Management of snakebites at a rural South African hospital

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Abstract

Background: Snakebites remain a source of considerable morbidity and mortality in many countries, with an estimated global true incidence of envenomation exceeding five million a year, with about 100 000 of these cases developing severe sequelae. Despite the availability of polyvalent snake antivenom, inappropriate first aid, regional effects of envenomation and inappropriate use of antivenom result in significant and at times potentially avoidable morbidity and mortality, particularly in children. The study was undertaken in Lephalale (previously Ellisras) Hospital, Limpopo Province, due to the frequency of snakebites managed at the hospital.

Methods: This was a record-based retrospective study in which patient files with the diagnosis of snakebite were reviewed. The objective of this study was to document the management of snakebites at Lephalale Hospital, a rural hospital in South Africa. The hospital files of all patients managed at the hospital for snakebites from 1 January 1998 to 31 December 2001 were reviewed.

Results: Seventy patients were treated for snakebites during the study period. The results showed a male preponderance (60%) and a mean age of 27.3 years among the reported cases. Twenty-nine patients (41.1%) were bitten between dusk and dawn (18:00 and 06:00), 43 (61.4%) were bitten on the lower limb and the mean duration of admission in the wards was 4.2 days. Twenty-one bites (30%) were attributed to known poisonous snakes, 22 (31.4%) patients received polyvalent antivenom, 42 (60%) received promethazine, which has not been shown to prevent anaphylactic reactions, 12 (17.1%) developed complications and two died (a case fatality rate of 2.9%). None of the patients was given tetanus toxoid as prophylaxis, as no previous tetanus immunisation was documented.

Conclusions: The findings of this study highlight gaps in the management of snakebites at this rural hospital where they were treated frequently. It is crucial for primary care physicians to be familiar with the most common venomous snakes in South Africa and the management of their bites in humans. Elevation of the affected limb, administration of intravenous fluids and administration of analgesia, with close monitoring of patients during and after antivenom administration, form the basis of most clinical protocols on the management of snakebites.

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Introduction

Snakebites remain a source of considerable morbidity and mortality in many countries with an estimated global true incidence of envenomation exceeding five million a year, with about 100 000 of these cases developing severe sequelae.[1] Despite the availability of polyvalent snake antivenom, inappropriate first aid, the regional effects of envenomation and inappropriate use of antivenom result in significant and at times potentially avoidable morbidity and mortality, particularly in children.[2]

Snake venoms, the most complex of all poisons, are a mixture of over 20 enzymes and non-enzymatic compounds (neurotoxins and haemorrhagens) as well as other non-toxic proteins including carbohydrates and metals. Different species have differing proportions of most if not all of the mixtures.[3,4,5] Immediate application of a broad, firm pressure immobilisation bandage over the bitten area, if possible over the entire limb, aimed at impeding lymphatic and capillary flow, together with limb immobilisation is effective in the field management of human snake envenomation.[5,6]

Antivenom administration is indicated only if serious manifestations of envenomation are evident. Conventionally, 50 ml (five vials) to 150 ml (15 vials) is infused, depending on the severity of envenomation.[3,7,8] However, in patients who received half the conventional dose, there was no significant difference in the time taken for clotting to normalise.[9] Theoretically, there does not seem to be an upper dose limit and even 45 vials have been used successfully in a patient.[10] Antivenom is administered intravenously after a test dose.[5] Intramuscular administration of antivenom followed by standard hospital management led to a definite reduction in the number of patients with systemic envenomation, complications and mortality from Russell's viper envenomation.[11]

Although the best results from antivenom are observed within four hours of the bite,[5] antivenom has been noted to be effective in symptomatic patients even when administered more than 48 hours after the bite. Reports suggest that antivenom was efficacious even 6 – 7 days after the bite in settings where patients presented late.[12,13] Response to infusion of antivenom is often dramatic and normalisation of blood

pressure is an early response.[14] Within 15 to 30 minutes, bleeding stops though coagulation disturbances may take up to six hours to normalise. Neurotoxicity improves from the first 30 minutes but 24 to 48 hours may be required for full recovery.[15] Hypersensitivity reactions may occur in 3–4% of cases, usually within 10 to 180 minutes after infusion is started. These usually respond to conventional management including adrenaline, antihistamine and corticosteroids.[16] Of note is that intramuscular antivenom is ineffective in the South African context.

