Epidemiological Survey of the Snakebite Problem in Human in the Terai Region of Nepal, 1996/97

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Abstract

In this survey the team visited 13 zonal or district hospitals, veterinary hospitals, and municipalities across the Terai and gathered a variety of informations. Epidemiological data on snakebite incidence was collected for 1996 & 1997 from all these hospitals. Information on treatment protocols for snakebite by medical staff, availability and cost to the patient of ASV, and awareness of the rural populations about first aid treatment for snakebite was gathered. Age & sexwise venomous snakebite cases were recorded in Nepal for the year 1996/1997. The case fatility rate is higher in children: 8% in 1996 and 3% in 1997, than adults: male 3% & female 4%. The 1994 study demonstrated a total of 1917 bites by venomous snakes in the Terai area and a total of 151 deaths, the mortality rate being 8% over a period of 6 years. Morbidity was highest in Mechi, Koshi, Sagarmatha, Bharatpur and Lumbini hospitals respectively. The peak season for snakebite was from June to September, during and following the monsoon, when snakes are most abundant. It has been shown that a breakdown of snakebite morbidity by age and sex for 10 years (1985/86 - 1994/95) from Bharatpur hospital, Chitwan. The case fatality rate exceeded 20% in this district.

Mortality and injury to both humans and livestock due to the bites of venomous snakes is a serious public health problem in much of the developing world, and particularly in Southeast Asia where there are abundant venomous snakes (Navy, 1965a). It has been estimated that there are on average 3000 reported human deaths per year from snakebites (Sawai, 1993), and this figure is probably underestimated. Several prior epidemiological studies (Joshi 1982, 1983, 1994) have demonstrated that mortality and morbidity caused by snakebite is a significant problem in the Terai region of Nepal. Studies in neighbouring India have identified 4 species of snake responsible for the majority of fatal bites: the Indian cobra (*Naja naja*), common krait (*Bungarus caeruleus*), Russell's viper (*Vipera russellii*), and saw-scaled viper (*Echis carinatus*) (Gaitonde, 1979). The polyvalent anti-snake-venin (ASV) produced in India by the Haffkine Institute and Serum Institute of India, and currently purchased by His Majesty's Government for use in Nepal, is directed against the venom of these four snakes. Recent studies (Joshi et al., 1996) in Nepal suggest that the Indian cobra and common krait are the problem snakes in the Terai region, whilst Russell's viper and the green pit viper (*Trimeresurus albolabris*) constitute a threat in the hill and mountain forest areas of Nepal.

Fear and dislike of snakes often leads to indiscriminate killing of snakes on sight, even though the great majority of snakes are non-venomous. In addition to the ecological impact of decimating snake populations, there are economic impacts to farmers of such actions. It has been suggested that 20 - 50% of India's grain crop is destroyed by rodents (Whitaker, 1975), and snakes constitute one of the most effective natural controls over rodent populations, often multiplying in response to increasing rodent populations. Unfortunately, indiscriminate killing of snakes removes this natural control leading to expanding rodent populations and increased loss or grain and crops.

Keywords: Snakebite; Nepal.

Background Information on Nepal

Nepal is a land-locked country bordered by China to the north and India to the west, south and east. It's dimensions are roughly 885 km (east to west) by 193 km (mean width) with a total land area of 147,181 km2. Politically, Nepal is divided into 5 developmental regions, 14 zones, and a total of 75 districts. The population was 18,491,097 in 1991 and is growing at a rate of 2% a year. For such a small country, Nepal is a land of extremes, and can be divided into 4 main geographic regions. The Himalayan Mountain region in the north contains the worlds tallest peak, Sagarmatha (Mt. Everest) at 8,848 meters, and 8 of the worlds 14 highest peaks. In sharp contrast is the lowland Terai region to the south, which ranges in altitude from only 100 to 300 meters above sea level. The other 2 geographic regions are the hill region, which includes the Siwalik and Mahabharat ranges, and the Valley region, which includes the Kathmandu and Pokhara Valleys. The Terai

region is primarily agricultural region and has a hot tropical climate with high seasonal rainfall and lush natural vegetation, making it ideal habitat for snakes. The abundance of snakes in the region, many of them venomous, and the labour intensive farming practices bring humans, their livestock and snakes into intimate contact.

