Morbidity and mortality following envenomation by the common night adder (*Causus rhombeatus*) in three dogs

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In South Africa dogs are frequently presented to veterinarians following snakebite. The offending snakes are usually puff adders (*Bitis arietans*), cobras (*Naja* spp.) and mambas (*Dendroaspis* spp.). Night adder (*Causus rhombeatus*) bites in dogs have not yet been reported in South Africa. This article deals with three cases of dogs bitten by night adders in which extensive tissue damage was noted and one fatality occurred. Night adder bites may be indistinguishable from puff adder bites. Non-specific treatment included addressing the hypovolaemia and swelling. Specific treatment involving immunotherapy using the South African polyvalent antivenom would be ineffective as it does not contain immunoglobulins against night adder venom. Veterinarians should also include night adders as the possible cause of dogs suffering from severe and painful swellings suspected to be due to snakebites.

Introduction

The incidence of snakebites in human patients in Africa constitutes a public health problem (Chaari *et al*. 2010), with some 600 000 envenomations and 20 000 estimated deaths per year (Bellefleur & Le Dantec 2005; Chippaux 2005). The true global incidence of envenomation is probably under-reported in developing countries (Chippaux 1998). In South Africa dogs are frequently presented to veterinarians for snakebite (Hoole & Goddard 2007; Leisewitz *et al*. 2004; Lobetti & Joubert 2004), as they are in other parts of the world (Najman & Seshadri 2007). The type of snakebite encountered varies according to the geographic location and distribution of the various snakes. In South Africa the most common reports of snakebite in humans requiring medical attention involve puff adders (*Bitis arietans*), cobras (*Naja* spp.) and mambas (*Dendroaspis* spp.) (Blaylock 2005; Hodgson & Davidson 1996; Lavonas *et al*. 2002; McNally & Reitz 1987; Ogunbanjo & Kyeyune 2009). In dogs the offending snakes are the same species (Leisewitz *et al*. 2004; Lobetti & Joubert 2004).

In humans snakebites by the common night adder (*Causus rhombeatus*) are referred to in a popular book as being feebly cytotoxic and generally not dangerous, causing pain and swelling (Marais 1992). Examination of the live caught or dead snake enables positive identification. The common night adder, average length 40 cm – 60 cm, is grey-brown dorsally with a series of rhombic markings and a distinctive brown or black forward-directed V-shaped marking on the head, the apex of which extends to between the eyes. It should not be confused with the harmless egg-eating snake (*Dasypeltis scabra*), which has similar markings but on the neck, and does not have a flat head (Marais 1992).

Proteomic characterisation of venom can be employed as a taxonomic signature for unambiguous species identification, independently of geographic origin and morphological characteristics, and may in future become valuable in identification of venom antigens specific to certain snake species (Tashima *et al*. 2008).

The most common and logical approach to treating snakebite without knowing the species of snake concerned is to follow the syndromic management of snakebite (Bellefleur & Le Dantec 2005; Berkman *et al*. 2003; Blaylock 2005; Wood, Webb & Demeyer 2009). This entails identifying three syndromes: painful progressive swelling (PPS), progressive weakness and bleeding (Bellefleur & Le Dantec 2005). Non-specific treatment includes addressing the hypovolaemia, consumptive coagulopathy, tissue necrosis and respiratory failure (Bellefleur & Le Dantec 2005).

Complications of snakebite associated with PPS are bite-site infections, necrosis, compartment syndrome from femoral vessel entrapment, deep vein thrombosis, and respiratory complications (Bellefleur & Le Dantec 2005). Antibiotic therapy is indicated for snakebite victims with tissue necrosis and should cover Gram-negative bacilli and Gram-positive aerobic cocci (Blaylock

1999). Specific treatment involves immunotherapy by administering intravenous injection of polyvalent or monovalent purified immunoglobulin fragments against the venom (Bellefleur & Le Dantec 2005). In severe cases antivenom is the only effective treatment (Brown & Landon 2010; Dzikouk *et al*. 2002; Stock *et al*. 2007; Warrell 1993).

