Retching Post-Fundoplication

Miguel Saps, MD
Associate Professor of Pediatrics
Northwestern University, Feinberg School of Medicine
Director of Motility and Functional Bowel Disorders
Ann & Robert H. Lurie Children's Hospital of Chicago

The Wrap is Right

Reflux For 100

Nissen R. Schweiz Med Wochenschr (Beiheft) 1956;86: 590–2.

Einstein died in 1955 of internal bleeding due to rupture of abdominal aortic aneurysm, surgically reinforced by Dr. Rudolph Nissen in 1948 at Brooklyn Jewish Hospital.

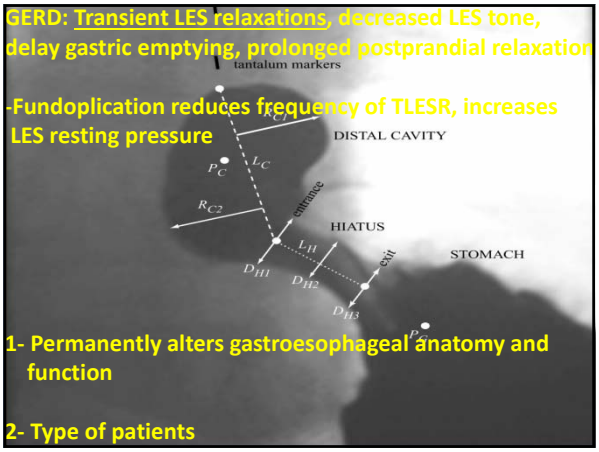
Antireflux Surgery

- "Gastric fundoplication"- among most common pediatric surgeries. Most common surgery GERD
- Success- Fundoplication effective surgical treatment GERD
- Beneficial- High level satisfaction.
- >2/3 parents report improved GERD symptoms, feed tolerance, nutrition, chest infections

O'Loughlin EV, et al. J Pediatr Gastroenterol Nutr. 2013;56:46-50

GERD: Transient LES relaxations, decreased LES tone, delay gastric emptying, prolonged postprandial relaxation

-Fundoplication reduces frequency of TLESR, increases LES resting pressure



1- Permanently alters gastroesophageal anatomy and function

2- Type of patients

- Neurologic dysfunction - 40% fundoplication surgeries in children
- GERD common in neurological dysfunction
- GERD affect quality of life (symptomatic esophagitis, peptic stricture, recurrent pneumonia)

Lasser MS, et al. Pediatrics. 2006;118:1828–1835

- Complications: reflux esophagitis, recurrent pulmonary aspiration, dysphagia (malnutrition, recurrent pulmonary aspiration)
- Poor coordination of swallowing- undernutrition and recurrent aspiration
- GT feeding-nutritional rehabilitation and/or risk of aspiration (GT may aggravate reflux and aspiration)
- GER less responsive to medical therapy than in neurologically normal individuals.

O'Loughlin EV, et al. J Pediatr Gastroenterol Nutr. 2013;56:46-50

- Antireflux surgery- prevent GERD-morbidity, reduce risk of aspiration, prevent severe GERD

Neurological Status
Major Predictor of Operative Success

- Incidence of postoperatory complications greater than neurologically intact
- X 4 more patients with neurological dysfunction reoperated (19% vs 5%)
- Surgical- Wrap herniation due to crural disruption is the most common cause of operative failure.

Pearl RH, et al.J Pediatr Surg. 1990 ;25:1169-73.

