

PedsCases Podcast Scripts

This is a text version of a podcast from PedsCases.com on “Approach to Pediatric Vomiting.” These podcasts are designed to give medical students an overview of key topics in pediatrics. The audio versions are accessible on iTunes or at www.pedsCases.com/podcasts.

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Approach to Pediatric Vomiting (Part 1)

Introduction

Hi, Everyone! My name is Erin Boschee and I’m a medical student at the University of Alberta. This podcast was reviewed by Dr. Melanie Lewis, a General Pediatrician and Associate Professor at the University of Alberta and Stollery Children’s Hospital in Edmonton, Alberta, Canada. This is the first in a series of two podcasts discussing an approach to pediatric vomiting.

We will focus on the following learning objectives:

- 1) Create a differential diagnosis for pediatric vomiting.
- 2) Highlight the key causes of vomiting specific to the newborn and pediatric population.
- 3) Develop a clinical approach to pediatric vomiting through history taking, physical exam and investigations.

Case Example

Let’s start with a case example that we will revisit at the end of the podcasts.

You are called to assess a 3-week old male infant for recurrent vomiting and ‘feeding difficulties.’ The ER physician tells you that the mother brought the baby in stating that he started vomiting with every feed since around two weeks of age. In the last three days he has become progressively more sleepy and lethargic. She brought him in this afternoon because he vomited so forcefully that it sprayed her in the face. The physician confirms that the baby is stable, and his vitals are within normal range, except that he is mildly tachycardic.

What else will you want to ask when you go to see the baby? What will you look for on physical exam and what tests might you order?

Before we think about our clinical approach to this vomiting infant, let's take a few minutes to discuss some of the common causes of pediatric vomiting.

Pathophysiology

Vomiting is the forceful expulsion of the stomach contents through the mouth via contraction of the abdominal and chest wall muscles. An emetic response may be triggered by irritation of the gastric mucosa by toxins, drugs or overdistension, which stimulates vagal afferents to the vomiting center in the brain. Afferent impulses from other areas of the brain, such as the vestibular system, the amygdala (as with emotion or fear), or from certain organs outside the GI tract can stimulate vomiting in a similar mechanism. Stimulation of the 'chemoreceptor trigger zone' in the area postrema of the 4th ventricle by toxins, electrolyte or metabolic disturbances or increased intracranial pressure also results in vomiting through activation of the vomiting center.

It can be helpful to think of the pathophysiological mechanisms that cause vomiting when trying to create a differential diagnosis.

Differential Diagnosis

Vomiting is a very common pediatric presentation, and the differential is extremely broad. While GI (gastrointestinal) causes tend to come to mind first, there are many non-GI causes for vomiting that have to be considered. The causes for pediatric vomiting can be broken into categories including **gastrointestinal, infectious, neurologic, metabolic/endocrine, respiratory, toxin or medication-related and psychogenic or behavioral.**

Now that you know a broad systems approach to the causes of vomiting, let's focus a bit more on some of the common specific conditions.

Gastrointestinal Causes

There are several approaches that can be followed when considering the **GI** causes of pediatric vomiting. A simple approach is to group the causes **by age** as different diagnoses tend explain vomiting in newborns versus vomiting in infants and older children.

Important causes of vomiting **in the newborn period** include pyloric stenosis, duodenal atresia, intestinal malrotation and tracheo-esophageal fistula. We'll spend a few minutes now discussing the distinguishing features of these conditions.

Pyloric stenosis is the hypertrophy of the pyloric muscles at the outlet of the stomach. This results in *projectile*, non-bilious vomiting immediately following feeds that presents in the first few weeks of life. Infants are classically firstborn males with a positive family history of pyloric stenosis, and may have visible abdominal peristalsis or a palpable olive-shaped mass near the umbilicus. It is considered a medical (not surgical)

emergency due to the risk of severe electrolyte disturbances – classically, a hypochloremic hypokalemic metabolic alkalosis.

Duodenal atresia is the congenital absence of a portion of the first part of the small bowel. Symptoms typically present shortly after birth. They may present with either bilious or non-bilious vomiting, depending whether the atresia is distal or proximal to the ampulla of Vater, the site where bile and pancreatic enzymes are released into the duodenum from the common bile duct. It typically does not present with abdominal distension. A classical x-ray finding associated with duodenal atresia is the 'double bubble sign.'

In contrast, **intestinal malrotation**, a congenital anomaly in rotation of the midgut as it forms, presents as intermittent bilious vomiting, usually with significant abdominal distension. It may be associated with severe abdominal pain if associated with midgut **volvulus** causing bowel ischemia. Since the bowel obstruction is often intermittent, the timing of presentation can be variable. Bilious or bile-stained vomiting should be treated as a potential surgical emergency.

