Apparent Life Threatening Events: Actual Life Threatening Events?

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This is an *Actual* Life Threatening Event
This has great potential...

Apparent Life Threatening Events: Another Lengthy Time-consuming Evaluation?

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Disclosures

- No financial disclosures
- No conflicts of interest

Objectives

- Define ALTE and associated clinical entities
- Discuss etiology and evaluation of ALTEs
- Examine future directions of ALTE management and research
Couple of Cases

Case 1

- 3 week old “lost his breath,” cyanosis, “got stiff and arched his back for 1 minute,” after that was “lifeless”
- Got CPR for one minute at home while waiting for EMS
- EMS arrives to find child crying in parent’s arms, transported to ED in same condition and you are called to evaluate them for possible admission
- What do you do?
Couple of Cases

- Case 2
  - 1 m/o female who 10 minutes after a “normal feed” spit-up, choked, gagged, turned blue, and became limp
  - Formula noted in mouth
  - Dad blew in child’s face and was about to call 911 when child started crying again
  - Parents bring to local ER where you are evaluating them
  - What do you do?

Thoughts about ALTE

- Not a diagnosis
- A constellation of signs and symptoms that are a result of underlying pathology
  - ALTE and shock simile
    - An ALTE has a cause as does shock
    - The skill is stabilizing patient until cause of either condition is found
Thoughts about ALTE

- Anxiety provoking
  - Parents just saw child “die”
  - We generally see a normal child
    - So what do I do?
- A point of consternation
  - Hard to tell who’s sick sometimes
  - Who gets big work-up?
  - Who can go home from office or ED?
  - Can breed complacency and missed diagnoses

“Remember that when there is nothing wrong, there is nothing wrong—except there is nothing wrong.”
- Harold G. Moore, LTG, USA-ret
First Things First...

- **Apparent life-threatening event (ALTE):** sudden event, frightening to the observer, in which the infant exhibits a combination of symptoms, including apnea, change in color, change in muscle tone, choking, gagging or coughing.

- **Apnea:** cessation of airflow for any reason
  - May be central, obstructive or mixed

- **Pathologic apnea:** lasts >20 seconds and accompanied by bradycardia, cyanosis, hypotonia or other signs of compromise

More Definitions

- **Periodic breathing:** 3 or more pauses, >3 seconds, but < 20 seconds and normal respiration in between

- **Sudden Infant Death Syndrome:** sudden death of a child without historical, physical, laboratory or post-mortem findings that explain the cause of death
Apnea of Infancy vs. Apnea of Prematurity

- AoI
  - TERM INFANT!
  - Unexplained pauses lasting >20 seconds
  - <20 second pauses with systemic compromise
    - Bradycardia, color change, hypotonia
  - Reserved for ALTE without identifiable cause

- AoP
  - Preterm infant
  - Same characteristics as AoI with relation to times and systemic signs
  - Usually resolves by 37 weeks gestation but may persist up to 43 weeks GA

Epidemiology

- ~1% of ER visits and ~2.5% of admissions
- Average LOS 4.4 days (±5.6 days)
- Mean adjusted charge
  - $15,567±$28,510
- 2.5% readmission rate
- Inpatient mortality ~0.6%
  - ~75% were <2 months old
- Variable resources utilization between hospitals and within hospital groups as well
Also of Note…

- **CHIME Study Group**
  - 43% of healthy term infants have at least one 20 sec apnea event in first 3 months of life
    - Irony is only about 5% of these events get reported or observed by parents
  - Premies—up to 76% had at least one severe apnea event
    - Risk normalized by 43 weeks PCA

Epidemiology

- **Kiechl-Kohlendorfer in 2004**
  - 2.46/1,000 live births
  - ALTE risk factors not identical to SIDS
    - Smoking was the only common risk factor
      - Thank goodness no one in Kentucky smokes...
So What?

