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## Some Principles of the Clinical Recognition, Assessment and Treatment of Snakebites

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In this essay I shall try to put across one or two of the broad principles which should affect the thinking of a casualty officer when assessing a snakebite and which should help him to decide upon a line of treatment. I feel that these are important points, as ignorance in the assessment of snakebites can lead to a lot of unnecessary treatment which may actually endanger the life of a patient.

First of all, the casualty officer must know how to classify into broad categories the types of snakes present in the country, roughly their habitat, which ones are likely to bite human beings and the effects of their bites.

For the sake of simplicity I shall classify snakes in four groups, using colloquial terminology:

- (1) Viperine snakes, or hinged front-fanged snakes.
- (2) Front-fanged colubrine snakes, or "fixed" front-fanged snakes.
- (3) Back-fanged colubrine ("colubrine" = long, thin) snakes.
- (4) Harmless snakes.

### THE VIPERS

The viperine snakes include all adders, rattlesnakes and vipers and bear resemblance to one another in that they are for the most part short fat snakes, sluggish movers and have mobile "hinged" or folded fangs in the front of their mouths. The common members of the group which may cause casualties in this area are the puff-adder, the berg adder, the night adder and perhaps the horned adder. The most impressive and dangerous member of the group in Central

Africa is the Gaboon viper, which is rare and unlikely to be encountered outside a snake park.

Puff-adders are short, squat, slow-moving snakes which have the habit of basking in the sun on paths and roads. They are not usually aggressive, and when disturbed they give good warning in the form of a loud hiss. They live on rodents and may therefore be found where rats and humans dwell; and although they come out into the sunshine in the mornings and afternoons, they may be found lying around on warm paths and roads well after sunset. They usually bite humans only when stepped upon or carelessly aroused, and it is a myth that they strike backwards over their own bodies. They coil themselves low upon the ground, with their heads well hidden among their coils, unlike the heads of the colubrines, which are always held proud and prominent well above the ground. The result is that the adders strike from a low position across their own coiled bodies, which gives the impression of striking sideways or "backwards," and they are not likely to inflict a bite much above the ankle of a human being.

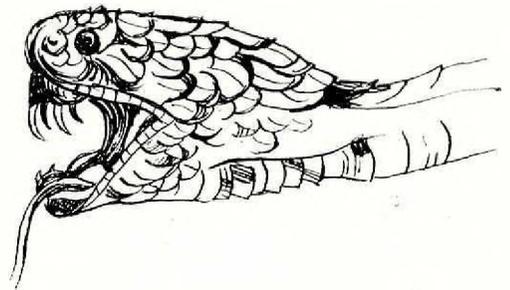


Fig. 1—Hinged front-fanged snake (puff-adder). Note the comparatively large typical adder- or viper-type fangs, with the reserve fangs behind the operative ones.

The fangs of the puff-adder are large and typify those of the "hinged-fanged" group and are easily recognised and distinguished from the "fixed-fanged" group. They lie folded from front to back and hinged on the top jaw at about the position one would expect to find the canine teeth of a mammal. If the tip of a

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pencil is run from behind to the front it will catch the fangs and unfold them forwards, bringing with them a protective sheath of mucous membrane in which the fangs lie. Folded behind the first pair of fangs may be seen a row of reserve fangs which will grow and successively replace the foremost or operative fangs, as these are either shed or left behind in the flesh of prey or foe. The fangs of all the viperine snakes conform to this pattern, although they vary considerably in length. Those of a puff-adder, for instance, may be as long as three-quarters of an inch, while those of a night adder are seldom longer than a quarter of an inch. It must be mentioned that the fangs and "teeth" (non-poisonous dental structures) of snakes, like those of sharks, are modified scales and have no mesodermal component, unlike those of the mammals. They are therefore shed each time the snake sloughs its skin, and any fangs lost in conflict with the snake's enemies are soon replaced.

Night adders, having smaller fangs, tend to inflict a less harmful bite. As their name suggests, they tend to move around at night and, like the puff-adders, they live in human-inhabited areas. They like lying on paths and roads at night and during the day they hide under rocks or boxes and may often be found under building materials or in timber yards, brickfields and so on. But the usual bite from a night adder is on the human foot and is possibly the most common snakebite sustained by Africans walking along a path at night.

