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Original Article

Epidemiological profile and management of snakebite cases – A cross sectional study from Himachal Pradesh, India

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ARTICLE INFO

Article history:

Received 15 September 2015

Accepted 19 November 2015

Keywords:

Snakebite

Envenoming

Antisnake venom

ABSTRACT

Background/objectives: Snakebite envenomings are an important but neglected public health problem. Our objectives were to describe the clinico-epidemiological profile and management practices of snakebite cases in Himachal Pradesh, India.

Methods: We did a cross-sectional analysis of data extracted from the records of snakebite cases (2008–2012) in Zonal Hospital, Solan, Himachal Pradesh. We estimated time trends, age/sex distribution of cases, and distribution of bites by colour of snake. We categorised the clinical manifestations into syndromes. Cases with locally toxic, haemotoxic or neurotoxic manifestations were classified as poisonous bites. Amongst the poisonous cases, we analysed trends in use of vials of antisnake venom (ASV) and its clinical outcomes and financial implications.

Results: Of the total 497 snakebites reported during 5 years, cases increased from 77/55,784 (0.14%) total hospital admissions in 2008 to 110/68,770 (0.16%) in 2012, 73% occurred in rainy season (July–September), and 266 (54%) amongst females. Colour of snake was recorded in 159 (32%) of which 122 (77%) were green. In all, 171 (34%) were poisonous out of which 96 (56%) were haemotoxic. Cases of poisonous bites decreased from 42 (2008) to 17 (2012). Out of 25 referred envenomings, 2 (8%) were given ASV at peripheral institutes. Use of ASV vials decreased from 747 (2008) to 71 (2012), with a corresponding reduction of 73% in the expenditure on ASV per cured patient. Cure rate remained above 70%. Five (3%) poisonous snakebite cases died.

Conclusions: Effective management of snakebites would include appropriate ASV use and production of monovalent antitoxin as per predominance of specific species of snakes.

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<http://dx.doi.org/10.1016/j.cegh.2015.11.007>

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1. Introduction

Envenoming from snakebites is a neglected but important public health problem in rural areas of South Asia, South-East Asia and sub-Saharan Africa.¹ Snakebites are more commonly seen in poorer sections of the population.² There is a wide variation in the estimates of morbidity and mortality due to snakebites. World Health Organization (WHO) estimates the problem as 421,000 envenomings and 20,000 deaths per annum. The same report also suggests that the burden may be as high as 1,841,000 envenomings and 94,000 deaths globally.¹ India is reported to have the highest number of deaths due to snakebites in the world.³ In India 119,368 envenomings and 1559 deaths per annum were reported in 2011.⁴ Mohapatra et al.³ estimated the snakebite mortality in India to the extent of 45,900. Himachal Pradesh has reported 1095 envenomings and 40 deaths per annum,⁴ which as per estimates maybe as high as 208 deaths per annum.⁵

In India, 236 species of snakes have been reported.⁶ These include the front-fanged venomous snakes of the families Elapidae and Viperidae. Viperidae are represented by true vipers and pit vipers.⁷ Green Pit Vipers are commonly found in the hilly regions of India.⁶ The family Elapidae has 17 species, which includes Cobras, King Cobras, Kraits and Coral Snakes. The spectacled Cobra (*Naja naja*) is one of the commonest snakes in India. Monocellate Cobra (*Naja kaouthia*) is seen in the Northern and North-Eastern Parts of India.⁷ Kraits are nocturnal snakes, which enter human dwelling at night in search of prey and many victims are bitten in their sleep.⁶ The prevalence of different snakes varies in different geographical parts of the country. As a result, the clinical manifestations and management practices vary.

WHO prescribes a standard protocol for treating snakebites in South East countries.⁸ Whilst a national protocol for management of snakebites in India is also in place,⁹ some states have developed their own protocols.¹⁰ These protocols are not followed strictly which may lead to inappropriate management and irrational use of antivenom (ASV). ASV is a scarce and costly commodity.¹¹ Both monovalent and polyvalent ASVs are available. In the rural tropics, victims are often bitten in an agricultural field or jungle, and in many instances the biting species is not identified. In such situations, treatment with polyvalent rather than monovalent ASV may be more appropriate. Central Research Institute (CRI) in Himachal Pradesh produces a polyvalent ASV, which has antitoxins against Cobra, Russell's viper, Common Krait and Saw Scaled Viper mostly used at Zonal Hospital, Solan.¹² This ASV does not contain antivenom against Green Pit Viper. There is a need to understand venom composition as per the geographic variation in species. ASVs should be designed against medically important species in India.¹³ The data on the epidemiology of snakebites are sparse in India.¹⁴ Information about the types of snakes and management of snakebites is pertinent to ensure the appropriate use of ASV. We describe the epidemiological profile, clinical manifestations and management practices of snakebites in the hilly, north Indian state of Himachal Pradesh in India.

