

## REVIEW ARTICLE

# Venomous Snake Bite in India - Why do 50,000 Indians Die Every Year?

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## Abstract

Snakebite is an occupational hazard causing considerable morbidity and mortality worldwide, particularly so in tropical countries like India. An estimated 50,000 Indians die due to venomous snakebite every year, seventy percent of whom are males between the ages of 20 to 50 years. Along with the associated morbidity and mortality, snakebite leads to a significant financial burden on the victim, both by way of hospital bills and labour hours lost. Snakebite is also a cause for considerable psychological stress among survivors. Most snakebites are eminently treatable and curable. Given a concerted thrust from all concerned, this menace could surely be curtailed considerably over the next few years.

## Background

Snakebite is a predominantly rural agrarian problem rampant in the tropics and subtropics. Snakebite is an occupational, environmental and domestic health hazard with a significant economic fallout on the individual and the family. The estimated number of snakebites worldwide has been put as 5.4 million resulting in 2.5 million envenomations and 125,000 deaths.<sup>2</sup> It is estimated that there are over 1,000,000 snakebites in India alone leading to between 45 000 and 50 000 deaths annually. Of the estimated deaths due to venomous snakebite worldwide, half occur in India (Alirol et al., 2010). Seventy percent of bites are in males between 20 and 50 years of age (Alirol et al., 2010). What this basically means is that bites are most common in the active, productive bread winners of the family. The economic implication is tremendous as in most villages males are the sole earning member on whom depend the rest of the family.

Venomous snakebite has a significant global and national impact, in spite of which it has remained a low priority for governmental health policy makers, pharmaceutical industry, health providers and public health advocacy groups. There is a paucity of data regarding snakebite prevalence, treatment, course in hospital and outcomes in India as elsewhere in the tropics.

Venomous snakebite was listed as a NTD-“Neglected Tropical Disease”, by the WHO in 2009. What this implies is that snakebite is in a group of diseases that prevail in tropical and subtropical conditions in 149 countries affecting more than a billion people, costing developing economies billions of dollars of loss every year. NTDs mainly affect populations living in poverty. Effective control against NTDs can be achieved when public

health approaches are combined. In the case of snakebite, interventions are therefore guided by local epidemiology and availability of appropriate detection, prevention and treatment measures that can be delivered locally.<sup>1</sup>

The Australian continent has many more species of venomous snakes but in contrast to India the number of deaths due to venomous snakebite is less than 10 per year. Similarly the United States too does not lack in number of venomous snake species, but there too, the number of deaths due to venomous snakebite is less than 10 per year.

Why this stark difference in numbers?

The reasons for the alarming statistics from India are many, and include:

### Socio demographic factors

- Ever increasing population leading to greater encroachment thereby increasing the chances of human reptile contact and bites
- inadequate infrastructure in villages, including lighting, sewerage systems, roads, in house water supply etc all of which co-contribute to bites specially at night
- improper sanitation which in turn increases the rat population and thereby

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increases the likelihood of snake presence

- poor transport facilities in the rural hinterland leading to an enormous and at times fatal delay in the shift of patients to a secondary or tertiary care centre

#### Socio-Cultural

- the fact that most village dwellers do not use protective foot wear (70% of bites are on the lower limbs)
- habit of sleeping on the floor/ground
- presence of livestock near the house which in turn attracts rats
- defecating in open fields, often after dark
- increasing alcoholism, a significant number of male victims being under the influence of alcohol when bitten

#### Medical

- lack of awareness among victims of the immediate measures to be followed when bitten
- Alternate forms of treatment practised in villages wherein the victim is first taken to a faith healer (quack), precious time being lost therein
- Improper first aid measures immediately after the bite which increases the chances of systemic envenomation and additional complications
- unavailability of the standard treatment, anti-snake venom (ASV) in rural centres,
- reluctance on the part of the primary caretaker at the village centre to admit and treat snakebites fearing complications and reactions to ASV