The National Health Laboratory Services (NHLS) produces a polyvalent antivenom that is effective against all venomous snakes common in Southern Africa except for the boomslang (*Dispholidus typus*) and the twig snake (*Thelotornis capensis*). The NHLS produces a monovalent antivenom specific for the boomslang; unfortunately, there is no antivenom for twig snake envenomation.[7]

Methods

This study was undertaken in Lephalale Hospital, which serves a predominantly rural population of roughly 90 000 people in Limpopo Province. A record-based, retrospective study design was used. All patients managed at the hospital for snakebites from 1 January 1998 to 31 December 2001 were included in the study. To ensure that all relevant data were evaluated, the records of paramedics, nursing staff and doctors were reviewed. Epi-info 6.04 software was used for data capture and analysis. Both descriptive and multivariate analyses were done with chi-square tests used where appropriate for association of variables. This study was approved by the Research, Ethics and Publications Committee of the Medical University of Southern Africa (now the University of Limpopo, Medunsa Campus) and permission was obtained from the Department of Health and Welfare, Limpopo, to conduct the study.

Results

Data were obtained on 70 patients of which 42 (60%) were males and 28 (40%) were females. The age range was between one and 70 years with a mean of 27.3 years (SD ± 15.7 years). Only 65 files (92.9%) had adequate information for accurate determination of duration of admission. The period of admission ranged from zero to 26 days with a mean of 4.2 days (SD ± 6.4 days).

Sixteen patients (22.9%) were bitten between dawn and dusk (06:00 and 18:00), 29 patients (41.4%) were bitten between dusk and dawn (18:00 and 06:00) and 25 patients (35.7%) had no records of time of bite. Only 26 patients (37.2%) reported within less than four hours after being bitten by a snake.

Forty-three patients (61.4%) sustained snakebites on the lower limb, 17 patients (24.3%) were bitten on the upper limb, six patients (8.6%) were bitten on other parts of the body and four patients (5.7%) had no comment on the site of the bite.

A chart showing the common snakes in Southern Africa was used to identify the snakes. Three bites (4.3%) were attributed to puff-adders, 14 (20.0%) to Mozambique spitting cobras, two (2.9%) to Egyptian cobras and two (2.9%) to black mambas. One bite (1.4%) was attributed to the southern stiletto snake, six (8.6%) to other species and for 12 patients (17.1%), the files indicated that the snakes were never identified. Thirty charts (42.8%) had no comment on the snake species (Table I). Thirteen out of 70 patients (18.6%) had bite puncture wounds, three (4.3%) had therapeutic cut wounds, 32 (45.7%) had swelling and 31 (44.3%) had tenderness over the bite marks. One chart indicated that a clinic sister had removed a tourniquet before referring the patient to hospital. None of the charts indicated usage of either herbal medicine or pressure immobilisation bandage. The patients in this study received various treatments, as indicated in Table II.

Table I: Snakebite and responsible snake species

Snake species	Frequency	Percentage
Puff-adders	3	4.3
Mozambique cobras	14	20.0
Egyptian cobras	2	2.9
Black mambas	2	2.9
Southern stiletto snake	1	1.4
Other species	6	8.6
No snake identified	12	17.1
No comment on snake species	30	42.8
Total	**70**	**100.0**

Table II: Treatment given for snakebites (n = 70)

Treatment	Frequency	Percentage
Promethazine	42	60.0
Hydrocortisone	32	45.7
Intravenous fluids	31	44.3
Antibiotics	22	31.4
Analgesics	39	55.7
Tetanus toxoid	29	41.4
Elevation of affected limb	20	28.6
Polyvalent antivenin	22	31.4

Further analysis showed that the two patients who developed anaphylaxis received promethazine prior to polyvalent antivenom administration. Two patients (2.9%) received adrenaline and eight patients (11.4%) had debridement done. A total of 12 patients developed complications as follows: two (2.8%) anaphylaxis, one (1.4%) compartment syndrome and nine (12.9%) tissue necrosis.