- SIDS and ALTE are different
  - No ALTE kids went on to have SIDS
  - Mean age of ALTE was 8 wks
  - Mean age of SIDS was 18 wks with peaks at 12 and 36 wks
  - Back to sleep works for SIDS not ALTE

Take Home Message

- SIDS and ALTE are different
- Some programs reduce SIDS but not ALTE
- Smoking cessation may reduce BOTH
- Relatively low incidence
  - Despite the fact I seem to have 2-3 on service at any given time!
Pathophysiology

- Central Apnea
  - Disruption of brainstem respiratory output and neuromuscular response
    - Trauma, tumor, prematurity, congenital central hypoventilation syndrome

- Obstructive Apnea
  - Breathing through an occluded airway
    - Pierre-Robin sequence, adenotonsillar hypertrophy, foreign bodies, functional or dynamic obstructions, vocal cord paralysis

- Mixed Apnea
  - Components of both obstructive and central apnea
    - Adenotonsillar hypertrophy and sedation
    - GERD-Choking, bronchospasm and laryngeal chemoreceptor reflex central apnea
    - RSV-reflex central apnea due to altered laryngeal chemoreceptor sensitivity with airway inflammation

Differential Diagnosis

- ALTE and shock simile
  - Both are descriptions or clinical conditions
  - Have to consider a vast array of possible causes
  - Percentages of disease frequency are confusing
  - Will list in order of most common to less common
Differential Diagnosis

- Gastrointestinal
- Idiopathic
- Neurologic
- Respiratory
- Abuse/Neglect

- Metabolic/Endocrine
- Cardiovascular
- Miscellaneous infections
- Miscellaneous events

Differential Diagnosis

- Gastrointestinal (33)
  - GERD, gastroenteritis, esophageal dysfunction, colic, surgical abdomen

- Idiopathic (23)
  - About 20% of the time, the idiot (that’s me) can’t figure out the pathology

- Neurologic (15)
  - Seizure, head injury, central apnea/hypoventilation, CNS infection, hydrocephalus, mass, neuromuscular disorders, vasovagal reactions, congenital anomalies

(occurrence % listed in parentheses)
Differential Diagnosis

- **Respiratory (15)**
  - Infections, aspiration, reactive airway disease, dynamic/functional obstructions, foreign body

- **Abuse/Neglect (11)**
  - Shaken Baby, Munchausen-by-proxy, suffocation

- **Metabolic/Endocrine (1)**
  - Electrolyte disorders, hypoglycemia, inborn errors of metabolism

- **Cardiovascular (1)**
  - Congenital heart disease, cardiomyopathy, myocarditis, arrhythmias

- **Miscellaneous infections**
  - Sepsis, UTI

- **Miscellaneous events**
  - Anemia, drug reactions, physiologic events, breath holding, choking, hypothermia

- **So, in other words, think of everything!**
History is Paramount

- Chief Complaint
- History
  - Birth, Medical, Allergies, Medications, Family history, Maternal medications, Past ALTEs, Monitor use
- Abuse Red Flags
  - Recurrent ALTE, previous infant death in the care of the same person especially if caregiver is unrelated, discovery of blood in mouth or nose

Physical Exam is Just as Important

Uncle Billy says so

“Get the patient in good light. Use your five senses. We miss more by not seeing than we do by not knowing. Always examine the back. Observe, record, tabulate, communicate.”

Sir William Osler
Clinical Clues

- Caregiver-child interactions
- Stigmata of abuse
- Growth curve evaluation including head circumference
- Dysmorphic features

Diagnostic Evaluation

- Get ready, because my karma might run over your dogma!
- There is no peer reviewed, trial proven, standardized evaluation for apparent life-threatening events
Society for the Study of Prevention of Infant Death

