Essay on snake-bite and some strategies to reduce mortality and morbidity

Law, Criminal Justice

SNAKE-BITE MORTALITY AND MORBIDITY IN INDIA

Mortality and morbidity should no longer be a common result of snake-bites in India but this health hazard is still a tragic problem. Montiero (et al., 2012) noted that although " snake-bite is an important and preventable health hazard" envenomations around the world are high and result in 10s of thousands of death every year. India is considered to have the highest numbers of poisonous snake-bites each year which result in medical problems, many due to complications from coagulation, resulting in thousands of needless deaths. Alirol (et al., 2010) stated that except for antivenom production " snake-bite envenoming . . . shares all the characteristics of a neglected tropical disease."

The purpose of this essay was to explore what is being done in India to prevent or at least reduce snake-bite mortality and morbidity. Although great advances have been in manufacturing anti snake venom the expectation was to find that the ASV is not used being used efficiently particularly when cost of the ASV was part of the evaluation of ASV use. Also the author expected to find both simple and complex changes necessary in order to decrease snake-bite mortality in India.

Epidemiology

Mohapatra (et al., 2011) conducted a national study to evaluate the total annual number of snakebites in India. The study reported approximately 49, 500 annual deaths caused by snakebites. Ninety seven percent of the snake-bite victims were in the countryside, and males were bitten more often than

females. The worst time for snake-bite risk was determined to be from June to September (during monsoon season). The three states determined to have the highest mortality due to snake-bites were Andhra Pradesh, Uttar Pradesh and Bihar (Mohapatra et al., 2011, e1018).

Ahmed (et al., 2012) explained that cultural problems cause too many deaths due to snake-bites. ‘ It is because of the crazy, illogical and superstitious first aid treatments used’ (Simpson 2007 as cited in Ahmed et al 2012). Tourniquets were used on 98 percent of the victims immediately after the bite and more than 50 percent of the epidemiological cases studied used some type of odd, inappropriate method of first aid (Ahmed et al., 2012)

Venomous Snakes in India

In India the cobra and krait have been identified as the perpetrators of most envenomization (Ahmed et al., 2012). Anil (et al., 2010) reported that during the monsoon season in northwest India the common krait species, bungarus caeruleus (the most toxic snake) is responsible for the most snake-bites. Their venom causes muscle paralysis. A snake-bite does not always result in envenoming (the injection of poisonous venom into the victim’s body) on the other hand a mark is not always detected or even a scratch by a poisonous snake can cause death (George et al., 1987; Anil et al., 2012). The snake may not be venomous or if it is the venom may not have been released. Sixty species of venomous snakes are found in India; severe envenoming can result if bitten by one of them (Mohapatra, 2011, e1018).

Both the cobra and the common krait are members of the Elapid species. Brutto and Brutto (2011) explain that the different toxins in venom cause “ pain and focal signs are more prominent following a viper bites . . . and may occur in elapid bites.” Elapid snakes have a “ high concentration of phospholipases A2 and three finger toxins” causing neurotoxicity. The envenoming of colubrid and vipers “ is most often associated with haemorrhage and necrosis because of the presence of metalloproteinases and serine proteases.” (Brutto and Brutto, 2011, 3) The common krait searches for prey along cracks in house so victims receive morning bites while sleeping. When they wake-up they have blurred vision and ptosis (drooping of the eyelids). Cobras most often are in the fields so the most common victim of cobra bite are men and the bite is around the ankle or lower leg; also causing the neurotoxic envenomation (Ahmed et al., 2012, 48)

Clinical Features of Snake-bite

White (2005) listed the potential health problems from and envenoming which have “ major clinical significance include (a) flaccid paralysis, (b) systemic myolysis, (c) coagulopathy and haemorrhage, (d) renal damage and failure, (e) cardiotoxicity, and (f) local tissue injury at the bite site” (951). Morbidity and mortality can be enabled either directly or indirectly by coagulopathy in patients due to the synergistic reactions in the bloodstream (White, 2005, 964-965).

