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Educational Gap

In 2007, *Pediatrics in Review* published a review article on apparent life-threatening events (ALTEs) and the role of home monitors. This update references the previous article and provides an update on the topic. Most novel ALTE literature since the publication of the review in 2007 has focused on one of four areas: identifying risk factors for ALTEs; comparing risk factors for ALTEs and sudden infant death syndrome; determining appropriate diagnostic testing for infants presenting with ALTEs; and evaluating the need for infant hospitalization after an ALTE.

Objectives

After completing this article, readers should be able to:

1. Recognize a child with an apparent life-threatening event (ALTE).
2. Differentiate risk factors for ALTE versus sudden infant death syndrome.
3. Know the differential diagnosis of ALTEs.
4. Know the appropriate management of a child who has an ALTE.

What We Knew Then

Definition

Apparent life-threatening event (ALTE) refers to a constellation of unexpected physiologic events in an infant that are witnessed by and distressing to a caregiver. In 1986, an expert panel sponsored by the National Institutes of Health developed the now widely accepted definition of ALTE as "an episode that is frightening to the observer and that is characterized by some combination of apnea, color change, marked change in muscle tone, choking, or gagging." The expert panel rejected an association between ALTE and sudden infant death syndrome (SIDS). Because ALTE is a diagnosis based on symptomatology rather than pathophysiology, the differential diagnosis and medical evaluation of ALTEs can be broad.

Epidemiology

The incidence of ALTE has been described in population-based studies as 0.6 to 2.46 per 1,000 live births and 0.6% to 0.8% of all emergency visits for children younger than age 1 year. These figures may underestimate the true incidence of ALTE because studies may miss cases in which the underlying cause is identified eventually. Events occur equally between boys and girls. An estimate of the percentage of ALTE cases that result in death from all causes is 7.6%.

Clinical Aspects

DIFFERENTIAL DIAGNOSIS. In approximately one half of all cases diagnosed as ALTE, no apparent cause for the event is ever found. In the other one half of the cases, a comorbid condition is identified eventually. The three most common comorbid conditions (gastroesophageal reflux, seizure, and lower respiratory tract infection) account for roughly 50% of all diagnoses eventually made. There are also other less common but potentially dangerous or treatable conditions

Abbreviations

ALTE: apparent life-threatening event
CBC: complete blood cell
CT: computed tomography
SIDS: sudden infant death syndrome

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associated with ALTE (Table 1). Careful consideration is necessary when attributing ALTE to gastroesophageal reflux because half of all normal infants age 0 to 3 months may experience daily regurgitation.

Nonaccidental trauma should always be considered in an infant who presents with ALTE. Because child abuse can take many forms such as inflicted head injury, poisoning, and smothering, all of which are often difficult to diagnose, it is possible that some cases of ALTE with no attributable cause are actually cases of abuse. In one study involving covert video surveillance, abuse accounted for approximately one third of all diagnosed cases of ALTE in which initial resuscitation was needed. (1)

EVALUATION. Infants who experience an ALTE may be asymptomatic by the time they are brought to medical attention. The first task is to determine whether the respiratory component qualifies as true apnea according to the definition of ALTE. Shallow breathing, short episodes of central apnea lasting <30 seconds, and periodic breathing of the newborn can be normal events if not associated with cardiac instability. History taking should include an assessment of severity of the event (ie, whether the ALTE was self-resolving or whether resolution required stimulation or resuscitation). It is important also to determine whether the child experienced central cyanosis versus flushing or acrocyanosis, because the latter two color changes may be consistent with normal changes in perfusion. Physical examination should be directed toward distinguishing underlying medical conditions that can present as an ALTE.

HOME CARDIORESPIRATORY MONITORS. Typical home cardiorespiratory monitors, also known as apnea monitors, are designed to alert caregivers to episodes of apnea and bradycardia. Some also assess blood oxygen saturation and have event recorders. Although there is no convincing evidence that apnea monitors can prevent SIDS after ALTE, monitoring may be appropriate for two groups: (1) premature infants who are at high risk of recurrent episodes of apnea, bradycardia, and hypoxemia, and (2) infants who are technology dependent, have unstable airways, have medical conditions with disregulated breathing, or have chronic lung disease.

