Chapter 19

Infants and Toddlers

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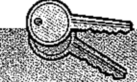


KEY POINTS

- Intussusception, trauma, and ingestion should be considered when the etiology of persistent vomiting is unclear. Vomiting does not always imply infectious gastroenteritis.
- Bilious emesis or peritonitis in small children requires emergency surgical consultation.
- Oral rehydration therapy is indicated for mild to moderate dehydration due to gastroenteritis.
- Young children have less respiratory reserve and progress to respiratory distress and failure more rapidly than older children or adults.
- Hypoxemia and hypoventilation may result in cardiopulmonary arrest in infants and toddlers.
- The cough reflex can be induced by stimulation of pulmonary or extrapulmonary chemical receptors.
- Physical abuse is the leading cause of serious head injury in young children.
- When the cause of altered mental status is not obvious, the EP should maintain a high level of suspicion for abuse, accidental toxin ingestion or exposure, intussusception, infection, and nonconvulsive seizure activity.

Vomiting

■ SCOPE

Vomiting in children is usually caused by a self-limiting condition but may be the result of a severe, life-threatening illness. A systematic approach based on age-specific considerations is critical to the appropriate diagnosis and treatment of infants and toddlers who are presented with vomiting. The EP should consider an expanded differential diagnosis in a child who comes to the ED with vomiting but no diarrheal illness.

■ EPIDEMIOLOGY

Episodes of acute gastroenteritis in children younger than 5 years lead to 2 to 3 million physician visits annually.[1] The majority of these children have uneventful clinical courses.

■ PATHOPHYSIOLOGY

Vomiting, the forceful expulsion of gastric contents through the mouth, is coordinated by the vomiting center in the reticular formation of the medulla. This

Documentation

INFANT OR TODDLER IN THE ED

Document consideration of life-threatening diagnoses.

Create a word picture of the child: minor or serious illness; for example:

"Child is playful, interactive, and taking bottle or fluids well."

"Well-hydrated, non-toxic, and no evidence of trauma, sepsis, meningitis, or distress."

"Alert, good tone, moving all extremities."

"Appropriately cries but can be consoled by caregivers."

vomiting center integrates and responds to afferent pathways from higher cortical centers in the brain and visceral afferents from receptors in the gastrointestinal tract and other organs. Specifically, the chemoreceptor trigger zone in the floor of the fourth ventricle monitors chemical abnormalities in the blood and cerebrospinal fluid. Drugs such as chemotherapeutic agents and metabolic aberrations (e.g., uremia, diabetic ketoacidosis) act at the level of the chemoreceptor trigger zone. A basic understanding of these major pathways is essential for developing diagnostic and treatment strategies for infants and toddlers with vomiting.

■ CLINICAL PRESENTATION

A review of the expansive list of potential causes of vomiting emphasizes the importance of developing an organized approach to achieve an accurate diagnosis. The EP should first elicit an AMPLIFIEDD history (Box 19-1) and perform a thorough "head-to-toe" physical examination focusing on the age of the infant or toddler. Associated evidence of bowel obstruction or peritonitis and signs or symptoms suggestive of extraintestinal disease should be sought. Hydration status (Box 19-2) should be assessed, and a risk of future dehydration established through quantification of the frequency and amount of vomitus and diarrhea, if present. At the onset of the clinical encounter, the EP should clarify whether child has had bilious or nonbilious vomiting. Bilious emesis in infants should be attributed to intestinal obstruction unless proven otherwise and requires immediate surgical consultation.[2] Bilious vomiting due to malrotation with volvulus, leading to bowel ischemia, is associated with high rates of morbidity and mortality.

The child should be assessed for abnormal behavior and appearance, such as a decrease in activity or level of consciousness, which might indicate more serious illness. Vital signs should be reviewed for clues of systemic disease. A bulging fontanel suggests increased intracranial pressure due to meningitis, trauma, or intracranial mass or bleeding. Retinal hemorrhages or scleral icterus, suggestive of nonaccidental trauma or hepatobiliary disease, respectively, should be sought. An unusual odor may be the first clue of an inborn error of metabolism. Marked abdominal distention, peristaltic waves, increased bowel sounds, palpable masses, bloody stools, and guarding all point to an intra-abdominal disorder. The child should be undressed and examined to exclude torsion of the testis and the ambiguous genitalia associated with congenital adrenal hyperplasia. The skin should be examined for rashes that raise suspicion for an infectious etiology or even sepsis. The child should be evaluated for unusual contusions or musculoskeletal injury that may evidence trauma.

