Evan's Story

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Botulism Overview
- Rare but serious paralytic illness caused by nerve toxin produced by:
  - *Clostridium botulinum*
  - Occasionally: *C. Inyricum or C. baratii*
- Five types of botulism: foodborne, wound, infant, adult intestinal toxemia, iatrogenic
- All forms can be fatal and are considered medical emergencies
**Clostridium botulinum**

- Rod-shaped bacteria found in soil that grow best in low oxygen conditions
- Can exist in a dormant state (endospore) until conditions are favorable
- Seven types of botulism toxin: A-G
  - A, B, E, F cause illness in humans

**Botulism in the United States**

- Average 145 cases reported yearly
  - ~65% infant botulism
  - ~20% wound botulism
  - ~15% foodborne botulism
  - Rare: adult intestinal toxemia & iatrogenic botulism
- Outbreaks
  - Foodborne: usually associated by home-canned food
  - Wound: most associated with black-tar heroin

**Symptoms of Botulism**

- Muscle paralysis caused by the bacterial toxin
- Classic botulism
  - Double / blurred vision
  - Drooping eyelids
  - Slurred speech
  - Difficulty swallowing
  - Dry mouth
  - Muscle weakness
- Infant botulism
  - Lethargic
  - Feed poorly
  - Constipation
  - Weak cry
  - Poor muscle tone
- Left untreated, symptoms may progress
  - paralysis of respiratory muscles, arms, legs, trunk
Infant Botulism

- Constipation is often the first sign
- Most recover completely, but severe cases can lead to paralysis or death
  - Fatality rate is less than 2%
- Clostridium spores are ingested
  - Spores germinate in large intestine, producing toxin
  - Different than foodborne botulism (ingest toxin)
- Spores are ubiquitous
  - Children and adults regularly ingest them, but rarely contract botulism
  - One possible cause of SIDS

Prevention of Infant Botulism

- Honey can contain Clostridium spores and has been linked to cases of infant botulism
  - In a US survey, 10% of honey samples contained botulism spores
  - CDC, American Academy of Pediatrics and National Honey Board recommend not giving honey to infants less than 12 months of age
- Most cases cannot be prevented
  - Bacteria found in dust and soil inside homes
  - On floors, carpets, and countertops even after cleaning

Infant Botulism & the Immature Gut

- The Clostridium spores are thought to travel with microscopic dust particles
  - Infants may breathe in spores
  - Spores mix with saliva and are swallowed
  - Rarely, adults with recent intestinal surgery or otherwise altered intestinal tracts have contracted botulism through ingesting spores
  - Therefore, researchers believe an incompletely developed intestinal flora may be to blame
Infant Botulism in Michigan 1985-2012

<table>
<thead>
<tr>
<th>Date</th>
<th>Gender</th>
<th>Toxin Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1985</td>
<td>Female</td>
<td>A</td>
</tr>
<tr>
<td>October 1985</td>
<td>Male</td>
<td>A</td>
</tr>
<tr>
<td>February 1989</td>
<td>Female</td>
<td>B</td>
</tr>
<tr>
<td>September 1991</td>
<td>Female</td>
<td>B</td>
</tr>
<tr>
<td>October 1991</td>
<td>Male</td>
<td>B</td>
</tr>
<tr>
<td>November 1997</td>
<td>Male</td>
<td>A</td>
</tr>
<tr>
<td>February 2002</td>
<td>Male</td>
<td>A</td>
</tr>
<tr>
<td>May 2012</td>
<td>Male</td>
<td>B</td>
</tr>
</tbody>
</table>

- 62.5% Male
- 50% toxin A; 50% toxin B

Case History

- 40 week c-section-birth weight 7 lb 12 oz/ now 6 months old
- Mom-31-Registered Dietician
- Dad-39-Engineer
- Caucasian/first child/Breast-fed exclusively
- Mild jaundice-resolved quickly
- Immunizations UTD
- Healthy/no medical issues
- No daycare/very sterile environment
Symptoms

- 5-13-12: Last bowel movement on 5-9-12 - weak, hoarse cry, fussy, feeding poorly
- 5-14-13: No wet diapers/went to AA-ER - given a suppository - sent home
- 5-14-13: Mom still concerned - saw PCP - referred back to ER - treated for dehydration - admitted to pediatric floor for decreased activity and mental status

R/O Diagnosis

- Dehydrated - 10%
- Blood glucose - 57 mg/dl
- Abd ultrasound and heat CT - negative
- R/O Meningitis - LP done - Protein - 32 White cells - 3
- R/O Sepsis
- R/O Endocrine Syndrome
- R/O seizures
- Mom put symptoms into WEB MD - Botulism first diagnosis she saw

Hospital Course - 5-16-12

- Limp and expressionless
- Very altered weak cry
- Poor, weak, suck
- Difficulty breathing
- Decreased responsiveness
- Pupils fixed and dilated
- R/O Botulism now a possible diagnosis
- Transferred to PICU
- Feeding tube inserted/Oxygen administered
Call from Dr. Ruta Sharangpani – MDCH

- Advised LCDPH of possible Infant Botulism case
- Requested CD nurse call and interview Mother
- Will do Botulism testing/only if treatment started/BabyBIG-available from California
- Testing expensive and takes time

Interview with Evan’s Mom

- Current weight 18#’s
- Uses teething rings about 6 times per day
- No honey consumption
- Exclusively breast-fed
- Had about one tablespoon rice cereal on 5-13-12/only time fed solids/they do have the box-Nature’s Best-taken to the hospital
- Extensive landscaping done a few weeks ago/organic cow manure/mulch/and flowers.
- Evan has never had bottled or well water

