REVIEW ARTICLE

Venomous Terrestrial Snakes In The Tropics Of Malaysia: A Review On Management, Envenomation And Surgical Interventions

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INTRODUCTION

Snake bites accounts for a less common yet significant morbidity and mortality among farmers, plantation workers and those outdoor labour workers, especially in those countries with heavy greeneries and forestry – Malaysia is one example (1). Statistically about 5 million people per year are bitten by snakes and approximately 0.02% - approximately 100,000 develops complication or sequelae from the bites (1). Bites from these venomous snakes can cause local and systemic envenomation that can lead to a life-threatening medical crisis (2). These snakes are prevalent in many tropical and subtropical countries. Malaysian data and literature on the snakebites and epidemiology is scarce. Snake bite incidences are not notifiable diseases in Malaysia however a quantitative data is available in the Malaysian Health Informative Centre (2).

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CLASSIFICATION

Generally, there are 3 types of snake families in Malaysia that are venomous (2). All the snakes in the Elapidae and Viperidae and few of the Natricidae family are venomous and potentially dangerous to human when bitten. Examples of non-venomous snakes are green snakes, rate snakes, boas and phytons (3).

1. **Elapidae**
   Includes cobras, king cobra, kraits , coral snakes, sea snakes and their allies (2). Elapidae are relatively long, thin, with large smooth symmetrical scales on the dorsum of their heads. They have relatively short fixed front fangs. Cobras, raise the front part of their body off the ground and spread and flatten the neck to form a hood. A cobra type, Naja Sumatrana can spray its venom one metre towards the eyes of perceived enemies (2). Most sea snakes have flattened paddle-like tails and their ventral scales are greatly reduced in size or absent (2).

2. **Viperidae**
   Comprises of two subfamilies, True viper or Old World vipers (Viperinae) and Pit vipers (Crotalinae) (2). They have relatively long fangs which are normally folded against the upper jaw and are erected only during a bite. The Crotalinae have a special sensing organ, the loreal pit organ, to detect their warm-blooded prey. This is situated between the nostril and the eye. Pit vipers are from the Crotalinae subfamily. The toxinology of venoms from Crotalinae snakes is significantly different from that of venoms from Viperinae snakes (2).

3. **Natricidae**
   Most snakes of this family do not cause significant harm to human. One species of Natricidae of medical importance had been identified in Malaysia, the red-necked Keelback (Rhabdophis subminiatus), which has the potential to cause significant coagulopathy (2).

Venomous versus Non-venomous snakes

It is important to distinguish between venomous and non-venomous snakes as the management differs. Different snake bites require different medical assistance. By understanding which snake had bitten, accurate assessment of potential risks, increasing the chances of survival (3).

These are few features that we can observe as distinguishing features:

