Goals and Objectives

• Fill an hour with useless information.
• Avoid finishing early so there is no time for questions.
• Have enough money in my retirement plan so that in five years I can quit AMC and work part time at the LL Bean store.
• Go fly fishing in New Zealand.

General Symptoms of Respiratory Failure or Distress

• Grunting
• Flaring
• Retracting
Stridor (turbulent flow)

- Turbulent air flow in a narrowed upper or lower airway
- Sign of partial airway obstruction (most common cause is the tongue)
- May be inspiratory, expiratory, or both
- May be chronic or acute
- Can cause very impressive retractions

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Stridor (retropharyngeal abscess)
Stridor (epiglottitis)

Stridor (laryngomalacia)

Stridor (croup)
Stridor (tracheomalacia)

- At outset, similar to croup
- Secondary bacterial infection (mixed bacteria)
- High fever, child looks sick
- Diagnosis usually made at intubation
- Airway above the glottis is normal

Stridor (bacterial tracheitis)

- At outset, similar to croup
- Secondary bacterial infection (mixed bacteria)
- High fever, child looks sick
- Diagnosis usually made at intubation
- Airway above the glottis is normal
Stridor Rx

• Keep the child CALM
• Racemic Epinephrine
• Heliox
• IV or PO steroids

Wheezing

• Narrowing of small airway
• May be inspiratory, expiratory, or both
• May be chronic or acute
• Asthma in kids
• Bronchiolitis in infants
Asthma

- Viral
- Allergic
- Exercise
- Cold air
- Seasonal
- Emotional
- Cardiac
Asthma

Asthma Rx

- Albuterol— and LOTS of it!
- Steroids— IV vs. PO
- Ipratropium
- Mg SO4
- Ketamine
- Terbutaline
- Endotracheal Intubation

Bronchiolitis
Peribronchial Cuffing

Causative Agents

• RSV
• Parainfluenza
• Adenovirus
• Influenza
• Metapneumovirus
• Rhinovirus
• Enterovirus

Seen mainly in fall and winter months, but.................
...may also be seen in spring and summer!

**A Clinical Diagnosis**

- URI symptoms
- Poor feeding
- Tachypnea, Flaring, Retractions
- Decreased SaO2
- Wheezing
- Apnea (sometimes, without wheezing)

**Epidemiology**

- 21% of North American infants develop lower respiratory tract illness
- 3% of all children in first year of life are hospitalized with bronchiolitis
- RSV causes about 80% of cases
- Hospitalization for kids <1yr with bronchiolitis has doubled in last 20 years (22% to 47%)
The Treatment Junkpile

• Syringes of Subcu Epi
• Vials of IV RSVig
• Ampules of Interferon
• Boxes of Mist Tents
• Crates of SPAG units

Probably wasting time and money

• Inhaled furosemide
• DNase
• Antihistamines, decongestants, nasal vasoconstrictors
• Saline aerosols

Some say it works, some say it doesn’t

• Albuterol
• Racemic Epi (2 studies show it improves clinical score, improves oxygenation)
• Steroids (3 of 7 studies showed longer term decreased wheezing and decreased need for asthma treatment)
• Ipratropium (1 of 3 studies showed better oxygenation and shorter hospitalization)
Why test for viruses?

- Positive in 26 to 95% of patients
- May eliminate the “sepsis workup”
- Diagnosis is unclear (if positive, may decrease the worry about pertussis)
- Identify cohorts for patient rooms
- Epidemiology
- Evaluation of therapies

Management

- Suctioning of oral and nasal secretions
- Chest PT (may or may not be helpful)
- Start O2 when SaO2 is consistently < 91
- Trial of albuterol
- Add racemic epi if no response to albuterol
- IV fluids, NPO
- Abx based on history, physical, CXR (serious bacterial infection is present in less than 2% of pts. 60 days or younger)
- AAP Recommendations: Oxygen and Fluids

Discharge

- RR less than 60, no increased work of breathing
- Parent knows how to bulb suction
- On RA or O2 at a level low enough to be managed at home
- Adequate oral feeding
- Parent is OK with going home
- Meds- depends on patient response
Prevention

- Decrease exposure
- Handwashing / Isolation
- Palivizumab: for kids <2 with chronic lung disease or ≤ 32 wks. EGA
  - Debate about cost effectiveness continues
  - Medication: $3000 to $5000 per infant
  - Hospitalization: $12,000 to $120,000 per infant
  - Decreases hospitalization by 78% in premies < 6 mos., 39% in BPD, 55% in all infants
  - For children with CHD, BPD, Preemies
  - Use in immunodeficiency still up in the air

ALTE’s
What is it?

