

# Apparent Life-Threatening Events in the Young Infant and Neonate

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An apparent life-threatening event (ALTE) is characterized by some combination of apnea, change in color and tone, choking, or gagging. It is frightening to the observer and presents a difficult clinical challenge. There is no standard evaluation for an infant with an ALTE, with history and physical examination being the keys to directing the diagnostic workup. In young infants, prematurity plays a significant role in the diagnostic possibilities that include gastrointestinal, neurologic, and infectious conditions. The goal is to identify a treatable cause that will define the expected natural history. Evidence is lacking regarding the true risk of subsequent events and death vs the perceived risk of death, which is complicated by the heterogeneity of the group of infants with ALTE. The presentation, differential diagnosis, plan for evaluation, and management of the young infant with ALTE will be reviewed, as well as the relationship of ALTE and sudden infant death syndrome and the literature regarding ALTE in the newborn infant.

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An *apparent life-threatening event* (ALTE) was defined in 1986 by the National Institutes of Health Conference on Infantile Apnea and Home Monitoring as “an episode that is frightening to the observer that is characterized by some combination of apnea (central or occasionally obstructive), color change (usually cyanotic or pallid but occasionally erythematous or plethoric), marked change in muscle tone (usually marked limpness), choking or gagging. In some cases, the observer fears that the infant has died [1].” A large amount of information has been amassed in the 20 years since an ALTE was defined. However, ALTE as a clinical syndrome is open to considerable interpretation, initially on the part of the observer of the event as well as upon presentation to a physician's office or emergency department (ED). This diagnosis is especially difficult because the patients represent diverse pathophysiology; however, they often appear well and “normal” at the time of ED presentation. Because there is no standard evaluation or minimal workup for an infant with ALTE [2], the physician's challenge is to create a management plan to identify those infants who may be at subsequent risk for significant morbidity and death. The ALTEs typically occur in children younger than 12 months, with the median age

of presentation at about 2 months [3-7]. The focus of this article will be to review the presentation, differential diagnosis, plan for evaluation, and management of the young infant with ALTE and examine the literature regarding ALTE in the newborn infant.

## Clinical Presentation

An ALTE should not be regarded as a specific diagnosis but as a chief complaint that requires medical attention and evaluation. As per definition, the presentations are characterized by a combination of breathing irregularities that may include apnea; difficulty breathing; color change (typically cyanosis); altered tone; and, in an infant, altered level of consciousness. The initial history provided by the witness is of extreme importance in directing the investigation and determining the severity of the event to

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determine disposition. Although there are no data concerning reliability of parental reporting of ALTE, one could extrapolate from the data of the reliability of parental reports of apnea occurrence in infants on home monitoring that demonstrate that there may be considerable observer error [8]. Caretaker anxiety may overestimate the event, and lack of professional experience may underestimate the event especially when the infant appears well. In all cases, the event must be taken seriously.

## Etiologies

Depending upon the case series, more than 50% of ALTE infants ultimately have a cause identified [3,4,6,7,9]. The challenge is that infants may have multiple coexistent diagnoses, and 1 specific diagnosis may not account for the life-threatening event. Among the etiologies, the 3 most common are gastrointestinal (GI) conditions, neurologic problems such as seizures, and infections, typically in the lower respiratory tract. Less common diagnoses include cardiovascular disease, breath-holding spells, inborn errors, metabolic problems, child abuse, and a variation of normal physiology. Some of these diagnoses will be considered in further detail as they relate specifically to the neonate and young infant. If no cause is determined, then the ALTE is considered idiopathic. The term *apnea of infancy* is reserved for an infant greater than 37 weeks' gestation at birth in which no specific cause can be identified for the ALTE and is related to the onset of pathologic apnea [1].