This report deals with three cases of dogs bitten by night adders, in which extensive tissue damage was noted and one fatality occurred.

Case selection

Three cases of snakebite were selected out of 22 that presented to a private animal clinic over a 3-year period (2009–2011). The selected cases all had at least two or more visible snake fang marks and showed clinical signs of PPS. In all three the owner had witnessed the snakebite, and the offending snake was presented to the clinic for identification and positively identified by the authors as the common night adder.

Clinical progress of the cases

Severe PPS was the most obvious presenting clinical sign at the site of the bite. The lips, tongue, intermandibular area and ventral aspect of the neck were most severely affected. Shaving of affected areas revealed large suggillations covering lips, face and neck. Respiratory distress was noted in one case, caused by swelling of the tongue, pharynx and ventral neck. In this case an intermandibular incision was made in an attempt to reduce complications caused by the severe swelling, facilitate drainage of fluids and attempt to improve breathing, but the dog died within 36 hours of the bite. The remaining two cases revealed necrosis surrounding the area of the bite by the second day, which required surgical debridement. The resulting wounds were left open to heal by second intention and the dogs made an uneventful recovery.

Ethical considerations
Potential benefits and hazards

No animals were harmed and no specific procedure or intervention was performed on these animals other than treatment intervention that would normally have take place in the handling of these cases during clinical practice. No protocol was submitted as the article merely describes treatment and outcome of clinical cases which presented to private practice.

Recruitment procedures

No specific recruitment procedures were used in any of the cases, as the owners presented their pets at random to the veterinary practice out of free choice after the animals had suffered snakebite.

Informed consent

Standard informed consent was obtained in writing for all the cases, in accordance with the custom of the veterinary hospital. This consent obtains permission by the hospital and its staff members to perform all the necessary procedures and treatments deemed necessary for the pet presented.

Data protection

All data collected remain confidential and remain the property of the veterinary hospital; they will be kept for a minimum of five years and are available for inspection on request.

Discussion

There are no previous reports of night adder bites in dogs in South Africa. In this study none of the humans frequenting the same premises where the dogs were bitten had ever themselves been bitten. It is quite possible that because of the inquisitive nature of dogs the incidence of snakebite is higher in them than in humans (who generally fear snakes).

It is well documented that children suffer more serious complications (Bellefleur & Le Dantec 2005) and have a less favourable outcome following snakebite (Fourn *et al*. 2005; Hadley, McGarr & Mars 1999; Ogunbanjo & Kyeyune 2009; Wilkinson 1994; Wood *et al.* 2009). It may be speculated that body weight, tissue mass at the bite site and amount of toxin to weight ratio may play a role here. Since dogs generally weigh substantially less than humans, it could be speculated that they are likely to be more severely affected. Although no comparative study has been reported, the data from two reports suggest a higher fatality rate in dog victims of snakebite than human victims (Chippaux 1998; Lobetti & Joubert 2004).

It is fair to speculate that since the dogs in this report all suffered from more than one bite, they may have received a larger volume of venom than would normally be the case in humans, where single bites are the rule. It is also likely that snakes that are being bitten by dogs and are in mortal danger are more likely to bite the dog repeatedly and deliver larger volumes of venom to their victim. The investigative and persistent nature of dogs may perhaps also explain why they are more often bitten by back-fanged snakes like the boomslang (*Dispholidus typus*) (Hoole & Goddard 2007; Vaughan-Scott & Lobetti 1995) than humans are (Leisewitz *et al.* 2004). Partial consumption of the snake was noticed in some of the cases in this study. One interesting report described a human patient who presented authentic systemic signs of snake poisoning after ingesting a whole raw viper (Chaari *et al.* 2010). From this it must be deduced that this mode of envenomation is also possible in dogs.

