

## Analysis of referral letters to assess the management of poisonous snake bite in rural Papua New Guinea

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### Abstract

A prospective series of patients envenomed after snake bite was seen at Port Moresby General Hospital (PMGH), Papua New Guinea, between January 1991 and December 1992. Referral letters were received with 60 of the patients who had been initially seen at a health centre. These letters were analysed in conjunction with our own clinical observations. The importance of non-clotting blood and local lymphadenopathy as early signs of systemic poisoning did not appear to be universally recognized by staff in health centres. In some cases, no attempt was made to transfer the patient to hospital until signs of neurotoxicity were established with potentially dangerous delay. Analysis of both hospital and health centre records suggests that the majority of deaths which occurred in Central Province, Papua New Guinea, during the period of the study were due to delay in transfer to hospital. We suggest that all patients with unequivocal signs of envenoming in Central Province, Papua New Guinea, should be transferred to PMGH as soon as possible. Antivenom should also be given as soon as possible, but this does not remove the need for immediate transfer.

### Introduction

Snake bite is a significant problem for rural populations in the tropics. For most patients, the initial point of contact with medical services is a rural health centre. In Central Province, Papua New Guinea, about 100 patients a year are admitted to hospital with signs of envenoming following a bite from an elapid snake (CURRIE *et al.*, 1991). The predominant biting species are the Papuan taipan (*Oxyuranus scutellatus canni*) and the death adder (*Acanthopis* spp.). The venom of both species contains powerful neurotoxins and taipan venom also contains a procoagulant which causes consumption coagulopathy and defibrinogenation (CAMPBELL, 1966, 1967; LALLOO *et al.*, 1992). Other species of venomous snake which occur in Central Province include whip snakes (*Demansia* spp.) and the Papuan black snake (*Pseudechis papuanus*).

The majority of patients are seen initially at a rural health centre where treatment is instituted. Severely envenomed patients are referred to Port Moresby General Hospital, a 600-bed university teaching hospital, for further management which includes ventilation in a high proportion of patients. Most health centres are staffed by health extension officers who have undergone 3 years training, by a trained nursing officer, or by both. Standard treatment schedules are contained in manuals published by the Department of Health (ANONYMOUS, 1988, 1989). The recommended indications for the administration of antivenom are the development of neurological signs, signs of bleeding, or non-clotting blood. Intravenous promethazine and subcutaneous adrenaline are recommended as routine pre-medication if antivenom is to be given. Efforts to educate local and health centre staff in the management of snake bite patients have been made over the past 6 years. Detailed snake bite observation sheets have been produced by the Papua New Guinea Department of Health, posters showing correct first aid treatment have been distributed, and all of the health centres in the province have been visited by medical personnel. We have examined the referral letters of patients referred to us over a period of 2 years and have used these to assess the quality of the management and assessment of snake bite victims in the health centres. We have also visited health centres throughout the province and assessed records of snake bite patients.

### Methods

Referral letters were reviewed for all patients referred to Port Moresby General Hospital, Papua New Guinea, with a diagnosis of snake bite envenoming in 1991 and 1992. The information contained in the referral letter

was noted, with specific attention being paid to the following features: patient identification, details of the bite including location, description of the snake, first aid used, time that the patient presented, symptom history, clinical signs, details of treatment, progress of the patient after treatment, and reasons for referral.

Recorded symptoms and signs were compared with the history and examination on admission to hospital and omissions were noted. Information about treatment was assessed as to whether adequate details were given and whether the treatment was appropriate for the recorded clinical condition of the patient. If antivenom was administered, the pre-medication used was assessed. The indications for, and timing of, referral were reviewed for each patient.

### Results

Referral letters of 60 envenomed patients from 15 different health centres were assessed; 18 letters (30%) were from health extension officers, 3 (5%) from doctors, and 30 (50%) from nursing sisters. The source of 9 letters was unstated (15%). The patients' identification details were adequate in 55 of the 60 referrals (92%). Other general details are shown in Table 1.

**Table 1. The number of referral letters detailing specific aspects of snake bite**

Details	Number
Time of bite recorded	52 (87%)
Location recorded	4 (7%)
Site of bite wound	18 (30%)
Snake described (or comment if not seen)	27 (45%)
Time of arrival at health centre stated	36 (60%)
Correct diagnosis made	59 (98%)

The frequency of recording the presence or absence of common symptoms and signs of elapid envenoming is shown in Table 2.

Details of documentation of treatment at the health centres are shown in Table 3. The figures show the numbers of patients for whom the institution or non-institution of the treatment steps listed in the standard treatment book was recorded.

