

Full Length Research Paper

Inclusion of incorrect information on snakebite first aid in school and university teaching materials in Nepal

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In previous studies in Nepal, snakebite victims were found to either not have Pressure Immobilization Bandaging (PIB) or Local Compression Pad Immobilization (LCPI) performed for first aid, or had it performed incorrectly. The goal of this study was to evaluate training texts regarding first aid measures for snakebite and the rates of performance of both methods currently recommended, as well as ineffective or harmful practices. The study was conducted from September, 2009 to November, 2010. It evaluated the venomous snakebite first aid measures recommended in the 31 most recently published and commonly used Nepalese reference works and textbooks aimed at paramedical personnel, primary health care workers, medical undergraduates, and students of class five to bachelor's degree. It compared the suggestions of these with those of published guidelines for the management of snakebite envenomation. Up to 100% of first aid measures advocated in these materials differed significantly from published guidelines. This included the omission of appropriate activities, misstatements and prescription of inappropriate treatments. Among appropriate recommendations that were missing was the advice to apply PIB or LCPI, and the suggestion to go to a snakebite treatment center. Fifty-five percent of the references did recommend emergency transport. Inclusion of accurate evidence-based information regarding first aid measures for venomous snakebite in commonly used texts could help to reduce the application of ineffective or harmful pre-hospital practices, their associated morbidity and mortality, and increase the use of appropriate methods.

Key words: Envenomation, snakebite, pressure immobilization bandaging, local compression pad immobilization, curriculum, health education.

INTRODUCTION

Snakebite envenomation is a common but neglected public health problem in tropical and sub-tropical regions. Recent epidemiological studies revealed annual deaths of 45,900 in India alone (Mohapatra et al., 2011) and about 6,000 in Bangladesh (Rahman et al., 2010). A community based study in the southeastern lowlands of

Nepal reported 162 snakebite deaths annually per 100,000 population (the highest incidence of snakebite deaths in Asia ever reported) (Sharma et al., 2004a). Kraits and cobras are responsible for the majority of snakebite envenomations and deaths in Nepal (Thapa and Pandey, 2009; Epidemiology and Disease Control

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Division (EDCD), 2011). About 22 venomous snake species (six species of kraits, two cobras, king cobra, one coral snake, Russell's viper, nine pit-vipers, and two *Rhabdophis* spp.) have been reported from Nepal (Shah and Tiwari, 2004; Pandey, 2012; Kuch and Sharma, pers. comm.). Fifty-seven percent of the national population inhabiting 26 districts of the tropical lowlands of Nepal, are at great risk of snakebite envenomation (Shah et al., 2003; Central Bureau of Statistics (CBS), 2011). Those involved in subsistence farming (59%) (Pandey, 2007), 44% (Sharma et al., 2004a, b) particularly suffer from snakebites and associated morbidity, disability and mortality during the months of March to November (Pandey, 2006; Thapa and Pandey, 2009). Snakebite has been listed as a neglected tropical disease (Williams et al., 2010); however, it has not yet been considered a public health priority by the National Government of Nepal (Nepal Health Research Council (NHRC), 2012).

The use of traditional healing methods after a snakebite, before seeking professional treatment, is common in Bangladesh (86% by statistics) (Rahman et al., 2010), Nigeria (81%) (Michael et al., 2011), Pakistan (75%) (Chandio et al., 2000), Kenya (68%) (Snow et al., 1994), India (74%) (Hati et al., 1992) and 61% (Inamdar et al., 2010), and Nepal (22%) (Sharma et al., 2004a), (56%) (Pandey, 2007) and (26%) (Pandey et al., 2010a). In Nepal, snakebite victims in many cases still use various dangerous and useless first aid measures. The most common are tourniquets (88 to 93%), eating of chilies (believed to combat envenomation effects) (44 to 57%), washing the wound (22 to 50%), burning the wound (26%), making of local incisions and trying to suck out the venom (16 to 18%), and applying topical concoctions (herbal medicines, mud, garlic, ash, salt) (16%) or the use of snake stones (4%) (Heap and Cowan, 1991; Bhetwal et al., 1998; Sharma et al., 2004a, b). These treatments are potentially deleterious, prolonging time to definitive care at best instances and potentially causing increased morbidity or mortality at worst cases. For this reason, a consensus of scientific reviews and organizations actively discourage these measures (Leopold and Huber, 1960; Tun-Pe et al., 1987; Lawrence et al., 1996; Amaral et al., 1998; Pochanugool et al., 1998; Bush et al., 2000; Shah et al., 2003; Alberts et al., 2004; Chippaux et al., 2007; CSL, 2008; World Health Organization (WHO), 2010). However, several textbooks and reference works that are commonly used in schools and universities of Nepal still advocate these measures (Table 1) and these practices are still widespread and transcend to other South-east Asian countries. A recent study reported that more than 95% of snakebite victims documented in Chittagong Medical College Hospital in Bangladesh applied ligatures proximal to the bite site and 13% incised the bite site (Harris et al., 2010). These books are misleading and inadequate for people in the pre-hospital management of

