Apparent Life-Threatening Events: ED Evaluation and Disposition
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Background:
- An ALTE is defined as an episode which is
  - Frightening to the observer (usually a parent)
  - Characterized by apnea, color change (blue, pale, plethoric), change in muscle tone (usually limp), choking or gagging
  - Attempts to resuscitate occasionally included in definition
- Estimated incidence of 0.6/1000 infants
  - Accounts for 0.6-0.8% of ED visits for children <1
- Historically, relationship between ALTE and SIDS (sudden infant death syndrome) has been controversial
  - SIDS = “the sudden death of an infant under 1 year of age that remains unexplained after a thorough case investigation, including performance of a complete autopsy, examination of the death scene, and review of the clinical history”
- Major concerns include
  - Risk of subsequent episodes or SIDS
  - Presence of serious conditions such as seizures, CNS abnormalities, cardiac abnormalities, sepsis, metabolic disorders, and child abuse.
- 2 major questions:
  - What (if any) diagnostic testing to do
  - Whether to admit
    - Home monitoring another issue
- No U.S. consensus statement or guidelines exist for admission or diagnostic evaluation for ALTE

Evidence: Diagnoses Associated with ALTE
McGovern 2004:
- Summarized 8 descriptive studies to define most common diagnoses found in pts with ALTE
- Most common diagnoses:
  - GERD = 31% of all diagnoses (dx by studies or clinical criteria)
  - Unknown = 23% (varied from 8-83% in various studies)
  - Seizure = 11% of total dx
  - Lower respiratory tract infection (LRTI) = 8% (eg: pertussis and RSV)
  - Other (ENT = 3.6%, Metabolic disease = 1.5%, Drug/toxin = 1.5%, UTI =1.1%, Cardiac =0.8%)
- Long-term follow up/prognosis
  - Recurrences varied from 0 to 24%
  - 5 deaths (0.8%) - 2 from severe GERD, 3 from rare metabolic conditions
- Overall, H and P estimated to reveal cause in 50% of infants
- Authors recommended initial investigative steps only in those in whom H and P is inconclusive

Evidence: Need for Admission
Claudius, 2007:
- Goal was to identify criteria for low-risk infants with ALTE who could be safely D/Cd from ED.
  - Prospectively followed infants <12mo with ALTE over 3 years (validation set needed!)
  - Included both well and ill-appearing children
  - Excluded those with h/o extreme prematurity, cardiac disease, seizure DO, developmental delay, chronic lung disease, or previous ALTE’s.
  - Children were managed per ED physician’s discretion, and followed for subsequent events, interventions or diagnoses mandating admission.
    - 1/3 of pts were contacted at 3 mo after event
  - Based on the follow-up, pts were categorized as hospitalization required (HR) or hosp not required (HNR) (eg: HR if subsequent events, pathologic condition requiring treatment, diagnosis for which pt would normally be admitted (eg: child abuse), development of life-threatening condition during hospitalization, etc)
- Results:
Of a total of 59 infants: 8 (14%) were placed in HR category.
Features of HR infants which were significantly different from HNR infants included:
- H/o mult ALTEs (OR of 4), age <1 mo (OR of 3.3), prematurity (OR of 14)
Model created to predict HR with 2 criteria: h/o multiple ALTE and prematurity
- All HR patients met these criteria, and 22 of the NHR infants met these criteria
- NPV of 100%, PPV of 57%, Spec of 27%
Of the 51 NHR pts, 47 were admitted
- Using above criteria, 26 of these infants (44%) could have been safely DC’d

Conclusions:
- Infants with multiple events, <1mo old, premature, “ill-appearing”: admission recommended
- Other considerations: social concern/abuse risk
- Also consider: family history, resuscitation required, multiple events at home, prolonged apnea

