Botulism or *Clostridium botulinum*

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BIO 234
History of Botulism

- Named by a German physician John Muller, Botulism is derived from the Latin word for sausage
- The toxin was weaponized by multiple countries during the 1930s
- The disease was isolated in 1895 after an outbreak following a funeral involving smoked ham in a Belgian village

Facts

- In 2015, improperly home canned potatoes caused the largest outbreak of botulism in forty years
- The botulinum toxin is what is used in Botox injections
- Honey is known to contain Clostridium botulinum which is why it is recommended children less than twelve months old do not consume it
Case Study

• On a hot summer day in July of 1971 Banker Sam Cochran and his wife Grace (ages 61 and 63 respectively) sat down in their New York home to eat a bowl of cold Bon Vivant vichyssoise soup. Due to a funny taste, they decided not to finish the meal.
• Within 24 hours Banker was reported to have double vision, trouble speaking and was later admitted to the hospital where he would later die. Grace would be admitted as well and would remain there for 3 months receiving treatment for paralysis.
• The FDA confirmed the couple had ingested *Clostridium botulinum* in the soup. After recalling nearly 6,500 cans of the soup, five other cans contained traces of the disease.
Description and Virulence Factors

- *Clostridium botulinum* is a Gram positive, anaerobic, motile, rod-shaped bacterium
  - Seven forms (A, B, E, F only affect humans)
- The bacterium thrives in a habitat with high levels of oxygen. Lower levels are toxic to the cells.
- As seen to the right, the bacterium stains with a gentian violet stain. The circular shapes are spores produced by the cells. (see next slide)
Virulence Factors

- When under both normal and extreme living environments the bacterium will produce spores. A habitat which is lower in oxygen will cause these spores to germinate and produce a toxin.
  - While the spores can become the instrument to produce a deadly toxin, without germination they are harmless and are quite common.
Pathophysiology

- Botulism is a disease caused by the production of a toxin from the spores of Clostridium botulinum.

- Symptoms of the disease usually set in within 12 to 36 hours in a few different stages.

Symptoms

- Fatigue, weakness and/or vertigo

- Blurred vision, dry mouth and difficulty swallowing and speaking (vomiting, diarrhea, constipation and abdominal swelling also possible)

- Paralysis beginning with neck and arms, then moving to the respiratory muscles and lower body. There is no loss of consciousness
Modes of Transmission

- **Foodborne transmission**: the most common form of transmission for botulism, the toxin will be likely be ingested by consuming foods with low-oxygen packaging (canned, home canned, etc.)

- **Infant transmission**: occurring in children mostly under six months of age, this form takes place when an infant ingests the spores and the bacteria colonizes the gut, releasing the toxin.

- **Wound transmission**: a rare form of botulism caused by spores entering an open wound, generally seen through the injection of black tar heroin

- **Other forms**: while extremely rare, inhalation botulism is a possibility if the toxin is weaponized through an aerosol
Diagnosis, Prevention and Treatment

- **Diagnosis** for botulism occurs when a patient is assessed based on symptoms and history, along with other specialized tests
  - It is important to differentiate between botulism and other diseases with similar symptoms such as stroke and myasthenia gravis

- As of now the only preventative measure known are safe food cooking practices, avoiding injectable street drugs and feeding children less than 12 months of age honey or corn syrup

- Depending on the severity of the disease at the time of diagnosis, **treatment** will always include an antitoxin. If the patient has become paralyzed, he or she may need to be in intensive care or on a ventilator for an extensive period of time
During 2014, 161 laboratory confirmed and 16 probable cases of botulism were reported to the Center for Disease Control.

Oregon reported 1 of these cases (foodborne).

2014 had the highest number of reported botulism cases in the previous 5 years.
Table 1. Summary of reported botulism cases – United States, 2014

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Median Age</th>
<th>Gender</th>
<th>Death</th>
<th>Toxin type</th>
<th>Exposures</th>
<th>Outbreaks*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Foodborne-Confirmed (15 cases)</strong></td>
<td></td>
<td>53 years (range: 8–85 years)</td>
<td>7 (47%) male, 8 (53%) female</td>
<td>2 confirmed</td>
<td>4 (27%) type A, 4 (27%) type B, 7 (47%) type E</td>
<td></td>
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<tr>
<td><strong>Foodborne-Probable (5 cases)</strong></td>
<td></td>
<td>53 years (range: 28–86 years)</td>
<td></td>
<td>0 confirmed</td>
<td></td>
<td></td>
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<tr>
<td><strong>Infant (128 cases)</strong></td>
<td></td>
<td>17 weeks (range: 2–54 weeks)</td>
<td>69 (54%) male, 59 (46%) female</td>
<td>0 confirmed</td>
<td>56 (44%) type A, 71 (55%) type B, 1 (&lt;1%) type Bf</td>
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<tr>
<td><strong>Wound-Confirmed (16 cases)</strong></td>
<td></td>
<td>53.5 years (range: 21–66 years)</td>
<td>13 (81%) male, 3 (19%) female</td>
<td>1 confirmed</td>
<td>15 (94%) type A, 1 (16%) type not specified</td>
<td>16 (100%) injection drug users</td>
<td></td>
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<tr>
<td><strong>Wound-Probable (11 cases)</strong></td>
<td></td>
<td>34 years (range: 23–55 years)</td>
<td>8 (73%) male, 3 (27%) female</td>
<td>0 confirmed</td>
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<tr>
<td><strong>Unknown, Other (2 cases)</strong></td>
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<td></td>
<td></td>
<td></td>
<td>2 (100%) type A</td>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>
Importance of Botulism in Research

• Botulism remains a very viable subject in research due to its severity during infection and the possibility of use as a bio-weapon. Despite biological weapons having been banned since 1975, cases within the last 25 years have sprung up in which governments or cults have weaponized the toxin (Iraq and Japan). Research should push to eradicate botulism as a threat to society no matter the transmission form.
References


• Clostridium botulinum Neurotoxins. Retrieved July 13, 2016, from https://microbewiki.kenyon.edu/index.php/Clostridium_botulinum_Neurotoxins In-line Citation: (“Clostridium botulinum Neurotoxins,” n.d.) – **Microbiology Wiki page on Clostridium botulinum**

• Erbguth, F. J. (2004). Historical notes on botulism, Clostridium botulinum, botulinum toxin, and the idea of the therapeutic use of the toxin. *Movement Disorders, 19*(S8), S2–S6. doi:10.1002/mds.20003 In-line Citation: (Erbguth, 2004) - **Scientific journal article written on the history and future of botulism and the bacterium**

• Ross, N. (1972, July 5). Botulism: The Tragedy At Bon Vivant. *The Ledger*. Retrieved from https://news.google.com/newspapers?nid=1346&dat=19720705&id=84xOAAAAIBAJ&sjid=bfoDAAAAIBAJ&pg=6772,1410985&hl=en In-line Citation: (Ross, 1972) - **News article from 1972 on the Bon Vivant botulism outbreak and the company’s demise**