Antireflux surgery (n=234)
Neurologically Impaired (NI) vs. Normal (NN)

- Neurological status major predictor of operative success
- **Late postoperative complications-26% NI vs. 12% NN** (P<.01)
- Late postoperative period, NI children **reoperation 4 times more frequent** as NN children (NI 19% v 5% NI, P<.01).
- **Wrap herniation accounted 38% of complications and 59% of reoperations** in the late postoperative period.
- **Mortality** secondary to aspiration 9% NI vs 1% NN group

Neurological Status
Predictor Operative Failure After Redo

- **81 children-redo Nissen fundoplication 16 months after initial Nissen fundoplication.**
- **Age redo Nissen fundoplication 3.3 years** (0.3-15.9)
- **Redo failure- neurological impairment and open surgery at first fundoplication**
- **42% presented with recurrent vomiting (failure).**
- **Not significant predictors- Retching-gas bloat, and esophageal atresia.**

Pacilli M, et al. Pediatric Surgery International. 2007.

Neurological Dysfunction

- **A troublesome symptom is postoperative retching, with or without recurrent vomiting**
- **Most parents: improvement in symptoms and complications of GERD, BUT less improvement in pain and distress with feeds, gagging and retching.**

O'Loughlin EV, et al. J Pediatr Gastroenterol Nutr. 2013;56:46-50

Complications Fundoplication- Neurological Impaired

O'Loughlin EV, et al. J Pediatr Gastroenterol Nutr. 2013;56:46-50

No Complications	68%	
Gagging/retching	20%	
Surgical	10%	Most common: redo, slipped fundoplication
Dumping	3%	abnormal glucose tolerance test
Bloating	3%	Solved with venting

- Gagging/retching- Severe enough to warrant investigation or change of management
- 5/20 converted from gastrostomy to jejunostomy (remainder improved with changes in feeding regimes or sedatives)
- May affect willingness to accept oral feedings because the child may develop oral aversion

GER and Retching/Vomiting Are Different

- Confusion: Term "vomiting" used to describe different processes- gastric contents expelled from the mouth
- Retching - attempt to vomit without bringing back gastric contents.
- Emetic reflex is still present, but there is a physical obstruction to vomiting (inability). Retching is the first part of the ejection phase of the emetic reflex.
- So-called "vomiting" may be due to GER or to retching which is not a part of the GER symptom complex (and may occur in the absence of GER), but is part of the emetic reflex resulting from activation of emetic reflex

Retching Is Part of Emetic Reflex

- Although symptoms similar, GER and vomiting or post-operative retching are different physiological mechanisms
- Important distinction as treatment differs
- Retching- Commonly occurs as a postoperative symptom, less commonly, as preoperative symptom

Richards CA, et al. Neurogastroenterol Motil. 2000;12:65-74.

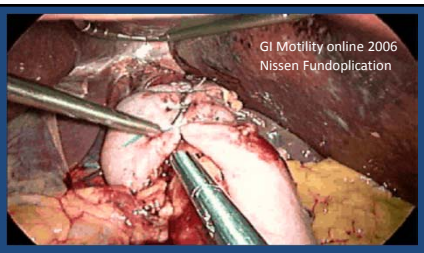
- Children who retch preoperatively more likely to retch postoperatively
- Retching more common neurologically impaired.

Gagging and Retching

Preoperative factors predict occurrence?

- Children at high risk of retching, and vomiting may be identified preoperatively.
- Children with Hx of pallor, retching, sweating and forceful vomiting had more gagging and retching
- But, 25% neurologically impaired children develop retching postoperatively for first time

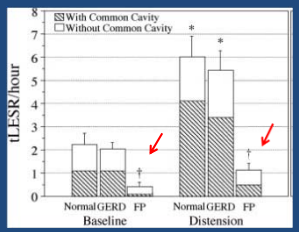
Richards CA, et al. J Pediatr Surg 2004;36:1401–4.



- Main motor function of stomach- serve as reservoir that stores and mixes food and modulates the rate of transfer into the duodenum
- Fundoplication reduces gastric volume of stomach and uses most of proximal stomach to create wrap around the lower part of esophagus

Fundoplication, gastric cardia within the fundic wrap, reduced ability to stretch or elongate:

↓ TLESRs frequency



Most TLESRs in fundoplication:

1- Higher residual pressure (incomplete relaxation)

2- Associated with fewer common cavities.

