Botulism

CHAPTER CONTENT

The following chapter is adapted with permission from Alberta Health, for additional guidance related to the management of Botulism see: Alberta Public Health Disease Management Guidelines: Botulism.

1. CASE DEFINITION

Confirmed Cases

- *Clostridium botulinum* (*C. botulinum*) and its toxin cause several different types of illness, each type is uniquely defined and confirmed
  - **Foodborne Botulism**
    - Clinical illness* with laboratory confirmation of intoxication:
      - Detection of botulinum toxin in serum, stool, gastric aspirate, or food** ***OR***
      - Isolation of *C. botulinum* from stool or gastric aspirate ***OR***
      - Clinical illness* and indication the client ate the same suspect food** as an individual with laboratory confirmed botulism
  - **Wound Botulism**
    - Presence of a freshly infected wound in the 2 weeks before symptoms and no evidence of consumption of food contaminated with *C. botulinum* **AND** laboratory confirmation of infection:
      - Detection of botulinum toxin in serum ***OR***
      - Isolation of *C. botulinum* from a wound

- **Infant Botulism**
  - Laboratory confirmation with symptoms compatible with botulism in a person less than one year of age***:
    - Detection of botulinum toxin in stool or serum **OR**
  - Isolation of *C. botulinum* from the patient's stool or at autopsy
- **Intestinal Colonization Botulism**
  - Laboratory confirmation with symptoms compatible with botulism in a patient aged 1 year or older with severely compromised gastrointestinal tract functioning (i.e. abnormal bowel) due to various diseases, such as colitis, or intestinal bypass procedures, or in association with other conditions that may create local or widespread disruption in the normal intestinal flora:
    - Detection of botulinum toxin in stool or serum **OR**
    - Isolation of *C. botulinum* from the patient's stool or at autopsy

Probable Case

- **Foodborne**
  - Clinical illness* and consumption of a suspect food item** in the incubation period (12-48 hours)

Suspect Case

- **Foodborne**
  - Clinical illness* in a person without laboratory confirmed infection or an epidemiological link

*Clinical Illness is characterized by diplopia, blurred vision, and bulbar weakness. Symmetric paralysis may progress rapidly.

**Identification of organisms in a suspected food is helpful but not diagnostic because botulinum spores are ubiquitous. Therefore, the presence of toxin in a suspected contaminated food source is more significant.

***Clinical illness in infants is characterized by constipation, loss of appetite, weakness, altered cry, and loss of head control.

2. DIAGNOSIS

- Botulism diagnosis is based primarily on clinical presentation and should be suspected in a person with:
  - Acute onset of gastrointestinal dysfunction,
  - Autonomic dysfunction (such as dry mouth or difficulty focusing eyes),
  - Cranial-nerve dysfunction (diplopia, dysarthria, dysphagia),

- The diagnosis is even more likely if the patient has recently eaten home-canned foods or if family members/companions who have shared the same meals are similarly ill
- Specimens should be obtained and sent **in consultation** with the Microbiologist on call at the ProvLab
  - Please see the ProvLab "Guide to services" for specimen collection
- Testing of samples for suspect cases of botulism will be coordinated through the CPHO (or designate)
- Most specimens collected (food and clinical) are sent by the ProvLab to the Botulism Reference Laboratory in Ottawa, Ontario
- Electromyography (EMG) studies may be useful in establishing the diagnosis of botulism
- EMG may be helpful if distinguishing botulism from Myasthenia Gravis and Guillain-Barre´ Syndrome, diseases that botulism often mimics closely
  - This test is very uncomfortable and should not be requested unless botulism is a serious consideration
- Laboratory evaluation includes anaerobic cultures and toxin assays of serum, stool, and the implicated food if available
- Cases caught early are more likely to be diagnosed by the toxin assay, whereas those studied later in the disease are more likely to have a positive culture than a positive toxin assay
- The most sensitive test for toxin remains the mouse bioassay
- Toxin excretion may continue up to 1 month after the onset of illness, and stool cultures may remain positive for a similar period
- For more information, refer to the Public Health Laboratories (formerly ProvLab) Laboratory Services and the Botulism Reference Service for Canada

3. REPORTING

Health Care Professionals

- Confirmed or probable cases are to be reported to the Office of the Chief Public Health Officer (OCPHO) by telephone (867) 920-8646 **immediately *AND***
- Complete and fax (867) 873-0442 the NWT Communicable Disease Report Form and the Food and Waterborne Illness Investigation Form to the OCPHO within **24 hours.**
- **Immediately** report all outbreaks or suspect outbreaks by telephone (867) 920-8646 to the OCPHO.
  - ➢ In foodborne botulism, one case is considered an outbreak

