

The ocular complications of an envenomous snakebite

Sithole HL, BOptom, MOptom

School of Interdisciplinary Research and Graduate Studies, College of Graduate Studies, University of South Africa

Correspondence to: Lawrence Sithole, e-mail: sithohl@unisa.ac.za

Keywords: snakebite, venom, ocular complications, public health

Abstract

An envenomous snakebite is an important public health problem that can lead to irreversible loss of vision. Snake venom neurotoxins mainly act on the peripheral nervous system at the neuromuscular junction, and result in the implication of the cranial nerves. Consequently, mild neurological symptoms that relate to cephalic muscle paralysis, including exotropia, ptosis, diplopia and ophthalmoplegia, can occur. This happens because the extraocular muscles are especially susceptible to neurological muscular blockage. Other neurological complications of snake venom include accommodation paralysis, optic neuritis, globe necrosis, keratomalacia, uveitis, and loss of vision due to cortical infarction. Haemostatic complications may include subconjunctival haemorrhage, hyphema, and vitreous and retinal haemorrhages. Another rare complication of a snakebite is ocular injury. Snakebite injuries are often accompanied by facial swelling, periorbital ecchymosis, massive subconjunctival haemorrhage, severe corneal oedema and exophthalmos in the affected eye. Unfortunately, such injuries result in permanent loss of vision, as early evisceration is deemed necessary to reduce the amount and effect of the venom in the affected eye. With such a variety of ocular complications as a result of a venomous snakebite, it is important for primary care physicians to have some basic knowledge of the management of these complications, as they may prove to be vital where patients present with a snakebite and possible venom injection in the eye.

© Peer reviewed. (Submitted: 2012-07-10 Accepted: 2012-08-23.) © Medpharm

S Afr Fam Pract 2013;55(2):161-163

Introduction

A snakebite constitutes a common acute medical emergency and has several systemic and even ocular consequences. According to Patil et al,¹ the importance of this public health problem has largely been ignored by medical science. There are approximately 3 000 snake species worldwide, of which fewer than 15% are classified as venomous.² The incidence of snakebites is estimated to occur in 2.5 million people annually worldwide, with 125 000 resulting in death.³ A poisonous snakebite is a serious public health problem in Africa,⁴ with an incidence rate of 100-400 bites per 100 000 people.⁵ The identification of the type of snakebite injury is usually uncertain, especially in the 40% of patients who do not see the offending snake, unless there are paired fang marks or typical findings of envenomation syndrome.⁶ Also, snakebites lead to between 30 and 80 hospital admissions per 100 000 people per year.⁷⁻¹⁰ They are most common in the summer months, from late afternoon to early evening, and affect men and women equally.⁶ Unfortunately, snake venoms are complex heterogeneous poisons and have multiple effects on the central nervous system.¹¹ Venoms are rich in protein and peptide toxins that have specificity for a wide range of tissue receptors, making them clinically challenging and scientifically fascinating, especially for drug design.¹² The venom mass ratio is larger in children, resulting in a higher mortality rate than occurs in adults.^{7,8,9,10}

Although ocular complications following venom exposure are rare,^{4,11} they do take place and need urgent medical attention when they arise. Therefore, it is important for primary care physicians to know about the incidence of ocular complications as a result of a snakebite and to be familiar with some discourse on the management of such incidences.

Neurotoxic and haemostatic effects of venom in the eye

Snakebites are a common medical emergency in tropical and subtropical regions,¹ particularly in rural and farming areas.¹³ At present, the literature is restricted to case reports predominantly, which have contributed to formal protocols on management.¹⁴ Venomous snakebites may result in neurological or haemostatic dysfunction,¹³ and as a result, involvement of the eye has also previously been reported.¹⁵⁻¹⁸ Snake venom neurotoxins act mainly on the peripheral nervous system at the neuromuscular junction and can affect the cranial nerves.² Mild neurological symptoms that relate to cephalic muscle paralysis include exotropia,² ptosis, diplopia¹⁹⁻²¹ and ophthalmoplegia.²² This is because the extraocular muscles are especially susceptible to neurological muscular blockage because the ratio of nerve fibres to eye muscle fibres (1:6 to 1:12) is high compared to that seen in the case of the large proximal limb muscles.²³

As a result, even a small amount of neurotoxin can affect the extraocular muscles.² Other neurological complications include accommodation paralysis, optic neuritis, globe necrosis, keratomalacia, uveitis¹⁸ and loss of vision due to cortical infarction.²⁴ Haemostatic complications may include subconjunctival haemorrhage, hyphema, and vitreous and retinal haemorrhage.²² With such a variety of ocular complications, it is important for primary care physicians to have some basic knowledge of the management of these complications, as this knowledge may prove to be vital should patients present with snakebites.

