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Venomous snake bite: A case report of limb loss from a neglected bite and review of literature

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Abstract

Background: Venomous snake bites have been reported in many climes across the globe with attendant morbidity and mortality. Many people still fall victim to this menace largely from occupational hazards and some socio-cultural practices. This study presents a patient who suffered limb loss from neglected snake bite and a review of the existing body of literature on snake bite management including current concepts and future trends.
Methods: Relevant clinical information on the patient were extracted from the medical records. An in-depth search into medical literature on snake bite was carried out using Pubmed and other relevant search engines.
Result: Wound assessment revealed extensive right lower limb necrotic wound with no evidence of vascularity. He was optimized, counselled and had above knee amputation with development of post-operative surgical site infection that was managed with antibiotics and wound dressing.
Conclusion: Early medical intervention will reduce the attendant morbidity and mortality associated with venomous snake bites. Public health education will also create more awareness among the populace to imbibe safety practices.

Keywords: Snakebite, Venomous, Multi-disciplinary care, Future trend.

Introduction

A snake bite can be described as an injury caused by the bite of a snake, especially the venomous type. This is commonly seen in agrarian communities and rural settlements where farming is the main occupation of the inhabitants.[1] Other categories of people at risk include the snake charmers, construction workers and people whose sewage pipes are broken. People living in the urban regions are not immune to the menace of snake bites as series of such events have been recorded. In warm and hot climates such as in the tropics and the desert regions, snake bites are a common event; therefore, residents of these geographical locations need to be aware and conscious of this environmental hazard that could be life-threatening.[2,3] Not all snake attacks are associated with venomous bites. More than 70% of snake attacks are dry bites (no venom released into the victim). The hallmark of a venomous bite is the presence of two puncture wounds on the limb of the victim from the fangs (fang marks).[4] After a venomous snakebite, there is usually evidence of local inflammation at the site and this could progress to systemic toxicity if unabated or unattended to. Complications that could ensue from such venomous bites include loco-regional inflammation, myonecrosis of the affected limb and systemic envenomation which could lead to a cascade of events that could culminate in death.[5] The keys to a good treatment outcome include identification of the type of snake, timely presentation to a healthcare facility, use of anti-venom and more importantly public health

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education.

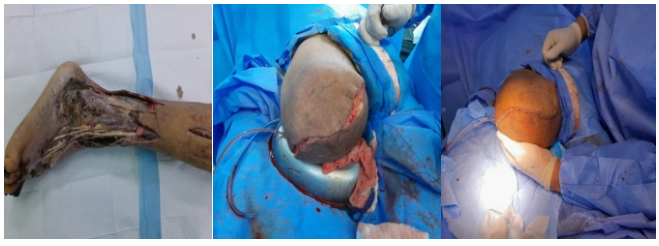
Case presentation

A 47-year-old farmer was bitten by an unidentified snake while working on his farm. He applied local herbs and did not come to the hospital for medical attention. After 3 days, he presented to the emergency room with a necrotic right lower limb and high grade fever.

Clinical examination revealed a middle aged man who was conscious and alert., Vital signs at presentation included a pulse rate of 113/min, blood pressure of 135/91mmHg, temperature of 37.8^{o}C, respiratory rate of 26cpm, and peripheral oxygen saturation (SpO2) of 97% at room air.

Musculoskeletal examination of the right lower limb revealed the presence of a gangrenous limb with copious discharge of purulent and turbid effluent. He was admitted and blood sample was taken for haematological profile and blood chemistry. Broad spectrum antibiotics were commenced as well as intravenous fluids and generous analgesia. Doppler sonography done revealed no evidence of vasculature below the popliteal vessels. He had initial wound debridement done at admission and same was done twice every day in the ward.

He was counselled on the need for an above-knee amputation, which he refused initially. However, with the rapid spread of the ascending infection following extensive tissue necrosis which was convincingly evident to the patient, he was counselled about the possibility of septicaemia/ septic shock ensuing, after which he obliged to have the amputation. Amputation was done on the 5th day on admission under subarachnoid blockade and post-operative recovery was uneventful. There was residual surgical site infection which resolved on daily wound dressing and antibiotics therapy. He was discharged home on the 6th post-operative day to the out-patient clinic for follow-up.