■ DIFFERENTIAL DIAGNOSIS

The list of potential causes of vomiting in infants is extensive but can be conveniently organized according to age-related categories (Table 19-1). Young infants, from birth to the first few months of life, commonly experience reflux exacerbated by overfeeding. However, many other serious medical conditions may initially manifest as vomiting, including infectious causes such as sepsis, meningitis, urinary tract infections, and hepatitis. These conditions must be differentiated from urgent and emergency surgical conditions such as pyloric stenosis, incarcerated hernia, intussusception, and malrotation with volvulus. Older infants and children experience some of the same diseases, although intussusception is the most common cause of intestinal obstruction among those 3 months to 5 years old, whereas appendicitis is the most common condition requiring surgical intervention.[3,4]

■ DIAGNOSTIC TESTING

The large numbers of potential causes of vomiting make routine laboratory and radiographic evaluation impractical. History and physical finding should direct the choice of testing for each patient. For most common conditions causing vomiting, laboratory testing is not indicated. A bedside finger-stick (or heel-stick) glucose measurement should be performed in any child with an alteration in mental status. Serum electrolytes should be measured in children with dehydration requiring intravenous rehydration. A serum bicarbonate level lower than 17 mEq/L appears to be the most useful laboratory value for predicting the likelihood of 5% dehydration.[5,6] Electrolyte abnormalities are associated with pyloric stenosis as well as metabolic and renal diseases. An elevated white blood cell count is associated with bacterial infections and sepsis but lacks sensitivity and specificity. Cerebrospinal fluid analysis should be performed if there is suspicion of meningitis or encephalitis. Drug screening may be necessary to

BOX 19-1
The "AMPLIFIEDD" History for an Infant or Toddler with Vomiting

Allergies: to medications or foods (protein intolerance to cow milk, soy, gluten)

Medications: prescription, over-the-counter, or "natural remedies"

Past medical history:

- Chronic or previous illness: metabolic or endocrinopathy, recent unresolved illness
- Prior surgery, suggesting abdominal adhesions, shunt infection, or obstruction
- Newborn screen: identify abnormalities
- Appropriate developmental milestones?

Last "feed, pee, poop, sleep":

- Feed: diet, amount, and frequency; correct formula preparation; recent changes; types of solids
- Pee and poop: urine output and characterization of stooling pattern (diarrhea, blood, mucus)
- Sleep pattern: waking with intermittent episodes of pain (intussusception)

Immediate events (history of the present illness and review of systems)—OLD CAARS:

- *O*nset of vomiting
- *L*ocation of pain (e.g., abdomen or head)
- *D*uration and frequency of vomiting: estimate ongoing volume loss by quantifying number and quantity of vomiting or diarrheal episodes
- *C*haracterize the emesis:
  - Contents: undigested gastric contents (reflux), bilious (postampullary obstruction), feculent (colonic obstruction), blood or "coffee ground" (gastritis, ulcer, Mallory Weiss tear)
  - Force of vomiting: Projectile (pyloric stenosis), non-projectile (reflux, postfeed regurgitation)
- *A*ggravating factors: What factors exacerbate the vomiting (early morning: central nervous system mass; feeding: food allergen, after ingestion of toxin)?
- *A*lleviating factors: What factors relieve the vomiting (keeping child in upright position: reflux)?
- *R*ecurrent: similar episodes suggestive of recurring disorders (pyloric stenosis, cyclical vomiting, inborn error of metabolism, malrotation with intermittent volvulus)
- *S*ystem review: inquire about fever, trauma, neurologic symptoms (headache, vertigo, visual symptoms), diarrhea (infectious gastroenteritis), ingestion of toxins

Family/social history:

- Infectious contacts, travel
- Characterize caretaker-infant interactions: identify risk for child abuse

Immunizations: up to date?

EMT history: elicit history from emergency medical personnel for potential trauma, ingestion, abuse, or toxin exposure

Doctor: name of primary care physician or specialist to contact for additional information and help

Documents: obtain prior medical records

BOX 19-2
Key Objective Physical Findings for Assessing Dehydration

Presence of two findings indicates >5% dehydration; presence of three or more findings indicates >10% dehydration:

- Capillary refill time >2 seconds
- Dry mucous membranes
- Absence of tears
- Abnormally lethargic or listless appearance

Adapted from Gorelick M, Shaw K, Murphy K: Validity and reliability of clinical signs in the diagnosis of dehydration in children. Pediatrics 1997;99:e6.

confirm an ingestion. Urinalysis, liver function test, and serum lipase and ammonia measurements should be considered when the differential diagnosis is broadened.

Diagnostic imaging is also dictated by clinical findings. Computed tomography (CT) of the head should be performed to evaluate for closed-head injury, intracranial tumor, or hydrocephalus. Plain radiographs may be used to assess for bowel obstruction. An upper gastrointestinal (GI) series is the preferred radiographic modality for diagnosing malrotation with volvulus.[7] Diagnostic ultrasonography is the modality of choice for diagnosing pyloric stenosis and intussusception.[8] Ultrasonography and abdominal CT are used to investigate potential appendicitis when the diagnosis is in question. In children with equivocal findings for appendicitis,