Survey Methodology

The survey team visited 13 zonal and district hospitals and municipalities in the following zones (municipality in parentheses): Mahakali (Mahendranagar), Seti (Dhanghadi), Bheri (Gulariya and Nepalganj), Rapati (Ghorahi), Lumbini (Butawal and Siddharthanagar), Narayani (Bharatpur and Birganj), Janakpur (Janakpur), Sagarmatha (Rajbiraj), Koshi (Biratnagar) and Mechi (Bhadrapur). Since detailed epidemiological data from most hospitals had already been obtained by the previous teams (Joshi et al., 1994, 1996), this survey focused primarily on gathering information on approaches to treatment
used in different hospitals, standards of record keeping, availability and cost to the patient of ASV, snakes commonly involved, and any useful information that the doctor may be able to provide. The level of knowledge of the local populace regarding snake-bite first aid and problems related to lack of knowledge, time factors in reaching hospitals from outlying villages, and belief in traditional healing methods was also established.

Findings of the Survey

Epidemiology and Treatment of Snake-bite in the Terai

Detailed epidemiological studies have been published (Joshi et al., 1994 & 1996). The data from those studies are summarized briefly here to demonstrate the scope of the problem in the Terai. The 1994 survey visited 15 districts in the Terai and gathered morbidity and mortality data from 1989 to 1994 (Joshi et al., 1994, Table 1 & fig. 1). In addition, the district of Chitwan was chosen for a more detailed study due to its high incidence of snake-bite cases and rich reptile flora. A total of 11 years worth of data was collected for this region (Joshi et al., 1996, Table II).

Table I: Nationwide Venomous Snakebite cases in Nepal, 1989-1994

Year	*Total Cases*	*Cured*	*Deaths*	*CFR%*
1989	268	240	28	10
1990	440	412	28	6
1991	516	479	37	7
1992	246	223	23	9
1993	193	176	17	9
1994	254	236	18	7

Fig. 1: Nationwide Morbidity, Mortality and Case Fatality Rate of Poisonous Snakebite in Nepal, During the Year 1989-1995.

Tabel II: Venomous Snakebite cases at Bharatpur Hospital, Chitwan.

Year	Adults		Children		*Death*	*CFR%*	*Total*
	Male	*Female*	*Male*	*Female*			
1985/86	23	26	5	3	5	9	57
1986/87	10	16	8	5	11	28	39

1987/88	10	20	7	4	8	20	41
1988/89	20	26	4	9	13	22	59
1989/90	34	33	16	11	20	21	94
1990/91	8	27	6	9	25	50	50
1991/92	16	30	14	10	18	26	70
1992/93	15	31	5	7	14	24	58
1993/94	9	17	5	1	6	19	32
1994/95	10	15	0	3	4	14	28
Total	155	241	70	62	124	24	528

The 1994 study demonstrated a total of 1917 bites by venomous snakes, in the Terai area and a total of 151 deaths, the mortality rate being 8% over a period of 6 years (Table III & fig. II). Morbidity was highest in Mechi, Koshi, Sagarmatha, Bharatpur and Lumbini hospitals respectively (data not shown). The peak season for snakebite was from July to September, during and following the monsoon, when snakes are most abundant. The case fatality rate exceeded 20% in this district. Age & Sexwise and Monthwise Venomous Snakebite Cases Recorded in Nepal is shown in Table IV & V for the year 1996/1997. The fatility rate is higher in children, 8% during 1996 and 3% in 1997, than adults male female.

Table III: Snakebite Fatality Rate in Different Hospitals in Different Years

Hospitals	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Mechi ZH	4.5	0.0	0.0	0.0	0.0	0.0	0.0
Koshi ZH	NR	1.2	0.6	0.0	0.0	0.0	0.0
Sagarmatha ZH	NR	9.7	2.3	4.8	2.2	NR	0.0
Janakpur ZH	NR	NR	13.0	9.5	13.3	NR	0.0
Narayani ZH	NR	NR	9.7	10.7	0.0	7.6	7.6
Bharatpur H	0.0	23.5	25.0	23.2	24.1	7.1	2.0
Bheri ZH	NR	NR	50.0	0.0	25.0	0.0	40.0
Lumbini ZH	NR	NR	16.0	10.6	10.3	NR	5.0
Gularia H	NR	NR	NR	0.0	0.0	0.0	0.0