Discussion

Epidemiology

Snake bites are a global concern. Cases are being reported from different climes with attendant morbidity and mortality. The World Health Organization (WHO) in the year 2023 reported that about 5 million persons are victims of snake bites annually, out of which about 25% come down with different complications and some eventually die.[6] Reported cases from the United States revealed that about 8,000 people are bitten by venomous snake every year with attendant fatal complications seen in less than 1% of such individuals.[7,8]

Reported incidence of snake bites from other regions of the world varies from one place to another. For example, reported incidence in sub-Saharan Africa have shown that more than 300,000 venomous snake bites are recorded every year with attendant 20,000-30,000 deaths.[9,10] In Nigeria, the incidence has been put at about 497/100,000 population per year with an attendant 12% mortality rate.[11-13] The reason for the high incidence of snake bites in this region is not far from geographical and occupational reasons. Snakes being ubiquitous are abundant on the farms and forests, and they can stealthily creep into residential areas; hence, making the farmers, children, forest workers to all be at risk of this stealthy creature. There has been some reported incidence of snakes creeping through broken sewage conduits to gain entrance into the toilets of residential homes.

Classification and toxicokinetics of envenomation

It is important to note that it is not all snake bites that are venomous. Snakes bites could be dry or venomous depending on whether there is venom injection or not. In dry bites, the snake doesn't release any venom with its bite and this is quite commonly seen with non-venomous snakes whereas in venomous bites the snake injects the venom into the victim's body during the bite.[4] The clinical presentation therefore depends largely on the type of toxins present in such venom and the metabolic response from the body's immune system.[14]

Generally speaking, venomous snakes are classified as follows:[15]

1. Elapidae (cobras, mambas, coral snakes):

these snakes have grooved fangs that are short, fixed, and covered by mucous membrane.
2. Viperidae (puff adder, vipers, rattlesnakes, copperheads): have long, moveable fangs canalized like hypodermic needles.
3. Hydrophidae (sea snakes): usually found along sea coasts.

Depending on the species, these snakes produce venoms generally classified as neurotoxic, haemotoxic or cytotoxic. The snake venom has been found to contain various catalytic proteins, neurotoxins and metalloproteinases, all of which are responsible for various from of pathological events both at the local site of the bite and/or systemic sequelae.[14,16,17,18,19] Snake venoms have been identified to contain hyaluronidase, phospholipase A2 and many proteolytic enzymes, in addition to other substances.

Phospholipase A2 has both local and systemic effects especially on the neural junction (destruction of both the pre- and post-synaptic neuromuscular junctions and vascular tissues), thereby leading to the destruction of the central nervous system and causing paralysis of respiratory muscles.[20] In a similar manner, cytotoxins present in the venom is capable of modulating the activity of membrane-bound enzymes thereby causing depolarization of excitable membranes of cardiac cells and neurons which could lead to cardiac arrest.[21,22]

The haemotoxic venom works in 2 different ways, either to trigger a bleeding diathesis (by consumptive coagulopathy/disseminated intravascular coagulopathy) or initiate a pro-coagulation pathway. The pro-coagulant variant of the toxin initiates microvascular angiopathy by activating factors V, factor X, prothrombin. The synergistic effect of the pro-coagulant toxin with tissue destroying action of the metalloproteinases could result in thrombocytopaenia, thrombotic microangiopathy and acute kidney injury.[23,24]

Myotoxic phospholipase present in snake venom could cause myotoxic injury through calcium mediated cellular injury thereby causing the release of inflammatory cytokines such as bradykinins, proteases, vascular endothelia growth factors leading to myokymia, rhabdomyolysis, hypotension and myocardial depression.[25,26] The cumulative effects of the myotoxin, rhabdomyolysis and hypotension can lead to or worsen an underlying renal impairment.

Complications

Complications that could ensue following venomous snake bites depend on the type of snake, the type of venom injected, first aid attention received and time interval to seek medical attention. These are individual but inter-related factors that determine the prognosis of the victims; hence, complications could be categorized as local/loco-regional and systemic. Loco-regional complications include localized inflammation, dermonecrosis, myonecrosis and limb loss leading to amputation.[27-32] Reconstructive surgeries and/or provision of prosthesis may be considered in patients that earn amputation in order to improve their quality of life. Other notable complications that should be watched out for include anaphylaxis, haematuria, consumption coagulopathy, acute renal failure, arrhythmias, paralysis of respiratory muscles, and eventually cardiac arrest.[28]

Management

In approach to management of snake bites, the guiding general principles include:

i. Recognition and correction of immediate life threatening conditions
ii. Provision of analgesia and allay fear
iii. Assessment for local and systemic toxicity
iv. Minimizing local tissue damage and/or prevention/treatment of loco-regional or systemic toxicity
v. Follow-up of patient for medium and long term sequelae.

Managing venomous snake bites can be multi-disciplinary (involving the surgeons, physicians, anaesthesiologists and clinical haematologists) and the goal of treatment is to be proactive in order to prevent complications from ensuing and/or halting the course of event if they are already present by following the general principles earlier stated. Treatment of snake bites includes both pharmacological and non-pharmacological interventions; however, prompt presentation to the health care facility is very crucial in instituting the appropriate treatment protocol.

