Pediatric Vomiting and Diarrhea — Causes and Therapy

Pediatric gastrointestinal disturbances are common, often simple to manage and yet, unfortunately, life-threatening in some instances. Sometimes, seemingly innocuous vomiting can be a harbinger of a serious underlying disease. This article expounds on various pathophysiological aspects of pediatric vomiting and diarrhea and expatiates on the rapid aggressive treatment of accompanying dehydration.

Pediatric Vomiting

Vomiting is a symptom rather than a diagnosis. It can be secondary to gastrointestinal causes or rarely secondary to distant organ system such as vomiting secondary to increased intracranial pressure. The whole symptom constellation with associated complaints and examination findings aided by a meticulous history is often crucial in the correct interpretation of vomiting and its subsequent treatment.

Various etiologies leading to vomiting can be segregated as per age of the child:

<table>
<thead>
<tr>
<th>Age</th>
<th>Possible cause</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

See online here
Infants | To be distinguished from regurgitation – spontaneous expulsion of gastric contents. Possible differentials for vomiting comprise of gastroenteritis, GERD, food allergy, milk protein intolerance, overfeeding, an inborn error of metabolism.

Neonates | GI obstruction related to congenital malformation, sepsis, sinusitis and otitis media.

Children, adolescents | Gastroenteritis, systemic infections, toxic ingestions, appendicitis, ulcers, pancreatitis, migraine, medications, pregnancy, Intracranial pathology, otitis media.

Another way of classifying vomiting is according to the responsible system; the same is tabulated below:

<table>
<thead>
<tr>
<th>System</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolic</td>
<td>Inborn errors of metabolism, urea cycle disorders</td>
</tr>
<tr>
<td>Intoxication</td>
<td>Medication, aspirin</td>
</tr>
<tr>
<td>Endocrine</td>
<td>DKA, Addisonian crisis</td>
</tr>
<tr>
<td>Sepsis</td>
<td>Pneumonia, otitis media, meningitis, UTI</td>
</tr>
<tr>
<td>Intracranial disease</td>
<td>Brain tumors, hydrocephalus, raised intracranial pressure</td>
</tr>
<tr>
<td>Gastro-intestinal</td>
<td>Infection: appendicitis, hepatitis, pancreatitis, gastroenteritis</td>
</tr>
<tr>
<td></td>
<td>Motility disorders: pyloric stenosis, achalasia</td>
</tr>
<tr>
<td></td>
<td>Inflammation: GERD, duodenal ulcers, food allergy</td>
</tr>
<tr>
<td></td>
<td>Anatomical obstruction: intestinal malrotation, volvulus, intussusception, obstructed a hernia</td>
</tr>
</tbody>
</table>

Etio-pathogenesis

Vomiting is a **vagal mediated reflex** and actually a protective mechanism. It is mediated by peripheral receptors and central controlling units. The central processing units are situated in the medulla near the obex of the fourth ventricle.

Vomiting is composed of nausea, retching and conscious expulsion of gastrointestinal contents. It is a culmination of synchronized contraction of intercostals muscles, diaphragm and abdominal muscles with the sequential relaxation of the esophageal sphincter.

Diagnosis of Pediatric Vomiting

Vomiting is a symptom and a potential harbinger of an underlying serious disorder.

Extensive **history taking**, followed by a **relevant clinical examination**, can often narrow down the system involved.

Salient points to be essentially covered in history are:

- Demographic details of the patient: age, sex, place of residence (important in cases of epidemics and food poisoning)
- Onset/duration/progress of complaints
- Association of food intake
- Any other associated complaints: fever, earache, headache, abdominal pain, dysphagia
- Review of systems, past medical and surgical history, drug intake, drug allergy, social and nutritional history
- Nature of the vomitus (projectile/non-projectile), color, contents, painful/painless
Color and content of vomitus are often of crucial significance. A rough estimate of the level of obstruction can be discerned based on these findings alone as follows:

<table>
<thead>
<tr>
<th>Nature of vomitus</th>
<th>Approximate level of obstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-bilious acidic vomitus</td>
<td>Distal to stomach, proximal to duodenum</td>
</tr>
<tr>
<td>Bilious vomiting</td>
<td>Distal to 2nd part of duodenum</td>
</tr>
<tr>
<td>Feculent vomitus</td>
<td>Obstruction in the large bowel</td>
</tr>
<tr>
<td>Non-digested food content</td>
<td>Proximal obstruction</td>
</tr>
</tbody>
</table>

History should aid in performing localized relevant examination.