1. Head Shape and Pits

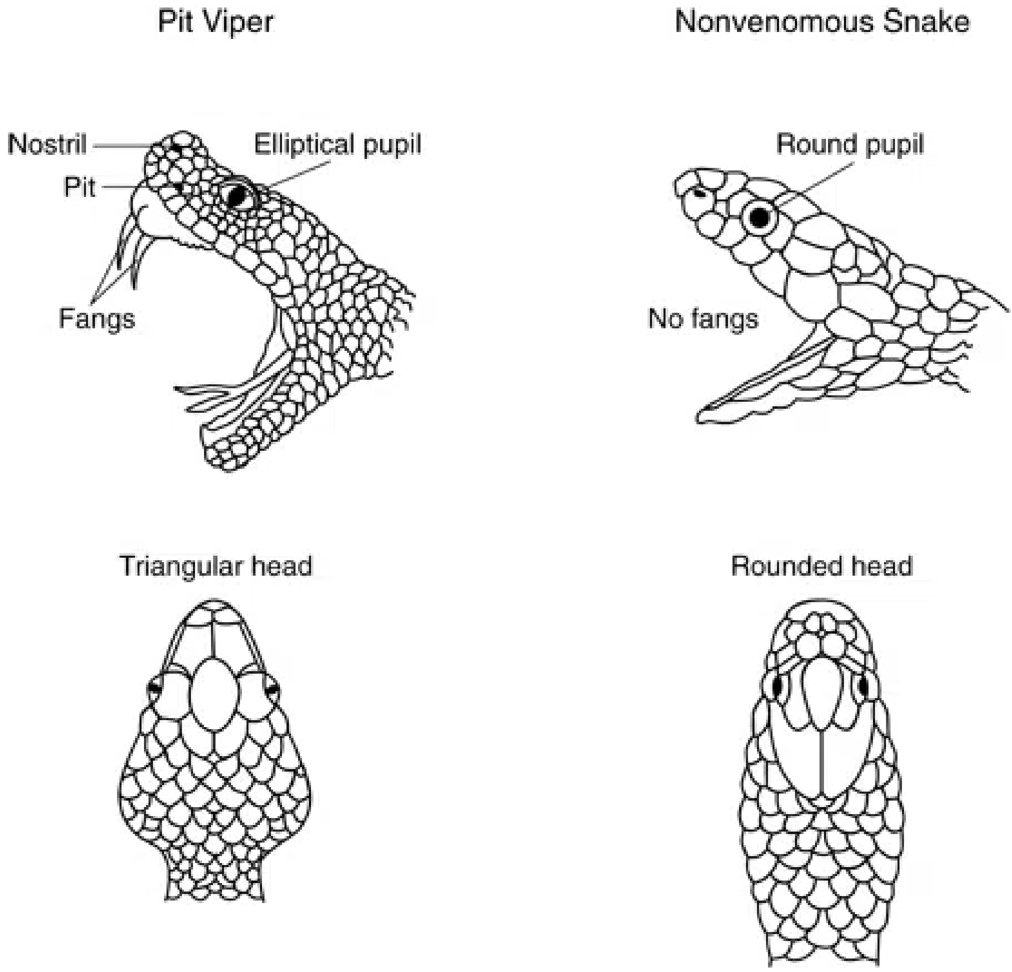

Figure 1: Snake head shapes and pits – venomous versus non venomous snakes (3)

Venomous snakes have distinct head shapes. Their heads are typically wider at the back and attached to a narrower neck giving off a triangular-shaped appearance. While this seems like a good indicator, it is not always accurate (3). The non-venomous snakes have a tendency to flatten their heads into a more triangular shape, appearing more dangerous to potential predators (3). This can then lead to them being confused with venomous snakes. As a result, poisonous snakes cannot be identified solely by head shape.

Another indicator that can assist in further identification is the pits (or holes) that appear on their heads. Rattlesnakes, copperheads, cottonmouths, and coral snakes all fall under the category of pit vipers. This means that each snake has two pits that appear on their snouts. Pits resemble nostrils and are located midway and slightly below the eye. Non-venomous snakes do not have pits.

2. Pupils

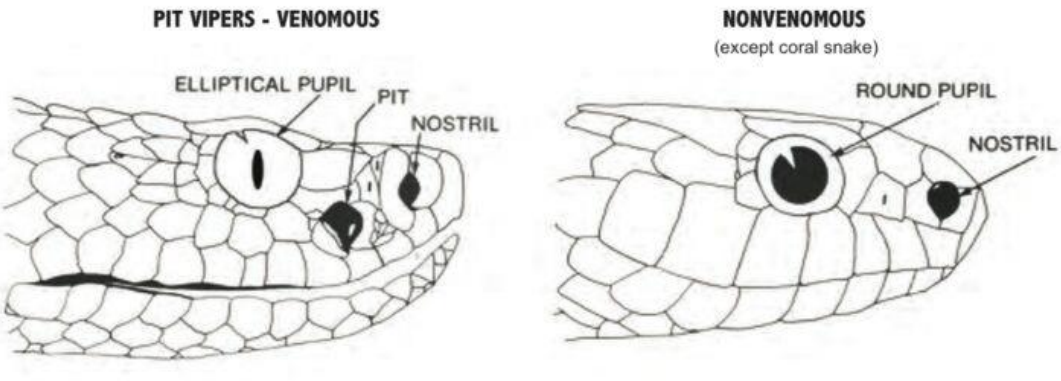

Figure 2: Pupils of venomous versus non venomous snakes (3)

Snakes' pupils can be a great indicator when trying to determine whether it is venomous or not. Poisonous snakes' eyes are comparable to a cat's eye, as they possess slit-like elliptical pupils. In contrast, harmless snakes have round pupils. With that being said, this identification method can be dangerous. It is better to keep a safe distance when observing a snake (3).