Tracheo-esophageal fistula, or TEF, is an abnormal connection between the trachea and esophagus. TEF usually presents with cough, cyanotic episodes with feeding, respiratory distress, or recurrent pneumonia. Other defects associated with the VACTERL association may be present, such as vertebral anomalies, anal atresia, congenital heart disease, renal or radial anomalies or limb defects. There are five different forms of TEF, which are distinguished by the location of the esophageal atresia and connection to the trachea. Types with a complete esophageal atresia typically present shortly after feeding begins as there is a complete obstruction. However, other variants such as the H-type of TEF may present later in life with symptoms of recurrent cough or aspiration pneumonia. This is because the main feature is an abnormal connection to the trachea, and there is no complete esophageal atresia.

Necrotizing enterocolitis is common in premature infants and may present as decreased feeding tolerance, vomiting, abdominal distension, diarrhea or hematochezia. Other neonatal causes of vomiting include meconium ileus, Hirschsprung disease, and imperforate anus.

After the newborn period, important gastrointestinal causes of vomiting include gastroesophageal reflux disease (GERD), intussusception and other causes of bowel obstruction, food allergy, eosinophilic esophagitis and appendicitis.

Gastro-esophageal reflux (GER) is extremely common and typically presents in infants between 1-3 months of age. It is characterized by frequent small volume regurgitation of a milky substance, irritability with feeds or when lying supine, or back arching with feeds. Many infants are asymptomatic. Gastro-esophageal reflux is a normal physiologic process in infants and must be distinguished from gastro-

esophageal reflux disease (GERD), which is associated with esophagitis, failure to thrive and recurrent aspiration.

Intussusception involves invagination of a portion of the small bowel into another portion of bowel. It is the most common cause of intestinal obstruction in children six to 36 months of age. In addition to vomiting, the classic triad of features includes intermittent, progressive abdominal pain, red currant jelly stools and a palpable sausage-like abdominal mass.

Food **allergies** such as milk protein allergy in infants or celiac disease in older infants and children are other fairly common causes of vomiting.

Eosinophilic esophagitis, a disease characterized by eosinophilic infiltrates in the esophagus is another cause of vomiting often found in older children or adolescents with a history of asthma, atopy and eczema, who complain of food sticking in the esophagus.

Lastly, **appendicitis** is a common GI cause of vomiting in children and adolescents that should not be missed. Usually, there will also be a history of fever and abdominal pain.

Non-Gastrointestinal Causes

Let's take a few moments to review the common **non-GI** causes of vomiting in children.

The classic **infectious** cause of vomiting is **gastroenteritis**, and it is likely the most common cause of vomiting from infancy into adolescence. It is typically associated with fever, diarrhea and/or abdominal cramping or pain. Often there is a history of sick contacts. Gastroenteritis can become quite serious, especially in infants and younger children, who are highly susceptible to dehydration and electrolyte disturbances.

Other common infectious causes in children must also be considered. These can include urinary tract infections, meningitis and sepsis. Note that **meningitis** and **pyelonephritis** classically present with vomiting and fever.

Neurological causes of vomiting relate to increased intracranial pressure and can include hydrocephalus, intracranial neoplasms, and pseudotumor cerebri in older children. The history should be suggestive of other symptoms of increased intracranial pressure, such as morning headaches, focal neurological deficits or changes in vision. Migraines can be another common cause for vomiting in older children.

Metabolic and **endocrine** causes include diabetic ketoacidosis (DKA) associated with type 1 diabetes mellitus, congenital adrenal hyperplasia (CAH) and inborn errors of metabolism (IEM). DKA is a cause that should not be overlooked as it can have life-threatening effects if missed. Typically, a child in DKA may also present with abdominal pain, changes in respiratory pattern, and confusion or lethargy.

Respiratory-related vomiting refers to post-tussive emesis, which is common in children with asthma, foreign body aspiration or respiratory infections following prolonged and forceful coughing episodes.

Intoxications such as accidental or intentional ingestions, as well as iron or lead poisoning can also cause vomiting in children. Certain **medications** like anticonvulsants, opiates and aspirin can also produce vomiting.

Less common categories of pediatric vomiting include **psychogenic** and **behavioral** causes, which includes overfeeding in infants and bulimia nervosa in adolescents. Pregnancy must also be considered in adolescents.

This concludes Part I of this podcast on pediatric vomiting. So far, we have reviewed the pathophysiology and differential diagnosis, including both GI and non-GI causes.

Check out the supplemental materials to this podcast to view a chart displaying the common causes of pediatric vomiting, grouped according to age of presentation.

Continue on to Part II to learn about the clinical approach to vomiting - including history taking, physical exam and investigations, and to hear the conclusion to the case we presented at the start of the podcast.