#### Legislative / Governmental

- High cost of horse serum based ASV
- absence of a centralized quality

control on the process of manufacture of ASV as also its standardization

- absence of regional or zonal pools of snake venom. The venom used for the manufacture of ASV for the entire country is from one or two sources limited to a small geographical area. Venom researchers have shown regional variation in venom constituents and chemical properties, intra-species, which is why it is mandatory that regional/zonal venom centres come up with the facilities to manufacture ASV for a particular region or zone
- delay in initiation of ASV due to non-availability of kits for the early diagnosis of venomous snakebite
- absence of a national protocol for the diagnosis and effective treatment of venomous snakebite
- step motherly treatment meted out to the subject of snake bite in the medical curriculum as also in the governmental health policies

A few of these points need further discussion. Presently the Irula Co-operative Society, near Chennai, is the only authorised supplier of venom for manufacture of Anti-Snake Venom (ASV). The Society supplies venom to the major manufacturers of ASV, namely VINS Bioproducts, Bharath Serum and Premium Serums. Which means that ASV manufactured for the entire country is from venom procured from a small geographical area. Basic scientists have shown that the venom of the *Naja naja* (Spectacled Cobra) or the *Daboia russelii* (Russel's Viper) from South India is different in its physico-chemical properties and thereby toxicity profile from that of the East, though of the same species, namely *Daboia* or *Naja*. They also proved through further experiments that there is a significant difference in the neutralising capacity of ASV

to venom from different zones. What this boils down to is that the standard ASV available in India may not be ideal for treating venomous snakebite in the East, West and Northern parts of our country.

The standard ASV neutralises the venom of the Big 4 namely *Daboia russelii*, *Naja naja*, *Echis carinatus* (Saw-scaled Viper) and *Bungarus caeruleus* (Common Krait). There are a significant number of bites reported from *Hypnale hypnale* (Hump nosed Pit Viper), *Trimeresurus malabaricus* (Malabar Pit Viper), *Trimeresurus gramineus* (Bamboo Pit Viper), *Echis carinatus sochureki* (Sochurek's Saw-scaled Viper) and *Naja kaouthia* (Monocled Cobra) in areas where these snakes abound. There are other species like *Bungarus fasciatus* (Banded Krait), *Bungarus sindanus* (Sind Krait) and *Opiophagus hannah* (King Cobra), bites of which have been reported, but rarely. The venom of the snakes mentioned above is not neutralised by the standard ASV available in India. It is believed that there would be some degree of para-specificity to venom of similar species for example *Echis carinatus sochureki* with *Echis carinatus carinatus* and *Naja naja* with *Naja kaouthia*. We do not have any robust data on the degree of neutralisation and it may well be that the venoms of the above mentioned species are not neutralised to the desired degree. This may also be a reason for the extravagant use of ASV in certain parts of the country when standard doses of ASV do not bring about a clinico-biochemical improvement in status of the bitten patient.

Unfortunately, patients in many parts of the country depend more on traditional medicine men (Ojhas, Visha chikitsa, kavirajs etc.), precious time being lost therein. It has to be stressed that the only scientifically proven treatment for venomous snakebite is ASV.

In the medical curriculum venomous snakebite is covered in

the textbook of Forensic Medicine and Toxicology. Identification of venomous species and symptomology is covered from a forensic angle, which is to say for the dead. It is compulsory that venomous snakebite and scorpion sting be taught as part of Internal Medicine, where it belongs. This and other tropical diseases are what a fresh MBBS graduate from any of the medical colleges is likely to face in his day to day practice. The focus of medical education we believe should shift from the knowledge based approach as taught in most of our medical colleges, from Western texts to a more practical one based on the disease conditions medical graduates are likely to encounter in their practice.

Most Peripheral Health Centres in the country lack the manpower and the equipment necessary to manage venomous snakebite. This is particularly pertinent to areas where neurotoxic snakebites are in plenty. A person in respiratory distress secondary to a neurotoxic snakebite (especially krait bite) is unlikely to survive a 1 hour journey to a tertiary care centre without ventilatory support. Doctors in PHCs especially in areas where neurotoxic bites are common should be trained in endotracheal intubation or 'Bag and Mask Ventilation', which would be enough to maintain oxygen saturations till definitive treatment is given.