Table 19-1 DIFFERENTIAL DIAGNOSIS OF CAUSES OF VOMITING IN INFANTS AND CHILDREN USING THE "HEAD-TO-TOE" MEMORY TOOL

	Infants	Toddlers
Head	Meningitis/encephalitis Central nervous system (CNS) mass Head injury Hydrocephalus (i.e., shunt malfunction) Otitis media Oral ingestion (overdose) "Spitting up"	Meningitis/encephalitis CNS mass Head injury Hydrocephalus Otitis media Oral ingestion (overdose) Cyclic vomiting Psychogenic
Chest	Post-tussive emesis due to reactive airways Respiratory infection (pneumonia)	Posttussive emesis due to reactive airways Respiratory infection (pneumonia)
Abdomen Gastrointestinal tract	Gastroesophageal reflux disease Gastroenteritis Nutrient intolerance Rumination Obstruction: Pyloric stenosis Intussusception Malrotation Incarcerated hernia Hirschsprung's disease Peritonitis	Peptic ulcer disease Gastroenteritis Obstruction: Intussusception Malrotation Incarcerated hernia Hirschsprung's disease Appendicitis Meckel's diverticulum Peritonitis
Adrenal glands	Congenital adrenal hyperplasia	Adrenal Insufficiency
Renal system	Uremia Obstruction Urinary tract infection or pyelonephritis Renal insufficiency	Uremia Obstruction Urinary tract infection or pyelonephritis Renal insufficiency
Liver	Hepatitis Inborn errors of metabolism	Hepatitis Inborn errors of metabolism
Pancreas	Diabetic ketoacidosis Pancreatitis	Diabetic ketoacidosis Pancreatitis
Other	Sepsis	Sepsis

ultrasonography using the graded-compression technique should be performed, followed by focused abdominal CT if ultrasonographic findings are normal.[9] Similarly, implement protocols for appropriate use of ultrasonography and CT for evaluation of intra-abdominal pathology such as trauma, intra-abdominal mass, or nephrolithiasis.

■ TREATMENT

Initial management of the vomiting infant or toddler should focus on stabilization if signs and symptoms are consistent with shock. Persistent vomiting, severe dehydration, and electrolyte abnormalities necessitate treatment in parallel with other diagnostic testing. Rehydration is accomplished with intravenous 20-mL/kg boluses of isotonic saline that are repeated as indicated. Treatment should be directed toward the underlying cause.

A surgeon should be consulted immediately for infants presenting with bilious vomiting. Malrotation with volvulus is a surgical emergency requiring rapid response to prevent infarction of the bowel. Timely surgical consultation is also the standard of care for other conditions, such as peritonitis, incarcerated hernia, and pyloric stenosis. In selected cases the radiologist may be able to successfully reduce the intussuscepted bowel with an air or contrast enema, although surgical "backup" is required in case such treatment fails or complications occur. Children with ileus or bowel obstruction should undergo decompression with nasogastric suctioning.

Most infants and children with vomiting do well with oral rehydration alone. Administration of an antiemetic may serve as a successful adjunct to suppress vomiting and allow for oral rehydration. Intravenous and oral ondansetron (a selective [5-HT_3] receptor antagonist) have been successfully used in the ED in infants and children with gastroenteritis.[10,11]

Oral rehydration therapy (ORT) should be administered in children with mild to moderate dehydration due to gastroenteritis (Box 19-3).[12] A meta-analysis of randomized control trials involving 1545 children younger than 15 in 11 countries compared ORT with intravenous hydration. This study concluded that enteral rehydration by the oral or nasogastric route is as effective as if not better than intravenous rehydration.[13]

BOX 19-3
Oral Rehydration Therapy

Rehydration Phase

1. Replace fluid deficit over 4 hours using rehydrating solution (Rehydralyte, Pedialyte).
2. Administer oral rehydration solution (ORS) in frequent, small amounts: no more than 5 mL every 1 to 2 minutes using syringe, spoon, cup, or nasogastric tube. Goal: 50 mL/kg in mild dehydration, 100 mL/kg in moderate dehydration.
3. Replace ongoing losses from diarrhea (10 mL/kg/watery stool) and vomiting (2 mL/kg/episode of emesis) with ORS.
4. Avoid giving nonphysiologic foods like sports drinks, juices, tea, and colas during this phase.

Maintenance Phase

Begin realimentation with goal to return to unrestricted age-appropriate diet.

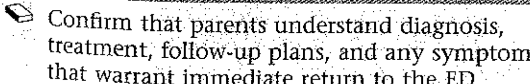
Data from Practice parameter: The management of acute gastroenteritis in young children. American Academy of Pediatrics, Provisional Committee on Quality Improvement, Subcommittee on Acute Gastroenteritis. Pediatrics 1996;97:428-429.

■ DISPOSITION

The infant or toddler with a self-limiting condition and no evidence of systemic illness or dehydration can be discharged. The parents or caregiver should be given clear plans for follow-up and instructions for outpatient oral rehydration as indicated. The EP should confirm that the caretaker understands that he or she should return the child to the ED if there is any progression of illness.

Infants or children with persistent vomiting, abnormal electrolyte values, or a more complex diagnosis requiring further medical or surgical management should be admitted. The EP should communicate a concise summary of diagnostic and therapeutic interventions and any ongoing concerns to consultants prior to transferring the patient to their care.

PARENT TEACHING TIPS
INFANT OR TODDLER IN THE ED



- Confirm that parents understand diagnosis, treatment, follow-up plans, and any symptoms that warrant immediate return to the ED.
- Reinforce that parents are always welcome to return to the ED with any concern.