According to some reports on literature reviews, other forms of ocular complications as a result of snakebite may include macular infarction, ocular injury and loss of vision.

Macular infarction

A study by Singh et al¹⁸ reported on a case where a 17-year-old was bitten by a snake and admitted to a local hospital in an unconscious state. The patient regained consciousness 14 hours after the snakebite and six hours later reported loss of vision in the left eye. Visual acuity was recorded as 20/20 in the right eye, while there was no light perception in the left eye. An ophthalmological examination disclosed unremarkable anterior segment and normal intraocular pressures in both eyes. A relative afferent pupillary defect was observed in the left eye. A fundus examination revealed optic disc hyperaemia, splinter-shaped haemorrhages at the posterior pole and a cherry-red spot at the centre of the macula, which indicates nonperfusion of the retina.

Following systemic examination and laboratory investigations, which revealed no deficit and mild anaemia respectively, and therapy, the visual acuity remained, as well as no light perception in the left eye. Optic disc pallor and gross attenuation of the perifoveal vessels was noted. The macula showed pigment clumping and atrophy. The most likely cause of visual loss is ophthalmic artery occlusion, with subsequent dislodging of the fibrin emboli into the end arterioles at the posterior pole, or retinal necrosis and macular infarction secondary to an aborted disseminated intravascular coagulopathy process associated with toxic optic neuropathy.¹⁸ This further shows that the neurotoxic and haemostatic effects of venom may result in serious complications and compromise the integrity of the vasculature in the eye. This may subsequently lead to irreversible loss of vision and consequently, blindness.

Ocular injury

Another rare complication of snake bite is ocular injury. A case report by Chen et al²⁵ revealed that intraocular injection of venom from a snakebite can occur. The case reported that a 34-year-old man was bitten by a snake on the right eye. It was reported that the patient had no light perception in the eye four-and-a-half hours after the snakebite. Facial swelling, periorbital ecchymosis, massive subconjunctival haemorrhage, severe corneal oedema and exophthalmos were noted in the affected eye.²⁵ Unfortunately, this kind of injury may result in permanent loss of vision as early

evisceration is deemed to be necessary to reduce the amount and effects of venom in the eye. Also, it is believed that necrosis and loss of vision cannot be prevented by intraocular injection of antivenom.²⁵ This further indicates that loss of vision is inevitable should a snakebite occur in the eye area.

Loss of vision

In another case report by Kweon et al,¹⁵ a patient with controlled aplastic anaemia developed loss of vision after bilateral retinal and subretinal haemorrhages following a snake bite. The patient presented with blurred vision in both eyes and a best corrected visual acuity of 20/400 in both eyes. The intraocular pressures were 19 mmHg (right eye) and 18 mmHg (left eye). Anterior segment examination of both eyes was unremarkable. The fundus examination showed profound retinal and subretinal haemorrhages with Roth spots, which also indicate nonperfusion of the retina.

Blood tests revealed a haemoglobin value of 4.9 g/dl, a hematocrit of 15.2%, 2 000 platelets/ μ l and increased titres of fibrin degradation products and D-dimer (previously 5.8 g/dl, hematocrit 17.7% and 10 000 platelets/ μ l before the snakebite). After transfusion, the blood counts returned to normal values of a haemoglobin of 8.1 g/dl, hematocrit of 23.3% and 21 000 platelets/ μ l. After two months, the best corrected visual acuity had improved to 20/100 in the right eye and 20/60 in the left eye. However, a funduscopic examination showed persistent retinal and subretinal haemorrhage in both eyes.¹⁵

The observed complications in the above-described patient occurred because of the complex nature of snake venom, which is a mixture of proteins²⁶ that affect both the haemostatic and neurologic systems, as explained earlier.^{2,22} According to Kweon et al,¹⁵ the general manifestations of a snakebite depend on the specific toxins that constitute the venom. Antihemostatic snake venom factors can lead to acute fibrinolysis, a severe reduction in platelet levels and damage to the vascular endothelium.¹⁵ Snake venom also causes the breakdown of permeability barriers, provoking fluid extravasation and oedema. The peripheral neutrophil count can increase up to 20 000 cells/ μ l or more in severely envenomed patients. Initial haemoconcentration, a consequence of plasma extravasation, is followed by anaemia caused by bleeding, or more rarely, haemolysis. However, it is important to note that the signs, symptoms and magnitude of snake envenomation depend on multiple factors, such as age, the presence of underlying disease and the time interval between the bite and treatment.¹⁵ Therefore, it is possible that loss of vision after a snake bite may be as result of a combination of these factors.