Seti ZH	NR	NR	12.5	12.5	6.3	22.3	6.0
Mahakali ZH	NR	NR	NR	7.4	15.3	10.6	25.0

NB:NR = Not Recorded

Fig. 2: Hospitalwise Snakebite Cases in Nepal, 1996 & 1997

Table IV: Age & Sexwise Venomous Snakebite Cases Recorded in Nepal

Age & Sex	*1996*				*1997*			
	Total Cases	*%*	*Death*	*CFR*	*Total Cases*	*%*	*Death*	*CFR*
0 - 15 Male	188	17	7	4	298	21	7	2
0 - 15 Female	141	13	5	4	210	15	2	1
16 & above Male	398	37	13	3	457	32	12	3
16 & above Female	356	33	13	4	452	32	18	4
Total = >	1083	100	38	4	1417	100	39	3

Fig. 3: Agewise Snakebite Cases in Nepal (2052) 1995/96

Fig. 4: Age & Sexwise Snakebite Cases Recorded in Nepal, 1996 & 1997.

Fig. 5: Age & Sexwise Snakebite Cases Recorded in Nepal, 1996 & 1997.

Table V: Monthwise Snakebite Cases Recorded in Nepal

Month	*1996*					*1997*				
	Male	*Female*	*Total*	*Death*	*CFR*	*Male*	*Female*	*Total*	*Death*	*CFR*
Jan	1	-	1	-		-	-	-	-	-
Feb.	5	3	8	-	-	-	-	-	-	-
March	11	8	19	-	-	-	-	-	-	-
April	14	21	35	1	3	55	42	97	5	5
May	36	11	47	3	6	90	72	162	2	1

June	103	72	175	8	5	205	181	386	15	4
July	134	114	248	10	4	109	103	212	7	3
Aug	127	114	241	9	4	138	112	250	8	3
Sept.	94	85	179	6	3	95	99	194	2	1
Oct.	38	60	98	1	1	44	33	77	-	-
Nov.	18	11	29	-	-	19	16	35	-	-
Dec.	2	1	3	-	-	3	1	4	-	-
Total	583	500	1083	38	4	758	659	1417	39	3

Fig. 6: Monthwise Snakebite Cases Recorded in Nepal, 1996 & 1997

It is important to note that only bites by venomous snakes are recorded here. The majority (around 90%) of snakebites are by non-venomous snakes, but victims are rarely able to differentiate venomous from non-venomous snakes and usually go to hospital for treatment anyway. Even a non-venomous snake-bite will result in travel time and cost to the victim and family, hospital costs, and lost productivity due to overnight hospital admission. Interestingly, it was found that Bhadrapur hospital has very few records of snakebite cases because most people in the area go to the nearby Army Hospital, which is cheaper and reportedly gives better treatment. Unfortunately a phone call to the Army Hospital was unsuccessful in procuring snakebite statistics. It should be noted that the Bhadrapur hospital is badly under-funded and under-equipped, not even having refrigeration. It was reported that snakebite is more often a problem in newly cleared farmland, with lots of tree stumps, and in areas directly bordering the large national parks in India, or the national parks of Nepal, such as Chitwan National Park. As farmland ages, and tree stumps are used for fuel, the problem lessens due to a reduction in potential snake habitat, and also probably due to depletion of snake populations through indiscriminate killing. Streams and river areas are reported to be sites of high snakebite incidence, but these are probably more often by non-venomous water snakes.

Snakebite Treatment Management by Hospitals

A similar approach to treatment of patient admitted for snake-bite is used by all hospitals, although there are important variations. In general the patient is admitted to the emergency room, and if there are no clinical signs of snakebite envenomation the wound is cleansed, treated topically with potassium permanganate or other disinfectants, and tetanus toxoid is administered at some, but not all, hospitals. The patient is then admitted and observed for development of clinical signs for 8 to 24 hours, depending on the hospital, and discharged if no signs develop. Only a few hospitals (Dhangadhi, Siddharthanagar and Rajbiraj) reported placing an IV catheter during the observation period. Siddharthanagar withholds food and water during the first 8 hours of observation. Only Gulariya hospital administers ASV in the absence of clinical signs, and only if a venomous snake has been positively identified by hospital staff.

