

## Field treatment of snakebites in the Israel Defense Forces

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### ABSTRACT

Eight species of venomous snakes capable of inflicting bites dangerous or fatal to humans inhabit the State of Israel. Soldiers in the Israel Defense Forces (IDF) routinely serve under field conditions, and are at greater risk for contact with venomous snakes than are their civilian counterparts. Every year scores of military personnel are bitten by poisonous snakes. The IDF has developed a protocol for field-level treatment of snakebite victims, which we present in this article. Employment of a number of simple therapeutic measures for early treatment of snakebite can prevent or significantly reduce venom-induced morbidity and mortality.

**Keywords:** snakebites, field treatment, Israel Defense Forces

### BACKGROUND

Eight species of venomous snakes inhabit the various regions of Israel, some of which can be harmful or fatal to man. The *Vipera palaestinae* is the most widely distributed venomous snake in Israel, found in all regions north of Be'er Sheva, and accounting for 100-300 reported cases of envenomation every year (1,2). Before the utilization of anti-serum for the treatment of snake envenomation, one to two fatalities occurred each year in Israel due to *Vipera palaestinae* envenomation. Although some snakes may be potentially dangerous or fatal to man,

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they generally do not initiate contact with humans, and are most often content to remain hidden under bushes, in small tunnels, or under trash piles, rocks, and logs. For the most part, encounters between snakes and humans end with the former disengaging and retreating. If, however, a successful retreat is not possible, the snake will often warn the offender against further approach by means of hissing or rattling. Only if the human surprises the snake or ignores its warning will the encounter end in an attack and bite (3).

Agricultural workers, soldiers, hikers, and others who live, work, and recreate in the outdoor environment, are at particular risk of snakebite (3,4). Soldiers in the Israel Defense Forces (IDF) often live and train under field conditions. Troops bivouac in tents or other temporary dwellings, and engage in outdoor activities such as navigation and patrol of areas commonly inhabited by venomous snakes. Therefore human-snake encounters are far more common among soldiers than among their civilian counterparts, and each year scores of IDF soldiers are bitten by venomous snakes (5, this issue).

Proper early field-level treatment of snakebite victims is crucial for favorable prognosis. It is of great importance, therefore, that all IDF medical personnel, as well as medical personnel of armed forces worldwide, learn and employ proper early field practice for treatment of snakebite victims.

### **FIELD-LEVEL TREATMENT (Table 1)**

Early treatment of snakebite is, as mentioned above, of critical prognostic significance. As the life-threatening systemic effects of snake envenomation occur when the venom enters the victim's

**Table 1**

*Field treatment*

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- Reassurance
  - Splinting
  - Complete rest
  - IV fluid administration
  - Medication
  - Fast
  - Evacuation to hospital
-

circulatory system, the goal of field-level treatment is to impede the spread of venom from the intracellular space of the injected area to the lymphatic circulation and from there to the venous circulation. Delaying the onset of systemic effects allows time for evacuation to a hospital emergency department, where life-threatening conditions can be more effectively treated (6).

The IDF approach to field treatment of snakebite is relatively simple, and it is designed to eliminate unnecessary and ineffective measures which invariably delay definitive evacuation. The treatment plan is based on three basic principles: reassuring the patient and maintaining full rest; infusion of intravenous fluids; and rapid evacuation to the closest hospital emergency department (7).

### **Reassurance and rest**

Victims often respond hysterically to snakebite (8). Snake venom causes anxiety and psychomotor unrest which, coupled with physical exertion, may lead to an increase in heart rate and muscular contraction in the bitten region, facilitating rapid systemic spread of the venom (3). In order to prevent this, the IDF protocol calls for calming of the victim. This can be achieved by reassuring the victim, stressing the availability of anti-serum at the nearest hospital, and emphasizing the excellent prognosis in cases of early treatment. The victim must be placed in the supine position and the bitten limb immobilized and splinted in the method employed for fractures. The patient should not be permitted to walk or move about (9).