Bonkowsky, 2008:
- Goal was to characterize short and long-term risks for death, child abuse and abnormal neuro outcomes after ALTE, and identify clinical features associated with these outcomes.
- Prospective evaluation of 471 infants aged (0-12mo) hospitalized with ALTE
  - Excluded infants with pre-existing neuro disorder, or dx apparent at presentation (sepsis).
- Outcomes:
  - 2 pts died (1 of epilepsy, 1 of severe DD),
  - 11% eventually dx with child abuse (physical abuse = 0.9%; baseline rate is 0.02% ),
    - There were no clinical predictors for child abuse
  - 4.9% had adverse neuro outcomes (3.6% with epilepsy, 3% with DD). No cases of SIDS.
    - Neuro eval at time of ALTE did NOT predict chronic epilepsy.
    - Predictor of poor neuro outcome included family hx and male gender.
- Conclusions:
  - Children with ALTE are at risk for epilepsy, poor neuro outcomes, and child abuse.
    - However, few clinical predictors were found at presentation
  - Close FU essential, as at higher risk of subsequent child abuse (especially neglect)

Evidence: Diagnostic Testing
Brand, 2005:
- Goal was to determine yield of diagnostic testing in helping to identify the cause of ALTE
- Patients were classified into 4 categories based on contribution of H and P to diagnosis:
  - Dx based on tests ordered from + findings in H and P (both contributory) – 49%
  - Dx based on H and P alone (diagnostic tests noncontributory) – 21%
  - Dx based on tests ONLY (H and P noncontributory) – 14%
  - Cause unknown – 16%
- Overall, H and P contributory in 70% of pts, with testing confirmatory of suspected diagnosis
- Pts received average of 15.5 +/- 5.2 tests: 17.7% were positive; 33% of positive tests contributed to dx
- Tests most useful in pts WITH contributory H and P:
  - CBC, lytes, cultures, CSF, metabolic screening, resp pathogens, screening for GER,
- In those with noncontributory H and P, 5 tests identified ALL occult cases:
  - GER screening, UA/culture, head imaging, pneumogram, WBC count
- Conclusions:
  - H and P usually diagnostic or contributory (70% of cases)
  - For most tests, + results are rare and contributory + results even rarer.
  - Considering yield of test most helpful when H and P is non-contributory (eg; occult ALTE)
    - The subset of tests which identified ALL causes of occult ALTE (when H and P not revealing)
      - GER screening, UA/ex, brain neuroimaging, pneumogram, WBC count

Warren, 2007:
- Evidence-based review of appropriate evaluation for infant with ALTE
- Review of 3 prospective case series:
  - Davies (2002) found that lactate, CXR and GER testing most likely to be positive
  - Pitetti (2005) showed that infants with recurrent ALTE’s had higher rate of anemia (21%) than controls (9%) and those with only 1 ALTE (16.9%)
- Review of two retrospective case series (DePiero 2004, Gray 1999)

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Tests performed did not add any diagnostic info not already known from H and P
  i. Most common tests were; CBC< blood cx, electrolytes;
  ii. Most common discharge diagnoses were pertussis, hypoglycemia, anemia

- European recommendations (Kahn, 2003):
  a. Detailed H and P should guide all subsequent studies (recommend against treatment or monitoring without detailed medical evaluation)
  b. Options for testing (in no particular order) include: CBC, ABG, head CT, CXR, EKG, echo, EEG, GER eval, funduscopic eval, lytes, sleep study, tilt-table, toxicology, video surveillance, cultures

Percelay, 2008:
- Review article describing variation in practice
- Commented that Tieder et al (2008) found great variation in length of stay between institutions (1-day: 5-30%), (5-day: 20-40%). Most pts had CBC, CXR, but wide variation in use of sleep tests, EEG, etc.
- This likely reflects lack of consensus and absence of national guidelines
- Reducing variability within institutions will allow for comparisons of outcomes between institutions
- Also, no formal ICD-9 code exists for ALTE, current proposal by AAP to add ICD-9 code, which would allow further study.

