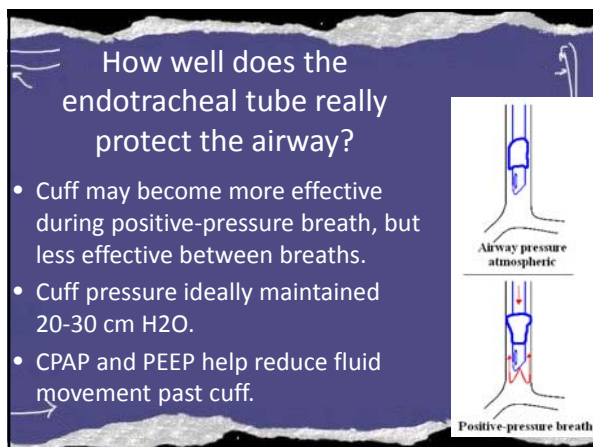
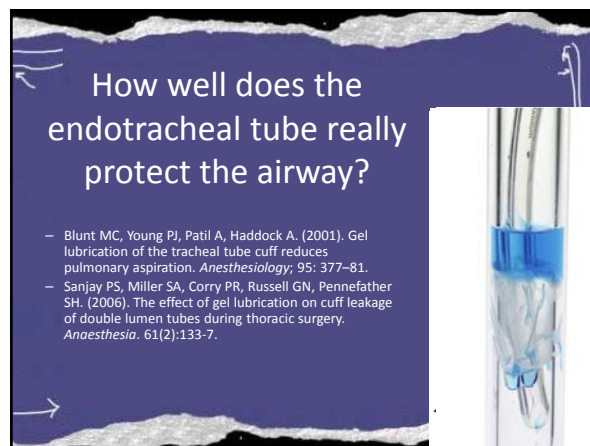
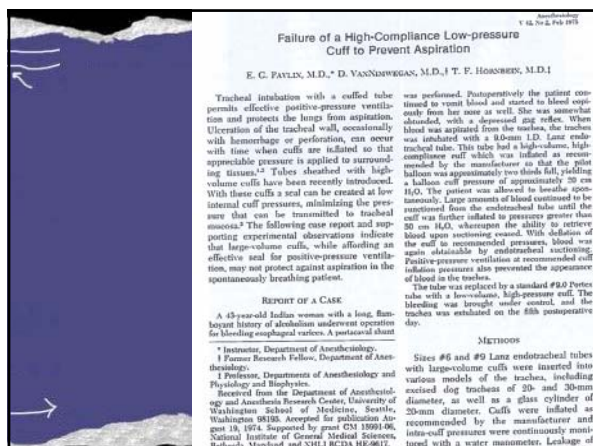
What's more, through cases in which clinicians applied cricoid pressure along with rapid sequence induction, claims related to result in smaller damage awards, the procedure was used in roughly half of the malpractice claims involving the question of its effectiveness,” the researchers said.

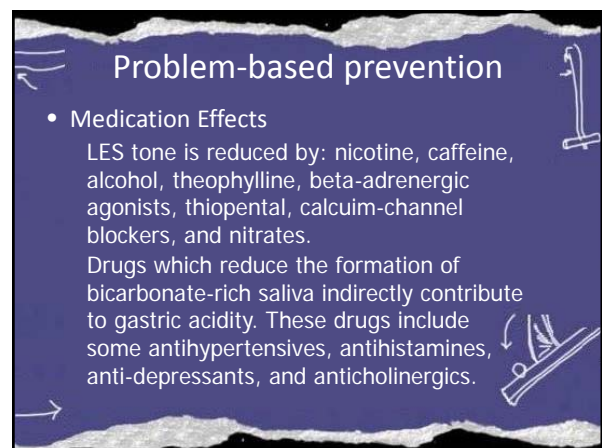
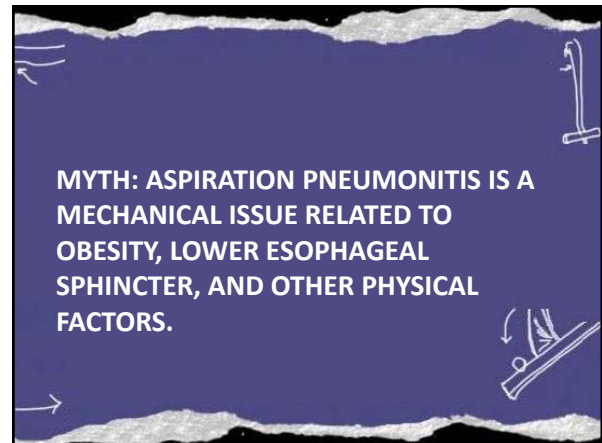
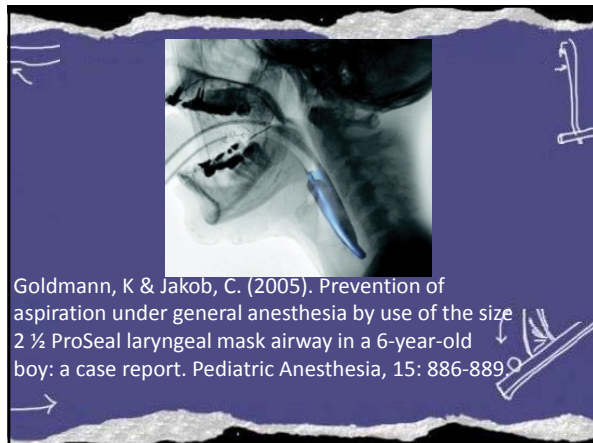
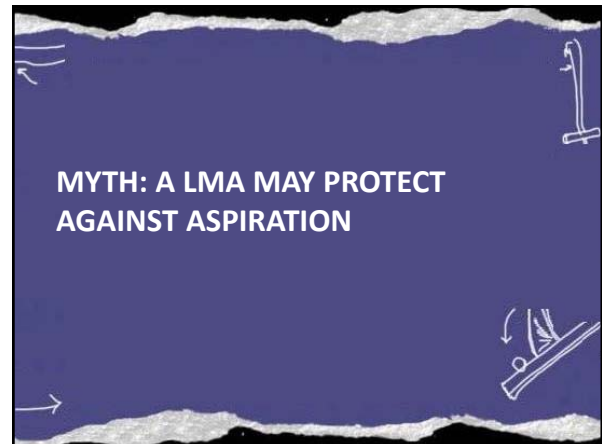
The findings are based on a new analysis of the Closed Claims database focusing on the liability to anesthesiologists whose patients aspirate.

