Pediatric Upsies, Downsies and Oopsies – Nausea and Vomiting

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I have nothing to disclose

Objectives

- Identify the pertinent history information regarding the symptoms of nausea and vomiting.
- Describe the appropriate assessment of nausea and vomiting in the pediatric patient.
- List the treatment/management of nausea and vomiting in the pediatric patient.

First things first…what do you mean by "nausea"?

- Feel like throwing up?
- Dizziness?
- Room spinning (vertigo)?
- Grossed out?
- Feeling something in the throat?

Do not assume that we all use the word the same way!

First things first…what do you mean by "vomiting"?

- Spitting out saliva?
- Regurgitation?
- Rumination?
- Forceful/projectile vomiting?

Do not assume that we all use the word the same way!

Nausea and/or vomiting are symptoms, not diseases

- "GI" conditions
  - Gastroesophageal reflux
    - Uncomplicated GER of infancy
    - GERD
  - Upper GI tract infection, inflammation, chemical irritation
    - Eosinophilic esophagitis
    - Food allergies/intolerance
    - H. pylori infection
    - Celiac disease
    - Crohn's disease
  - Rumination syndrome

Nausea and/or vomiting are symptoms, not diseases

- "GI" conditions
  - Congenital anomalies (e.g., vascular ring/sling, esophageal atresia, duodenal atresia, antral web, annular pancreas)
  - Acquired obstruction (pyloric channel/duodenal bulb ulcer, intussusception, midgut volvulus, hypertrophic pyloric stenosis, post-surgical adhesions, incarcerated hernia)
  - Food poisoning
  - Abdominal migraine/cyclic vomiting syndrome
  - Foreign bodies
- Biliary disease
- Pancreatic disease

Nausea and/or vomiting are symptoms, not diseases

- "Non-GI" conditions
  - Anxiety, hyperventilation
  - Motion sickness
  - Noxious sights and smells (getting grossed out)
  - Pregnancy
  - Urinary tract infection
  - CNS disease
  - Medication side effects
  - Cannabis hyperemesis syndrome
  - Severe pain

Where do we start?

HOW DO MAKE THIS LESS COMPLICATED?

Aged-based approach to evaluation and treatment

- Know the presentation and findings of the most common benign age-specific causes of nausea/vomiting
- Know the presentation and findings of the more common serious age-specific causes of nausea/vomiting
- Look for signs, symptoms and findings to determine whether there is a good match or significant mismatch with these typical presentations
- If mismatch, think harder and look deeper

Newborns/Infants Gastroesophageal reflux

- Spit-ups happen
- Regurgitation, not vomiting
  - "Spilling out"
  - Not forceful
  - Most common when prone
  - Babies not necessarily uncomfortable
  - Treatment is usually not necessary
  - Should resolve by one year of age, usually sooner

Newborns/Infants Gastroesophageal reflux

- Why spit-ups happen
  - Large volume of breastmilk/formula consumed compared to body weight
  - Short length of esophagus in young infants
  - Large amount of time spent in the prone position
  - Feedings are mostly liquid
  - Feedings are physically strenuous for infants
  - Possible milk protein sensitivity

Newborns/Infants Gastroesophageal reflux disease

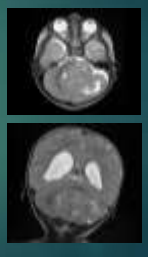
- When "GER" is no longer normal
  - Failure to thrive
  - Refusal to feed
  - Aspiration pneumonia
  - Apnea, cyanosis, ALTE
  - Laryngomalacia
  - Hematemesis
  - Forceful vomiting
  - Associated atopic dermatitis, allergies

Diff Dx for "it's coming up…not GER" (newborns/infants)

- Congenital anatomical obstructions
  - Esophageal atresia/stricture
  - Antral web
  - Duodenal atresia/stenosis
  - Vascular rings/slings
- Hemorrhagic gastritis of the newborn
- GERD
- Allergies/eosinophilic gastrointestinal disorders
- Hypertrophic pyloric stenosis

Diff Dx for "it's coming up…not GER" (newborns/infants)

- Neurological
  - Congenital brain malformation
  - hydrocephalus
  - Meningitis
  - Head trauma/child abuse
  - Brain tumor
  - Seizures/epilepsy
- Metabolic
  - Inborn errors of metabolism
  - Mitochondrial enzyme disorders
  - Familial dysautonomia