2. Methods

We conducted a cross-sectional study amongst the snakebite cases at Zonal Hospital, Solan, Himachal Pradesh. We scrutinised the admission and death registers of the indoor and emergency departments. We extracted the treatment records of cases of snakebite admitted to the hospital, between January 2008 and December 2012. We analysed the monthly and yearly trends of occurrence of snakebites, the characteristics of the cases and colour of the snakes.

Locally toxic, haemotoxic, or neurotoxic bites were classified as poisonous bites.⁸ We classified bites having any of the manifestation such as local swelling, bullae, local necrosis or gangrene as locally toxic bites. The bites having any of the following manifestations – whole blood clotting time (WBCT) of more than 20 min, haematuria, epistaxis, hypotension, ecchymosis, sub-conjunctival bleed, haematemesis or encephalopathy – were classified as haemotoxic bites. Those having ptosis, diplopia, convulsions, dysphagia or inability to speak were classified as neurotoxic bites.

We described the management practices amongst the poisonous cases in relation to the use of ASV. We calculated the cure rates, case fatality rates, proportions of referral to higher institutions and proportions of patients, who had left against medical advice. We described the reasons of referral to higher institutions as proportions. We calculated the median time of hospital stay by type of bites. We analysed the data using Microsoft Excel 10 and Epi Info software, version 3.5.3.

3. Results

A total of 497 cases of snakebites were admitted from 2008 to 2012 at the Zonal Hospital, Solan. The reporting of snakebite cases increased from 77/55,784 (0.14%) total hospital admissions in 2008 to 110/68,770 (0.16%) in 2012 (Fig. 1). Of all the snakebites in a year, 63–83% occurred in the months of July–September (Fig. 2). Two hundred sixty-six (54%) of all cases were females, amongst whom 126 (48%) were 20–39 years old. Of 231 males, 112 (49%) were 10–29 years old (Table 1). Of all the bites, left hand was bitten 28% of the times, left foot 20%, right hand 19%, and right foot 18%. Amongst 171 poisonous snakebites, 67 (39%) were on the upper extremities of either side (Table 2). Each year, 92–96% cases were reported from rural areas. The median time to reach the hospital after

Fig. 1 – Yearly trend of snakebite cases admitted in Zonal Hospital, Solan, Himachal Pradesh, India, 2008–2012 (N = 497).

Fig. 2 – Monthly trend of poisonous and non-poisonous snakebite cases admitted in Zonal Hospital, Solan, Himachal Pradesh, India, 2008–2012 (N = 497).

Table 1 – Age and gender distribution of snakebite cases admitted in Zonal Hospital, Solan, Himachal Pradesh, India, 2008–2012.

Age group (years)	Male		Female		Total	
	n	%	n	%	N	%
0–9	11	5	7	3	18	4
10–19	50	22	23	9	73	15
20–29	62	27	58	22	120	24
30–39	35	15	68	26	103	21
40–49	30	13	44	17	74	15
50–59	27	12	39	15	66	13
60+	16	7	27	10	43	9
Total	231	100	266	100	497	100

snakebite was 3 h. Traditional methods of treatment of snakebites like tourniquets and giving incision were used in 27 (5%) of the cases before reaching the hospital. Amongst all bites, the colour of snake was recorded in 159 (32%) bites; out of which, 122 (77%) were green. Out of all the bites, 56 (11%) were referred from peripheral health institutions.

Out of the total bites, 171 (34%) were poisonous. Colour of the snake was recorded in 43 (25%) of the poisonous bites of which 30 (70%) were due to green coloured snakes. Local swelling was observed in 122 (71%) and WBCT of more than 20 min was observed in 96 (56%) of the 171 poisonous bites (Table 1). Fifty-six (33%) poisonous bites were haemotoxic with local toxicity, 64 (37%) were locally toxic, 40 (23%) were haemotoxic, 9 (5%) were neurotoxic and 2 (1%) were neurotoxic with local swelling.

Of the 56 cases referred from peripheral health institutions, 24 (43%) were bitten by poisonous snakes. Amongst these envenomings, only two (8%) were given ASV at the peripheral institute before referral, and one was given ASV in the ambulance during transportation to the Zonal Hospital. At the Zonal Hospital, test dose of ASV was given to 36 (21%) of 171 envenomings. Prophylactic regimen consisting of dexamethasone/hydrocortisone and chlorpheniramine maleate in injectable forms was used in 92 (54%) of the cases prior to administration of ASV. Of all the poisonous bites, 122 (71%) were given ASV at the Zonal Hospital. Repeat doses of ASV were given to 78 (46%) of the cases. The average number of vials used was 2.30 (range: 1–10) for the initial dose and 7.62 (range: 1–75) for repeat dose. The total average number of vials

Table 2 – Site of bite and clinical manifestations amongst poisonous snakebite cases admitted in Zonal Hospital, Solan, Himachal Pradesh, India, 2008–2012 (N = 171).