Karen Domino, MD, MPH, of the University of Washington in Seattle, and colleagues queried the Closed Claims database for malpractice cases arising from aspiration of gastric contents, finding 129 such cases since 1990. They then compared the aspiration suits with all other claims in the database.

MYTH: AN INTACT ENDOTRACHEAL TUBE WILL PREVENT ASPIRATION OF REGURGITATED MATERIAL






Problem-based prevention

- Reduced protective reflexes

Avoid opioids where risk of obtundation exists prior to securing airway

Increase attention to residual relaxation post-op




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

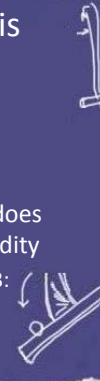


MYTH: ASPIRATION RISK CAN BE REDUCED PROPORTIONATELY TO THE DURATION OF FASTING



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
 - (Ljungqvist & Soreide *Br. J. Surg* 2003: 90:400-406.)




NPO Guidelines

Preoperative Fasting Guidelines for various foods

Food Type	Minimum Hours Preoperatively
Clear Liquid	2
Breast Milk	4
Light Meal	6
Animal Milk	8
Infant Formula	8
Fatty Meal	8



MYTH: NEW GENERATION ANTACIDS ARE MORE EFFECTIVE THAN TRADITIONAL ONES.



Pharmacologic Prophylaxis

- Various Modalities:
 - Diminish gastric acid volume
 - Promote forward flow
 - Reduce acidity of gastric contents

H2 Blockers- Important Facts

	Dosage IV	Dosage PO	Duration (IV)	Pregnancy Cat.
Famotidine	20 mg	20 mg	12 hour	B
Ranitidine	50 mg	150 mg	8 hour	B
Cimetidine	300 mg	400 mg	4 hour	B
Nizatidine		150 mg	12 hour (PO)	C

Pediatric Dosages

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

	Dosage IV	Dosage PO
Famotidine	0.4 mg/kg/dose q12h	0.4 mg/kg/dose q12h 0 mg
Ranitidine	1.5 mg/kg/dose q6h	1-2.5 mg/kg/dose q8h
Cimetidine	5-10 mg/kg/dose q6h	5-10 mg/kg/dose q 6

H2 Blockers- Other considerations

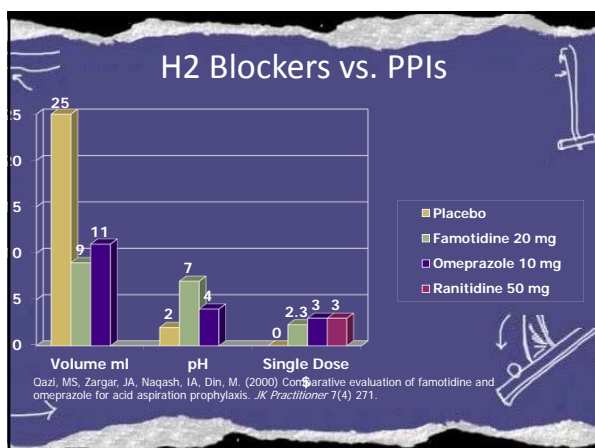
- Cimetidine- inhibits of the cytochrome P-450- potential for interactions with theophylline, warfarin, lidocaine, and phenytoin
- Famotidine- no drug interactions, less adverse effects, long duration, less cost
- Ranitidine- thrombocytopenia possible with prolonged use

Proton Pump Inhibitors

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

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



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)

Hauptfleisch, JJ & Payne, KA (1999) An oral sodium citrate-citric acid non-particulate buffer in humans. *British Journal of Anaesthesia* 77:642-644.