Cough

■ SCOPE

Cough is usually a symptom of minor respiratory infection in infants and toddlers, although it may also appear in more serious illnesses, which must be recognized early and appropriately treated. Respiratory difficulties in this age group can rapidly progress to respiratory failure, the most common cause of cardiopulmonary arrest in children. Young children have higher metabolic demands and less respiratory reserve than older children or adults and so progress to distress and even failure more rapidly when hypoxia or hypoventilation occurs.

■ EPIDEMIOLOGY

Young children with respiratory symptoms are commonly presented to the ED. Respiratory infections encompass a wide variety of conditions that lack definitive end-point criteria by which to facilitate disease surveillance. A syndromic surveillance study of 39 EDs in New York City showed that, of all children presenting for evaluation and treatment, 5.8% were diagnosed with viral "colds," 13.3% with other respiratory illnesses, and 4.9% with asthma.[14]

Aspiration can also induce cough, leading to respiratory compromise. Foreign body obstruction after aspiration or ingestion with external compression of the upper airway can be immediately life-threatening. The most common products aspirated by young children are food products such as peanuts, nuts, candy, and hot dogs.[15]

■ PATHOPHYSIOLOGY

A cough is produced by a complex reflex arc that facilitates the clearance of secretions and inhaled particles that are irritating to the respiratory tract. The cough reflex may also be initiated by a variety of extrapulmonary disorders through stimulation of receptors in the esophagus, stomach, diaphragm, pericardium, or external ear. Therefore, the causes of cough encompass a broad differential diagnosis consisting of respiratory and nonrespiratory problems.

The upper airways of young children are narrow and more susceptible than the adult's to obstruction from excessive secretions, localized edema, foreign bodies, external compression, or mechanical constriction. The chest wall is more compliant in the young child than in older children or adults, making the diaphragm less effective (a reason for paradoxic breathing or "see-saw respirations").

■ CLINICAL PRESENTATION

Cough can be classified as either an acute or chronic symptom. The most common and most life-threatening coughs manifest an acute onset.

An AMPLIFIEDD history should be obtained to gather the essential data for reaching an accurate

BOX 19-4

The AMPLIFIEDD History for an Infant or Toddler with Cough

Allergies to medications, food, or environmental allergens

Medications: prescription, over-the-counter, or "natural remedies"

Past medical history:
- Birth history suggestive of prematurity
- Eczema
- Asthma, previous pulmonary infections
- Congenital heart disease

L—Relation of cough to "last" feed or associated with any feed

Immediate events (history of present illness and review of systems)—OLD CAARS:
- *Onset*: rapid or gradual? Age and conditions at onset of cough (e.g., present since birth)? Nocturnal cough or cough resolves at night
- *Location*: seems to originate from lower vs. upper airway?
- *Duration*: How long has the cough been present?
- *Character*: paroxysmal (pertussis), barking (croup), staccato (chlamydial pneumonia), loud-honking (psychogenic), brassy (tracheitis)
- *Alleviating factors*: What mitigates the cough (bronchodilators, antihistamines)?
- *Aggravating factors*: What aggravates the cough (triggers: allergens, smoke, cold, exercise)?
- *Recurrent*: episodes of wheezing?
- *System review*: Is cough associated with upper respiratory symptoms, fever, choking episode, chest pain, weight loss?

Family/social history:
- History of asthma, allergic or atopic disease, cystic fibrosis, immune deficiency
- Travel
- Smokers in home
- Exposure to pets

Immunizations up to date?

EMT history: elicit history from emergency medical personnel for potential trauma, ingestion, abuse, or toxin exposure

Doctor: name of primary care physician or specialist to contact for additional information and help

Documents: obtain prior medical records

diagnosis (Box 19-4). The timing and progression of symptoms should be established. Acute-onset coughing associated with a choking episode suggests foreign body aspiration. Rapid onset of cough may also be associated with anaphylaxis or trauma involving the airway, whereas a more gradual onset of cough with fever is more consistent with respiratory infection. Mild symptoms followed by rapid decompensation can occur with tracheitis or epiglottitis. Children with psychogenic cough often have a loud, honking type of cough that is absent during sleep. A primarily nocturnal cough may reflect reactive airway disease or sinusitis.

The caretaker should be asked to characterize the quality of the cough. A "barking" or "seal-like" cough reflects croup, whereas a paroxysmal cough followed by an inspiratory "whoop" is heard with pertussis. Triggers associated with the cough can give key diagnostic clues. Cough due to asthma is often triggered by exercise, cold exposure, allergens, or smoke. Children who have gastroesophageal reflux or the less common condition tracheoesophageal fistula cough during or after feeding.

The EP should focus on key elements of the past medical, family, and social histories. Premature infants with neonatal respiratory distress syndrome are at risk for bronchopulmonary dysplasia and chronic lung disease. Infants or toddlers with cough since birth may have a congenital anomaly causing an anatomic obstruction, such as a vascular ring or airway stenosis. A child with a family history of asthma or atopy has a higher risk for chronic cough due to reactive airway disease. A family history of cystic fibrosis can raise suspicion for this inherited, autosomal recessive disorder. Systemic factors associated with cough, such as headache and fever suggesting sinusitis or cough with weight loss suggestive of tuberculosis, should be reviewed. Cough with nasal congestion is often associated with a viral upper respiratory infection, but a protracted cough in a child with more systemic signs of illness may indicate a bacterial infection.

