



# YOUR HEALTH

An Official Monthly Publication in English of the Indian Medical Association since 1952 for the people to propagate Health Awareness in the Community



## SNAKE BITE

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# **YOUR HEALTH**

## OF INDIAN MEDICAL ASSOCIATION HEADQUARTERS (KOLKATA)



Sir Nilratan Sircar IMA House, 53 Sir Nilratan Sarkar Sarani (Creek Row),  
Kolkata-700014, West Bengal, Ph: 033-22364200/9123674412,  
Email: yourhealthofima@gmail.com,yourhealthoffice@gmail.com



**Dr Ketan Desai**  
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Indian Medical Association



**Dr Rajan Sharma**  
Imm. Past National President  
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Indian Medical Association



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Hony. Jt. Finance Secretary  
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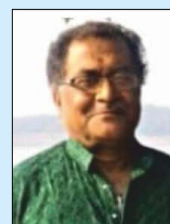


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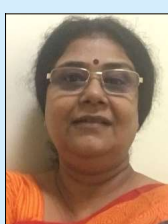
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of the

# INDIAN MEDICAL ASSOCIATION



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## Glimpses of Doctors' Day Celebration





**Dr. Sanjoy Banerjee**  
Hony. Jt. Finance Secretary, IMA HQs.

'Doctors' Day', is celebrated in India on July 1 every year, holds special significance for medical practitioners in India. Just like Mothers' Day we pay tribute to our Mothers, Fathers' Day to our Fathers, Teachers' Day to our teachers, Children's' Day to children; it is on this day that Doctors' are celebrated for the irreplaceable roles that they play in our lives. From dentists to neurosurgeons, homeopaths to heart specialists, physicians to pediatricians, Doctors' Day is the time to pay tribute to the entire medical profession. This is in commemoration of the Birth and Death Anniversary of Eminent Physician and Patriot Dr. Bidhan Chandra Roy.

The history of this special day dates back to the 1800's when an American, Dr. Crawford W. Long became the first physician to use anesthesia in an operation that he performed on March 30, 1842. To commemorate this unprecedented event, March 30 was declared as National Doctors' Day in the United States.

The red carnation was chosen as the official symbol of Doctors' Day because of the colour of the flower denotes love, charity, sacrifice, bravery and courage, all of which are synonymous with the medical profession.

Interestingly, the story of Doctors' Day in India is quite different and few people actually know why it is celebrated. First of July happens to be the Birth & Death Anniversary of a famous Indian physician, Dr. Bidhan Chandra Roy who was born on this day in the year 1882, in Patna, Bihar. After his medical graduation at Calcutta, he completed his MRCP and FRCS at London and returned to India in 1911. His career as a physician began in 1911, after he returned to India. Thereafter, he joined the teaching staff of the Calcutta



## Doctors' Day - A brief history

Medical College and then moved to Campbell Medical School after which he moved to the Carmichael Medical College. He excelled not only as a physician and educationist but even as a freedom fighter, joining Mahatma Gandhi in the Civil Disobedience Movement. He was instrumental in starting many institutions including hospitals and for caring of thousands of patients. Dr Roy's dedication to the upliftment of Indian society and his love for serving the people led him to the political arena, where he first became leader of Indian National Congress and later Chief Minister of West Bengal. After a life of work and service, the Doctor

passed away on July 1, 1962, on his birthday.

Doctors' Day thus pays tribute to all doctors like Dr. Bidhan Chandra Roy, who spend their lives helping others. The nation has honoured Dr. Roy with Bharat Ratna and the B.C.Roy National Award instituted in 1976.

Majority people are of the opinion that Doctors' Day is the Birth & Death Anniversary of Dr. Bidhan Chandra Roy and it is observed in many places paying homage to the legendary figure.

It was Indian Medical Association, Kidderpore Branch, Calcutta who first came out with the proposal of "Doctors' Day" in the year 1989 with Dr. Santanu Banerjee (President) and Dr. Pradip Kumar Chatterjee (Secretary) and designated 1st July in commemoration of the Birth & Death Anniversary of Eminent Physician and Patriot Dr. Bidhan Chandra Roy, which was passed first in State Working Committee, IMA Bengal State Branch and then in Bengal State Council Meeting in 1989 with Prof. Ashok Chaudhuri (State President) and Dr. Subir Gangopadhyay (State Secretary) and

forwarded to IMA Central Working Committee and passed in CWC meeting 24-25 April 1991 under the then National President Dr. Ram Janam Singh (Bihar). IMA Hqrs. directed all its branches to observe 1st July as "IMA Doctors' Day" from 1st July 1991. The IMA Hqrs. then persuaded the Government of India and after a long process ultimately "National Doctors' Day" got official recognition in India only in the year 1991 by Dept. of Health & Family Welfare, Government of India, 29 years after the death of Dr. Bidhan Chandra Roy. Dept. of Health & Family Welfare, Government of India instructed all State Governments to organize & observe "National Doctors' Day" and 1st July 1992 became the most important date for Doctors all over India when "National Doctors' Day" was observed for the first time with Government extending financial support to IMA.

This special day is an ideal opportunity to remind people of the critical role doctors' play in our lives. Being a doctor is not just a 'job'; it is a challenging commitment to service that requires high levels of skill and precision. To make a tough job even tougher, doctors also have to deal with the reality that even a small professional mistake could drastically affect a patient's life. Doctors' Day is the perfect time for patients to acknowledge the high-pressured job and appreciate their Doctors' ability to comfort and heal.

Doctors' Day is also a significant day for doctors themselves as it provides them with an opportunity to revitalize and rededicate themselves to the practice of medicine. All doctors begin their professional lives with the noble ideals of serving humanity and healing those in need; however some practitioners lose sight of these ideas and become corrupt and unethical. Doctors' Day is thus a time for doctors to reflect on their own careers, realize the responsibility they bear and redirect themselves onto an ethical path of healing those in need.

Unfortunately, the medical profession today is witnessing a rapidly deteriorating patient-doctor relationship, with people losing faith in their doctors' abilities. The easy availability of medical information, and misinformation, from the media and the Internet is also responsible for clouding a patient's view of their doctors' advice. Nowadays, doctors are more often the victims of criticism while their successes are overlooked. It is true that the medical profession carries a heavy responsibility with it, but people need to realize that behind the white coat and stethoscope is a normal human being and like in all other professions, doctors too need appreciation for their work and efforts.

It must be mentioned that different sectors observe

this day in different way that suits them forgetting the actual reason. The media stays a passive onlooker on this day as they require stories to criticize medical fraternity overlooking their contribution to the society; corporate healthcare institutions comes out with patient friendly business deals, organize free camps to attract business for their own needs, medical organizations playing puppet in the hands of political leaders call upon Doctor Community to build up good Doctor-Patient relationship, give free treatment, organize free camps, organize rallies/tabloids for mass education; the Pharmaceutical Companies utilizes this day approaching those doctors who matters with gifts & wishes (but not to all) and lastly political parties felicitate their core group Doctors.....

In FATHERS' DAY we wish our fathers, MOTHERS' DAY we wish our mothers, TEACHERS' DAY we wish our teachers, CHILDREN'S DAY we wish little children, we do something for their appreciation.....but on Doctors' Day the Doctors only are supposed to do all types of activities themselves for the society.....This is not what DOCTORS' DAY is for.....

On this Doctor's Day, make an effort to honour doctors for their skill and commitment. Single out a family doctor and show them your gratitude for the care they have provided to you and your loved ones. This day provides students and those who work in hospitals, nursing homes or other medical facilities with the ideal opportunity to express their thanks to doctors for mentoring, being supportive and encouraging.

Give your doctor a card, a single red rose, a gift or just say a simple, heart-felt 'Thank You': it will brighten up their day and make them feel respected and appreciated.



**Dr Samarendra Kumar Basu**

The World Health Organization (WHO) has set the target of reducing by half the number of deaths due to snakebite envenoming by 2030 and India's efforts to prevent and control this disease will largely influence this global target.

Since deaths are restricted mainly to lower altitude, intensely agricultural areas, during a single season of each year, this should make the annual epidemics easier to manage. India's tremendous snakebite burden is staring us in the face and we need to act now. Targeting these areas with education about simple methods, such as 'snake-safe' harvest practices, wearing rubber boots and gloves and using rechargeable torches (or mobile phone flashlights) could reduce the risk of snakebites.

Need for more nationwide epidemiological studies in snakebite endemic countries

Additional nationally representative studies together with increasing mapping resolution and multi-sourced data granularity, including both hospital-based mortality and morbidity data including those collected at the community level, are needed for more targeted and effective public health interventions in other snakebite endemic countries.

It is also noted that the Government of India's official declaration of snakebite deaths in public hospitals during the period 2003 to 2015 was only 15,500, one tenth of the 154,000 snakebite deaths detected during this same period by the MDS from public and private hospitals.

To repair this gross under-reporting, the authors recommend that the Government of India designate and enforce snakebite as a 'Notifiable Disease' within the Integrated Disease Surveillance Program. Accurate snakebite data are essential if the Government of India's strategies to reduce snakebite deaths are to succeed.

My special thanks to Prof. (Dr.) Udas Chandra Ghosh, Chairman of the Editorial Advisory Board of YOUR HEALTH and Dr Dayal Bandhu Majumdar for their efforts to publish this issue.

**All snake photos courtesy: Mr. Vishal Santra**



**Dr. Sarbari Dutta**

## *From the Desk of Secretary*

We express our satisfaction in bringing out an issue in the month of Doctors' Day which is of utmost importance in this part of the World, and which is neglected as well so far, "THE SNAKE BITE"

India has the unenviable distinction of being the snakebite capital of the world accounting for about 58000 of the 80000 to 140000 deaths occurring annually, worldwide... Dr Jaideep C Menon has mentioned in his article 'Epidemiological situation of snake bite in India'

There are more than 330 identified species of snakes in India, out of which about 66 are venomous. The four so called common venomous snakes of medical importance in India, whose bites can be fatal to humans, are generally referred to as the "Big Four". 'The Big four snakes of India' of Mr CS Nagabhusan says.

In his article 'Snake venom Composition and Variability', Mr Vishal Santra discussed how Snakes have evolved ways to subdue their own poisons and can digest their prey . At the same time the preys also evolves with the snake species developing resistance to those toxins. This is called co-evolution. So this constant battle to survive goes on as long as there is life on this planet.

Mrs. Priyanka Kadam elaborated the four pillars of interventions: Community Engagement and Advocacy, A Safe and Effective Treatment, Strengthening the Health System and Partnership, Collaborations and Resource Management

The most important thing in snakebite is 'The Prehospital Management of Snakebite' which can reduce the death rate. Dr. Soumya Sengupta discussed in details which must be read.

Dr Rajeev Jayadevan nicely elaborated 25 tips to prevent snakebite in schools and homes. Every point is equally important for general public to follow.

Dr. Dayal Bandhu Majumdar said about the lack of clear idea in the medicos (medical college teachers, new medical graduates, doctors), high-ranking employees, teachers, students, & general people. Even people who have been doing science movement are ignorant about many important things of snakebite management.

Dr. Maya Gopalakrishnan discussed how Russell's viper is complex and challenging as it results in a rapidly progressive condition involving many organs culminating in death.

Tertiary care management should be done very promptly and right way. It requires teamwork, Dr. DC Patel said.

Dr. Sudipta Pal and Dr. K. Chakraborty enlightened about the Forced alkaline Dialysis. In a haemafocic snake bite if patient develops oliguria or dipstick positive for blood give a trial of FAD within first 24 hours may be tried to avoid pigment nephropathy leading to acute tubular necrosis (ATN). Delayed FAD has no role.

Dr. Syamal Kundu discussed on Small molecules in snake bite which is very important. Snake Toxins that is commonly implicated in pathogenesis are snake venom Phospholipase A2 (SVPLA2), Zn dependent snake venom metalloproteinases ( SVMP) , 3 finger toxin ( 3FTX) and Snake venom serine proteases ( SVSP) . SVPLA2 with its several isoforms are found in Kraits, cobras and vipers.

Medicolegal cases (MLC) are an integral part of medical practices and for Snakebite it has also an important aspect which is reflected in the article of Dr. Saptarshi Chatterjee.

I am sure this special issue on 'Snake Bite' will go a long way in uplifting the face of 'Your Health' in times to come.

We are indebted to all the authors. I specially thank Dr. Udas Chandra Ghosh, Dr. Symal Kundu and Dr. Dayal Bandhu Majumdar for their contribution.

Everyone should keep a copy of this book in home as a valuable collection.

Long live Your Health of IMA!





**From the Desk of Chairman  
Editorial Advisory Board, Your Health****Prof (Dr) Udas Ch Ghosh****We Do Not Want Two Diseases: 1) Nature Made 2) Doctors Made**

The 2011 paper estimated that 46,000 snakebite deaths took place in India in 2005. The 2020 paper estimated the annual deaths from snakebites to be an average of 58,000 (12 lakh snakebite deaths between 2000 and 2019). The Kraits are the most dangerous venomous snake of India and one of the deadliest snakes of the world. Russell's vipers, kraits and cobras were responsible for most deaths. The remaining deaths were caused by at least 12 other species of snakes.

Brazil is the country with the largest number of species of snakes in the world. But do you know that there is a country in the world where there are no snakes? Ireland is one country completely devoid of snakes. India has full of snakes, which causes death in a group of patients. The World Health Organization (WHO) designated poisoning by snakebite as a Neglected Tropical Disease in 2017, and last year launched a global initiative to halve the number of deaths and disabilities it causes by 2030. Snakebite "is just still really not very well studied or understood at the same level as a lot of these other [tropical] diseases",

Ptosis is the sign of snake bite when other neurological causes of ptosis are not found and when suspicion of Krait bite is present. Clinical suspicion is the only diagnostic clue.

We should take proper actions to treat the patient as per DO it RIGHT protocol. R = Reassure; I = Immobilize; G & H = Go to Hospital; T = Tell the Doctor. Proper treatment with Inj. AVS is to be given without any delay. But many of the snake bites patients do not go to the hospital due to ritual custom and ignorance and this causes death of the patient. But how to prevent this?

Krait-bite fatality is reduced to less than 10% by training of peripheral doctors in accurate documentation of the history of a patient and in recognising the symptoms of krait bite, and by increasing the availability of anti snake venom and ventilators in rural areas. No patient with symptoms of a venomous bite should be transferred to a higher-level facility (usually a district or rural hospital) without administration of the full dose of ASV.

Community education is the most effective preventive measure. The clinical staff in the primary health care centres and local people should be trained in first aid measures. This first aid kit and antivenom should be available in the centre to take immediate action.

