



VENOM DETECTION KITS IN THE MANAGEMENT OF SNAKEBITE IN CENTRAL PROVINCE, PAPUA NEW GUINEA

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A. J. Trevett, D. G. Lalloo, N. C. Nwokolo, R. D. G. Theakston, S. Naraqı and D. A. Warrell. Venom detection kits in the management of snakebite in Central Province, Papua New Guinea. *Toxicon* 33, 703-705, 1995.—The bites of six species of venomous elapid snakes in Central Province Papua New Guinea produce similar clinical syndromes. Optimal management of envenomed patients involves the use of monospecific antivenom. In this study, Venom Detection Kits (VDKs) (CSL Diagnostics, Melbourne) were used to try to make a specific diagnosis in envenomed patients at their admission. VDKs detected venom in admission bite site swabs from 39 of 46 patients (85%). Thirty-eight of these patients were shown to have been bitten by taipans. In all cases where venom was detected by the VDK, this correlated with subsequent laboratory enzyme immunoassay results. Selective use of VDKs in Central Province could allow more widespread use of monospecific antivenoms and produce considerable financial savings.

Around 90 patients are admitted to Port Moresby General Hospital each year with systemic envenoming following a bite by one of the six venomous elapid snakes occurring in the region. Clinical distinction of the biting species is usually impossible and patients are usually treated with polyspecific antivenom which is more expensive than monospecific and potentially more likely to cause significant side-effects (Sutherland and Lovering, 1979; Sutherland, 1992). Bedside venom detection kits (VDK) based on an enzyme immunoassay (Coulter *et al.*, 1980) are widely used in Australia for the rapid diagnosis of biting species. This study assesses the potential value of these kits in Papua New Guinea.

Forty-six patients were included in the study with unequivocal signs of systemic envenoming and an identifiable bite site. On admission, the bite site was carefully wiped with a cotton wool swab moistened in the diluent provided. The swab was then tested for venom according to the instructions provided with the VDK, and stored at -70°C . A sample of 5 ml of blood was taken from each patient, the time to clot noted and the serum separated and stored at -70°C . Swabs and serum samples were shipped on dry ice to the Liverpool School of Tropical Medicine and tested blind by enzyme immunoassay (EIA) for the presence of taipan (*Oxyuranus scutellatus canni*), Papuan black snake (*Pseudechis papuanus*), death adder (*Acanthopis spp.*), eastern brown snake (*Pseudonaja*

textilis) and small-eyed snake (*Micropechis ikaheka*) venom (Theakston *et al.*, 1977; Ho *et al.*, 1986).

EIA demonstrated venom antigen in all 46 patients in either swabs alone (5), serum alone (12) or both (29) (Table 1). VDKs detected venom antigen in 39 of the 46 patients (84.8%). Both the VDK and the swab EIA detected venom antigen in four patients in whom no venom antigen was detectable in the serum. Three of these patients had previously received antivenom, and one presented to PMGH more than 10 hr after the bite. The VDK was negative in one patient who had a positive swab by EIA but venom antigen was detected by VDK in five patients whose swab was negative.

In all cases in which the VDK was positive, the type of venom found correlated with that detected by EIA. The only non-taipan bite was identified by VDK. A true test of the discriminatory value of the VDK in Papuan snakebite would require a wider spread of species than seen in this series, but the test is clearly sensitive. EIA detected venom antigen in all of the envenomed patients in either bite-site swab, admission serum or both.

VDKs can be used with bite-site swabs, aspirates, serum and urine samples. The bite-site swab is suggested by CSL to be the most likely to give a positive result. The failure of the VDK to detect venom in swabs from seven patients may have been due to failure to identify the bite site correctly, prior washing of the site or inadequate volumes of venom deposited on the skin surface. In only one of these patients was venom antigen detected by EIA in the same bite-site swab, and only at a very low concentration.

