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Buyer Beware: Exotic Snakebite

The need for timely treatment of snakebites—preferably with an antivenom—is evident in this case of a man bitten by a cobra he believed to be "devenomated."

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Case

A 25-year-old man with a history of depression and bipolar disorder purchased an albino monocled cobra (*Naja kaouthia*; see Figure 1 for an example), which, he was told, was "devenomated." The next day, the man was bitten on his right hand, and within 3 hours he was discovered "shaking" and nearly apneic. His wife attempted rescue breathing, and when EMS arrived he was intubated due to severe respiratory distress. He was initially brought to a local hospital but was quickly transferred to the regional snakebite center for further management. Upon arrival, he was unresponsive and flaccid, with initial vital signs as follows: blood pressure, 156/103 mm Hg; heart rate, 112 beats/min; respiratory rate, 17 breaths/min; temperature, 35.9°C; Spo_2, 100% on a ventilator. The remainder of the physical examination was unremarkable except for the area of the bite: Two pinpoint puncture marks were visible on the dorsolateral portion of the patient's right fifth digit, and his right upper extremity had mild to moderate edema.

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FIGURE 1. Albino monocled cobra.

What common features allow snakes to be classified if the exact species is not known?

Certain physical features of indigenous crotaline and elapid species allow broad classification of US venomous snakes. The subfamily Crotalinae includes the rattlesnakes as well as copperheads and water moccasins. They have characteristically triangular heads with fangs and elliptical pupils that are vertical in orientation.[1] Crotalines exhibit a single row of subcaudal scales, differentiating them from similar-appearing nonvenomous species that have two such rows. They also have a unique heat-sensing organ seen as a small depression behind their nostrils, earning them the moniker "pit-viper." Species-specific features include the "rattle" of the rattlesnake (Figure 2), the white mouth of the cottonmouth (aka *water moccasin*), and the reddish brown coloration and hourglass markings of the northern copperhead (Figure 3).

Brightly colored rings along their bodies easily identify native snakes of the family Elapidae, commonly

Image courtesy of Jim Thomson

FIGURE 2. Timber rattlesnake.

Image courtesy of Brian Hardiman

FIGURE 3. Northern copperhead.

known as *coral snakes*. One can distinguish these venomous species from the similar-appearing but benign scarlet king snakes by the sequence of the stripe colors. It is frequently taught: "Red on yellow kills a fellow; red on black, venom lack," since coral snakes have red bands adjacent to yellow bands. Coral snakes also tend to have smaller fangs than those of the crotaline species.[2]

The identification of exotic (non-US) snakes can prove more challenging than that of native snakes. Although there are online resources, consultation with a herpetologist via an academic institution, museum, or zoo may be helpful; this can usually be obtained through a regional poison center. In the absence of this luxury, certain unique traits might allow snake identification. For example, the snake in this case, a monocled cobra, also known as the *Asiatic*, *Thai*, or *monocellate cobra*, among other names, has a circular mark on the posterior aspect of its hood, surrounded by a pale ring, giving the appearance of a monocle (Figure 1).

Why did the patient become symptomatic if the snake was "devenomated"?

Venomous snakes that have been subjected to surgical procedures to make them nonvenomous are often termed *venomoid* in the lay literature. However, the reliability of such procedures is unknown. For example, the incomplete surgical removal of both exocrine venom glands may still allow venom production to occur. Similarly, ligation of the channel that connects the venom glands to the fang can fail if the channel recanalizes. These procedures may be attempted by nonveterinarian amateurs of dubious competence.

Case Continuation

In the ED, the patient received 15 vials of antivenom over a period of 6 hours. Despite this intervention, he became increasingly tachycardic, with a heart rate of 150 beats/min, normal blood pressure, and an otherwise normal ECG. Normal saline was infused intravenously, and the patient maintained normal urine output. Initial lab values included a CBC that was notable for a mildly elevated white blood cell count, at 10.7 x 10^3/μL. Initial venous pH was 7.3 with an elevated lactate level of 2.77 mmol/L. The patient's initial creatine phosphokinase (CPK) concentration was elevated, at 813 U/L, and his troponin level was slightly elevated, at 0.11 ng/mL. His right upper extremity became increasingly edematous, prompting evaluation by the plastic surgery hand consultant and the initiation of IV antibiotics.

