ToxTidbits

Maryland Poison Center
UNIVERSITY OF MARYLAND SCHOOL OF PHARMACY

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The Maryland Poison Center's Monthly Update: News, Advances, Information

Botulinum Toxin: The Science Behind Botox and Botulism

Botulism is a rare, potentially fatal neuroparalytic illness caused by botulinum neurotoxins produced primarily by *Clostridium botulinum*, a gram-positive, anaerobic, spore-forming bacterium. Botulinum toxin types A, B, E, and rarely F are most often associated with human disease. The major forms of botulism include foodborne botulism, infant botulism, wound botulism, and inhalational botulism, with similar neurologic manifestations regardless of exposure route.[1-3]

Foodborne botulism occurs after ingestion of preformed toxin, classically from improperly preserved or stored foods that allow spore germination and toxin production in an anaerobic, low acid environment. Home canned foods, fermented fish or meat products, and improperly stored potatoes have been implicated. In infants, botulism usually occurs after ingestion of *C. botulinum* spores, which can germinate in the immature GI tract and produce toxin in vivo. Because honey may contain these spores, it should be avoided in infants younger than 12 months.[1,4]

Botulinum toxin acts at peripheral cholinergic nerve terminals, including the neuromuscular junction and autonomic synapses. After binding to the presynaptic nerve terminal, the toxin is internalized and prevents acetylcholine release by disrupting proteins required for vesicle fusion. This produces characteristic motor and autonomic paralysis. Sensation and mental status are typically preserved because botulinum toxin does not meaningfully cross the blood-brain barrier. Recovery can take weeks to months because it depends on regeneration of functional nerve terminals.[1-3]

Botulism classically presents as an acute, afebrile, symmetric descending flaccid paralysis that begins with cranial nerve involvement, causing symptoms such as muscle weakness, blurred or double vision, hoarse voice, difficulty swallowing, dry mouth, and sore throat. In foodborne botulism, GI symptoms such as nausea, vomiting, abdominal pain, or diarrhea may occur early and are often followed by constipation. Severe cases can progress to respiratory failure due to upper airway obstruction, impaired swallowing, aspiration, or diaphragmatic weakness.[1,3,5]

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Did you know?

Cosmetic Botulinum toxin, known as "Botox", temporarily relaxes facial muscles to reduce wrinkles in small, localized doses. Injections can cause harmful systemic effects often with counterfeits or mishandled products.

References:

1. Geyer HL. Botulism. In: Nelson LS, Howland M, Lewin NA, Smith SW, Goldfrank LR, Hoffman RS. eds. *Goldfrank's Toxicologic Emergencies, 11e*. McGraw-Hill Education; 2019.
2. Smith SW, Geyer HL. Botulinum Antitoxin. In: Nelson LS, Howland M, Lewin NA, Smith SW, Goldfrank LR, Hoffman RS. eds. *Goldfrank's Toxicologic Emergencies, 11e*. McGraw-Hill Education; 2019.
3. Rao AK, Sobel J, Chatham-Stephens K, Luquez C. Clinical guidelines for diagnosis and treatment of botulism, 2021. *MMWR Recomm Rep*. 2021;70(2):1-30.
4. Carrillo-Marquez MA. Botulism. *Pediatrics in Review*. 2016;37(5):183-192.
5. Lonati D, Schicchi A, Crevani M, et al. Foodborne botulism: clinical diagnosis and medical treatment. *Toxins (Basel)*. 2020;12(8):509.
6. Centers for Disease Control and Prevention. Harmful reactions linked to counterfeit "Botox" or mishandled botulinum toxin injections. December 17, 2024.

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Infant botulism often presents differently and should be considered in infants with constipation, poor feeding, weak suck, weak cry, drooping eyelids, hypotonia, and loss of head control. The infant may appear as a "floppy baby," but fever is usually absent unless there is a secondary infection.[4]

Diagnosis is primarily clinical and should not be delayed while awaiting confirmatory testing. Botulism can be mistaken for myasthenia gravis, Guillain-Barré syndrome, tick paralysis, or other neurologic conditions. Serum, stool, gastric contents or emesis, wound specimens, and suspected food can be submitted for testing when appropriate. Specimens should ideally be collected before antitoxin administration, but collection should not delay administration.[3-5]

Management centers on early supportive care, close respiratory monitoring, and timely antitoxin administration. Mechanical ventilation may be required for severe respiratory muscle weakness. Botulinum antitoxin neutralizes circulating toxin that has not yet bound to nerve terminals, so it can limit progression, but does not reverse existing paralysis. In the US, heptavalent botulinum antitoxin is used for symptomatic noninfant botulism and is obtained through public health authorities. Infant botulism is treated with human-derived botulism immune globulin, also known as BabyBIG, which can only be obtained through contacting the California Department of Health.[2-4] Prevention includes safe food preservation practices, avoiding bulging or spoiled canned foods, proper pressure-canning of low-acid foods, and avoiding honey in infants younger than 12 months.[3,4]

Botulism is reportable to local or state health departments due to the risk of outbreaks as even a single case may indicate a shared contaminated food source. If botulism is suspected or for guidance on management, please call your local poison center at 1-800-222-1222.