## Evaluation: History and Physical Exam

A detailed history and physical examination are the basis from which to start sorting through the myriad of possible diagnoses and directing a diagnostic evaluation. Therefore, key components of the history are a description and duration of the event and the intervention. Description of the ALTE includes infant state (awake or asleep); color change location (eg, circumoral, peripheral, or whole body); location, position, and activity of the infant; respiratory effort; tone; and associated noise of choking, cough, gagging, wheezing, stridor, or emesis. Description of the intervention that terminated the event could include minimal or no intervention, gentle stimulation or blowing in the face, vigorous stimulation, or mouth-to-mouth resuscitation. This description is especially important in the young infant in that a caretaker may observe normal physiologic patterns and consider them pathologic. Periodic breathing—respiratory pauses with or without a sigh for up to 20 seconds—may appear frightening to the inexperienced observer and may even prompt resuscitation, and needs to be accurately described to be reassuring to all involved. Another important prognostic factor is to determine if there were similar events in the last 24 hours or in the past.

After a description of the event, a complete history should be obtained that includes questions about the pregnancy and perinatal period, particularly critical in the neonate and young infant. Special attention should be given to determining the gestational age of the infant. This is especially important in the late preterm infant. Without detailed probing of the “due date,” the infant's relative immaturity may not be appreciated; and prematurity contributing to the etiology of the event might be overlooked. Other pertinent newborn history includes prior history of admission or short stay in a newborn intensive care unit or observational nursery, birth trauma, antibiotic use, significant jaundice, and possible risk for anemia, all of which may be indicative of an evolving or unresolved neonatal problem. Identifying when the newborn screening was obtained and ensuring that the newborn screening was indeed sent are important in that a very small amount of blood may hold the key to several diseases with significant morbidity. A feeding history is also important to determine if there is interest in feeding; the feeding pattern; and associated gagging, coughing, or arching behaviors. Additional questions should include sick contacts, medications given, recent immunizations, and trauma, both accidental and intentional. The infant's developmental history, behavior, and sleep patterns should be reviewed. A family history is important to identify genetic, metabolic, cardiac, or neurologic conditions or other early infant deaths that may be a manifestation of these conditions. A social history that includes alcohol, tobacco, or substance use as well as medications in the home may raise the index of suspicion for an unintentional or intentional ingestion of a toxin.

After the history is obtained, a careful and thorough physical examination should be performed. The general impression of the infant's wellness after the event is important and may direct further investigation and the disposition of the infant. The physical examination is directed to determine underlying etiologies. Specific areas to focus on include growth parameters, especially in the preterm infant, and recent newborn discharge to ensure normal growth. Vital signs are essential. Pulse oximetry has become almost “routine” monitoring in the ED, although no study has examined the systematic use of oximetry in evaluating ALTE infants. Evidence of trauma should be assessed, which would include bruising, fontanel size and fullness, and conjunctival or retinal hemorrhages.

The importance of the history and physical examination is demonstrated by a prospective study of 243 infants admitted to a tertiary care academic center after an ALTE [7]. A cause was identified based on the history and physical examination alone in 21% of cases. In another 49%, the history and physical examination suggested a cause that was confirmed by testing. The next challenge is which diagnostic tests to order to identify a cause of the ALTE.

## Evaluation: Diagnostic Testing

At present, there is no evidence-based standard evaluation of the infant with ALTE. In the prospective study of 243 patients noted above [7] of which almost half ( $n = 120$ ) were younger than 2 months, 3776 tests were ordered (mean of  $15.5 \pm 5.2$  tests per patient). Only 18% of these tests were positive, and only 6% contributed to the diagnosis. In this series, 70% of infants had an etiologic diagnosis for their ALTE. Among the remaining 30% ( $n = 72$ ) of patients, the further tests led to identification of an occult cause in 14% ( $n = 33$ ); and in the remaining 16% ( $n = 39$ ), no cause was found. The 6 tests that identified a cause in these 33 patients were a white blood cell count, urine analysis and culture, chest x-ray, screening for gastroesophageal reflux (GER), multichannel recording, and brain neuroimaging. A larger patient sample will be needed to determine if a battery of tests would be useful in the infant who does not have suggestive findings on the initial history and physical examination. One must also balance the risks of testing—including a potentially invasive procedure, a financial burden, an emotional burden, possible unnecessary testing that may have complications, or acquisition of nosocomial infections—with the benefits of securing a diagnosis vs the potential of a delayed or missed diagnosis. There has been no study that has supported a standard testing strategy [2,7]. With such a small yield from a significant amount of diagnostic testing (only 6% of the 3776 tests ordered in the previously mentioned study) contributing to a diagnosis, it begs the question as to whether too many tests are being done, or perhaps not the correct tests; and thus, the whole approach needs to be reexamined. A retrospective study using a large database on hospital admissions for ALTE from 12 067 patients aged 3 days to 5 months from 36 children's hospitals across the United States enrolled in the Pediatric Health Information System highlights significant variability in length of hospital stay, use of medications, and diagnostic testing [10]. These data strongly support further research for an alternative strategy to improve quality of care for these infants.