Gastric Accomodation

- Reduction of tone, and provides a reservoir for the meal.
- **Components**: **receptive relaxation**, within seconds of gastric distension (induced by oropharyngeal stimulation), and **adaptive relaxation**, slower response modulated by specific nutrients
- **Vagally mediated reflex -** Afferent signal generated by activation of **stretch-sensitive mechanoreceptors in stomach wall** and by activation of osmo- and chemoreceptors stomach and duodenum
- **Allows considerable volume without significant rise of intragastric pressure or induction of GI symptoms**

Impaired Gastric Accommodation Results In Upper gastrointestinal symptoms

- **Early satiety**
- **Distension/Bloating**
- **Epigastric pain**
- **Weight loss**
- **Nausea**
- **Reduced accommodation: functional dyspepsia, vagal neuropathy/vagotomy**

- **Functional Dyspepsia- Impaired accommodation, delayed gastric emptying, visceral hypersensitivity**

Accomodation

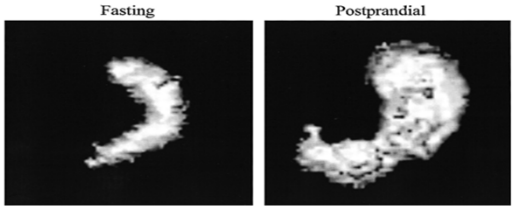
- **Barostat-Polyethylene balloon into the stomach linked to a barostatic device measures intragastric volumes in the fasting and postprandial periods- Accomodation- postprandial change in intragastric balloon volume at a preset pressure**

- **SPECT- Measures changes in gastric segment volumes postprandially (approximately two- to almost fourfold)**

Bouras EP, et al. Gut. 2002; 51: 781–786

Outlines of fasting and postprandial stomach, constructed from transaxial SPECT images using Analyze software.

HEALTHY VOLUNTEERS



Kulken S D et al. Am J Physiol Gastrointest Liver Physiol 1999;277:G1217–G122 1

AMERICAN JOURNAL OF PHYSIOLOGY Gastrointestinal and Liver Physiology

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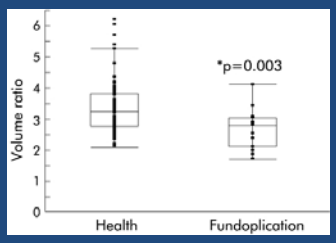
	Total	Proximal	Distal
% Volume change from baseline (fasting) (3–12 min) postprandial	271 ± 29	313 ± 39	219 ± 51
% Volume change	289 ± 26	342%	188 %

Lower Accomodation Post-Nissen

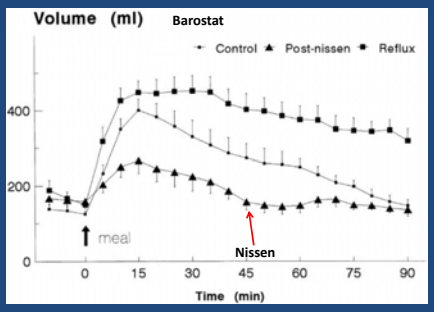
Single Photon Emission CT



Postprandial/fasting gastric volume ratio by SPECT lower in post-fundoplication patients than in healthy controls

Bouras EP, et al. Gut. 2002; 51: 781–786.

Lower Accomodation Post-Nissen



Bouras EP, et al. Gut. 2002; 51: 781–786.

Intragastric bag volumes during before and after ingestion 200 ml liquid meal

Impaired Accommodation

- **Gastric accommodation- impaired** in 47% of functional dyspepsia, **44% of postfundoplication**.