Central Province, which has the highest incidence of snakebite of any area of PNG, has several dangerous elapids producing clinical syndromes which overlap. Use of the VDK allows a definitive diagnosis of the species which has bitten an envenomed patient and indicates the appropriate antivenom to use. This allows the clinician to use monospecific antivenom which is cheaper than polyspecific antivenom (polyspecific is currently £594/vial, taipan £545, death adder £346, black snake £436) and possibly less likely to produce side-effects (Sutherland and Lovering, 1979). The VDK costs £34/test.

Antivenom is an extremely expensive drug for the PNG Department of Health and a scarce resource. Ideally, VDKs could be used in all systemically envenomed patients. Because of the expense, this is unlikely to be achieved in the near future but the kits could be used selectively with both clinical benefit and potential financial savings. Seventy-seven per cent of envenomed patients admitted to PMGH between 1990 and 1992 following a taipan bite had non-clotting blood. The predictive value of non-clotting blood for taipan bite in envenomed patients admitted during this period was 0.96. We suggest that in Central Province, all envenomed patients in whom the biting species is unknown, with blood which does not clot in a new clean dry glass tube within 20 min (Warrell *et al.*, 1977), should receive taipan antivenom. Envenoming by a Papuan black snake, eastern brown snake and small-eyed snake may all also produce a coagulopathy but these species have only been responsible for 4% of envenomed patients admitted to PMGH in the last 3 years,

Table 1. Results of VDK and EIA tests

	Positive taipan	Positive death adder	No venom detected	Total
VDK	38	1	7	46
EIA swab	33	1	12	46
EIA serum	41	0	4	45

No serum sample was analysed from the patient with positive VDK and EIA swab for death adder venom.

and less than half of these had non-clotting blood. Small numbers of VDKs could be stocked at PMGH, solely for use in unequivocally envenomed patients who do not have coagulopathy, with the aim of using monospecific antivenom in as many of these patients as possible. If the VDK is negative or cannot be done, and the biting species is unknown, polyspecific antivenom should be given. If these guidelines were followed, approximately one patient a year at PMGH, who has been bitten by a Papuan black or eastern brown snake, is likely to receive inappropriate antivenom. While this is clearly undesirable, retrospective analysis shows that there have been no deaths amongst the 12 patients bitten by these two species in the past 3 years, despite two receiving no antivenom and two receiving inappropriate antivenom. This policy could save a considerable amount of confusion and, assuming rates of VDK positivity similar to those found in this study, produce a financial saving of almost £5000 each year, which could be spent on additional antivenom to distribute to rural health centres which desperately need it.

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REFERENCES

- Coulter, A. R., Harris, R. R. and Sutherland, S. K. (1980) Enzyme immunoassay for the rapid clinical identification of snake venom. *Med. J. Aust.* **1**, 433–435.
- Ho, M., Warrell, M. J., Warrell, D. A., Bidwell, D. and Voller, A. (1986) Critical reappraisal of the use of enzyme-linked immunosorbent assays in the study of snake bite. *Toxicon* **24**, 211–221.
- Sutherland, S. K. (1992) Antivenom use in Australia. Premedication, adverse reactions and the use of venom detection kits. *Med. J. Aust.* **157**, 734–739.
- Sutherland, S. K. and Lovering, K. E. (1979) Antivenoms. Use and adverse reactions over a 12-month period in Australia and Papua New Guinea. *Med. J. Aust.* **2**, 671–674.
- Theakston, R. D. G., Lloyd-Jones, M. J. and Reid, H. A. (1977) Micro-ELISA for detecting and assaying snake venom and antibody. *Lancet* **ii**, 639–641.
- Warrell, D. A., Davidson, N. McD., Greenwood, B. M., Ormerod, L. D., Pope, H. M., Watkins, B. J. and Prentice, C. R. M. (1977) Poisoning by bites of the saw-scaled or carpet viper (*Echis carinatus*) in Nigeria. *Q. J. Med.* **181**, 33–62.