The infant or toddler with a cough should be assessed immediately for signs of respiratory compromise or failure. The general appearance and behavior of the child provide a rapid assessment of the work of breathing and the potential for respiratory failure. Evaluation for signs of distress is accomplished through inspection for tachypnea, nasal flaring, use of accessory muscles, or paradoxic ("see-saw") breathing.

The EP should characterize the sounds of the respiratory cycle. Prolongation of the inspiratory component of the respiratory cycle associated with stridor reflects extrathoracic obstruction. Prolongation of the expiratory cycle reflects intrathoracic obstruction and produces wheezing.

In children with respiratory distress, treatment should be initiated in parallel with a "head-to-toe" physical examination. The EP should evaluate for nasal congestion, rhinorrhea, or foreign body and listen for subtle inspiratory stridor or wheezing. Auscultation should be performed for rales, which can be associated with pneumonia, pulmonary edema, or chronic lung diseases such as bronchopulmonary dysplasia. Murmurs or extra heart sounds suggest cardiac disease. The abdominal examination may

Table 19-2 DIFFERENTIAL DIAGNOSIS OF COUGH IN INFANTS AND TODDLERS

	Acute Cough	Chronic Cough
Upper airway	Nasal congestion/postnasal drip Nasal foreign body Allergic rhinitis Acute viral upper respiratory infection (e.g., croup) Sinusitis/tonsillitis Epiglottitis Tracheitis Foreign body (aspiration, esophageal) Allergy/anaphylaxis Trauma Chemical irritation (e.g., smoke, fumes)	Laryngotracheomalacia Airway malformation (e.g., stenosis, webs) Tracheoesophageal fistula Cystic mass Tumors (e.g., polyp, hemangioma) Vascular compression (e.g., sling, rings)
Lower airway	Asthma/reactive airways (cough variant) Pneumonia (viral, bacterial, atypical—e.g., *Chlamydia*, tuberculosis) Pertussis Viral (e.g., bronchiolitis) Passive smoking Pulmonary edema (e.g., cardiogenic)	Chronic lung disease: Cystic fibrosis Bronchopulmonary dysplasia Pulmonary sequestration Bronchiectasis Tumors (mediastinal) Chronic infection (tuberculosis, fungal, parasitic) Interstitial lung disease
Other (cardiac, gastrointestinal)	Pulmonary edema Pulmonary emboli	Recurrent aspiration (gastroesophageal reflux) Psychogenic Granulomatous disease Medications (e.g., angiotensin-converting enzyme inhibitors) Foreign body in otic canal

show a liver edge consistent with hyperinflation or hepatomegaly seen in congestive heart failure. Skin findings consistent with eczema should raise the suspicion of asthma.

■ DIFFERENTIAL DIAGNOSIS

It is helpful to classify the causes of cough as acute or chronic, with emphasis on anatomic location, either along the pulmonary tree and/or with extrapulmonary involvement (Table 19-2).

Cough with stridor usually reflects some form of upper airway obstruction. Associated fever suggests an infectious process, whereas the acute onset of stridor in an otherwise healthy child should prompt concern for foreign body aspiration or inhalation of a chemical or environmental irritant. In infants and toddlers with chronic stridorous cough and no clearly associated infection, congenital airway malformations and vascular compression, including such anomalies as laryngomalacia, tracheal stenosis, and vascular rings or slings, should be considered.

■ INTERVENTIONS AND PROCEDURES

The child's anxiety should be alleviated and empirical therapy (such as the administration of supplemental oxygen and bronchodilators) should be initiated. In the case of acute respiratory decompensation, the airway should be secured to achieve adequate ventilation and oxygenation.

For complete airway obstruction in infants younger than 1 year, back blows and chest thrust are recommended; the Heimlich maneuver is reserved for older children.[16] Immediate laryngoscopy may enable the EP to directly visualize and remove an obstructing foreign body.[17] Children who have partial airway obstruction and adequate oxygenation and ventilation should be prepared for intraoperative bronchoscopic removal of a foreign body with general anesthesia.

■ DIAGNOSTIC TESTING

Thorough history and physical examination are generally adequate to make a diagnosis in most clinical situations of infants or toddlers presenting with cough. Pulse oximetry should be used to evaluate for hypoxemia. A screening chest radiograph should be ordered in children with focal auscultatory findings or if the diagnosis is uncertain.

When a nonradiopaque foreign body aspiration is suspected, right and left lateral decubitus radiographs may show air trapping. If no air trapping is noted and clinical findings are suggestive of aspiration, fluoroscopy or bronchoscopy should be performed.

Few laboratory tests are useful in the initial evaluation of the young child with a cough. Selective testing is dictated by history and physical examination in the pursuit of a specific diagnosis. A complete blood count with differential analysis may suggest diagnosis on occasion; findings of the differential

Documentation

INFANT OR TODDLER WITH A COUGH

Record consideration of foreign body aspiration as appropriate.