What We Have Learned Since Then

Most novel ALTE literature since publication of the review in 2007 has focused on one of four areas: identifying risk factors for ALTE; comparing risk factors for ALTE and SIDS; determining appropriate diagnostic testing for infants presenting with ALTE; and evaluating the need for infant hospitalization after an ALTE. In addition, there have been articles that have reaffirmed the commonly diagnosed conditions presenting as ALTE, but because little novel information has been added to this area of inquiry, we will focus on the other four areas.

Recently Recognized Risk Factors for ALTEs

POSTCONCEPTIONAL AGE. Infants born prematurely (<37 weeks' estimated gestational age) are at increased risk for ALTE, given their immature respiratory centers, arousal mechanisms, and airway reflexes. In a national surveillance survey of all secondary and tertiary care facilities in the Netherlands in 2002, the percentage of premature infants who experienced an ALTE (29.5%) was over twice the percentage in the general population (13%). (2)

With an awareness of the role of central respiratory control immaturity in ALTE, the issue of age-based risk more logically focuses on an infant's postconceptual rather than postnatal age. Lack of identification of infants' postconceptional age in earlier studies may explain apparent discrepancies between earlier and more recent studies. For instance, although several earlier studies revealed that older infants (age >2 months) were at higher risk for ALTE, in a recent study of patients admitted for ALTE, having a postconceptional age of <43 weeks was associated with a 5.2 increased relative risk of subsequent extreme events (defined as episodes of bradycardia for ≥10 seconds or apnea for ≥30 seconds). (3)

Another study revealed that among infants with a postconceptional age of <44 weeks, preterm infants and infants who had experienced an ALTE were at higher risk for so-called "extreme events" than healthy term infants. (4) This effect was not apparent among infants with a postconceptional age of ≥44 weeks. Central respiratory control is not completely functional even at term. Thus, one study revealed that postconceptional age of <48 weeks among preterm infants and postnatal age of <1 month among term infants was associated with bronchiolitis-associated apnea. (5)

FIRST 2 HOURS AFTER BIRTH. Recently, researchers have recognized the risk of severe ALTE (as well as SIDS) among healthy term infants within the first 24 hours of age. A nationwide retrospective survey in Germany revealed the rate of severe ALTE (requiring resuscitation) and SIDS in the first 24 hours was 2.6 per 100,000 live births. (6) The majority of these cases occurred during

Table 1. Apparent Life-Threatening Events (ALTEs): Common Causes and Potential Discriminating Features

Causes	Potential Discriminating Features
Causes Associated With Central Apnea	
Central nervous system:	
Seizure	• Loss of consciousness • Eye deviation • Convulsion • Hypotonia or hypertonia • Micro- or macrocephaly or other dysmorphic features
Apnea of infancy/breath-holding spells	• Lack of other associations
Metabolic	• Family history of metabolic disorder or death in childhood • Seizure activity • History of feeding difficulties or frequent or severe illnesses • Dysmorphic features
Cardiovascular:	
Dysrhythmia Congenital heart disease	• History of feeding difficulties • Diaphoresis • Central cyanosis
Infectious:	
Meningitis Sepsis Urinary tract infection	• Fever or hypothermia • Lethargy
Medications:	
Drug toxicity	• Lethargy • History of medication use
Intentional poisoning	• Lethargy • Delayed presentation for care • Discrepancies in the historian's account of the ALTE • Sibling of sudden infant death syndrome (SIDS) • History of ALTE
Causes Associated With Obstructive Apnea or Mixed Central/Obstructive Apnea	
Gastrointestinal:	
Gastroesophageal reflux Aspiration	• Vomiting, coughing, choking, or gasping • Recent feeding • Milk in the mouth or nose
Intussusception Volvulus	• Bilious emesis • History of pulling legs to the chest during the ALTE • Bloody/mucusy stools • Lethargy after the ALTE • Abdominal distension (with volvulus)
Respiratory:	
Infection (especially with respiratory syncytial virus or pertussis)	• Coryza • Coughing • Wheezing • Fever or hypothermia
Aspiration/foreign body	• History of ingestion • Stridor
Airway anomaly	• Stridor • History of feeding difficulties
Nonaccidental trauma:	
Smothering Blunt trauma Munchausen by proxy	• History of trauma • Blood in the mouth or nose • Sibling of SIDS • History of ALTE • Delayed presentation for care