Considerable intraspecies venom variability has also been reported (Gutirrez *et al*. 2009). This variation in snake venom composition in the same species is thought to be subject to strong natural selection as a result of adaptation to regional differences in specific diets available to the snake (Casewell *et al.* 2009). This has important implications, and strongly advocates further investigations into the medical significance

of venom variation within certain snake species and its impact on antivenom therapy (Casewell *et al.* 2009).

Antivenomics is the study involving immunoreactivity of antivenom to the venoms of snakes (Gutirrez *et al.* 2009). This proteomic approach is based on the ability of antivenom to immunodeplete homologous or heterologous venom proteins (Calvete *et al.* 2010). This field of study supports the hypothesis that antevenoms prepared from the venom of some snakes may be partially or fully effective against snakes in the same genera but from different species (Calvete *et al.* 2010). This hypothesis is supported by the observation that some antivenoms proved effective against the venom of *Echis leucogaster* and *Echis ocellatus* although no venom of the genus *Echis* was used to immunise the horses during preparation of the antivenom (Dzikouk *et al.* 2002).

Paraspecificity of snake antivenoms must be proven and not assumed in selecting immunotherapy for snakebite victims (Dzikouk *et al.* 2002). In another study it was proven that there is cross-neutralisation between two Australian elapid venoms, tiger snake (*Notechis scutatus*) and brown snake (*Pseudonaja textilis*) venoms, by their respective monovalent antivenoms (O'Leary & Isbister 2009). Paraspecificity of the polyvalent antivenoms has been raised by increasing the number of immunising antigens, to allow treatment against the bite of the many species of viperid and elapid snakes in Southern and Equatorial Africa (Hawgood 2001).

There is no antivenom available for treating bites from vine snakes (*Thelotornis capensis*), berg adders (*Bitis atropos*), and night adders (*Causus* spp.) (Leisewitz *et al.* 2004). It is not known whether the local antivenom shows paraspecificity against night adder bites. Although of interest, these tests are unlikely to be conducted because of the generally benign nature of night adder bites in humans, as well as dangers associated with antivenom reactions in humans. However, in dogs this might be of future interest. Since antisera-related reactions in humans are frequent and may be fatal (Bellefleur & Le Dantec 2005; Ogunbanjo & Kyeyune 2009; White 1977), indiscriminate use of antivenom by lay people outside the hospital away from high-care facilities should be strongly discouraged (Moran *et al*. 1998; Wood *et al.* 2009).

It is uncertain whether the same incidence of serious anaphylactoid reaction occurs in dogs following antivenom administration, but the paucity of reports suggests that they are rare in dogs. A mild reaction was reported in a dog after administration of boomslang antivenom (Hoole & Goddard 2007). Considering the apparent low incidence of antivenom reactions in dogs, a case can be made for its administration in dogs with suspected snakebite. In one study 36 dogs were treated with polyvalent antiserum, and none showed reactions to it. Considerable progress has been made in antivenomics and immunotherapy, which has led to a canine rattlesnake vaccine (Najman & Seshadri 2007).

From the three selected cases it is clear that envenomation by a common night adder may be serious and result in death in dogs. The PPS noticed in this report and associated necrosis is perhaps more akin to what is seen with puff adder bites in humans. Dogs bitten by puff adders show mostly local haemorrhage, severe swelling and occasionally tissue loss. The observations in these cases do not imply that night adder bites in dogs will always lead to severe PPS, require hospitalisation or lead to death. It remains unknown what percentage of night adder bites in dogs are associated with severe complications, and what other factors may be involved in clinical manifestations of these bites in dogs. It is hypothesised that large volumes of night adder venom may be required to bring about the severe complications described in the three selected cases reported here.

Conclusion

Extrapolating from human medicine, veterinarians have always assumed that night adder bites in dogs will also be benign. This report confirms that veterinarians should also include night adders as possible culpable snakes in cases of dogs suffering from PPS following confirmed snakebites.

Acknowledgements

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