At time of discharge, document a repeat pulmonary examination that includes no evidence of respiratory distress, a respiratory rate within a normal range for age, and adequate oxygen saturation.

PARENT TEACHING TIPS

INFANT OR TODDLER WITH A COUGH

- Bringing the child back for any evidence of shortness of breath or distress
- Reinforcement of the importance of close follow-up
- Children with persistent cough will need further urgent evaluations

analysis could include a marked lymphocytosis with pertussis, eosinophilia in an allergic processes or parasitic disease, or neutrophilia in bacterial infection. Rapid assays are available to test nasopharyngeal aspirates or swab specimens for respiratory syncytial virus (RSV), influenza, and pertussis. The EP should arrange for sweat testing (pilocarpine iontophoresis method) in patients with history, signs, or symptoms suggestive of cystic fibrosis. The results of the tuberculin skin test may support the diagnosis of tuberculosis.

Other radiographic studies that may prove useful in selected children with cough are barium swallow (for tracheoesophageal fistula) and CT of the sinuses (sinusitis), neck (trauma), or chest (mediastinal mass, bronchiectasis, pulmonary sequestration). Many institutions are using magnetic resonance imaging (MRI) to evaluate for congenital vascular anomalies. In addition to cases of airway foreign body, bronchoscopy may be indicated for the evaluation of airway masses, atypical pneumonias, and airway anomalies. Specialists should be consulted early so they can help guide the diagnostic approach.

■ TREATMENT AND DISPOSITION

The underlying cause of the cough should be treated if known. Early in the ED visit, the child should receive oxygen, the complicated or failed airway should be secured, and pharmacotherapeutic measures, such as bronchodilators, steroids, anticholinergics, and antibiotics (if appropriate), should be instituted.

Proper disposition requires the consideration of multiple factors. For discharge to home, young children must demonstrate adequate oral intake, tolerance of secretions, oxygenation, and ventilation without evidence of an excess work of breathing. Admission or transfer to a pediatric specialty center is dictated by severity of illness and institutional resources. All transfers should be performed by personnel skilled in pediatric airway management.

Altered Level of Consciousness

■ SCOPE

The infant or toddler with an altered level of consciousness or self-awareness may have a life-threatening illness that requires immediate recognition and treatment to prevent permanent central nervous system (CNS) dysfunction.

■ EPIDEMIOLOGY

An altered level of consciousness in this pediatric age group is caused by nonstructural etiologies (e.g., infection, metabolic abnormalities, or toxin ingestions) or primary structural disease of the CNS (e.g., hemorrhage or tumors). Physical abuse is the leading cause of serious head injury in young children. Shaken baby syndrome most often involves children younger than 2 years and can be easily misdiagnosed.[18]

■ PATHOPHYSIOLOGY

A normal level of consciousness requires proper function and communication of the cerebral cortex and the reticular activating system. Normal neuronal activity involves a multifaceted balance of water, electrolytes, metabolic substrates, and neurotransmitter concentrations within a tightly controlled environment of temperature, pH, and osmolality. Any alteration of this environment resulting from insufficient blood flow, electrolyte imbalance, lack of substrate, presence of toxins, abnormal concentration of metabolic waste products, or loss of temperature results in the final common pathway of CNS dysfunction and an altered level of consciousness.

■ CLINICAL PRESENTATION

The history and physical examination should be directed toward potential life-threatening conditions that require immediate intervention to prevent progression of disease and long-term sequelae. Emergency conditions such as hypoxia, hypotension, extremes of temperature, hypoglycemia, seizure activity, and increased intracranial pressure should be diagnosed and treated. Once these issues have been excluded, the EP should perform an AMPLIFIEDD history (Box 19-5). Also, all available caretak-

BOX 19-5

The AMPLIFIEDD History for an Infant or Toddler with Altered Level of Consciousness

Allergies: to medications, environmental allergens

Medications: prescription, over-the-counter, "natural remedies"

Past medical history:
- Birth history
- Congenital anomaly
- Chronic disease (e.g., inborn error of metabolism, endocrinopathy)
- Infections
- Seizures

Last "feed, pee, poop": feeding, stool, and urine pattern; use of formula (dilution?)

Immediate events (history of present illness and review of systems): OLD CAARS
- *O*nset: rapid or gradual
- *L*ocation: evidence for localized pain?
- *D*uration and progression of symptoms
- *C*haracterize change in level of consciousness: lethargy, irritable, excessive crying
- *A*lleviating factors: Can child be consoled?
- *A*ggravating factors: Does movement of child cause apparent discomfort (e.g., meningitis, peritonitis, injury)?
- *R*ecurrence of symptoms: ever had similar presentation?
- *S*ystem review: trauma, seizure activity, fever, vomiting, diarrhea, recent infection, shortness of breath, change in behavior (e.g., colicky pain, paroxysmal crying), rash, irritability

Family/social history:
- Inherited disorders
- Day care: Who cares for child?

Immunizations up to date?

