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A Review: Snake Bite

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Abstract: ***With millions of victims each year and high rates of morbidity and mortality, snake bites are a serious but little-known public health issue, especially in tropical and subtropical areas. Numerous clinical symptoms, such as local tissue necrosis, coagulopathy, neurotoxicity, renal failure, and, in extreme cases, death, can arise from poisonous snake envenomation. The snake species and the venom's makeup have a significant impact on the kind and intensity of symptoms. Effective management requires accurate identification, timely antivenom administration, and prompt first assistance. Rural communities have long employed a variety of herbal and traditional medicines in addition to conventional care, yet little is known about their clinical effectiveness. Programs to lower the death rate from snake bites have been started by the World Health Organization (WHO) and a number of national governments. These initiatives include better access to antivenom, healthcare training, and public education. The species and categorization of venomous snakes, the pathophysiology and composition of snake venom, clinical characteristics, diagnostic techniques, and current treatment protocols—including the use of antivenom therapy—are all covered in this overview. Future research directions, government and WHO activities, and the role of traditional medicine are also examined. The necessity of creating broad-spectrum antivenoms, better diagnostic instruments, and community-based awareness campaigns is emphasized. In order to combat this neglected tropical illness and meet WHO' s target of halving the global burden by 2030, multidisciplinary approaches integrating contemporary medicine, traditional knowledge, and international cooperation are essential.***

Keywords: ***Snake bite, Antivenom, Envenomation, Traditional medicine, WHO initiatives***

I. INTRODUCTION

Particularly in tropical and subtropical areas where snake-human interactions are common, snake bite is a serious but frequently disregarded public health concern. It is regarded as a medical emergency that, if left untreated, can result in serious morbidity and fatality. As a Neglected Tropical Disease (NTD), snake bite envenomation affects millions of people each year, resulting in between 81,000 and 138,000 fatalities and over 400,000 survivors who are permanently disabled, according to the World Health Organization (WHO). Because of underreporting, particularly in rural and economically deprived regions, the real incidence is probably underestimate[1-2].

Nearly half of all envenomation deaths worldwide occur in India, making it one of the nations most impacted by snake bites. The bulk of potentially fatal bites are caused by the so-called "Big Four" poisonous snakes of India: saw-scaled viper, common krait, Indian cobra, and Russell's viper. If treatment is delayed, the extremely poisonous venom of these snakes can result in serious systematics symotoms such paralysis ,bleeding , renal failuare and in many cases death.[3-4]. Venomous bites, in which lethal venom is injected into the body, and dry bites, in which venom is not injected, are the two main types of snake bites.

Even though antivenoms, the only targeted treatment for snake envenomation, are readily available, a number of obstacles prevent efficient management. These include problems with the delivery and storage of antivenoms, poor training of medical staff, a lack of knowledge among the general public, and restricted access to healthcare institutions in remote areas. The patient's prognosis is further deteriorated by traditional beliefs and reliance on untested local medicines, which frequently postpone medical appointments[5-6].

Effective diagnosis and therapy depend on an understanding of the pathophysiological pathways triggered by snake venom, its composition, and the resulting clinical symptoms. Depending on the species, snake venom, which is a complex combination of proteins, peptides, and enzymes, can be myotonic, cytotoxic, hemotoxic, or neurotoxic. Because of this, the clinical symptoms can range greatly, from localized pain and swelling to systemic symptoms such acute renal failure, respiratory paralysis, or disseminated intravascular coagulation (DIC) [7-8]. A thorough understanding of snake bites, including the different kinds of venomous snakes, the mechanisms of envenomation, clinical characteristics, diagnostic techniques, first aid procedures, and treatment protocols, as well as preventive measures and international initiatives to lessen the burden of this often ignored but potentially fatal illness, is what this review seeks to provide. In order to ensure prompt and efficient care of snake bites globally, special attention will also be paid to the difficulties in antivenoms therapy, continuing research, and the necessity of community education[9-10].

