Venomous snakes and snake bite

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Incidents of venomous snake bites and their deleterious effects have been well documented in North American newspapers. In one year, worldwide, an estimated 300,000 people are bitten by snakes (Roberts, 1987). The number of deaths per annum attributed to snake bite is estimated at 50,000-100,000 ("Deadly viper," 2000). (See Appendix A). Although the total number of bites in Canada and the United States is lower than that of other countries, a number of fatalities resulting from envenomation have occurred.

It has been estimated that 8,000 bites from venomous snakes occur each year in the United States (Dart & Gomez, 1996). In August of 1992, Larry Moor of Langley, British Columbia died shortly after a bite from an Egyptian cobra. Of particular interest is the fact that Mr. Moor was dedicated to educating the public about snakes. He was the founder of the B.C. Association of Reptile Owners and used to visit schools to correct children's misconceptions about snakes and to teach them about their proper handling. ("Cobra bite," 1992; "Snake handler,"1992).

Expertise in the area of venomous snakes does not ensure protection against a potentially fatal snake bite. More evidence for this comes from the case of Brian Leslie West from Emmitsburg, Maryland. Mr. West instructed local paramedics in the treatment of snake bite. However, in May of 1992 he went into cardiac arrest and died following a bite from an Indian king cobra ("Bite kills," 1992). More recently, in December 1999, a zoo volunteer in California was fatally bitten by one of 10 venomous snakes she kept in her home ("Bite kills," 1999). These incidents are a small sample of the sort of tragic events that can occur as a result of keeping and handling venomous snakes.

Snake venom can have various physiological effects on humans. Among these are cardiac arrest, respiratory failure, neurological effects, tissue destruction, interference with blood clotting and profuse bleeding, and pain. Effects can be long-term and irreversible and can terminate in death.

The keeping of venomous snakes is always accompanied by a risk of their escape. In zoo facilities, special precautions are taken to minimize the chances of escape and there are established protocols in case an escape were to occur (B. Johnson, Curator of Reptiles, personal communication, July 13, 2000). Individual pet owners and snake hobbyists often do not have the funds or resources to take these important measures. By keeping venomous snakes as pets they are endangering themselves and their surrounding community. Thus, many municipalities have established bylaws that prohibit the keeping of venomous snakes as pets ("Snakes charm," 2000).

General Information About Venomous Snakes

Types of venomous snakes have been divided into three groups ("Types of snakes," 2000) *Opithoglyphs* have rear fangs and those that are dangerous to humans include boomslangs, twig snakes, and mangrove snakes. *Proteroglyphs* have small, non-movable front fangs. Members of this group have been described as "some of the deadliest snakes in the world". Cobras, kraits, mambas and coral snakes are *Proteroglyphs*. Finally, there are *Solenoglyphs* that have movable front fangs that can be extended at almost a 180° angle. This allows these snakes to effectively stab their prey. Included in this group are gaboon vipers, copperheads, and cottonmouths. Because of the aforementioned characteristics of snake fangs, it has been suggested that in the unfortunate event of being bitten, it is advisable to push the head of the snake *forward*. (See Appendix B). More damage is done when the head is pulled *away* and it is also more difficult to dislodge the fangs (Roberts, 1987).

Many snake experts have cited the African black mamba (*Dendroaspis polyepis*) and the Australian taipan (*Oxyuranus scutellatus*) as the world's most dangerous snakes (Hunter, 1998). In addition, some snakes are reputed to be actively aggressive and may attack with little or no provocation. The Black forest cobra and African black mamba have this characteristic of being particularly aggressive (B. Johnson, July 13, 2000; Hunter, 1998). It is sometimes argued that kraits rarely bite, but it is important to note that krait venom is especially toxic (Roberts, 1987). The traits described above make these species, in particular, a severe threat to humans.

Physiological Effects of Venom

The effects of venom and their severity are mediated by a number of factors. The toxicity of the venom is determined by its component enzymes ("Types of snakes," 2000) and is usually denoted by an *LD50* number (Zug & Ernst, 1999). This measure is based on a test in which large groups of mice are injected with varying amounts of venom. The dosage at which 50% of the mice die in 24 hours is the LD50. (See Appendix C for LD50 numbers for various species.) Other factors associated with the bite itself include: the location of the bite, the proximity to major blood vessels, penetration of one or both fangs, and the amount of venom injected. The snake's health and the time since the snake last used its venom also affect the outcome. Influential factors associated with the human who sustains the bite include size, age, health, and psychological state.

Depending on the severity of the bite, effects can be local (restricted to the limb or part where the bite occurred) or systemic (involving other parts of the body). The following are descriptions of local and systemic effects of bites of various snakes that are grouped according to common effects of their venom.

The genus *Naja* consists of 15 or so species of cobras (Norris, 2000a). Cobra venom has two types of general effects: tissue destruction and neurological damage. Components of cobra venom include neurotoxins which attack the brain and nervous system, cardiotoxins which affect heart functions and enzyme toxins which break down the body's proteins ("Types of snakes," 2000).