Seventeen patients received polyvalent antivenom, 4 patients received monovalent black snake antivenom, and 4 patients received antivenom of unstated type. The indication for antivenom was stated in 24 of 25 cases, and agreed with the recommendations of the standard treatment book. The time at which antivenom was administered was recorded in only 9 of 25 patients (36%). Only 15 of 25 patients (60%) appeared to have been given the

**Table 2. The documentation of symptoms and signs in 60 referral letters after snake bite**

Symptom/Sign	Recorded at health centre		PMGH <sup>a</sup> Present
	Present	Absent	
Groin pain	31 (52%)	3 (5%)	54 (90%)
Abdominal pain	23 (38%)	6 (10%)	35 (58%)
Vomiting	18 (30%)	1 (2%)	37 (62%)
Headache	22 (37%)	0 (-)	35 (58%)
Ptosis +/- or ophthalmoplegia	20 (33%)	2 (3%)	49 (82%)
Bleeding	24 (40%)	2 (3%)	36 (60%)
Lymphadenitis	35 (58%)	0 (-)	56 (93%)
Non-clotting blood	29 (48%)	5 (8%)	43 (72%)

<sup>a</sup>Patients reporting symptoms occurring before transfer from the health centre and those who had signs on admission to Port Moresby General Hospital (PMGH).

**Table 3. Assessing the documentation of treatment given for snake bite**

Intervention	Recorded as given/not given
Antivenom	48 (80%)
Adrenaline	6 (10%)
Promethazine	22 (37%)
Tetanus toxoid	36 (60%)
Procaine penicillin	20 (33%)
Hydrocortisone	3 (5%)

recommended pre-medication. The giving of antivenom at the health centres appeared to be appropriate in all 25 cases, judged by the reported state of the patient at the time of administration and by the clinical state of the patient when he or she arrived at Port Moresby General Hospital. One patient was given intramuscular promethazine and subcutaneous adrenaline despite not being given antivenom. The reasons for referral to Port Moresby General Hospital were stated in 48 letters (80%) and are detailed in Table 4.

**Table 4. Reasons given for referral of cases of snake bite**

Reasons for referral	No. of patients
No antivenom at health centre	25
Progressing signs	16
No suction available	2
Family pressure	1
Lack of staff	1
Suspected renal failure	1
Antivenom reaction	1
Suspected appendicitis	1
Not stated	12

There was considerable variation in the clinical state of the patients at the time when the decision to transfer to hospital was taken (and, as described above, documentation was often incomplete). Most patients were referred with established signs of neurotoxicity; 17 patients were referred with coagulopathy alone, but most of these appear to have been actively bleeding at the time of referral. There seems to have been a reluctance to refer patients with coagulopathy alone, and several patients who had non-clotting blood at admission to the health centre were not referred until the onset of signs of neurotoxicity several hours later.

## Discussion

Elapid snake bite is a problem in the coastal areas of Papua New Guinea. Respiratory paralysis is the major cause of death and the only place in Central Province where patients can be ventilated is Port Moresby General Hospital. Most of the deaths that occur result from respiratory arrests occurring before patients reach the hospi-

tal. However, over 70% of all snake bites in Central Province are by non-venomous species or do not involve significant envenoming (D. G. Laloo, unpublished observations). It is therefore vital that staff in primary health care facilities can accurately identify those patients who need referral and that they understand the indications for treatment. Administration of antivenom is potentially dangerous, and it is also prohibitively expensive for a country with a limited health budget; the current cost is US\$750 per vial for taipan antivenom, US\$815 for polyvalent antivenom, and US\$475 for death adder. It is not possible, for logistic reasons, to send all snake bite victims to Port Moresby; in some areas, with a one-way travelling time of at least 6 h, this would mean committing the only ambulance for the whole day. The ability of the health centre staff to make informed decisions therefore has both medical and economic implications.

The referral letters received with patients are a valuable source of information and a guide to appropriate hospital management. The location and time of the bite may give clues to the biting species. A clear description of the snake is rare but, if present, can help considerably; for example, a snake with a red or orange back in Central Province could only be a taipan. Specific signs also carry diagnostic significance; in Central Province the presence of non-clotting blood is an indication of the taipan as the biting species with a positive predictive value of 93.5%, and makes it extremely unlikely that the patient has been bitten by a death adder (D. G. Laloo & A. J. Trevett, unpublished observations).

The poor recording of 2 particular signs was of concern. Non-clotting blood is an early sign of envenoming, usually present within 1-2 h of a taipan bite. It was clear from the referral letters that over 40% of health centres were either not using the simple test-tube clotting test or not recording the result (WARRELL *et al.*, 1977). Lymphadenitis in the bitten limb is also a highly sensitive early sign of envenoming (93%, in this series). It was disappointing that 42% of referral letters failed to comment on the presence or absence of this sign. These 2 signs are the most sensitive early clinical features of envenoming in Central Province and their importance needs to be further stressed. The indicators and significance of neurotoxicity are both widely appreciated, but 30% of letters still failed to make it clear whether these signs had been observed. Recognition of neurotoxicity is vital, as its progression is responsible for the majority of deaths which occur.