Continued

Table 1. (Continued)

Causes	Potential Discriminating Features
	• Discrepancies in the historian's account of the ALTE • Vomiting/irritability • High severity ALTE or emergency medical services involvement
Accidental smothering	• ALTE occurred while infant was sleeping • Infant was in the prone position • Infant had soft objects (eg, pillows or blankets) covering/near face

the first 2 hours after birth. A prospective regional study from France revealed a rate of ALTE and SIDS to be 0.032 deaths per 1,000 live births within the first 2 hours after birth. (7)

Although rare, severe ALTE and SIDS among infants within the first few hours of birth seemed to be more common among primiparous mothers, during early skin-to-skin contact or breastfeeding, and when infants were not being observed by health-care personnel. Most cases were thought to be caused by obstruction of the infant airway. Thus, although early skin-to-skin contact for maternal-infant bonding and early establishment of breastfeeding are undoubtedly important, it would be prudent if these practices occurred with constant surveillance (recognizing the logistic difficulties associated with this suggestion) or at least frequent checks by health-care personnel within the first 2 hours after birth when both the mother and infant can be expected to be fatigued. After testing for effectiveness for preventing perinatal ALTE and SIDS, wireless cardiorespiratory monitors may be useful to health-care personnel for providing surveillance in the future.

Comparison of ALTE to SIDS

As stated by the American Academy of Pediatrics Task Force on SIDS, there is no evidence that an ALTE is a precursor to SIDS. This lack of association is evidenced by the fact that the incidence of SIDS has decreased since the 1994 Back to Sleep Campaign, whereas the incidence of ALTE has not. Also, most risk factors for ALTE and SIDS are different. For instance, approximately half of ALTEs occur during wakefulness, whereas the majority of SIDS cases occur during sleep. In fact, extreme apneic and bradycardic events are less common during the early morning hours when SIDS tends to occur and more common among Asians who are at lower risk for SIDS. In addition, the age of mothers of infants who have ALTE follows the distribution of the normal population, whereas the distribution of mothers whose infants die of SIDS is skewed toward a younger age. ALTEs occur equally between boys and girls, whereas boys succumb to SIDS more frequently than girls.

Although ALTE is not a precursor to SIDS, the two entities may share similar risk factors, which could explain why 0% to 7% of SIDS cases are preceded by an ALTE. The one common risk factor for both ALTE and SIDS is maternal smoking. In one study, 33.3% of infants with ALTE who subsequently died of SIDS had the dual risk factors of prone sleep position and late prenatal smoke exposure, compared with 13.3% of ALTE survivors. (8) A separate study of polysomnograms revealed that infants who had experienced an ALTE and who had nonsmoking mothers had fewer total arousals, cortical arousals, and subcortical activations than normal controls, but that their spontaneous arousals were altered in patterns that differed from future SIDS victims. (9) However, infants who had ALTE whose mothers smoked had arousal and respiratory characteristics similar to future SIDS victims. These two studies suggest that there may be a minor subpopulation of infants who have experienced an ALTE who are at higher risk of SIDS and that at least part of this risk may be conferred by maternal smoking.

Diagnostic Testing

A recent review of 36 children's hospitals across the United States revealed that the most common laboratory studies ordered after an ALTE episode were complete blood cell (CBC) count (70%) and electrolytes (65%). (10) A chest radiograph was ordered in 69% of patients, 26% had upper gastrointestinal fluoroscopy or swallow testing, and 36% had electrocardiography performed. There was large interhospital variability for all aspects of care involving ALTE, including costs, diagnostic tests, and medications.

