Current Practice

Snakebite in the Tropics

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Medically important snakes have fangs at the front of their mouths which enable them to inject venom efficiently. These are the "poisonous" snakes and there are three types—elapids (neurotoxic), seasnakes (myotoxic), and vipers (vasculotoxic). The elapid family have short fixed fangs (covered by a gum-fold, the *vagina dentis*); they include cobras, mambas, kraits, coral-snakes, and all the Australian poisonous snakes such as taipans and tiger snakes. Seasnakes have very short fixed fangs and characteristic flat, rudderlike tails; they are common in Asian coastal waters. Vipers have long, erectile fangs, triangular heads, and, usually, short fat bodies. Vipers are subdivided into crotaline or pit vipers, having a thermosensitive pit between eye and nose, and viperine vipers, without pits. The pit detects warm-blooded prey in the dark. The "non-poisonous" snakes are also of three types—small burrowing snakes often resembling worms, large constricting snakes such as pythons or boas, and the numerous family of colubrine snakes. Some colubrines have fangs at the back of the mouth, but, though technically venomous, their bites are harmless to man, with the rare exception of some back-fanged snakes in Africa such as the boomslang.

The distinction of poisonous from non-poisonous snakes is often difficult, but is *not* usually important for the clinician; he should be able to diagnose whether or not a patient has poisoning, and, if so, of what type and severity.

Epidemiological studies have confirmed that snakebite in the tropics is a rural and an occupational hazard. Most bites occur in daylight and on the foot or ankle because the victim treads on or near the snake. The severity of poisoning is not related to the time of the bite, breeding habits of the snakes, or the age of the victim.

Incidence of Poisoning

About 15 drops of viper venom could be fatal to an adult man; 3 drops of cobra venom could be lethal; and one drop of seasnake venom could kill 5 men. Fortunately, however, biting human beings is a defensive reaction which rarely results in much venom being injected. The paramount fact about bites of man by poisonous snakes is that more than one-half of the victims will have minimal or no poisoning. Only about one-quarter will develop systemic poisoning. Hence poisonous snakebite is not synonymous with snakebite poisoning.

Fear and Emotional Reactions

The most common symptom following snakebite (whether the snake is poisonous or non-poisonous, and, if poisonous, regardless of the venom injected) is fright—particularly the fear of rapid and unpleasant death. Fear in varying degrees is present in all victims bitten by snakes and often dominates the

clinical picture. Emotional symptoms come on rapidly, within minutes of the bite, whereas symptoms of systemic poisoning rarely appear until a half to one hour after the bite. The frightened patient may appear semiconscious, with cold, clammy skin, feeble pulse, and rapid shallow breathing. These symptoms resolve dramatically after a placebo injection.

Many doctors become emotionally affected by having to deal with snakebite patients because they are unfamiliar with the problem. Even in the tropics, where snakebite is comparatively common, cases often receive unwarranted prominence in the local press.

Diagnosis

Local swelling starts within a few minutes of a viper bite if venom is injected (Fig. 1). It is a valuable clinical sign, because if swelling is absent and one knows the biting snake was a viper then poisoning can be immediately excluded. Local swelling is also a feature of poisoning by Asian cobra bites, though it may not appear for one to two hours (African cobra bites are not sufficiently documented to indicate whether local swelling is a reliable feature). Other elapids (such as mambas and kraits) and the seasnakes have no local effects. Local pain in snakebite is extremely variable and of no help in diagnosis.

FIG. 1.—Twenty minutes after a viper bite; local swelling is a most valuable sign, confirming that venom has been injected.

The important early diagnostic signs of systemic poisoning are as follows: Viper—blood-stained spit (Fig. 2); later, non-clotting blood. Elapid—ptosis (Fig. 3); glosso-pharyngeal palsy. Seasnake—general myalgia (Fig. 4); three to five hours later, myoglobinuria.

Nonclotting blood is best detected using a capillary tube with blood taken from a finger prick. The tube should be kept horizontal at room temperature for 20-30 minutes and then raised vertically. Nonclotting blood runs out of its own accord. Myoglobinuria shows as a brown or red colour of the urine (seasnake bite poisoning does not cause haemoglobinuria).

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Usually, the minority of victims who receive a venom dose large enough to cause systemic poisoning will already have signs of this by the time they see a doctor. In the rare cases seen soon after the bite, within the latent period between bite and possible onset of systemic symptoms (1–2 hours generally but up to 10 hours with some elapids), the patient should be given a placebo injection and then carefully observed every half hour by the doctor for these early systemic signs.

There are exceptions to the above generalizations. The South American rattlesnake has neurotoxic, not haemorrhagic, effects although it is a pit viper. Some Australian elapid snakes have vasculotoxic and coagulation effects although they are principally neurotoxic. Some vipers (such as the puff adder and the gaboon viper in Africa) do not affect clotting.