Venom analysis is severely hampered by the excessive cost of snake venom and also by the fact that the Big 4, being protected species, requires permission from the Forest Department of states for milking. Availability of venom has been a major stumbling block for Ph.D scholars in Mysore, Tezpur and MGR Universities who along with the Kolkata group have been at the forefront of venom research for two to three decades now. The necessary permissions for venom and genetic material from snakes are hard to get, which is why fewer

and fewer of young researchers venture into this area.

Manufacture of ASV is now almost solely by private companies, the two State producers, Haffkine Institute and King Institute having stopped production years back. Standardisation of ASV is done in situ in the companies itself without governmental verification or standardisation.

Cost of ASV is ever on the increase; in 2016 one vial of ASV cost as much as Rs950.

### **Mitigation of Snakebite in South Asia -- Some Suggestions for a Way Forward**

1. Improvement of venom production protocol to the WHO standard by the Irula Snake-catchers Co-operative, India's primary venom producer for anti-venom production.
2. Production of venom from different geographic regions in India to solve the problem of geographic variation by amalgamating the Irula Co-operative into a Multi-State Co-operative.
3. Improvement of Indian anti-venoms by raising the titre to the levels of anti-venom produced in the 1950s. Then the standard (apparently set by Government of India) was 4.0mg/mL for *D. russelii* venom and 2.0mg/mL for *N.naja* venom. Today the standard is a fraction of what it was: 0.6mg/mL for *D.russelii* and *N.naja*. What this means is that much more anti-venom needs to be bought and used by a patient. Complaints of allergic reactions to Indian anti-venoms also need critical attention.
4. Improvement of Indian anti-venoms by using methods developed at the Instituto Clodomiro Picado in Costa Rica using caprylic acid fractionation of plasma.
5. Standardizing and translating into local languages an accepted protocol for SNAKEBITE FIRST-AID AND TREATMENT with attention and discussion given to the more controversial and much debated subjects such as anti-venom dosages, use of neostigmine and a long list of other things regularly argued about by clinicians and others.
6. Guaranteed stocking of anti-venom where it is needed, at Primary Health Centres in areas with high incidence of snakebite, with adequate training in its administration.
7. And perhaps one of the most important measures to be taken: Development of well-publicized, all-India snakebite hotlines, with appropriate regional/language representations by doctors willing to receive calls at all hours to give instant advice on snakebite.
8. Bringing ASV into the list of essential medicines in states thereby helping reduce the cost. The Government must provide anti-venom free of charge to rural India
9. Development of a national protocol for the treatment of venomous snakebite
10. Make snakebite a notifiable disease and carry out epidemiological studies in states where venomous snakebite is a significant problem so as to be able to arrive at an accurate mortality and morbidity figure.
11. Venom to be made available to research laboratories to foster snake venom and genetic research on snake species
12. To analyse the LD50 of regional variants of the Big 4, namely *Naja kouthia*, *Echis sochureki* etc, study their toxicity profile

and degree of neutralisation (ED50) by the standard ASV now available

13. To include treatment of venomous snakebite in the subject of Internal Medicine in the medical curriculum, and encourage research and conferences on this much neglected subject.

Snakebite in India has remained a much neglected subject in spite of the significant mortality and morbidity it causes. If diagnosis and treatment be given in a timely fashion the victim can go back to a productive life. Given the fact that most (70%) of bitten are males and the bread winners of the family adds an extra dimension to this problem. Snakebite was and still remains a problem that can easily be tackled given a sustained effort towards that goal involving all concerned, namely herpetologists, clinicians, basic scientists, industry and most importantly, the government. A number of state governments pay Rs.100,000 to the family in case of

death due to snakebite. If 50,000 families of victims were to claim the same, it would drain the exchequer of Rs 500 crores annually. We believe that a small fraction of the above mentioned amount would be enough to mitigate the problem in India, to a large extent, once and for all. We are sure that with the advances that India has made on all fronts here too we can be successful in bringing down the annual death rate to a fraction of what it is in the coming years.

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