- An acute, unexpected change in an infant’s breathing pattern that frightens the caretaker
- May include:
  - Apnea
  - Color Change
  - Change in muscle tone
  - Choking or gagging
Apparent Life Threatening Events

The Challenges of ALTE

- ALTE is a “wastebasket” term and not a specific diagnosis
- ALTE is a syndrome
- ALTE can be caused by a variety of things with diverse pathophysiology
- Management needs to be individualized

Epidemiology

- ALTE was coined in 1986 by an NIH consensus conference on Infantile Apnea and Home Monitoring.
- Replaced terms such as “near miss SIDS” and “aborted crib death”
- Potential for overdiagnosis since the case definition depends on observations of scared and medically untrained caregivers
- Incidence of ALTE is .05 to 1 percent
Causes

GI (up to 50%)
• Gastroesophageal reflux
• Swallowing abnormalities
• Gastric volvulus
• Intussusception
• Other GI abnormalities

Neurologic (30%)
• Neurologic conditions affecting respiration
• Seizure disorder
• Febrile seizure
• CNS bleeding
• Vasovagal reflexes
• Hydrocephalus
• CNS infection
• Venticuloperitoneal shunt malfunction
• Malignancy
Respiratory (20%)
- Conditions affecting respiratory control (prematurity, central hypoventilation)
- Obstructive sleep apnea
- Vocal cord abnormalities
- Airway obstruction resulting from congenital abnormalities
- Foreign-body aspiration
- Laryngotracheomalacia
- Respiratory compromise from infection, respiratory syncytial virus, pertussis, mycoplasma, croup, other pneumonias
- Breath-holding spells

Cardiac (5%)
- Arrhythmia
- Long QT syndrome
- Wolff-Parkinson-White syndrome
- Congenital heart disease
- Myocarditis
- Cardiomyopathy

Metabolic (<5%)
- Inborn errors of metabolism
- Endocrine, electrolyte disorders
- Urinary tract infection
- Sepsis
- Other infections
Child Abuse (<5%)

- Events require CPR and occur only in the presence of a single caretaker
- Smothering (unintentional or intentional)
- Munchausen by proxy (suffocation, intentional poisoning, medication overdose)
- Diagnostic evaluation: no yield
- May require covert videography
- Abusive head injury (2003: of 243 babies admitted for evaluation of ALTE, 6 were diagnosed with head injury)

Other

- Food allergy (uncommon)
- Anaphylaxis
- Medication (prescription, over the counter, herbal remedies)
- Four calling birds
- Three French hens
- Two turtle doves
- And a partridge in a pear tree

Idiopathic

(approximately 50 percent)

- This is the medical term for “We don’t know what the hell is causing this problem.”
- In layman’s terms, it’s just like the fame of Kim Kardashian, the popularity of Justin Bieber, and Bob Dylan’s Christmas CD: something that defies all explanation and happened for no apparent reason
- This is a diagnosis of exclusion
Many of these can be eliminated based on the history, physical, and routine lab work.

Diagnosis

- Detailed history and physical alone can make the diagnosis in about 20% of cases
- Testing prompted by history and physical adds an additional 49%
- Most important diagnostic tool: detailed description of event and intervention required
- Determine whether the event was actually life threatening or just frightening

Frightening

Life Threatening
Parents: please circle one of the items in parentheses

- Little Johnny was (sleeping, eating) in his (crib, car seat, cardboard box) when he suddenly started to (choke, cry, cough, gasp) and stopped breathing for (10, 20, 30, 60, over 60) seconds. His (hands, feet, face, entire body) turned (pale, red, blue, gray). To get him breathing again (I, grandma, the babysitter, the Lone Ranger) started (patting his back, shaking him, mouth-to-mouth, CPR) and he started to (cough, cry, breathe, vomit, have a seizure). After that, he looked (fine, sick, dazed) and he acted (sleepy, irritable, normally, just like his pain-in-the-ass father). After that (EMS, the Fire Department, the Police, his father) was called and he was brought to (the Emergency Room, an Urgi-Care Center, his pediatrician) by (ambulance, car, taxi, bus, police car). When he arrived he looked (not so good, happy, normal, orange because of the Cheez Doodles).