In 2009, the Dutch Pediatric Association became the first national pediatric association to advocate use of an evidence-based consensus pathway for the diagnosis, management, and follow-up of children who have

experienced an idiopathic ALTE. (11) The pathway recommends a minimum initial diagnostic panel for ALTE that includes the following: CBC count with differential, C-reactive protein, serum glucose level, arterial blood gas determinations, urinalysis, electrocardiography, and assessments for *Bordetella pertussis* and respiratory syncytial virus in season (with other diagnostic tests performed at the clinician's discretion). There is solid evidence for the benefit of including these tests in the initial evaluation of a child presenting with ALTE.

The minimum diagnostic panel suggested by the Dutch Pediatric Association is less inclusive than the often cited algorithm published previously by McGovern and Smith in 2004 (12) based on a systematic review of studies detailing the final diagnoses of ALTE cases. In addition to the tests advocated in the Dutch pathway, McGovern and Smith (12) also include in the initial evaluation serum metabolic studies, urine toxicology screening, investigations for gastroesophageal reflux, EEG, and head imaging. In the next few paragraphs, we will review the recent evidence for and against inclusion of these other studies in the routine initial investigations for idiopathic ALTE, keeping in mind that screening tests ideally should be sensitive, relatively specific, not too expensive, relatively easy to obtain, and not excessively burdensome for the patient.

ELECTROENCEPHALOGRAPHY. McGovern and Smith (12) recommended inclusion of EEG in initial investigations based on the fact that, in their review, seizures accounted for 11% of the total final diagnoses. However, only two of seven studies in their review revealed that the diagnosis of epilepsy was made by EEG. It is possible then that the diagnosis in other studies was made from other evidence, such as parental report of the episode being consistent with seizure, underlying serum chemistry anomaly, or abnormal brain imaging.

In a 5-year study by Bonkowsky et al in 2008 (13), EEG had a sensitivity of only 15% for diagnosing epilepsy. Of the 3.6% of infants in that study who presented with ALTE and developed chronic epilepsy, 71% had a recurrent ALTE event within 1 month, and 47% were diagnosed as having seizures within 1 week of the initial event. Given that EEG is difficult to obtain in the emergency department setting and has a low sensitivity for diagnosing chronic epilepsy, as well as the fact that most patients who have epilepsy return with a second episode, we suggest that EEG be reserved for those with recurrent ALTE.

NEUROLOGIC IMAGING. In addition to EEG, neurologic imaging, including cranial computed tomography (CT), MRI, and ultrasonography can be used to help diagnose chronic epilepsy by demonstrating underlying anatomic anomalies. Neurologic imaging also can identify patients who have experienced abusive head trauma. In the study by Bonkowsky et al (13), all neurologic imaging modalities together had a sensitivity for predicting chronic epilepsy of only 6.7%.

The most common cranial imaging study ordered for ALTE workup is head CT. Head CT is ordered more commonly than head ultrasonography and MRI combined. Head CT may be abnormal in 63% to 70% of cases of closed head injury. This fact is important because abusive head trauma may be missed in the emergency department; approximately one half of the cases were undetected in one study. By using Markov models, researchers have found that ordering head CT for *all* asymptomatic infants with history of ALTE actually saves money from a medical payer perspective. (14) Nevertheless, only ~1% to 3% of all cases of ALTE are due to abusive head trauma, meaning that many infants would be irradiated unnecessarily if all infants presenting with ALTE were to undergo head CT.