George (et al., 1987) reports that the mark left by a poisonous viper looks like two distinct fang impressions sitting close to each other but a small

distance from other teeth marks. Non poisonous snake bites usually look like a series of small impressions. A poisonous viper’s venom is contains a mix of low molecular weight proteins, enzymes, and peptides. Other compounds in the venom include glycoproteins, lipids, metal ions, and biologic amines (George et al., 1987, 92; Brutto and Brutto, 2011, 2);

Hematoxic actions can slow blood clotting time especially in the venom of Echis carinatus and Vipera russelli. Renal failure is common because of the strain on the kidneys caused by “ haemorrhagins, coagulopathy, and/or secondary shocks” (George et al., 1987, 93; White, 2005, 960). Allergic reactions to the ASV, especially exhibiting as cellulitis is, are also commonly reported (Monteiro et al., 2012, 205) Anil (et al., 2010) reported on a total of eighty nine snake-bite patients, seventy three of the patients exhibited neurotoxic symptoms and sixteen exhibited haemotoxic systems (85). For the seventy two patients admitted for a bite from B. Caeruleus (common krait) the following range of symptoms were observed: “ abdominal pain, dyspnoea, giddiness, nausea, vomiting, altered sensorium, ptosis, weakness of neck flexors, respiratory failure, and hypertension” (Anil et al., 2010, 85).

Suchithra (et al., 2007) investigated the clinical characteristics which lead to complications from emergency medical care for snake-bite envenoming. They determined that the most relevant issues are (a) the common complications that arise from coagulopathy and leucocytosis plus (b) the “ timing of polyvalent snake antivenom (ASV) administration.” The researchers reported that thirty four percent of the total snake-bite cases they observed were envenoming. Three percent was the mortality rate observed and the

causes were “(a) capillary leak syndrome, (b) respiratory paralysis, and (c) intracerebral bleeding” (Suchithra et al 2007, 201-203). Those patients who received ASV 6 hours or more after the bite had a higher risk for complications such as adrenal failure (35%). The three highest risk factors for complications were severe coagulopthy, leucoytosis and receiving the ASV late (Suchithra et al., 2007). The researchers concluded that risk of complications is reduced the sooner ASV is received after the bite. When a patient exhibits leucocytosis or severe coagulopathy, the risk for complications is greater. (Suchithra et al., 2007)

Clinical Features of Envenoming

In general pain is evident, the top layer of the skin and the subcutaneous tissue become swollen, blistered and necrosis. A snakebite victim will immediately have swelling at the area and pain plus they might vomit. Other symptoms might be oliguria (infrequent or very little volume of urination, ecchymosis (bruising) and/or confusion. (Monteiro et al., 2012, 203). The site of the bite might bleed, haematuria (bleeding from the kidneys), haematermesis (coughing blood from below the larynx), epistaxis (nosebleed) or intracerebral bleeding (ruptured blood vessel in the brain). (Monteiro, 2012, 205-206) The victims of the common krait envenoming (very common in India) often need respiratory support due to “ severe respiratory paralysis” (Anil, 2010, 86). The envenoming of the common krait also causes “ a reduction iin the compound muscle action potential and detrimental to repetitive nerve response” (Anil, 2010, 86).

The body’s systems may develop vasodilatation (blood vessel dilation) capillary leakage and/or hypovolema (blood or other body fluid loss). Irregular heartbeat can be caused from safarotoxins in the venom. “ Hypovolemic shock, consumption coagulopathy, rhadomyolysis, and direct nephrotoxicity causing tubular necrosis may cause renal failure.” Other complications caused can be blood vessel clots and haemorrhaging. (Brutto and Brutto, 2011, 3)

Management of Snake Bite Victims and Recommended Treatment

Precise diagnosis of snake venom poisoning is only possible if the snake is correctly identified and the characteristics of the envenomomg are known. The snake should be taken to the hospital with the victim so an examination can be made. (Gold et al 2002 347) A correlation between efficient recovery and immediate administration of antivenom by medical staff has been shown in many studies (Anil et al., 2010, 86; Ahmed, 2012, 47;