snakebite. Although there are recommended treatments, their acceptance is hindered by these poor educational materials. The Epidemiology and Disease Control Division (EDCD), Ministry of Health, Nepal Government, does not monitor the application of recommended first aid measures, and the Curriculum Development Center (CDC), Ministry of Education, Nepal Government, and the Council for Technical Education and Vocational Training (CTEVT), Bhaktapur, Nepal, have not evaluated the limitations of the first aid measures that are mentioned in the curricula prescribed for schools and universities (Table 1). Our study examined the curriculum accuracy regarding the pre-hospital care of snakebite in the currently used teaching materials and assessed its possible impact in Nepalese community.

Pressure immobilization bandaging (PIB) (Sutherland et al., 1979) and local compression pad immobilization (LCPI) (Tun-Pe et al., 1995) are the important pre-hospital snakebite management tools for delaying the systemic absorption of venom, the onset of systemic envenomation effects, and the development of life-threatening respiratory paralysis without pain and other serious consequences. Even so, there is controversy over their efficacy. PIB involves the use of an elastic bandage (Canale et al., 2009) on the bitten appendages, applying pressure of 40 to 70 mm Hg for an upper limb and 55 to 70 mm Hg for a lower limb (Howarth et al., 1994), followed by immobilization of the limb with a splint or sling. LCPI involves the application of a firm rubber pad (or cotton pad) followed by cotton bandaging over the bite site and immobilization of the limb with a splint or sling. Both measures have the same mechanism of achieving the mentioned benefits.

Following encouraging results in several studies on monkeys, pigs, and humans (Sutherland, 1979; Murrell, 1981; Pearn et al., 1981; Sutherland et al., 1981a, b; Sutherland, 1994; Tun-Pe et al., 1995, 2000; German et al., 2005), several scientific reviews and organizations widely recommend PIB and LCPI for confirmed bites by elapid and viperid snakes, respectively (Oxer, 1982; Sutherland and Tibballs, 2001; Shah et al., 2003; Commonwealth Serum Laboratories (CSL), 2008; WHO, 2010). There is, as yet, no general agreement on first aid treatments for cobra bites which, depending on the species, may cause local envenomation with necrosis, neurotoxic envenomation, or frequently both.

The principle is that snakebites with high systemic toxicity (that is, high mortality) may benefit from PIB at the cost of tissue necrosis, and snakebites with low systemic toxicity (that is, low mortality) but high tissue necrosis, should not be treated with PIB. There are some snake species with both high systemic and local (tissue) toxicity like some viperids and some cobra species, making the decision about using PIB difficult and dependent on clinical judgment. Therefore, the suggestion to use PIB for spectacled cobra (*Naja naja*) bites based on experiments on primates, in which no

Table 1. Sources of scaled commission of inappropriate first aid measures.

