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Snake Bite in Adult: A Comprehensive Review

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ABSTRACT

Snakebite remains a significant medical emergency in many parts of the world, particularly in tropical and subtropical regions. Adults are frequently affected due to occupational and outdoor activities, leading to high morbidity and preventable mortality. This review summarizes the current concepts in the clinical presentation, diagnosis, and evidence-based management of snakebite in adults. The pathology of envenomation varies with snake species, resulting in vasculotoxic, neurotoxic, cytotoxic, or mixed clinical features. Early recognition, prompt first aid, rapid transport, and timely administration of appropriate Anti-Snake Venom (ASV) remain the cornerstones of management. Supportive care including hemodynamic stabilization, management of coagulopathy, respiratory support, wound care, and monitoring for complications is crucial. The review also highlights recent advances, common pitfalls in treatment, and preventive public health strategies. Strengthening community awareness, training healthcare workers, and ensuring the availability of ASV can significantly improve outcomes in adult snakebite cases. Snake bite remains a major medical and public health emergency in tropical regions. Adults are commonly affected due to occupational and outdoor exposure. This review discusses the epidemiology, clinical presentation, first aid, investigations, anti-snake venom therapy, supportive management, complications, prognosis, and preventive strategies. A structured overview is provided to support clinicians and students in understanding the comprehensive management of snake bites in adults.

Keywords: Snake bite; Anti-snake venom; Envenomation; Neurotoxic; Hemotoxic; First aid; Adult management

INTRODUCTION

Snakebite is a major public health concern in many tropical and subtropical countries, particularly in South and Southeast Asia, Africa, and parts of Latin America. It is recognized by the World Health Organization as a high-priority neglected tropical disease due to its significant morbidity, disability, and mortality. Adults constitute a large proportion of victims because of their occupational exposure—farmers, laborers, forest workers, and individuals involved in outdoor activities are at increased risk. Snakebite in adults often presents as a medical emergency that requires prompt recognition and treatment to prevent life-threatening complications.[1]

Envenomation results from the injection of venom through the fangs of a venomous snake. The clinical severity depends on several factors, including the species of snake, amount of venom injected, site of bite, and time interval between bite and medical care. Venoms are complex mixtures of enzymes, proteins, and toxins that can produce a wide spectrum of effects such as local tissue destruction, neurotoxicity leading to paralysis, hemotoxic effects causing coagulopathy and bleeding, and systemic complications affecting vital organs.

Effective management of snakebite begins at the community level with proper first aid and rapid transport to a healthcare facility. In the hospital, timely administration of Anti-Snake Venom (ASV), close monitoring, and supportive care form the cornerstone of treatment. Despite advances in emergency medicine, delayed presentation, traditional practices, and limited access to healthcare continue to contribute to poor outcomes in many regions.

This review focuses on the epidemiology, pathophysiology, clinical manifestations, diagnostic approaches, and evidence-based management of snakebite in adults. It also highlights preventive strategies and public health measures aimed at reducing the burden of snakebite-related morbidity and mortality.

CLASSIFICATION OF SNAKE VENOM

Snake poisoning, or envenomation, occurs when a venomous snake injects toxic venom into human tissues through its fangs. The major sources include:

Venomous Snake Species

Viperidae (Vipers and Pit Vipers): e.g., Russell's viper, Saw-scaled viper.

These snakes cause hemotoxic effects, coagulopathy, shock, and local tissue necrosis.

Elapidae (Cobras and Kraits): e.g., Indian cobra, Common krait.

These species primarily produce neurotoxic effects leading to paralysis and respiratory failure.

Hydrophiidae (Sea snakes): Common in coastal regions.

These snakes cause myotoxicity leading to muscle breakdown and renal failure.[1,2]

CLINICAL PRESENTATION

Adult snake-bite victims may present with both local and systemic symptoms. Local symptoms include fang marks, swelling, bruising, blistering, and tissue necrosis. Systemic manifestations vary: hemotoxic bites cause coagulopathy and bleeding; neurotoxic bites result in ptosis, dysphagia, and respiratory paralysis; myotoxic bites cause muscle pain, dark urine, and renal injury.