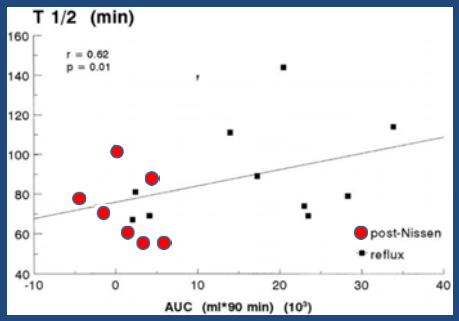
Camilleri M, et al. Dig Dis Sci. 201 56: 1729–1734.

- Surgical fundoplication and gastric banding result in **displacement of solids to the distal stomach and acceleration of overall and proximal gastric emptying**.

- **Gastric emptying accelerated postfundoplication**

Bredenoord AJ, et al. Clin Gastroenterol Hepatol. 2003;1:264-72

Gastric Emptying Solids



How Postprandial Gastric Accommodation Affects Emptying?

- **In the absence of a surgical intervention, reduced postprandial gastric volume accommodation does not necessarily impair gastric emptying.**

- **In reduced postprandial accommodation without surgical intervention, the stomach is able to compensate for the impaired accommodation, and to empty solids at a normal rate.**

Camilleri M, et al. Dig Dis Sci. 2011; 56: 1729–1734.

- **Therefore , changes in GE found in patients with functional dyspepsia (reduced accommodation and delay GE, vagal dysfunction?) do not apply to Nissen.**

Pathophysiology

- Motor function of the proximal stomach in fasting state (compliance) and after meal ingestion (postprandial relaxation)
- Gastric emptying
- Visceral perception
- With or without vagal injury

Sensation of Fullness

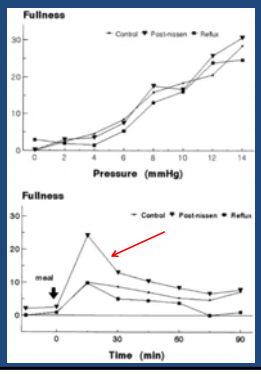
GERD, Post-Nissen Fundoplication, Healthy Controls

Isobaric distension

No differences in perception during pressure distension

In response to a liquid meal

increased in post-Nissen, compared with GER and controls, in the early postprandial phase (15 min after meal ingestion)



Vu MK, et al. Am J Gastroenterol. 1999;94:1481-9

Retching in Neurologically Impaired

- Normal brain- greater ability to modulate peripheral afferent input
- In neurologically impaired children, inhibition of the emetic reflex is lost or becomes hypersensitive and is activated in normal everyday activity

Fundoplication may "tip the balance"

- 1-By controlling GER, may disclose a previously undetected activation of the emetic reflex that was previously unappreciated (unmask emetic symptoms)

Richards CA, et al. J Pediatr Surg 2001;36:1401- 4.

Retching and Gas Bloat Syndrome May Indicate Underlying Intestinal Motility Disorder

- Children fundoplication previous GER with symptoms unchanged /worsened post Sx: vomiting, **retching (46%),** distention, satiety
- Antroduodenal motility- **abnormalities in 90%** (most common no MMC, similar to pseudoobstruction)
- Tracing similar to non-surgical patients with = symptoms
- In children with severe GI symptoms, antroduodenal manometry uncovered physiological abnormalities, and fundoplication failed to relieve symptoms. Di Lorenzo, et al. J Pediatr Gastroenterol Nutr. 1991;12:169-73.

- 14 Neurological impaired **WITH/WITHOUT FUNDO all AD study abnormal. GE no fundo ¾ delayed** , fundo 60% normal Werlin S. BMC 2004
- Neurologically impaired infants with GER delay GE is common Papaila JG, et al. Arch Surg. 1989;124:933-936
- Delay GE 67% neurologically impaired Del Guidice E, et al. Brain Dev. 1999;21:307-11