SN	Publisher	Class	Book's name/medium	Publication year	Author	Page	RA	RAFA	Error		
									NRA	PAA	Total (%)
1	Asia Publication (AP), Private Limited, Kathmandu (Ktm.)	5	Health and Population (HP)/English	2007	KP Sapkota	82-83	0	No	i-iii	iv	100
2	Janak Shikshya Samagri Kendra (JSSK), Ltd., Bhaktapur	9	Health, Population and Environment (HPE)/English	2009	na	176	i	No	ii-vi	vii	86
3	Curriculum Development Centre (CDC), Bhaktapur	9	HPE/Nepali	2007	na	176	i	No	ii-vi	vii	86
4	AP, Private Limited (Pvt. Ltd.), Ktm.	9	HPE/English	2009	YS Gautam	249-50	i	No	ii-v	vi	83
5	Rastogi Publication,(RP), India	B.Sc.	Economic Zoology/English [reference book (Ref.)]	2007-2008	GS Shukla,VBU	306	v	No	i-iv	vi	83
6	Bhudi Puran Prakasan (BPP), Ktm.	B.Ed., 1st year	Foundation of Health (FH)/ Nepali	2007	SK Maharjan	364-65	i	No	ii-v	vi	83
7	CDC, Bhaktapur	6	HP/ Nepali	2007	na	38-42	i	No	ii-v	vi	83
8	CDC, Bhaktapur	8	HP/ Nepali	2009	na	47-53	iii,vi	No	i, ii, iv, v, vii	viii	75
9	Ratna Pustak Bhandar (RPB), Ktm.	B.Ed., one year	FH/ Nepali	2007	SN Dhakal	363-64	i,ii	No	iii-vii	viii	75
10	Vidhyarthi Pustak Bhandar (VPB), Ktm.	Paramedical	Clinical-III/ Nepali	2010	Dr. TB Pathak	84	i,ii	No	iii-vi	vii	71
11	VPB, Ktm.	Paramedical	A handbook of First-aid and Basic Surgery/Nepali	2009	Dr. TB Pathak	84	i,ii	No	iii-vi	vii	71
12	CDC, Bhaktapur	8	HP/ English	2009	na	51-52	iii, v	No	i, ii, iv	vi, vii	71
13	AP, Pvt. Ltd., Ktm.	8	HP/ English	2008	KP Sapkota	87-88	ii,v	No	i, iii, iv, vi	vii	71
14	Vidhyarthi Prakashan (VP), Pvt. Ltd., Ktm.	B.Ed.	Basic Health Science (BHS)/Nepali	2005	SN Dhakal	367-68	i,iii	No	ii, iv, v, vi	vii	71
15	RPB, Ktm.	B.Ed., 2nd year	BHS/ Nepali	2005	L Serchen	249-50	iii,iv	No	i, ii, v, vi	vii	71
16	RPB, Ktm.	B.Ed., 1st year	FH/ Nepali	2001	OP Baral	174-75	i, iii	No	ii, iv, vi	v, vii	71
17	MK Publisher and Distributors (MKPD), Ktm.	11	Introductory Health, Population and Environment/Nepali	2001	Dr. AK Jha	195-96	i,ii	No	iii-vi	vii	71
18	MKPD, Ktm.	B.Ed., 1st year	HPE/Nepali	1997	Dr. AK Jha	109-11	i,ii	No	iii-vi	vii	71
19	VP, Pvt. Ltd., Ktm.	Paramedical	Fundamental of Nursing/ English	2009/2010	S Pathak, R Devkota	325	i,vii,ix	No	ii-vi	viii	67
20	RPB, Ktm.	9	HPE/English	2009	Prof. Dr. RKM, Dr. BKR, UBK	188	i-iii	No	iv-viii	ix	67
21	Mrs. B. Shrestha, Ktm.	B.Sc.	Herpetology of Nepal/ English [Ref.]	2001	Prof. Dr.TK Shrestha	238-39	i,vi	Yes	ii-v	0	67
22	Ekta Book Distributors (EBD), Pvt. Ltd., Ktm.	5	HP/ English	2009	Dr. AK Jha, C Timothy	81-93	vi-viii	No	i-iv	v	63
23	BPB, Ktm.	Paramedical	A textbook of Health education, Health care system and First aid/ English	2009	SR Dhital	195	i, vii, viii	Yes	ii-vi	0	63
24	Taleju Prakashan, Ktm.	Paramedical	Foundation of First-aid and Basic Surgery/ Nepali	2007	U Sharma, RK Sharma	30-31	i,ii, vii	No	iii-vi	viii	63

Table 1. Contd.