Initial labs

- When an explanation is not available from history and exam
- CBC, lytes, CXR, EKG, Tox screen
- Most helpful tests: Urinalysis and culture, CT/MRI brain, Polysomnography
GERD

- Role of reflux in infants with ALTE is uncertain since all infants spit up and vomit
- Reflux may trigger laryngospasm
- Laryngospasm can also occur in the absence of reflux
- Austria: feeding difficulties (not just GERD) were associated with a greater than twofold increase in ALTE events
- Infant is usually miserable
- Treatment is not always effective
  - More likely to respond if emesis at the time of ALTE
  - More likely if episodes happen while awake and supine
  - More likely if component of obstructive apnea
NP Reflux and Aspiration

Polysomnography

- Heart Rate and EKG
- Thoracic and abdominal wall impedance
- Oximetry
- Nasal thermistor +/- ETCO2
- Esophageal pH
- + / - EEG
- “Pneumograms” are outdated and should not be used
- Extremely helpful in diagnosis of ALTE that is not readily apparent from history, physical, and labs

Central Hypoventilation
SIDS vs. ALTE

• ALTE is a heterogeneous group of problems that range from benign to near fatal. SIDS is fatal.
• Majority of SIDS victims do not experience apnea prior to death (i.e.- no causal relationship between pre-existing apnea events and SIDS)
• Over 80% of SIDS deaths are between midnight and 5 am
• Over 80% of ALTE’s happen between 8 am and 8 pm
• “Back to sleep” has not resulted in a decreased incidence of ALTE
• SIDS is a diagnosis, ALTE is a syndrome

Management

• Even if infant looks well, an ALTE must be taken seriously
• Requires in-hospital monitoring
• Medical or surgical treatment is possible in about 50% of patients with ALTE if a specific cause can be determined
Apnea

- Obstructive
- Central
- Sleep
- Infectious
- GERD
- Common to all are hypoventilation and hypoxia

Apnea (questions to ask)

- Has it happened before?
- How long did it last?
- What was the child doing when it happened?
- Any change in skin color?
- Any vomiting?
- What needed to be done for breathing to start again?

Apnea (differential diagnosis)

- Very broad!
- Seizures, infections, drug intoxications, aspiration, disordered respiratory center, head injury, anatomic abnormalities, cardiac disease, neuromuscular disease, metabolic disease, Munchausen’s by Proxy
Apnea (treatment)

- Usually none required other than observation
- Otherwise: basic airway support with oxygen, stimulation, bag/mask ventilation
- Possible: anti-reflux measures, caffeine, surgery, tracheostomy, etc.
- Note: if needing vigorous stimulation or bag/mask ventilation, consider intubation!

A note on the “blue baby”

- If saturations do not improve with oxygen, consider cardiac disease
- Tiring while feeding and feeding intolerance are early symptoms of CHF
- The younger and bluer the baby, the higher the likelihood of congenital heart disease
- If prostaglandins are started, be prepared to treat apnea

Between the Devil and the Deep Blue Sea
Definitions

• Drowning - dies within 24 hours
• Near Drowning - survives 24 hours
• Wet Drowning - aspiration of fluid
• Dry Drowning - no aspiration
• Immediate Disappearance Syndrome
• Warm water - > 68 degrees
• Cold water - < 68
• Very cold - < 41

New Definitions

• The World Congress on Drowning and the World Health Organization: “the process of experiencing respiratory impairment from submersion/immersion in liquid.”
• Outcomes: “death,” “no morbidity,” or “morbidity” (further categorized as “moderately disabled,” “severely disabled,” “vegetative state/coma,” and “brain death”).

Epidemiology

• WHO: 4th leading cause of death in 5-14 year olds, 11th in 0-4 year olds
• Est. 500,000 deaths annually worldwide
• US: 3rd most common cause of unintentional injury and 2nd leading cause of death in 1 to 19 year olds
• Temperate US: 70-90% of drowning deaths occur in pools
• Drowning rates have fallen steadily from 2.68 per 100,000 in 1985 to 1.32 in 2006.
Yes, women ARE smarter than men:

- Adolescents more likely to drown in open water
- Teen drowning - 5 males:1 female
- Children ≤ 4 account for 60% of pool drowning accidents
- African American and Native American children have higher risk of death from drowning

Epidemiology (continued)

- 92% of survivors are found in less than two minutes
- 86% of non-survivors are found after 10 minutes
- 15% of all “drowning” admissions die in the hospital
- 20% suffer severe brain damage
Epidemiology (continued)

- 90% of all drownings occur within 10m of safety
- 40-45% occur during swimming
- 12-29% while boating
- 80% of ocean drownings occur in rips
- Pool drownings - missing from sight 5 minutes, in care of one or both parents
- Pools lacking fences are 60% more likely to cause drowning.