Laboratories

- Report all positive results to the OCPHO by telephone (867) 920-8646 **immediately *AND***
- Fax (867) 873-0442 all positive results to the OCPHO **within 24 hours**

Note:

- The Botulism Reference Service for Canada is the only laboratory that can do toxin detection and culturing of *C. botulinum*
- Prior to sending specimens, consult the Botulism Reference Service for Canada

4. OVERVIEW

Causative Agent

- Botulism is caused by toxins produced by *Clostridium botulinum*, a spore-forming obligate anaerobic bacillus
- Only a few nanograms of the toxin is needed to cause disease and botulinum toxin is considered the most potent lethal substance known to humankind
- Human botulism is primarily caused by the strains of *C. botulinum* that produce toxin types A, B, and E
- Strains of *Clostridium baratii*, which produce type F toxin and *Clostridium butyricum* which produce type E toxin, have also been implicated in human botulism
- Type G has been isolated from soil and autopsy specimens, but an etiologic role has not been established
- Most cases of infant botulism have been caused by type A or B
- Conditions that promote germination and growth of *C. botulinum* spores include,
  - Absence of oxygen (anaerobic conditions),
  - Low acidity (pH > 4.6),
  - Temperatures > 4ºC,
  - High moisture content

Clinical Presentation and Major Complications

For information regarding the presentation and complications of Botulism see Alberta Public Health Disease Management Guidelines: Botulism.

Transmission

- **Foodborne botulism**
  - Foodborne botulism is caused by toxins which can be produced in:
    - Improperly canned, low acid foods

  - Pasteurized and lightly cured foods held without refrigeration, especially if stored in airtight packaging
- Newer varieties of certain garden foods such as tomatoes, formerly considered too acidic to support growth of *C. botulinum*, may now be higher risk foods for home canning
- Most poisonings in North America are due to home-canned vegetable and fruits
- Changes in the epidemiology of botulism have emerged in the past few decades
  - Recently identified modes of transmission include:
    - Homemade salsa
    - Uneviscerated fish
    - Baked potatoes sealed in aluminum foil
    - Cheese sauce
    - Improperly handled commercial potpies
    - Sautéed onions
    - Minced garlic in oil
    - Home-prepared pickled eggs
    - Home-prepared fermented tofu
- Type E outbreaks are usually related to fish, seafood, and meat from marine mammals
- Type E toxin can be produced slowly at temperatures as low as 3ºC (37.4ºF), which is lower than that of ordinary refrigeration
- Foods commonly found contaminated with botulism toxin type E in the North include:
  - Walrus
  - Seal or whale blubber (muktuk)
  - Meat aged in tightly sealed containers
  - Fermented fish eggs/heads
  - Fish
  - Seafood

- **Wound Botulism**
  - Wound botulism occurs when *C. botulinum* contaminates a wound and is accompanied by anaerobic conditions that allow for in-vivo toxin production in the wound
  - Historically, the primary cause of wound botulism was due to soil contamination from a penetrating trauma or crush injury but in the past decade, parenteral drug abuse related cases have surpassed those related to trauma
  - Most cases of wound botulism are associated with the intramuscular or subcutaneous injection of (contaminated) black tar heroin as well as sinusitis in those who snort cocaine

- **Infant botulism**
  - Infant botulism results from the ingestion of *C. botulinum* spores (rather than by ingestion of preformed toxin) that then germinate in the intestinal tract and produce toxin
  - The infant's intestinal flora is thought to be particularly permissive for the germination of spores, which leads to the production of toxin
  - Although the source of ingestion in most cases is unknown it is thought that the spores are acquired from environmental sources in which botulinum spore counts are high
    - Possible sources of spores for infant botulism include foods and dust
      - Persuasive evidence that links infant botulism to corn syrups or other syrups is lacking
      - Random sampling of honey shows that less than 5% of honey products produced in Canada contain the bacteria spores
- **Adult intestinal toxemia botulism**
  - Intestinal botulism, although rare, can also occur in older children and adults after intestinal surgery, in the presence of inflammatory bowel disease and with exposure to antimicrobial agents
- **Inhalation botulism**
  - Inhalation botulism has occurred in laboratory workers
  - Studies in monkeys indicate that, if aerosolized, the toxin can also be absorbed through the lungs, but the incubation period may be slightly longer than that for foodborne botulism
- **Iatrogenic botulism**
  - Iatrogenic botulism occurs from accidental injection of the botulism neurotoxin into systemic circulation