3. Colouring

Colour may not be a completely accurate method in distinguishing between venomous and non-venomous snakes. With that being said, there are some colour aspects that can be useful in identification. If a snake has solid colours, it is often harmless (3). Comparably, if the snake is more patterned and colourful, it is a good idea to use caution when approaching.

4. Tails

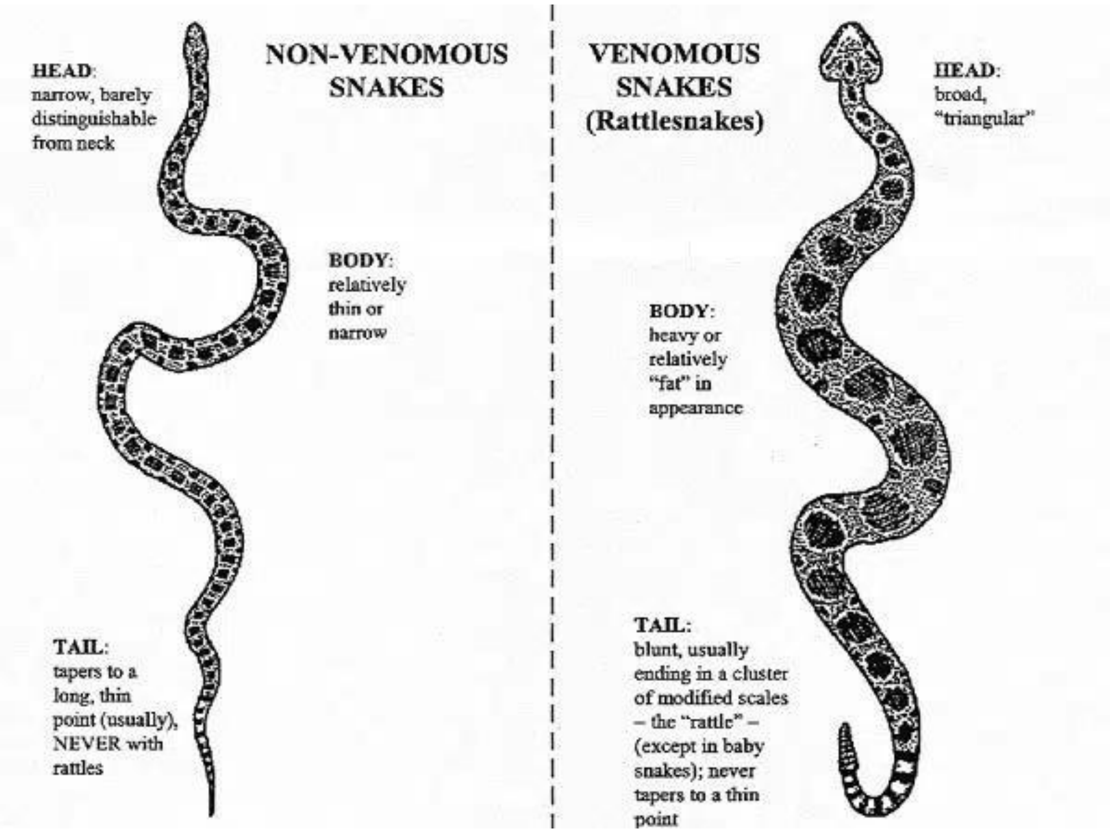

Figure 3: Snake anatomy and tail distinguishing venomous versus non venomous snakes (3).

One noticeable identifier can be a snake's tail. Young cottonmouths and copperheads can be identified by their tails. The major identifiers of a venomous snake's tail is if it rattles. If you hear a rattling sound, you are about to come into contact with one of the most poisonous snakes. You should safely flee the area as soon as possible.