First aid considerations

As a defensive mechanism, the Mozambique spitting cobra,^{27,28} which is found mostly in the KwaZulu-Natal province of South Africa,²⁷ spits very accurately up to a distance of 2 m, aiming for the eyes of the victim.²⁷ This results in severe pain on contact. The eye should be irrigated

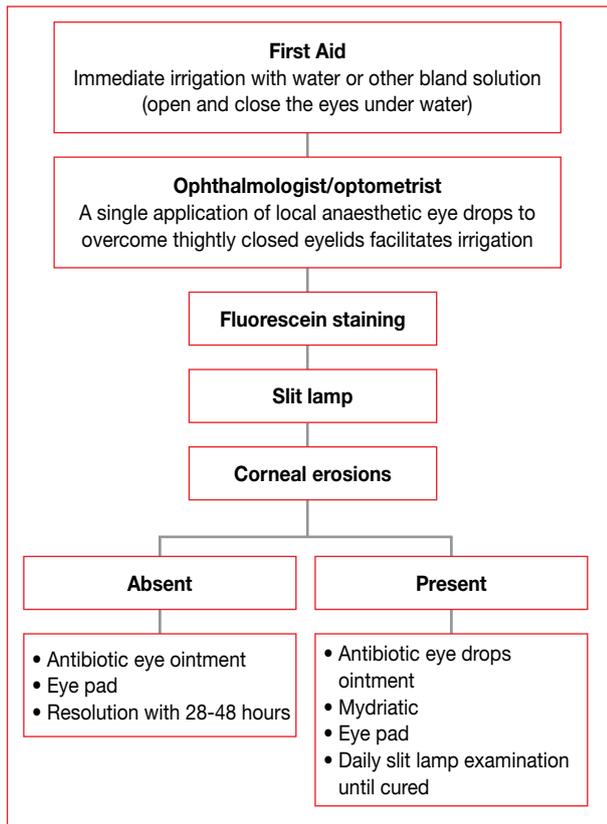


Figure 1: Management of venom ophthalmia. Antivenom (dilute) not indicated, topically or systemically. Steroids (topical or systemic) are also contraindicated.

well to prevent the rare complication of blindness.^{29,30} However, there is no single good first aid measure for all snakebites.⁶ The measures attempt to denature the venom, remove it, or retard its absorption. Venom on the skin should be wiped or washed away. However, venom ophthalmia may be complicated by corneal erosions which require slit lamp examination, specific treatment and follow-up by the practitioner.³¹ Therefore, it is important that, where necessary, referrals to eye care practitioners are made as soon as possible. First aid applications after eye exposure to venom are shown in Figure 1.

Conclusion

Physical examination of the snake shortly after the bite, especially where the offending snake has been captured, is important to check if the venom glands are empty or not. This will help the attending physician to decide whether or not administration of antivenom is required. However, it should be noted that such a decision cannot be straightforward, especially when the victim requires medical attention soon after the snakebite, before any signs of envenoming are detectable. Although ocular complications following a snakebite are relatively rare, as reported in the literature, disturbances of the visual system do occur. Unfortunately, when these disturbances transpire, they are usually very serious, to the extent of causing irreversible loss of vision and blindness. Therefore, it is important for primary care physicians to be well conversant with the applicable first aid

measures that can be employed when a patient presents with eye exposure to snake venom. It is also important to note that snakebites are medical emergencies. Therefore, victims should always be referred to appropriate treatment facilities, such as clinics and hospitals, as soon as possible.

Conflict of interest

I declare that I have no financial or personal relationships that may have inappropriately influenced me in writing this paper.