25	RPB, Ktm.	8	HP/ English	2009	Prof. Dr. GBM, Prof. Dr. RKM	58	ii,iv	No	i, iii, v	0	60
26	BPB, Ktm.	11	HP/ Nepali	2009	Dr. S Giri, TR Poudel	177-78	ii,iv	No	iii	i,v	60
27	S. Pandit, Ktm.	Paramedical	Tatkal Doctor Nabhayama*/ Nepali [also, ref. to others]	2004	BP Pandit,	53-54	v-vii	Yes	i-iv	0	57
28	Tribhuvan University, Ktm.	11	Fundamental Health and Physical Education/ Nepali	2008	KP Acharya ,TB Karki	170-71	i,ii, vii, viii	Yes	iii-vi	0	50
29	EBD, Pvt. Ltd., Ktm.	8	HP/ English	2005	Dr. AK Jha	85-86	i,ii,iv,v,ix	No	iii, vi, vii, viii	x	50
30	Makalu Publication House, Ktm.	Paramedical	First aid, Basic Surgery and basic medical procedure/Nepali	2007	Dr. P. Subedi, H. Thapa	67-68	i-vi, vii, viii, ix, xi	No	x	xii	17
31	VPB, Ktm.	Paramedical	A textbook of First aid and Basic medical procedure/English	2010	Dr. TB Pathak	25-26	i-v, vi, vii	Yes	0	0	0

Class: B.Ed. = Bachelor of Education, B.Sc. = Bachelor of Science; Paramedical = Aayurvedic health assistant, Auxillary nursing midwifery, Aayurvedic auxillary health worker, Bachelor in Pharmacy, Bahelor in Public Health, B.Sc. Nursing, Bacherlor of Nursing, BAMS: Bachelor of Aayurvedic Medical Science, BDS = Bachelor of Dental Surgery, Community Health Worker, Community Medicine Assistant, Diploma in Pharmacy, Health Assistant, Lab. Technician, Proficiency Certificate Level (PCL) of Nursing, PCL of Pharmacy; Books: * = English translation: When there is no doctor immediately; Publication year (recently edited year was considered): Publication in Nepali year [Bikram Sambat (BS)] is generalized as: 2054 BS = 1997, 2058 BS = 2001, 2061 BS = 2004, 2062 BS = 2005, 2064 BS = 2007, 2065 BS = 2008, 2066 BS = 2009; Author: BKR = BK Ranjit, GBM = GB Mali, na = not available, RKM = RK Maharjan, TBK = TB Karki, TBK = TB Karki, UBK = UB Karki, VBU = VB Upadhyay; RA = recommended advice (advice to use PIB or LCPI are bold); NRA = non-recommended advice; PAA = partially accurate advice (advice to carry victims to a doctor or to undefined health facilities is bold); RAFA = recommendation to go to an appropriate facility provided with anti-snake venom (Yes = mentioned, No = not mentioned).

aggravation of local tissue necrosis was observed (Sutherland et al., 1981b), cannot be recommended to all cobra bites. However, retarding the onset of envenomation using PIB until antivenom can be given is critical in the case of those elapid snakes that cause life-threatening respiratory paralysis and little or no local tissue necrosis. The use of PIB is considered to be contraindicated in viper bites which cause serious local tissue necrosis (Seifert et al., 2011) because it may further intensify the local tissue damage. Thus, PIB should not be applied to bites of all venomous snake species in Nepal. LCPI (Tun-Pe et al., 1995) was developed for viper bites (Tun-Pe et al., 2000) and its application to

non-viper bites has not been evaluated yet. Therefore, PIB and LCPI differ in their application procedures as well as recommended indications based on the type of snake involved in the bite. Despite their controversial efficacy, application difficulties, and negligible clinical and follow-up studies (Russell, 1982; Blaylock, 1994; Warrell, 2006; Simpson, 2007), PIB and LCPI appear to be more beneficial, more comfortable, and safer first aid measures (WHO, 2010) for Nepalese snakebite victims than arterial tourniquets and other measures because the majority of the people in Nepal suffer from elapid bites (estimates include 92% elapid bites) (Pandey et al., 2010b), 50% krait bites (EDCD, 2011), 29 to 35% krait