Ahmed (et al., 2012) note that snake bite marks are not always detected. They list the range of envenomations for hospital admitted patients as (a) no envenomation (no local or system reactions; there may or may not be fang marks); (b) mild envenomation (fang marks, moderate pain, minimal local edema, erythema; there may or may not be ecchymosis symptoms but there are no systematic reactions; (c) moderate envenomations (fang marks, severe pain, moderate local edema, erythema and ecchymosis plus systemic weakness, sweating, syncope, nausea, vomiting, anemia or thromobocytopenia; (d) severe envenomation (fang marks, severe pain,

moderate local edema, erythema and ecchymosis plus hypotension, paresthesia, coma, pulmonary edema, respiratory failure). (Ahmed et al., 2012, 46)

Ahmed (et al., 2012) explained that " The management of neurotoxic snake bite victim is primarily ASV administration along with mechanical ventilation as supportive therapy (49). Those patients who exhibit the most severe envenomations symptoms and complications are those who have been bitten on the head and/or neck; in the largest numbers they sustained the " maximum complications of cardiac arrest, renal failure, and ventilator associated pneumonia." (Ahmed et al., 2012, 45)

Warrell (2010) in a WHO report sets out steps for managing a snake bit as

(a) first aid treatment, (b) transport to hospital, (c) rapid clinical assessment and resuscitation, (d) detailed clinical assessment and species diagnosis, (e) investigations/laboratory tests, (f) antivenom treatment, (g) observing the response to antivenom, (h) deciding whether further dose(s) of antivenom are needed, (i) supportive/ancillary treatment, (j) treatment of the bitten part, (k) rehabilitation, and (l) treatment of chronic complications. (Sect. 1: 61)

First Aid

Montiero (et al., 2012) reported that the most common first aid given to snakebite victims are tourniquet 10%), incision (2%), tourniquet and incision (2%), or no first aid at all (17%) (205). Brutto and Brutto (2011) explain that a tourniquet applied right after a bee bite may make local symptoms worse,

causing complications as well as causing the whole arm or leg to swell (edematous) and even a syndrome of complex symptoms may develop. (Brutto and Brutto, 2011, 3) Gold et al., 2012 suggests the following first aid treatment immediately after the snake-bite: (a) move victim safe distance away from the snake, (b) allow the victim to rest, cover with blanket, and (c) take them immediately to the nearest health care facility. The snake bitten area should be kept on a level below the heart and kept still. Jewellery, rings and watches, snug clothing and anything restrictive on the body should be removed. If available breathing support should made ready; if a tourniquet has been placed next to the bite it should be left on until medical personnel remove it. (Gold et al., 2012, 351)

Anitvenoms

Anil (et al., 2010) reported on the use of neostigmine and atropine in victims of B. caruleus (common krait) bites. Ahmed (et al., 2012) describes the mechanism that the bungarotoxin concentrations in neuroparalytic snake venom, " blocks the pre-synaptic and post-synaptic acetylcholine receptors" which " depletes the synaptic vesicles at the synaptic sites; once the block has bee accomplished the polyvalent ASV cannot do anymore than neutralize the free flowing venom." In other words the ASV cannot reverse the action the venom. (Ahmed, 2012, 46)

Ancillary Treatment

Respiratory ventilator support is essential for victims of snake-bite from the Elapid species, the cobra and krait. Ahmed (et al., 2012) explained that even with ASVs a patient with respiratory failure needs the support for some

period of time (depending on the patient’s condition) (46). Warrell (2010) describes the following ancillary treatments which may be necessary. Patients with respiratory failure/paralysis need assisted ventilation, “ strict bed rest to avoid even minor trauma; transfusion of clotting factors and platelets, and plasma;” shock, myocardial damage (hypovolaemia) requires “ colloid/crystalloids, controlled by observation of central venous pressure” and ancillary “ pressor drugs” such as dopamine, epinephrine-adrenaline or astropine. (Warrell, 2010, Sect 1: 91)