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II. TYPES OF SNAKES AND CLASSIFICATION

Snakes are limbless reptiles that are members of the Serpentes suborder. They may be found in a broad range of environments, including forests, grasslands, marshes, and deserts. Only 15% of the 3,000 or so snake species that exist in the world are venomous, and even fewer are dangerous to human life. Grasp the medical relevance of snake bites, particularly with regard to the composition of venom and its clinical consequeces requires a grasp of snake taxanomy. In general, snakes may be divided into two groups: venomous and non-venomous. While venomous snakes employ specialized venom glands and fangs to inject venom into their prey or in defence, non-venomous snakes often kill their prey via constriction or by simply swallowing tiny prey whole[12].

A. Snakes that aren't poisonous

The vast majority of snake species are non-venomous. They don't inject harmful venom, although they could bite in self-defense. These comprise species such as boa constrictors, pythons, green vine snakes, and rat snakes. Although their bites are seldom fatal, they can nonetheless result in discomfort, illness, or allergic responses. They are essential to the ecological management of rats and other pests.

B. Poisonous Snakes

Venomous snakes are further classified into families based on their fang structure, venom composition, and behavioral traits. The three major families of venomous snakes of medical importance are:

1) Elapidae

Snakes in this family have strong neurotoxic venom that mainly damages the nerve system and small, fixed front fangs.
For Instance, the Indian cobra (Naja naja) (Bungarus caeruleus) common krait (Ophiophagus hannah) King cobra Snakes of coral
Venom action: If left untreated, neurotoxins can cause paralysis, breathing failure, and occasionally even death by interfering with nerve signal transmission[14-15].

2) The Viperidae

When not in use, the long, hinged fangs of these snakes may be folded back. Their venom predominantly affects blood vessels and coagulation, making it hemotoxic.
For instance: the Davidia russelii, or Russell’s viper
Viper with saw scales (Echis Cearinatus)
Viper of pits
Venom action: Results in kidney injury, hypotension, tissue necrosis, haemorrhage, and coagulopathy. Particularly, the Russell's viper is infamous for inflicting severe renal damage and extensive bleeding[16]
Sea snakes (Hypphiidae): Sea snakes inhabit coastal seas and are extremely deadly. They have powerful, myotonic venom that damages muscular tissue and their tails are paddle-shaped.
Venom action: Leads to kidney damage, paralysis, and muscular breakdown (rhabdomyolysis). However, because they are not aggressive, human bites are uncommon.

C. The Colubridae

There are both slightly poisonous and non-venomous snakes in this huge family. Although the venom of certain colubrids is present, it is often not dangerous to people[17-18].

III. COMPOSITION OF SNAKE VENOM

A complex combination of physiologically active proteins, enzymes, peptides, and toxins, snake venom has distinct effects on the body of its victim. It usually contains neurotoxins, hemotoxins, cytotoxins, and myotoxins, however the exact composition varies from species to species. Proteases, phospholipase A2, hyaluronidase, and other enzymes aid in tissue destruction and venom dissemination. Whereas hemotoxins hinder blood coagulation and result in internal bleeding, neurotoxins interfere with nerve signal transmission, causing paralysis. Myotoxins harm muscle fibres, whereas cytotoxins kill cells and tissues. Venom's varied biochemical makeup allows it to immobilize prey and start digestion, but it also poses major health hazards to humans who are envenomated[19-20].

IV. PATHOPHYSIOLOGY OF SNAKE BITE

The kind and makeup of the venom, the dosage, and the bite site all affect the pathophysiology of snake bite envenomation. The complex combination of proteins, enzymes, and toxins that make up snake venom can have cytotoxic, hemotoxic, neurotoxic, or myotoxic effects, leading to a variety of clinical symptoms.

By obstructing synaptic transmission at neuromuscular junctions, neurotoxic venom, which is frequently found in elapid snakes Like cobras and kraits, attacks the neurological system. Progressive muscular weakness, ptosis, breathing difficulties and in extreme situation, respiratory paralysis and death, result from this. The coagulation cascade is disrupted by hemotoxic venom, which is characteristic of vipers like saw-scaled vipers and Russell's vipers. It may result in hematuria, hypotension, disseminated intravascular coagulation (DIC), and spontaneous bleeding.