### **Intravenous fluids and medications**

Snake envenomation may lead to hypovolemic, hemorrhagic, or anaphylactic shock. Therefore our treatment plan calls for administration of intravenous (IV) fluids as soon as possible. Initiation of IV fluids should be started before evacuation to the hospital, unless the evacuation time is especially short and the patient's status is rapidly deteriorating, with the onset of systemic signs such as headache, nausea, vomiting, and abdominal pain (10). In such cases, the evacuation should not be delayed at all, even for the relatively short period of time required for placement of the IV line. The IV line must never be placed on the bitten limb. As a rule, there is no call for administration of medication to snakebite victims in the field. The

onset of anaphylactic shock, however, calls, for adrenaline and IV steroids. Steroids should not be given in other cases. If for some reason medications must be given, they must be administered intravenously, never orally or intramuscularly. The oral and intramuscular routes are unacceptable, due to the imminent threat of shock and poor perfusion. This holds true especially for analgesics: IDF medics are routinely equipped with morphine syrettes for intramuscular administration, and medical staff are specially instructed to refrain from giving intramuscular morphine to snakebite victims, due to the unreliability of drug distribution in shock victims.

The victim should be permitted no oral solids or fluids due to the potential development of shock and the systemic complications of envenomation, including gastrointestinal signs such as nausea, vomiting, and abdominal pain.

### **Evacuation**

Victims must be evacuated as soon as possible to the nearest hospital facility (3,6,11,12). The IDF protocol stresses that snakebite victims should not be evacuated to primary, secondary, or regional medical clinics, as in Israel anti-serum is found only in hospital emergency departments. All hospitals routinely stock this medication. This strict rule requiring evacuation of all snakebite victims to hospitals was designed to prevent cases in which the victim is at first transported to a nearby military clinic in good condition with no systemic signs, only to later to develop life-threatening symptoms, at which point anti-serum is required but not available.

Our protocol calls for the most rapid evacuation possible, whether by ambulance, helicopter, or other available vehicle. The mode of transportation is decided on a case-to-case basis, and is a function of distance, road conditions, and vehicular availability. Due to Israel's relative small size, almost any soldier can be evacuated and transported to a hospital within 2–3 hours. This relatively short period of time allows for timely hospital treatment before the onset of irreversible effects of snake envenomation.

### **CONTRAINDICATED MEASURES (Table 2)**

Initiation of certain treatment steps may be far less crucial than simply refraining from implementation of needless and sometimes harmful

contraindicated measures. These measures are often based on “popular wisdom” and ignorance, and the IDF protocol specifically addresses and subsequently prohibits them so as to prevent any misconceptions about their effectiveness.

**Table 2**

*Do not !!!*

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- Cut
  - Apply suction
  - Apply arterial or venous tourniquet
  - Give hot fluids
  - Give alcohol
  - Cool
  - Cauterize or freeze
- 

### **Incision and suction**

Some medical texts recommend incision of the bitten limb and oral or instrumental suction of the area as a means of extracting the venom from the interstitial area (3,9,13). This procedure has not been shown to be effective and is expressly prohibited by the IDF treatment protocol (6,11,12). The time to onset of systemic effects of snake venom is relatively prolonged, requiring many hours to days, while in Israel evacuation times are quite short, lasting in almost no cases longer than three hours. Thus, incision and suction expose both victim and rescuer to unnecessary danger. The incision causes transection of blood vessels in the area of the bite, thus allowing direct access of the venom from the interstitial space to the circulatory system, speeding the systemic dissemination of venom. In addition, an incision at the bite site tends to heal slowly and often leaves a disfiguring scar. This is due in part to the necrotic tissue present at the bite wound edges, caused by the enzymatic actions of lipase and protease present in the venom (3,9). Oral suction is usually ineffective, especially if not performed immediately after envenomation. In addition, this procedure exposes the rescuer to blood-borne pathogens and snake venom which may be absorbed through oral mucous membranes.

## **Tourniquets**

Systemic dissemination of venom proceeds through the lymphatic system. Placement of an arterial tourniquet is not only unnecessary but contraindicated as well, as it may inflict additional damage by increasing the effects of ischemia and necrosis initiated by the venom (6,11,12).

The role of venous tourniquets is in dispute in the literature. Some researchers have found venous tourniquets to be ineffective in preventing proximal spread of venom (6,15), while others maintain that this type of barrier does in fact inhibit systemic venom dissemination (14). While venous tourniquets may in fact be effective at retarding the systemic effects of snakebite, they also may contribute to limb ischemia by increasing compartment pressures (3), and tourniquets in place for extended periods may cause a massive release of venom from the limb when removed in the hospital. Therefore the IDF treatment protocol forbids the use of venous tourniquets. This aspect of our protocol may not be applicable in foreign settings. In Australia, for example, where evacuation times from remote areas may last from many hours to days, treatment protocols call for crepe bandaging of the bite area, thus slowing the lymphatic spread of the venom (6).