Control and Prevention

Harrison (et al., 2011) recommended that education about mortality plus physical and emotional morbidity be started at the level of the victim and family, to the community and through the health services of the community (1769). Simpson (2008) highly recommends intensive training in workshops for health care professionals and technicians in appropriate, effective ASVs use and clinical care (1113; Bawaskar and Bawaskar, 2010, 805; Ghosh et al., 2008, 267). Public health campaigns are needed which are designed for each region or state. The purposes of the campaign should include reducing exposure to possible snakebite events, making sure there is readily available transportation to the nearest health care facility, and reducing snakebite victim deaths by educating people to immediately to the closest modern health care facility. (Harrison et al., 2011, 1769) Any type of transport available including a motorcycle is appropriate if necessary for the victim to reach a modern health care system as soon as possible (Sharma et al., 2004, 234). Antivenom needs to be affordable and made specific to the region

where it is used (Harrison et al., 2011, 1969; Bawaskar and Bawaskar, 2010, 805).

Steps are being taken in India ameliorate the problem of snake-bite victims' death and morbidity. Yet much progress must be made in order to decrease the mortality rate. Antivenoms must be used more effectively. The antivenoms should be produced in the region in which they will be used. Healthcare professionals and technicians must be trained to administer proper dosages not only due to economic issues but also because proper dosing facilitates recovery. The Minister of Health must continue to support training workshops and public health awareness projects in order to successfully lessen the number of deaths due to snakebites.

Al-Lawati, Adil, Al-Abri, Seif S. And David B. Lalloo. " Epidemiology and outcome of snake-bite cases evaluated at a Tertiary Care Hospital in Oman." Journal of Infection and Public Health. Vol. 2 (2009): 167-170.

Alirol, Emilie, Sharma, Sanjb Kumar, Bawaskar, Himmatrao Saluba, Kuch, Ulrich and Francois Chappuis. " Snake-bite in South Asia: A Review." PLOS Neglected Tropical Diseases. 4(1), 11 pages.

Ahmed, syed Moied, Nadeem, Abu, Islam, Mohd, Sabihul, Agarwal, Shiwani and Singh Lalit. " Retrospective analysis of snake victims in Northern India admitted in a tertiary level institute." Journal of Anaesthesiology Clinical Pharmacology. Vol. 28, no. 1 (2012): 45-50.

Anil, a., Singh, Surjit, Bhalla, Ashish, Sharma, Navneet, Agarwal, Ritesh, and Ian D. Simpson. “ Role of nesotigmine and polyvalent antivenom in Indian common krai (Bungarus caeruleus) bite.” Journal of Infection and Public Health. Vol. 3 (2010): 83-87.

Coppola, M. and D. E. Hogan. “ When a snake-bites.” Journal of the American Osteopathic Association. Vol 94, no. 6 (1994): 494-501.

Gawarammana, I., Mendis, S., and K. Jeganathan. “ Acute ischemic strokes due to bites by Daboia russelii in Sri Lanka – First authenticated case series” Toxicon. Vol. 54 (2009) 421-428.

George, Abraham, Tharakan, Varghese, T. And Kim Solez. “ Viper Bite Poisoning in India: A Review with Special Reference to Renal Complications.” Renal Failure. Vol. 10, no. 1 (1987): 91-99.

Ghosh, Soumitra, Maisnam, indira, Murmu, Bijoy K., Mitra, Pradip K. Roy, Aniruddha and Ian D. Simpson. “ A locally developed snake-bite management protocol significantly reduces overall anti snake venom utilization in West Bengal, India.” Wilderness and Environmental Medicine. Vol. 19 (2008): 267-274.

Harrison, Robert A., Cook, Darren A., Renjifo, Camila, Casewell, Nicholas R. Currier, Rachel B. and Simon C. Wagstaff. “ Research strategies to improve snake-bite treatment: Challenges and progress.” Journal of Proteomics. Vol. 74 (2011): 1768-1780

Ménez, André. The Subtle Beast: Snakes, from Myth to Medicine London, Taylor and Francis, 2003. Chapter 8 Venom potency and Chapter 9. Clinical aspects of snake-bites.

