HIGH VOLTAGE SHOCK TREATMENT FOR SNAKE BITE

SIR,—The mainstay of treatment of a person bitten by a venomous insect or reptile is to give anti-venom as soon as possible. However, the serum needed may not be available in remote areas of the world. In Ecuador high voltage, low current electric shocks have proved very successful. In the eastern Amazon jungles of Ecuador 4% of deaths are caused by snake bites.[1] 45% of the Waoroni tribe have been bitten by a snake and 50% of adult males will be bitten more than once. Most of the bites in Ecuador are from snakes identified by Dr Giovanni Onores (Catholic University, Quito) as *Bothrops atrox, B bileneatus, B nasutus, B schlegelei, B castelnaudi,* and *Lachesis muta*.

The idea of using an electrical current for treating venomous bites arose from a report in a local paper in Illinois, USA, of a farmer who was hyperallergic to bee stings and who found that applying a high voltage, low amperage, direct current shock to the site of his bee stings prevented his usual severe reactions. For snake bites a 20–25 kV, < 1 mA direct current is applied to the site of the bite. The bitten area (usually a limb) is electrically grounded as close to the bite as possible and current is applied via an insulated probe to the bite for 1–2 s. Usually four or five shocks are given with 5–10 s between them. An outboard motor is one commonly available source of such a current. A lead carrying an insulated probe can be attached to the spark plug, and the current is best applied with the engine at half-throttle. Other motors with spark plugs (eg, lawn mowers and auxiliary lighting plants) have also been used with excellent results.

We have records on 34 cases of bites on limbs where there was evidence of penetration of the skin. The current was applied within 30 min, and 10–15 min later all pain had gone and the usual sequelae of an untreated bite (swelling, serosanguinous bullae, bleeding, shock, and renal failure) did not develop. No patient died. After an hour the patient was usually able to go home. At follow-up there was no necrosis of tissue around the bite due either to the bite or the treatment. 7 people who refused the shock treatment experienced the classic complications and 2 needed life-saving amputations.

2 other patients were not treated until 2 h after being bitten by viper snakes (*B atrox* and *L muta*) and they arrived with swollen limbs and intense pain; 1 had signs of spontaneous bleeding. Seven electrical treatments were given, producing pain relief in 30 min; 12 h later the swellings had not progressed and there were no signs of bleeding. After 3 days the swelling had almost disappeared; however, 1 had a small necrotic area around the bite site.

This technique has been used equally successfully by other investigators in the jungles of Ecuador for other types of bite, such as those of the ant (*Paraponera sp*) and the black scorpion (*Tityus sp*). Colleagues in Irian Jaya, Indonesia, and Peru have also used this technique with similar results.

Moving towards a more portable system for this treatment, we have modified a 5 × 13 cm unit, popularly known as a "stun gun", with a 9 V battery to deliver a direct pulsating current of around 25 kV and less than 1 mA. One probe acts as the ground terminal while the other applies the current to the bite. Such currents do not stimulate myocardial muscle.[2]

The biological basis of this treatment is unknown. There may be a local effect on the host tissues or there may be a direct effect on the activity of the venom itself. Venom has a short half-life and a shut-down of local vessels by electrospasm may confine the venom locally long enough for it to become inactive. Whatever the mechanism, this technique is a practicable and potentially life-saving procedure.

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BIOLOGICAL BASIS FOR HIGH-VOLTAGE-SHOCK TREATMENT FOR SNAKEBITE

SIR,—Dr Guderian and colleagues (July 26, p 229) propose high-voltage shock as a treatment for snakebites. 20–25 kV direct current shocks of less than 1 mA to the site of the bite led to early relief of pain and diminished local toxic and inflammatory tissue reactions. Not one of thirty-four patients had signs of systemic envenomation. Guderian et al speculate that shutdown of local vessels by electrospasm would prevent the rapid distribution of snake venom.

Snake venoms contain a complex mixture of enzymes, neurotoxic proteins, polypeptides devoid of enzymatic activity, and low-molecular-weight compounds such as peptides, nucleosides, and metal ions.[1] Of at least twenty-six enzymes that have been detected in snake venoms twelve are found in all venoms (eg, phospholipase A and hyaluronidase[2]). A second major group of proteins and polypeptides responsible for the toxicity of the snake venom is characterised by an overall net positive charge (eg, cardiotoxin, cytotoxin, and direct lytic factor). These compounds act on membranes, disturbing their organisation and function.[3] An electrostatic interaction between the basic compounds and the negative charged surface of the membrane is presumed to be essential to their cytotoxic action on leucocytes and nerve and muscle cells. Most of these membrane-active polypeptides can potentiate the action of phospholipase A.[4]

Like snake venoms hymenopteran venom contains very similar constituents (eg, phospholipase A, hyaluronidase, and positively charged polypeptides[5]). Melittin, for instance, the main constituent of honeybee venom represents the correspondent basic polypeptide. Synergism between melittin and phospholipase A results in an enhanced toxic effect on target tissue.[6]

As we know from unpublished experiments with purified bee venom, a high-voltage current applied in vitro decreases the histamine-releasing activity of phospholipase A and melittin on purified peritoneal mast cells from the rat. We conclude that electrical current may directly modify the toxicity of animal venoms. Three different mechanisms seem to be responsible:

(1) The current will influence the hydrogen bonds of the enzymes, destroying their secondary and tertiary structure.

(2) The high voltage, low amperage current applied will reduce metal ions and zinc, copper, magnesium, iron, or calcium ions are firmly bound to some venom enzymes and are mandatory cofactors for these enzymes.[2]

The electric particles interfere with the membrane as well as the positive charged polypeptides decreasing their cytotoxic properties.[7] Taken together the protective high-voltage treatment for venomous snake bites is at least in part due to a direct action of the electrical current on the venom itself.

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