<table>
<thead>
<tr>
<th>Standard procedures</th>
<th>Potential diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete child and family history</td>
<td>Infection, anaemia, asphyxia</td>
</tr>
<tr>
<td>Medical examination of the infant</td>
<td>Dehydration, hypo- hypercalcaemia</td>
</tr>
<tr>
<td>Complete blood count, pH, inflammatory tests</td>
<td>Hypoglycaemia</td>
</tr>
<tr>
<td>Blood electrolytes, urea, calcium, phosphate</td>
<td>Infection</td>
</tr>
<tr>
<td>Blood glucose</td>
<td>Upper airway infections</td>
</tr>
<tr>
<td>Virology and bacterial screening</td>
<td>Infection, metabolic screening</td>
</tr>
<tr>
<td>Nasopharyngeal aspirate</td>
<td>Infection, cardiacmegaly</td>
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<tr>
<td>Urinalysis and culture, liver enzymes</td>
<td>Arhythmias, QrTc anomyly</td>
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<tr>
<td>Chest X-ray film</td>
<td>Infection</td>
</tr>
<tr>
<td>Electrocardiogram</td>
<td>Abuse, shaken infant</td>
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<tr>
<td>Stool culture</td>
<td>Infection, haemorrhage, metabolic study</td>
</tr>
<tr>
<td>Ocular examination</td>
<td>Fracture, hypertension</td>
</tr>
<tr>
<td>Specific procedures</td>
<td>Seizure</td>
</tr>
<tr>
<td>Spinal fluid examination</td>
<td>Mass (tumour, haematoma)</td>
</tr>
<tr>
<td>Skull X-ray film</td>
<td>Congenital abnormalities</td>
</tr>
<tr>
<td>Electroencephalogram</td>
<td>Airway obstruction or abnormality</td>
</tr>
<tr>
<td>Brain CT scan or MRI</td>
<td>Congenital malformation, cardiac function</td>
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<tr>
<td>Osseousphalgal pH monitoring</td>
<td>Congenital metabolic abnormality</td>
</tr>
<tr>
<td>Osseousphalgal barium study (or CT scan)</td>
<td>Fractures, malformations</td>
</tr>
<tr>
<td>ENT study, laryngoscopy</td>
<td>Intoxication, drug effects</td>
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<tr>
<td>Echocardiography</td>
<td>Facial dysmorphism</td>
</tr>
<tr>
<td>Metabolic work-up</td>
<td>Cardiorespiratory, neurological or oxygenation abnormalities</td>
</tr>
<tr>
<td>Skeletal survey</td>
<td>Excessive autonomic responses</td>
</tr>
<tr>
<td>Toxicology</td>
<td>Abuse, Munchausen by Proxy</td>
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<tr>
<td>Craniofacial study and X-ray film</td>
<td></td>
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<tr>
<td>Sleep polygraphic study</td>
<td></td>
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<tr>
<td>Tilt or other autonomic tests</td>
<td></td>
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<tr>
<td>Video surveillance</td>
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Children’s National Medical Center

Thorough history from primary witness and physical exam

Was the event consistent with obstructive symptoms?

Yes →

Un accomplices, or history of pregnancy-related illness, nausea from an URI, or breath holding spell?

Yes →

Is the exam (including the spine) normal?

Yes →

Have you observed an organized and reassuring baby?

Yes →

Do you and the family feel reassured that the event is unlikely to recur and/or consistent with a generally benign process?

Yes →

Are there any features that could be the shaken baby?

Yes →

Urine Head U1. Urea Head U1. Positive?

Yes →

Is there any feature that could be the shaken baby?

Yes →

The diagnosis is consistent with a persistent unstable airway or abnormal respiratory control?

Yes →

Patient required resuscitation or parents unusually concerned?

Yes →

Discuss with the family the option of a home monitor

No →

Advisory patient and treat as indicated

Review discontinuation techniques, CPR techniques and SIDS risk factors

Ensure follow-up

No →

Involve CPS

Yes →

Discuss with the family the option of a home monitor
Still Don’t Like That?

**EXAMINATION:**
- To include SaO2 and endoscopy for haemorrhages

**AS SOON AFTER EVENT AS POSSIBLE:**
- Blood haemoglobin, glucose and lactate
- Chest radiograph
- ECG rhythm strip
- Postural swab for pertussis
- Urine microscopy
- Take blood and urine for storage (for inborn errors of metabolism and toxicology)

**Admit for period of observation**
- Consider contacting family practitioner/health visitor for information

IF EXAMINATION REMAINS NORMAL
- INFANT < 2 MONTHS OLD, AND
- LACTATE < 2.0 mmol/l

⇒

IF NOT, AND DIAGNOSIS REMAIN UNCLEAR AFTER 24 HOURS

- → reassure parents, offer resuscitation training and/or follow up appointment
- → consider further investigation* either at this stage or if AITE recurs

* Further investigation should consider the following disorders: gastro-oesophageal reflux, seizures, intracranial abnormalities, hypoglycaemia, cardiac arrhythmias and upper airway disorders. Consider factitious illness if AITE recurs.