Evidence: Relationship with SIDS/Need for Monitoring After ALTE
Esani, 2008:
- Goal was to compare risk factors between ALTE and SIDS:
- Found 4 similar characteristics (maternal smoking, %male, gest age, very low BW).
- 3 important differences:
  o Peak age: ALTE occurs in first 2 mon, SIDS peaked at 2-4 mo
  o Death rate: 0.6% for ALTE infants (if 7% of SIDS cases were in fact preceded by an ALTE, then higher death rates would be predicted in ALTE cohort)
  o SIDS moms younger
  o Higher rates of SGA in SIDS infants
  o Incidence of SIDS has decreased since Back to Sleep, while ALTE has not
- Conclusions:
  o Most evidence suggests that ALTE is NOT predictive of SIDS and that the 2 are of separate etiologies.

AAP Consensus Statement on Apnea, SIDS and Home Monitoring (2003):
1. Ideal use of home monitoring remains controversial, and has not been shown to prevent SIDS
   a. Providers should instead use proven strategies (smoking cessation, safe sleeping, CPR techniques)
2. Evidence supports limiting use of home monitors to specific circumstances:
   a. May be warranted for premature infants at high risk of recurrent episodes of apnea/bradycardia after hospital discharge, until 43 weeks gestational age OR cessation of extreme episodes
   b. May be indicated in infants with unstable airways, or medical conditions affecting regulation of breathing, or chronic lung disease

Recommendations: Diagnostic Testing and Management of Infants with ALTE
1. Suggested initial investigative plan in infant after first ALTE is presented in the algorithm below.
2. Diagnostic testing:
   - Testing should be guided by diagnoses suspected by H and P
   - Testing most likely to reveal a diagnosis includes testing for GER and testing for LRTI
   - Consider child abuse as a possible cause of occult ALTE
3. Admission
   - Admit infants with severe or prolonged episodes, when condition is likely to be progressive or not treatable (eg: pertussis, metabolic condition, seizures), or if further inpatient workup is indicated (eg: suspected child abuse)
   - CONSIDER in those in whom initial workup is unrevealing and/or parental anxiety is high
4. Home monitoring
   - Not routinely recommended in patients with ALTE, even when the cause is unclear.
   - CONSIDER in infants with recurrent ALTE’s or other risk factors for apnea (premature and <43 weeks post-conception, mechanical airway, chronic lung disease)
Proposed Evaluation of Infant Presenting to the ED with Apparent Life-Threatening Event (ALTE)

Initial assessment and complete H and P

- Is child ill-appearing, premature* or had multiple ALTE’s?
  - Yes: Stabilize patient, admit and proceed with further workup as indicated
  - No: Perform baseline investigative studies, guided by results of H and P and likelihood of diagnoses

- Brief, self-correcting episode clearly associated with feeding or with nasal congestion?
  - Yes: Reassurance and anticipatory guidance to family
  - No: Does H and P reveal the likely cause? (reflux, upper/lower airway infection, cardiac disease, possible child abuse)
    - Yes: Further investigation and treatment as indicated
    - No: Cause identified from baseline investigations?
      - Yes: Treatment and/or admission as indicated
      - No: Baseline Studies to Consider:
        - Workup for possible GER (milk scan, pH probe, upper GI)
        - Workup for respiratory infections (CXR, nasal wash, pertussis culture)
        - Screen for infection, anemia or electrolyte imbalance (CBC, lytes, blood culture)
        - Urine studies (UA, culture, tox)
        - Cardiac evaluation (CXR, EKG)
        - Neurologic evaluation (EEG, brain imaging)
        - Child abuse evaluation (retinal exam, skeletal survey, child protective services)
        - Metabolic evaluation (blood gas, lactate, pyruvate, ammonia, organic and amino acids)
        - Other (tox screen, CSF analysis, pneumogram)

- Admit for observation if < 1 month of age, episodes are severe or prolonged, or parental anxiety high
- Consider discharge with careful outpatient follow if reliable caregiver

*Premature = <32 weeks gestational age, and currently <43wks post-conceptional age