Pathophysiology

- instinctive drowning response
- breath holding
- increased PaCO2
- involuntary gasping
- fluid enters larynx
- laryngo and bronchospasm
- +/- aspiration
- hypoxia and dysrhythmias

<table>
<thead>
<tr>
<th>Water Temperature</th>
<th>Exhaustion or Unconsciousness in</th>
</tr>
</thead>
<tbody>
<tr>
<td>70–80° F (21–27° C)</td>
<td>3–12 hours</td>
</tr>
<tr>
<td>60–70° F (16–21° C)</td>
<td>2–7 hours</td>
</tr>
<tr>
<td>50–60° F (10–16° C)</td>
<td>1–2 hours</td>
</tr>
<tr>
<td>40–50° F (4–10° C)</td>
<td>30–60 minutes</td>
</tr>
<tr>
<td>32.5–40° F (0–4° C)</td>
<td>15–30 minutes</td>
</tr>
<tr>
<td>&lt;32° F (&lt;0° C)</td>
<td>Under 15 minutes</td>
</tr>
</tbody>
</table>
Cold Water Drowning

- 2 1/2 y.o. survived after 66 mins
- 51 y.o. survived after 45 mins
- 62 y.o. survived after 15 mins
- Core body temperature must fall rapidly
- Submerged dogs: core temperature dropped 7.5°C in 2 minutes
- “Diving reflex”- contribution may not be as great as once thought

Cold Water Drowning (continued)

- Seattle 1992- age < 20, water cold but rarely icy (no hypothermic protection): 92% of good survivors had core temp above 93.2. 61% of dead or PVS had core temp less than 93.2
- Finnish study- ped victims, water temp 61 deg.: no beneficial effect of hypothermia
- Sonoma County EMS: no bodies of water classify as “cold”, question resuscitation efforts for those submerged more than 10 minutes

Predictors of Good (intact survival) Outcome

- 68-90% of all children with submersion accidents have good outcomes
- CPR within 2 minutes
- Spontaneous respiration after CPR (especially if at the scene)
- CPR duration less than 10 minutes
- GCS > 6
- Submersion time < 5 to 10 minutes
Predictors of Poor (Death or PVS) Outcome

• age < 3
• submersion > 10 minutes
• anoxia/asystole > 25 minutes
• CPR delayed > 10 minutes
• Ongoing CPR (apnea, asystole) in ED or CPR beyond 25 minutes
• GCS < 5
• pH < 7.1
• blood glucose > 250
• water temp > 50 F

Who should be hospitalized:

• submerged beyond one minute
• was cyanotic or apneic
• required pulmonary resuscitation
• need to monitor mainly for development of pulmonary edema and/or aspiration

Prevention

• Pool fences can reduce drowning accidents by 50 to 90%
• 84% of drownings happen because of inadequate adult supervision
• About half of pool owners do not know CPR
• Almost 50% overestimate their own swimming skills
• 85% of children < 14 who drowned in boating accidents were not wearing a PFD
Counseling (0 to 4 yrs)

- Never leave child alone, empty all buckets, accompany to toilet
- keep phone at poolside
- learn CPR
- For docs: identify pool owners in your practice
- Swim Lessons?

Counseling (5 to 12 yrs)

- Encourage swim lessons
- Never swim alone or without adult
- PFD for boating or fishing
- Jumping/Diving
- Drowning risks in Fall/Winter

Counseling (13 and up)

- Alcohol and water activities
- Drugs and water activities
- Learn CPR
- Learn to swim
- Baby sitters: pool safety and CPR
Transport goals

- Get to child as quickly as possible
- Prevent further deterioration
- Get the child to a facility with the proper services
- Provide a level of care equal to the accepting facility (within the limits of the transport environment)

Referring MD decisions

- Go to another facility?
- Which one?
- Mode of transport- Car? Ambulance? Helicopter?
Responsibilities

- Quickly assess child
- Secure all tubes and lines
- Obtain consent
- Call receiving hospital
- ANTICIPATE PROBLEMS THAT MIGHT BE ENCOUNTERED ON TRANSPORT
- Safe movement of patient
- Ongoing monitoring during transport

Accepting MD

- Evaluate appropriateness of transport team and mode of transport
- Advise referring MD for initial care
- Advise referring MD until transport team arrives
- Once the transport team arrives, the accepting MD is responsible for care

Things to ask yourself:

- How far am I from “home”?
- Will the weather slow us down?
- Has the child’s condition improved, worsened, or stayed the same since I arrived here?
- Do I have all the equipment I might need readily available?