Instead of compulsive head CTs for all infants presenting with ALTE, we feel that neurologic imaging should be reserved for cases suspicious for abuse. In two separate studies, a documented discrepancy in the history of the ALTE (eg, history is confusing, varies among caregivers, or changes over the course of the evaluation) was highly predictive of physical abuse. These studies revealed that a delay in seeking medical care in one study and vomiting, irritability, or a call to 911 in the other, also were associated with abusive head trauma. (15)(16)

Given the high levels of radiation associated with head CT, we suggest having multiple emergency department personnel use a checklist (Table 2) to take the history from the caregiver more than once, looking for inconsistencies and for other potential markers of abuse, and reserving head CT for suspicious cases. In suspected cases of physical abuse, retinal examinations, which may detect 33% to 60% of head trauma, and skeletal surveys, which may detect 14% of physical abuse, also should be obtained. Covert video surveillance while the infant is hospitalized to detect the caretaker smothering or shaking the infant also should be considered in such circumstances.

SERUM METABOLIC STUDIES. The following blood chemistry concentrations are included in the McGovern and Smith (12) initial minimum screening: sodium, potassium, urea, calcium, magnesium, ammonia, lactate, and pyruvate. Although the results from a basic serum

Table 2. Example: Standardized Checklist for Obtaining ALTE History

Who observed the episode? *Try to obtain history directly from the observer, by phone if necessary.*
When did the episode occur?
What was the infant doing right before the episode? If she was asleep, where was she and in what position?
Did the infant fall or experience any other trauma?
Does the infant currently have a runny nose, cough, vomiting, diarrhea, or fever?
How was the infant acting on the day the episode occurred?
How did the infant look during the episode?
- Did she gasp, choke, gag, or cough?
- Did her body change color and if so what part?
- Did she vomit?
- Did she become weak, floppy, limp, stiff, or start shaking?
- Did she lose consciousness?
- Did the observer notice any unusual eye rolling?
- Did the observer notice any blood, milk, or stomach contents in her mouth or nose during or right after the episode?

How long do you think the episode lasted? *If the observer is unsure, ask him to describe or act out exactly the occurrence of events and what he was doing from start to finish.*
Did the episode stop on its own or did someone do something to stop it?
If someone intervened: What did that person do? Were emergency medical services involved?
How has the infant been acting since the episode occurred?
Please name any prescription or over-the-counter medication or herbal remedies that the infant received within 24 h before the episode.
For breastfeeding mothers: please name any prescription or over-the-counter medication or herbal remedies that the infant's mother took within 24 h before the episode.
Has the infant ever experienced a similar episode in the past and, if so, what was done to evaluate her afterward?
Does the infant have any medical problems or conditions?
When was the infant born: on time (at 40 wk of pregnancy), early, or late?
Has anyone in the infant's family ever experienced a similar episode or died of sudden infant death syndrome, also called SIDS?
Has anyone in the infant's family been diagnosed with a genetic, metabolic, cardiac, or neurological condition or died in childhood of unknown causes?

metabolic panel are not likely to reveal a definitive cause of the ALTE, they may suggest a cause. For instance, studies have identified rare cases of ALTE due to hypocalcemia and hypomagnesemia. Other electrolyte disturbances conceivably could present as ALTE, such as hypo- or hypernatremia leading to seizures and hypo- or hyperkalemia leading to cardiac arrhythmias.

Metabolic disorders, including organic acidemias, urea cycle disorders, fatty acid oxidation disorders, and mitochondrial disorders, cause ~2% to 5% of all cases of ALTE. Although they account for a minority of eventual ALTE diagnoses, ALTE can be a classic initial presentation for an infant who has a metabolic disorder. If not recognized and treated promptly, some metabolic disorders can progress and lead to long-term sequelae. Because serum chemistry tests are relatively inexpensive, easy to obtain, and may be the only means of diagnosing some disorders for which early treatment is important, we advocate for their inclusion in the initial evaluation of ALTE.

URINE TOXICOLOGY SCREENING. Including urine toxicology screening in the initial evaluation of ALTE can uncover cases of intentional and unintentional poisoning. In a prospective study of children younger than age 2 years presenting with an ALTE, of the 274 children who had a toxicology screen performed, 8.4% were positive for a medication that could have caused apnea. (17) Notably, 4.7% of infants screened positive for over-the-counter cough and cold preparations, some of which contain ingredients that may cause apnea in infants. Cough and cold medications are not recommended for children under age 2 years, and none of the parents in the study admitted to having administered any to their infants. For these reasons and because the test is relatively inexpensive and easy to obtain, we suggest including urine toxicology screening in the initial set of tests for ALTE.