The clinical presentation of snakebite in adults varies widely depending on the species of snake, the amount of venom injected, and the site of the bite. Most patients initially present with a history of a bite, often accompanied by acute pain, swelling, or local tissue changes at the affected limb. In vasculotoxic bites such as those from vipers, local signs are prominent and include rapidly progressing swelling, bruising, blister formation, and sometimes necrosis around the bite site. Systemic manifestations commonly develop within a few hours and may include spontaneous bleeding from gums, nose, or injection sites, hematuria, hypotension, and signs of disseminated intravascular coagulation. In contrast, neurotoxic bites, such as those from cobras and kraits, may present with minimal local swelling but early neurological symptoms. Patients often develop ptosis, blurred vision, difficulty in swallowing, slurred speech, drooling, and progressive respiratory muscle paralysis if untreated.[3]

Some individuals may also experience non-specific symptoms like nausea, vomiting, abdominal pain, headache, dizziness, sweating, and anxiety soon after the bite. Myotoxic envenomation, particularly from sea snakes or certain cobras, can lead to severe muscle pain, stiffness, dark urine due to myoglobinuria, and risk of acute kidney injury. The severity of clinical features depends largely on the duration since the bite; delayed presentation often results in advanced complications such as shock, renal failure, or respiratory compromise. Overall, recognizing early clinical signs and monitoring for progression are critical steps in effective management of snakebite in adults.[2,3]

FIRST AID MANAGEMENT

First aid plays a crucial role in preventing venom spread. The patient should be reassured and immobilized. Remove tight clothing, avoid manipulation of the bite site, and transport the patient urgently to a medical facility. Tourniquets, incision, suction, ice application, and traditional remedies must be avoided. Immediate first aid plays a critical role in reducing morbidity and mortality from snakebite, and the primary objective is to slow the spread of venom while ensuring the patient reaches medical care as quickly as possible. The victim should be reassured and kept calm, as panic and movement increase heart rate and speed up venom absorption. The bitten limb should be immobilized using a splint, keeping it at heart level to minimize venom dispersion. Tight tourniquets, cutting, sucking, or applying chemicals to the wound should be strictly avoided, as these methods are harmful and increase the risk of tissue damage and infection. In neurotoxic bites, particularly from elapid snakes, a pressure immobilization bandage may be useful if applied correctly, but it must not obstruct blood circulation. Any constrictive items such as rings, bangles, or tight clothing near the bitten area should be removed because swelling develops rapidly. The patient should not walk or run; instead, they should be carried or transported safely to the nearest hospital. Oral intake of food, alcohol, or stimulants should be avoided, and no attempts should be made to capture or kill the snake, although a photograph from a safe distance can be helpful for species identification. Early arrival at a medical facility equipped with anti-snake venom and emergency support remains the most important aspect of first aid. Overall, effective first aid focuses on calmness, immobilization, avoidance of harmful traditional practices, and rapid transport to definitive medical care.[4]

HOSPITAL MANAGEMENT

Upon arrival, the patient should undergo an ABCDE evaluation. Airway stabilization is essential for neurotoxic bites, often requiring intubation. Intravenous access, monitoring, and baseline investigations such as CBC, PT/INR, WBCT20, renal and liver function tests are required. Hospital management of snakebite in adults focuses on rapid assessment, stabilization, and timely administration of anti-snake venom (ASV). On arrival, the patient's airway, breathing, and circulation are assessed immediately, followed by monitoring of vital signs, oxygen saturation, and level of consciousness. The bitten limb is examined for swelling, progression of local tissue damage, bleeding, and signs of compartment syndrome. Intravenous access is secured, and baseline investigations such as complete blood count, coagulation profile, 20-minute whole blood clotting test (20WBCT), renal function tests, electrolytes, and urinalysis are performed. ASV is administered as soon as there is evidence of systemic envenomation, coagulopathy, neurotoxicity, or rapidly worsening local reaction; the dose depends on clinical severity rather than body weight.[5]

Patients are closely monitored for ASV reactions, and anaphylaxis is managed promptly with adrenaline, antihistamines, and corticosteroids if required. Supportive care is crucial and may include intravenous fluids for hypotension, blood products for coagulopathy, analgesics for pain, tetanus prophylaxis, and management of local necrosis or secondary infections. Neurotoxic cases may need ventilatory support if respiratory paralysis develops, while hemotoxic bites may require repeated ASV dosing until coagulation normalizes. Monitoring urine output and renal function is essential to detect early acute kidney injury. In severe cases, dialysis, wound debridement, or surgical interventions may be needed. Overall, effective hospital management combines timely ASV therapy, vigilant monitoring, and comprehensive supportive care to prevent complications and improve outcomes.[5,6]