## Admission and Hospitalization

Most of the investigations to determine an underlying etiology are done after admission to the hospital. Many reviews of ALTEs have reported data from hospital admissions [4,6,7,10] but did not examine the question of who should be admitted. In 1 study published in 1999, 83% of the 130 patients [3] were admitted with an ALTE. However, the study offered a recommendation that, until management guidelines were developed, all infants should be admitted for a period of observation because there was concern that etiologic diagnoses changed from the ED to the ward and that diagnoses made in the ED may be made on insufficient evidence. In a later study from 2004, 77% of

150 patients [5] were admitted for observation after an ALTE. This study also supported admission of all patients, and 8% of those hospitalized required medical interventions during their admission after an unremarkable ED evaluation. Prematurity appeared to be a significant risk factor for the occurrence of an intervention during hospitalization.

A prospective study [11] was designed to develop criteria to identify infants with an ALTE who may be safely discharged from the ED. High-risk infants were those who “required” hospitalization because of subsequent events, significant interventions, and treatment of specific diagnoses (such as sepsis). Among 59 infants presenting to the ED with an ALTE, 8 (14%) infants experienced significant events or interventions (apnea, seizures, infections, ventilation) during their hospitalization. Multiple ALTEs within the 24 hours before admission and age not exceeding 1 month identified this high-risk subgroup of infants requiring admission. Another factor that was found to be predictive of subsequent events was prematurity. A larger validation set will be required to substantiate these criteria for differentiating high-risk infants (eg, younger than 1 month with multiple ALTEs in the 24 hours before admission) and low-risk infants (eg, older than 30 days and who experienced a single ALTE) and outpatient vs inpatient disposition. In those infants who do not meet the high-risk criteria, care must still be individualized. In considering discharge from the ED, the infant must appear well, there should be no family or social issues or concerns that would be suspicious for nonaccidental injuries, and appropriate follow-up care should be identified.

For infants who are admitted, investigations and observations often include cardiorespiratory monitoring as well as oximetry. Some centers may have an ALTE protocol requiring formal studies of multichannel recordings or polysomnography in those infants without an identified etiology to direct further workup at the time of admission. From a study of 73 admitted infants (88% with an idiopathic ALTE), events of apnea and bradycardia that were documented during the initial hospitalization predicted subsequent events recorded at home [12].

To reiterate, it is imperative that all ALTEs be taken seriously. In those infants with physiologic compromise, or who appear ill, or who required significant stimulation or resuscitation, a period of hospitalization for further observation and evaluation is clearly indicated. These observations will then assist in creating an individualized discharge plan.

## Potential Etiologies of ALTE in the Neonate and Young Infant

### The Convalescing Preterm Infant

Former preterm infants who are not yet at least 1 month postterm may continue to have the maturational delay associated with prematurity that may contribute to their