INVESTIGATIONS FOR GASTROINTESTINAL REFLUX. Approximately one in four infants admitted with ALTE undergoes an upper gastrointestinal fluoroscopy or swallow test. Although these tests are useful for demonstrating anatomic anomalies as a cause for ALTE, they are less useful for proving gastroesophageal reflux as the cause because daily regurgitation is typical for many normal infants. A better test for demonstrating a causal link between gastrointestinal reflux and ALTE is esophageal pH sampling via a pH probe, correlating the probe findings with episodes of apnea or hypoxemia documented on concurrent cardiorespiratory monitoring. However, pH probe results that demonstrate acid reflux not associated with respiratory compromise do not allow for

decisive attribution of the ALTE to reflux. In addition, the test is fairly uncomfortable for patients and not inexpensive. Therefore, we suggest gastrointestinal reflux testing be included in an ALTE evaluation only if the infant reportedly has frequent gastrointestinal reflux, the ALTE was immediately preceded by a feeding, or gastric contents were noted in the infant's mouth or nose by the caregiver during the episode.

HOSPITAL OBSERVATION VERSUS DISCHARGE FROM HOSPITAL. Admitting an infant after an ALTE can facilitate diagnostic testing for an underlying cause and allow for prompt medical intervention if the need arises. However, typical hospital charges for an ALTE admission were $15,567 in one study, and it is unclear whether all infants who experience an ALTE need to be admitted. (10) Thus far, there has not been any large-scale prospective trial of a predictive model to determine which infants need to be admitted after an ALTE due to a high risk of experiencing a subsequent life-threatening event requiring immediate medical intervention. Also, there are no data as to current admission rates.

The average length of stay for infants admitted for ALTE in the United States is 4.4 days, with wide variation among hospitals. In a retrospective study of 625 infants admitted for ALTE, 13.6% had a subsequent extreme cardiorespiratory event, 85% of which occurred within the first 24 hours of hospitalization. (3) Most extreme events were associated with an eventual diagnosis of respiratory tract infection and occurred on average within 4 days of initial presentation. Risk factors for having an extreme event were prematurity, postconceptional age <43 weeks, and displaying symptoms of upper respiratory tract infection.

In a prospective case series in which all 66 infants were admitted for ALTE for at least 24 hours, 12% had recurrent episodes within 24 hours, 9% had episodes requiring moderate stimulation, and 3% required resuscitation measures. (18) Approximately one half of the patients requiring medical intervention were born prematurely. In another prospective study of 59 infants, age <1 month and having had a previous ALTE conferred higher risk of requiring acute medical attention. (19) Based on these studies, we believe that the majority of infants who have experienced an ALTE should be admitted for a minimum of 23 hours of observation, with continuous cardiorespiratory monitoring and, ideally, continuous measurement of pulse oximetry with event recording.

If the event is an infant's first ALTE; he was not born prematurely; he has no significant medical history; he is well-appearing with stable vital signs at the time of evaluation; the episode was brief, nonsevere, and self-resolving; and if there is a probable cause that is nonprogressive (such as gastroesophageal reflux), it may be reasonable to discharge the infant without 23 hours of observation.

Regardless of whether an infant is admitted after an ALTE, caretakers should be educated about techniques to prevent and treat further episodes. Specifically, caretakers should be told not to shake their infants during an ALTE because shaking may cause physical harm. Approximately one in three parents shook their infants to stimulate them during an ALTE, according to a national Dutch survey. (2) Resources for infant basic life support courses should be given to caretakers. In addition, it is important to ensure follow-up for the infant with a health-care practitioner soon after discharge because ~10% of ALTEs are recurrent.