bites and 19 to 25% cobra bites (Thapa and Pandey, 2009). PIB and LCPI do not need to be loosened intermittently and thus the dangerous consequences of periodically releasing tourniquets can be avoided. In addition, Saul et al. (2011) recently proposed a promising first aid treatment for snakebite but it has not been approved by WHO and the scientific community yet (GK Isbister, pers. comm.). Thus, while definitive data on the pre-hospital care of cobra, krait, and viper bites in Nepal is still lacking, the current consensus based on the best available evidence includes bandaging, immobilizing the extremity using sling or splint, and quickly transporting the victim to a snakebite treatment

center (Sutherland et al., 1979, 1981a; Tun-Pe et al., 1995, 2000; WHO, 2010).

MATERIALS AND METHODS

We evaluated the first aid measures recommended for snakebite in the most recently published and commonly used 31 reference works and textbooks (Table 1) available in Nepal from September, 2009 to November, 2010. We sought a wide spectrum of currently used books from academic institutions in Chitwan and Nawalparasi districts in the south-central lowlands of Nepal.

These publications were aimed at paramedical personnel, primary health care workers, medical undergraduates and students of class five to eleven, B.Ed., and B.Sc. nationwide in Nepal (Table 1). These teaching materials (texts) were recommended for paramedical and general education countrywide by Council of Technical Education and Vocational Training (CTEVT), Sanothimi, Bhaktapur, CDC, Sanothimi, Bhaktapur, Higher Secondary Education Board (HSEB), Bhaktapur, and Tribhuvan University (TU), Kathmandu. Annually, CTEVT alone enrolls about 15, 000 paramedical students nationwide (CTEVT 2011).

There might be additional books in Nepal that we did not look at. We compared practices recommended in texts with the published guidelines of the WHO (WHO, 2010), Commonwealth Serum Laboratories (CSL) Bioplasma Limited, Australia (CSL, 2008), and EDCD, Ministry of Health, Nepal Government (Shah et al., 2003). We graded the prescribed measures in each text into: recommended, non-recommended, and partially appropriate advice (Table 1). We considered the last two types of advice as erroneous. We analyzed the applicability of these texts based on consequences of suggested first aid measures.

RESULTS

Thirty-one reference works and textbooks were evaluated (Table 1). Up to 100% (mode: 71%) of first aid measures advocated differed significantly from published guidelines, including omission of appropriate methods and the recommendation of inappropriate ones. Recommendations to apply PIB or LCPI were present only in the last two references (Table 1; points in column 'Recommended Advice' are bold). Emergency transport was recommended in 17/31 (55%) of references. Five out of 31 references (16%) suggested going to an appropriate facility provided with anti-snake venom for treatment. Non-indicated and/or harmful recommendations included incision in 27 out of 31 reference works (87%), ligature/tourniquet application (77%), providing liquid/water to the victim (55%), wound sucking by mouth and/or suction pump (39%), washing the bite-site with soap and water (55%), potassium permanganate solution (35%), antiseptic (13%), or water (10%), and application of an icepack or cold water (23%). Of the 31 references, 26 (84%) omitted necessary information about the availability of antivenom. There were a number of references to partially correct practices. Of the 31 references, 25 (81%) advised people to carry victims to a doctor or to health facilities. However, this instruction is incomplete and might result in delayed definitive care in the context of Nepal because not all healthcare

institutions in Nepal have antivenom or sufficient facilities and training for managing venomous snakebite cases. Similarly, 5 (16%) references insufficiently recommended bandaging. Incomplete instructions and inappropriate usage of PIB and LCPI could render them functionless or deleterious.