It is of paramount importance to assess hydration status in every pediatric patient with vomiting. The red-flag signs of dehydration should usher emergent, rapid, aggressive fluid management. These are documented as follows:

- Reduced skin turgor
- Sunken eyes, often tearless
- Dry mucous membranes
- Sunken fontanelle
- Tachycardia, tachypnea
- Prolonged capillary refill time

Investigations

The list of differentials formed at the end of clinical assessment help guide the investigations to be performed. Some frequent investigations and their relevance are:

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete blood count</td>
<td>To look for leucocytosis in case of infections</td>
</tr>
<tr>
<td>Serum creatinine and electrolytes</td>
<td>Assess hydration, potential electrolyte imbalance after vomiting, renal function</td>
</tr>
<tr>
<td>Blood glucose level</td>
<td>In DKA</td>
</tr>
<tr>
<td>Blood gases</td>
<td>In inborn errors of metabolism,</td>
</tr>
<tr>
<td>Imaging</td>
<td>Abdominal imaging: X-ray, ultrasonography, CT abdomen with pelvis, endoscopy as per the etiology Brain imaging: if intracranial etiology is suspected.</td>
</tr>
</tbody>
</table>

Treatment of Pediatric Vomiting

Once the cause is identified, there are two phases of management of vomiting – namely to resuscitate and stabilize the patient in an emergent manner with subsequent treatment of the inciting factor.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess hydration status</td>
<td>Hydration is the most important step in the resuscitation of a pediatric patient. Well-established protocols are available based on age, the weight of the patient and customized therapy can be initiated. Regular monitoring is a must. While oral intake is desirable, one should use intravenous resuscitation when deemed necessary.</td>
</tr>
<tr>
<td>Check for electrolyte imbalance</td>
<td>Vomiting is associated with an electrolyte imbalance which can occasionally turn symptomatic. A careful assessment of a patient’s hydration and electrolytes with the simultaneous management of the same is the key.</td>
</tr>
<tr>
<td>Treat underlying etiology</td>
<td>Definitive treatment of the underlying condition is the ultimate treatment.</td>
</tr>
</tbody>
</table>
Pediatric Diarrhea

The normal frequency of bowel movement is about thrice daily up to alternate daily. Excess of **daily stool volume of more than 10 ml/kg/body weight per day** is an objective definition of diarrhea.

The working definition involves liquid consistency, increased frequency and increased volume of stools. Twice the normal frequency of motions for an infant and more than three liquid stools per day in older children is considered abnormal.

These definitions are rather to be used precariously, always taking into account the age, diet, and weight of the child.

The presence of certain substances in stools is never normal and should initiate appropriate workup and subsequent management. These are:

- Mucus
- Fresh blood - red
- Altered blood - black
- Foul smell
- Runny, watery stools

Certain subsets of the pediatric population are more prone to develop diarrhea. The relevant significant ones are:

- Lack of breastfeeding
- Malnutrition
- Measles
- Attendance to childcare centers
- Exposure to unhygienic circumstances
- Poor maternal education
- Immunodeficient individuals

Classification

Pediatric diarrhea can be classified as variously as follows:

**Based on temporal relation:**

- Acute: for less than 14 days
- Chronic/persistent: for more than 14 days

**Based on mechanism:**

- Osmotic: stool volume depends on diet and decreases with fasting
- Secretary: stool volume is increased and does not vary with diet
- Motility disturbance: often diagnosed in older children
- Mucosal inflammation: secondary to invasive bacteria and inflammatory bowel disease
- Mixed secretary-osmotic: seen in infections like Rotavirus

**Based on clinical features:**

- Acute watery diarrhea:
  - Most common, usually self-limiting. The most crucial concern is the maintenance of hydration status.
- Rota-virus, Vibro cholerae
  - Acute bloody diarrhea:
    - Also known as dysentery; the culmination of intestinal mucosal erosion by invasive species. The most significant complications are sepsis, HUS (Hemolytic Uremic Syndrome), malnutrition and dehydration.
  - Entamoeba histolytica, Shigella species.