EMT history: elicit history for potential trauma, ingestion, abuse, or toxin exposure

Doctor: name of primary care physician or specialist to contact for additional information and help

Documents: obtain prior medical records

ers and EMS personnel should be interviewed. The EP should ask questions about the risk for accidental or nonaccidental trauma, infection, ingestion, or toxin exposure while identifying signs or symptoms suggestive of systemic disease.

Once the primary survey has been completed and emergency interventions have been performed, a "head-to-toe evaluation" should be performed with the infant or toddler completely undressed. Alterations in level of consciousness can be subtle or profound. The EP should:

- Pay close attention to pupillary responses, which generally remain intact with metabolic insults but may be absent with structural lesions, toxin exposures, or severe asphyxia.
- Note the eye position (e.g., deviation of conjugate gaze away from brainstem lesions and toward cerebral lesions).
- Identify abnormalities in the respiratory pattern that may reflect CNS insults or metabolic conditions such as metabolic acidosis.
- Evaluate motor strength, tone, and reflexes and characterize activity that may be consistent with seizures, cerebrate or decerebrate posturing.
- Look for signs of trauma, such as scalp contusions and lacerations, hemotympanum, postauricular or periorbital hematomas, retinal hemorrhages, cerebrospinal fluid otorrhea, and a bulging anterior fontanel suggestive of increased intracranial pressure.
- Note odors, which may give clues to inborn errors of metabolism or other metabolic disorders (e.g., the smell of acetone in the child with diabetic ketoacidosis).
- Identify physical findings that may signify systemic CNS illness, such as infection (e.g., vesicular or purpuric rashes), intussusception (e.g., abdominal mass or blood in stool), liver (e.g., jaundice, icterus), or cardiopulmonary disease (e.g., hypoxia, rales, or hepatomegaly).

DIFFERENTIAL DIAGNOSIS

A comprehensive differential diagnosis for alterations in consciousness in infants and toddlers can be generated with the "head-to-toe" memory tool (Fig. 19-1; Table 19-3). Possible causes involve essentially every organ system. When the underlying cause of altered mental status is not obvious, a high level of suspicion should be maintained for abuse, accidental toxin ingestion or exposure, intussusception, infection, or nonconvulsive seizure activity.

INTERVENTIONS AND PROCEDURES

The ABCs of resuscitation—airway, breathing, and circulation—should be assessed rapidly, and any interventions necessary to promote ventilation, volume resuscitation, and termination of seizure activity should be instituted immediately. If indicated, broad-spectrum antibiotics should be administered early. The child should be connected to a cardiorespiratory monitor, pulse oximetry started, rapid bedside glucose testing performed, and antidotes for toxin exposure or poisonings (e.g., naloxone for opioid ingestion) considered.

Table 19-3 DIFFERENTIAL DIAGNOSIS OF ALTERED LEVEL OF CONSCIOUSNESS IN INFANTS AND TODDLERS USING THE "HEAD-TO-TOE" MEMORY TOOL

Region	Cause
Head	Seizure (postictal state)
	Infection:
	Meningitis
	Encephalitis
	Abscess
	Ventriculoperitoneal shunt malfunction or infection
	Closed-head injury:
	Epidural, subdural, or intraparenchymal hematoma
	Concussion
	Cerebral edema
	Vascular:
	Ischemic or hemorrhagic infarction
	Subarachnoid hemorrhage
	Venous thrombosis
	Central nervous system tumor
Mouth	Toxin ingestion or exposure
	Sedatives
	Anticholinergics
	Tricyclic antidepressants
	Salicylates
	Alcohols
	Precipitant of methemoglobinemia
	Carbon monoxide
	Heavy metals
Neck	Hypothyroidism
	Hyperthyroidism
	Parathyroidism (hypercalcemia, hypocalcemia)

Region	Organ	Cause
Chest	Pulmonary	Respiratory failure
		Asphyxia
		Hypoxia secondary to pulmonary disease
	Cardiac	Hypotension (congenital heart disease, dysrhythmias, congestive heart failure)
		Anemia
Abdomen	Gastrointestinal tract	Intussusception
		Dehydration secondary to vomiting or diarrhea
	Liver	Inborn errors of metabolism
		Reye's syndrome
		Hepatic encephalopathy
	Pancreas	Hypoglycemia
		Diabetic ketoacidosis
	Kidney/urinary tract	Electrolyte disorders:
		Hyponatremia
		Hypernatremia
		Hypermagnesemia
		Hypomagnesemia
		Uremia
		Metabolic acidosis or alkalosis
		Infection: pyelonephritis with urosepsis
	Adrenal glands	Cortisol deficiency
Other		Sepsis
		Hypothermia
		Hyperthermia