Thank you for listening!

Approach to Pediatric Vomiting (Part 2)

Welcome back everyone. This is the part II of the podcast on pediatric vomiting.

My name is Erin Boschee and I'm a medical student at the University of Alberta. This podcast was reviewed by Dr. Melanie Lewis, a General Pediatrician and Associate Professor at the University of Alberta and Stollery Children's Hospital in Edmonton, Alberta, Canada.

Now that we know about the common causes of vomiting specific to the neonatal and pediatric population, let's discuss a clinical approach to the assessment of a child with vomiting.

History

A complete vomiting history will thoroughly investigate the history of presenting illness. As with many standard complaints, the onset, frequency, time frame, provoking and alleviating factors should be explored. The vomit should be characterized in detail including the amount, color, and consistency.

First, it should be categorized as **bilious** or **non-bilious**. Bilious vomit has a greenish appearance due to the presence of bile and is indicative of obstruction distal to the

ampulla of Vater, the opening of the common bile duct into the duodenum. Thus, determining whether vomit is bilious or non-bilious helps to localize GI problems within the GI tract.

Second, it should be categorized as **bloody** or **non-bloody**. Blood in the vomit indicates inflammation or damage to the GI mucosa and may indicate need for endoscopy to rule out acute upper GI bleed.

Third, the vomit should be identified as **projectile** or **non-projectile**, as projectile vomiting may point to a specific diagnosis – namely, pyloric stenosis. True expulsive vomiting should be distinguished from regurgitation, which is not associated with retching or prodromal features like nausea, sweating and tachycardia.

Fourth, the **age of presentation** should be considered. The most common causes of vomiting in the neonatal period include gastroenteritis, malrotation, pyloric stenosis, TEF and necrotizing enterocolitis. In infancy, common causes are GERD, gastroenteritis, bowel obstruction, milk protein allergy and UTI. In children, one must think of gastroenteritis, UTI, DKA, post-tussive vomiting and increased intracranial pressure. In adolescents, consider gastroenteritis, appendicitis, DKA and increased intracranial pressure on the differential.

Fifth, one should determine whether the child is **febrile** or **afebrile**. The presence of fever increases the likelihood of an infectious etiology.

One should also ask about the presence of any associated GI symptoms, including nausea, abdominal pain, distension, diarrhea, and obstipation. Infectious symptoms should be elicited, including fever, dysuria, ear pain, cough, coryza, shortness of breath and meningismus. Other important associated symptoms to ask about are headache, changes in vision, polyuria, polydipsia and weight loss, to rule out increased intracranial pressure or DKA.

Red flag symptoms that you do not want to miss include meningismus, costovertebral tenderness, abdominal pain and any evidence of increased intracranial pressure. Do not miss a child who is vomiting due to a life-threatening condition such as meningitis, DKA or pyelonephritis.

Finally, it is very important to elucidate the child's **hydration status**, so one should always ask about oral intake, urine output, tear production and weight changes.

Physical Exam

As with any physical exam, begin with an assessment of the patient's **vital signs** and ask yourself, is this child well or unwell? The initial management and investigations of a stable versus unstable child can be quite different.

The physical exam should then begin with an assessment of **hydration status**. The examiner should assess the fontanelles, skin turgor, mucous membranes, and look for objective measures of stool and urine output.

A thorough **abdominal exam** should be performed looking for abdominal distension, masses or visible peristalsis on inspection. Auscultation should be done to look for hyperactive or absent bowel sounds. Palpation should assess for tenderness, though this is difficult to assess in infants and younger children, and feel for masses or organomegaly. In older children, special tests to assess for appendicitis or cholecystitis can be performed.

A **neurological exam** should also be done to rule out signs of increased intracranial pressure. This should include assessment for papilledema, bulging fontanelles and the presence of focal neurological signs. A full neurological examination should be done including the cranial nerves, focusing especially on cranial nerve VI, which is typically the first affected to due its long intracranial course.

Examination for **evidence of infection** is also important and should include inspection of the tympanic membranes and pharynx, auscultation of the chest and assessment for meningismus.

Lastly, particularly in neonates and infants, the presence of dysmorphic features, ambiguous genitalia or unusual odours should be noted as they may point to an underlying congenital or metabolic cause.

Investigations

Investigations should be based on the history and age of the patient. For instance, a three-month old with vomiting, fever and lethargy is at a high risk of sepsis, so this child should receive a **full septic work-up** including blood cultures, urine cultures and a lumbar puncture. An older child with a history clearly suggestive of gastroenteritis who does not appear unwell will likely not require any investigations.