Based on etiology:
- Infectious: secondary to infection
- Mal-absorptive: increased stool output with an excess of fluid and electrolytes

Infectious Diarrhea

Viral infectious diarrhea is the most prevalent pediatric diarrhea. Pyogenic follows next in line. The key to diagnosis is to recover the organism in stools. **Enzyme immunoassay** is helpful in some cases.

A short summary of infectious diarrhea is presented below:

<table>
<thead>
<tr>
<th>Infectious agent</th>
<th>Diarrhea-key points</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Viral etiology</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotavirus</td>
<td>Most common viral diarrhea; prevalent during winter. Most common cause of watery diarrhea; lasts for 7-10 days. It may be associated with vomiting.</td>
<td>Symptomatic management; maintain hydration</td>
</tr>
<tr>
<td>Norwalk virus</td>
<td>Prevalent in cruise ships</td>
<td>Symptomatic management; maintain hydration</td>
</tr>
<tr>
<td><strong>Bacterial etiology</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. coli</td>
<td>Enteropathogenic E.coli is responsible for breakouts in nurseries and daycare.</td>
<td></td>
</tr>
<tr>
<td>Salmonella</td>
<td>Salmonella reaches pediatric population through eggs, milk, poultry, and reptiles.</td>
<td>Antibiotics indicated only for age &lt; 3 months, toxic state and disseminated disease. Trimethoprim/sulfamethoxazole is typically used, but it prolongs carrier state.</td>
</tr>
<tr>
<td>Shigella</td>
<td>Transmitted through contaminated food; Shigella can cause seizures.</td>
<td>Trimethoprim/sulfamethoxazole is the first choice.</td>
</tr>
<tr>
<td>Campylobacter</td>
<td>Transmitted by contaminated food.</td>
<td>Antibiotics for severe disease, erythromycin is the drug of choice.</td>
</tr>
<tr>
<td>Yersinia</td>
<td>Transmitted by pets, contaminated food, may be associated with arthritis and rash (often confused with Inflammatory Bowel Disease, pseudo-appendicitis)</td>
<td>Antibiotics for &lt; 3 months of age and septicemia. Aminoglycosides or third-generation cephalosporins are recommended.</td>
</tr>
<tr>
<td>S. aureus</td>
<td>Onset within 12 hours of ingestion, toxin-mediated.</td>
<td>Penicillin and third-generation Cephalosporin work; for resistant species; Vancomycin is advocated.</td>
</tr>
</tbody>
</table>
**Diagnosis of Pediatric Diarrhea**

Diarrhea is deceptive and not always innocuous and benign in nature. Constant vigilance and prevention of dehydration is a must. Correct, timely diagnosis is the key.

The diagnostic strategy begins with expert **history taking** and performing a relevant clinical examination.

The relevant key points to be focused upon in history are as follows:

- Demographics of the child
- Onset, duration, progress of diarrhea
- Nature, content, color, smell, consistency, frequency of stools
- Presence of blood, worms, mucus, foreign body in the stools
- Associated complaints: fever, abdominal pain, earache, history of measles, vaccination, convulsions
- Treatment history

The relevant physical examination can then be carried out in the right perspective as suggested by a focused history is very helpful. The **assessment of hydration status** forms the heart of a physical examination in pediatric diarrhea.

In children, the signs and symptoms of dehydration are not always loud and clear. A simplified grading of dehydration status based on clinical acumen is as follows:

<table>
<thead>
<tr>
<th>Degree of dehydration</th>
<th>Clinical feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 3% loss of body weight (NO DEHYDRATION)</td>
<td>Eyes: Normal, Tongue: Moist, Skinfold: Supple with instant recoil when pinched</td>
</tr>
<tr>
<td>3-9% loss of body weight (SOME DEHYDRATION)</td>
<td>Tears: Adequate, Tongue: Moist, Skinfold: Supple with instant recoil when pinched</td>
</tr>
<tr>
<td>More than 9% loss of body weight (SEVERE DEHYDRATION)</td>
<td>Eyes: Normal, Tongue: Moist, Skinfold: Supple with instant recoil when pinched</td>
</tr>
</tbody>
</table>