DISCUSSION

The most common problems of the texts commonly used nationwide in teaching in Nepal were omitting the recommendation from EDCD, CSL, and WHO to use PIB or LCPI, and including actions that are ineffective, harmful, and delay appropriate care (Shah et al., 2003; CSL, 2008; WHO, 2010). These weaknesses in the texts encourage and perpetuate ineffective, obsolete measures. This may help to explain why beliefs in traditional and/or contraindicated treatments for snakebite are still deeply rooted among the people of Nepal (Sharma et al., 2004a,b; Pandey, 2007) and why snakebite victims did not use PIB or LCPI (Pandey et al., 2010b). Of all currently non-recommended measures, the application of an arterial tourniquet is most popular in Nepal (93%) (Heap and Cowan, 1991), 88% (Sharma et al., 2004a), 90% (Sharma et al., 2004b), 69% (Pandey et al., 2010b) and other countries [Pakistan (79%) (Chandio et al., 2000), Bangladesh (95%) (Harris et al., 2010), 64% (Rahman et al., 2010), Nigeria (54%) (Michael et al., 2011), India (11%) (Chauhan et al., 2005)].

The recommendation for an arterial tourniquet by the majority of texts (77%) used in schools and universities in Nepal (Table 1) corresponds to its broad adoption by Nepalese snakebite victims. Although Christensen (1969) advocated tourniquets after a trial on mice and Watt et al. (1988) found it to delay neurotoxic effects of Philippine cobra bites, it was ineffective in Russell's viper bites (Tun-Pe et al., 1987) and discouraged in other venomous snakebites because of discomfort, risk of necrosis, atrophy or gangrene, and the serious consequences of its intermittent release with respect to rapid systemic uptake of venom (Watt et al., 1988; Theakston, 1997; Warrell, 2006; WHO, 2010).

Pre-hospital care of snakebite envenomation should aim at reducing the spread of venom and expediting the transport of victims to the snakebite treatment center. The PIB or LCPI can be an effective pre-hospital snakebite management tool which delays the absorption and the spread of venom from the site of the bite until antivenom can be given. Prompt treatment with antivenom is rare in Nepal because of supply, distribution, and storage problems. Lack of sufficient respiratory support (for example, ventilators) and widespread inability of medical staff to manage life-threatening respiratory paralysis or reactions to antivenom are additional challenges. Antivenom use outside medical or paramedical settings would be impractical also because of the

high rate of adverse reactions to antivenom and the frequent need for respiratory support.

Moreover, the majority of venomous snakebites, especially krait bites, occur in the evening and at night (27% from 18:00 to 20:00 and 25% from 21:00 to 03:00) (Pandey, 2007), 100% from 23:00 to 05:00 (Ariaratnam et al., 2008) and 36% (Rahman et al., 2010) especially in rural areas (90%) (Kulkarni and Anees, 1994), 82% (Chauhan et al., 2005) and 70% (Inamdar et al., 2010).

In Nepal, 83% of the total population inhabits rural areas (CBS, 2011) where transportation and health facilities are very poor or inadequate. Snakebite victims therefore often need several hours to access a snakebite treatment center with sufficient antivenom and respiratory support (50% snakebite victims needed > 4 h (WHO, 1987), 41 to 42%, 1 to 2 h (Sharma et al., 2004b; Pandey, 2007). In these complex circumstances, appropriately applied standard first aid could be essential to slow down the absorption and spread of venom, preventing the development of life-threatening respiratory paralysis until definitive care can be obtained. Hence, in the context of Nepal and similar countries, first aid prior to antivenom treatment has enormous potential to save the lives of people. It could be achieved by educating people in the appropriate use of PIB and LCPI, not employing useless or harmful treatments, and obtaining expedited transport to a snakebite treatment center. Although emergency transport was recommended in 55% of references, promoting the concept of a 'motorbike ambulance' in Nepal and similar countries would seem to be much superior (Seppa, 2011). The application of appropriate and non-delaying first aid, accompanied by the use of a motorbike ambulance, might further increase its life-saving effects in rural areas where motorbikes are common.

Some studies in Nepal (Sharma et al., 2004a, b; Pandey, 2007; Pandey et al., 2010b) noted that victims were treated without PIB and LCPI. Also, such measures were occasionally misapplied, and traditional treatments which had no efficacy and may cause harm, were often used. The assessment of the available literature and outcome of the present investigation showed that inaccurate and inadequate educational materials developed by non-experts, without considering the published evidence and relevant guidelines, have the potential to distract or confuse people in the use of pre-hospital care. Consequently, such poor teaching materials complicate snakebite management in Nepal.