Berg adders are quite common in the Eastern Highlands of Southern Rhodesia. They are very similar in physique and habits to the puff-adder, but are much smaller and live in the mountains. They have a surprisingly loud hiss for such a small snake, which has drawn the attention of many a mountaineer to their presence with alarming effect.

The effects of viperine snakebites are mainly local, but it was noted a few years ago that Berg adder bites could cause ophthalmoplegia with relatively little local effect, indicating the presence of a neurotoxin (Montgomery, 1959).

The usual picture of a puff-adder bite is one of acute oedema of the affected extremity, sometimes with blistering of the overlying skin. In severe cases this oedema progresses until the circulation is impaired and gangrene sets in. These are the "cytotoxic" effects of the venom and appear to be the most important aspect

of a puff-adder bite, though general symptoms of shock may be present and occasionally death may result from one of these bites. The night adder bite follows a similar pattern, but seems to be less drastic.

If gangrene is therefore the most serious of the sequelae of these bites, besides death, it must be decided at the time of a bite from a puff-adder whether or not a tourniquet is going to be to the patient's advantage, for it may in fact, by impairing the circulation and viability of the tissues, actually precipitate gangrene where it would not necessarily have occurred. And the specific treatment of these bites must be directed, in cases which are not likely to endanger life, towards the reduction of oedema and the maintenance of a free circulation in the limb.

On the same theme, therefore, although polyvalent serum injected intramuscularly soon after the advent of a puff-adder bite is obviously indicated, I believe that it is possibly a profitless procedure injecting serum locally in and around the bite and it is probably harmful in these cases, in that it may constitute a further insult to the already devitalised tissues.

It is, furthermore, with the object of saving the affected limb from gangrene that anti-inflammatory and anti-allergic agents such as steroids and the antihistamines are recommended in these cases. It was found some years ago in this country that the intravenous injection of calcium gluconate in doses of 10 ml. every eight hours had a dramatic effect in preventing tissue death in cases of puff-adder bite (Strover, 1955), and the steroids have been used since to good effect in combating this aspect of sea snakebites in Malaya. It is therefore logical to use both or all of these therapeutic weapons when incipient gangrene is diagnosed. In addition, intravenous or intramuscular steroids should perhaps be used in any case of snakebite where polyvalent serum is given in order to counter a serum reaction which may prove suddenly fatal.

#### THE FRONT-FANGED COLUBRINES

The front-fanged colubrine snakes are the long, slender, poisonous snakes whose fangs are also situated in the front of the mouth, but in contrast to the viperine group their fangs are not hinged and therefore tend to be shorter in order to fit unfolded into the mouth. The group includes the cobras, the mambas and the coral snakes. Of these, the cobras are by far the most important from a medical point of view.

The mambas, although they enjoy a high degree of notoriety in lay literature, are actually rare, shy and live far from human habitations, therefore constituting practically no menace or danger to human lives except in the snake parks, where the dare-devils of herpetology might occasionally be bitten through carelessness or bravado. Even then it is more likely to be the cobra or puff-adder which does the damage than the dreaded mamba.

The coral snakes are small and are unlikely to possess enough poison to endanger human life.

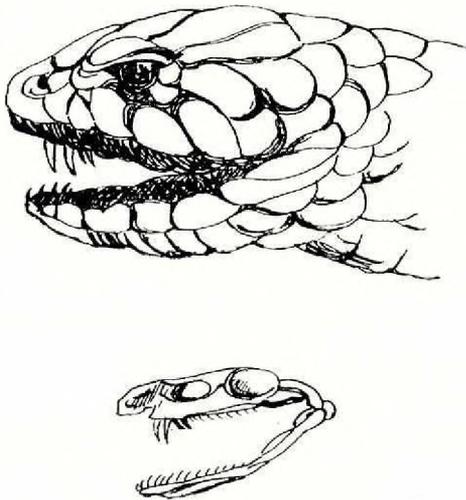


Fig. 2—Fixed front-fanged snake (cobra). Note the situation of the fangs in the upper jaw and the smaller reserve fangs just behind the operative fangs.

The cobras are very common in Rhodesia and are to be found wherever humans have their dwellings, for the reason that they eat rats, chickens' eggs and baby chicks. They are often a menace in fowl runs, where they kill the adult hens without eating them. All cobras are distinguished by the presence of a "hood," which they almost invariably display as a warning before attempting to bite or spit at an assailant. The Egyptian cobra is the commonest local species, but the Cape cobra and the spitting cobras (the black-necked cobra and the ringhals) are also in fair abundance.