- Eyes: Normal, Mildly sunken, Deeply sunken
- Tears: Adequate, Decreased, Absent
- Tongue: Moist, Dry, Parch dry
- Skinfold: Supple with instant recoil when pinched, Recoil in less than 2 seconds, Recoil in more than 2 seconds
- Mental status: Normal, Normal or fatigues; may be restless and irritable, Lethargic, apathetic, drowsy or sometimes frankly unconscious
- Thirst: Normal, Thirsty and looks forward to fluids, Unable to drink
- Heart rate: Normal, Normal to increased, Increased; bradycardia may be encountered in severe cases
- Extremities: Warm, Cold, Cold, cyanotic and mottled
- Urine output: Adequate; or slightly decreased, Decreased, Grossly decreased
Capillary refill | Normal | Prolonged | Prolonged with little refill
--- | --- | --- | ---

Assessment and subsequent desired treatment of dehydration is the most significant life-saving act that medical personnel is expected to perform in the management of pediatric diarrhea.

### Investigations

**Ancillary tests** are often helpful in reaching the correct diagnosis, but they do not bring about a drastic change in the acute management of pediatric diarrhea. They are definitely relevant in the long run to know the exact etiology and rule out predisposing factors, if any.

These tests can be summarized as follows:

| Routine blood investigations | The complete blood count is adjunct to confirming infectious etiology. Renal function tests and electrolytes are helpful in the assessment of hydration status. |
| Stool microscopy and culture | The following points are noted:  
Presence of blood, ova, cysts or trophozoites  
Leucocyte count (more than 10 per HPF) is indicative of invasive diarrhea.  
For chronic diarrhea, stool cultures are obtained. |
| Imaging | Ultrasonography, endoscopy are mostly reserved for patients with chronic diarrhea. |
| Serum enzyme assays | Increasing a number of specific biochemical enzyme assays is available to accurately pinpoint the cause of diarrhea. |

### Treatment of Pediatric Diarrhea

It is worth reiterating that the acute management of diarrhea revolves around the emergent maintenance of **hydration** status. The long-term management consists of the determination of the cause, inciting factors and correction of the same to prevent a relapse.

The treatment strategy is summarized as follows:

| Acute fluid management | Rapid recognition of dehydration and treatment of the same is very important. Oral rehydration therapy is typically used. In infants and neonates, the continuation of breastfeeding is strongly recommended. |
| Zinc | Zinc is advocated by WHO, especially for children in developing countries as its deficiency is associated with impaired cellular and humeral immunity and dysregulated electrolyte balance. Zinc supplementation reduces morbidity associated with pediatric diarrhea. |
| Probiotics | Probiotics strengthen the mucosal immune response and consolidate the tight junctions between the enterocytes. Competitive inhibition of binding of pathogens to the bowel mucosa is often instrumental |
| Prevention | Hand washing post defecation and prior to the consumption of food can halve the burden of infectious diarrhea. |
| Drug therapy | Antibiotics are to be used only in very small children and in patients with systemic infliction. The use of drugs like anti-mobility and anti-secretory agents is rather condemned in a pediatric set-up. |
Summary

- Vomiting by itself is more of a symptom than a diagnosis. Meticulous history taking and a relevant physical exam with pertinent ancillary tests performed help in making the right diagnosis. Treatment follows accordingly.

- Pediatric diarrhea can be variously classified based on etiology, mechanism, and temporal relation.

- The key factor in the treatment of both pediatric vomiting and diarrhea is the maintenance of the hydration status.

- Long-term management consists of the evaluation of the inciting factor, treatment of the same and corrective steps taken to avoid relapses.

Review Questions

The correct answers can be found below the references.

1. Which of the following statements is false?

A. Otitis media can cause vomiting.
B. Meticulous history taking and the relevant physical exam is the key to making the correct diagnosis of vomiting.
C. Projectile non-bilious vomiting can be caused by pyloric stenosis.
D. Zinc is detrimental and should be avoided in children with diarrhea.

2. Which of the following infectious agent causes diarrhea with convulsions?

A. E.coli
B. Salmonella
C. Shigella
D. Yersinia

3. Which of the following signs indicate severe dehydration?

A. Deeply sunken eyes, minimal capillary refill
B. A thirsty child with a normal pulse rate
C. Vomiting child with easy skin recoil
D. Tachycardia with normal urine output

References


**Correct answers:** 1D, 2C, 3A

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