ALTE. In 1 retrospective study, a series of 150 infants with ALTE in which 33% were less than 37 weeks' gestation, prematurity was a risk factor for the need for significant medical intervention[5]. Although infants with apnea of prematurity typically resolve by 37 weeks' gestation, some may continue to have apnea until several weeks past term [1]. In infants of 24 to 28 weeks' gestation, apnea of prematurity frequently persists beyond term [13]. Data from the large Collaborative Home Infant Monitoring Evaluation (CHIME) that monitored 1079 infants (infants with idiopathic ALTE, siblings of infants who died of sudden infant death syndrome [SIDS], symptomatic and asymptomatic preterm infants with birthweight less than 1750 g, and healthy term infants) demonstrated that *conventional events* (defined as apnea  $\geq 20$  seconds; if  $< 44$  weeks, heart rate  $< 60$  beats per minute [bpm] for at least 5 seconds or  $< 80$  bpm for at least 15 seconds; if  $\geq 44$  weeks, heart rate  $< 50$  bpm for at least 5 seconds or  $< 60$  bpm for at least 15 seconds) were common among all groups of infants and that preterm infants had an increased risk of *extreme events* (defined as apnea  $\geq 30$  seconds; if  $< 44$  weeks, heart rate  $< 60$  bpm for  $\geq 10$  seconds; if  $\geq 44$  weeks, heart rate  $< 50$  bpm for  $\geq 10$  seconds). Preterm infants had increased risk of extreme events until 43 weeks postconceptional age [14]. This is why identifying the correct gestational age of the infant is of key importance.

The preterm infant may have a number of resolving issues of prematurity such as lung disease, anemia, poor suck-swallow coordination with increasing volume of feeding, along with a maturing cardiorespiratory pattern. Individually, these conditions may not precipitate an ALTE but in sum may create a vulnerability that might result in an ALTE. Anemia may contribute to the problem especially at a time when an infant may be approaching his or her physiologic nadir. Thus, a comprehensive view of the infant is required to determine if causality of the ALTE can be attributed to any one of these multiple issues. In scenarios where 1 underlying etiology cannot be identified, the infant is still immature, the ALTE required vigorous stimulation or resuscitation, and the physician cannot determine the true risk for morbidity, monitoring may be chosen to aid characterizing and documenting the frequency, severity, and resolution of the ALTE events.

### Monitored Infants

Preterm infants who are discharged on home monitoring for resolving apnea of prematurity may also present to the ED as an ALTE and may manifest as increased alarms. In those cases, it is imperative to review the monitor's alarm settings. Numerous alarms occur if the apnea alarm is set at 15 seconds, as short apnea is common [14] and not necessarily pathologic. Baseline heart rate decreases with advancing age, and bradycardia limits should be adjusted appropriately. Home memory monitors may be downloaded to review and identify events that may have

contributed to the ALTE, and the data can be compared with the observer's account of the ALTE.

### Gastroesophageal Reflux

This is one of the most common diagnoses associated with ALTEs in infants. The question becomes whether the ALTE is associated with or caused by GER. In a systematic review of 8 studies involving 643 infants, GER was the most common diagnosis found in 227 (35%) infants [9]. However, the criteria for GER were variable and based on clinical grounds, pH studies, and radiological studies. A large prospective study from 1 site [7] found GER (based upon pH probe and upper GI series findings) in 69 (28%) of 243 infants evaluated. Evaluation for GER was 1 of 6 studies that aided in the establishment of a diagnosis when the history and physical examination were noncontributory. In a large multicenter study [10] using a database from 36 children's hospitals, the most common discharge diagnosis among 12 067 infants was GER; GER was diagnosed in 33.9% (4091 of 8964) of infants younger than 2 months and 45.8% (1421 of 3103) of infants aged 2 to 5 months. Again, there was a great deal of variability in diagnostic testing for GER, with sleep apnea testing, pH probe, and upper GI studies used. The problem with these findings is that GER is a common problem in infants. Gastroesophageal reflux, or frequent regurgitation without physiologic compromise, should also be differentiated from gastroesophageal reflux disease, which has physiologic compromise that may include esophagitis, growth failure, and respiratory problems.