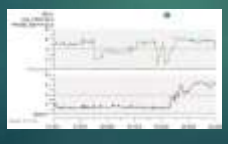


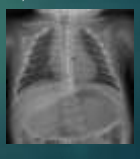
Newborns/infants Tests for "vomiting"

- A good clinical history and examination
  - No further testing necessary for uncomplicated GER of infancy, colic
- Radiology
  - Chest X-ray/KUB (duodenal atresia, obstruction, diaphragmatic hernia, etc.)
  - Barium swallow/UGI series (esophageal atresia, vascular ring, hypertrophic pyloric stenosis, malrotation, etc.)
  - Pylorus ultrasound (pyloric stenosis)
  - CT/MRI rarely needed
  - CNS imaging (cranial ultrasound, head CT/MRI)
- Laboratory tests
  - Electrolytes (hypertrophic pyloric stenosis – dehydration, hypochloremic metabolic alkalosis)
  - CBC, INR (GI bleed)
  - Urinalysis, creatinine, lipase

Newborns/infants Tests for "vomiting"

- Esophageal pH/impedance testing
  - May be helpful with atypical GER symptoms
  - 24-hour study, may be done with a polysomnogram
  - Not helpful if a diagnosis of GERD/vomiting has already been established





Newborns/infants Tests for "vomiting"

- Endoscopy (EGD)
  - Primarily for evaluating for mucosal inflammation, bleeding
  - Foreign body removal

Newborns/Infants
Hypertrophic pyloric stenosis

- The pylorus normally reaches a maximal thickness during infancy around 6-8 weeks of age
- Excess thickening/hypertrophy causes gastric outlet obstruction
- Signs and symptoms
  - Projectile vomiting
  - Very hungry baby
  - Dehydration, hypochloremia, metabolic alkalosis
  - An olive-sized mass may be palpable
- Diagnosis – UGI series or pylorus ultrasound
- Treatment
  - Surgery (pyloromyotomy) – almost always done in the U.S.
  - Atropine (relaxes pylorus) if surgery is not a good option

Newborns/Infants
Treatments for "vomiting"

- (Mostly) uncomplicated GER
  - Reassurance, lots of patience
  - Thickened feedings
    - Rice cereal (up to 1 tablespoon per ounce of breastmilk/formula)
    - Carob bean gum-based thickener
    - Pre-thickened formula
  - Acid reducers
    - Antacids (use milk of magnesia if the baby is also constipated – has both antacid and stool softening effects!)
    - H2RA class medications (e.g., ranitidine, famotidine)
    - Avoid excessive use of PPI medications (e.g., omeprazole)

Newborns/Infants
Treatments for "vomiting"

- Complicated GER
  - Consider trial of protein-hydrolysate or amino acid-based formula
  - More aggressive use of acid reducing medications, including PPI
  - Consider use of "prokinetic" type medications
    - Bethanechol, low-dose erythromycin, metoclopramide
    - Effects are less predictable
    - Greater risk of side effects
      - Bethanechol – cholinergic effects (diarrhea, hypotension, sweating, vomiting)
      - Erythromycin – increased risk of hypertrophic pyloric stenosis
      - Metoclopramide – neurological
  - Surgery (fundoplication) is rarely necessary

Newborns/Infants
Treatments for "vomiting"

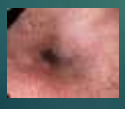
- Congenital anatomical anomalies
  - Surgery is usually the treatment of choice
  - Therapeutic endoscopic treatment is sometimes possible

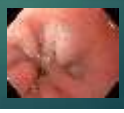
Toddlers/children
Nausea and vomiting

- This is no longer "uncomplicated GER of infancy"
- Acute illnesses
  - Gastroenteritis
  - Respiratory tract infections/post-tussive emeses
  - Food poisoning
- Foreign bodies in the esophagus
  - Coins are the most common
  - Lithium batteries (20 mm) in the esophagus are the most dangerous
  - May be unwitnessed and incidentally discovered on X-ray
  - Radiolucent (e.g., plastic) foreign bodies are difficult to locate

Toddlers/children
Eosinophilic esophagitis (EoE)

- Can present before 2 years of age, usually as vomiting
- Adult presentation – esophageal strictures, food impaction in the esophagus
- A personal/family history of food allergies, asthma, eczema, and other atopic conditions is common
- Requires EGD with esophageal mucosal biopsies to establish diagnosis





Toddlers/children
Eosinophilic esophagitis (EoE)