Capillary leak syndrome and multi-organ failure, especially acute kidney injury (AKI) from direct nephrotoxicity and hemolysis are also brought on by endothelial damage. Local tissue damage, blistering, necrosis, and swelling are all brought on by cytotoxic components. If left untreated, it may lead to amputation or lifelong disability as well as subsequent infections. Myotoxic venom, which is frequently found in sea snakes, causes rhabdomyolysis, or the breakdown of muscles, which releases myglobin into circulation and may result in renal failure, The clinical picture is further complicated by systemic envenomation, immune-mediated reactions, and inflammatory responses. Symptoms may appear minutes to hours after the bite, which highlights the significance of prompt treatment.Anticipating problems and directing proper medical therapy, such as the administration of antivenoms and supportive care, need an understanding of the pathophysiology[21-23].

V. CLINICAL MANIFESTATIONS

The kind of snake, the kind and quantity of venom administered, and the victim's reaction to envenomation all affect the clinical signs and symptoms of a snake bite. After the bite, symptoms usually appear minutes to many hours later. Immediate pain, swelling, redness, bruising, and even blistering or necrosis at the bite site are examples of local symptoms. The significant local damage caused by cytotoxic bites may result in subsequent infections or compartment syndrome.

Sytematic symptoms vary depending on the kind of venom and are more severe: Drooping eyelids (ptosis), swallowing difficulties, impaired vision, slurred speech, and progressive respiratory paralysis are all symptoms of neurotoxic envenomation (e.g., cobra, krait), which can be lethal without ventilatory care.

Hemotoxic envenomation, such as that caused by vipers, can result in coagulation problems, hematuria, hypotension, and spontaneous bleeding from the mouth, nose, or puncture sites. These symptoms frequently progress to disseminated intravascular coagulation (DIC).

Sea snakes and other myotoxic envenomation can cause acute kidney damage by generating muscular discomfort, weakness, and dark urine from rhabdomyolysis.

Fever, nausea, vomiting, stomach discomfort, lightheadedness, and shock are further examples of systemic symptoms. Multi-organ failure may happen in extreme circumstances, For a timely diagnosis, antivenom medication, and supportive care, early identification of these symptoms is essential[24-27].

VI. DIAGNOSIS

The primary clinical diagnosis of a snake bite is made using the patient's medical history, the snake's identity (if possible), and the symptoms that are now present. Fang marks, swelling, discomfort, bleeding, and neurological symptoms are important warning indications. A straightforward test at the bedside for evaluating coagulopathy, particularly in snake bites, is the 20-minute Whole Blood Clotting Test (20WBCT). Complete blood counts, coagulation profiles, renal function tests, and urinalyses are examples of laboratory testing. Respiratory monitoring is crucial in neurotoxic bites. Though medication is frequently started based on symptom pattern and intensity regardless of the precise species, identification of the snake species, when feasible, leads specialized treatment[28-29].

VII. FIRST AID AND EMERGENCY RESPONSE

When treating snake bites, prompt first aid is essential. To prevent the spread of venom, the sufferer should be calmed and comforted. Use a splint to immobilise the bitten limb, keeping it below the level of the heart. To make the situation worse, refrain from rushing, cutting the wound, swallowing venom, or using tight tourniquets. Applying chemicals or ice is not advised. Take off any tight clothes or jewellery that is close to the bite location. As soon as you can, take the patient to the closest medical institution. If it's safe, take note of the snake's appearance so you can identify it. Results are significantly improved by antivenom medication and early hospital intervention[30-31].

VIII. MANAGEMENT AND TREATMENT

Antivenom medication, supportive care, and quick assessment are all necessary for effective snake bite management. Vital signs are tracked and symptoms are assessed once at a medical facility to assess the extent of envenomation. The sole particular therapy is antivenom, which need to be given as soon as symptoms appear. Polyvalent antivenom is frequently used in India to combat the "Big Four" dangerous snakes.

Intravenous fluids, pain relief, tetanus prevention, and antibiotics in the event of an infection are all examples of supportive care. Respiratory care, including mechanical breathing, may be required in cases with neurotoxic bites. Blood transfusions, fresh frozen plasma and renel failure monitoring are critical for hemotoxi envenomtion.

After receiving antivenom, patients should be monitored for allergic reactions or anaphylaxis. In extreme situations, several dosages can be necessary. Until clinical symptoms subside and test values return to normal, ongoing observation is required. Mortality and complications are greatly decreased by prompt, adequate treatment[32-33].