Despite the frequency of the finding of GER in infants with ALTE, there is an abundant literature that presents a convincing argument that there is only a weak association between GER and documented apnea and bradycardia [15-17]. Among a subset of 21 infants being evaluated for apnea by polysomnography and pH probe monitoring for GER (defined as pH  $< 4$  for  $\geq 6$  seconds), of 741 apneas events, only 19% ( $n = 140$ ) were associated with reflux: 94% of the apneas (67% obstructive) preceded reflux, and only 6% followed the episode of reflux [15]. This lack of temporal relationship of ALTE and GER was also demonstrated in preterm infants [17]. Among 119 infants (gestational age mean  $\pm$  SD of  $28 \pm 2$  weeks at birth and  $37 \pm 4$  weeks at time of study), there were 6255 episodes of GER, with only 1% of these events associated with apnea of at least 15 seconds. There was no difference in the apnea rate before, during, or after GER; and GER did not prolong apnea duration.

These investigations raise the question as to the role of GER and its association with apnea and, as a result, the ability of GER to cause an ALTE. Studies are limited in that a clinically significant ALTE did not necessarily occur at the time of the recordings. The mechanism of a GER related ALTE may be through stimulation of laryngeal chemoreceptors resulting in a reflex response of apnea, bradycardia, and pallor or through laryngospasm resulting in



obstructive apnea. One must use caution in interpreting GER as the cause of an ALTE especially if there are coexistent diagnoses. However, ALTE may be related to GER when there are episodes that occur when the infant is awake and that are associated with gross emesis or regurgitation at the time of the ALTE. The history of formula in the nose and mouth or similar findings on the physical examination would support this diagnosis and lead to diagnostic testing for GER and a treatment plan for reflux.

## Infection

In the young infant, one must consider late-onset sepsis or meningitis as a possible cause of ALTE in the first weeks to first 3 months of life. Thus, a detailed history of the pregnancy, delivery, and newborn hospitalization is indicated. Etiologies may reflect the maternal, nursery, or postnatal environment; and the workup is directed to identifying an infection and appropriate antibiotic treatment.

The more common infections reported in infants with ALTEs are those related to the lower respiratory tract, with bronchiolitis, pertussis, and respiratory syncytial virus (RSV) being the most frequent [3,7,9]. Respiratory syncytial virus infection may present with prolonged apnea or as an ALTE more commonly in the young infant and those infants with a history of prematurity [18,19]. Passive immunization for RSV has reduced but not eliminated the disease; and RSV should remain in the differential of an infant presenting with an ALTE with a history of congestion, cough, or a sick contact. Rapid diagnostic testing for RSV along with other laboratory data can assist in making the diagnosis. Apnea related to RSV is typically self-limited and resolves with the resolution of the illness [19]. However, preterm infants who still have cardiorespiratory immaturity may have a longer period of resolution and may require monitoring.

## Seizures

Neurologic problems that are frequently diagnosed in infants with ALTE include intracranial hemorrhage, hydrocephalus, infection, or malformations. A history of birth trauma or prematurity is important to elicit. Breath-holding spells are also reported [7,9] and may be confused with a seizure. Although the onset of breath-holding spells is typically between 6 to 12 months of age, in a series of 95 patients with severe spells, 12% presented in the first 6 months and 5% within the perinatal period [20]. The history may reveal an inciting event that results in crying followed by apnea, which may result in pallor or cyanosis with altered tone and consciousness and is thus quite frightening to the observer. A positive family history may also support the diagnosis [20].

One of the most common neurologic diagnoses made in ALTE is seizures, both febrile and afebrile. Seizures can also be the result of a hypoxic event or prolonged apnea from another etiology such as RSV or pertussis bronchiolitis.

Therefore, seizures may be the presenting diagnosis in the ED but not be the final diagnosis upon hospital discharge. A description of the event may include eye fluttering, staring, eye deviation, or stiffening; but often, the young infant may only have apnea and/or cyanosis as the presenting signs of a seizure. Electroencephalogram (EEG) recordings may not be diagnostic because the interictal EEG is generally normal, and repeated recordings or a video EEG recording over a prolonged period may be necessary.

