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SNAKE VENOM OPHTHALMIA*

BY

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SPITTING has long been recognised as a method of defence of certain African snakes and injuries to the human eye are not uncommon. Few cases have been reported in the literature, and in view of certain peculiar characteristics a single instance is perhaps worth recording.

It will be recalled that there are two families of poisonous snakes, the viperine and the colubrine. The viperine, exemplified by the puff adder, Gaboon viper, etc., has long thin movable fangs not unlike hypodermic needles from the apex of which is ejected a venom which is chiefly haemolytic though to some extent also neurotoxic. The colubrine, or more correctly the sub-family elapine, exemplified by the various types of cobra has strong fixed fangs sometimes grooved as opposed to hollow from which is discharged a mainly neurotoxic venom. In general colubrines have narrow bodies and heads and are very active, while viperines have broad bodies and angular heads and tend to be sluggish —sometimes being trodden on by barefooted natives.

Naja nigricollis, the black necked cobra frequently incorrectly called the black mamba, is the usual spitting snake, though other African cobras, *N. melanoleuca, N. haje* and *N. goldii* have to a less extent the power to eject venom. All these snakes are exceedingly poisonous, the venom being second only in virulence among African snakes to that of *pendraspis* the true mamba, an elapine tree snake. Death from neurotoxic venom is due to respiratory paralysis and 1/5th grain is said to be fatal. Generally 10-20 times the fatal dose is injected if the fangs remain in the tissues for a few seconds.

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N. nigricollis is nocturnal and usually prefers escape to attack but may be surprised when asleep during the day. Fully grown it is some six feet in length and is commonly found near human dwellings on account of its liking for chickens. When confronted by an enemy it rears up, expands its hood, which is much smaller than that of the Indian cobra and spits venom with unerring aim at the eyes of its enemy. The Africans think that having blinded a man the snake then bites him on the foot, but in most cases it prefers to escape.

The mechanism of spitting has been studied in captives. For a fraction of a second the jaws are slightly opened and with a sharp hiss two jets of venom shoot forwards for about two feet and afterwards break up into a spray. There is no dribbling and spitting can be repeated four or six times; after that the glands very rapidly refill though the new venom is of lower specific gravity and less toxic. It is uncertain whether propulsion of the venom is caused by contraction of the temporal muscles acting on the liquid in the gland or by the emptying of the lung sac, but probably both mechanisms are employed concurrently. The venom will forcibly strike a glass plate five feet away and its maximum range has been estimated at from 8 to 12 feet. So far as is known the Indian cobras and the deadly Hamadryad of Malaya do not spit. Certain viperines, especially the rhinoceros-horned variety *Bitis nasiconis* have been known to spit for a short distance during careless handling though there is no evidence that this is other than an involuntary action during fright. *Sepedon haemachates,* or the Ring Hals Slang of South Africa also spits and indeed according to Calmette is the chief spitting snake.

The venom of all snakes and scorpions acts as a strong irritant in the eye and it appears that some animals such as dogs and rabbits are particularly sensitive. The venom cannot penetrate unbroken skin and absorption from the conjunctiva is apparently slight. First aid treatment as with other chemical ophthalmias is immediate irrigation, the sap from a banana tree has been recommended, and provided early treatment is given, most victims fully recover their sight, though instances of blindness from corneal opacities possibly aggravated by secondary infection have been reported.

Report of a Case

Gogi Kusasi, age about 30 years, a labourer, was cutting long grass with a native " scythe " when he discovered a snake concealed in a tussock. The reptile at once raised its head and forcibly spat venom, some of which entered the right eye. It appears that some four or five feet separated the snake from the

man's face. Within a few minutes the patient was seen by a nearby medical officer and about 20 minutes after the injury he walked into the ophthalmic department of a hospital accompanied by one of his colleagues carrying the decapitated snake which was identified as a black necked cobra some five feet in length.

The patient complained of considerable pain in the right eye. There was a moderate degree of conjunctival injection. The whole corneal epithelium was oedematous; the lower 2/3rds was opaque and showed diffuse punctate staining with fluorescein. In addition there were two sharply delimited staining areas semi-circular in shape and some 2 mm. in diameter in the interpalpebral corneal periphery. Corneal sensation was absent. The left eye was normal and there were no general toxic symptoms. The treatment given was saline irrigation and atropine. Antivenene was not used locally or by injection.

On the second day there was well-marked chemosis with a profuse mucoid discharge accompanied by some oedema of the lids. The lower half of the cornea was bare of epithelium but sensation was absent when tested by the application of cotton wool to any part of the corneal surface.

By the fifth day the cornea was completely covered by oedematous, very loosely attached epithelium which formed a pyramidal elevation just below the centre. Sensation was present though much diminished.