Site/clinical manifestations	n	%
Site of snakebite		
Left hand	36	21.1
Right foot	27	15.8
Right hand	25	14.6
Left foot	24	14.0
Right leg	6	3.5
Right arm	3	1.8
Left arm	3	1.8
Left leg	2	1.2
Right ear	1	0.6
Not recorded	44	25.7
Local manifestations		
Local swelling	122	71.35
Bullae	2	1.17
Local necrosis	3	1.75
Gangrene	1	0.58
Neurotoxic manifestations		
Ptosis	2	1.17
Dysphagia	2	1.17
Unable to speak	2	1.17
Diplopia	1	0.58
Convulsions	1	0.58
Haemotoxic manifestations		
WBCT >20 min	96	56.14
Haematuria	2	1.17
Epistaxis	2	1.17
Unconscious/semiconscious	2	1.17
Hypotension	1	0.58
Ecchymosis	1	0.58
Subconjunctival bleed	1	0.58
Haematemesis	1	0.58
Encephalopathy	1	0.58

used was 9.92 (range: 1–80). On an average INR 4960 (US\$ 99.2) was spent on ASV per poisonous bite. The maximum amount spent on ASV for a case of snakebite was INR 40,000 (US\$ 800). From 2008 to 2012, the total number of vials of ASV used as initial dose decreased from 116 to 15. The total number of vials used as repeat doses decreased from 631 to 56. The average number of vials used per envenoming came down from 3.9 (2008) to 1.8 (2012) for initial dose and from 16.2 (2008) to 3.6 (2012) for repeat doses. The cure rate remained above 70% from 2008 to 2012 (Fig. 3). The expenditure on ASV per cured patient

Fig. 3 – Consumption of ASV and cure rates in Zonal Hospital, Solan, Himachal Pradesh, India, 2008–2012 (N = 171).

reduced from INR 14,033 (US\$ 280.7) to INR 3833 (US\$ 76.7), a reduction of 73%.

Amongst the poisonous bites, 140 (82%) cases were cured, 22 (13%) were referred to higher institutions and 4 (2%) left against medical advice. Amongst the 22 cases who were referred 8 (36%) were due to hypersensitivity to ASV, 6 (27%) due to neurotoxicity and 3 (14%) due to complications of haemotoxicity. Two cases were referred due to unavailability of ASV and one due to unavailability of a paediatrician in the hospital. The median duration of hospital stay was 23 h for all 497 snakebites. This was 46 h for all poisonous bites and 2 h for neurotoxic bites. Out of 171 poisonous bites 5 (3%) cases died; all of which were neurotoxic. Amongst all 11 neurotoxic bites 6 (54.5%) were referred and 5 (45.5%) died.

4. Discussion

We reviewed the hospital records (2008–2012) of snakebite cases in Zonal Hospital, Solan in Himachal Pradesh, India. There was an increase in cases being admitted to the hospital. More cases were from rural areas, in the productive age group and amongst females. Majority of the bites were by green snakes in these areas. The clinical manifestations suggest predominance of viper bites.

The increasing number of cases over the years could be due to increased awareness in the community and better accessibility to health facilities in the form of improved ambulance services in Himachal Pradesh.¹⁵ The median time to report to the hospital was shorter in this study compared to that reported by studies from Karnataka, Pondicherry and Chandigarh.^{16–18} There was an increase in the numbers of snakebites in the rainy season in this region. The snake pits get flooded during the rains and the chances of human contact with snakes increases. The problem of snakebite assumes greater public health significance as it affects mostly people in the productive age group. We see more women getting bitten in this age group, as they are mostly engaged in the activities of cutting grass for fodder. The left hand is the commonest part of the body being bitten as it is this hand which is extended first into the grass. Green was the most commonly recognised colour of the snake. The common belief that green snakes are mostly non-poisonous may not hold good in the setting of Himachal Pradesh, as green pit vipers are quite common here and known to be haemotoxic.⁶ The ASV used in Zonal Hospital, Solan does not contain antitoxin against green pit viper. Hence, the management of Green Pit Viper bites would be observation of the cases for deterioration of signs and symptoms, administering symptomatic treatment, and blood or blood products transfusion, as and when required. In our study, nearly one-third of the snakebites were poisonous. The syndrome of haemotoxicity, with or without local toxicity, was observed in more than half of the envenomings. This shows an abundance of vipers in this region in contrast to the studies from Punjab and Chandigarh^{16,19} that report more neurotoxic bites. These studies were set in tertiary hospitals, where more neurotoxic bites are referred. Additionally, reporting of fewer neurotoxic bites in our study setting could be due to the low prevalence of neurotoxic snakes in this area. Another reason could be the inability of these cases to reach the hospital in