They vary a lot in colour, and pitch-black varieties are often mistaken for black mambas. Again, detailed knowledge of their varieties and the identification of the various species are not necessary from a medical point of view, but

the ability to recognise the front-fanged colubrine group is simple and sufficient to institute a logical line of therapy.

The cobras and mambas are long snakes and might easily attain a length of nine feet or more. This and their ability to rear up before biting would tend to make the site of their assault much higher up on the limb of a human being than that of the vipers. Again, it is the man who inadvertently steps upon or brushes against a cobra who gets bitten, but the worst bites will perhaps involve the herpetologists in this country and the snake-charmers in the East, especially in view of the fact that their attractive hoods make the cobras very popular for public display.

The puncture marks of the fangs do not usually display any other specific feature to distinguish them from those of the bite of one of the vipers, except the site of the bite. It may be logical that the hinged fanged (viperine) snakes, in contrast, less often manage to sink both fangs into the flesh of an enemy, as their fangs unfold independently of one another and are very long. The cobra fang wound is therefore simply two single punctures surrounded by less local reaction than those of the viper.

The clinical effects of the poison of this group are mainly described by the word "neurotoxic," and the problem is therefore one of general or systemic effects than local pathology. The picture is one of progressive paralysis affecting both spinal and cranial nerves. Eventually the neuromuscular mechanism of respiration is put out of action, and finally the heart may suddenly and unexpectedly fail. The site of action of the neurotoxic elements of the venoms of these snakes is said to be on the neuromuscular junctions like the muscle relaxants used in modern anaesthesia, though the precise chemical mode of action I have not seen described. Suffice it to say that the problem is mainly one of the maintenance of adequate respiration and could therefore be grouped with other such problems as tetanus, Guillain-Barré syndrome or even curare poisoning.

The armamentarium of therapeutic weapons in this group may therefore be listed as follows:

(1) Tourniquet as a first-aid measure is important and can be life-saving. It is logical to completely occlude the circulation to the affected limb, if a substantial bite has been inflicted, until more specific measures are available.

(2) Polyvalent snakebite antivenine is indicated here almost without exception, and especially when there is a tourniquet to be released with the danger of the concomitant release of venom into the general circulation.

(3) Again I would advocate the use of steroids with the antivenine, especially if the latter is to be used intravenously. I know of no other logical reason for using steroids in these cases, and the antihistamines and calcium gluconate may again be used on an empirical basis.

(4) Oxygen and artificial respiration may be necessary over periods varying from a few hours to a week or more. Although this is the problem of the physician and the specialist anaesthetist in the big centres, it might be borne in mind that teams of orderlies have managed to keep a patient alive who had been paralysed by a cobra bite, for many hours using the simple old-fashioned "Sylvester" manoeuvre of artificial respiration. The more modern mouth-to-mouth or mouth-to-tube respiration is probably more effective until the patient can be transferred, and intermittent positive pressure respiration by means of intubation and the use of an Ambu bag are measures which may be carried out in centres with even very limited facilities. Under specialist care and with modern methods of mechanical ventilation, a patient with severe neurotoxic poisoning may be tided over the paralytic phase until motor function returns in just the same manner as with cases of Guillain-Barré syndrome or acute porphyria with respiratory paralysis.

(5) In cases who are incompletely paralysed and who maintain enough respiratory excursion to effect some degree of ventilation, a tracheostomy, by reducing the dead space in the bronchial tree, may by itself be an adequate measure.

It must be emphasised that once that patient has reached the stage of respiratory paralysis the problem is not insoluble, and if ventilation and the metabolism of respiration can be maintained to an approximation of physiological levels the patient is likely to recover.

#### BACK-FANGED COLUBRINE GROUP

The third large group of snakes, the back-fanged colubrine group, includes an immense number of species (about 300). Within this group, therefore, may be found a wide range of morphological variety, and it includes the

boomslang or tree snake and the twig or vine snake, both of which are known to have extremely potent venom. Others, such as the herald snakes, the sand snakes, the skaapstekers, are common enough, but are regarded as being of practically no danger to human lives. But it is as well to realise that the bites of most of the members of this large group of snakes are as yet unrecorded in medical literature and many may be more dangerous than they have hitherto been regarded. Both the boomslang and the vine snake were regarded as being relatively harmless for many years.