The key message is: SNAKEBITE IS A MEDICAL EMERGENCY – DON'T WASTE TIME – GO TO HOSPITAL – GET AN INJECTION OF ANTIVENOM. IGNORANCE IS THE MAIN CAUSE OF DEATH.

Health education is the most important preventive path to reduce the number of death due to snake bite. This issue of YOUR HEALTH surely helpful to the doctors and also the general people for the management of snakebite.

I am really thankful and grateful to Dr. Dayal Bandhu Majumder and Dr. Syamal Kundu for helping me to publish the issue.

Long Live Your Health

Long Live IMA.



**Dr Dayal Bandhu Majumdar**

Resource person for Snakebite Training, Govt of WB.

WHO had declared Snakebite as a Neglected Tropical disease in the year 2009. This author had been shouting for this neglected killer disease since 2007 when he was working as a Medical Officer of a rural hospital of West Bengal. There were a lot of misconceptions amongst doctors about management of venomous snake bite cases. Practically, there was no standard treatment guideline for Snakebite management in that time. Probably West Bengal was the first state to publish one guideline for Snakebite management in the year 2012. Publishing a guideline is not enough. To implement the guideline is more difficult than publishing it. Officials of the Health Headquarter of WB were then motivated to arrange for in-service training of Medical Officers. One beautiful module was also published in the year 2012, for training of MOs. That module had been upgraded time to time following new guidelines from the WHO. Till 2018 more than eight thousand MOs of WB Health Service were trained. Hundreds of new MOs join Health Service every year. From our field experience, we had noted that, most of these new MOs had no exposure to primary management of venomous snake bite cases. Just one day (five hours) modular training had dramatically improved the scenario in the primary care hospitals in WB.

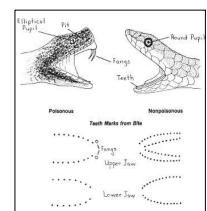
There is another effective training system for in service MOs in WB. The induction training system is running here for many yrs; one class on Snakebite is included in this in the year 2012. Just one class of one hour had produced many Snakebite experts here in WB. We had been advocating to take regular classes in MBBS curriculum; but without any encouraging result. Some teachers had taken few classes in their own motivation. NMC should take necessary action for including Snakebite classes for MBBS students.

Snakebite is not a pure medical problem; it is also a social problem. Century old belief on faith healing is a big problem in the management of Snakebite. Time is very precious in venomous Snakebite management. In spite of availability of effective treatment in the village health centres, most of the snakebite cases visit the faith healers first. In doing so valuable time is lost. For this reason, involvement of social workers is very vital in the management of Snakebite.

Scientists had been giving warning for yrs about effectiveness of present Indian Polivalent Anti Snake venom serum. Actually the present ASV prepared from the venom collected from only the Mahabolipuram district of Tamilnadu is not very effective in other parts of this vast country. At least four regional venom collection centres should be there to cover the whole country.

Not only regional variations, Indian Polivalent ASV has its own limitations. The Big four theory is back dated now. Besides the big four venomous snakes there are many venomous snakes in India. In WB only we see a vast population of Monocled cobras. Black kraits are plenty in North Bengal districts. Assam has a good population of Pitvipers with frequent cases of venomous bites attending Govt hospitals. It was scientifically proved yrs ago that, Hump Nosed Pit vipers (*Hypnalehypnale*) of westernghat areas are highly venomous. All these venomous snakes are not covered by the ASD prepared from Big four snakes; if we don't mention sea snakes and king cobra. Herpetologists are facing difficulty in getting permission from the forest departments of different states; this is keeping us back dated regarding venom research.

Well coordinated multi departmental action can only save thousands of unfortunate deaths from venomous snakebites in India. Health department, forest department and education department should work together to mitigate the problem of snakebite.





### CS Nagabhushana

Wildlife rescuer from BBMP Forest Cell

BMC Member of CMC & KFD Bangalore Rural

There are more than 330 identified species of snakes in India, out of which about 66 are venomous. The four so called common venomous snakes of medical importance in India, whose bites can be fatal to humans, are generally referred to as the “Big Four”;

- a) Spectacled Cobra (*Naja naja*)
- b) Common Indian Krait (*Bungarus caeruleus*)
- c) Russell's Viper (*Daboia russelii*)
- d) Saw-scaled Viper (*Echis c. carinatus*)

These four species of venomous snakes are widely distributed over most of India, particularly, Southern, Central, Western and parts of Northern India.

These snakes commonly co-exist and thrive in and around human settlements as such areas provide their preferred habitats and diet. According to Romulus Whitaker if you perform a line transect in an agricultural field in India or any other South Asian county we will come across many snakes in comparison to a line transect in a forest. Also the agricultural field will have less diversity of species than the forest. So, we can see that selected venomous and non-venomous species have adapted very well in these man-

made habitats over the centuries and thus the snakebite problem has become a ground reality in India.

Now the problem does not end here. Apart from the “Big Four” there are other venomous snakes that are common in parts of their range and whose bites can be and are equally fatal to human beings. They are:

- i. Monocellate/Monocled Cobra (*Naja kaouthia*)
- ii. Central Asian Cobra (*Naja oxiana*)
- iii. Greater Black Krait (*Bungarus niger*)
- iv. Hump-nosed Pit Viper (*Hypnale hypnale*)
- v. Wall's Krait (*Bungarus walli*)
- vi. Sindh Krait (*Bungarus sindanus*)
- vii. Lesser Black Krait (*Bungarus lividus*)
- viii. Sochurek's Saw scaled viper (*Echis sochurekii*)

## The big four snakes of India



- ix. Pitvipers of several species in the Western Ghats and the Northeast (*Trimeresurus*, *Ovophis*, *Cryptelytrops*, *Viridovipera*, *Protobothrops* etc).

The above mentioned snakes are also responsible for numerous health complications and even death. The *Naja kaouthia*, *Bungarus niger*, *Bungarus lividus* and *Bungarus cf walli* are mainly distributed in the North and Northeast India. *Bungarus sindanus* envenomation resulting to death has also been reported from Maharashtra in the West India. There are reported deaths following *Bungarus walli* bite in North Bengal. In all these cases a huge amount of the present Polyvalent Antivenom was used but it did not work. The *Echis sochurekii* is distributed throughout Rajasthan and parts of Gujrat. Reports of Indian ASVS not effective against its bite are prevalent. The *Naja kaouthia* is one of the snakes prevalent in the Eastern and Northeastern states of India and responsible for considerable number of envenomation leading to mortality and morbidity. The Indian Anti-venom (ASV) is not specifically designed to neutralize this snake's venom. This cobra species overlaps with the *Naja naja* and thus makes the problem of snake envenomation double in these areas. Professor David A Warrell rates this species as Category 1 species in terms of medical significance. The *Hypnale hypnale* is distributed



throughout the Western Ghats, from Goa to the southernmost end of Tamil Nadu. The Hypnale hypnale envenomation and death has been considerably reported from Kerala and the bordering areas of Tamil Nadu and Kerala. So here we are looking into a greater problem in the perspective of Snakebite Management in India. The “Big Four” theory is thus put into question in respect of other Medically Significant venomous snakes in other parts of the country.

We don't exactly have a clear picture or reasoning behind the 'Big Four' concept. It will be good to know the policy makers or Government agencies that took the initiative to declare the concept. All we can hypothesize is that the data given by the hospital administrations be it anecdotal or systemized where they might have observed that snakebite victims brought to the hospitals were mostly bitten by these four species of snakes. These hospitals must have been based in metropolitan/centralized cities like Delhi, Mumbai, Chennai, Bangalore etc. where technology & communication is better compared to rest of India. And thus the information derived from these areas was taken as a representative of the rest of the country. One must not forget if the identification of species during those times was vetted through an expert. Other parts of the country might have been neglected from where communication has not reached the policy makers. As a result the present day polyvalent Antivenom has been designed which is far from being able to solve the massive snakebite problem of the country. Another problem in India is traceability due to very poor keeping and management of data. Probably these are the reasons why apart from Big four, other species have not come to the notice of the policy makers. The constant highlighting of just four species of snakes and saying that they cause the majority of snakebite will not be right and might have detrimental effects on an effective policy making.

So what is the right way out? Since Snake bite deaths in India has an alarming number of over 58000 per year, people from various platforms like researchers, scientist, clinicians, herpetologists, individuals etc has started working on Snake bite, we now have some amount of data that can tell us which are the other species of snakes biting people across India apart from Big four. In one of the publications, it is reported that North East and North have very low Snake bite data & come to the conclusion only by looking to the hospital data and math modeling. Studies have pointed out in the past that the majority of deaths due to snakebite occur outside of hospital settings. Only a small percentage of people visit the hospital following snakebite. Community based surveys along with the hospital data might provide a realistic figure of the

burden of snakebite.

The present Antivenom is designed for the four species snakes known as the 'Big Four'. But there are speculations that it might have a certain degree of cross neutralization capacity which has not been properly studied yet. Another short coming is that majority of venom used for the design and production of the present polyvalent antivenom is sourced from Tamil Nadu, whereas it has been shown time and again that same species can have considerable variation in their venom composition. So, not only four species of snakes are responsible for mortality & morbidity in India, but there are other snake species of medical significance.

There is a dire need to invest a lot of time and sincere effort into basic fundamental research in our country to better understand the complexity of the snakebite problem and have evidence based approach to finding solutions.



**Titir Sarkar**, Kolkata is one of those specially trained social activists in India, who rescue poisonous snakes from household and hand them over to the Forest Department.





**Vishal Santra**

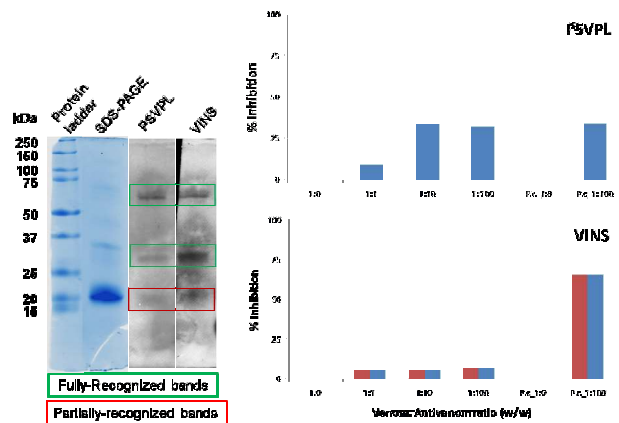
Herpetologist – Society for Nature Conservation,  
 Research and Community Engagement Co-Founder &  
 Co-Director – Captive and Field Herpetology Expeditions.  
 Member – IUCN SSC Viper Specialist Group

## Snake venom composition and variability - The Indian Story

India is a land that geographically harbors some of the most medically significant venomous snakes in the world. Now for sometime there has been some serious questions raised, related to management protocols, variation in venom, venomous species other than the 'big four' variation in syndromes, toxicity, efficacy of ASVS etc which have been making the rounds. Solving snakebite in India is a complex problem that needs to be addressed at multiple levels simultaneously, and at all levels we need to implement a mixture of short-term fixes, basically how we could improve the things we are doing already, as well as the longer-term strategic changes i.e. the innovations that will be game-changing but might take some time to be implemented.

Reduction of snakebite mortality and morbidity requires a multidisciplinary approach and concerted effort between multidisciplinary experts from various backgrounds, with a view to both reducing the impact of snakebites and the frequency of occurrence. India has the highest global incidence of snakebite mortality, estimated at 58,000 deaths per year and three times morbidity of that figure, and with the recent (2017) addition of snakebite to the WHO's portfolio of Neglected Tropical Diseases, is under pressure to create a national strategy for reducing this undeclared public health problem. One must remember that snakebite unlike Dengu fever, Malaria, HIV etc. is not a nationally notifiable disease. Snakebite though still exceeded by cancer, malaria, road traffic deaths,

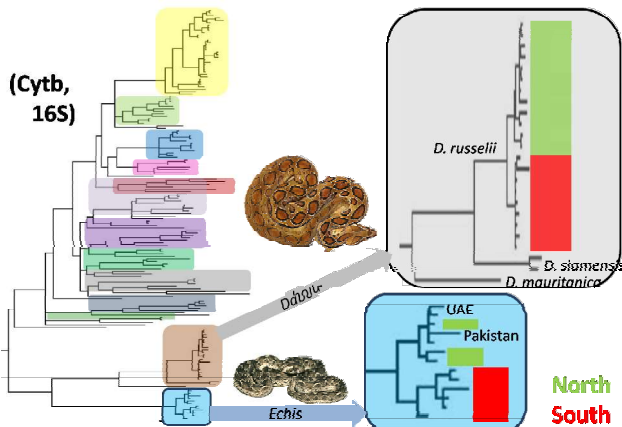
**HP *Daboia russelii*: cross-reactivity with Indian PVA**



suicide and HIV, but not as much as you might think. Statistics say every 1 death to snakebite for every two deaths from AIDS. But in terms of resources devoted to addressing it, snakebite lags far behind. It is not as if an effective treatment is not available: several manufacturers making it against the BIG FOUR species (Russell's viper being one) and available on the open market. But not all are available in lyophilised form, which has the major advantage of not requiring a cold chain and has very long shelf life (disadvantage is longer prep time as it needs to be dissolved before administration and sometime vigorously shaken to speed up but can deplete the

antibodies which stick in the foam thus created). Not all is equally good: Bharat Serums has performed particularly poorly in tests compared to Premium Serums. Several even apparently selling the VINS African product! Other opportunistic brands selling at many times the standard price although there is no evidence they have a higher neutralising capacity. While there is even a homeopathic remedy labelled as antivenom and selling for the same price. The efficient clinical management of snakebites requires timely administration of 'appropriate antivenom' that neutralizes the numerous different toxins contained in a given venom. The composition of snake venoms varies both between and within species; for example, the Spectacled cobra (*Naja naja*) in north Bengal has

**DNA analysis reveals cryptic diversity in vipers**



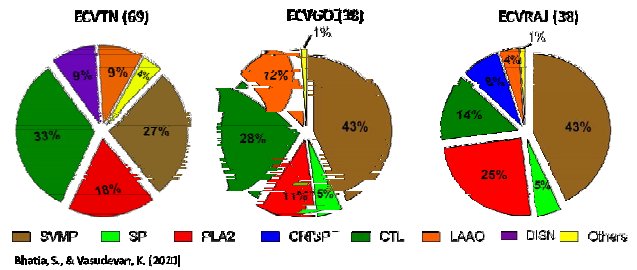
more necrotic venom than populations of the same species in south-west Bengal. Thus, the rational design, production and distribution of antivenoms depend on a comprehensive understanding of the diversity and geographic distribution of venomous snakes and their toxins. Studies on regional venom variation have shown the single polyvalent antivenom available in India to be ineffective even among cases

of the “Big Four” species against which it is made (i.e., the Spectacled cobra (*Naja naja*), Common krait (*Bungarus caeruleus*), Russell's viper (*Daboia russelii*) and the Saw-scaled viper (*Echis carinatus*)). This is probably because the venom used in manufacture is currently derived from a single geographical source. However, no studies have yet investigated the link between venomous snake systematics and regional venom variation in India. Additionally, there is evidence for the presence of cryptic species diversity in some groups. These issues have serious implications for toxinological and epidemiological research, which has confounded the effective management of snakebite in India thus far.