Incubation Period

- **Foodborne and Inhalation Botulism**
  - Neurological symptoms appear within 12 – 36 hours (range is 6 hours to 8 days) after toxin ingestion
  - Generally, the shorter the incubation period, the more severe the disease and the higher the case fatality rate
- **Wound Botulism**
  - Usually 4 – 14 days from the time of injury until the onset of symptoms
- **Infant Botulism**
  - The incubation period is estimated at 3 – 30 days from the time of exposure to the spore-containing substance

Clinical Guidance

- For patient-specific clinical management consult your local healthcare professional, paediatrician, infectious disease specialist, or NWT Clinical Practice Guidelines

5. PUBLIC HEALTH MEASURES

Key Investigations

- Contact the Microbiologist-On-Call at the ProvLab for information on collection and transportation of both food and clinical specimens
- Notification of a suspicion of a single case of botulism constitutes a public health emergency and may herald the beginning of a larger outbreak
- Investigation of a suspect case of botulism includes a search for other possible cases, identification of suspect food exposures, and diagnostic testing of both cases and foods as needed
- Efforts to locate persons exposed to the same suspect food may lead to early diagnosis and/or instituting an emergency product recall
- **Foodborne Botulism**
  - Involve environmental/public health inspectors and Canadian Food Inspection Agency
  - Collect food samples and forward to the laboratory for toxin analysis
  - Take a detailed food history of those who are ill, especially foods consumed within the last 2-3 days
    - Include consumption of home-preserved foods and traditionally prepared foods
    - Even theoretically unlikely foods should be considered
  - *C. botulinum* may or may not cause container to bulge and the contents to have "off-odours"
  - Other contaminants can also cause cans or bottle lids to bulge
  - **Before administering the antitoxin**
    - Collect clinical samples (sera, gastric aspirates, and stool) from patients
    - When indicated, collect clinical samples (sera, gastric aspirates, and stool) from others exposed but not ill
    - Forward all samples immediately, with relevant clinical history, to the ProvLab
  - Identify individuals who may have been exposed to the same source
- **Infant Botulism**
  - Investigate source, in particular, history of honey consumption
  - Identify individuals who may have been exposed to the same source
- **Wound Botulism**
  - Contact the physician to determine the possible source of infection

- Determine history of trauma, or intravenous drug use (IDU)
  - Following confirmation of IDU forward sample of drug for testing, if possible
- Identify individuals who may have been exposed to the same source

Management of Cases

- Persons with botulism require immediate emergency medical treatment
  - **Treatment must not await laboratory confirmation**
- Hand washing and other routine practices are indicated
- Management requires:
  - Supportive care,
  - Respiratory and nutritional laboratory testing of appropriate specimens,
  - Rapid availability of antitoxin
- A consultation with an Infectious Disease Specialist and the CPHO (or designate) is required prior to administration of antitoxin
- Botulism antitoxin is given to all who have eaten the contaminated source and are exhibiting signs and symptoms of botulism
- Refer to product monograph regarding skin tests for sensitivity to antitoxin
- Recovery may take months, and deficits may persist indefinitely
- When investigating infant botulism, ingestion of honey or corn syrup should be ruled out
- Test and recover all suspect food, especially food consumed in the 2 - 3 days prior to onset of symptoms
- Home preserved foods are a prime suspect until ruled out
- A supply of botulism antitoxin to *type A, B, C, D, E, F, and G* must be available at Stanton Territorial Hospital in Yellowknife, and the Inuvik Hospital, as well as the Sachs Harbour, Paulatuk, Ulukhaktok, Tuktoyaktuk, and Aklavik Community Health Centers
- No immunity is conferred, even following severe disease

Management of Contacts

- Environmental Health:
  - Determine method of transmission of *C. botulinum*
  - Determine the source from which it was transmitted
  - Contain and isolate the suspected source
  - Ensure appropriate samples are taken and laboratory specimens are appropriately forwarded
  - Consult CPHO or (designate)

- OCPHO:
  - Identify others who may have been exposed, or who present with similar clinical indicators of illness
  - Contacts should be kept under close medical supervision
  - Botulism is not passed person-to-person, therefore, direct contacts of the index case do not require follow-up

  Prophylaxis
  - Botulism antitoxin (BAtx, equine) is used therapeutically in people with established or suspected botulism
    - Contact the OCPHO (867) 920-0442 to initiate a request
  - If antitoxin is required, it should be given within 1 – 2 days of ingestion of the suspect food
  - Testing for hypersensitivity to the equine antitoxin preparations should be carried out in accordance with the manufacturer's recommendations before the antitoxin is administered