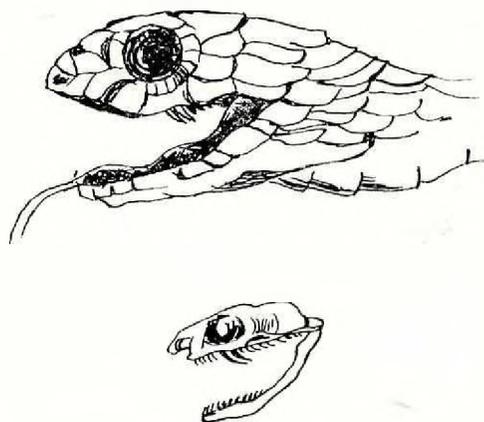


Fig. 3—Back-fanged snake (boomslang). Note the situation of the fangs just behind the eye.

The common feature of all the snakes of this group is easily detected when the mouth is opened and the fangs are examined. At the front end of the mouth are to be found a row of little teeth ("tooth" again implies a non-poisonous dental structure). Behind these teeth on the top jaw, just about at the level of a vertical line drawn from the eye of the snake, is seen a definitely larger "fang." As a consequence of its situation, the back fang is not an efficient weapon for the quick injection of venom. The back-fanged snakes kill their prey by gripping it with their front teeth and working their top jaws independently in a series of step-wise movements until the fangs meet the foe, and then the venom is injected. The clinical significance of this slow and determined manoeuvre is that a quick strike from a back-fanged snake is not likely to be effective and also that the punctures in the skin of the victim are likely to be multiple and ragged, in contrast to the single pair of skin punctures made by the front-fanged snakes.

For the reasons mentioned earlier I think that a substantial bite from any member of this group must be regarded as being dangerous, and for that reason I shall take the boomslang, which is known to be dangerous, for an example.

These snakes are shy and non-aggressive and are unlikely to bite a human being unless they are wounded or badly annoyed. The most likely people to be bitten are again the herpetological folk and the amateur snake-catchers.

The clinical effects of the poison of these snakes are described by the word "haemotoxic." The venom of the boomslang is said to be a powerful blood coagulant, and by precipitating fibrin in the blood vessels a state of afibrinogenaemia results. This results in an acute bleeding disorder with extravasation of blood in practically every organ. The picture is therefore similar to one of any acute bleeding disorder, the complications are the same and the therapy of the condition presents similar problems. The mainstay of life-saving measures here is blood transfusion and the specific treatment of haemorrhages into the various systems of the body.

Polyvalent serum must be given, again with steroids. Fibrinogen, calcium gluconate and vitamin K are all logical measures and should be given where purpuric signs and symptoms are manifest. Although, on the knowledge so far available about the action of this venom, it is perhaps not strictly logical to administer anti-histamines and steroids in these cases, I feel that there is a place for their use on an empirical basis supposing that an acute reactive or hyper-reactive element in the victim may have a part in the development of purpura in this condition.

#### THE HARMLESS SNAKES

The harmless snakes are derived from an evolutionary point of view from all of the above groups, from the constrictor family (boas, pythons, house snakes) and also from the lizards. They are therefore a very varied group and include some of the smallest as well as the largest snakes in the world. They inhabit all the niches occupied by the poisonous snakes and may therefore be found in human habitations, in trees, in burrows in the ground, in mountains, in the bush and in water. The point about this is that the habitat of a snake does not necessarily mean that it is poisonous, and furthermore the colouring and shape of a snake can also be misleading, as the harmless types very often find their only protection in mimicry of the battle colours of their poisonous

cohorts. For instance, the harmless egg-eater mimics the colours of a night adder with remarkable accuracy and even fakes a hiss by rubbing his scales together.

The shapes and sizes of the mouths of the harmless snakes are again varied, but they are all distinguished from the poisonous groups by the absence of fangs. In some the top jaw is furnished with a row of teeth, all equal in size and able to imprint a bite showing regularly spaced puncture marks.