Table 19-4 LABORATORY AND RADIOGRAPHIC TESTING IN INFANTS AND TODDLERS WITH ALTERED LEVEL OF CONSCIOUSNESS

	Laboratory Testing	Radiographic Testing
Routine	Rapid bedside glucose measurement	Chest radiograph
	Bedside urine dipstick test	
	Complete blood count	
	Electrolyte measurements	
	Blood urea nitrogen and serum creatinine measurements	
	Urinalysis	
Selective	Arterial blood gas measurements (ventilation/oxygenation)	Cranial computed tomography (CT)
	Toxicology screening	Abdominal ultrasonography
	Liver function testing	Abdominal CT
	Serum ammonia and lactate measurements (inborn errors of metabolism)	Skeletal survey
	Collect samples for acylcarnitine profile, quantitative plasma amino acid, qualitative urine organic acids (inborn errors of metabolism)	Magnetic resonance imaging of head
	Serum osmolality (measured and calculated)	Barium or air contrast enema
	Blood and urine cultures	Shunt series
	Cerebrospinal fluid analysis and culture	
	Ethanol level	
	Lead level	
	Serum cortisol measurement	
	Thyroid profile	

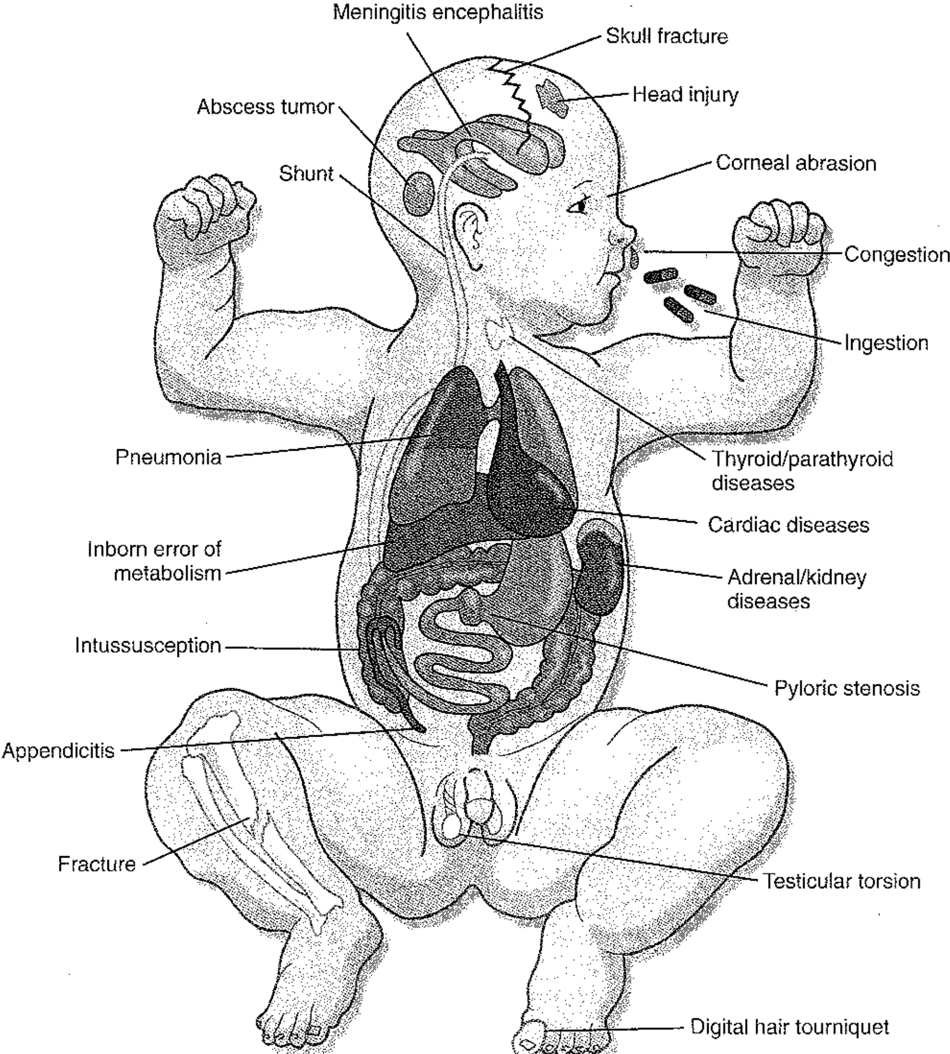


FIGURE 19-1 Head-to-toe differential diagnosis.

■ DIAGNOSTIC TESTING

Perform laboratory and radiographic testing using a systematic, comprehensive approach (Table 19-4). In the critically ill infant or toddler without a definitive diagnosis, routine testing for sepsis, trauma, and metabolic derangements should be supplemented with selective tests as dictated by the progression of the clinical course, by the response to initial interventions, and by history and physical findings.

> **Tips and Tricks**
>
> **INFANT OR TODDLER WITH ALTERED LEVEL OF CONSCIOUSNESS**
>
> Perform rapid bedside glucose testing on arrival.
>
> If underlying etiology is not clear, consider following diagnoses: intussusception, accidental ingestion, environmental exposures, nonaccidental trauma.

■ TREATMENT AND DISPOSITION

When a definitive diagnosis is not established in a child with altered level of consciousness upon arrival at the ED, supportive care should be instituted to assist ventilation, adequate circulation maintained, and potentially life-threatening conditions, such as sepsis or electrolyte abnormalities, treated. When an etiology is diagnosed, appropriate treatment should be given. Unless an easily recognizable and reversible cause is found, all children with altered level of consciousness should be admitted to a pediatric intensive care unit.

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