Monteiro, F. N. P., Kanchan, T., bhagavath, P. Kumar, G. P. Menezes, R. G. and K. Yoganarasimha. “ Clinic-epidemiological feature of viper bite envenomation: A study from Manipal, South India.” Singapore Med. Journal. Vol. 53, no. 3 (2012): 203-207.

Mohapatra, Bijayeeni, Warrell, David A., Suraweera, Wilson, Bhatia, Prakash, Shingra, Neeraj, Jotkar, Raju M. Rodriquez, Peter S., Mishra, Kaushik, Whitaker, Romulus, Jha, Prabhat and for the Million Death Collaborators. Mortality in India: A Nationally Representative Mortality Survey PLOS Neglected Tropical Diseases. Vol. 5, no. 4 (2011) 8 pages.

Nelson, B. K. “ Sanke envenomation: Incidence, clinical presentation and management. Medical Toxicology Adverse Drug Exp. Vol. 4, no. 1 (1989): 17-31.

Paul, V. Pratibha, S. Prahlad, D. A., Earali, J. Francis, S. and F. Lewis. “ High-dose anti-snake venom versus low-dose anti-snake venom in the treatment of poisonous snake-bites: A critical study. Journal of Association of Physicians of India. Vol. 53 (2004): 11-13.

Sells, Paula G. “ Animal experimentation in snake venom research and in vitro alternatives.” Toxicon. Vol. 42 (2003): 115-133.

Seneviratne, U. And S. Dissanayake. “ Neurological manifestations of snake-bite in Sri Lanka. Journal of Postgrad. Medicine. [serial online] 2002 [cited 2012 Arp 14]; 48: 275. Available from : http://www. jpgmonline. com/text. asp? 2002/48/4/275/80.

Simpson, Ian D. “ A study of the current knowledge base in treating snake-bite amongst doctors in the high-risk countries of India and Pakistan: Does snake-bite treatment training reflect local requirements? Transactions of the Royal Society of Tropical Medcine and Hygiene. Vol. 102 (2008): 1108-1114.

Suchithra, N., Pappachan, J. M. and P. Sujathan. “ Sankebite envenoming inKerala, South India: Clinical Profile and factors involved in adverse outcomes.” Emergency Med. Journal. Vol. 25 (2008): 200-204.

Tarian, D. D., Philip, P. J. Alexander, G., Macaden, S., Jeyasee4lan, L. Peter, J. V. and A. M. Cherian. “ Randomized controlled trial on the effective dose of anti-snake venom in cases of snake-bite with systemic envenomation.” Journal of the Association of Physicians of India. Vol. 47, no. 4, (1999): 379-371.

Theakston, R. D. G. “ An objective approach to antivenom therapy and assessment of first-aid measures in snake-bite.” Annals of Tropical Medicine and Parasitology. Vol. 91, no. 7 (1997): pp. 857-865

Warrell, David A. Guidelines for the Management of Snake-bites World Health Organization Regional Office for Southeast Asia. (WHO) New Delhi: WHO Publishing, 2010.

Warell, David A. Snake-bite. Lancet Vol. 375 (2010): 77-88.

White, Julian. “ Snake venoms and coagulopthy.” Toxicon. Vol. 45 (2005): 951-967.

Williams, David J., Gutiérrez, José-Mariá, Calvete, Juan J., Wüster, Wolfgang, Ratanabanangkoon, Kavi, Paiva, Owen, Brown, Nicholas I., Casewell, Nicholas R., Harrison, Robert A., Rowley, Paul D., O’Shea, Mark, Jensen, Simon D., Winkel, Kenneth D., and David A. Warrell. “ Ending the drought: New strategies for improving the flow of affordable, effective antivenoms in Asia and Africa.” Journal of Proteomics. Vol. 74 (2011): 1735-176.