Standard investigations might begin with a CBC with differential, electrolytes, creatinine, urea, glucose, liver function tests, and urinalysis with culture and sensitivities to rule out systemic infectious or common endocrine causes. In the presence of bloody diarrhea or history of recent travel, stools should be sent for culture and sensitivity.

Abdominal imaging can be very useful to identify the cause of GI-associated vomiting. An abdominal flat plate can assess for bowel obstruction through the presence of air fluid levels and bowel distension. A CT scan of the abdomen or upper GI series with contrast can be used to further identify the location of the obstruction or anatomical abnormality. Abdominal ultrasound is the modality of choice to assess for suspected pyloric stenosis.

Gastroscopy should be performed in the presence of hematemesis to rule out upper GI bleeding. A **CT head** should be ordered if the clinical history and physical exam is suspicious for increased intracranial pressure.

Further investigations may be required based on the clinical history and presentation.

Treatment

Treatment of pediatric vomiting depends on correction of the underlying cause. The treatment for specific etiologies of vomiting is beyond the scope of this podcast. Symptomatic relief for gastroenteritis can be achieved through the use of anti-emetic agents such as ondansetron (Zofran) in infants and children 6 months of age and older.

All children with vomiting should be assessed and treated for dehydration and electrolyte disturbances. Mild dehydration can be treated with encouragement of oral fluids, such as Pedialyte. Moderate to severe dehydration should be treated with IV fluids.

Case Example – Resolution

Let's think back to the case example presented at the start of the podcast. The patient was a 3-week old male infant with a one-week history of recurrent vomiting associated with feeds.

You ask the mother to describe the vomiting episodes in more detail and clarify that the vomiting is non-bilious, non-bloody and projectile. He has become more lethargic over the past three days and, at the same time, the mother noticed that she had only changed his diaper once or twice per day.

You examine the baby and see that he is pale and severely dehydrated. You check the CBC, electrolytes, Cr and BUN ordered in the ER, which shows a hypochloremic hypokalemic metabolic alkalosis. You order the nurses to start an IV and begin infusing IV fluids to re-hydrate and correct his electrolyte abnormalities.

You present a summary of your history and findings to your staff, stating that this is a 3-week old infant with new-onset projectile, non-bilious vomiting. Together, you decide to order an abdominal ultrasound, which confirms a hypertrophied pyloric muscle consistent with pyloric stenosis. You consult Pediatric General Surgery for surgical correction.

Summary

Here are a few key points about pediatric vomiting to take away from this podcast:

- 1) The history can be very helpful to differentiate the cause of vomiting. Use descriptors such as **bilious, projectile, and bloody** to help rule out serious or

specific causes. Consider the **age of the patient** to narrow the differential diagnosis. And always remember to rule out **red flag symptoms** like meningismus, CVA tenderness and signs of increased intracranial pressure that point to a life-threatening cause.

- 2) The differential diagnosis for vomiting is extremely broad and does not include only GI causes. Don't forget to consider non-GI causes like increased intracranial pressure, pyelonephritis, drugs, and DKA.
- 3) **Dehydration** is one of the most common complications of vomiting in children. Don't forget to assess hydration status in your history and physical exam, and to consider this as an important aspect of your treatment plan.

That concludes this series of podcasts. Hopefully now you feel comfortable forming a broad differential diagnosis and a basic approach to a child who is vomiting.

I want to thank Dr. Melanie Lewis for editing the podcasts and thank you for listening!

References

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Supplemental Information

Table 1: Common causes of pediatric vomiting by age of presentation.

Neonatal (0-2 days)	Newborn (3 days-1 month)	Infant (1-36 months)	Child (36 months-12 years)	Adolescent (12-18 years)
-Duodenal atresia -TEF (types A/C)	-Gastroenteritis -Pyloric stenosis -Malrotation +/- volvulus -TEF (types B/D/H) -Necrotizing enterocolitis -Milk protein intolerance -CAH -IEM	-Gastroenteritis -UTI, pyelonephritis -GER -GERD -Ingestion -Intussusception -Milk protein intolerance	-Gastroenteritis -UTI -DKA -Increased intracranial pressure -Eosinophilic esophagitis -Appendicitis -Ingestion -Post-tussive vomiting	-Gastroenteritis -Appendicitis -DKA -Increased intracranial pressure -Eosinophilic esophagitis -Bulimia nervosa -Pregnancy -Post-tussive vomiting

Reference: Di Lorenzo, C. Approach to the infant or child with nausea and vomiting. From UpToDate 2013. Accessed online 28 Aug 2013.

Abbreviations:

- TEF = tracheo-esophageal fistula
- CAH = congenital adrenal hyperplasia
- IEM = inborn errors of metabolism
- UTI = urinary tract infection
- GER = gastro-esophageal reflux
- GERD = gastro-esophageal reflux disease
- DKA = diabetic ketoacidosis