An additional recommendation is the use of a lymphatic tourniquet, which can be achieved by placing a blood pressure cuff proximal to the bite and inflating to 40 mmHg. The lymphatic tourniquet does not inhibit arterial or venous blood flow, but does effectively prevent systemic spread of venom.

## **Food and fluids**

The initial signs of systemic venom toxicity are often nausea, vomiting, and abdominal pain; and as toxicity progresses there may be shock and altered state of consciousness. It is recommended, therefore, to refrain from administering any food or oral fluids. Our protocol emphasizes this point, and specifically prohibits giving hot fluids such as coffee or tea and alcoholic beverages, mistakenly thought to calm the victim or "dull the pain". These beverages, in addition to opposing the strict fasting orders may contribute to vasodilatation and tachycardia, thus increasing systemic distribution of venom.

### **Local cooling**

Cooling of the bitten limb with cold compresses often reduces pain and swelling, and retards lymphatic venom spread (3). Even so, the IDF protocol for field treatment of snakebite, as opposed to our scorpion sting protocol, prohibits limb cooling. Cold compresses, especially direct placement of ice on the wound area, cause local vasoconstriction, and may increase the risk of ischemia and necrosis (3,6,11,12). Again, due to the short evacuation times in Israel, efforts should be concentrated on evacuation measures rather than on improvising other measures.

### **Cauterization**

Under no circumstances should cauterization of the wound with a hot metal object or a burning cigarette be attempted in the senseless hope of denaturing the venom proteins. This ineffective measure results only in unnecessary pain, tissue damage, and scarring.

## **HOSPITAL TREATMENT**

As stated earlier, the IDF protocol for treatment of snakebite is based on rapid evacuation for treatment with snake venom anti-serum, available at all hospital emergency departments. There are no military hospitals in Israel; all are civilian-run, and provide care for soldiers. This article will not attempt to explain in detail the treatment protocols used in the hospital, but no review would be complete without a brief description of the tertiary care of the snakebite victim.

### **Supportive measures**

The specific need for supportive measures varies greatly from patient to patient, but in general this type of treatment is aimed at correcting any imbalances caused by the snake venom. Supportive measures include, but are not limited to, respiratory support, reversal of hypotension, and treatment of cardiac arrhythmias and hemostatic abnormalities (6).

### Antiserum

This treatment modality is available in Israel solely at the hospital level. Hospitals in Israel carry anti-serum to three venomous snakes: *Vipera palaestinae*, *Echis coloratus*, and *Walterinnesia aegyptia*. The bites of *Vipera palaestinae* and *Echis coloratus* together constitute the majority of snake envenomations in this country. The *Vipera palaestinae* antivenin is highly effective and should be administered even later than 24 h after envenomation (2,16). Indications for antivenin use include onset of systemic symptoms of toxicity and rapidly spreading edema or hematoma. Treatment with snake venom anti-serum is not without risk, and may result in serious side effects including serum sickness and anaphylactic shock (6). In a recent study conducted in an intensive care unit in Israel, complications due to serum sickness were found in 44% of patients treated with antivenin (17). Antivenin is reserved for use, therefore, only in cases where an absolute indication for treatment exists.

### Adjunctive measures

Although the oral cavity of the snake is host to a wide variety of flora, antibiotics are not routinely administered to snake bite victims. Instead, their use is reserved for care of patients with signs of secondary infection at the wound site. Occasionally surgical intervention is necessary for debridement of necrotic tissue, amputation of necrotic distal digits or limbs, or for escherotomy in cases of severe compartment syndrome (6,12). Tetanus toxoid should be administered to all victims who have not received a booster dose within the last 10 years.

### CONCLUSION

Snakebite is a potentially dangerous and sometimes lethal environmental hazard which poses a special threat to soldiers and other individuals working or living under field conditions. The IDF offers a protocol for early and effective field-level treatment of snakebite victims, which addresses the "do's" and "don'ts" of immediate care. Training personnel to follow a protocol such as ours can save lives and prevent additional injury.



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