Fifty-two patients (74.3%) were discharged, 11 (15.7%) were referred to tertiary hospitals and two (2.9%) died from the complications of snake envenomation. For the remaining five patients (7.1%), it was not possible to determine the outcome from their files; two patients had inadequate clinical notes and three patients were admitted but refused hospital admission. There was a statistically significant difference between the snake species and polyvalent antivenom administration ($p = 0.004$). Only 22 patients (31.4%) received polyvalent antivenom, as shown in Table III. There was no consistency among prescribers on the dosages of antivenom given, and the most common analgesic administered was paracetamol.

Discussion

The study population had a mean age of 27.3 years (SD ± 15.7). These findings are quite different from those in other studies. In Nepal, snakebites were more common between the ages 11 and 20 years (36.7%)[11] and in KwaZulu-Natal (KZN), South Africa, 40% of snakebites occurred in children under 10 years of age.[17] The male preponderance

Table III: Association between snake species and polyvalent antivenom administration

			Polyvalent antivenom		Total
			No	Yes	
Species of snake	Adders	Count	-	**3**	**3**
		% within snake species	-	100.0%	100.0%
		% within polyvalent antivenom	-	13.6%	4.3%
		% of total	-	4.3%	4.3%
	Elapids (cobras and mambas)	Count	**8**	**10**	**18**
		% within snake species	44.4%	55.6%	100.0%
		% within polyvalent antivenom	16.7%	45.5%	25.7%
		% of total	11.4%	14.3%	25.7%
	Back-fanged snakes	Count	**1**	**0**	**1**
		% within snake species	100.0%	0	100.0%
		% within polyvalent antivenom	2.1%	0	1.4%
		% of total	1.4%	0	1.4%
	Other species	Count	**4**	**2**	**6**
		% within snake species	66.7%	33.3%	100.0%
		% within polyvalent antivenom	8.3%	9.1%	8.6%
		% of total	5.7%	2.9%	8.6%
	Species not identified	Count	**10**	**2**	**12**
		% within snake species	83.3%	16.7%	100.0%
		% within polyvalent antivenom	20.8%	9.1%	17.1%
		% of total	14.3%	2.9%	17.1%
	No comment in files	Count	**25**	**5**	**30**
		% within snake species	83.3%	16.7%	100.0%
		% within polyvalent antivenom	52.1%	22.7%	42.9%
		% of total	35.7%	7.1%	42.9%
Total		Count	**48**	**22**	**70**
		% within snake species	68.6%	31.4%	100.0%
		% within polyvalent antivenom	100.0%	100.0%	100.0%
		% of total	68.6%	31.4%	100.0%

Chi-square tests

	Value	df	Asymp. sig. (2-sided)
Pearson chi-square	17.042	5	0.004*
Likelihood ratio	17.867	5	0.003*

* = significant at 0.05 level

in this study is comparable to the findings from Nepal, where snakebites were 2.5 times more common in males,[10] but different from findings from KZN, where the person most at risk of snakebite was the young black adult female.[18] The difference in gender distribution in this study could be explained by the fact that farming is the main occupation in this rural area and this tends to attract more males as farmers.

Of the 45 patients for whom there was information on time of bite, about two-thirds were bitten between dusk and dawn. This is comparable with the Nepal study, where 57% of bites occurred between 16:00 and midnight,[10] and a study from Zimbabwe, where 61% of snakebites occurred at night.[17] These findings are slightly different from those from the KZN study, where only 30% of the bites occurred at night.[19]

Forty-three patients (61.4%) sustained bites on the lower limbs and these results are comparable with findings from Zimbabwe, where 64% of bites were on the lower limb,[17] and from KZN, where the victims were usually bitten on their bare feet.[18]

Only one file indicated that a patient arrived at the local clinic with a tourniquet. Although the use of a tourniquet in the management of snakebite is discouraged due to the risk of avascular necrosis[3,14] and possible increase in local envenomation,[20] its use is recommended after cobra bites since it delays the onset of neurotoxicity, and sudden release may lead to precipitous worsening of symptoms.[21] Cut wounds around the bite site are discouraged since they might increase the risk of sepsis and tetanus infection.[14]

The three groups of snakes of clinical importance (adders, elapids and back-fanged snakes) were implicated in about a third of the reported snakebites. It was interesting to note that in the group for other species and the group where the species were never identified, two patients from each group received antivenom and were referred to tertiary hospitals. Furthermore, in the group where there was no comment on the snake species, five patients received antivenom and two patients developed tissue necrosis.