Simple methods can have a significant impact in reducing morbidity and mortality. A simple and cost-effective public health education course given to community health volunteers in Nepal reduced the pediatric fatality rate by 61% over the past decade (Republica Daily, 2010). Snakebite first aid training in Madi valley, Nepal, changed the attitude of people, reduced dependency on traditional healing, and increased the use of PIB and LCPI (Pandey et al., 2010a). How-

ever, Simpson et al. (2008) reported that short-term training alone could not prompt people to apply PIB appropriately. Norris et al. (2005) noticed difficulties in the application of precise pressure between the bandage and skin, even when applied by health professionals. Canale et al. (2009) reported an improvement in the ability to apply elasticized bandage, after training. To improve the ability to apply recommended methods, the widely used and safer first aid techniques (PIB and LCPI) should be taught in schools and universities in Nepal. The teaching should be practical and carried out regularly in different classes. Appropriate first aid procedures should be described in the curriculum texts used by first aid personnel, students, and others to enable them to apply PIB or LCPI with appropriate pressure between the bandage and the skin, and apply splints or slings properly.

We identified 30 books used in schools and universities throughout Nepal which inadequately and inaccurately educate people in snakebite first aid skills. Twenty-three books were published between 2007 and 2010 (Table 1). Similarly, Quraishi et al. (2008) also noted three textbooks that are inadequate in terms of snakebite management in the context of Pakistan. Thus, these teaching materials should be updated as new information becomes available. Teaching PIB and LCPI may be lifesaving, particularly in the rural parts of tropical and subtropical regions where antivenom is not readily available and transport facilities are very poor. Hence, it is imperative to include in the curriculum, information on appropriate methods of first aid, on antivenom availability in the nearest health facilities, and on the need of quick transport of the victim to a nearby snakebite treatment center. These works should likewise discourage the application of ineffective or deleterious first aid treatments. The use of accurate published materials in the teaching of snakebite first aid and subsequent management would likely increase the appropriate management of venomous snakebite and reduce inappropriate care, and its associated morbidity and mortality in Nepal and other countries.

Since appropriate pre-hospital management of snakebite in Nepal depends on the school and university curriculum, NHRC, EDCD, CDC and other authorities should recognize that the current curricula contain inappropriate snakebite first aid measures. They should instruct and encourage authors and publishers to amend the texts, and prompt teachers rapidly to implement the most appropriate and updated first aid measures sanctioned by reliable sources like WHO and EDCD, Nepal Government. After certain intervals of implementation of amended curricula and community awareness programs, the existing knowledge and skills of applying PIB and LCPI among recipients of the full course of snakebite first aid should be assessed. This may help to promote the practicability of these life-saving first aid measures.

Recently, ointment containing nitric oxide (NO) has been proposed to provide a new pharmacological approach to snakebite first aid (Saul et al., 2011). Its combination with the previous mechanical approach (PIB and LCPI) might additionally delay the venom movement in the body fluids. To evaluate the efficacy of these first aid measures, prospective, comparative, randomized, and controlled clinical studies (Currie, 2003; 2006; Currie et al., 2008) should be carried out that involve identified bites by several species of venomous snake. Such studies could resolve questions of efficacy, application difficulties, and possibilities of improvements in existing first aid techniques, to make them effective and affordable. The most rational snakebite first aid methods could then be promoted in the curricula and other teaching materials throughout the snakebite prone areas.

Conclusion

The omission of current standard-of-care information and the inclusion of contraindicated and potentially dangerous information in texts that are in common use in Nepal contributes to substandard care being delivered. Improvement of educational materials leads to better snakebite management and saves lives of snakebite victims. As the procedures and use of PIB and LCPI depend on the species of snake responsible for bites, people in snakebite prone areas should be taught to identify elapid and viperid snakes. This could help them to select the appropriate first aid type. Instead of methods that have been proven to be ineffective and/or harmful, PIB could be taught in the lowlands of Nepal where elapid (neurotoxic) snakebite predominates and bites by kraits (with no local envenomation effects) are common. At the same time, our survey highlights the need for clinical studies to evaluate the context-specific efficacy and safety of first aid measures for snakebite.

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