## Child Abuse

Although less common, there should be a low threshold for the consideration of child abuse as an etiology. When there is a history of recurrent ALTEs, especially in an infant requiring resuscitation while in the care of the same person, the suspicion of child abuse, Munchausen syndrome by proxy, or intentional suffocation should be raised. In 1 study, abusive head injury was identified in 6 (2.5%) of 243 patients, of which 2 subsequently died in hospital [21]. Another study demonstrated intentional suffocation in 18 (12%) and fabrication in 7 (5%) of 157 patients with an ALTE who required cardiopulmonary resuscitation [22]. So that the diagnosis of child abuse is not overlooked, there must be continued vigilance. The history may reveal a caretaker (typically the mother) who appears dedicated, may have a health care background, and may have a personal history of unusual illnesses. Identification of child abuse is less complicated when signs of trauma or neglect are evident on physical examination. A fundoscopic examination [23], skeletal survey, neuroimaging, and toxicology screens may be revealing. These screens have been used to identify abuse as the cause for an ALTE, but have not been applied in a consistent manner to a study population of idiopathic ALTEs to determine if there is underreporting of child abuse among ALTE infants. Urine toxicology studies are useful to identify recent intentional or unintentional exposure to drugs, and long-term exposure may be identified by hair analysis. Investigators have also used covert video recordings to confirm suspected cases of intentional suffocation and Munchausen syndrome by proxy [22,24]. In all these scenarios, the safety of the infant is of paramount importance to avoid returning the infant to an unsafe environment.

## The Term Infant with ALTE in the First Week of Life

Apparent life-threatening events occurring in newborns have been reported in the literature. A report from Sweden [25] over a 5.5-year period identified 13 infants aged 9 to 91 hours of life who experienced an ALTE: 3 did not survive the resuscitation, no cause was found in 7, and 4 died later, 2 of which had neonatal sepsis. Another report from a tertiary referral center [26] identified over a

5-year period 10 previously healthy term infants aged 15 hours to 3.5 days who experienced an ALTE: 5 of these neonates died; and in the other 5, the workup was unrevealing. Over a 3-year period with 15 000 births at a hospital in Washington, DC, there were 20 previously healthy term infants with an ALTE in the first 3 days of life, with half of the events occurring on day 1 [27]. Potential causes were found in 40% of infants, which included airway obstruction, delayed transition, and neurologic disorders. These studies highlight that ALTEs do occur in the early newborn period although infrequently. They occur in a heterogeneous group of infants who require a thorough investigation and may have a high risk for mortality. In an effort to better define and separate events that may be related to transition to extrauterine life, the definition of a postnatal age of greater than 12 hours may be a useful addition to the diagnosis of an ALTE [14] in the newborn period.

## Relationship Between ALTE and Sudden Infant Death Syndrome

The complete definition of ALTE in 1986 by the National Institutes of Health Conference on Infantile Apnea and Home Monitoring included that “in some cases, the observer fears that the infant has died. Previously used terminology such as ‘aborted crib death’ or ‘near-miss sudden infant death syndrome (SIDS)’ should be abandoned because it implies a possibly misleading close association between this type of spell and SIDS [1].” It has taken 20 years since that conference, amid significant controversy, to attempt to abandon the close association of ALTE and SIDS. Earlier studies described an association of increased mortality in infants with prior ALTE and recurrent apnea [28], and prior ALTE events occurred in less than 7% of infants who died of SIDS [1]. It is important to note that most SIDS victims do not experience a prior ALTE. Earlier studies have had methodologic differences that include reliance on parent reports that are subject to recall bias. Another obscuring factor is the lack of adequate death scene investigations. Subsequent data have emerged that argue against the relationship of ALTE and SIDS. Infants with ALTE typically have a benign outcome but are a heterogeneous group, and some infants may have an increased risk of death; but there is no evidence that the mechanism is similar to SIDS. A different time course is evident for SIDS and ALTE. Most infants with ALTE experience their events at a younger age (8 weeks) than those who die of SIDS (18 weeks) [6]. Data from the CHIME study that monitored 1079 infants (detailed above) demonstrated that the resolution of extreme events occurred before the time of the peak incidence of SIDS, suggesting that extreme events were not a precursor to SIDS [14]. In a prospective, population-based study [6], smoking was the only risk factor that was found to overlap