- Treatment
  - Steroids (not a good long-term solution
  - Acid suppression (with PPI) may work sometimes
  - Mast cell stabilizers (Montelukast) may be beneficial
  - Elimination diet
    - Targeted food group elimination based on allergy testing
    - Six food-group elimination diet (SEFD) – no milk/dairy, egg, wheat, soy, nuts (peanut and tree nuts), seafood (fish and shellfish)
    - Amino acid-based formula
    - Very difficult to do, but complete resolution of esophagitis is possible

Toddlers/children
Celiac disease

- Can present primarily with vomiting/upper GI distress that is not relieved by acid reducers
- May be associated also with poor growth, abdominal pain, diarrhea, positive family history of celiac disease and other autoimmune disorders
- Laboratory screening is readily available
- Diagnosis requires EGD with small intestinal biopsies
- Lifelong adherence to a gluten-free diet is usually necessary.

Celiac disease
Response to gluten-free diet

5/30/2013	9/11/2013	11/6/2014
(tTG) Ab, IgA: >100 (H)	*(tTG) Ab, IgA: 8 (H)*	*(tTG) Ab, IgA: 2*
Endomysial Ab IgA: POSITIVE (A)	*Endomysial Ab IgA: NEGATIVE*	
Endomysial Ab Titer: 1:320 (H)		
**Initial diagnosis at 22 months of age*		

Celiac disease

Duodenum - normal

Duodenum – celiac disease

Toddlers/children Behavioral/neurogenic

- Behaviorally mediated vomiting
  - Temper tantrums
  - Crying, hyperventilation
- Noxious stimuli
  - Getting "grossed out" (disgusted by smells, sights)
  - Pain
  - Motion sickness
- Rumination syndrome
  - Vomits after eating
  - Gastric content brought up by abdominal muscle contractions
  - May be a self-stimulatory behavior

Toddlers/children Childhood periodic disorders

- Two major GI presentations
  - Abdominal migraine
  - Cyclic vomiting syndrome
- Onset during childhood, usually resolving during adolescence
- Family history of migraine is common
- Onset of attacks is usually at night or early in the morning
- Multiple medical visits prior to eventual diagnosis
- May require IV hydration during attacks
- Sometimes associated with fever and/or diarrhea

Toddlers/children
Childhood periodic disorders

Pediatric Rome IV diagnostic criteria for ABDOMINAL MIGRAINE

- (Criteria fulfilled for at least 6 months before diagnosis)
- Must include all of the following occurring at least twice:
  - 1. Paroxysmal episodes of intense, acute periumbilical, midline or diffuse abdominal pain lasting 1 hour or more (should be the most severe and distressing symptom)
  - 2. Episodes are separated by weeks to months.
  - 3. The pain is incapacitating and interferes with normal activities
  - 4. Stereotypical pattern and symptoms in the individual patient
  - 5. The pain is associated with 2 or more of the following: anorexia, nausea, vomiting, headache, photphobia, pallor)
  - 6. After appropriate evaluation, the symptoms cannot be fully explained by another medical condition.

Toddlers/children
Childhood periodic disorders

Rome IV diagnostic criteria for CYCLIC VOMITING SYNDROME in children & adolescents

- Must include all of the following:
  - 1. The occurrence of 2 or more periods of intense, unremitting nausea and paroxysmal vomiting, lasting hours to days within a 6-month period.
  - 2. Episodes are stereotypical in each patient
  - 3. Episodes are separated by weeks to months with return to baseline health between episodes.
  - 4. After appropriate medical evaluation, the symptoms cannot be attributed to another condition

Toddlers/children
Childhood periodic disorders

- Differential diagnosis
  - Metabolic disease (more likely to present during infancy)
    - Disorders of energy metabolism
    - Urea cycle defects
    - Mitochondrial enzyme defects
  - Intermittent/partial small bowel obstruction
    - Malrotation/midgut volvulus
    - Postsurgical adhesions
    - Bilious vomiting raises suspicion of possible obstruction
    - UGI series is usually diagnostic

Toddlers/children
Childhood periodic disorders

- Treatment
  - Abortive/symptomatic
    - Migraine abortive medications (sumatriptan, rizatriptan, etc.)
    - Ondansetron
  - Preventive
    - Cyproheptadine
    - Amitriptyline (low-dose)
    - Magnesium supplements (?)
    - Coenzyme Q10 (?)
    - High-dose riboflavin (?)
    - Avoiding identified triggers (specific foods, stressors)