**Why do Venoms Vary in Composition?**

This question brings us to the evolution of snakes. How and when did they come into existence, Why are some snakes venomous and some are not, etc. Without going into the intrinsic details of snake evolution let us first understand that they have speciated from a single group and as the landmasses kept moving and colliding it created natural barriers confining smaller groups in certain geographies. These groups evolved over millions of years speciating and segregating within themselves based on an array of variables, such as food, habitat, physiology, climate etc. And if we have understood Charles Darwin correctly we know how evolution works. Now certain species specialize in eating certain types of prey. So they have evolved certain toxins to subdue them and digest them. At the same time the prey also evolves with the snake species developing resistance to those toxins. This is called co-

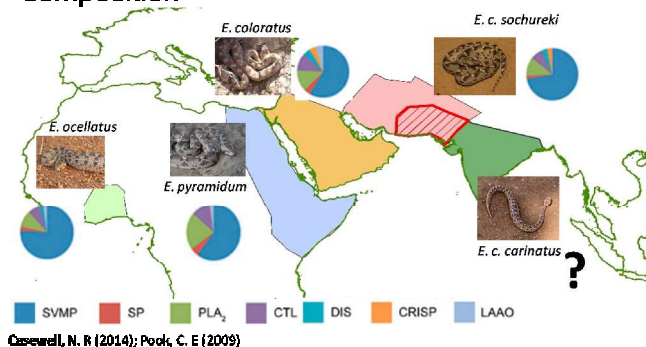
**Toxin Family composition of ECV**



evolution. So this constant battle to survive goes on as long as there is life on this planet. It is quite interesting that snake venoms work significantly in human system causing deaths and disabilities. But at the same time it is quite fascinating how snake venoms evolved over millions of years. Generally it is thought that the toxins in snake venom are genetically coded. That is certain genes express certain toxins. And that is the reason why only snake venom studies will not provide a perfect answer while addressing the complexity of venom variations. We need to study the species at a molecular level to put it on the distribution map based on the molecular analysis of their DNA.

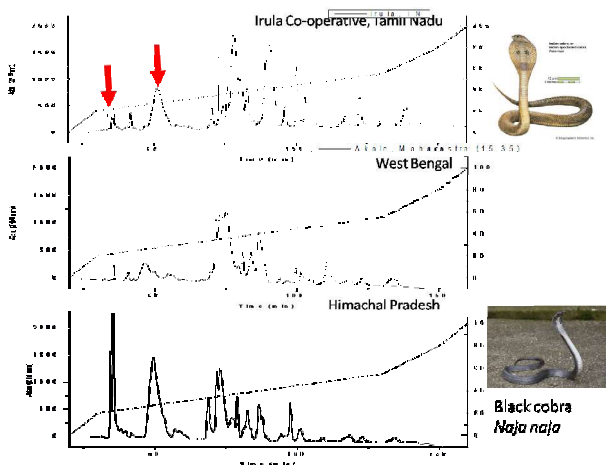
Our research is primarily directed towards improving antivenom formulation through identifying the mixture of clinically relevant species present in different regions, and evaluating the effectiveness of current antivenom towards their venoms. The resulting biological information and standards will contribute to improving the outcome of snakebite, and provide the basic data required to allocate limited resources in the most efficient manner. We have identified the Greater and Lesser Himalayan region (encompassing part of Pakistan, the northern and northeastern states of India, Nepal, Bhutan and many parts of Bangladesh) as being most in need of this work because it has multiple additional venomous species of medical importance that are not covered by the current Indian polyvalent antivenom. In some parts of this region, none of the “Big Four” species against which the antivenom is raised are present, raising doubts about the effectiveness of any currently available antivenom. We have developed collaborations between our group (primarily taxonomists and molecular ecologists) and Indian counterparts, including protein biologists, clinicians involved in the treatment of snakebite, and field herpetologists. The development of these collaborations was funded by an EU Staff exchange grant (IRSES), and subsequently the impact of the initial work was enhanced through a number of Bangor ESRC-IAA grants. However, the grant income so far has

**Echis genus distribution and its proteome composition**

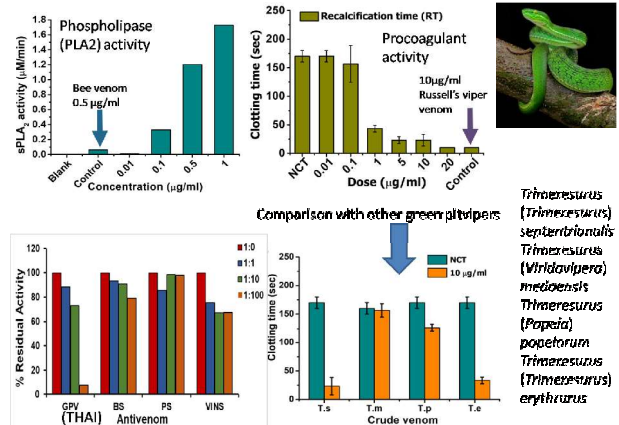


only been sufficient to carry out preliminary analysis of samples collected. We have been able to show that there is significant underlying genetic structure in three out of four species included in the antivenom preparation. Tests of cross-reactivity of antivenom with related species of cobra that replace the spectacled cobra in significant regions of the country showed limited efficacy and variation in efficacy between antivenom from different manufacturers. We have also recently tested Thai Green pitviper antivenom prepared against *Cryptelytrops albolabris* venom (a species not found in India) against a variety of pitviper species from the focal region. We have been able to show that there is good in vitro cross-reactivity with the venom of *Cryptelytrops erythrus*, a related species common throughout the northeast, and some cross-reactivity with *C. septentrionalis*, common in the western Himalayas. Further studies are needed to extend the analysis across other significant venomous species, especially vipers, and to evaluate the efficacy of various antivenoms in neutralizing envenomation in mouse models.

All venom samples are accompanied by tissue samples for species verification and for addressing areas of uncertainty surrounding current taxonomic assignments through DNA analysis. Proteomic analysis on individual venoms will establish the extent of intra-individual variation as well as geographic variation. The peaks show venom components that are eluted at different times as the solvents change in composition, according to their different solubility in those solvents. Each peak may contain several toxins. It provides a "fingerprint" of the venoms to show similarities and differences which MAY suggest that antivenoms prepared against one will be less effective against another with a different fingerprint. Red arrows indicate peaks of different heights in Himachal Pradesh cobra venom that indicate that some components are present in much larger quantities



**Activity & cross-reactivity of Western green pitviper venom**



than in the venom from the Irula co-operative in South India from which the antivenom is prepared and so the available antivenom will likely not be able to neutralise these. This could be the reason

**why people in Himachal Pradesh bitten by the black cobra die despite of being treated with Antivenom.**

A subset will undergo antivenomic analysis to determine how well the current antivenoms bind venom components. However, demonstrating binding is not the same as demonstrating neutralization of toxic action, as the toxic site could still be available if the binding site is distant from it on a large protein such as a metalloproteinase. Thus, in vitro tests will be complemented by in vivo (mouse model) tests for making clinical

recommendations about the best antivenoms for different species. These tests will be done using protocols that follow WHO guidelines and incorporate the principles of the 3Rs. Because of the larger amounts of venom required and the need to reduce the number of animals used, venoms showing similar characteristics will be pooled for in vivo tests. We only use antivenoms for animal testing when they have passed the first in vitro screening tests, thus again reducing the number of animals to be used. Ethical clearances for these tests have been sought from both Bangor as well as CCMB ethics committees. All currently available brands of Indian polyvalent antivenom are being compared, as previous work has shown them to be very variable in neutralizing capacity and cross-reactivity.

**What does the WHO say?**

In October 2005, the WHO Expert Committee on Biological Standardization (ECBS) recognized the extent of the problem and asked the WHO Secretariat to support and strengthen world capacity to ensure long-term and sufficient supply of safe and efficient anti-venoms. In March 2007, snake anti-venom

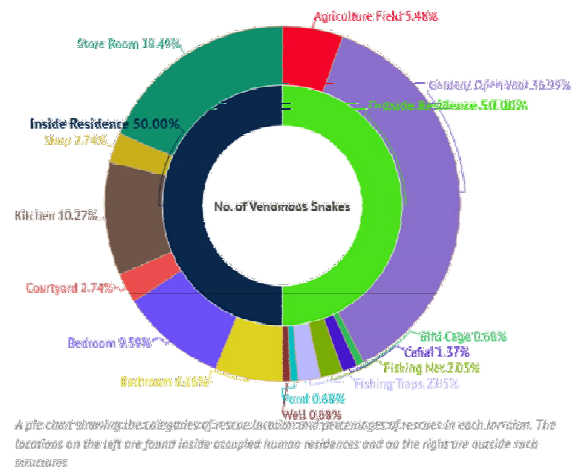


Immunoglobulins were included in the WHO Model List of Essential Medicines, acknowledging their role in a primary health care system. Urgent measures are needed to support the design of immunizing snake venom mixtures that can be used to make the right polyspecific anti-venoms for various geographical areas of the world. Sustainable availability of effective and safe anti-venom Immunoglobulins should be ensured and production systems for these effective treatments should be strengthened at the global level. Meaningful preclinical assessment of the neutralizing capacity of the snake anti-venom Immunoglobulins needs to be done before these products are used in human and medicines regulatory authorities should enforce the licensing of these products before they are used on humans.

The present “WHO Guidelines for the Production Control and Regulation of Snake Anti Venom Immunoglobulins” ([www.who.int/bloodproducts/snakeantivenoms](http://www.who.int/bloodproducts/snakeantivenoms)) were developed in response to the above mentioned needs. These guidelines cover all the steps involved in the production, control, and regulation of venoms and anti-venoms, as well as an appendix providing detailed information about the distribution of the most important snake venoms for use in anti-venom preparation in each country, territory or geographical area. The production of snake anti-venom following good manufacturing practices should be the aim of all countries involved in the manufacture of these life-saving biological products.

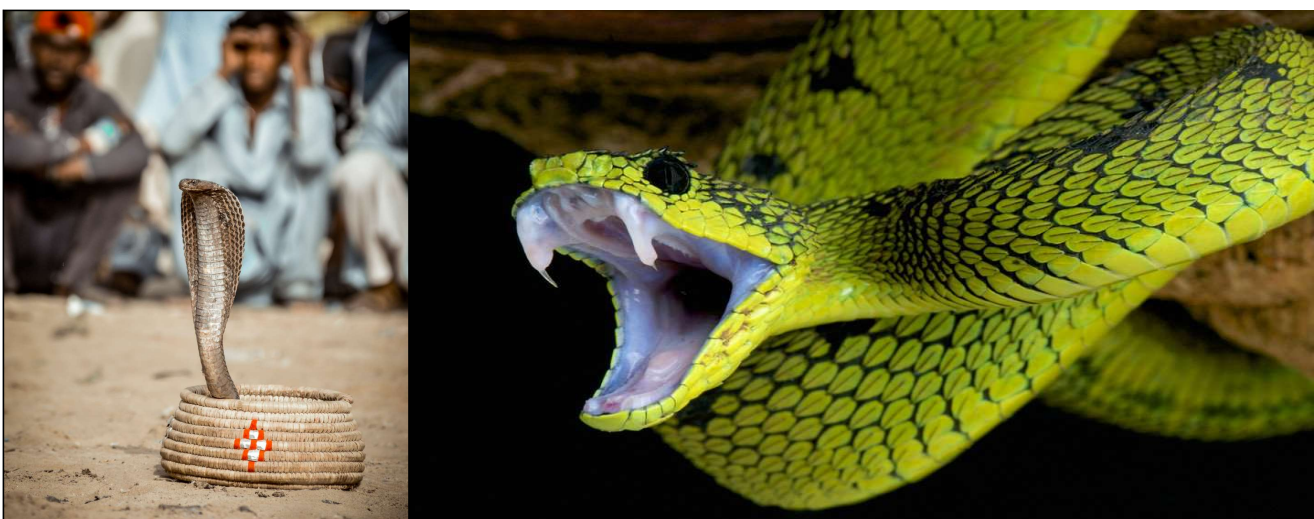
A secondary aim of our project is to better understand the ecology of venomous snakes to help identify human-snake conflict flashpoints and formulate strategies and education campaigns to reduce snakebites, a virtually unexplored line of research globally. We also aim to raise awareness and increase knowledge among at-risk communities about

Where were the Venomous Snakes Rescued?



Made with infogram

snakebite prevention and treatment, and to train organizations involved in wildlife conflict mitigation to respond safely to human-snake conflict. As such, our project seeks to help develop an unprecedentedly integrated approach into snakebite treatment and prevention in India. While improved clinical treatment of snakebites can reduce mortality and morbidity from sustained bites, it is desirable to prevent snakebites from occurring in the first place, yet rigorous research into snakebite prevention is almost entirely lacking globally. Identifying flashpoints of human-snake conflict is essential to reduce the incidence of snakebite through education and management of potential snake habitats. This requires a much more detailed understanding of the ecology of venomous snakes, especially movement patterns and preferred microhabitats, in relation to the use of space and time by local human populations.







**Dr Jaideep C Menon**

Consultant Cardiologist, Amrita Instt of Medical Sciences, Kochi

## Epidemiology of Snake Bite in India

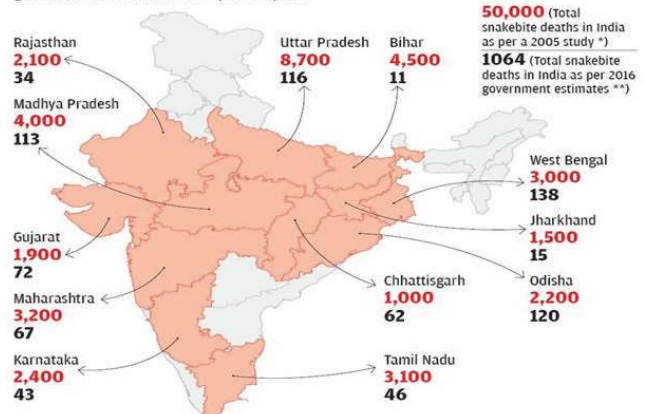
**Introduction:** India has the unenviable distinction of being the snakebite capital of the world accounting for about 58000 of the 80000 to 140000 deaths occurring annually, worldwide. The World Health Organisation (WHO) estimates the number of bites worldwide as 4.5-5.4 million annually, leading to envenoming in 1.8-2.7 million. India it is estimated records 2 million snakebites yearly.