Some cobras, known as spitting cobras, are able to eject venom (Norris, 2000a). Spitting cobras are very accurate in their aim even at a distance of 3 m. Usually targeted towards the eyes, sprayed venom causes severe pain, blurring of vision, and in some cases, permanent blindness.

Specific symptoms of cobra envenomation are pain and swelling in the region of the bite, neurological symptoms, respiratory arrest (can occur within minutes), paralysis of neck and jaw muscles, general muscle weakness, tightness and pain in the chest, nausea, vomiting, low blood pressure, abdominal pain, cranial nerve dysfunction (e.g., pain in the eyes, weak eye muscles, inability to swallow, impaired speech), and excessive salivation. Complications relating to the respiratory system and cardiovascular system (e.g., low blood pressure) can terminate in death.

Bites from king cobras are of special concern because of the greater volume of venom injected. These bites, therefore, are associated with a more rapid onset of neurological symptoms as well as a higher number of resulting deaths.

Coral snakes belong to the family *Elapidae* (Norris, 2000b). There are about 40-50 species of this relatively shy snake in the Americas. Norris (2000b) notes that "Most people bitten by coral snakes are intentionally handling them." Coral snakes have small, unmovable, hollow fangs that

are used to "chew" venom into their victims. Because of this method of venom delivery, coral snakes must hold on for a longer period of time for significant envenomation to occur.

Coral snake venom is extremely neurotoxic, although symptoms may be delayed in onset for as much as 12 hours. General effects are neurological dysfunction, impending respiratory failure, and cardiovascular collapse. The specific symptoms of coral snake bite include: respiratory distress, spasms of the pharynx, excessive salivation, discoloration of the skin (bluish colour), low blood pressure, irregular heartbeat, change in mental status, weak eye muscles, and, general weakness.

Rattlesnakes are among the pit vipers and are included in the genera *Crotalus* and *Sistrurus* (Bush, 2000b). These snakes inject their venom via movable hollow fangs. Sometimes injections are directly into muscles or veins. Rattlesnake venom is made primarily of digestive enzymes and spreading factors. General effects are interference with blood clotting accompanied by excessive bleeding and high or low blood pressure. Cardiac arrest and renal failure may ensue (Davidson, 2000). Neurologic effects are rare, except in the case of Mojave rattlesnakes. Rattlesnake envenomation is characterized by pain, swelling, taste changes (e.g., metallic taste), nausea, vomiting, bleeding, high or low blood pressure, erthyma, ecchymyosis, bullae, fasciculations, and rhabdomylosis. Without antivenin, mortality rates are estimated at 5-25% (Bush).

Moccasins are of the genus *Akistrodon* and include such species as cottonmouths, copperheads, mamushi, and pit vipers (Bush, 2000a). Venom is injected through their hollow, movable fangs. “A large percentage of bites are considered nonaccidental when the snake is handled, kept as a pet, or abused”(Bush). The general physiological effects of their venom are similar to

rattlesnakes, but may be lesser in degree. For this reason, the mortality rate associated with moccasin envenomation is generally low.

The major result of moccasin envenomation is coagulopathy, or complications associated with blood clotting. Specific symptoms of moccasin envenomation include: pain, local swelling, bleeding, low blood pressure, nausea, vomiting, skin lesions, severe blistering, and bleeding into the skin (Bush, 2000a)

Treatment for Envenomation

Treatment of venomous snake bites varies depending on the particular snake and the severity of the bite. However, treatments maintain common general characteristics.

First aid measures involve getting the victim to lie flat and to avoid as much movement as possible (Davidson, 2000). A crepe bandage should be applied to slow the absorption of venom. If possible, the bitten limb is put in a resting position below the level of the heart.

Treatment in a hospital emergency department or intensive care unit involves the administration of antivenin (Dart & Gomez, 1996). Antivenin, also known as antivenom, may be *monovalent* (snake-specific) or *polyvalent* (incorporating antibodies for several species). Monovalent antivenin is preferable to the polyvalent type since it is less hazardous to the patient and likely to be more effective in the treatment of the particular bite. However, a positive identification of the species of snake is required for the administration of snake-specific antivenin (Thompson & Loadsman, 1996). In many cases identification is difficult or impossible. When identity is at all uncertain, the polyvalent type should be used.

Almost all antivenins are derived from horse serum. Horses are injected with progressively larger doses of venom until immunity is achieved (Roberts, 1987). Thus, antivenin neutralizes the effects of venom by giving antibodies to the recipient. One of the disadvantages of antivenin is that because it contains horse serum, it is common for people to have allergic reactions following antivenin treatment (Dart & Gomez, 1996). Thus, it is advisable that a skin test be given before antivenin treatment. Based on the result, a decision is made as to whether antivenin should be given. It is important to note that paralysis may arise from excessive antivenin therapy (Stagg, Schweiss, Sy, & Folger, 1994).

Usually 10-20 vials of antivenin are required, although additional antivenin therapy may be needed (Dart & Gomez, 1996). Other treatments that are commonly part of the treatment of envenomation include blood transfusion (whole blood or components), pain relievers, antibiotics, and tetanus booster. Cardiovascular and respiratory support should always be kept ready (Norris, 2000a; 2000b). Treatment of allergic reactions to horse serum involve antihistamines, adrenaline, and/or corticosteroids (Davidson, 2000).