Interview continued

- No one else in the family ill
- Evan was sitting on a blanket in the yard/while Dad was doing yard work
- Evan had pictures done in the yard on 5-13-12
- Pets include two dogs and one cat-all well-cat is exclusively inside, dogs are primarily inside
- No re-modeling inside the home
Interview-continued

- Travel-only to St. Claire-MI-on Easter
- No daycare/no one else watched Evan
- Honey in the home-Dad has not had any for several months
- Maple Syrup in the home/Organic-Meyer brand/ Dad does use occasionally
- 5-11-12-Went to Mom’s sister’s house-played with 3 year old/and 11/2 year old cousins-they are well/played outside/sat in grass on a blanket

Case conference

- Environmental/Dr. Lawrenchuk/Tiffany Henderson-Regional Epidemiologist/Rebecca Cook-Nursing Supervisor/Linda Weiman-CD coordinator
- Discussed case/interview results
- Talked to Dr. Levine/U of M
- Decision to test/treat for Botulism
- BabyBIG ordered from California
- Stool testing started at state lab

Laboratory Testing: Infant Botulism (1)

1. Stool is diluted, spun until clear (supernatant) and prepared for mouse injection and for culture

2. Supernatant for mouse injection is divided into aliquots:
   a) Left untreated
   b) Treated with heat (inactivates all toxin types)
   c) Treated with enzyme (ensures toxin is active)
   d) Combined with antitoxin (neutralizes a specific toxin)
Laboratory Testing: Infant Botulism (2)

3. Samples of aliquots are injected into pairs of mice:

<table>
<thead>
<tr>
<th>Sample</th>
<th>Antitoxin</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat-treated supernatant</td>
<td>No Antitoxin</td>
<td>Inactivates Toxin</td>
</tr>
<tr>
<td>Enzyme-treated supernatant</td>
<td>No Antitoxin</td>
<td>May Help Activate Toxin</td>
</tr>
<tr>
<td>Supernatant</td>
<td>No Antitoxin</td>
<td>...</td>
</tr>
<tr>
<td>Supernatant</td>
<td>Antitoxin A</td>
<td>...</td>
</tr>
<tr>
<td>Supernatant</td>
<td>Antitoxin B</td>
<td>...</td>
</tr>
<tr>
<td>Supernatant</td>
<td>Antitoxin E</td>
<td>...</td>
</tr>
<tr>
<td>Supernatant</td>
<td>Antitoxin Trivalent ABE</td>
<td>Combination of 3 Antitoxins</td>
</tr>
</tbody>
</table>

Laboratory Testing: Infant Botulism (3)

4. Mice are observed for 4 days

5. Concurrently, the sample undergoes an enrichment process where the culture is grown for 4-7 days

Laboratory Testing: Infant Botulism (4)

6. If test is negative:
   a) No mice die during the 4-day observation
   b) Entire mice injection process repeated with enriched culture

7. If test is positive:
   a) Mice die if antitoxin *does not match* toxin type
   b) Mice live if antitoxin *matches* toxin type
Laboratory Testing: Infant Botulism (5)

8. To confirm initial positive results, organism is identified, purified, and grown in pure culture

9. Mice are injected with purified organism plus antitoxin

Case Test Results!

<table>
<thead>
<tr>
<th>Sample</th>
<th>Antitoxin</th>
<th>Testing Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supernatant</td>
<td>Antitoxin A</td>
<td>Mice died</td>
</tr>
<tr>
<td>Supernatant</td>
<td>Antitoxin B</td>
<td>Mice lived</td>
</tr>
<tr>
<td>Supernatant</td>
<td>Antitoxin E</td>
<td>Mice died</td>
</tr>
<tr>
<td>Supernatant</td>
<td>Antitoxin A, B, &amp; E</td>
<td>Mice lived</td>
</tr>
<tr>
<td>Supernatant</td>
<td>No Antitoxin</td>
<td>Mice died</td>
</tr>
</tbody>
</table>

- Testing results indicated botulism toxin B
- Do NOT wait for laboratory results to treat
- Lengthy testing process with many potential iterations
- Under the best circumstances, lab confirmation is achieved in approximately 65% of the cases that are clinically diagnosed
Preliminary Report

- Clostridium Botulism toxin type B

Clinical Course

- Received BabyBIG
- Within 24 hours improvement noted
- Started moving head from side to side
- 5-18-Passed swallow study for thickened liquids
- PT/OT started
- Discharged from the hospital 5-26-12

Recommendations for Parents

- **Precaution Duration**
  - The toxin is thought to be shed in the stool 90 days.
  - The bacterial organism is thought to be shed in the stool for 3-4 months.

- **Hand Hygiene**
  - Always practice good hand washing, especially after a diaper change. Soap and water or alcohol-based hand sanitizer can be used.
  - Use gloves with leaky diapers and if there are any cuts on the hands of the person changing the diaper.
Recommendations for Parents

- Soiled Clothing and Diapers
  - Soiled clothing should be washed using hot water as the heat inactivates the toxin.
  - It is important to keep dirty diapers away from other family members, visitors, and away from pets.
  - Perhaps an outdoor trash that has a lid, but whatever system works for the family.

Recommendations for Parents

- Vaccines
  - Administer inactivated vaccines according to immunization after baby has returned to health.
  - Live vaccines-discuss with PCP prior to administration regarding spacing of vaccines.

Recommendations for Parents

- Activities around others, including children
  - Diaper care should be done away from others, especially other children.
  - Do not share toys or other items that children may touch or put in their mouth.
  - There is no issue with visitors coming into the household.
Referrals

- Early On
- PT/OT
- Public Health follow-up
- MD follow-up
Resources

- Botulism. CDC.  
  www.cdc.gov/ncezid/divisions/dhf/diseases/botulism
- Infant Botulism and Honey. MT Sanford, E Atkinson, J Ellis.  