**Background:** Incidence and mortality due to snakebite have been grossly under reported. While the epidemiological studies suggest over 50000 deaths per year the numbers cited by the government was 1064 for the year 2016 (Figure 1). The diagnosis of snakebite can only be corroborated from the symptom-complex, signs and circumstances as very often especially at night, snakes are not seen. A definite diagnosis can only be made if the bitten individual has actually seen the snake and identifies it or captures or kills the specimen. There are no laboratory tests which can definitely distinguish between the different elapid and viperid species bites. Circumstantial evidence alongside signs and symptoms forms the basis of a “syndromic approach” for the diagnosis of snakebite. What complicates the matter further is that snakebite is listed as a MLC (medico-legal case) and thus can only be substantiated with clear cut evidence, which in turn leads to medical case report entries as; Unknown bite/ ? unknown snakebite/ ? venomous snakebite etc all the various permutations of which do not enter the definitive diagnosis list and hence go unaccounted. Of late given that a few state governments provide compensation in case of snakebite or a death due to snakebite, there has been a welcome change with a covering letter from the treating doctor being considered good enough for payment of compensation.

The other major reason for this is that the majority of snakebites occur in rural areas, in individuals between 25-69 years of age, male and while at workplace or at home. To this day in very many states the first contact with the health system tends to be alternate healers (Ozas, Kaviraj, Sarpa Chikitsak etc) who are readily available in most villages. Most PHCs do not have medical help on hand 24X7 nor have all PHCs the facilities to admit inpatients. Given all this most victims depend on faith healers and alternate medicine which have till date not shown any proven value. All victims treated and seen by alternate healers too do not figure in the official records and hence the gross discrepancy

### Huge gaps

The figures for snakebite deaths as given by independent researchers and government estimates are poles apart



in statistic.

**Epidemiological studies:** There has been no nationwide study looking at the incidence of snakebite in India. The earliest reported study was in 1992 (AK Hati) from the Burdwan district of West Bengal. This was followed by a study on the epidemiological profile of snakebite in the 24-Parganas district of West Bengal. Most of the other data has been from hospital based epidemiological studies, case-series or extrapolations from compensation paid to snakebite victims. Another hospital based epidemiological study was done for the Paschim Medinapur district of West Bengal in 2017.

Most other studies have been on the death statistic with the 1MDS (One Million Death Study) which used a verbal autopsy tool to study the cause of death in 13 states of India reporting the number of deaths due to snakebite as 45,900 annually (CI-40900-50900). A recent update to the study suggests a figure of 58000 as the number of deaths annually in India between 2000-2109. A study from Bihar reported that snakebites accounted for 7.6% of all unintentional injury deaths across all ages but for 33.3% of deaths in the 10-14 years age group. In addition there here have been hospital based case-series reports from Maharashtra, Kerala, Andhra Pradesh and Tamil Nadu.

**Discussion:** The easiest way forwards to ensure that all snakebites get entered into the records is by either of making snakebite a notifiable disease, or by removing it

....contd on page 28



**Priyanka Kadam**  
President & Founder, SHE-INDIA

## Snakebite Mitigation Strategy – An activist's perspective

Snakebite envenoming is one of the most under-reported health issues in India. The majority of the victims of snakebites come from a marginally under-privileged background and the lack of immediate access to healthcare results in a high number of deaths and disabilities.

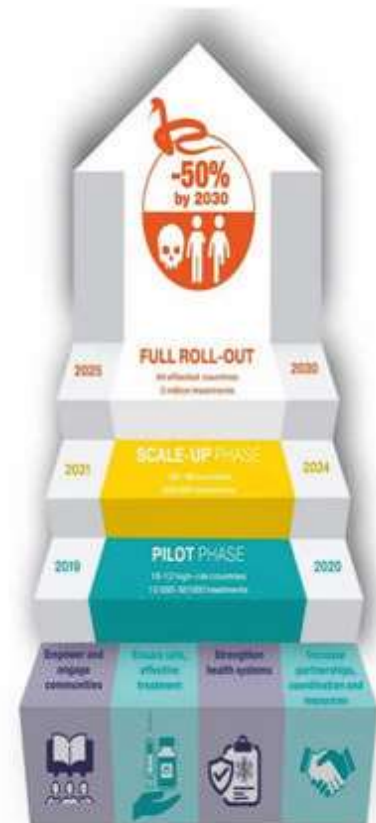
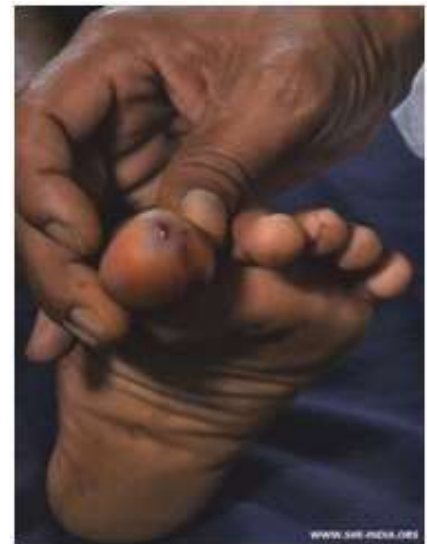
Snakebite has been recognised by WHO (World Health Organization) as the most neglected tropical disease in 2017. A strategy to bring down the death and disability by 50% by 2030 has been released by WHO in May 2019. The strategy focuses on 4 pillars of intervention to bring down the death numbers and combines the efforts of various stakeholders in countries that are exposed to this poor man's disease.

### The four pillars of intervention are:

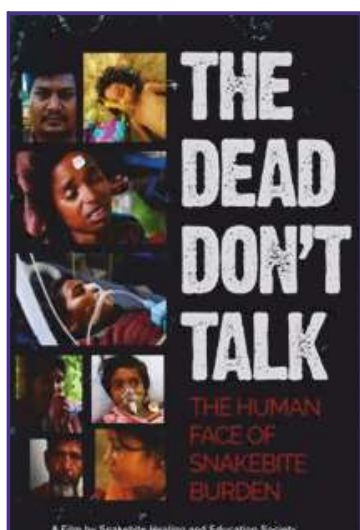
- 1. Community Engagement and Advocacy:** This is the most important link if we want to save lives “today”. However, efforts invested in awareness and prevention endeavours is unfortunately the most ignored aspect in the snakebite mitigation exercise as it is difficult to measure the country level impact. Any study in this regard is done at a village or district level and extrapolated to a larger area. Due to this challenge, there has been negligible funding for advocacy and awareness related activities.
- 2. A Safe and Effective Treatment:** The current antivenom used in many geographies where the bite incidences are high are of weak efficacy. Research has also pointed to evolution in venom of the same species of snakes occurring in different parts. There is therefore a pressing need for a tighter antivenom as this is an important step in the recovery of a snakebite patient.
- 3. Strengthening the Health System:** The health system, especially in the rural belts, needs upgrading and strengthening along with capacity building of medical staff to support medical emergencies. Unless we address this need at the community level, the number of deaths and disabilities won't go down.
- 4. Partnership, Collaborations and Resource Management :** There is a great need for advocacy and collaborations at country, state, district and village level to ensure that each level of stakeholder works with alacrity and in tandem to collectively mitigate the snakebite burden. Similarly, collaborations between scientific institutions, knowledge share, funding of research and advocacy projects (the two sides of a coin) will ensure meaningful impact on the ground.

The issue is challenging simply because we cannot eradicate the cause of this burden. Snakes are ecologically important and hence cannot be systematically expunged from the environment unlike other vector borne diseases that are easier to eliminate. The onus of bringing about behavioural changes therefore lies within the system (country and its policies) and the population that suffers this burden.

With the backdrop of this malaise, the harsh reality is the indifference of



Source : WHO Strategy on Snakebite Prevention & Control



the state towards acknowledging this cause and bringing about constitutional and fundamental changes in its policies to allocate budgets where it is most needed - the health infrastructure at the community level.

Unfortunately, until now, civil societies, charitable institutions and to some extent, CSR (Corporate Social Responsibility)

funding are the only entities doing the heavy lifting to make a difference with interventions in select pockets of the country. Most of these organizations are disadvantaged due to low resources and funding opportunities. Snakebite Healing and Education Society (SHE-INDIA) is one such initiative that works strategically as well as at the grassroots level to create maximum snakebite prevention impact. The initiative produced India's first advocacy film, *The Dead Don't Talk*, which explores the snakebite burden story from the perspective of the victim and her/his family. With meagre funding and honorariums, SHE-INDIA has produced educational materials like short snakebite prevention and first-aid videos and illustrative posters in twelve regional languages to maximize the awareness and outreach efforts.

Snakebite is a human rights issue simply because this is a treatable injury and yet a large number of the disadvantaged population get exposed to fatal bites resulting in deaths and disabilities that can be life changing for the entire family. The constitutional and most relevant fundamental right - "Right to Life (Article 21)" - is thus compromised in this case.

The challenges at a rural level that results in deaths and disabilities are non-access to healthcare, non-access to affordable transportation for visits to hospitals for wound management and other complications which are the aftermath of a venomous snakebite. The poor are further pushed into poverty due to loss of livelihood and cost of treatment along with overheads like post treatment care and long recuperation period.

The solution lies in absorbing the issue into the government's existing schemes instead of framing new policies - designating the status of snakebite injuries as a notifiable condition, allocating budgets through the NHM (National Health Mission) and NITI Aayog at a central level and State Disaster Management

Authority and State Health Department at the state level.

All strategies to strengthen the medical infrastructure and capacity building of clinicians and medical staff needs to be implemented by experts from a similar background who understand the nuances of where to focus the effort; while being fully sensitive to ground level challenges. Most policy level decisions are made either by politicians or by bureaucrats with little educational and practical experience from the field. The task force working on such interventions should have clinicians with public health and community medicine background. Bringing the right talents to drive such initiatives will ensure proper, systemic and methodical solutions that are impactful on the ground. Basically what is needed is, bringing in skill sets that have the judgement regarding what will work and what won't.

Lastly, while engaging with communities and building health infrastructure in the main trunk of the strategy, another important branch is research on venom evolution of the same species of snakes, distribution of medically significant snakes and study of venomous snakes occurring in India that are still under-researched. The state level forest departments play an important role in this activity as all such studies need raw materials like snake venom, scales and blood samples to ascertain their phylogenetic identity and venom glands for the development of next generation antivenoms. And to collect the necessary samples, the onus of giving approvals and permission in each state lies with its forest department.

To sum up, if all states are allocated 10% of the financial year's health budget to strengthen the rural health infrastructure with an aim to achieve universal health, we will manage to stay on track in implementing the WHO strategy to minimize the damage caused by snakebites. The implementation process should be audited by the state's financial controller to ensure incorruptibility. After all, integrity is an important spoke in the wheel to driving in the right direction.







### Soumya Sengupta

BSc ( Hons), Assistant Teacher, Radhanagar Board Primary School

## Prehospital Management of Snakebite - A Social Responsibility

Introduction : Snake bite is a burning problem in India. Official data say that, due to snake bite, near about 50,000 people die in India every year. But, actually it is more than 100000, because most of them are not included in the government database. And yet, reducing this death rate is not at all an impossible task. And to prevent such deaths, the role of hospital management is the most important part to start with.

### 1. What is Pre-HOSPITAL Management?

When a person is bitten by a snake, he/she thinks that "I am going to die", as most of them think that every snake has poison, and every bite is lethal! So it creates a panic attack. Due to such panic attack one person, even if bitten by a non-poisonous snake, might still die easily.

But instead the person might be given the "reassurance" that, just like in a gunshot you cannot hit the point every time, there may not be any poison in bite, as the snake may be non-poisonous, or even if it's poisonous, it might still fail to deliver poison while biting. And again, even if it's poisonous and it could deliver enough poison, with proper treatment your life can be still be saved easily. Having such a reassurance, he or she can reduce the chemical reaction in his body, which could otherwise create a huge anxiety.

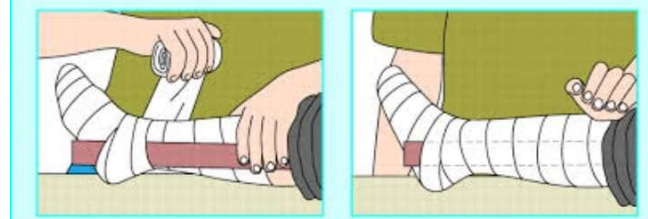
So there is a huge role of REASSURANCE, in pre-hospital management.

Next to that, how should one person go to hospital? That's also a very important step to give the doctor the right opportunity to save the life of the patient. That is, to immobilize the bite area and go to hospital as soon as possible.

If IMMOBILIZATION is not performed, venom will spread quickly, which will reduce the probability of saving the life of the snake bite patient. We know many incidents, where the patient tried to go to hospital all by himself by cycling, and the doctor did not get any chance to save his life.

And then GOING TO HOSPITAL as soon as possible, with proper previous management, will also increase that chance to save the life.

And the last but very important point is that TELL THE DOCTOR WHAT HAPPENED. It may be something unusual that happened with the patient. It may be



unusual swallowing, bleeding, hematuria, difficulty in swallowing, breathing or anything they want to say. Because, a doctor should know what happened to the patient, to make a quick and right decision to start proper management.

So, jotting down all those described above in brief, WHO recommended, "Do it RIGHT" as peripheral management. It means :-

- R - Reassurance
- I - Immobilisation
- GH - Go to Hospital
- T - Tell the doctor

### 2. Old method discarded

We know a great aphorism saying, "Rather than doing many many wrong things, it's better not to do anything."

But we saw that after a snake bite, people generally do many many wrong things. Tourniquet is one of the most deadly acts people are used to doing. Still now most common people think that tight ligature will stop the spreading of venom throughout the body. They also think that cutting or washing the wound area may reduce the amount of venom in the victim's body.

These types of acts, followed by common people, are also responsible for the death. We all have to change this mindset of the common people through proper education.

### 3. Present Situation in India

If you take a newspaper of any State of India, and take a close look, every day we will see the report of snake bite death. If we take a more closer look, we will see that most of them died because they went to local faith healer (Ojha, Tantrik, Pir etc), before going to hospital. Still now most common people in India think that faith healers can save snake bite victim's life. They saw that most of the people, going to faith healers, are getting well, and only some of them dies. Almost certainly, they do not have the slightest knowledge of a hilarious



but wise saying of Modern Medicine that, "A disease can be 'cured', with medicine (example – treating poisonous snake bite with AVS), without medicine (example – non-poisonous snake bite and common Flu getting cured without treatment), and despite medicine (example – patient might feel a relief from any pain or problem, if he or she believes that the medicine/ Tabij/ Kavach/ Enzyme tonic given by 'the special person' will reduce his/her pain or problem).