Summary

- Based on strong research evidence, the most common causes of apparent life-threatening events (ALTEs) are gastroesophageal reflux, lower respiratory tract infection, and seizure. (2)(12)(13)(20)
- The minimum initial diagnostic panel for ALTE should include complete blood cell (CBC) count with differential; blood levels of C-reactive protein, glucose, sodium, potassium, urea, calcium, magnesium, ammonia, lactate, and pyruvate; arterial blood gas determination, urinalysis, and toxicology screen; electrocardiography; and assessments for *Bordetella pertussis* and respiratory syncytial virus in season. (11)(12)(17)
- Other testing should be done based on the infant's clinical presentation and clinician's degree of suspicion.
- Most infants should be hospitalized for cardiorespiratory monitoring for 23 hours after an ALTE. (3)(18)(19)
- There is strong evidence that newborns are at higher risk of ALTE and sudden infant death syndrome (SIDS) within the first 24 hours after birth and therefore should be frequently monitored *as much as possible* while room sharing with their mothers. (6)(7)
- Evidence suggests that maternal smoking may place an infant for higher risk of SIDS after an ALTE. (8)(9)

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PIR Quiz

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1. A previously healthy 1-month-old boy has had a runny nose and worsening cough for 2 days. On the morning of the third day of his illness, he briefly stops breathing and turns pale and motionless. He responds to gentle stimulation and begins breathing again. His frightened mother calls 911, and he is taken immediately to the emergency department (ED) by ambulance. Given the history, you suspect his apnea is most likely caused by

   A. A respiratory syncytial virus (RSV) infection.
   B. A seizure.
   C. An organic acid disorder.
   D. Dysrhythmia.
   E. Intentional poisoning.

2. A previously healthy 1-month-old boy has an episode of sudden choking and gagging that frightens his mother and grandmother. His face briefly turns red. He does spit up occasionally, but such an event has never occurred before. In the ED, he appears well, and a thorough examination is normal. He is admitted for 23 hours. No more spells occur. Recommended routine screening is unremarkable. His apparent life-threatening event (ALTE) is most likely explained by

   A. Gastroesophageal reflux.
   B. Intracranial hemorrhage.
   C. Pertussis.
   D. Seizure disorder.
   E. Urea cycle disorder.

3. A previously healthy 1-month-old boy is brought to the ED the morning after having had three bouts of choking and gagging the previous evening, during which his face and body turned dusky. His mother states he does spit up occasionally, but such an event has never occurred before. However, the details of her history vary from those of her boyfriend and the grandmother. The child appears lethargic, but careful examination produces no other abnormal findings. He is admitted to the hospital. The explanation for the ALTE is most likely to be provided by

   A. A cardiac event monitor.
   B. A computed tomography (CT) scan.
   C. An electroencephalogram.
   D. An esophageal pH probe.
   E. Organic acid screening.

4. A previously healthy 1-month-old boy has an event of floppiness and cyanosis that frightens his mother and grandmother. He spits up occasionally, but such an event has never occurred before. In the ED, he appears lethargic and pale. Arterial blood gases reveal a mixed acidosis. Your diagnosis is an extreme ALTE. A careful examination produces no other abnormal physical findings. He is admitted to the hospital and gradually recovers fully. All other recommended routine screening tests and a CT scan produce normal results. Which one of the following most elevates his risk for subsequent sudden infant death syndrome (SIDS)?

   A. He was delivered at 44 weeks' postconception.
   B. His mother is Asian.
   C. His mother just turned 30.
   D. His mother smoked cigarettes throughout the pregnancy.
   E. The boy sleeps on his side.

5. A 1-month-old boy has a brief event of choking and gagging that frightens his mother and grandmother. In the ED, he appears well and a thorough examination is normal. No more spells occur. Given the circumstances, after reassuring the mother and grandmother, you would be most comfortable in discharging him from the hospital directly if his only risk factor for having another spell is that

   A. A nasal swab is positive for RSV.
   B. He spits up a small amount of formula several times a day.
   C. He was delivered at 32 weeks' postconception.
   D. The grandmother recalls one previous similar but milder episode a week ago.
   E. The mother smoked cigarettes throughout the pregnancy.

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