In this study, 42 patients (60%) received promethazine and although promethazine is commonly administered, it has been shown not to prevent early anaphylactic reactions.[22] The two patients who developed anaphylactic reactions had received promethazine prior to the antivenom administration. Therefore patients should be closely monitored during antivenom infusion and the subsequent hours after infusion. The use of analgesics, which is an important facet in the management of snakebites, was only documented in slightly over half of the patients managed (55.5%).

Hydrocortisone was used in only 32 patients (45.7%), but even though hydrocortisone has been shown to delay the appearance of tissue necrosis, it does not lessen the severity of the outcome,[23] is of no value and interferes with the venom/antivenom reaction.[24] Intravenous fluids were also used in 31 patients (44.3%), and it is recommended that colloids be used and, where necessary, plasma or blood be given to correct the deficits.[25]

Antibiotics were used in a third of the patients but in general, antibiotics are usually unnecessary as bacterial infection is uncommon unless secondary to necrosis or iatrogenic. Moreover, only 29 patients (41.4%) received tetanus toxoid, but since four cases of tetanus have been documented following snakebites,[15] tetanus toxoid is a recommendation for those patients who have not received a booster in the five years preceding the snakebite.[26] Despite the fact that swelling was documented in 32 patients (45.7%), elevation of the affected limb was only prescribed for 20 patients (28.6%).

Only 22 patients (31.4%) received polyvalent antivenom and there was a statistically significant difference between the snake species and polyvalent antivenom administration ($p = 0.004$). Due to the risk of hypersensitivity reactions,[6,25] antivenom is indicated only if serious manifestations of envenomation are evident, such as coma, neurotoxicity, hypotension, shock, bleeding, disseminated intravascular coagulation (DIC) and electrocardiographic (ECG) changes.[5,7,8] In the absence of these systemic manifestations, swelling involving more than half the affected limb, extensive bruising or blistering and progression of the local lesions within 30–60 minutes after the bite are other indications.[4] Though it was

impossible to determine the severity of envenomation in this study, the results indicate that the doctors were more likely to administer antivenom if the snake was identified as poisonous as opposed to when the snake was identified as non-poisonous or not identified at all.

In this study, it was found that two children (2.9%) had died. One was bitten by a snake from the adder group and the other by one from the elapid group. While there are many factors influencing the outcome in victims of snakebites, there is an overall agreement that the case fatality rate generally varies from 2% to 10%.[5,10,27,28] Mortality is higher in children owing to larger amounts of toxin per kilogram body weight absorbed.[15]

Conclusions

The findings of this study highlighted gaps in the management of snakebites at this rural hospital, where they are treated frequently. It is crucial for primary care physicians to be familiar with the most common venomous snakes in South Africa and the management of their bites in humans. Elevation of the affected limb, intravenous fluids and administration of analgesia, with close monitoring of patients during and after antivenom administration, form the basis of most clinical protocols on the management of snakebites. This study further highlighted the need for all doctors managing snake envenomation in children to be proactive in their management and to refer such patients to centres with better support facilities as early as possible.

Study limitations

As this was a retrospective study, some of the information required was incomplete. Management of snakebites among health care professionals was also not consistent. The dosages of antivenom administered also varied, but this was not part of the study objective.

Ethics approval

This article was extracted from the M Med (Family Medicine) dissertation 'approved' by the Research, Ethics and Publications Committee of the former Medical University of Southern Africa (now the University of Limpopo, Medunsa Campus): clearance certificate number MP 104/2002.

Conflict of interest

No conflict of interest exists.

Dedication

This article is dedicated to the memory of Dr Charles Kyeyune who tragically passed away in a motor vehicle accident on 11 June 2007, who I supervised and assisted in converting his MFamMed dissertation into this article. May his gentle spirit rest in peace.

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