So when someone become well, they think that the faith healer has a super natural Power, but when someone dies in faith healer's place, they think that the poor person don't have any more life in his/her 'fate', or that they must not have obeyed the God's Words meticulously enough!

This is how; they are hesitating going to hospital at night time and losing their lives. Lack of proper education and also lack of proper hospital management in a large number of localities of India are also responsible for this type of mindset.

#### 4. How are we working now?

We, the members of Science and Rationalists' Association of India (Bharatiya Vigyan O Yuktibadi Samiti), have been working in West Bengal, on this area for the last three decades. By organising Slide shows, Puppet Shows, Poster exhibitions in Schools, Colleges, local festivals, in street corners, we are trying to motivate people to go to hospital, after snake bite, as soon as possible by Motorbike.

We also conducted Training programs with Asha's Workers with the help of CMOHs, about Snake Bite and Snake Bite Management. In such programs we not only talk about the peripheral snake bite management, i.e. "Do it RIGHT", but also the signs and symptoms of poisonous snake bite.

The bite of Common Krait is painless. Bilateral Ptosis is the main Symptom to identify a Krait Bite. So we are also making people aware about the mysterious signs and symptoms of the poisonous snake bite, so that they go to hospital as soon as possible, and cooperate the doctor on duty, thus enabling a proper treatment.

Of course we can convince people that, this is not true that your lifespan is predetermined. It's not the fate, but the opportunity to get the right treatment in the right time, will determine whether you will be alive or not. So we can convince people to go to the hospital in RIGHT time, and in RIGHT way. It is the one and only way to stop this flow of deaths.

In our locality, we reduced nearly all deaths attributable to delays due to going to faith healers. In West Bengal, every bedded PHCs also have ASV and it's free to all. Constant monitoring, awareness programs have reduced the death rate. No one even gives any ligature in bite sites. And they use motorcycles to reach the hospital instead of

ambulances to reduce time to arrive at the hospital. Here, at our locality, at Radhanagar BPHC, doctors are doing snake bite management greatly.

Now we are also focusing on making people aware about the signs and symptoms of poisonous snake bite, so that they can understand the symptoms of Common Krait also, and go to hospital without any delay. The doctor's treatment, including starting AVS without bite mark, will not be mysterious to them anymore.

#### We will finish with a great story in my life as a science worker.

In our locality, one Faith healer (Ojha) was bitten by a cobra. He was drunk. While breaking the fang, the snake bit him. He gave ligature. By chance we came to know that, and rushed there. There was a huge crowd. We told about the advantage of availing Hospital Management, but the victim himself and the people surrounding were not ready to do so. Ultimately we managed to convince his wife about the urgent necessity of Hospitalization and AVS management.

Finally we saved his life. After getting discharged from the hospital, we had to give him regular dressing to heal up the wound due to Necrosis. Last of all, he became our team member. In an awareness program he also told people, "Please don't go to faith healer after snake bite. I was a faith healer. But, with my life, I understood that I was wrong. No faith healer has the capacity to heal people with any supernatural power! Do RIGHT, in case the snake has bitten."

Beside all these, we have to assure people. After getting a snake bite, the patient must listen to his peers saying, "Dear friend, don't waste your time, go to your nearest local hospital. There you'll get a trained doctor. Yes, every necessary equipment and medicine is there also. And yes, everything is free there! So, don't make panic. Immobilize the bite area. Go to the Hospital and Tell the doctor what happened to you! The doctor will save your precious life."





**Dr Rajeev Jayadevan, MD, MRCP**  
Vice Chairman, Kerala state IMA Epidemic Control Cell

The recent tragic news of a child who died from snake bite at Wayanad dominated the headlines for several days. The child was apparently bitten by a snake that was hiding in a crevice inside a classroom. This article is specifically written to outline the steps that may be taken to prevent snake bites in schools and homes.

Identification of common snakes and treatment of snakebite have already been addressed in my earlier article: <https://english.manoramaonline.com/lifestyle/health/2019/04/10/snake-bite-what-to-do.html>

#### Essential steps in preventing snake bite:

1. Do not let garbage accumulate in the school premises. Food waste attracts rats, and this in turn invites snakes. Snakes also arrive in search of frogs, lizards, chameleons and snails. Rodent control must be given priority.
2. While constructing compound walls around schools using stones or bricks, Make sure that there are no gaps or holes where reptiles can hide. Plastering with cement is essential. Periodic maintenance is required to fill gaps that appear with time, as a result of erosion.
3. Do not let logs, firewood, bricks, tiles or other construction material accumulate in the school premises. Reptiles are known to hide underneath.
4. Playgrounds are often surrounded by shrubbery and bushes. While playing football and cricket, children frequently venture into wooded areas to retrieve the ball. In their excitement, they may blindly reach underneath a bush where a snake could be lying in wait. The child's finger, being a warm object can be detected by heat sensors located on the heads of vipers. They can strike at lightning speed, mistaking the moving finger for a small animal. Children must therefore be instructed to use a long stick to retrieve the ball from the undergrowth.
5. Snakebites that occur during playtime or after dark occasionally get mistaken by children for a thorn prick, thus delaying medical attention. This is because the snake might not always get noticed during the incident.
6. Snakes may take shelter inside schools and office buildings where old files, papers and books are kept undisturbed over a period of time. Periodic clean-up is therefore necessary.
7. Some schools in rural areas are housed in old dilapidated buildings. They have hollow foundations with multiple burrows, in which reptiles are known to hide. Such buildings must be periodically refurbished, and all gaps plastered meticulously.
8. While clearing weeds and bushes around the school property, remember that snakes might come out of their natural hiding places and seek shelter inside the school building. Therefore, proper precautions must be taken before such clean-ups are done.
9. Vipers are sometimes found amongst dried leaves on the ground, underneath trees. It is almost impossible to detect a viper in such settings because of its remarkable camouflage. Regular cleaning of school premises is therefore necessary.
10. Children must be encouraged to walk only on designated paths and not through grassy or wooded areas. They should never walk barefoot through such areas.
11. Children must be discouraged from venturing into abandoned properties near the school premises; such areas can be infested with snakes.
12. Snakes are frequently found in rubber estates, amongst fallen leaves and twigs. Small vipers can be particularly hard to spot.
13. While walking in between paddy fields where a harvest has recently been completed, children must be careful not to tread on snakes. Cobras and other snakes frequent such areas looking for rats, who come there in search of grains. The burrows built by rodents serve as convenient homes for visiting snakes.
14. Snakes occasionally enter houses that are built on low ground, without sufficient barrier with the outdoor premises. The white-banded Krait, an extremely poisonous animal with paralysing neurotoxin - is known to enter homes at night in search of food. The snake may accidentally bite a child who is sleeping on the floor, as the child turns

or stirs during sleep. To keep snakes out in such settings, gaps beneath doors must be filled. Children must not sleep on the floor in open spaces.

15. Snakes are known to seek shelter inside shoes that are kept outside the house. Children must be instructed to not keep shoes outside. Shoes that are left outside must be checked for any hidden reptiles before wearing them the following day.
16. Those who raise poultry in their premises are at risk for visiting snakes. Homes that have bird nests nearby are also at risk. Snakes love to feed on bird eggs. They may pay a visit, after being attracted by the odour of the nest.
17. Tree branches that touch the house must be trimmed, as snakes are known to climb trees and enter the top floor of homes in search of food and shelter. Window nets help prevent them from entering. Any drainage pipes that allow snakes to hide or enter the home must be protected with a wire mesh. Small ponds on the property can attract snakes too.
18. If a baby snake is found, remember that multiple other snakes could be found nearby. A search is therefore warranted.
19. Snakes come out of their burrows during rain. Children must be warned to be careful while walking after a rain.
20. Even an apparently dead snake can bite; this is a unique feature of reptiles. It has been observed that even a snake's head that has been cut off recently, can bite from reflex action. Therefore, one must be extremely careful while handling a dead snake.
21. Children must never attempt to handle snakes, particularly after getting inspired by videos on social media. Snakes can bite at lightning speed. They can reach further than most of us can imagine. Their behaviour cannot always be predicted. Remember that even the greatest snake experts in the world have been bitten multiple times, some of which proved to be fatal.
22. Even if a poisonous variety of snake has bitten the child, it is not necessary that envenomation should occur. In other words, not all bites from poisonous snakes result in injection of venom into the body. These are called 'dry bites.' The cause of this behaviour is unclear. There was a myth that dry bites occurred because the snake had a meal recently; this has been proved wrong.
23. One must remember that non-poisonous snakes also are well-known to bite. Even if we think it was a non-poisonous snake that bit the patient, it is safer

to take the patient to the hospital, as it is not easy for a lay person to identify all venomous snakes correctly.

24. The treatment for snake bite is anti-snake venom (ASV). One must not waste time trying traditional remedies. An occasional allergic reaction can occur to ASV, but treatment for this is readily available in all hospitals. In India, a common polyvalent serum is used for all poisonous snake bites. Therefore, it is not necessary that the snake is visually identified in all cases.
25. A patient with suspected snakebite must be taken to the nearest centre that has ASV in stock, because valuable time could be lost otherwise. Not all cases of snakebite need ASV. The doctor will carefully observe for signs of envenomation and then only administer the ASV—even if it was a witnessed bite from an apparently poisonous variety of snake.

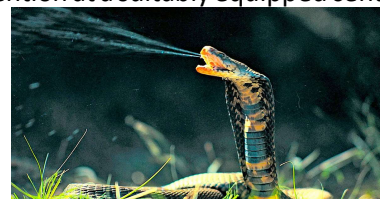
The role of ASV is simply to neutralise venom that is circulating in the body. However, if the venom has already affected the kidney, nervous system or blood, additional supportive treatment measures will be necessary such as dialysis, ventilator and blood products. If the hospital administering ASV does not have these advanced facilities, the patient may be transferred to such a centre afterwards with suitable precautions.

Due to the warm tropical climate and dense vegetation, snakes are common in Kerala. They are frequently found in wooded hilly areas. Schools authorities in such areas should know the nearest centre where anti-snake venom is available, and must promptly take all suspected snakebite cases to this hospital.

It is helpful to call the hospital by phone in advance to confirm that ASV is available in stock. This will help avoid delay in administering life-saving treatment.

Teachers might not necessarily know how to react in all medical emergencies, as they are not medically qualified. It is therefore useful to know the local doctor's number, for any quick queries before transporting a child to hospital.

**In summary,** as the saying goes, trouble seldom comes with prior warning. However, if we act diligently, we can create a safer environment at home, school and at work. Emergencies such as snakebite require prompt medical attention at a suitably equipped centre.







### Dr Dayal Bandhu Majumdar

Resource person for Snakebite Training, Govt of WB.

In the last fourteen years, I have attended numerous discussions about snake bites, speaking in training classes, public awareness, etc. This issue is still not clear to people of all classes in the society. I have seen the lack of clear idea in the medical college teachers, new medical graduates, doctors, high-ranking employees, teachers, students, and general people. Even people who have been doing science movement fall into this category.

In a class a few months ago, I was talking to a group of school teachers and a few school inspectors about snakebite. One teacher said that they have been running a science movement for many years, including raising awareness about snake bites. He said himself at the end of that one-hour class that there had been so many misconceptions. We have also experience of treatment of snake bite cases in the last few years, in general, it is becoming difficult to treat, for the misconceptions that educated people have known for centuries.

Let me discuss some cases of Common Krait (Kalach) snake bite. 1) On the morning of August 14, 2011, a 32-year-old male patient was admitted in NilratanSirkar Medical College &Hospital , Kolkata with abdominal pain. The patient was discharged after five hours of treatment. Naskarbabu came to Calcutta National Medical College & Hospital at 12:10 pm due to some physical problems. Stomach pain was treated again from noon to evening. Senior doctors visited until 3 PM. After 7 pm, Srijita, the junior house staff went to the patient and saw the specific symptoms of the snake bite and was convinced that the patient was a Kalach (C krait) snake bite patient. She immediately infused ten Anti Venoms ( ASV).

The next morning the patient recovered. The senior doctors came and were surprised to see all this. Here is the question I ask everywhere during the training of doctors; How could so many senior doctors from two medical colleges have mistaken a simple patient who was diagnosed by Srijita in just four months of house staff experience? There is a very beautiful Chinese phrase. "What the mind does not know, the eyes do not see." That there is a mysterious snake called Kalach (C krait), which usually bites in the open bed late at night. Moreover, in about ninety-nine percent of cases, the patient does not know that he has been bitten in his sleep. But most of the time the patient comes with

## Mystery of Common Krait bites



abdominal pain in the morning. It is not possible to know these news without training. Srijita had heard this in a class a few months ago.

But the bigger thing is, "timing". Time, time is the most precious thing in our lives. Srijita went to see the patient at bed number 127 at the right time. The most definite symptom of Kalach snake bite is Bilateral Ptosis. Two eyelids fall off. How long after the snake bites the eyelids will fall off, there is no hard and fast rule. It can happen after two hours, it can happen again after twenty four hours. We got it after 36 hours, even 42 hours. In fact, we do not know when the Kalach (C krait) snake had bitten at night. Also the same disease, brings different symptoms in different people. Maybe if Srijita saw that patient an hour ago, she would not get this Ptosis.

Case number 2) One 40 yrs, male Pt was transferred to CNMC&H from a S D Hospital after CT Brain, with a diagnosis of G B Syndrome. The Pt was very restless on the stretcher, throwing his all limbs. Only this finding of moving legs was enough to rule out G B Syndrome. I saw Bilateral Ptosis and was thinking of C Krait bite. Patient's relatives strongly ruled out any snake bite.

....contd on page 26





### Dr Maya Gopalakrishnan

Assistant Professor, Dept of Internal Medicine  
All India Institute of Medical Sciences, Jodhpur

India has the largest burden of snakebite deaths and disabilities in the world. Estimates suggest that snakebite deaths in India contribute to more than half the deaths occurring worldwide. Many experience lifelong disabilities as well. Those who are affected are usually young productive adults belonging to poor background who experience subsequent social stigma and discrimination.

Snakebites are broadly categorised as venomous snakes affecting the nerves and venom affecting the blood and blood vessels. Nerve related symptoms are usually due to elapid bites i.e., cobra and krait, and bleeding symptoms are usually due to vipers.