On the ninth day corneal sensation was normal but the bulla remained. Two days later a large area of loose epithelium involving about half the area of the cornea was removed with a blunt untreated match stick revealing opacity in Bowman's membrane at the site of the epithelial bulla. Fresh epithelium grew rapidly but appeared oedematous, and thickened around the opacity. On the fourteenth day the epithelium was normal and apart from the localised faint corneal opacity the eye had completely recovered. Vision was 6/6 (illiterate). The opacity was present two months later.

The interesting features of this case appear to be the prolonged corneal anaesthesia, persisting for five to seven days, and the abnormal epithelial regeneration resembling the epitheliolysis of neuroparalytic keratitis or recurrent erosion. There was no evidence of absorption through the conjunctiva.

A search through the literature of the past 20 years has revealed only two papers on snake venom in the eye, both from East Africa. Zanettin (1935) reported two cases of *nigricollis* venom causing marked pain and blepharospasm persisting for about 3 days. The conjunctiva was strikingly pale at first and discharge was slight though later an area of local necrosis developed. Corneal lesions

were not reported. Calmette's antivenene was given in one case but both did equally well. Pergola's (1942) three cases were very similar; blepharospasm was marked, the conjunctival lesion resembled a lime burn and there was no corneal damage. Huppenbauer (1944), however, in a personal communication reports having seen a number of cases during 30 years practice in West Africa in most of which a bullous corneal lesion was evident.

The remarkable toxicity of snake venom is due to enzyme action. The fluid contains many constituents of which the main appear to be water and salts 65 per cent. to 80 per cent., albumen, which is non-poisonous, and proto- and hetero-proteases which are the active principles. Toxic substances comprise neurotoxin, possibly choline esterase, haemorrhagin, probably lecithinase, which has also some cytolytic action and a blood-clotting fibrin ferment.

Though no venom is composed of one toxin only the first substance is characteristic of the elapine snakes, the second of the large adders and the third of Russell's viper and the Moccasin.

Cobra venom is a yellow, slightly acid and intensely bitter liquid which when dry cracks like gum, loses its acidity but remains potent for years. Watery solutions gradually lose their toxicity which can be destroyed by boiling for a few hours, being much more heat resistant than viper venom. Haemorrhagin may be removed by adding lecithin in chloroform and the product of haemorrhagin and lecithin can then be precipitated by ether leaving neurotoxin in solution. The neurotoxin acts chiefly on the central nervous system but also on peripheral nerve endings, especially sensory.

A 1/10,000 solution can be standardised by "mouse units," the greatest dose which by intramuscular injection is not fatal to a 20 gm. white mouse. Intravenous injections are ten times as toxic as intramuscular.

Anavenene, analagous to diphtheria toxoid can be formed by incubating venom with 0·4 per cent. formalin at 38 deg. C. Antivenene is produced from the serum of horses which have received graduated doses of venom. Polyvalent sera covering most species of snake can now be produced, a valuable asset in cases where the offending snake escaped identification. Early treatment with a tourniquet, free incision and antivenene greatly diminishes the mortality from snake bite.

Mankind in general has a loathing of snakes that it is surprising to discover the extensive literature on the beneficial uses of their venom. Cobra venom has been used as an analgesic for the relief of pain in tabes, cancer, angina pectoris, trigeminal neuralgia, etc. It also relieves the pain in herpes zoster without, however, modifying the course of the disease. As opposed to morphia and its

derivatives there is no drug addiction and after a trial dose of 2 mouse units, 5 MU are injected daily until pain is relieved. The relief is claimed to be of considerable duration.

Russell's viper venom is a useful styptic for bleeding tonsils, tooth-sockets and epistaxis, but its greatest value is in haemophilia where the clotting time is reduced from days to minutes.

Little work has yet been done on the employment of venom in ophthalmology but a harmless substance capable of producing prolonged anaesthesia of the anterior segment of the eye would be of considerable value in inflammatory conditions and after operations or other forms of trauma, and the styptic effect of viper venom might also have its uses. Valle (1937) has treated painful ocular neuralgias, particularly in leprosy with conjunctival and retrobulbar Crotalus anavenene and claims immediate and lasting relief. Pradham and Patwardhan (1941) treated a case of recurrent vitreous haemorrhage with eight injections of 1/1,000 viper venom. Vision improved to 6/12 and the authors claim not only coagulation but absorption of clot and granulation tissue by cytolysins.

Though the uses of crude venom are probably limited research may lead to the discovery of substances of value in ophthalmology and further experiments with cobra toxins are envisaged.

Summary

1. A brief description of spitting snakes is given together with an account of the composition and action of snake venom in general.

2. A case of snake venom ophthalmia is reported.

3. The therapeutic uses of venom are discussed.

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