Older children/adolescents
Nausea/vomiting

- You still need to think about all the conditions that cause nausea/vomiting in younger children!
- Functional nausea and functional vomiting are more common
  - No evidence of organic disease or abnormal test results
  - Symptoms tend to be worse in the mornings and on school days
- More common in older kids
  - Acid peptic disorders, functional dyspepsia
  - H. pylori infection
  - Inflammatory bowel disease (mostly Crohn's disease)
  - Gallstones, pancreatitis
  - NSAID overuse, cannabis hyperemesis syndrome, alcohol
  - Pregnancy
  - Anxiety, depression

Older children/adolescents
Acid peptic disorders

- Pain and discomfort is usually above the umbilicus
- Heartburn
- Morning hoarseness if there is acid irritation of the larynx
- Possible association with asthma/wheezing
- May be affected by diet
  - Peppers (bell peppers, chili peppers, hot sauce)
  - Onions, mint, chocolate
  - Fatty/fried foods
  - Acid foods
  - Smoking
- Improved with acid reducing medications

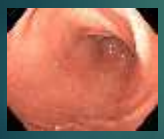
Older children/adolescents *Helicobacter pylori* infection

- The most common cause of duodenal ulcers in children and adolescents, but…
- Asymptomatic colonization is also very common
- Presence of H. pylori infection in someone with nausea/vomiting does not necessarily implicate causation
- Anti-Helicobacter therapy is clearly indicated if ulcers are present, otherwise it is "debatable"

Older children/adolescents *Helicobacter pylori* infection

- Diagnosis
  - EGD with biopsies – most accurate, but not commonly done in pediatrics
  - Stool test – pretty good, may have false-negative if on medications
  - Breath test – pretty good, but involves some radiation exposure, not readily available within Kaiser
  - Blood test – very easy to get, but not very useful
    - Poor accuracy
    - Does not distinguish between recent/past infection vs active infection

Older children/adolescents *Helicobacter pylori* infection



Normal stomach

H. Pylori gastritis

H. Pylori duodenal ulcer

Older children/adolescents *Helicobacter pylori* infection

- Treatment
  - Old triple therapy (amoxicillin, clarithromycin, omeprazole) is probably less than 70% effective in eradicating the organism
  - Newer treatment regimens often includes 4-5 drugs
    - High-dose PPI (e.g., omeprazole 20 mg BID)
    - Up to 3 antibiotics (amoxicillin, metronidazole, clarithromycin, tinidazole, levofloxacin)
    - Addition of bismuth subsalicylate (Pepto-Bismol)
    - Possible sequential therapy
    - Effectiveness is higher > 80%, but there is still a high chance of treatment failure
    - Treatment based on culture and susceptibility is possible (complicated process)

Older children/adolescents Crohn's disease

- Autoimmune GI disorder
- Onset during adolescence is common
- Disease can involve any part of the digestive tract
- Symptoms depend on the locations of disease involvement
- Can present with esophagitis, gastritis, duodenitis, duodenal ulcer, small bowel obstruction
- Dramatic weight loss is common
- May have very high ESR and/or CRP values

Crohn's disease

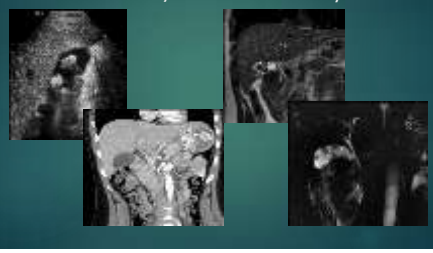
Duodenal ulcer

Small bowel obstruction

Older children/adolescents Gallstones

- Risk factors
  - Family history
  - Obesity
- RUQ abdominal pain
  - Murphy sign
  - Anterior cutaneous nerve entrapment syndrome may present with pain in the same location (workup would be completely negative…usually no vomiting)
- Ultrasound is diagnostic, MR cholangiogram if suspected CBD stone
- ERCP to remove CBD stone(s) – usually by adult GI ERCP specialist
- Surgery

Gallstones – imaging (note – not really visible on CT)



Older children/adolescents Nausea/vomiting

- NSAID overuse
  - Not very common in children/teens
  - Often seen in children with juvenile rheumatoid arthritides
- Cannabis hyperemesis syndrome
  - Severe nausea/vomiting in the mornings
  - Scalding hot shower seems to provide relief
  - Usually from long-term, heavy use
- Alcohol
  - This probably happens more often than suspected
- Pregnancy
  - You can miss this at first, but you can't miss it forever (the speaker has personal experience on this one)