First, it is very important to calm the patient because true venomous snake bite has to be established by

identification of fang marks. Over 70% of snake bites have been identified to be dry bites; hence, the patient has to be reassured at presentation. Identification of fang marks which confirms the bite and if possible, identification of the snake is important to determine the specific anti-venom to be given. At the scene of the bite, limb immobilization is achieved and thereafter, a quick transfer to the nearest healthcare facility is ensured.[33]

Our index patient presented to the emergency room with extensive tissue necrosis of the affected limb. Although, there was no symptoms suggestive of systemic envenomation but he was given polyvalent anti-snake venom and also placed in parenteral broad spectrum antibiotics and intravenous fluids.

In general, polyvalent anti-snake venom is usually given in cases where the snake could not be identified however this could be associated with anaphylaxis and the treating physician should be prepared for this. Anaphylactic reaction is usually treated with administration of subcutaneous adrenaline with anti-histamines. Other supportive care include the use of intravenous fluids and analgesics. It is desirable to administer the anti-snake venom within 4 hours of the bite and if by any reason of delay, within 24 hours.

In resource limited climes, if it is unclear whether there has been a true bite, it is better to admit the patient in the hospital and observe for 48 hours with close attention to development of signs of systemic envenomation before administration of the anti-venom. In this scenario, a 20-minute whole blood clotting time test is carried out. The blood sample is taken and kept in clean, dry glass test tube, and observed over 20 minutes. This bedside technique is a cheap and quick investigation that has high specificity for detecting coagulopathy following snake bite.[34,35] The failure of the blood sample to clot after 20 minutes raises a red flag for the treating physician to consider the use of anti-venom.

Assessment of severity of envenomation[15]

No envenomation	Absence of local or systemic reactions; fang marks (±)
Mild envenomation	Fang marks (+), moderate pain, minimal local edema (0–15 cm), erythema (+), ecchymosis (±), no systemic reactions
Moderate envenomation	Fang marks (+), severe pain, moderate local edema (15–30 cm), erythema and ecchymosis (+), systemic weakness, sweating, syncope, nausea, vomiting, anemia, or thrombocytopenia
Severe envenomation	Fang marks (+), severe pain, severe local edema (>30 cm), erythema and ecchymosis (+), hypotension, paresthesia, coma, pulmonary edema, respiratory failure

Indications for surgical intervention include debridement of the necrotic wound, fasciotomy to relieve compartment syndrome, daily wound care and amputation. The index patient presented with rapidly increasing necrotizing fascitis that necessitated amputation (above-knee). The eventual development of surgical site infection was not out of place and this was managed with broad spectrum antibiotics. Administration of fresh frozen plasma, cryoprecipitate or platelet concentrate may be considered by the physician and the haematologist depending on the extent of derangement of haematological profile. Other supportive care include the administration of intravenous fluids, anxiolytics, analgesics, broad spectrum antibiotics, supplemental oxygen, close monitoring of the vital signs while watching out for signs of systemic envenomation. The anaesthesiologist may be required to intubate the patient in the presence of complications such as pulmonary oedema and respiratory failure arising from paralysis of respiratory muscles.[36]

In the event of full recovery of patients from envenomation, it is strongly advised that such patients should be on regular follow up outpatient visits in order to watch out for long term sequelae. Such long term complications could be neurological (vertigo, migraine, hemiplegia, visual impairment), psychosomatic disorders, non-specific abdominal colics and respiratory difficulties or renal impairment.[37]

Current concepts

Recombinant technology has been able to identify a re-purposed Phospholipase A2 inhibiting agent (varespladib). Although at the experimental phase, this agent has been proven to block the tissue damaging effects attributed to phospholipase A2, thereby providing a therapeutic window that will possibly improve the morbidity in such patients.[38, 39] The long term use and follow up with this drug will be desirable in order to assess the efficacy in the prevention of extensive wounds and prevention of possible amputation that were hitherto associated with neglected snake bites.

With the advent of artificial intelligence in healthcare practice, it may be possible in the nearest future that software might aid clinicians in fang mark identification, detection of possible toxins in

the venoms and provide directions towards various targeted therapies at neutralizing the toxin and also preventing long term complications.[40,41]

Prevention

Adequate and regular public health education through various media channels will be an invaluable tool in the prevention of snake bites. This programme should be channeled to the general public with emphasis on at risk groups (farmers, rural dwellers, and construction site workers). Snake handlers and charmers need to be educated on the risk involved with such harmful practices. Sewage pipes and conduits should be well sealed and regular maintenance carried out on sewage lines to prevent the entrance of these animals into the domestic lavatory.

Conclusion

Venomous snake bites are a common occurrence especially in the tropics and more so in the agrarian communities. Therefore, public health education on self-protection and community awareness of this menace should be a regular exercise. With recent advances in molecular medicine, we hope that more potent medications would be available to combat the damaging effects of the venom toxins on human tissue.

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