IX. COMPLICATIONS OF SNAKE BITE

If not treated right after, a snake bite can result in a number of dangerous side effects. Acute kidney damage (AKI), respiratory failure, coagulopathy, and disseminated intravascular coagulation (DIC) are frequent problems. Limb abnormalities or amputation may be the consequence of local problems such tissue necrosis, gangrene, and compartment syndrome. Recovery may be made more difficult by sepsis, secondary infections, and antivenom-related allergic responses, such as anaphylaxis or serum sickness. Deficits in cranial nerves or persistent paralysis might result from neurological injury. Chronic pain, disability, and psychological trauma are examples of long-term effects. In order to reduce these consequences, early identification, efficient first aid, and suitable treatment are essential[34-35].

X. ROLE OF HERBAL AND TRADITIONAL REMEDIES

For millennia, people have utilized herbal and traditional medicines to cure snake bites, particularly in tribal and rural populations. Because of their anti-inflammatory, detoxifying, and enzyme-inhibitory qualities, plants such as Rauwolfia serpentina, Hemidesmus indicus, Aristolochia indica, and Andrographis paniculata are thought to possess anti-venom qualities. Nevertheless, there is little scientific proof of their effectiveness. These treatments should never be used in place of medical care, even if they could have supporting advantages. Reliance on traditional healers might cause delays in medical care, which can lead to poorer outcomes. To assess and standardize plant-based remedies for possible use into contemporary snake bite care, more investigation is required[36-37].

XI. GOVERNMENT AND WHO INITIATIVES

In 2017, the World Health Organization (WHO) designated snake bite as a Neglected Tropical Disease (NTD), acknowledging it as a public health concern. Through increased availability to antivenom, healthcare education, and public awareness, WHO hopes to cut the number of snake bite fatalities and disability in half by 2030. Governments have started initiatives to provide free antivenom, train rural health professionals, and set up procedures for managing snake bites, particularly in high-burden nations like India. There are also continuing public education and early hospital referral campaigns. In areas that are at risk, these initiatives seek to lower mortality, enhance treatment results, and boost readiness[38].

XII. FUTURE SCOPE OF STUDY

1) Broad-spectrum antivenom development research on antivenoms that are effective against a variety of snake species and have fewer adverse effects, whether they are region-specific or global.
2) Alternative to antivenom made from herbs and plants Herbal extracts with anti-venom qualities have been scientifically validated and formulated for use as adjunct or alternative therapy.
3) Better diagnosis instrument
   development of quick, point-of-care diagnostic tools to determine the kind and intensity of venom for more efficient, focused therapy.
4) Protenomic and genonic analysis of venoms thorough examination of the venom's composition utilizing cutting-edge omics technologies in order to comprehend processes and pinpoint new treatment targets.
5) Vaccines for snake bites:Investigation of vaccinations for high-risk groups, particularly in areas where the disease is prevalent.
6) Models of Community-Based Education and Surveillance:Creating efficient educational initiatives and online resources to increase awareness and enhance early detection in remote regions.

7) Artificial Intelligence in the Treatment of Snake Bite: AI is being used in healthcare contexts to identify snake species, forecast the severity of bites, and assist in decision-making[39-40].

XIII. CONCLUSION

Snake bites continue to be a serious but frequently disregarded public health issue, especially in tropical and rural areas with limited access to prompt medical care. Due to a lack of knowledge, postponed medical intervention, and insufficient healthcare infrastructure, snake bites continue to result in high rates of morbidity and fatality even though they are preventable and curable. Clinical signs and symptoms might range from localized swelling and necrosis to systemic consequences such neurotoxicity, coagulopathy, and renal failure, contingent on the snake species and venom type. Reducing complications and preserving lives requires early diagnosis, proper first aid, and timely antivenom delivery.

Even though contemporary medicine offers efficient treatment choices, some cultures still use traditional herbal treatments. After careful consideration, these ought to be verified by science and maybe combined with allopathic treatment. Snake bite deaths have decreased as a result of World Health Organization and national government initiatives, such as training, education, the free provision of antivenom; nonetheless, more work is required.

The creation of broad-spectrum antivenoms, quick diagnostic methods, and the promise of plant-based treatments must be the main areas of future study. Important aspects of managing snake bites include bolstering public health systems, increasing awareness, and guaranteeing that care is accessible in isolated locations.