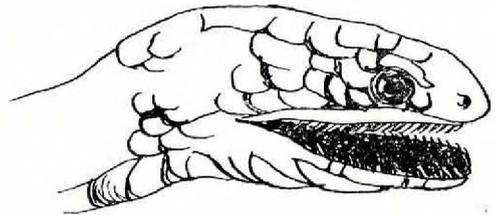


Fig. 4—Harmless olive-brown water snake.  
Note the absence of poison fangs.

As with the bites of any animals, the only dangerous effects of the bites from these snakes are those of secondary infection, which should therefore be guarded against by the injection of anti-tetanus serum where necessary and antibiotic coverage. The python, for instance, can inflict a painful wound in which he may leave a few small teeth which will soon become the centre of secondary infection.

As a general rule, and also to satisfy the patient that something positive is being done about his snakebite, adequate antibiotic coverage should be instituted in all cases of snakebite, whether or not specific therapy will be given.

To conclude, the casualty officer or out-station doctor need not have any great knowledge about the classification of snakes to be able to recognise the bite of a poisonous snake and to differentiate it from that of a harmless reptile. He must be aware of the different groups of poisonous snakes and the main problems involved in the treatment of their bites. He needs to know how to open the mouth of a dead snake and recognise the presence or

absence of fangs and the types of fangs. Furthermore, he must be able to look at the puncture wounds of a snakebite and have some intelligent idea of whether or not it is likely to have been inflicted by a poisonous or harmless snake.

Below are given some drawings to illustrate the differences between the different types of fangs.

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## Two Cases of Subdural Haematoma Complicating Anticoagulant Therapy

BY

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Subdural haemorrhage is a rare complication of anticoagulant therapy. We have recently encountered two such cases at the Salisbury Central Hospital, one following minor trauma, the other apparently occurring spontaneously.

#### Case Report No. 1

A 42-year-old man sustained a minor coronary thrombosis in February, 1963. He was started on Warfarin Sodium two tablets daily. The dose was adjusted to keep the prothrombin index between 60 and 80 per cent. Fortnightly prothrombin estimations were carried out and he was fit to return to his job.

In May, 1963, gall stones were demonstrated by a cholecystogram. On the 28th July he attended a football match as a spectator, but managed despite this to head the ball once during the game. On the same evening he developed a bad headache and felt unwell. When seen in the casualty department at the Salisbury Central Hospital at midnight he was holding his head and complaining bitterly of severe generalised headache.

On examination he had no neurological signs; the fundi appeared normal. Pulse 84, blood pressure 160/100. Heavily bloodstained fluid was obtained on lumbar puncture and he was admitted to the ward. He continued to complain of headache, and on 3rd August a carotid angiogram was performed. This showed a slight shift of both anterior cerebral arteries from right to left and a diagnosis of ? subdural ? intracerebral haemorrhage was made. The headache gradually became worse and was particularly severe in the right frontal region. A second lumbar puncture showed a pressure of 310 mm. C.S.F. with xanthochromic fluid. E.E.G. showed episodes of very slow waves in the right frontal areas. On the 9th August a second arteriogram confirmed the findings of the first one, and exploration was carried out through high right frontal and right temporal burr holes (Mr. L. F. Levy). Large quantities of subdural blood were evacuated. The patient made an uncomplicated recovery and was asymptomatic when seen six months later.

#### Case Report No. 2

A 58-year-old man was diagnosed as having coronary atheroma in 1962. On the 25th June, 1963, he was started on anticoagulant therapy because of a severe attack of cardiac pain with E.C.G. changes suggestive of infarction. After six weeks in hospital he was discharged on Dindevan 100 mg. daily. On the 10th September he was put on Digoxin and oral diuretics for early left ventricular failure, and on 3rd October he was found fit to go back to work. On the 21st October he was re-admitted to hospital with a right peritonsillar abscess, which resolved with a course of Broxil. He was discharged on the 26th October and was well for nine days. The prothrombin activity had been kept by frequent biochemical estimation within the therapeutic range (10-30 per cent.), but on the 30th October it was well below 10 per cent. Dindevan was stopped for one day, and subsequently the prothrombin activity was again kept at therapeutic levels.

On the 4th November he felt tired and the next day he developed a dull occipital headache. This gradually became more severe, spread over the vault of the skull and was more marked on the right side. Partial relief was obtained by analgesics. When he was re-admitted to hospital on the 19th November he was fully conscious and had no abnormal neurological signs. On the 25th November he became confused and drowsy with headache, mainly in the right parietal region. Examination showed