



Research Article

Gila Monster Envenomation: A Review for the Emergency Medicine Physician

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Abstract

An envenomation from a lizard is a rare occurrence but the emergency medicine physician must be aware of its treatment and potential complications. In southwestern United States, the Gila monster, *Heloderma suspectum*, and Mexican beaded lizard, *Heloderma horridum*, represent the only two venomous lizards that occur naturally in the wild. When envenomation from the Gila monster occurs the patient will complain of pain and paresthesia at the wound site but may also depict systemic symptoms of hypotension, anaphylaxis and myocardial infarction. Treatment should include local wound care, tetanus prophylaxis and antibiotics aimed at salmonella for those experiencing local symptoms. For those with systemic symptoms aggressive treatment should ensue. Although there is potential for mortality, the literature has shown that there have been no fatalities related to these lizards.

Keywords: Gila Monster, Toxicology, Emergency Medicine

Introduction

In the United States there are an estimated 3% of households that currently own one or more pet reptiles and the market for reptiles grosses approximately 2 billion dollars annually.¹ Although the most common of these lizards is the iguana, many enthusiasts own the Gila monster, *Heloderma suspectum*, through special permits and international trade.² The genus *Heloderma* contains the only two venomous species of lizards found in the United States, the Gila monster and the

Mexican beaded lizard.³ The Gila monster is a slow moving, non-aggressive lizard that inhabits the south western United States and northern portions of Mexico.³ The jaws of the Gila monster contain glands that inject venom into their victims and approximately 60% of bites are venomous.⁴ Local symptoms include intense pain and paresthesia while systemic symptoms include nausea, diaphoresis, dizziness and hypotension.⁵ Treatment typically includes removal of the lizard, local wound care and aggressive resuscitation if

hypotension persists following crystalloid infusion.

Lizard Characteristics

The genus *Heloderma* contains the only two venomous lizards in the United States: the Gila monster and the Mexican beaded lizard.³ In America there are two different subspecies of Gila monster. The reticulate Gila monster, *Heloderma suspectrum*, ranges in the southern portion its habitat while the banded Gila monster, *Heloderma s. cinctum*, the northern aspect.⁶

The Gila monster is a nocturnal, relatively slow moving large reptile. When born the lizard measures 160 mm but can grow up to over 550 mm in the first two years of life.⁶ Typical lifespan is between 10-25 years but research has shown that several lizards have lived for more than 27 years.⁶ All species feed on smaller mammals, bird eggs and insects. In the wild, the lizard feeds only eight to ten times a year and during this feeding may eat up to one third of its total body weight.⁶

The Gila monster is a heavy bodied lizard with short, stout legs which terminate in sharp claws and a heavy thick tail which may represent up to up to one half of its body length.⁶ The lizard has a large relatively flat triangular head with well demarcated mandibular muscles.⁶ The Gila monster is mottled or blotched with orange and black stripes which extend to the reptiles tail.⁶ The reticulate Gila monster is typically mottled and blotched, while the banded Gila monster has broad double crossbands.⁶

The habitat that the glia monster prefers are the scrublands, deserts and oak woodlands which allow for easy access to moisture.⁷ Rarely are they found in the open pastures or farmlands.⁷ In the United States, the Gila monster's habitat extends from southwestern Utah through southern Nevada, extreme southeastern California, most of Arizona and the south western portion of New Mexico.⁵ However, cases of wild Gila envenomation have been reported as far east as Missouri.⁸ In Mexico, the Gila monster mostly resides in Sonora.⁵

Venom Apparatus

The Gila monster's venom apparatus has evolved over hundreds of years but most researchers feel that it is more of a defensive mechanism and not a means for capturing food. The venom apparatus consists of a pair of venomous glands located along the anterior aspect of the mandible, venom ducts and edge teeth.^{5,6}

The venom gland is found along the anterior half of the lower jaw and can be noted by a swelling of the lower jaw.^{5,6} It is encompassed by a capsule of fibrous tissue which terminates into septae that separate the gland into four major lobes.^{5,6} The venom is then passed through a network of ducts and stored in a reservoir, called the dental sac, adjacent to the teeth. Through a capillary action the venom is pulled up through the dentition of the lower mandible.^{6,9}

The dentition of the Gila monster contains at least 18 maxillaries, 9 pre-maxillaries and 20 mandibular teeth. The teeth are sharp, lance shaped and periodically shed.⁵ The largest and most deeply grooved teeth are those nearest the discharge orifice of the venom ducts.⁵ Unlike venomous snakes where the venom is injected through a hypodermic like fang, the venom of the Gila monster is drawn into the puncture wound made by the tooth. Another major difference is the time in which it takes the venom to enter those who have been bitten. In a venomous snake bite, the venom is rapidly introduced into the victim. However, in a Gila monster envenomation the lizard grasps for up to 15minutes in order to allow venom to percolate into the victim.