What’s a Bloke to Do?

- **THINK!**
- **Consider** basic laboratory investigations
  - CBC, CMP, UA/Urine culture
  - ?lactate, ?EKG, ?CXR, ?EEG
- Observe a feed, if event associated around a feed
- Sepsis evaluation with appropriate cultures
How Beneficial is Testing?

- The more tests you do, probability states the more chance you have of getting a spurious result
- Diagnostic tests are more beneficial if performed based on contributing information from history and physical

How Beneficial is Testing?

- Brand in 2005 showed that diagnostic tests are positive only about 34% of the time
  - They contribute to a diagnosis only 6% of the time, most commonly UTI
  - Diagnostic tests may be better to rule out than rule in problems
How Beneficial is Testing?

- Altman *et al* in 2007 addressed the common concern of dogmatically performing a sepsis evaluation in a well appearing child
  - Retrospective study using Brand’s data
  - 90 infants with sepsis evaluations
  - 30 had serious bacterial illness
    - 25 had signs or symptoms
    - 5 who did not
      - 1 pneumonia, 4 UTI’s
  - All ALTEs should have UA/Ucx and CXR?

Take Home Message…

- The most important test is the LAP test
  - Look At Patient
- Keep the initial evaluation simple
- In a day and age of CPGs and algorithms, the evaluation of ALTEs requires thought and individual evaluation
Take Home Message…

- Diagnostic testing that was ordered based on information from the history and physical is beneficial
- Dogmatic testing is very low yield and expensive
- Low threshold for UTI screening

Discharge Planning

- Start this from time of admission
- Treatment aimed at the specific pathology or if none found, the chief complaint
- Basic resuscitation training
- Education on SIDS
- Consideration for an apnea monitor
A Few Final Issues

- ALTE and SIDS
- Apnea monitors
- ALTE and anemia
- Admitting all ALTEs
- Is a CPG possible?

Apnea Monitors

- AAP in 2003 recommended monitors for the following situations
  - Known unstable airway, abnormal respiratory control, technology dependent chronic lung disease
- CHIME study
- Obstructive apneas often missed
- Based on emotional stress, are they beneficial?
  - Abendroth, 1999, J Pediatr Health Care
ALTEs and Anemia

- When compared to controls, children with ALTEs do not have significantly different patient profiles
- When kids with single events vs. recurrent events were compared
  - Controls = 9.3% anemic for age
  - Single ALTE = 16.9% anemic for age
  - Multiple ALTE = 21.6% anemic for age

Do All ALTEs Need to be Admitted?

- Claudius and Keens, 2007, Pediatrics
  - Pilot study, small sample size, weakly powered
  - Showed that children with ALTE who were >1 month old and had only a single event could be discharged
- Multicenter trial needed and being planned
- Could reduce ALTE admissions up to 40%
Do All ALTEs Need to be Admitted?

- My answer is no
- It really does depend on your patient’s presentation and evaluation
- Dr. Maul’s 3Cs
  - Car, Communication, Clue
- Keep the evaluation simple and expand it as needed

Is a CPG Possible?

- Probably, and it is needed to help standardize ALTE care nationwide
- Currently in development between AAP Section of Hospital Medicine and Society of Hospital Medicine
  - Target release date is 2009-2010
Denouement

- **Case 1**
  - H&P found finger marks on posterior ribcage, retinal hemorrhages, admitted for suspected and eventually confirmed abuse

- **Case 2**
  - Simple choking event; “normal feed” = 8 oz, observed overnight without event, counseled on CPR, parents vehemently wanted monitor, didn’t get one

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**Reference List**

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Questions