Older children/adolescents Nausea/vomiting

- Anxiety, depression
  - Risk factors and clues
    - School problem
    - Peer relational issues
    - Family/parental discord, separation
    - Deaths, illnesses among family/friends, traumatic news events
    - Other physical symptoms – abnormal weight change, sleep disturbance, pain, in addition to nausea/vomiting
    - Substance abuse
    - Parents often look like they need to seen by psychiatrists also…

Older children/adolescents Nausea/vomiting

- Laboratory studies
  - Do not order everything. Know what you are looking for and why you need the test.
  - Common but not always useful or necessary (CBC with differentials, ESR, CRP, electrolytes, creatinine, ALT, lipase
  - Celiac disease panel – the probability of a positive result in the normal-risk population is about 0.7%
  - Stool H. pylori antigen to check for response to anti-Helicobacter treatment (routine testing for *H. pylori* is not recommended by major GI and peds GI societies)
  - Pregnancy test, drug screen

Older children/adolescents Nausea/vomiting

- Radiological studies
  - Plain abdominal films (KUB) – assess bowel gas pattern, rule out acute obstruction, ileus.
  - Abdominal ultrasound – rule out gallstones, pancreatic disease (order this on the basis of clinical suspicion only)
  - UGI series – rule out malrotation, anatomical anomalies, etc.
  - Nuclear radiology
    - HIDA scan with CCK – may help identify gallbladder dysfunction
    - Gastric emptying scan – rule out gastroparesis (rare in pediatrics, usually no vomiting)
  - CT and/or MRI of the abdomen and pelvis – rarely necessary outside of the emergency department

Older children/adolescents Nausea/vomiting

- Endoscopy is indicated for:
  - Evaluation and treatment of upper GI bleeding
  - Foreign body removal
  - Evaluation of unexplained nausea/vomiting
  - Investigation of failure to respond to appropriate treatment
  - Placement of wireless esophageal pH telemetry capsules for ambulatory esophageal pH monitoring (Bravo)
  - Follow-up evaluation for eosinophilic esophagitis, peptic ulcer disease, *H. pylori* infection, Crohn's disease, etc.
  - Establishing a diagnosis of celiac disease

Older children/adolescents Nausea/vomiting - treatment

- Dietary
  - Maintain healthy weight
  - Avoid fatty, fast foods, fad diets, alcohol, acid foods, spicy foods, etc.
  - Avoid gluten (celiac disease)
  - Avoid specific food allergens
  - Targeted nutritional supplementation may be needed for some elimination diets
- Stuff for acid
  - Antacids (TUMS, Mylanta, Gaviscon, etc.)
  - H2RA class medications (ranitidine, famotidine, etc.)
  - PPI class medications (omeprazole, pantoprazole, etc.)

Older children/adolescents Nausea/vomiting - treatment

- Other medications for GERD, gastroparesis
  - Low dose erythromycin, azithromycin for gastroparesis
  - Metoclopramide
    - The American Academy of Pediatrics recommend against using this medication in children
    - No real evidence that this medication works
    - Too much neurological side effects
  - Baclofen
    - Helps to reduce transient lower esophageal sphincter relaxations (TLESRs) between meals
    - Low dose (10 mg for teens) usually helps

Older children/adolescents Nausea/vomiting - treatment

- Cyproheptadine
  - Reduces nausea
  - Improves gastric accommodation during meals – makes kids eat better
  - Useful as preventive therapy for abdominal migraine and cyclic vomiting syndrome
- Amitriptyline
  - May help with nausea and vomiting in some cases
  - Very sedating – helps for those who can't sleep and wake up sick
  - May use as preventive therapy for abdominal migraine and cyclic vomiting in older children (over 7 years old)

Older children/adolescents Nausea/vomiting - treatment

- Ondansetron
  - Serotonin 5-HT_3 receptor antagonist
  - Effective for chemotherapy/radiation therapy-induced vomiting, post-anesthesia vomiting, cyclic vomiting syndrome
  - Also frequently used in acute gastroenteritis
  - May prolong QTc
- Antiemetics no longer recommended in pediatrics
  - Metoclopramide
  - Prochlorperazine
  - Trimethylbenzamide
  - Promethazine

Older children/adolescents Nausea/vomiting - treatment

- Extra stuff to try:
  - Ginger – helps reduce nausea, heartburn
  - Abdominal/diaphragmatic breathing
    - Relaxing technique
    - Prevents hyperventilation
    - Useful for pain reduction
    - Helps to control abdominal spasms in rumination syndrome
  - Wrist acupressure
  - Aromatherapy

Oda spreyi - next we talk about poop after a break…