Retching Post-Fundoplication

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The Wrap is Right
Reflux For 100

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

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

Neurological Status
  Major Predictor of Operative Success
  - Incidence of postoperative 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.
### 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% NN, *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

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### 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.


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### 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.

Complications Fundoplication - Neurological Impaired

<table>
<thead>
<tr>
<th>Complication</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Complications</td>
<td>68%</td>
</tr>
<tr>
<td>Gagging/retching</td>
<td>20%</td>
</tr>
<tr>
<td>Surgical</td>
<td>10%</td>
</tr>
<tr>
<td>Dumping</td>
<td>3%</td>
</tr>
<tr>
<td>Bloating</td>
<td>3%</td>
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</table>

- 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
  

- 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


**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 Accommodation

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)

**Lower Accommodation Post-Nissen**

**Single Photon Emission CT**

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


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**Lower Accommodation Post-Nissen**

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**.
  

- 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**
  

Gastric Emptying Solids

![Graph showing gastric emptying solids](image)

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.
  

- 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)


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

Retching and Gas Bloat Syndrome May Indicate Underlying Intestinal Motility Disorder

- Children fundoplication previous GER with symptoms unchanged/worsened post Sc: vomiting, retching (46%), distention, satiety
- Antroduodenal motility - sensitivity in 80% (most common no MMC, similar to pseudoobstruction)
- Tracing similar to non-surgical patients with similar symptoms
- In children with severe GI symptoms, antroduodenal manometry uncovered physiological abnormalities, and fundoplication failed to relieve symptoms.

14 Neurological impaired WITH/WITHOUT FUNDO all AD study abnormal. GE no fundo % delayed, fundo 60% normal

- Neurologically impaired infants with GER delay GE is common
- Delay GE 67% neurologically impaired

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

- 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?

Vagal Sensory Remodeling Post- Gastric Surgery

Sensitization of visceral afferent pathways

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

- **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

- 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
- 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
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)
Droswiness 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

<table>
<thead>
<tr>
<th>Abnormality</th>
<th>Drug</th>
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<tbody>
<tr>
<td>Motility</td>
<td>Nifedipine and dicyclomine</td>
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<tr>
<td>Diffuse esophageal spasm</td>
<td></td>
</tr>
<tr>
<td>Continuous bands duodenal contractions</td>
<td></td>
</tr>
<tr>
<td>Octreotide or Erythromycin</td>
<td></td>
</tr>
<tr>
<td>Appetite</td>
<td>Cyproheptadine</td>
</tr>
<tr>
<td>Appetite</td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>Imipramine or amitriptyline and/or gabapentin and/or ondansetron</td>
</tr>
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Treatment Outcomes

- 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 becomes more rapid after fundoplication.
- These changes occur even with normal vagus.
- Vagotomy reduces gastric accommodation and impairs gastric emptying, causing dumping of liquids and retention of solids
- Drugs, feeding management, psychological treatment alone or in combination beneficial

THE END