Diagnosis of Severity

Viperine poisoning is severe if within one to two hours of the bite swelling is above the knee or elbow, shock (Fig. 5) is evident, or haemorrhagic signs besides haemoptysis develop (gum bleeding, ecchymoses, positive tourniquet test, and so on do not usually appear for four to five hours).

Elapid poisoning is severe if neurotoxic signs start within one hour or less of the bite and rapidly progress to respiratory failure. Mental confusion strongly suggests respiratory failure, though ptosis and glosso-pharyngeal palsy can make assessment of mental awareness difficult. Shock may also be a feature of severe elapid poisoning.

Severe seasnake poisoning is shown by myoglobinuria as early as one to two hours after the bite, and by the development within a few hours of respiratory failure.

Later Effects

Blisters around the site of the bite are common in cobra and viper envenoming. Blisters extending up the limb in viper bites (Fig. 5) suggest a large dose of venom; they may be serous or sanguineous. Local necrosis is characteristic of poisoning from Asian cobra bites (Fig. 6) and some viper bites (such as the African puff adder). Necrosis can be extensive but it is usually superficial; involvement of tendons, muscle, and bones is exceptional. Bacterial infection follows necrosis

and may spread to joints. But in the absence of necrosis or middlesome local measures such as incision, application of dressings, and so on bacterial infection virtually never occurs.

Even without specific treatment the mortality in snakebite is low. Generally speaking deaths are most rapid after elapid bites, especially cobra bites (average death time is about five hours after the bite), and most protracted after viper bites (average is two to three days after the bite). Death in seasnake bite (usually 12 to 24 hours after the bite) and in elapid bite is mainly due to respiratory failure; shock and haemorrhage into vital organs are the main causes of death in viper bites.

In the absence of necrosis, pain after viper bites rarely exceeds two weeks. Swelling usually resolves completely in two to three weeks, rarely in two to three months, and in exceptional cases the limb may remain permanently swollen. If blisters are left alone and no dressing is applied they rupture spontaneously about two weeks after the bite and dry up in an additional one or two weeks. If dressings are applied infection usually follows and greatly prolongs healing. Healing of local necrotic lesions varies according to the extent of the lesions and the treatment given, but requires at least a month, and may take from five to six months or longer even with expert surgical attention. In patients who recover without receiving specific antivenom, systemic symptoms generally subside quickly. Neurotoxic features of elapid systemic poisoning resolve in two to three days as a rule, but exceptionally may persist as long as two weeks. However, the myotoxic effects of systemic poisoning from seasnake bite are prolonged and full recovery may take several months. The transaminases are a sensitive laboratory guide to the muscle damage. In systemic viper bite poisoning shock and haemorrhagic features generally resolve within a week, but in bites by some vipers coagulation changes may persist for two to three weeks or even longer.

First-aid Treatment

First-aid comprises the measures taken by the victim or associates before receiving medical treatment. Recommendations (it will be rare indeed for the doctor to have to apply them

FIG. 2.—Haemoptysis is an early sign of systemic viper poisoning. It is rarely as profuse as in this case—often the patient has to cough hard to produce blood-stained spit. As systemic poisoning is present, antivenom is indicated.

FIG. 3.—Ptosis is the earliest sign of systemic poisoning by neurotoxic elapid snakes; antivenom is needed.

FIG. 5.—Shock in severe systemic viper bite poisoning may be fatal. Blisters extending up the bitten limb also indicate a high venom dose. Specific antivenom can relieve the shock dramatically.

personally) should be short, simple, practicable, and more helpful than harmful. Reassurance is most important, as the danger of snakebite is greatly exaggerated. The site of the bite should be wiped and covered with a handkerchief or cloth; it should not be incised, as this frequently introduces infection. A firm but not tight ligature should be applied just above the bite,

FIG. 4.—Seasnake bites cause no local symptoms. Only one quarter of those bitten have systemic poisoning, myalgia starting half to one hour after the bite. Movement of neck, trunk and limbs—bending as here—becomes very painful. A few hours later urine is brown or red from myoglobin.

FIG. 6.—Local necrosis following the bite of a common cobra. No systemic poisoning developed and antivenom was therefore not indicated.

using cloth, handkerchief, or grass. The victim should then go to the nearest hospital. If available, aspirin or alcohol in moderation is helpful. If the snake has been killed it should be taken to hospital; otherwise it should be left alone, since attempts to find or kill it often result in further bites.

These recommendations are generally applicable to the tropics, but in special circumstances (for example, in the case of a sophisticated expedition) modifications may be appropriate.

Medical Treatment

Reassurance is most important, so tetanus toxoid or a placebo injection should be promptly given unless systemic signs are already evident; in this event specific antivenom should be given. If a tourniquet has been applied it should be released. Unless one is confident that there is no possibility of significant poisoning ensuing, the patient should be carefully observed every half hour for some hours. If tetanus toxoid has been given initially, a second dose should be injected about six weeks later.