The most consistent early signs of envenomation by neurotoxic type venom (cobra, krait) are ptosis, incoordination and difficult swallowing. Signs of pit viper bites, which are very rare in the Terai, include severe local swelling and pain, and blood in sputum, urine or faeces. Nepalganj hospital reports measuring clotting times (OSPT and PT) if a viper bite is suspected. If any of the above signs are present, most hospitals perform skin sensitivity testing of ASV (anaphylactic reactions to the horse serum in ASV are not uncommon) before administration of ASV. When clinical signs are severe there is often insufficient time to perform sensitivity testing, in which case ASV is administered immediately, and epinephrine kept on hand in case of adverse reaction. Rajbiraj hospital goes a step further by
pre-treating with epinephrine and dexamethasone if unable to do sensitivity test, whilst Gulariya hospital does not perform sensitivity tests at all, but simply has epinephrine available if needed. An initial dose of 1-2 vials of ASV is usually administered IV stat upon observing signs, and ASV is then usually administered as an IV drip in

5% dextrose or saline. Nepalganj hospital, for example, uses 4 vials of ASV per 450 ml 5% dextrose and administers at a rate of 1 vial per hour until resolution of clinical signs. The importance of administering ASV as soon as possible to small children needs to be emphasized strongly. The emergency doctor at Dhangadhi reported seeing deaths in as little as 30 minutes following onset of clinical signs in children bitten by venomous snakes.There maybe significant differences in response to cobra versus krait bites. Onset of clinical signs is fairly rapid with a cobra bite (2-4 hours), and response to treatment is correspondingly rapid. The medical superintendent at Rajbiraj reported that usually 10 to 15 vials of ASV was sufficient to treat a cobra bite, and recovery is usually complete within about 24 hours. Krait bites can be more insidious. The onset of clinical signs is slower (>4 hours to appearance of ptosis), leading to greater dissemination of the venom. Treatment with ASV for 2-3 days is often needed, and the use of over 50 vials in a single patient has been reported. Additionally, krait bites often occur at night when the patient is sleeping, and since there is no local pain the patient is often unaware of being bitten until symptoms begin. At none of the hospitals was mechanical ventilation equipment available. In case of respiratory failure, simple artificial respiration was most commonly used. Occasionally an endotracheal tube maybe inserted and manual bagging used to assist breathing. Oxygen was generally available if required.

Traditional Methods of Snakebite Treatments

A variety of traditional treatments performed by local healers have been described to treat snakebite injury, and many people in the rural areas trust these methods. It is doubtful that there is any merit in these treatments, and they may actually contribute to delay in going to a modern hospital. The belief in traditional treatment methods is reinforced by the fact that most snakebites are by non-venomous snakes, so when victims visit the local healer they obviously recover, and the healer takes the credit, thus enjoying a high success rate. It cannot be overemphasized that the only suitable treatment for a venomous snakebite is the use of ASV. Incision and bleeding of snakebite wounds following application of a tourniquet is commonly used as a method of first aid, and is often recommended. The benefits of bleeding wounds and sucking out venom are of questionable value. One text (Navy, 1965) reports that incision and suction are of no value if the envenomation is intramuscular, and that incision and suction following elapid bite (which includes cobras and kraits) has not been shown to be useful. A common practice in the Terai is for the healer to suck out the venom, rinse his mouth with alcohol, and spit it out. This practice is used both on animals and humans. A variant of this method is to bleed the wound and have chickens drink the blood. If the chickens die, this is taken as proof that the treatment is successful. Snake stones are commonly used. These may include either dried pieces of bone, or shiny black stone. They are applied to the wound and supposedly draw out the poison. A variation is to place the stones in milk after use, and if the milk turns black this demonstrates the venom has successfully been removed. There was one claim that the shiny black snake stones, obviously made of polished rock, are obtained from the skulls of snake-eating eagles, and magically bestow immunity to venom. A variety of plant materials are also touted as cures, either applied to the wound or given orally, although no specific plants were identified in this survey. The use of local plants is probably one area of traditional treatment that is worth follow-up. There was also a report of a type of wood, which wasn't identified, that when kept in the house keeps snakes away. Chants and mantras are often employed as "cures" for snakebite. Obviously, these methods rely purely on faith. Perhaps the most unusual traditional treatment was related to us by a red-cross health worker in Dhangadhi. Apparently the urine of a child is injected into the penis of the snakebite victim for cure !