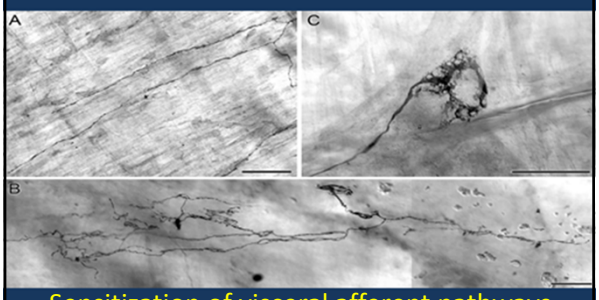
Alternatively, Retching Postfundoplication May Result From Sensitization of Gastric Vagal Afferents

- 2- retching may result from sensitization of **gastric vagal afferents, known to be a potent activator of the emetic reflex**.
- Surgical scarring and/or the fundoplication wrap may **irritate vagal trunks**, run along the serosal surface distal esophagus **inducing sensory-motor reflexes.**
- Damage to muscle or mucosa?

Richards CA, et al. Neurogastroenterol Motil. 2000;12:65-74.

O'Loughlin EV, et al. J Pediatr Gastroenterol Nutr. 2013;56:46-50

Vagal Sensory Remodeling Post- Gastric Surgery



Sensitization of visceral afferent pathways

Miranda A, et al. Neuroscience. 2009

Control of Postoperative Retching

Drugs

- Dopamine receptor2 antagonists
- 5-hydroxytryptamine receptor3 antagonists
- Histamine H1 blocker
- Tricyclic antidepressants

Venting and Feeds

- Frequent venting of gastrostomy
- Small, more frequent, feedings
- Slower feeding rate
- Continuous gastric feeds
- Bypassing the stomach with jejunostomy feeds

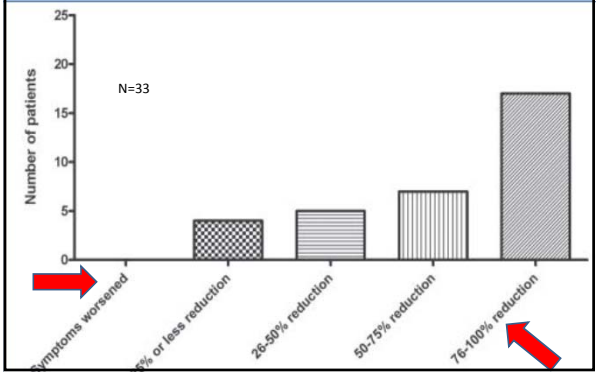
Pureed by Gastrostomy Tube Diet Improves Gagging and Retching in Children with Nissen Fundoplication

Pentiuk S, et al. JPEN. 2011;35:375-9

- **33 children post- fundoplication with gagging and retching with GT feedings**
- **88% neurodevelopmental delay**
- **Age >8 months (mean 34 months) Individualized pureed GT diet (blended foods) by boluses via gravity to meet nutrition goals.**
- **Diet administered by slow push via a 60-mm syringe (>14 Fr GT)**
- **No motility agents before or while receiving the PBGT diet.**

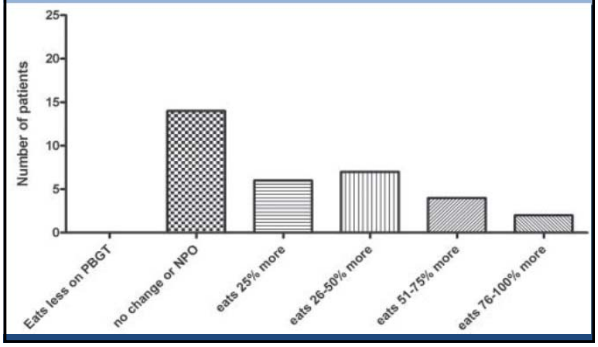
Pureed by Gastrostomy Tube Diet

52% children >75% reduction gagging and retching



Pureed by gastrostomy tube diet

57% increase in oral intake



Pureed by Gastrostomy Tube Diet

Pentiuk S, et al. JPEN. 2011;35:375-9

- Higher viscosity of feedings- slower emptying of the stomach and decrease dumping syndrome?
- Pureed foods stimulate a different hormonal response that favorably affects GI motility compared with the response from formula?