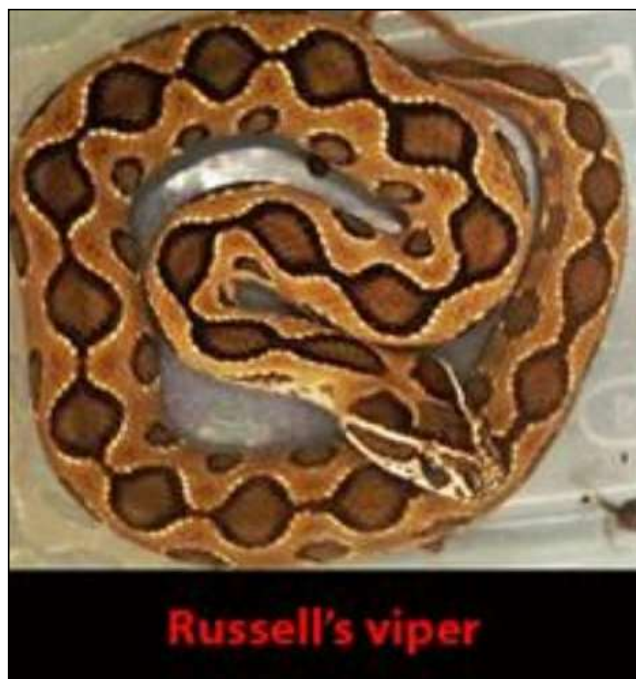
#### What are the medically important vipers in India?

Important viper species in India include Russell's viper, saw scaled viper (including sochurek's viper), hump-nosed pit viper and other pit vipers like bamboo pit viper and green pit viper. The vipers have a wide distribution and are found in almost every state in India.

Some of the vipers are specifically found in some geographical areas like hump-nosed pit viper along the south-western Malabar coast and green pit viper in the north-eastern states while sochurek's viper (a sub species of saw scaled viper) is found in Thar desert region of Rajasthan.

Among the viper species, Russell's viper is widely distributed throughout Indian subcontinent including Sri Lanka. A nationwide study has estimated that 43% of reported bites are likely due to Russell's viper envenoming in India. Russell's viper is also reported as the species responsible for nearly 80% mortality in several hospital-based studies across India.<sup>11,12</sup> Variation in venom composition between Russell's viper species from various parts of India leading to marked difference in neutralising capability of the polyvalent antivenom (ASV) has been demonstrated in laboratory studies. The other important viper species with widespread distribution is Saw-scaled viper (*Echis carinatus*) which has two subspecies: *Echis carinatus*, responsible for envenomings in the Indian peninsula and *Echis carinatus sochureki* thought to be responsible for bites in Northern India and Pakistan. Apart from this, several pit vipers such as hump-nosed pit viper (*Hypnale hypnale*), Himalayan and bamboo

## Confronting Viper bite - the multi-edged sword



Russell's viper

pit vipers in the north-east and Malabar pit viper in the western coast are also clinically significant. Hump nosed pit viper maybe misidentified as saw-scaled viper.

#### What happens in the body after viper bite?

Viper venom is a potent mix of proteins which digest tissue and proteins which affects blood cells and blood vessels. The main action of the viper venom is to disturb the clotting system made up of platelets and clotting factors, which are proteins in the blood which help blood clots during injury or bleeding. Venom disturbs these factors and small clots occur within the blood vessels in the body. Firstly, these are not normal and secondly, this uses up the clotting factors and the victim has no clotting factors left (termed as consumption coagulopathy) and hence bleeding starts unchecked by clotting mechanism. This imbalance of unwanted clots with bleeding is a dangerous state for the patient. This is common to all vipers.

#### Why are viper bites like a multi-edged sword?

We have seen that viper venom disturbs blood and blood vessels. As blood vessels are in every organ in the body any part can get affected by this. Bleeding can

range from mild bleeding like gum bleeds and bite-site bleeding to life threatening bleeds such as bleeding in the brain and intestines. Russell's viper is especially complex and challenging as it results in a rapidly progressive condition involving many organs culminating in death. The venom leads to "leaky blood vessels" reported from viper bites in Southern India, Sri Lanka and Myanmar and is associated with a poor outcome. Venom can routinely cause kidney failure and rarely heart failure. Also, endocrine glands are also affected in Russell's viper bite resulting in long-term consequences with hormone imbalances as well. Therefore, deaths are thought to be higher in viper envenoming as compared to elapid bites as managing viper bites is complicated involving multiple decisions like need for dialysis, ventilatory support, blood pressure improving medicines and blood transfusions based on which organ systems are involved and when.

#### **What are the long-term problems after viper bite?**

The most common long term problem after viper bite is the wound which may need surgical interventions. Some proportion of patients develop kidney failure needing lifelong dialysis support. Also, hormone deficiencies can happen after Russell's viper bite. Also, there is a huge price to be paid by the victims in terms of mental health: long term stress and anxiety are reported. Apart from all this there is a huge loss in terms of working capacity and economic productivity which can push victims into cycles of poverty.

#### **How can we manage the problem?**

The short answer: By giving antivenom! The antivenom (polyvalent ASV) in India acts against 4 snake species including 2 vipers: Russell's viper and saw scaled viper. Early antivenom can neutralise the venom effects and can save the life of the patient and prevent long term problems. Bleeding may need to be controlled with blood and other components transfusion while kidney may need support with dialysis.

#### **What strategy should we follow to reduce the problems with viper bites?**

Recently, World health organization (WHO) has evolved a strategy to halve the snakebite mortality by 2030 as compared to 2015. We need a multi-pronged approach to tackle this problem. Prevention is better than cure, hence community engagement with simple practices to avoid bites like wearing footwear and having torch light, sleeping under mosquito nets on cots must be emphasized. The next step is to reduce the bite to ASV time: i.e., to give ASV as early as possible after bite. This also needs to be addressed by education and social engagement so that victims reach health care facility early. Finally, victims need systematic long-term support for medical and non-medical problems after bite.

## **Mystery of Common Krait bites**

*....contd from page 24*

There was no history of floor bed. The Pt slept on a cot in mosquito net. Yet, I had written my diagnosis as "neurotoxic snakebite" and asked them to go to the admission counter. When they came with the admission ticket, they confessed that, the Pt had given a history of stepping on a black snake in the garden about 25 hours ago. The Pt was sent to the ITU and was ventilated till next morning, and was cured by ASV and other management of neurotoxic snakebite. On meticulous history taking, I came to know that, the Pt started complaining sore throat at about 2 am; was admitted at the S D Hospital at about 5 am. The Pt reached CNMC&H at about 11 am with features of neurotoxicity.

Keep aside bite in sleep; this Pt was bitten in the bright day light, yet didn't know. This is the mystery of C K bite. The bites are painless. There would be no local sign like bite marks and swelling. These local signs of Cobra bite are so dramatic and vivid that, nobody miss them. And the partial knowledge that, every venomous snakebite must be painful with two bite marks and progressive swelling (Pathognomonic of Cobra bites) creates all these confusion in C Krait bites.

The third case ended fatally due to lack of training of the junior doctors. This 16 yrs male pt was admitted first at Jangipara rural hospital in the early morning of 14th June 2016. Though Dr Sikdar diagnosed C Krait bite in time, patient's relatives were not convinced and didn't allow to infuse ASV for first two hours. Later on ASV was infused when the Pt started complaining of respiratory distress. The Pt was transferred to a Medical College of Kolkata with clearly written refer letter. But the junior doctor couldn't assess the Pt and did wait for the seniors to come. The Pt had died before the senior doctor came. Now someone passes an inadvertent comment that, the Pt was not at all a case of Snakebite. That comment created a lot of chaos at the Jangipara R H. Finally diagnosis of neurotoxic snakebite was confirmed by autopsy and a C Krait snake was found in the afternoon in the room where the Pt slept in the previous night.

Our trained juniors are diagnosing and successfully managing hundreds of C Krait bites cases in the Rural Hospitals of West Bengal. Making the patient's relatives convinced is a challenge. Treating the C Krait bite cases are no challenge.



**Dr. D C Patel, MS**  
Consulting Surgeon, Dharampur, Gujarat

#### Introduction:

Snakebite is a very serious and neglected sector of health care. Many interruptions are there for snake bite victims to reach at correct level for treatment like role of superstitious, role of faith healer. What we can say is health sector in India for snakebite management facing several challenges. Snakebite is a serious problem for snakebite victims, as subject concern to poor, rural people and farm workers.

Tertiary care for snakebite includes endpoint treatment part and prevention of incidence of snakebite. It starts from victim how came into conflicts of snakebite. Snakebite mostly occurs when people are working in farm, while sleeping on ground, while rescuing snake. Incidence usually occurs inside home, outside home, in farm. At daytime or night time. If victims of snakebite escaped from the mouth of faith healer and first goes to primary care then, survival ratio must be increased.

Tertiary care management should be done very promptly and right way. It requires teamwork.

#### Local Bite Site Scenario:

1. **Cobra bite** : More than 90% cases bite site gangrene, Abscess ,necrosis , sometime gangrene of digits. Require first step: incision and drainage and debridement. second step: skin grafting or amputation of involved part.
2. **Russell's Viper bite** : Bite site severe swelling , sometime if bite occurred in foot swelling may developed in whole limb, affected half of chest and abdomen ,even up to scalp. But on clinical judgment we should never go for fasciotomy. Another group severe blister formation, require rupture of blister and dressing . Very very rarely for necrosis and gangrene, require debridement.
3. **Saw scaled Viper** : Almost all patient swelling , pain, severe tenderness at bite site. No surgical intervention is needed. Blister formation at bite site, require rupture and dressing . In few cases gangrene and necrosis, require debridement. Very rarely amputation of affected digits.
4. **Bamboo pit Viper** : Blister formation at bite site, require rupture and dressing. Very rarely amputation of affected digits.

## Tertiary care in Snake bite



Post Viper bite ARDS patient on Mechanical ventilation

5. **Common krait** : In very rare cases, swelling at bite site .

#### Respiratory care:

Require in neuroparalytic effect of snake venom.

In Snake bite ventilator support required in cobra, common krait and in less situation in Russell's Viper . As such due to snakebite no direct venom effect to respiratory system. Respiratory complications arise due to secondary infection or aspiration of vomitus. No hurry in case of common krait bite patient to extubate, until strong achievement of motor power.

#### Renal care :

Renal care is very very tough scenario due to snakebite. In Russell's viper, first stage: Renal damage can be prevented by a correction of hypotension, by fluid correction . Renal damage can be prevented by the required dose of inj. frusemide. We have good



results with FAD (forced alkaline diuresis). For many person question arise about overload but, as soon as we started FAD cycle urine output getting started. If sometime no respond to FAD and not enough urine output then, we should stop FAD. At last stage renal damage can be saved by HAEMODIALYSIS.

#### indication of Haemodialysis:

- Acidosis
- Hyperkalemia
- Fluid overload
- Altered consciousness with increased serum creatinine level
- Decrease urine output less than 400ML in 24 hours

#### Shock management :

1. Russell's Viper first stage with oxygen support, iv fluid administration.
2. Inj. Noradrenaline, inj. Dobutamine, inj. Dopamine
3. Cobra and common krait at last grasping stage shock overcome by oxygen support, iv fluid, cardiorespiratory resuscitation.
4. Shock due to anaphylactic reaction overcome by oxygen support, inj. Hydrocortisone , inj. Dexamethasone , inj. Adrenaline.

**Injection Atropine and Neostigmine** : our experience, only good result in cobra bite.

#### ASV reaction:

Severe anaphylactic reaction requires prompt management.

Urticarial reaction treated with inj. Dexamethasone , inj. Hydrocortisone. As soon as reaction start, first stop ASV and then after few hours as soon as reaction desensitised, again ASV can be started slowly.

**Bleeding Diathesis of Russell's viper** : Thrombocytopenia, Anemia , VICC( venom induce consumption coagulopathy). Treated with PC, RCC, FFP.

**Capillary leak syndrome** : Encountered in Russell's Viper. Prompted diagnosis and management required, otherwise high mortality rate. correction of hypotension , required urgent FFP, PC and urgent Haemodialysis.

**TOXIC VASCULITIS** : Due to Russell Viper, we have one patient, after one year duration slowly Progress in walking, swallowing but no speech till today.

#### ASV administration :

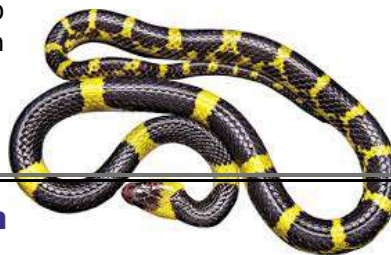
**Cobra** : In severe envenomation, loading dose of 2 to 3 vials and then infusion of more vial to complete 10 vials if some time delay outcome require more vials of ASV. Very occasional time if business bite occurs require more ASV.

**Common krait** : Not more than 10 vials , even patient remain on ventilator support for long time. Sometime in severe envenomation patient require more 5 vials.

**Russell Viper** : Russell's viper bite is very tough to decide dose of ASV , only judgment taken on clinical assessment in first 2 to 3 hours 5 vials, 10 vial or more than 30 vials . In severe envenomation require upto 40 vials.

**Saw scaled Viper** : 2 to 6 vials occasionally if bleeding not stop require more ASV.

**Bamboo pit viper** : No ASV required, only if bleeding from any orificies, 20WBCT not clotted status, decrease urine output and increase s.creatinine level.



....contd from page 17

## Epidemiology of Snake Bite in India

from the MLC list or to systematically carry out monitoring and surveillance programs especially in places where snakebites are common. The ICMR has recently launched a National Task Force (NTF) project to study the incidence, mortality, morbidity and socio-economic burden of snakebite covering 13 states, 34 districts and 6.12% of the total Indian population in the first Phase. This community level survey using ASHA (Accredited Social Health Activists) to identify victims at the ward level would ensure completeness of data

acquisition. This along with ICD coding for disease would again ensure that number of bites reaching hospitals are coded correctly.

Deaths due to snakebite, a largely preventable condition also reflects on the societal inequities present in India. Why should 50000 of our countrymen, most in the prime of their lives die due to snakebite while Indian health workers and pharmaceuticals companies are lauded the world over for excellence?





**Dr Kapiljit Chakraborty, DM**  
RMO Nephrology  
BSMC, Bankura



**Dr Sudipta Pal, MD**  
Asst Professor  
Gen Medicine, BSMC, Bankura

## Forced Alkaline Diuresis - risk & benefits in post snake bite Acute Kidney Injury

Snake envenomation is a common acute life-threatening medical emergency. WHO (World Health Organization) described this health hazard as neglected disease in South East Asian region.<sup>1</sup> It is a preventable public health hazard often faced by rural population in tropical and subtropical countries with heavy rainfall and humid climate. The renal injury from the vasculotoxic snake bite is the most significant reason for the morbidity and mortality associated with the snake bite.