Initially, no covering or dressings should be applied to the site of the bite, since they greatly increase the incidence of secondary bacterial infection. Similarly, blisters should be left alone. But as soon as local necrosis is obvious sloughs should be excised. It may take several days for cobra bite necrosis to show (over a week if steroids have been given). Normal saline is the best dressing after excision of the slough. Antibiotics may now help and tetanus antiserum should be given (only for cases with necrosis—not as a routine). Skin grafting may be needed if necrosis is extensive. Pain is rarely a problem once the victim has received an injection.

Blood transfusion helps in viperine shock, especially if the victim was anaemic before the bite (but specific antivenom is usually dramatically successful in viperine shock if given in adequate dosage).

If respiratory failure develops in elapid or seasnake poisoning—shown by confusion, stupor, rapid shallow breathing, rise in pulse and blood pressure—a tracheostomy should be done. Artificial respiration and intragastric drip feeds may also be needed.

Specific Antivenom

Specific antivenom should be given only when signs of systemic poisoning are clinically evident; it should not be given as a routine in all cases of suspected snakebite. Haemorrhagic signs indicate a viperine antivenom. Neurotoxic signs without local swelling indicate mamba antivenom in Africa and krait antivenom in Asia. Neurotoxic signs plus local swelling (not due to a ligature) indicate cobra antivenom. Clinical distinction of poisoning by the various Australian and Papuan elapid snakes is difficult. Nonclotting (defibrinated) blood is a feature of taipan poisoning, whereas coagulation is normal in death adder poisoning. In some countries only polyvalent antivenom is available, so these distinctions are academic. Serum sensitivity may be tested by injecting 0.2 ml. antivenom subcutaneously; if severe reactions occur desensitization is needed before antivenom treatment.

Antivenom should always be given by intravenous drip except in mild systemic viperine poisoning. At least 100 ml. antivenom (usually contained in 10 ampoules) is needed, and this should be repeated, specially in neurotoxic poisoning, within one hour if there has been little significant improvement. The antivenom can be suitably diluted in two to three volumes of isotonic saline.

Adrenaline should be readily available for immediate antivenom reactions, which may occur despite negative sensitivity tests. Steroids are useful for delayed serum reactions, but controlled trials in human patients show that poisoning is not helped.

If antivenom is correctly used the response in systemic poisoning is dramatic. Local effects of envenoming do not appear to benefit. If it were possible to inject antivenom locally at the site of the bite *within a few minutes of the bite* necrosis might well be prevented or minimized. But in practice this is virtually never possible, and therefore local injection of antivenom is not advocated.

To be effective antivenom must, generally speaking, be specific. But recent work suggests that tiger snake antivenom (made in Australia) may constitute a "broad spectrum" antivenom effective against all commoner types of neurotoxic poisoning by Afro-Asian land snakes and against seasnake bite poisoning. The following is a list of some institutes making antivenom suitable for snakebite in the tropics:

- (1) Algeria: Institut Pasteur d'Algérie, Rue Docteur Laveran, Algiers.
- (2) Australia: Commonwealth Serum Laboratories, Parkville, Melbourne.
- (3) Brazil: Instituto Butantan, Caixa Postal 65, Sao Paulo.

(4) France: Institut Pasteur, Service de Sérothérapie, 36 Rue du Docteur Roux, Paris XV.

(5) Germany: Behringwerke AG, Postachliessfach 167, 355 Marburg.

(6) India: (a) Central Research Institute, Kasauli, R.I., Punjab. (b) Haffkine Institute, Parel, Bombay 12.

(7) Indonesia: Perusahaan Negara Bio Farma, 9 Djalan Pasteur, Bandung.

(8) Iran: Institut d'Etat des Sérums et Vaccins Razi, Boite Postale 656, Teheran.

(9) Japan: Institute for Infectious Diseases, University of Tokyo, Shiba Shirokane-daimachi, Minato-Ku, Tokyo.

(10) South Africa: South African Institute for Medical Research, P.O. Box 1038, Johannesburg.

(11) Taiwan: Taiwan Serum Vaccine Laboratory, 130 Fuh-lin Road, Shiling, Taipei.

(12) Thailand: Queen Saovabha Memorial Institute, Bangkok.

(13) United States: Wyeth Inc., Box 8299, Philadelphia, 1, Pa.

Doctors who need supplies of antivenom for use in various geographical areas may find the following most useful:

Americas: Polyvalent viper antivenom from 13; coral-snake antivenom from 3.

North Africa: Viper antivenom from 1, 4, or 5.

Mid Africa: Mamba antivenom from 10 (or 4); African cobra antivenom from 4, 5, or 10; viper antivenom from 4 (Bitis-Echis), 5 (Echis) or 10 (Echis).