Cyproheptadine

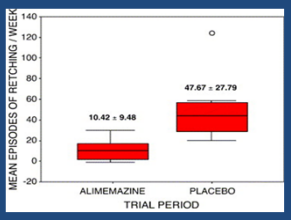
Rodriguez L, et al. J Pediatr. 2013;163:261-7

- Antagonist of serotonin (5-HT2A and/or 5-HT2B receptors), histamine H1, and muscarinic receptors (range, 0.04-0.62 mg/kg/day >4 weeks)
- Refractory upper GI symptoms (nausea, retching post-fundo, early satiety, vomiting, abdominal pain)
- Retching post-fundoplication- 86% response rate. Potential action- improves gastric accommodation and/or gastric hypersensitivity to distention?
- Early vomiting (<1 hour after starting meal) better than late vomiting.

Retching Post-Fundoplication- Alimemazine

Antao B, et al. Journal of Pediatric Surgery (2005) 40, 1737–1740

Prospective, double-blind, randomized, crossover, placebo-controlled study
Alimemazine- phenothiazine derivative histamine 1 antagonist- 0.25 mg/kg 3 times/day 1 week alimemazine or placebo with crossover



Number retching episodes - Alimemazine 10 vs. 48 placebo (P <0001)
No adverse effects completed the study (1 discontinued drowsiness)
Drosiness reported in medication and placebo

Gastrointestinal motility and sensory abnormalities may contribute to food refusal in medically fragile toddlers

- Pathophysiology of Nissen complications multifactorial
- Multidisciplinary treatment program
- Drip feedings
- Drugs for motility disorders, drugs to decrease visceral pain and non-specific arousal, and behavioral, cognitive and family therapy.
- 2-6 months assessment of daily frequency of retching and vomiting, feeding modification, and emotional health of the child.

Zangen T , et al. JPGN 2003

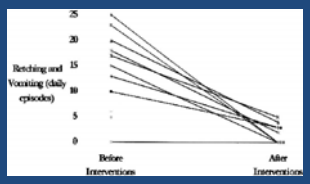
Treatment

Zangen T , et al. JPGN 2003

- GJ feedings to eliminate gastric distention (avoid retching secondary to gastric distention) (5 cases)
- Cognitive and family therapy
- Drugs

Abnormality		Drug
Motility	Diffuse esophageal spasm	Nifedipine and dicyclomine
	Continuous bands duodenal contractions	Dicyclomine (to relieve obstruction caused by absence of relaxation)
	Induce phase 3 of MMC	Octreotide or Erythromycin
Appetite	Appetite	Cyproheptadine
Pain	Raise gastric pain threshold	Imipramine or amitriptyline and/or gabapentin and/or ondansetron

Treatment Outcomes



Zangen T , et al. JPGN 2003

- **93% improved retching/vomiting episodes mean 15/day to 1.4/day (p<0.01)**
- **80% emotional health improvement after intervention**
- **43% advanced feeding (tube to oral)**
- **57% continued requiring most feeds through drip feeding despite significant decreased retching and vomiting in most**

Changes with Nissen

Summary

- May explain postoperative dyspeptic symptoms.
- **Reduced postprandial relaxation of the stomach** post-Nissen compared with controls and GERD.
- **Postprandial fullness is increased**
- **Gastric emptying of liquids and also solids (in some reports)** becomes more rapid after fundoplication.
- These changes occur even with normal vagus.

Vu et al. Am J Gast 1999;94, 1481–1489

- Vagotomy reduces gastric accommodation and impairs gastric emptying, causing dumping of liquids and retention of solids

Maddern, GJ, Jamieson, GG. Ann Surg 1985;301: 296–299

- Drugs, feeding management, psychological treatment alone or in combination beneficial

THE END