These renal manifestations have been reported with varying frequency in different studies. Information on the precise incidence in different geographic regions is lacking but obviously varies with the distribution of the viper like snake bites. Overall, about 20% of patients with snake bite, develops acute kidney injury leading to significant morbidity and mortality.<sup>2</sup>

The acute renal failure following snake bite is multifactorial<sup>3</sup>–

- i) Severe and persistent hypotension leading to acute tubular necrosis,
- ii) Hb and myoglobin deposition in renal tubule from haemolysis and rhabdomyolysis
- iii) DIC and vasculitis
- iv) acute diffuse interstitial nephritis
- v) extra capillary proliferative glomerulonephritis.

Most of the patients of acute tubular necrosis recovers by few weeks with the help of occasional need of hemodialysis but who develops cortical necrosis requires renal replacement therapy on a long-term basis.<sup>4</sup>

It is the hyperkalemia rather than elevated urea, creatinine that requires dialysis. The hyperkalemia of snakebite AKI is a hypermetabolic hyperkalemia, which may kill the patient within few minutes and calcium gluconate and glucose insulin is mostly ineffective. Early treatment with ASV can reverse the deterioration of renal function.<sup>4</sup>

There is variable opinion regarding efficacy of FAD (Forced Alkaline Diuresis) in hemotoxic envenomation to prevent AKI and its consequences. WHO has not



mentioned FAD as essential in the standard treatment protocol for snake bite management guideline due to paucity of data. Standard Treatment Guideline 2016 by Ministry of Health and Family Welfare has however demonstrated FAD protocol for specific patients.<sup>5</sup>

### Forced Alkaline Diuresis (FAD)<sup>5</sup>

In a hemotoxic snake bite if patient develops oliguria or dipstick positive for blood give a trial of FAD within first 24 hours may be tried to avoid pigment nephropathy leading to acute tubular necrosis (ATN). Delayed FAD has no role. Sequence of FAD in adults is as follows:

- i. Inj. Frusemide 40 mg IV stat
- ii. Inj. Normal saline 500 ml + 20 ml of NaHCO<sub>3</sub> over 20 minutes
- iii. Inj. Ringer's lactate 500 ml + 20 ml of NaHCO<sub>3</sub> over

20 minutes

- iv. Inj. 5% dextrose 500 ml + 10 ml of Potassium Chloride over 90 minutes
- v. Inj. Mannitol 150 ml over 20 min

Whole cycle completes within 2hr 30min and urine output of 3 ml/min is expected. If patient responds to first cycle, then to continue for 3 cycles. FAD usually converts oliguria into polyuria and avoids ATN. If there is no response to furosemide then FAD should be stopped and patient to be prepared for dialysis.

#### Benefits of FAD

Initial volume expansion is beneficial but we should always be cautious about not precipitating volume overload and subsequent pulmonary edema. Isotonic fluid is the preferred fluid for volume expansion.

In FAD urine pH is raised to above 6.5 which may diminish nephrotoxicity of heme pigments, precipitation of myoglobin and uric acid.

Mannitol may be beneficial causing diuresis which minimizes intratubular heme pigment deposition and cast formation and / or acting as a free radical scavenger, thereby minimizing tubular cell injury.<sup>6</sup>

The benefits of frusemide may be evident in the situation of volume overload associated with AKI.

#### Risk of FAD

FAD may precipitate pulmonary edema due to volume overload, if not monitored properly.

FAD may promote tubular calcium phosphate deposition promoting hypocalcemia.

Mannitol at first increases intravascular free water content which may cause volume expansion, hyponatremia and pulmonary edema in oliguric patients but in 2nd phase mannitol causes free water diuresis may cause volume depletion, hypernatremia, hyperosmolarity.

Frusemide may worsen hypocalcemia, since it induces calciuria and may increase the risk of cast formation.

One unpublished prospective intervention study took place in Bankura Sammilani Medical College Hospital Medicine indoor from May 2019 to October 2020 (18 months). 37 Patients with history of hemotoxic snake bite with sign of local toxicity/ haematuria/ unclotted 20 min WBCT (whole blood clotting time)/ oliguria were included in the study and received FAD. Renal outcome was compared with controls (who were not treated with FAD), taken from historical data collected from Record section. Total 14 patients out of 37 developed AKI in FAD group i.e., 37% whereas 33 patients out of 42 developed AKI in non-FAD group i.e., 78%.

There are very few studies on the role of force alkaline diuresis in hemotoxic snake envenomation in preventing AKI. In a prospective study by Pratik Giri et al. in 2009, 8 patients of hemotoxic snake bite received FAD along with anti-snake venom and none of them developed AKI.<sup>7</sup>

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**Dr Surajit Giri**

Anaesthesiologist Demow CHC Sivasagar, Assam

India is World's 'Snakebite Capital' with 2.8 million bites a year with 35,000–50,000 people dying per year according to World Health Organization (WHO) [1,2]. Lack of a coordinated comprehensive care in snake bite management is the key factor of highest numbers of deaths and morbidity in India.

Comprehensive care is a planned coordinated preventive, promotive, curative, mental & socioeconomic care to snake bite victims.

#### Why India needs a comprehensive care?

1. Lack of awareness amongst public.
2. Majority attended faith healers [3,4].
3. Poorly trained health care workers (HCW) in rural districts [5,6]. Fear of HCW to administer ASV (Anti snake Venom).
4. Poor transportation system to hospital.
5. Delayed ASV administration [7,8] 6. Nonavailability of ASV
7. No support to victim's family due to huge financial burden [9], if treatment is prolonged.
8. No address to mental issues post snake bite [10]
9. It is not approached as acute emergency.
10. Myth that snake bite cases can be treated only in tertiary center.

India has huge gaps from prehospital, point of source hospital, secondary care hospital to Government level. For effective treatment of snake bite victims, we should have an organized care system.

Prehospital management: Venom Response Team (VRT)

Prehospital management is greatly neglected in India due to lack of education of our society. After snake bite our public completely lost and often misled. A VRT can be constructed to guide snake bite victims in each gram panchayat level comprising gram Sevak, local organizations & ASHA workers. They can be trained so that they can activate, communicate HCW & can transfer victims safely to nearest hospital. It is the need of the hour.

Our effort towards comprehensive care in snake bite in Upper Assam

It is true that public and society have to rush to hospital

## A Comprehensive Care Model of Snakebite in India

once there is any snake bite. If they don't rush to hospital

immediately, morbidity and mortality couldn't be prevented at all. So, our model starts from public/society and ends in Government.

#### A. Public awareness & Education is the key. How we did it?

We have to take help of 3Ps. Public, Press & Politician. Now a days, digital platform is the best to reach out many within

short span of time. We have to publish our own successful stories in our own local language in various digital formats. Facebook and what's app is the most popular digital media in various nook and corners of India, we should post our success stories of venomous snake bite treatments with photographs and address of the victim (with their written informed consent) (Fig1). Let public know that snake bite means hospital admission. Make them believe that there is a full proof medical management of venomous/nonvenomous snake bite in India. We have also participated in Television talk show (Fig2) and Radio talk (Fig3) show campaigning for hospital admission immediately after snake bite.

We have formed a what's app group with our general public. The name of our group is SNAKE: Public awareness group (Fig 4). It works like VRT. Every small community should have such group. We are readily accessible, and we came to know any snake bite incident in our local area, who are immediately transferred to nearby hospital.

On 29th September 2019, we have conducted a



Fig1: Facebook

Fig 2: TV

Fig 3: Radio



scientific CME about snake bite with our local public and General Practitioners (Fig 5). We have trained general public along with doctors, paramedical staff & ASHA workers.

**B. Strengthening the health care system**

We have interviewed 100 victims of snake bite. We found all had full faith on local healers and they believed there is no medical treatment in snake bite. Few of them reached nearest hospital at the earliest but soon referred from one hospital to other and died in the ambulance itself. Many hospitals had ASV but did not administered due to possibilities of litigation and fear. Few had expired ASV, and many hospitals did not have the ASV at all. We have also witnessed nearby hospitals were 100-200 km apart and, in some places, transportation was also not feasible. We have to strengthen our primary (PHC) and community health Centre (CHC). It is true that bites from Cobra and

Russell's vipers, we may not get time. From 0hrs-3hrs, patient may develop fast neurotoxic symptoms. People staying in remotest village and transfer such victims to district hospital may kill these groups of patients. Point of source identification (at PHC and CHC level) of venomous snake bite symptoms and administration of ASV (and neostigmine in neurotoxic) will definitely prevents many deaths in India.

Even if patients come late to hospital with full blown neurotoxic symptoms to a PHC, our HCW should be educated and trained enough for simple maneuver like bag and mask ventilation and transfer with ASV.

We suggest every PHC/CHC should have snake bite room and SOP of snake bite treatment. Snake bite room is an organized room where all medications including ASV are kept, so that we can readily administer if required. Big display (photos) of venomous snakes of the local area should be there, so that patients can identify the snake who bitten him (Fig 6,7,8).

**C. Involving Government and policy makers**

Without involving Government and policy makers it is near impossible to solve the problem. We have repeatedly requested our government and policy



Fig 4: WA group with public Fig 5: CME with public

makers and we have suggested followings to Government and policy makers. We will soon meet our Chief Minister in this regard.

1. One class should be included in MBBS curriculum especially in 5th year (last year) of MBBS training. This class should be taken by a physician who is regularly treating a snake bite victim and by a herpetologist, as geographically some snakes are not available in some parts of India. Notably Saw scaled viper and Russel Vipers are not available in Assam. But some parts of lower Assam may have some Russel Viper. After passing out of MBBS and internship, they will do compulsory rural posting in different rural health centers, as per Government bond. If we can train/teach them at MBBS level, the fear to handle snake bite victims will be less at point of source (PHC/CHC level). If we start treating victims at PHC/CHC level, many mortalities and morbidity will be prevented. We have observed that emergency departments are run by just passed out Interns and as they are not trained in this subject, many a time they miss early clinical symptoms, causing unfortunate deaths. Therefore, a class at last year of MBBS will greatly help them to train in the subject.
2. All Government Hospital should have a dedicated snake bite room.
3. Yearly update of HCW about snake bite management.
4. Referral to higher center should be stopped unless indicated.
5. Snake bite victims should be approached as acute medical emergency, like road traffic accident.

With our continued request, we are happy that Government of Assam is going to organize a webinar on snake bite in month of July itself. Government will order it as compulsory attendance to all Doctors working in PHC & CHC. We will share our experiences of treatment of venomous snakes in CHC level. It will definitely enrich our doctors and encourage them to start snake bite treatment at point of source level.



Fig: 6,7,8 our snake bite room in Demow CHC

### Our Suggested comprehensive model in India

Any snake bite incident, report to local VRT. Team will provide prehospital management and transport.

Communication and activation of trained HCW in nearby hospital. Point of source HCW assesses the situation, treats there & if needed transfer to nearby ICU with bag & mask ventilation and ASV (for neurotoxic bite). Communication activation of tertiary care Centre by Primary/Secondary center. Government aids to these victims if treatment is prolonged, e.g., need of plastic surgery/amputation etc.

Follow up of these victims both by physician and psychiatrist at least for 6month.

As of now Indian clinicians are treating snake bite victims with SYNDROMIC approach. Clinicians have to wait for symptoms to develop. If our scientists can find a venom

detection kits, it will be paradigm shift in future in snake bite management in India.

### Conclusion

A comprehensive model for snake bite treatment in India starts from public, society, different social organizations, different electronic & print media, strengthening our health care systems & manpower from PHC level and willingness of our policy makers and Government. We all have to work as a unit, then only we can prevent many preventable deaths from snake bite.

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**Dr. Syamal Kundu**  
Professor, Department of Medicine  
BSMC, Bankura

## Small molecule in snake bite – A new hope

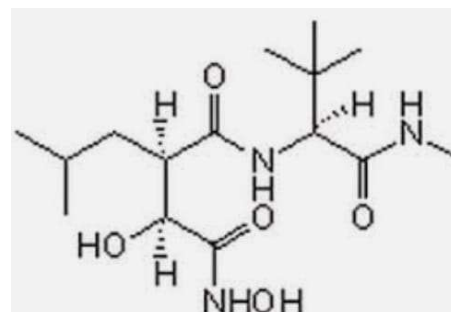
### Introduction: The need for a new therapeutic approach

Snake bite continues to be a significant health hazard in south - east Asian countries since last decade. WHO (SEARO) enlisted this problem as neglected tropical disease in order to focus global attention towards a substantial change in outcome. The two most common predictive factors of poor outcome of snake envenomation as identified in most of the observations are Bite to anti snake venom time (BAT) and efficacy of Anti snake venom (ASV). Minimizing BAT to 1 hour is an ideal goal than reality in India and is related to overall socio- cultural and economic development of the country. The other arena of scientific work is therapeutics. Needless to say that the best approach to treat snake envenomation is prevention of venom to act on tissues rather than to treat the manifestations of tissue damage. ASV is the only treatment available for snake envenomation that can neutralize venom in circulation. National STG 2017 for management of Snake bite in India has recommended use of Polyvalent ASV for envenomation by big four ( cobras -krait- Russell viper, and saw scaled viper and King cobra ). Use of ASV carries high risk of life threatening anaphylactic or anaphylactoid reaction. The drug is not available in the point of event and requires healthcare set up for storage and administration. Some snake species are inherently resistant to Indian polyvalent ASV; some are partially resistant. It has been reported in many studies that efficacy of Indian polyvalent ASV is not uniform across geographical areas for a given species . Moreover this polyclonal antibody is difficult to manufacture and hence costly.

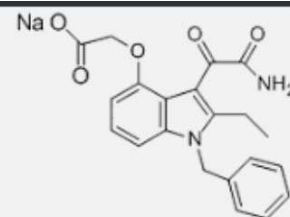
### Venom components: targets of drug development

Snake venom is a mixture of multiple active chemicals including protein, enzymes and minerals that can damage human tissues either through its toxic effects or by utilizing body's own physical functions.

Snake Toxins that is commonly implicated in pathogenesis are snake venom Phospholipase A2 (SVPLA2), Zn dependent snake venom metalloproteinases ( SVMP) , 3 finger toxin ( 3FTX) and Snake venom serine proteases ( SVSP) . SVPLA2 with its several isoforms are found in Kraits, cobras and vipers. The enzyme gets actively associated with presynaptic membrane and is internalized. It causes damage of acetyl choline granules in presynaptic axonal bulb. SVMP and SVSP inhibit action of coagulation factors II, VII, 1X, X leading to coagulopathy. They also produce procoagulant state, acute kidney injury, ARDS and tissue necrosis. Researchers showed maximum interest to these 3 components of snake venom and tried to inhibit those enzymes by repurposed molecules which failed to show benefit in their original fields. Varespladib (and Verespladib Methyl) was initially developed for treatment of coronary artery disease (CAD). It was subsequently

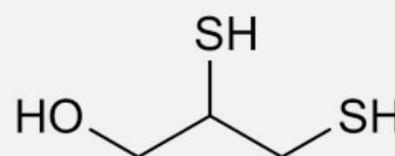


Marimastat - CAS 154039-60-8 ...