References

- Patil VC, Patil HV, Patil A, Agrawal V. Clinical profile and outcome of envenomous snakebite at tertiary care centre in western Maharashtra. *Int J Med*. 2011;1:28-38.
- Kim HD, Jung MS, Kim SY. Exotropia caused by pit viper snakebite. *J AAPOS*. 2009;13(4):424-425.
- Otten E. Venomous animal injuries. In: Marx J, Hockberger R, Walls R, editors. *Rosen's emergency medicine*. Philadelphia: Mosby Elsevier, 2006; p. 894-903.
- Mustapha SK, Mubi BM, Askira BH. Bilateral blindness following snakebite. *Trop Doctor*. 2010;40(2):117-118.
- Mebs D. *Venomous and poisonous animals*. Stuttgart: Medpharm Scientific Publishers; 2002.
- Blaylock RS. The identification and syndromic management of snakebite in South Africa. *S Afr Fam Pract*. 2005;47(9):48-53.
- Coetzer PWW, Tilbury CR. The epidemiology of snakebite in Northern Natal. *S Afr Med J*. 1982;62(7):206-212.
- McNally SL, Reitz CJ. Victims of snakebite: a 5-year study at Shongwe Hospital, Kangwane, 1978-1982. *S Afr Med J*. 1987;72(12):855-860.
- Wilkinson D. Retrospective analysis of snakebite at a rural hospital in Zululand. *S Afr Med J*. 1994;84(12):844-847.
- Blaylock R. Epidemiology of snakebite in Eshowe, KwaZulu-Natal, South Africa. *Toxicon*. 2004;43(2):159-166.
- Srinivasan R, Kaliaperumal S, Dutta TK. Bilateral angle closure glaucoma following snakebite. *J Assoc Physicians India*. 2005;53:46-48.
- Dawid AW. Guidelines for the clinical management of snakebites in the south-east Asia region. New Delhi: World Health Organization; 2005.
- Tungpakorn N. Unusual visual loss after snakebite. *J Venom Anim Toxins Trop Dis*. 2010;16:519-523.
- Vermaak SS, Visser A, le Roux TLB. A deadly bed partner: m'Fesi (Mozambique spitting cobra). *SA Orthop J*. 2010;9(4):58-62.
- Kweon EY, Lee DW, Ahn M, et al. Vision loss following snakebite in a patient with controlled aplastic anemia. *J Venom Anim Toxins Trop Dis*. 2009;15:163-167.
- Rao BM. A case of bilateral vitreous haemorrhage following snake bite. *Indian J Ophthalmol*. 1977;25(2):1-2.
- Bhalla A, Jain AP, Banait S, et al. Central retinal artery occlusion: an unusual complication of snakebite. *J Venom Anim Toxins Trop Dis*. 2004;10:311-314.
- Singh J, Singh P, Singh R, Vig VK. Macular infarction following viperine snake bite. *Arch Ophthalmol*. 2007;125(10):1430-1431.
- Ari AB. Patient with purely extraocular manifestations from a pit viper snakebite. *Mil Med*. 2001;166(7):667-669.
- Lee SY, Lee YC. Intermittent exotropia as the presenting sign of pit viper snakebite to an extremity: a case report. *J AAPOS*. 2004;8(2):206-208.
- Takeshita T, Yamada K, Hanada M, Oda-Ueda N. Case report: extraocular muscle paresis caused by snakebite. *Kobe J Med Sci*. 2003;49(1-2):11-15.
- Nayak SG, Satish R, Nityanandam S, Thomas RK. Uveitis following snake venom therapy. *J Venom Anim Toxins Trop Dis*. 2007;13:130-134.
- Bawaskar HS, Bawaskar PH. Envenoming by the common krait (*Bungarus caeruleus*) and Asian cobra (*Naja naja*): clinical manifestations and their management in a rural setting. *Wilderness Environ Med*. 2004;15(4):257-266.
- Merle H, Donnio A, Ayebova L, et al. Occipital infarction revealed by quadrantanopsia following snake bite by *Bothrops lanceolatus*. *Am J Trop Med Hyg*. 2005;73(3):583-585.
- Chen CC, Yang CM, Hu FR, Lee YC. Penetrating ocular injury caused by venomous snakebite. *Am J Ophthalmol*. 2005;140(3):544-546.
- Marsh NA. Snake venoms affecting the haemostatic mechanism: a consideration of their mechanisms, practical applications and biological significance. *Blood Coagul Fibrinolysis*. 1994;5(3):399-410.
- Broadley D. *Fitzsimons' snakes of Southern Africa*. Johannesburg: Delta Books; 1962.
- Marais J. *A complete guide to the snakes of Southern Africa*. Cape Town: Crede Press; 1992.
- Backshall S. *Venomous animals of the world*. Baltimore: The Johns Hopkins University Press; 2007.
- Meier J, White J. *Handbook of clinical toxicology of animal venoms and poison*. New York: CRC Press; 1995.
- Russel F. *Snake venom poisoning*. New York: Scholium International; 1983.