Analysis of the letters showed that, while positive symptoms or signs were often recorded (see Table 2), their absence rarely was. Of the 4 symptoms and 4 signs listed in Table 2, only 10 absent symptoms and 7 absent signs were recorded. Negative findings are important in determining the biting species and are also useful in detecting later deterioration in the clinical state of a patient. The Health Department of Papua New Guinea produces excellent recording sheets for snake bite victims which list both relevant symptoms and signs. All health centres should be encouraged to use these.

Most health centres have antivenom, although supplies are erratic. Early administration of antivenom is vital but, if antivenom is to be given at a health centre, the appropriate type must be used. Polyvalent antivenom should be given if the biting species is unknown. Antivenom had been given at the health centre to 25 of the 60 patients reviewed. For 4 patients the type of antivenom given was not recorded. In 4 of the other 21 cases, black snake monospecific antivenom was given, which was inappropriate to the biting species, later identified by serum or bite site immunoassay, although polyvalent antivenom was not available in 2 of these cases. This may be a reflection of the perceived importance of the Papuan black snake, which receives more attention from both medical staff and the general public than its current significance as a biting species in Central Province deserves.

It is very doubtful whether there is any role for black snake monovalent antivenom in Central Province at present although it is currently still being purchased and distributed by the Health Department.

The time and rate of administration of antivenom was rarely recorded. We were often unclear whether an infusion set up at the health centre, and which was still running on admission to the hospital, contained antivenom. With 9 of 25 patients, the concurrent administration of promethazine with the antivenom appeared to have been omitted, and 20 had not been given adrenaline. In another instance, promethazine and adrenaline were given to a patient who did not receive antivenom. Both observations suggest that the therapeutic role of these drugs is not universally understood. The recording of other treatments was erratic, and it was often unclear whether tetanus toxoid and procillin, both advised in the standard treatment book, had been given.

We thought that the referral of all the patients in this series to Port Moresby General Hospital was appropriate, although in some cases the reason stated for referral was eccentric. In total, 35 of 93 envenomed patients (38%) admitted to the hospital in 1991 required intubation despite having received appropriate antivenom. In the same year there were at least 8 deaths from snake bite among patients from Central Province health centres which occurred before transfer, 4 deaths during transfer, and 2 deaths occurring after admission to the hospital. Some of these deaths could probably have been avoided had the patients been transferred earlier, although for logistic reasons delay may have been unavoidable in some cases. Very few non-envenomed patients are referred from distant health clinics (6 patients in 1991 originated outside a radius of 20 km from the hospital, 46 inside), suggesting that careful consideration is given before organizing transfer from a distance. Delay in transferring envenomed patients is clearly dangerous and it is vital that health centre staff are clear about whom to refer. We believe that our figures indicate that all patients with unequivocal signs of envenoming should be referred to Port Moresby General Hospital. Whilst this will inevitably result in unnecessary referrals, it is impossible to predict which patients will progress to require intubation and ventilation and how quickly deterioration will occur. If this policy had been strictly adhered to in 1991, the additional patient load would have been approximately 34 extra patients and up to 12 deaths might have been prevented. It is desirable that emergency treatment, including antivenom, should be given to envenomed patients at health centres as soon as possible after the bite, but this should preface rather than replace immediate referral.

The drawback of this study is that omission of a record of a particular sign in a referral letter does not necessarily mean that the sign or symptom was not looked for in the patient. However, we feel it is justifiable to use these letters as an indication of what health centre staff consider

important in the management of snake bite and as a reflection of their prescribing and referral habits. Our results suggest that the major clinical features of snake bite are generally well understood at peripheral health centres but that the efficacy of antivenom is overrated with potentially dangerous consequences. The role of pre-medication to be given with antivenom is not universally understood. Continuing education is important for health staff working in the rural health centres and is often neglected. They would be greatly helped by an update on the predominant biting species in their own area, the distinctive features of envenoming by those species, emphasis upon the early recognition of envenoming, and other management issues such as the use of pressure bandages. Clear guidelines on the referral of patients need to be given. Health centres need to be encouraged to utilize existing radio links with Port Moresby General Hospital to discuss patients about whom they are unsure.

We now plan to visit all health centres in the province to discuss our findings and to give health centre staff an opportunity to question us. Most immediate treatment of snake bite will continue to be given in rural health centres, and continuing education at this level may be the best way to reduce mortality.

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