5. Behaviour

Behaviour can be used in distinguishing between venomous and non-venomous snakes. Each snake exhibits different behaviours and characteristics. A few noticeable behavioural differences can be seen in rattlesnakes and cottonmouths. Rattlesnakes tend to shake their tails and omit loud clicking noises when threatened, but not all rattlesnakes have rattles. Cottonmouths, or water moccasins, swim with their entire body on the water's surface while non-venomous snakes only allow their heads above the water. Cobras, raise the front part of their body off the ground and spread and flatten the neck to form a hood – all cobras are venomous.

Clinical presentation of a snake bite

In at least 20% of pit viper bites and a greater percentage of elapid and sea snake bites, no venom are injected – “dry bites” (4). Local features as follows:

- **Fang marks**: two puncture wounds indicates a bite by a poisonous snake. Non-venomous snakebite will have small puncture wounds in an arc. (3)

- **Pain**: Burning, bursting or throbbing pain with draining lymph nodes becoming painful.

- **Local swelling**: Viper bites produce more intense local reaction. Swelling may become apparent within minutes and becomes massive in couple of days. Regional lymphadenopathy may develop. Possible impending compartment syndrome - the envenomed tissue is contained in a tight fascial compartment. If there is no swelling 2 hours after a bite, it is safe to assume that there has been no envenoming (4).

- **Local necrosis**: Blistering and necrosis may appear over days following the bite. Necrosis is marked following bites of Vipers, and some rattlesnakes (4). Bites by Cobras can also cause tender local swelling and blistering. Krait bites however normally do not cause any local reaction. Patients spat at by spitting elapids may develop venom ophthalmia if it hits the eyes (4).

- **Secondary infection**: Typically bacterial flora of the oral cavity of the snakes contributes to secondary infection.

- **General features**: Flushing, breathlessness, palpitations, and dizziness, tightness in the chest, sweating and acro-paraesthesia are common. These are due to anxiety and sympathetic overactivity. Apart from these, early symptoms in elapid bites include vomiting, heaviness of eyelids, blurring of vision, hypersalivation, congested conjunctivae and ‘gooseflesh’. In krait bites, cramping abdominal pain followed by diarrhoea and collapse can occur. Sea snake envenomation causes headache, a thick feeling of the tongue, thirst, sweating and vomiting (4).

- **Systemic features**:
    - **Clotting defects and haemolysis**: Haemostatic abnormalities are characteristic of envenoming by Viperidae. Persistent bleeding wounds suggest that the blood is in dyscariasis. Spontaneous systemic haemorrhage occurs for example epistaxis, haematemesis, ecchymoses &haemoptysis (4).

- **Neurotoxicity**: Elapid and sea snake venoms have significant neurotoxicity. Sometimes the onset maybe delayed for more than 12 hours. Airway obstruction or paralysis of the intercostal muscles and diaphragm cause respiratory failure. Neurotoxic effects are completely reversible in response to antivenom or anticholinesterases or may wear off spontaneously within 7 days (4).

- **Myotoxicity**: Sea snake venom contains myotoxins that cause myalgias, myopathy and rhabdomyolysis. Generalized symptoms develops 1 to 4 hours after the bite. Trismus is common. Myoglobinuria secondary to rhabdomyolysis appears 3 to 8 hours after the bite (4).

- **Cardiotoxicity**: Viper and elapid venom can cause direct myocardial damage manifesting as arrhythmias, bradycardia, tachycardia or hypotension (4).

- **Nephrotoxicity**: Renal failure is secondary to ischaemia in Viper bites (4).

- **Shock**: A variety of factors contribute to shock. They include fright, hypovolemia, myocardial depression, haemorrhage into the adrenals and pituitary and increased kinin production (4).

MANAGEMENT OF AN ACUTE SNAKE BITE

First-aid for snakebite. There are several myth surrounds the first aid care over a snake bite. Many literature had been published bursting these myths.

a. <u>Tourniquet</u>: several and most studies on effect of tourniquet on snakebite have found no significant differences in applying tourniquet or without on outcome in dysfunction, morbidity or mortality (5).

b. <u>Incision of the bite wound</u>: No statistically significant difference in the incidence of death or disability on whether the bites need to be excised in most studies (5).

c. <u>Suction of the bite wound</u>: No significant increase in the occurrence of death or disability compared to patients who had not received first aid suction (5). The hazards are open to the person performing the suction.

d. <u>Traditional medicine and concoctions</u>: Statistically significant increased odds for death or disability in snakebite patients treated with concoctions (5) – either via topical application or ingestion.

e. <u>Pressure Immobilization</u>: multiple studies related to pressure immobilisation on snakebite but none of them reported any outcome of interest (5).