Commonly Encountered Snakes in the Terai

Joshi et al. (1996) provides a detailed list of snakes identified in Nepal. Described here are those most commonly encountered and familiar to the public. Interviews with veterinary and municipality staff, and human doctors, were used to identify the most commonly encountered snakes. Whitaker's Field Guide (Whitaker, 1975) was used as an aid in identification. The snakes most commonly responsible for venomous bites are the Indian cobra (*Naja naja*), of which there are several subspecies, and the common krait (*Bungarus caeruleus*). Russell's viper (*Vipera russellii*) and the green pit viper (*Trimeresurus albolabris*) may constitute a problem in the hill regions. Cobras are reported to thrive in rice growing areas, whilst kraits, which are nocturnal, seem to thrive around human settlements. Other venomous snakes in the area include the banded krait (*Bungarus fasciatus*) and king cobra (*Ophiophagus hannah*), although these snakes rarely bite, and neither seems to contribute significantly to the snakebite problem, despite the fact that both have very toxic venom. Several non-venomous snakes were reported by local names, and tentatively identified with the aid of Whitaker's Field Guide. These include:

"Dhoria" - Identified as a green keelback (*Macropisthodon plumbicolor*) in Biratnagar and checkered keelback (*Xynochropis piscator*) in Rajbaraj. It is possible that the name Dhoria is applied to several of the common water snake species. Interestingly, it is widely believed that the bite of this snake is fatal to animals but not to humans.

"Harahara" - Identified as the striped keelback (*Amphiesma stolata*). This harmless snake is believed to be

venomous by some people.

"Mahir" - There were several reports of this snake, which could not be identified, but is reportedly black and white, fairly small, and venomous. Supposedly, when kept in a jar near the house it will keep other venomous snakes away. This is the only snake not killed on sight.

"Sarkar" - We were unable to identify this snake, but it is reported to be small, black with white spots, non-venomous, and often found in human dwellings.

Additionally, rat snakes (*Ptayas mucosus*) and vine snakes (*Ahaetulla nasatus*) are common, and both are believed to be venomous by rural people. The bronzeback tree snake (*Dendrelaphis tristis*) was reported to be present in the Jhapa area.

Common Problems Related to Snakebite Treatment

a) The cost and availability of ASV is a significant problem in all the areas of the Terai. The government of Nepal purchases a certain amount of ASV annually from India and distributes it to regional hospitals. However, all the hospitals report that the supply of ASV is insufficient to treat the number of cases seen. ASV is available from local vendors close to the hospitals, but it is expensive (prices in local pharmacies ranged from Rs350 to Rs410 per vial in this survey) and the patient is often required to pay for a significant amount themselves (this can be in excess of 30 vials). This can constitute a huge economic burden to rural farmers who are often living at subsistence level. The amount of ASV supplied free by the hospital varies considerably. Dang Ghorahi and Butwal charge for all the ASV given, Bharatpur gives the 1st vial free, and Nepalganj and Gulariya cover half of the total cost, irrespective of the amount given. The other hospitals give the first 2 - 10 vials for free, after which the patient must purchase it themselves, although several hospitals report they will absorb the cost for very poor patients. In some areas (Siddarthanagar, Dang Ghorahi, Biratnagar), patients may apply to the local municipality for reimbursement, but it seemed the municipality would only reimburse a limited amount unlikely to cover the entire cost of treatment. Bhadrapur municipality reported that it only reimburses for treatment during election periods! In Siddarthanagar the local Red Cross also helps patients in financial need.

b) One of the leading contributors to death following snakebite is the delay in getting the patient to hospital. There are **two** major reasons for this. **Firstly**, distance, poor roads, and lack of transportation facilities, especially since most snake-bites occur in rural farming communities. Since treatment with ASV is most effective within the first few hours of the bite, delay of several hours reaching the hospital can be disastrous. Transport is especially a problem during the monsoon season, when most snakebites occur, since many roads to local villages are washed away or difficult to travel. The Birganj municipality maintains 10 ambulances, but reports that during the rainy season it cannot reach many of the villages within it's area of coverage. **Secondly**, factor relates the use of local healers. Often following a snakebite, victims often visit a local healer who uses a variety of traditional methods to "treat" the snake-bite. Since the majority of bites are by non-venomous snakes, the healer enjoys a remarkable "cure" rate. Unfortunately, if the snake was venomous, the traditional treatments are of no value and the delay in seeking proper medical care often proves fatal. Belief in local healers, and a corresponding distrust of hospitals, seemed to be stronger in the far east and far west regions of the country, whilst in the central regions most people were aware of the need to go to hospital as soon as possible.

c) Lack of basic knowledge of first aid to treat snakebite constitutes another problem. Typically, it is known that a tourniquet will stop the spread of the venom. However, only few rural people know the correct use of tourniquets, which are often tied overly tight, not loosened at regular intervals, and left on for far too long. All hospitals reported seeing patients with severe cellulitis and gangrene of limbs from improper use of tourniquets.

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