Varespladib Sodium, Water Soluble  
99.9% Purity, in vivo grade

Varespladib Sodium (LY315920...



Dimercaprol - Wikipedia  
en.wikipedia.org





demonstrated as potent inhibitor of SVPLA2. Synthetic Peptidometric hydroxamate - Batimastat and Marimastat initially developed for cancer therapy was repurposed to inhibit SVMP. Dimercaprol (British antileusite) and DMSO can chelate Zn and antagonise action of SVMP. SVSP was seen to be inhibited in vitro by Nafomastat. All these drugs have been approved for phase III clinical trials. Venom components: targets of drug development

Snake venom is a mixture of multiple active chemicals including protein, enzymes and minerals that can damage human tissues either through its toxic effects or by utilizing body's own physical functions.

Snake Toxins as found that is commonly implicated in pathogenesis are Phospholipase A2 (SVPLA2), Zn dependent snake venom metalloproteinases (SVMP), 3 finger toxin (3FTX) and Snake venom serine proteases (SVSP). SVPLA2 in several isoforms are found in Kraits, cobras and vipers. The enzyme gets associated with presynaptic membrane and is internalized. It causes damage of acetyl choline granules in presynaptic axonal bulb. SVMP and SVSP are associated with coagulopathy, procoagulant state, acute kidney injury, ARDS and tissue necrosis. In last ten years the researchers showed maximum interest in these 3 components of snake venom and targeted these enzymes by repurposed molecules which failed to show benefit in their original fields. Varespladib (and Verespladib Methyl) was initially developed for treatment of coronary artery disease (CAD) was discovered as potent inhibitor of SVPLA2. Batimastat and Marimastat – the Peptidometric hydroxamate, were initially developed for cancer therapy and finally repurposed to inhibit SVMP as they failed to exhibit efficacy in cancer. Dimercaprol (British antileusite) and DMSO can chelate Zn and antagonize action of SVMP. SVSP was seen to be inhibited in vitro by Nafomastat. All these drugs have been approved for phase II clinical trials.

#### **Efficacy and of small molecules : Clinical trials**

There is an unmet need for an alternative treatment of snake bite that is available at the spot and deliverable immediately after a bite. The proclaimed molecule must show pan – species efficacy across the geographical extent. The therapy should be well tolerated and should not have major adverse reactions. Oral bioavailability and tissue distribution should be fitting to venom action. Varespladib, Marimastat and DMSO are the new small molecules that confirm most of these required criteria and showed promising results in phase II trials. Each of the molecules exhibited good efficacy and tolerability in prehospital management animal models.



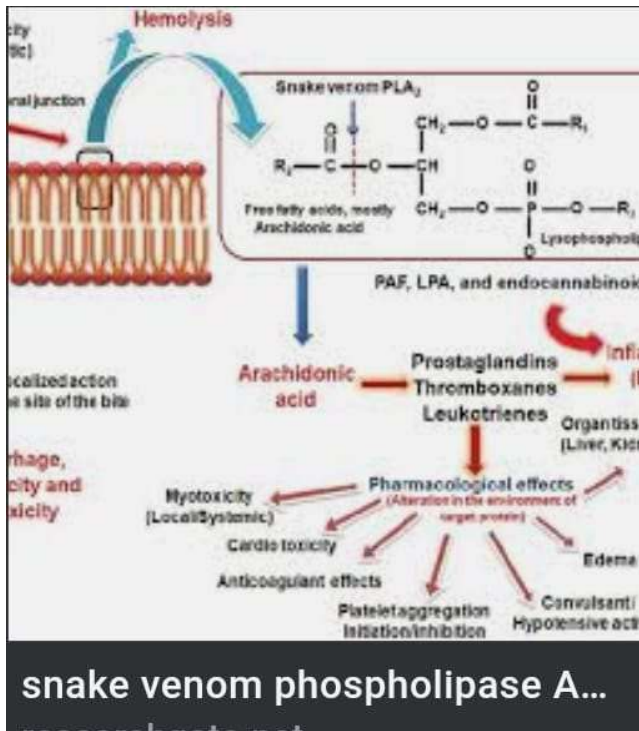
Combinations of Marimast with DMSO and Varespladib demonstrated superior efficacy in hemotoxic envenomation including Russell's viper and Saw scaled viper of India. These new molecules also showed improved preventive action when used with ASV. Tripple combination with ASV, Miramastat/ DMSO and Varespladib revealed augmented antivenom action as compared to solo regime or double combination in animal studies.

#### **Verespladib and Varespladib Methyl ( oral ) :**

The drug was originally investigated for treatment of coronary artery disease. It failed to exhibit expected efficacy in phase III clinical trial. The drug was repurposed to preclinical management of envenomation by Elapid and some Viperides. The drug inhibits SVPLA2 toxins which is implicated in presynaptic neurotoxic effect, coagulopathy and lethality of snake venom. Oral bioavailability is good; Half life (T<sub>1/2</sub>) in intravenous dose ( human equivalent 33.6 mg for 70 kg) is 5 hours. The drug has been approved for Phase III clinical trials and showed no serious toxicity in mice models. Efficacy to inhibit SVPLA2 is found to be generic across snake species and countries. Combination with polyvalent / monovalent ASV and other small molecules is additive / synergistic.

#### **Marimastat -**

Batimastat and Marimastat were developed in oncology utilizing their inhibitory action on Matrix Metalloproteinases (MMP). Development of Batimastat was dropped due to unparallel efficacy of Marimastat in phase II trials. SVMP shows structural similarity with MMP. Thus the drug Marimastat was repurposed in the field of snake bite. The drug has



shown remarkable efficacy against coagulopathy, procoagulant action, tissue necrosis and lethality caused by viperine venom excluding pit vipers. The drug is orally active with good bioavailability at human equivalent dose of 33.6 mg for 70 kg and the T<sub>1/2</sub> is 4 hrs. No major adverse effects have been documented. Considerable efficacy was exhibited in phase II trials against variety of viper species and Cobra venom causing coagulopathy. Combination with other small molecules as well as ASV demonstrated improved prevention. The drug has received approval for phase III clinical trial.

**Dimercaprol and DMSO-**

These drugs were licensed for treatment of heavy metal poisoning. DMSO / Dimercaprol can inhibit SVMP by chelating Zn in circulation. The drug showed promising results in phase 2 clinical trials both alone as well as in combination with other therapeutics. Pharmacokinetic and pharmacodynamic profile of DMSO is similar to that of Marimastat. The drug received approval for phase III clinical trial.

**Nafomastat-**

This drug was designed for trial in snake envenomation. It inhibits SVSP of saw scaled and Viper species. The drug is available in Intravenous formulation only. It has short T<sub>1/2</sub> (4 min). In phase II trials the drug exhibited detrimental off target effect. Hence the drug lost approval for further clinical trial.

**The future of small molecules in treatment of snake bite:**

The search for alternative therapeutic to mitigate lethality of snake envenomation is very much justified and to be considered as action of the hour. Small molecules have shown promising results in animal experiments. They have created enormous hope of better outcome. These molecules have emerged as point of care treatment applicable in prehospital condition and relatively safe as compared to ASV. The beauty of these molecules in therapeutics of snake bite is its spectrum of action against snake species.

The ease of administration and safety profile have broadened applications of these molecules by several stakeholders like social activists, herpetologists and semi-trained doctors. The remaining challenges scientists and drug developers to encounter are primarily technical and include stability of drug, finding appropriate dose, drug interactions, use in special groups, long term adverse effects, oncogenicity cost and availability. We may foresee an assiduous change in therapeutics of snake bite in near future.

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### Dr. Saptarshi Chatterjee MD( FSM)

Associate Prof., Dept. of Forensic Medicine & Toxicology, BSMC, Bankura

**Introduction:** Snakebite is a public health problem, causing an estimated 94,000 deaths annually, around the world(1). According to the most conservative estimates, at least 81,000 snake envenoming and 11,000 fatalities occur in India each year, making it the most heavily affected country in the world. Most of the snakebite deaths reported was due to delay in giving anti-venom or non-availability of species specific anti-venom and the relatives of deceased allege against doctors for their negligence(2). Forensic pathologist is expected not only to give the cause of death, but also to give opinions about potential negligence in such cases.

Medicolegal cases (MLC) are an integral part of medical practice. The occurrence of MLCs is on the increase. Proper handling and accurate documentation of these cases is of prime importance to avoid legal complications and to ensure that the Next of Kin (NOK) receive the entitled benefits.

#### **General Guidelines in handling Snakebite cases as Medicolegal issues:**

- a. In emergencies, resuscitation and stabilization of the patient will be carried out first and medicolegal formalities may be completed subsequently. The consent for treatment is implied in all emergencies.
- b. Hospitals will maintain a MLC register and the MLC will be initiated and documented in the register. Personal particulars, identification marks and particulars of the person accompanying the patient will also be noted.
- c. Medicolegal documents should be prepared in duplicate, preferably written with a ball point pen and avoiding abbreviations and to be preserved with utmost care in the Medical Record Section of the concerned hospital.
- d. The police should be informed as per Section 39 Criminal Procedure Code. Any failure to report the occurrence of MLC may invite prosecution under Sections 176 and/ or 202 of Indian Penal Code.
- e. In case of discharge/ transfer/ death of such a case in the hospital, the police should be informed.
- f. No cause of death will be mentioned in the death certificate. The statement that "Exact cause is to be ascertained by postmortem examination" is to be endorsed.
- g. In MLCs, the body will not be handed over to the NOK/ relatives. The police will be informed, who

## Medico-Legal aspects of Snake Bite

after medicolegal formalities, will hand over the body to the NOK/ relatives.

Guidelines to be observed during postmortem examination:

1. The autopsy surgeon should proceed for the postmortem examination, only after receiving the following articles from the police:-
  - a. Inquest report; b. Requisition for carrying out the postmortem examination; c. Dead body challan
2. The dead body should be identified before the autopsy surgeon by the accompanying police, whose name, number and place of posting, should be mentioned in the report.
3. The doctor should take utmost care in preserving the following:-
  - a. Stomach along with its contents
  - b. First 30 centimeters of intestine
  - c. At least 500 grams of liver
  - d. Longitudinal halves of each of the kidneys
  - e. Skin from and around the bite mark
4. The doctor should handover the preserved articles to the accompanying police after proper packing, sealing, labeling and signing for onward transmission to Forensic Science Laboratory.
5. The doctor shouldn't wait for the Chemical Examiners' report to help the NOK getting the entitled benefits by giving his opinion in the postmortem report.
6. The final opinion in the postmortem report may be placed as "Death was due to the effects of Poisonous Bite, features being consistent to that of snakebite, further opinion, if any, will be given after receipt of chemical examiners' report."

**Conclusion:** The way the medicolegal issues will be handled will have a profound impact on the public image of the hospital. So, MLCs must be handled tactfully by the medical officers. The administrative authorities must also help in maintaining goodwill and avoiding legal complications. It is hoped that this collation of directives on handling of medicolegal issues will act as a safeguard against procedural lapses & maintain the elite image of the doctors.

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**Dr Olivia Bhattacharya**

Resident, Department of General Medicine  
Medical College Kolkata

# Quiz

- 1) **The most important venomous snakes found in India which are referred as The Big Four includes?**
  - a) Spectacled Cobra
  - b) Russell's Viper
  - c) Common Krait
  - d) All of the above
- 2) **Which is not true for a poisonous snake?**
  - a) Elliptical pupil
  - b) Pits on head
  - c) Divided anal plate
  - d) All of the above
- 3) **All of the following snakes are neurotoxic except?**
  - a) Spectacled Cobra
  - b) Common Indian krait
  - c) Sindh krait
  - d) Russell's Viper
- 4) **Which of the following is NOT included in Prehospital management of snake bite?**
  - a) Reassurance
  - b) Immobilization of patient
  - c) Visit nearest hospital immediately
  - d) Application of a tight tourniquet over bite site
- 5) **All are common clinical features of Russell viper bite except?**
  - a) Mucosal bleeding
  - b) Ecchymoses
  - c) Reduced urine output
  - d) Ptosis
- 6) **Treatment options for snake bite includes?**
  - a) Atropine and Neostigmine
  - b) Anti snake venom(ASV)
  - c) Corticosteroids
  - d) All of the above
- 7) **Indications for hemodialysis in Vasculotoxic snake bite are all except?**
  - a) Refractory acidosis
  - b) Volume overload
  - c) Hyperkalemia unresponsive to therapy
  - d) Urine output around 1 litre/day
- 8) **Newer drugs being developed in the management of snake bite include?**
  - a) Nofomastat
  - b) Verespladib
  - c) Dimercaprol and DMSO
  - d) All of the above
- 9) **In case of death from snake bite and preservation of viscera which statement is incorrect?**
  - a) Stomach along with its contents are to be preserved
  - b) First 30cms of intestine to be preserved
  - c) Skin from around bite mark to be preserved
  - d) At least 200gms of liver to be used
- 10) **Essential step in preventing snake bites include?**
  - a) Avoid garbage accumulation
  - b) Regular cleaning of gardens and school premises
  - c) Refurbishment of dilapidated buildings with multiple burrows
  - d) All of the above

Send your answers to: The Hony. Editor, Your Health of IMA (email: [yourhealthofima@gmail.com](mailto:yourhealthofima@gmail.com))  
The first three correct respondents shall be honoured with surprise gifts.

### Answers of June 2021:

1) d    2) d    3) a    4) a    5) a  
6) c    7) a    8) d    9) d    10) d

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Sir Nilratan Sircar IMA House

53, Sir Nil Ratan Sircar Sarani,

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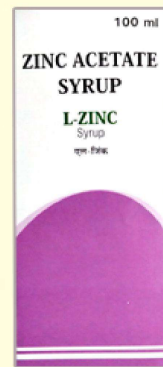
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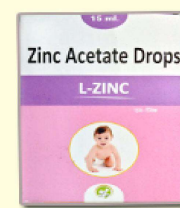
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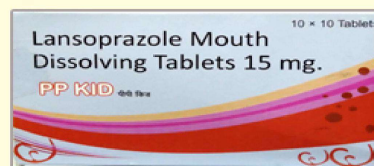
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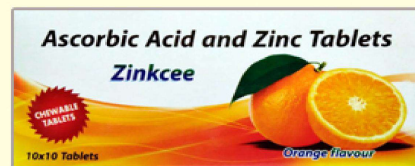
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