with both ALTE and SIDS. In addition, comparing risk factors of those infants with an ALTE enrolled in the CHIME with known SIDS risk factors demonstrated that the CHIME ALTE infants were younger, less frequently of low birth weight or growth restricted, and had fewer teenage mothers, suggesting that the 2 populations are different [29]. Risk reduction strategies (such as the Back to Sleep Campaign) that have been effective in reducing the incidence SIDS have not altered the incidence of ALTEs [6,30]. Currently, no conclusive evidence establishes a definitive link between ALTE and SIDS.

## Discharge Planning and Follow-up

The treatment and discharge plan should be tailored to the underlying etiology. Infants who demonstrate cardiorespiratory instability during their hospitalization should demonstrate stability before discharge. There may be infants as noted in the prior discussion of the convalescing preterm infant who may benefit from in-home monitoring because of resolving cardiorespiratory immaturity. In addition, monitoring may be indicated in some infants [31] because of the increased risk of sudden death.

Home memory monitoring has been useful in identifying an underlying pathology in infants with recurrent ALTEs when the initial evaluation was unremarkable and the diagnosis was determined to be idiopathic ALTE [22]. Clinical characteristics at the time of initial presentation such as skin color, tone, behavioral state, or degree of resuscitation were not significant factors predicting the recurrence risk of a subsequent event [32]. The risk of recurrence has not been well defined. Among 147 infants in a monitoring program (73 with ALTE), 53 (36%) had significant events and 46 (87%) experienced their first subsequent event within the first month of monitoring [12]. All infants being monitored for an idiopathic ALTE (107 term and 45 preterm infants) in CHIME had an increased risk for repeated extreme episodes; the difference only achieved significance for the preterm ALTE infants. When repeated events occurred, they occurred within 6 weeks of the prior event [14]. These studies support a duration of monitoring of 4 to 6 weeks after the initial event.

The decision to use home monitoring should be individualized. Thus, in certain infants, home monitoring may be a useful tool to help infants make the transition to home and to help the physician clarify the underlying mechanisms, natural history, and frequency of recurrence of ALTEs. As a standard of care, all home monitors should have event-recording capability [1] set with age-appropriate bradycardia alarms (80 bpm for an infant 34-44 weeks' gestation and 60 bpm for an infant greater than 44 weeks' gestation) and apnea thresholds (apnea alarms set at 20 seconds to alarm and record). Parents should be informed that there are no data indicating that monitors save lives and must understand that the purpose of monitoring is to alert the caretaker to a potentially life-

threatening event. There should be a support system in place for the family with appropriate teaching, cardiopulmonary resuscitation training, and directions for monitor use. Appropriate techniques for stimulation or resuscitation of an infant should be highlighted to reinforce that an infant should not be shaken. In addition, all caregivers should be instructed in safe infant sleep practices that should include supine sleeping with the face uncovered and to avoid overheating. A safe sleep environment also requires a firm sleeping surface, no loose bedding or soft crib toys in the crib, and a smoke-free environment.

## Summary

An infant presenting to the ED with an ALTE remains a difficult clinical challenge. The history and physical examination are key to directing the diagnostic workup. There is no standard evaluation for an infant with an ALTE. Currently, in-hospital observation and monitoring remain an accepted treatment for young infants and especially for those with repeated ALTEs. In young infants, prematurity plays a significant role in the diagnostic possibilities that include GI, neurologic, and infectious disorders. The goal is to identify a treatable cause that will serve to define the expected natural history. Evidence is lacking regarding the true risk of subsequent events and death vs the perceived risk of death. Diagnosis and treatment are complicated by the heterogeneity of the group of infants with ALTE. Collaborative multicenter studies are needed to develop and refine best practice guidelines, to improve coding and diagnostic criteria for infants with ALTE, and to identify the true risk of adverse outcomes.

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