How is the correct antivenom chosen?

Currently, the only snake antivenom commercially available in the United States is Crotalidae polyvalent immune Fab (ovine) antivenom.[3] This is FDA approved for the treatment of envenomations by rattlesnakes and other North American crotalines. An antivenom approved for treating coral snake envenomation currently does not exist. Treatment decisions for envenomations by nonnative snakes can be more challenging. In this case, a polyvalent equine antivenom produced in India for the treatment of cobra envenomations was administered. This antivenom is effective for the treatment of envenomation by a variety of elapids from Asia and the Indian subcontinent. Fortunately, this antivenom is often stocked by a zoo that houses a relevant species in

its collection, and it was released by the zoo for administration to our patient. This drug is not FDA approved, and the purity and safety of imported antivenoms varies widely. Hospital rules regarding administration of such products vary; therefore, early involvement of the appropriate leadership is important.

Unfortunately, there is no national system for distributing exotic antivenoms, though identification of potential antivenoms for exotic snake and other envenomations is simplified by the Association of Zoos and Aquariums Antivenom Index (www.aza.org/antivenom-index). This nonpublic online resource, which was developed in 2006, helps guide the initial query but does not provide a mechanism for distributing the necessary drug.

Is there any antidote to prevent cobra envenomation–induced respiratory failure?

Cobra venom, a complex mixture of proteins and other macromolecules, produces its neurotoxic effects primarily at the neuromuscular junction. α-Neurotoxins, for example, block acetylcholine receptors at the motor end plate, while β-neurotoxins cause presynaptic inhibition of acetylcholine release. While these toxins affect the neuromuscular junction, phospholipase A2, another venom component, causes weakness through direct effects on muscle fibers. Early clinical signs and symptoms of the neurotoxic process include ptosis, dysphagia, and diffuse muscle weakness. This patient's apnea, noted initially by EMS, resulted from paralysis of his respiratory musculature, the most consequential neurotoxic manifestation. A cardiotoxin is also present but is poorly characterized.[4]

In the case of *Naja kaouthia* envenomation, neurotoxicity results primarily from postsynaptic inhibition of the nicotinic acetylcholine receptor.[5] The administration of neostigmine or another acetylcholinesterase inhibitor may sufficiently increase the amount of acetylcholine in the synapse to reverse the respiratory failure.[6] In a series of Philippine cobra (*Naja philippinensis*) envenomations, neostigmine improved ptosis and respiratory function.[7] One case report involving a monocled cobra envenomation describes a dramatic and complete reversal of all neurologic signs, including respiratory dysfunction, following administration of neostigmine 0.5 mg IV.[8] The patient in this case report required three additional doses of neostigmine at approximately 20-minute intervals before ultimately receiving antivenom therapy.[8]

The antivenom is preferred, if available, as it would likely limit the degree of cardiotoxicity (elevated troponin) that was noted in our patient. Neostigmine is not expected to have any beneficial effect on this toxic effect.

Case Conclusion

The patient was transferred to the surgical ICU. He remained symptomatic and received an additional 10 vials of antivenom (a total of 25 vials). His lactate concentration peaked at 5.9 mmol/L; CPK, 1,653 U/L; and troponin, 0.38 ng/mL. Compartment pressures of the right hand and forearm were within normal range. Cellulitis with an abscess developed, which resolved with standard therapies. On follow-up 2 weeks after discharge, the hand wound had healed and the patient reported feeling well.

The patient had purchased this and two other venomous snakes at a snake expo in western Pennsylvania, where the trade in venomous reptiles is unregulated. He then transported them to New Jersey, whereby he violated state law, which prohibits possession of these dangerous animals. The snakes were seized by the state authorities. **EM**

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