Some cases of venomous snake bite are further complicated by Compartment Syndrome. This condition arises as a result of squeezing a nerve or tendon. This is characterized by intense pain that can be resistant to painkillers (Dart & Gomez, 1996). Severe cases involve surgery, permanent loss of limb function, and in some instances, death (Davidson, 2000).

Care and Husbandry

Zoos that keep venomous snakes take special precautions to prevent their escape and have established emergency procedures for when an escape occurs. Reptile curators and herpetologists advise that venomous snakes be kept in escape-proof containers. These are usually

aquarium-style enclosures that are kept securely locked (B. Johnson, July 13, 2000). Ideally they should be made of unbreakable glass. In addition, the room containing the venomous species should be locked. This is another precaution against snake escape and doubly serves to limit area access to individuals who are specialized in the handling of venomous snakes. People who are allowed access should also be fully trained in emergency procedures including first aid for snake bite and emergency protocols.

Snake handling should be minimized. Burchfield (1982) recommends that venomous snakes should only be handled when it is medically necessary for their survival and well being. It is known that snakes get stressed from handling and rough or excessive handling can cause death. Manual handling should only be a last resort (B. Johnson, July 13, 2000) and may be done with thick welders' gloves. The use of shift boxes may be the method of choice for moving snakes. The key benefit is that it does not require that the keeper's hand go near the snake.

Another preferred method of handling is the use of snake hooks. Many snakes readily balance themselves on the hooks to avoid falling off. Burchfield (p. 276, 1982) notes that "the ability of a technician to use this tool is probably one of the major safety factors or, conversely, potential problem-creators in daily maintenance of venomous snakes".

For active snakes (e.g., cobras) or arboreal species that climb or move rapidly, tongs are preferable to hooks (B. Johnson, July 13, 2000). For these species, tongs quickly and efficiently accomplish translocation of the snake. Caution should be exercised when using tongs since they apply pressure to restrain the snake. This tends to make snakes agitated.

An additional tool used by some handlers is a Plexiglas tube. Once well inside the tube, the snake can be restrained at the mouth of the tube (Burchfield, 1982).

One precaution suggested by some experts (Burchfield, 1982) is that once a snake is picked up, it should be allowed to bite an antibiotic soaked sponge. This releases some of the venom and decreases the relative danger to the handler. It is also important to note that one handler should never attempt to exchange grips with another handler who is holding a venomous snake.

Escape Protocols

Venomous snake handlers at the Toronto Zoo have written protocols for dealing with emergency situations. They also practice emergency procedure drills (B. Johnson, July 13, 2000). At zoos where appropriate safety measures are employed, the area containing venomous snake enclosures will be locked and escape-proof. If an escape were to occur, the snake would be restricted to the secured room and could quickly be retrieved.

When venomous snakes escape outside zoos, the police should be alerted. They, in turn, can enlist the aid of reptile experts in the retrieval of the escaped snake (R.Vos, Toronto Zoo, personal communication, July 14, 2000). Equipment, such as snake hooks, tongs, flashlights, and protective footwear (steel-toed boots) should be used when conducting searches for escaped venomous snakes.

In the event that a person is bitten, the aforementioned first aid and emergency treatment is required. If antivenin is unavailable at the hospital where the victim is admitted, it must be obtained from other hospitals.

If a snake bite were to occur in the Port Colborne area and the victim was admitted to the Port Colborne General Hospital, antivenin would have to be delivered from the Greater Niagara Falls Hospital or Welland County General Hospital (J. Sheret, Emergency Dept., Port Colborne General Hosp., personal communication, July 13, 2000). If the required type of antivenin was unavailable at these, or other, Ontario Antivenin Depots, the Queen's Park switchboard would have to be contacted (Ministry of Health, 1989). Arrangements to secure antivenin would then be made by the Ontario government pharmacy.

In some cases, the snake-specific antivenin may be unavailable anywhere in Canada. This was the case when a saw-scaled viper escaped in Toronto in May of this year. Antivenin was imported from the southeastern United States in case of a bite ("Deadliest snake, May 2000).

Recommendations

Venomous snakes pose a very real risk to the health and safety of all persons who keep, work, or live around them. They must be housed and handled by reputable professionals according to specific protocols and should not be kept by lay people, hobbyists or amateur zoo keepers.

Elected municipal officials must consider the danger posed by venomous snakes to the constituents they represent, as well as to police, fire, ambulance, utility, animal control and humane society workers who may come into contact with them during an emergency situation.

They must also consider the fact that monovalant antivenin is not available in Ontario hospitals, if a snake bite were to occur.

Only a small number of individuals keep venomous snakes. They do so for personal entertainment or commercial purposes. Their desire to engage in this activity should not outweigh the concerns of the community at large, or the health and safety of community members and emergency personnel. Therefore, it is recommended that the keeping of venomous snakes be prohibited.

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