These patients need to be rushed to the hospital for evaluation under the emergency department. It is safer to assume the bite is poisonous if in doubt. Unless a confirmatory verification that it isn't. If possible, to take a good clear picture of the snake to allow identification. Bringing in a dead snake into the hospital is not necessary and potentially dangerous as the snake might possibly not be dead and a dead snake can still envenomated (3) – posing a threat to the handler. Current recommendations for field treatment include limiting the victim's activity while lying them flat and keeping the bitten extremity immobilized at heart level (6).

Monitor the vital signs: pulse, blood pressure, respiratory rate, and muscle weakness periodically. Local swelling and necrosis should also be charted hourly. Examine signs for bleeding. Monitor ECG and CPK, serum transaminases, blood urea and serum creatinine daily. Serum electrolytes, especially potassium, should be estimated. Coagulation profile should be tested 4 hourly. A useful test for venom-induced defibrinogenation is the 20-minute whole blood clotting time (4). Poor coagulability indicates systemic envenomation. Other tests are ApTT, platelets and fibrinogen degradation product value that should be estimated twice daily (4). Urine test for microscopic haematuria and active sediments. Output should be monitored in case of renal failure and dehydration.

The most important decision in managing a case of snakebite is to decide whether to administer antivenom or not. There are evidences that in patients with severe envenomation, they benefits from this therapy - far outweighing the risk of reactions. There are many type of Antivenoms with different dosing regimens that will be prescribed under the jurisdiction of the Emergency Physician (5).

If compartment syndrome is clinically suspected, action needs to be taken in a timely manner as ignoring the need for a fasciotomy can lead to further tissue necrosis, ischemic complications and even loss of limb (6). In children, more accurate signs and symptoms that identify acute compartment syndrome are agitation, anxiety, and analgesia.

Gold standard and primary treatment for the wound is a through wound debridement with a wide fairly extensive debridement. The wound closure is a secondary concern after a resolved primary debridement. Overall incidence of envenomation injuries does require some kind of formal reconstruction. Post envenomation, plastic surgeons are frequently consulted regarding wounds where restoration of form and function are desired (6).

Supportive managements in case of acute snake bites are:

- Tetanus prophylaxis
- Antibiotics and analgesics
- Management of respiratory paralysis: Airway patency and toilet should be ensured. Ventilatory support must be considered and instituted early. The “Tensilon test” should be done as follows: Atropine sulphate (0.6 mg for adults and 0.02-0.05 mg/Kg for children) should be given I/V followed by Edrophonium chloride (10mg for adults and 0.25 mg for children) I/V. Patients who respond convincingly can be maintained on neostigmine methyl sulphate (50 - 100 μg/Kg body weight) and atropine four hourly or by continuous infusion (4).
- Haemostatic disturbances usually respond well to antivenom treatment. In case of severe bleeding fresh frozen plasma, cryoprecipitates, & platelet concentrates may be required. There is no role for heparin (4).
- Need for counter treatment due to reaction from the Antivenom includes high dose steroid for example Hydrocortisone and prednisolone with maintenance with antihistamines (5). No role for prophylaxis steroid administration otherwise (6).

CONCLUSION

Arterial tourniquets, cryotherapy and application of heat has no role. Incision and suction are not recommended (6). Ensuring safe, effective treatments which can bring down the burden of snakebite. Victims of snake bite envenomation need a multidisciplinary team that understands the underlying pathophysiology and potential complications to avoid a delay in treatment. In the tropics & Malaysia, snake bite is a rural and an occupational hazard among farmers, plantation workers and hunters. Regular public health programmes regarding the prevention, pre-hospital field management (first aid) and the importance of the early transfer to the hospital should be emphasized. Management of snake bite should be in accordance to the local protocol of care in a timely manner – as late treatment can and will lead to fatality.

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