time in the event of their early death. ASV was not administered in one-third of the envenomings. This could be due to limited local swelling. ASV is only recommended in case the local swelling is spreading.⁹ The swelling could be localised due to low dose of toxin injected during the bite or application of tourniquet or incision in a non-venomous bite. One-fifth of the envenomings were given test dose of ASV and nearly half were not given prophylactic regimen before the administration of ASV. Both of these practices are not as per the recommendations of the National Snakebite treatment protocol.⁹ The National protocol recommends 10 vials of ASV as the initial dose in both haemotoxic and neurotoxic bites. For haemotoxic bites 5–10 vials of ASV are recommended as repeat doses at 6 hourly intervals till the restoration of the coagulation profile. For neurotoxic bites a repeat dose of 10 vials is recommended.⁹ At the Zonal Hospital, Solan, the treating physicians started giving 2 vials of ASV in haemotoxic bite as initial dose. The repeat doses were also given in multiples of 2 vials. This practice led to a reduction in average number of vials used as initial and repeat doses per envenoming. The physicians became aware that a large number of cases in this region reported with bites from Green Pit Viper (Pandey D – personal communication). Therefore, they stopped administering ASV to such cases. They also stopped admitting these cases and monitored them as outdoor patients for any derangement in coagulation profile. In spite of the reduction in the usage of ASV a cure rate of more than 70% was achieved all through the years. ASV is not available in the open market of District Solan. The Government has to procure ASV from CRI, Kasauli and bear the cost. The overall cost to cure an envenoming came down by 73% due to reduction in the usage of ASV resulting in gross savings of the public exchequer. Before reaching the Zonal Hospital, a negligible proportion of envenomings were given ASV in peripheral institutions. This could be due to issues of unavailability of ASV or lack of confidence to administer ASV amongst medical officers. A good beginning is the availability of ASV in the ambulance but it needs to be ascertained whether the paramedics in the ambulance are trained for treating snakebites. Nearly one-tenth of the envenomings were referred-out from the Zonal Hospital. Of the referred one-third were due to hypersensitivity reactions. These referrals could have been avoided by not giving test dose of ASV, giving prophylactic regimen in all cases of envenomings and treating the hypersensitive reaction in the Zonal Hospital itself. Only in a few occasions, the cases were referred due to unavailability of ASV, or unavailability of a specialist. Amongst the few neurotoxic envenomings reported from the hospital, nearly half died and others were referred-out after 2 h of median duration of stay at the hospital. This could be due to lack of facilities, including dedicated ventilator and/or lack of confidence and experience in managing neurotoxic bites amongst the treating physicians at the district level. We recommend trainings in management of snakebites for the doctors serving in the peripheral institutions. This could prevent unnecessary referral of non-poisonous bites to district level hospitals. ASV should be provided at the peripheral institutes after the trainings. The district hospitals should be equipped with ventilators exclusively for the medical department to reduce referrals and mortality due to neurotoxic bites.

Our study had certain limitations. We could not extract data from some incomplete or partially filled treatment charts. In some places, the notes recorded by the physician were not legible. Hence the data for all the parameters were not available for all the snakebite cases. The physicians had also not recorded, whether the local swelling was part of toxicity or due to some other reasons such as tourniquets. This may have resulted in misclassification of few non-poisonous bites to locally toxic poisonous bites. Our study had certain strengths. The study was conducted at a secondary level hospital that provides the best scenario to know the clinico-epidemiological profile and management practices for snakebites. Snakebites are usually not managed in peripheral health institutions and are referred to secondary level hospitals. The tertiary hospitals on the other hand usually manage complications arising out of snakebites or neurotoxic bites. Our study did not influence the management practices, as we analysed real time data on snakebites under prevalent management practices. Our study is also the first of its kind in the region to do a cost analysis for the use of ASV.

The physicians can easily recognise the envenoming-related syndromes that can aid in the use of snake-specific monovalent antitoxin, if made available. The use of monovalent vaccine can further reduce the cost as well as the risk of hypersensitive reactions due to foreign protein. Despite having a national protocol for management of snakebites, it is not efficiently practiced in the country. The validation of management protocol followed in the study hospital can guide to develop area specific guidelines for management of snakebites. In the long run, this would result in cost effective utilisation of ASV without compromising the cure rates.

Conflicts of interest

The authors have none to declare.

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