Prevention

- Methods to control botulism should focus on the inhibition of bacterial growth and toxin production
- Manufacturers of commercially canned low acid foods use strict thermal processes which are designed to destroy spores of *C. botulinum*
- The Canadian Food Inspection Agency administers and enforces 13 Acts governing food safety and food inspection within Canada and at its borders
- Search for any remaining food from the same source that may be similarly contaminated and submit for laboratory examination
  - The implicated food(s) should be detoxified by boiling before discarding or the containers broken and buried deeply in soil to prevent ingestion by animals
- Contaminated utensils should be sterilized by boiling or by chlorine disinfection to de-activate any remaining toxins
- Usual sanitary disposal of feces/diaper from infant cases
- Educate the public about safe handling of food:
  - Do not use food from damaged or bulging containers; these containers should be returned unopened to the vendor
  - Foods with off-odors and unusual tastes should not be eaten or 'taste-tested'
  - Proper storage is key to food safety
    - Refrigeration slows down most bacterial growth
    - Encourage people to check the temperature of their fridge on a regular basis with a refrigerator thermometer
    - Set the refrigerator at or below 4°C (40°F)

  - Don't overload the fridge - cool air must circulate freely to keep food properly chilled
  - After grocery shopping, immediately refrigerate or freeze foods as indicated on the label
  - Storing food in non-airtight containers and at 4°C or lower will prevent growth of the bacterium
- Boil and stir home-canned foods (for at least 10 minutes) to destroy botulinum toxins
- Take precautions with home-prepared foods stored in oil (e.g., vegetables, herbs and spices)
- If these products are prepared using fresh ingredients, they must be kept refrigerated (below 4ºC) and for no more than 10 days
- If the above products are purchased from fairs, farmer's markets, roadside stands or have been received as a gift, and prepared more than a week ago, discard them

- Avoid feeding honey to infants (even pasteurized)

- Provide information to Indigenous groups regarding food preparation traditions that pose a risk of botulism
  - The importance of refrigeration with home-canning methods
  - Heating food to temperatures high enough to kill the botulism toxin
  - Keep aging meats such as whale, seal, or walrus in a cool place (below 4°C), in containers that allow air in and, if aged in oil, keep in a cool place, and stir frequently to allow the meat to be in contact with air
  - Given the integral role of traditional foods and food preparation to the cultural practices of the NWT indigenous populations, it is essential that healthcare workers recognize the potential risk to these populations, while also respecting the significance and longevity of these cultural practices

- Promote research to evaluate the safety of traditionally prepared (high-risk) foods, and to identify the precise conditions under which botulinum toxin will be present or absent

- If wound botulism occurs in Injection Drug Users (IDU), educate regarding safe injection practices:
  - Do NOT inject into muscle or under the skin
  - Decrease the amount of citric acid used to dissolve the drug
    - Too much citric acid damages the tissues under the skin leaving them susceptible to bacterial growth
  - Studies have shown that when cocaine is mixed with heroin and when injected at the same site it gives bacteria a better chance to grow so, inject different drugs at different sites on the body
  - Teach IDUs signs and symptoms of infection(s) and to seek physician help especially if infection seems different than ones had in the past

- Laboratory safety
  - Botulism requires biosafety level 3 practices
  - Refer to the current Canadian Biosafety Standard

6. PUBLIC & HEALTH PROFESSIONAL EDUCATION

For more information about Botulism:

- The Government of Canada: Canada/ Botulism
- The Government of Canada: Botulism Reference Service for Canada
- The Government of Canada: Pathogen Safety Data Sheet: Botulism
- The Government of Canada: Botulism-Guide for Healthcare Professionals
- Centers for Disease Control and Prevention: CDC/ Botulism
- Centers for Disease Control and Prevention: CDC/ Clinical guidelines for Diagnosis and Treatment of Botulism
- World Health Organization: WHO/ Botulism

7. EPIDEMIOLOGY

- Botulism remains a relatively rare disease and was first reported in 1933
- This primarily affects First Nations and Inuit people and are linked to fermented salmon roe in British Colombia as well as fermented sea mammal meat and improperly stored meat among Inuit
- The NWT has reported 10 cases of botulism since 1989
- Sporadic activity continues to occur in NWT coastal communities
- For more information on the epidemiology of Botulism in the Northwest Territories (NWT) see: Epidemiological Summary of Communicable Diseases HSS Professionals

8. REFERENCES

Information for this chapter was adapted with permission from Alberta Health's Public Health Disease Management Guidelines: Botulism.

Additional resources used in the chapter include:

1. Canadian Immunization Guide- Botulism antitoxin and botulism immunoglobulin: https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-5-passive-immunization.html#p5a4a
2. US Centers for Disease Control and Prevention-Information for Health Professionals: https://www.cdc.gov/botulism/health-professional.html