Gila monster venom consists of proteins which include phospholipase A2, kinin releasing activity, L-amino acid oxidase activity, and proteolytic enzymes. L-amino acid oxidase splits fibrinogen which can lead to platelet aggregation and phospholipase A2 cleaves lecithin to lysolecithin which can weaken cell membranes and allow for efficient spread of venom.^{4,10} Gilatoxin, molecular weight 35,000, is a strongly antigenic toxin that has been shown to be a serine protease with kallikerkerin-like and

thrombin-activating activity.^{4,5} The gilatoxin may potentiate hypotension through the breakdown of angiotensin I and can lead to anaphylactoid reactions through its homology to other mammalian peptides.^{4,5,8}

The degree of envenomation is related to the depth, duration and type of bite that the victim suffers. Classically, two types of bites are common amongst helodermatidae. The first is a slashing bite in which the lizard's teeth cut and slice the victim's skin with minimal contact.⁵ However the second bite is more of gripping bite when the venom is chewed into the wound. The later of the two bites is the more destructive and also the one that provides the greatest likelihood for envenomation due to the increase in duration of contact with the victim's skin.⁵

Treatment

Foremost, treatment of *heloderma* envenomation is to remove the lizard. Although this seems an easy task, the lizard clamps its jaws around its victims for up to fifteen minutes. Research has suggested that deposition of gasoline under the lizard's tongue, pulling on the tail or placing a flame to the underbelly or chin can release the lizard from a victim.^{5,8,11,12} These methods are currently not recommended due to their propensity to cause further harm to those bitten. Current recommendations include prying open the jaws, cutting the strong masseter muscles and immersing the lizards head in either warm or cold water.⁵

Immediate first aid should include removal of lizard followed by immobilization of the affected limb and prompt transfer to a hospital setting. Much like that with snake envenomation, it is not recommended to incise the wound and attempt to suction the venom and place constrictive bands or tourniquets on the affected limb.^{5,8,11,12}

Local wound care should include exploration of the bite for any fragments of teeth and copious irrigation of the wound with normal saline. A radiograph of the wound should be considered to assess for any tooth fragments that may be retained in the wound. Frequent

neurovascular checks as well as inspection for progression of local edema should be monitored. Although compartment syndrome is rare, it must be monitored for.^{5,8,11,12} Tetanus prophylaxis should be updated when appropriate and pain should be treated with intravenous opiates.^{11,12} The patient's pain should be treated appropriately and if opiates are to be used the opiate of choice should be fentanyl due to the possibility of hypotension associated with *heloderma* envenomation.

Although systemic symptoms are rare, case reports and animal testing prove that several symptoms are more prominent than others. Treatment should be aimed at controlling airway, breathing and circulation following severe systemic symptoms. Electrocardiogram, complete blood count, electrolytes, cardiac markers and coagulation studies should be considered in any patient with systemic symptoms.

Several cases have been reported of severe anaphylaxis following *heloderma* envenomation.⁹ An inquiry should be made into previous envenomation, time since envenomation, and pre-hospital treatments. Symptoms such as shortness of breath, urticaria, wheezing and coughing can be common but angioedema may also be present. Standard allergic reaction treatment including steroids and H2 blockers should be followed and if angioedema is present the usage of epinephrine has been used with impressive results.

Hypotension should be treated aggressively with crystalloid infusions and if persistent vasopressor therapy. These patients should be admitted to an intensive care setting and monitored closely. Antibiotics are not routinely prescribed but if warranted those aimed at the coverage of salmonella can be used. Current research shows that 90% of reptiles that are bred in captivity are carriers of salmonella secondary to hatchlings eating adult feces in order to establish normal intestinal flora.¹³

Currently there is no available anti-venin available commercially due to the prognosis for *heloderma* envenomation being favorable

as indicated by the case reports that have been published with no fatalities.

Conclusion

All herpetologists should use protective gloves when handling all lizards. If bitten by the Gila monster, herpetologists should seek immediate medical attention even if the bite is minor. The patient should be monitored and provided appropriate analgesia. Basic lab work and an electrocardiogram should be obtained if systemic symptoms are present and tetanus prophylaxis is warranted in those that are discharged. Lastly, in severe envenomation the patient's airway and hypotension should be managed aggressively and admission maybe warranted for further monitoring.

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