

Selected Topics: Toxicology



SHOT BY A GUN ... MISSED BY A PROVIDER

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Abstract—Background: Botulism is a paralytic disease caused by the neurotoxin produced by *Clostridium botulinum*. The majority of cases are due to ingestion or injection drug use. Wound botulism from traumatic injury is exceedingly rare, with only one to two cases reported each year in the United States. **Case Report:** A 27-year-old man presented to the Emergency Department with diplopia, dysphagia, and progressive weakness 10 days after sustaining a gunshot wound to his right lower leg. He had been evaluated for the same complaints at a different facility the day prior and was discharged. His wound appeared well-healing, but a high suspicion for wound botulism led to rapid consultation with the state Poison Control Center and the Centers for Disease Control and Prevention. The patient developed worsening respiratory insufficiency and required mechanical ventilation. Expedient treatment with equine heptavalent botulinum antitoxin resulted in significant recovery of strength in 4 days. Serum toxin bioassay tested positive for botulinum neurotoxin type A. **Why Should an Emergency Physician be Aware of This?:** Wound botulism now accounts for the majority of adult botulism in the United States. It should be considered in any patient with signs of neuromuscular disease and a recent injury, even if the wound appears uninfected. Published by Elsevier Inc.

Keywords—wound botulism; toxicology; neuromuscular disease; infectious disease; gunshot wound

Consent for the publication of this case and additional related information was taken from the patient involved in the study.

INTRODUCTION

Botulism is a potentially fatal illness caused by the neurotoxin produced by *Clostridium botulinum*. The toxin is the most lethal bacterial toxin known by weight. Small doses (0.09 to 0.15 μg) can be lethal in an average-sized person (1). Early recognition and treatment of the disease are paramount to recovery.

Cases due to wound contamination are rare, and the vast majority are related to intravenous drug use (IVDU). Wound botulism due to traumatic injury is exceedingly rare, with only one to two cases reported each year (2). Wound botulism from single-bullet injury has never been reported.

CASE REPORT

A 27-year-old man with no significant medical history suffered a gunshot wound (GSW) to the right lower leg. The wound was 5 mm in diameter, circular, and deep with minimal bleeding. He was treated in an emergency department (ED), where the wound was irrigated with 400 mL of normal saline and left open. Bullet fragments could not be retrieved due to the close proximity to popliteal vessels and surrounding nerves. His tetanus immunization status was confirmed to be up to date by electronic medical records.

The patient returned to the same facility 10 days later complaining of 5 days of diplopia, nausea, and throat irritation. The patient was sent to “Fast Track” where he was evaluated by a neuro-ophthalmology consultant. Vital signs were normal and the patient’s wound appeared well-healing. Unfortunately, the patient was uncooperative with visual testing by neuro-ophthalmology. Urine toxicology screening at this visit was negative. He was deemed well enough for discharge and outpatient neuro-ophthalmology follow-up.

The following day, he presented to a different ED with worsening diplopia, dysphagia, and progressive muscle weakness. He had no fever, nausea, vomiting, or abdominal pain. He denied consumption of home-canned foods, remote or current use of illicit substances, and had no history of preceding upper respiratory or gastrointestinal illnesses. He had not been taking any medications. He denied a history of significant skin wounds beyond a GSW to his left hand 4 years prior that required a bone graft.

On examination, the patient exhibited ptosis, symmetric bilateral motor weakness in upper and lower extremities, and diminished deep tendon reflexes. He had no autonomic or sensory deficits. His skin showed no needle track marks. The GSW over his right medial malleolus had no signs of infection. A computed tomography scan of the head and neck was unremarkable. A magnetic resonance imaging scan could not be performed due to retained bullet fragments within the soft tissue, as shown in a plain radiograph of his right leg (Figure 1).

Due to concern for wound botulism, the regional Poison Center was consulted and the patient was admitted to the intensive care unit. On hospital day 2, the patient was intubated due to shortness of breath at rest and worsening hypercapnia. An arterial blood gas prior to intubation had a pH of 7.36 and a $p\text{CO}_2$ of 52, compared with a pH of 7.40 and a $p\text{CO}_2$ of 45 on intensive care unit admission. About 6 h after intubation, equine Botulism Heptavalent Antitoxin (H-BAT) arrived from the Centers for Disease Control and Prevention (CDC) and one vial was administered to the patient. A 4-day course of intravenous penicillin G was given.

Blood and anaerobic wound samples were sent to the CDC for the mouse bioassay and culture. Briefly, the mouse bioassay involves inoculating mice with monovalent botulism antitoxin (types A, B, C, D, E, or F) and serum from the patient. If the mice show clinical signs of botulism such as labored breathing or weakness and then die, the test is considered positive. The mouse inoculated with the matching antitoxin should survive (3). The mouse bioassay revealed the presence of botulinum neurotoxin type A. Wound cultures showed no growth.



Figure 1. Plain radiograph of right lower leg.

While waiting for the results of the mouse bioassay, we continued to investigate other potential etiologies of muscle weakness. A lumbar puncture had normal opening pressures and cerebrospinal fluid analysis was unremarkable (Table 1). To evaluate for myasthenia gravis, tests for acetylcholine receptor and anti-muscle-specific kinase antibodies were performed, as was a tensilon test, all of which were negative. Blood toxicology analysis showed no evidence of illicit substances or heavy metal poisoning (Table 1). Electromyography and nerve conduction studies performed 4 days after administration of the antitoxin showed no signs of neuropathy, myopathy, or neuromuscular junction pathology. Throughout the course of his stay at the hospital, he showed no signs of drug or alcohol withdrawal.

Over the next several days, the patient regained motor strength and was extubated on day 6 of hospitalization. The patient required a gastrostomy tube due to persistent dysphagia. After almost 1 month of hospitalization, the patient was discharged home with outpatient physical therapy.

DISCUSSION

In the 10 years from 2005 to 2014, there were 399 cases of confirmed adult botulism reported to the CDC (2). Wound botulism accounted for 209 (52%) of these cases, with food-borne (41%) and unknown source (6.8%) accounting for the remainder (2). Intravenous drug use was implicated in 196 (94%) wound botulism cases. Traumatic injury was implicated in 12 (5.7%) cases. None of these

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