Ultimately, to meet WHO' s goal of halving snake bite fatalities and disability by 2030, a multidisciplinary strategy integrating contemporary research, traditional knowledge, public health tactics, and international collaboration is necessary. The secret to turning snake bites from an ignored problem into a controllable hazard will be ongoing research and community involvement.

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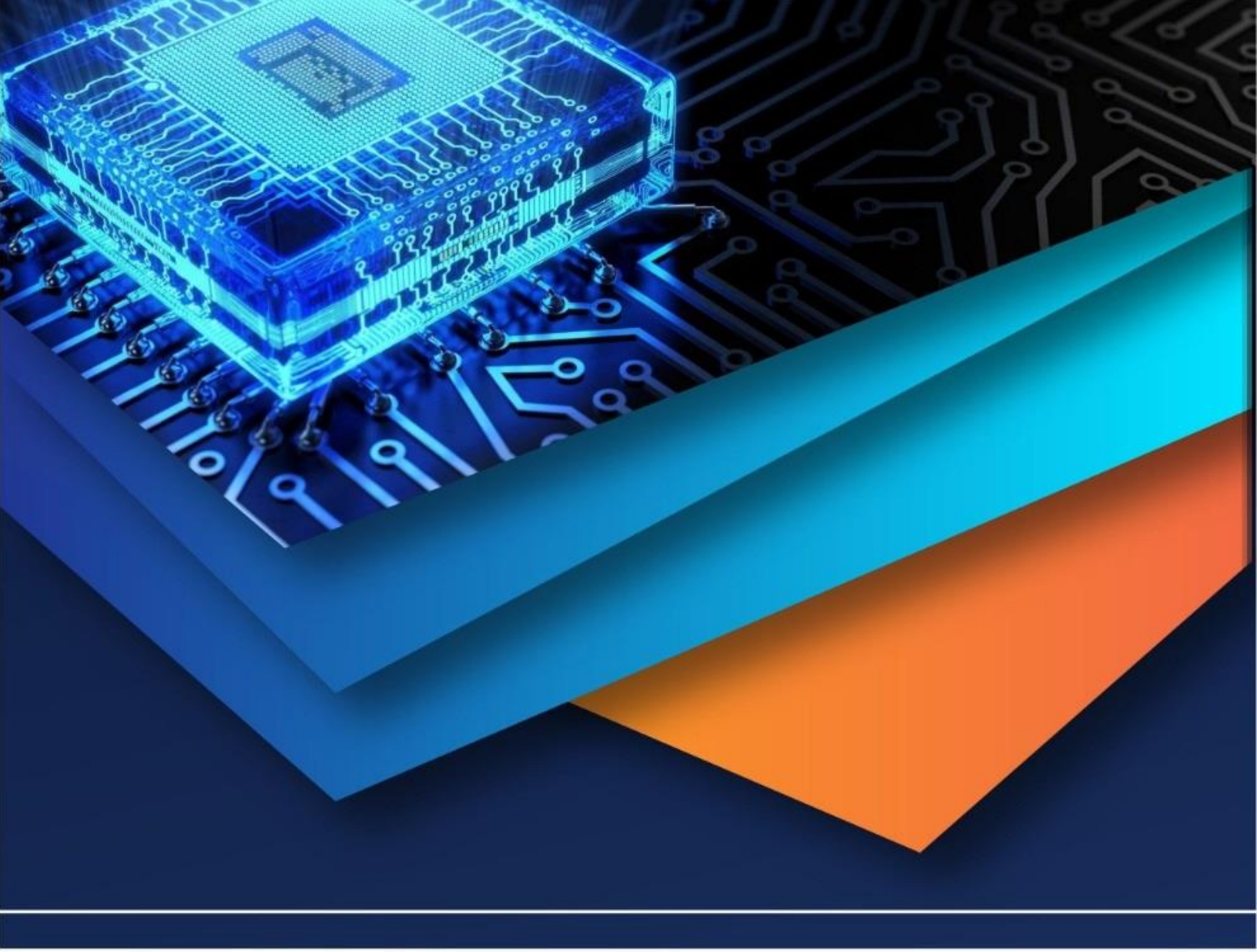

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