ANTI-SNAKE VENOM THERAPY

ASV is the only definitive treatment for systemic envenomation. Indications include neuroparalysis, coagulopathy, shock, significant local swelling, and acute kidney injury. The standard initial dose is 10 vials intravenously, repeated based on clinical response and laboratory parameters. Preparedness for anaphylaxis is essential due to potential hypersensitivity reactions.[7]

SUPPORTIVE MANAGEMENT

Supportive care includes IV fluids, analgesia, tetanus prophylaxis, and wound management. Neurotoxic bites may require neostigmine-atropine trials and ventilatory support. Hemotoxic bites require blood products, plasma, and monitoring for renal injury. Myotoxic bites require aggressive hydration and monitoring of electrolytes and CPK levels.[8]

COMPLICATIONS

Complications include respiratory failure, acute kidney injury, disseminated intravascular coagulation, shock, compartment syndrome, and serum sickness. Early detection significantly reduces morbidity.

Snakebite can lead to a wide range of complications that depend on the type of venom, severity of envenomation, and delay in treatment. Vasculotoxic bites, particularly from vipers, commonly cause coagulopathy leading to spontaneous bleeding, hematuria, gastrointestinal hemorrhage, and in severe cases, disseminated intravascular coagulation. Extensive local tissue damage may result in blistering, necrosis, secondary bacterial infection, cellulitis, and compartment syndrome, sometimes requiring surgical debridement or even amputation. Neurotoxic bites from cobras and kraits can produce progressive paralysis affecting the ocular, bulbar, and respiratory muscles, which may lead to respiratory failure if ventilatory support is not provided in time. Myotoxic envenomation, especially from sea snakes, may cause rhabdomyolysis, severe muscle pain, hyperkalemia, and dark urine, ultimately resulting in acute kidney injury. [8,9]

Renal failure is also common in hemotoxic bites due to hypotension, hemoglobinuria, and direct nephrotoxicity. Systemic complications such as shock, arrhythmias, and multi-organ dysfunction may occur in severe cases. Additionally, patients who receive Anti-Snake Venom (ASV) may develop early allergic reactions, anaphylaxis, or delayed serum sickness. Long-term outcomes may include chronic kidney disease, persistent neuropathies, psychological trauma, physical disability, and scarring. These complications highlight the importance of early recognition, timely ASV administration, and comprehensive supportive care to reduce morbidity and mortality associated with snakebite in adults.

PREVENTION

Preventive strategies include proper footwear, avoiding sleeping on floors, using flashlights at night, and community awareness. Timely access to healthcare and availability of ASV in rural areas also improve outcomes. Preventing snakebite relies heavily on reducing human–snake interactions through improved awareness, safe practices, and environmental modifications. Adults working in agricultural or forested areas should wear protective footwear, use gloves, and avoid walking barefoot, especially during early morning or nighttime hours when snake activity is high. The use of flashlights or mobile phone torches while walking at night significantly reduces accidental encounters. Homes in rural settings should be kept clean and free from rodent activity, as rodents attract snakes; sealing cracks, elevating bedding, and using mosquito nets can prevent nocturnal bites from kraits that commonly enter houses.

Safe handling of firewood, stones, and stored grains also minimizes risk. Community education plays a crucial role in discouraging harmful traditional practices and encouraging early hospital visits following a bite. Awareness programs should focus on first aid principles, dangers of tourniquets, and the importance of prompt medical treatment. At the public health level, ensuring availability of anti-snake venom, strengthening referral systems, and training healthcare workers in snakebite management can significantly reduce morbidity and mortality. Overall, preventive strategies require a combination of personal protective measures, environmental control, and community-level awareness to effectively reduce the burden of snakebite in adults.[10]

CONCLUSION

Snake bite is a critical medical emergency that requires rapid assessment and timely ASV therapy. Structured first aid, evidence-based hospital management, and community education remain the most effective strategies to reduce mortality in adults.

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