Gastric Prokinetics

- Metoclopramide (Reglan)
- Cisapride (Propulsid)- off market
- Erythromycin 200mg/day as effective as metoclopramide as gastric stimulant

Zatman TF, Hall JE, Harmer M. Gastric residual volume in children: a study comparing efficiency of erythromycin and metoclopramide as prokinetic agents. *British Journal of Anaesthesia*.(2001) 86(6):869-71

PHARMACOLOGIC ASPIRATION PROPHYLAXIS		
Category	Name	Typical Preop. Dose
Gastric Prokinetic agents	Metoclopramide (Reglan)	10-20 mg IV
Histamine-2 Receptor Antagonists	Nizatidine (Axiid)	150 mg PO at bedtime and preoperatively
	Ranitidine (Zantac)	50 mg IV
	Famotidine (Pepcid)	20 mg IV
H ⁺ , K ⁺ -ATPase pump (proton pump") Inhibitor	Omeprazole (Prilosec)	20 mg PO at bedtime and preoperatively
	Esomeprazole (Nexium)	(30 mg PO)
	Lansoprazole (Prevacid)	
Antacids	Sodium Citrate Sodium Citrate + Citric Acid (Bicitra) *Citric Acid + NaHCO ₃ (Alka-Seltzer)	30 ml PO 15 minutes preoperatively

MYTH: KNOWN ASPIRATION PNEUMONITIS SHOULD BE TREATED WITH AGGRESSIVE BRONCHIAL SUCTIONING, OXYGEN THERAPY, STEROIDS, AND HIGH-DOSE VOLATILES FOR BRONCHODILATION

Novel Approaches

- Lidocaine immediately before or after acid aspiration attenuated lung injury

– (Nishina, K, Mikawa, K, Takao, Y, Shiga, M, Maekawa, N, Obara, H. *Anesthesiology* 88(5):1300-9, 1998 May)

- Hyperoxia worsens lung damage after acid aspiration

– (Nader-Djalal N, Knight PR 3rd, Thusu K, Davidson BA, Holm BA, Johnson KJ, Dandona P. *Anesthesia & Analgesia*. 87(1):127-33, 1998 Jul)

– (Knight PR, Kurek C, Davidson BA, Nader ND, Patel A, Sokolowski J, Natter RH, Holm BA. Acid aspiration increases sensitivity to increased ambient oxygen concentrations. *American Journal of Physiology - Lung Cellular & Molecular Physiology*. 278(6):L1240-7, 2000 Jun.)

Cellular response- helpful?

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

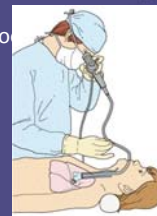
– Beck-Schimmer, B, et. al. (2005) Pulmonary Aspiration. *Anesthesiology*. 103:556-66.

Pneumonitis Treatment

- Therapy depends upon severity of symptoms
- Initial course is prognostic
- Majority do not require treatment beyond supportive care

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

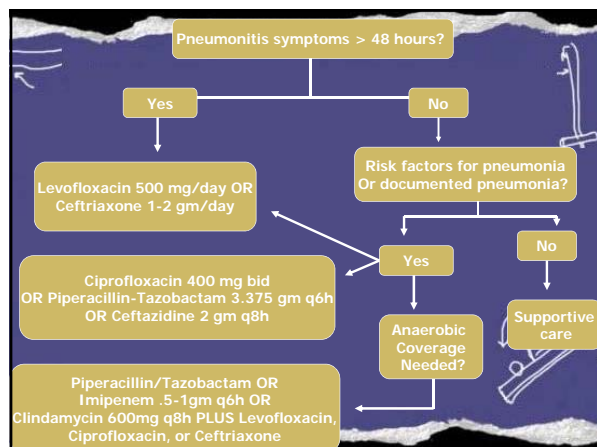
- Tracheal/bronchial suctioning
- Overzealous oxygen administration
- High dose volatiles as bronchodilators
- Nader-Djalal, Knight, Bacon. Alterations in the course of acid-induced lung injury in rats after general anesthesia: volatile anesthetic versus ketamine. *Anesth Analg*. 1998; 86:141-6.
- Steroids

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-alpha, 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.

MYTH: IN CASES OF KNOWN ASPIRATION, PATIENTS SHOULD BE TREATED WITH ANTIBIOTICS AUTOMATICALLY

Antibiotic Recommendations



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

Summary

- 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