South Africa: Mamba, cobra, and viper antivenom from 10.

Middle East: Viper-cobra antivenom from 4, 5, or 8.

Asia—Seasnake bite: Seasnake antivenom from 2.

Burma, India, and Pakistan: Cobra-krait-viper antivenom from 6 (a) or 6 (b).

Cambodia, Laos, Malaysia, Vietnam, Thailand: Viper and cobra antivenoms from 12.

Indonesia: Cobra-krait-viper antivenom from 7.

Japan: Viper antivenoms from 9.

Philippines and Taiwan: Cobra, krait, and viper antivenoms from 11.

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ANY QUESTIONS?

We publish below a selection of questions and answers of general interest.

Brucellosis and Aphthous Ulceration

Q.—Is there any evidence that brucella infection can cause aphthous ulceration?

A.—There is no evidence to suggest that chronic brucellosis is a cause of aphthous ulceration. Though the manifestations of chronic brucellosis may include rare cases of mucocutaneous involvement of the eye¹ and genital tract, any association with aphthous ulceration of the mouth is a fortuitous one.^{2,3}

REFERENCES

- Woods, A. C., *Arch. Ophthalmol.*, 1946, 35, 490.
- Ganardo, W., personal communication, 1968.
- Barrett, G. M., and Rickards, A. G., *Quart. J. Med.*, 1953, 22, 23.

Food Hygiene and Hydatid Disease

Q.—Is there any significant risk of the spread of hydatid disease from dogs entering food shops or from the contamination of the floors of shops or restaurants with the excreta of dogs which has become attached to the shoes of customers? How long are parasites able to survive after excretion by a dog?

A.—It is difficult to assess the significance of the risk of spreading hydatid disease to man by dogs in the circumstances mentioned. Several factors are involved—for example, the frequency of access of dogs to food shops and restaurants; the infection rate in dogs (usually low in this country, but 23% has been reported in farms in mid-Wales¹); the fouling of floors by dogs (probably infrequent) or by customers' shoes; the mechanical transport of eggs from floors on to food (rather unlikely, though flies, rats, and mice have been suspected²); and the degree of

resistance of eggs to desiccation. The resistance of eggs to desiccation is weak, and this is the main barrier to their survival after being evacuated by a dog. Otherwise the eggs can live for a long time, and they are resistant to strong antiseptics such as formalin, but they are quickly killed by heat, as in cooking.

It would therefore seem that the risk of customers becoming infected with hydatid disease in food shops or restaurants is not very significant, and that the principal causes of human infection conform with the "licking-tongue" or "dirty hands" hypotheses.³

REFERENCES

- Cook, B. R., *Ann. trop. Med. Parasit.*, 1964, 58, 147.
- Bisseru, B., *Diseases of Man Acquired from His Pets*, 1967. London.
- Swellengrebel, N. H., and Sterman, M. M., *Animal Parasites in Man*, 1961. London and New York.

Hypothyroidism from Iodides

Q.—Can thyroid depression or hypothyroidism result from the use of iodide therapeutically?

A.—A number of cases of goitre and hypothyroidism due to the therapeutic use of iodides by previously euthyroid subjects have been reported,¹ and the subject is well reviewed by Wayne, Koutras, and Alexander.² Most cases have occurred in patients who have taken proprietary cough medicines or remedies for asthma over a considerable period.

Many such preparations containing iodides are available and can be bought

freely without prescription. They must be very widely used, and, since iodide-induced hypothyroidism is rare, it follows that patients who develop a goitre and hypothyroidism must have a special sensitivity to iodides.

Studies of iodine metabolism in such cases shows that, in spite of a high level of circulating iodide and a high uptake of iodide by the thyroid gland, the production of thyroid hormone is deficient owing to a defective binding of iodine to tyrosine. If the iodide-containing medication is stopped the goitre will disappear and the patient revert to the euthyroid state spontaneously.

REFERENCES

- Begg, T. B., and Hall, R., *Quart. J. Med.*, 1963, 32, 351.
- Wayne, E. J., Koutras, D. A., and Alexander, W. D., *Clinical Aspects of Iodine Metabolism*, 1964. Oxford.

Cleft Palate and Lip

Q.—What are the chances of a mother who has a baby with a bilateral cleft palate and cleft lip, and who has a first cousin who had a baby who was similarly affected, having another child with the defect?

A.—The recurrence risk here with some degree of cleft lip with or without cleft palate malformation is of the order of 5%. The risk is somewhat higher with the more severe degree of malformation as here than with a lesser degree of the malformation. The affected first cousin has little or no effect on the risks.¹

REFERENCE

- Carter, C. O., in *Progress in Medical Genetics*, Vol. IV, 1965, edited by A. G. Steinberg and A. G. Bearn. New York.