Would you survive a snake bite?

Written by Giorgio Tzortzis 12557031

You are on holidays in Queensland and are unfortunate enough to be bitten on the right lower leg by an unidentified snake. As the bite only left a minor scratch, you felt it was suitable to disregard the incident and not seek medical attention right away because you felt fine. However, while many snakes are not venomous, you did not realise you were bitten by an Eastern Brown Snake which has rather small fangs and leaves barely a trace on you to show the severity of the bite. This snake has potentially injected a potent concentration of toxic rapid-acting venom. Within two hours you have collapsed and are having life threatening respiratory failure.

You may be thinking…yes I would have survived because I would have definitely sought after medical attention. But that might not have been enough either because the correct first aid treatment would not have been applied. Time is also another vital variable in the means to protect your life.

To understand the way to tackle this situation correctly we must take a step back and understand the general symptoms of a snake bite and the physiological effects venom has on the human body. Are you willing to find out the consequences? If not read on…

Why does this matter?

The most obvious thing to think is that once a snake has bitten you, it shoots its venom inside your body into your bloodstream. This is not true. Well not directly into the bloodstream at least. Snake venom actually enters your subcutaneous layer of your skin, it is then transported by lymphatic vessels via the lymphatic system throughout your body. Without the correct first aid procedures the venom will eventually enter yours bloodstream and lead to you being in life threatening condition (4).

Figure 1: The first giveaway sign or symptom that a snake has bitten you is the two fang marks left on your body.

Why is this important?

It is very important because knowing how the lymphatic system works will allow you to understand the reasoning for the first aid procedure called pressure immobilisation that the patient should have used in the case above.

So what does snake venom do to your body?

It is easier to understand what venom does to your body when you know what venom consists of. Venom is made of a cocktail of biologically active proteins and peptides that allow a wide range of local and systemic effects (4). These active proteins and peptides most commonly include neurotoxins, myotoxins and haemotoxins in Australia. These are the bad guys! Neurotoxins stop postsynaptic neuromuscular junctions and interfere with neuromuscular transmission which we need for our muscles to work. This commonly causes a paralysing effect and coagulation abnormalities. Myotoxins work through a non-enzymatic mechanism leading to muscle necrosis (break down) and acting rapidly to cause instantaneous paralysis. Haemotoxins destroy red blood cells and leads to a disruption in blood clotting and causes generalised tissue damage and organ collapse (4). Once the snake venom enters your body it is circulated through the lymphatic system, hence why the correct first aid treatments are required immediately to effectively reduce the risk of systemic envenomation from occurring (5).

Pro tip: It is also important to NOT wash the site, as venom at the bite site is used to assist in snake identification!

What are the symptoms of snake envenomation?

You'd expect to see two puncture wounds right? Well most of the time...but some snake's bites don't leave a wound due to the rapidness and sharpness of the bite, so we must be aware of the other symptoms. While the symptoms of snake envenomation are dependent on the snake species and the specific venom they contain, there are some most prevalent symptoms in the majority of Australian cases from the Elapidae snake family, which includes the Eastern Brown snake. Arguably the most common systemic envenoming symptom worldwide is venom-induced consumptive coagulopathy and is caused by various vipers and Australasian elapids. Coagulopathy is simply abnormal blood clotting and leads to excessive bleeding.

The systemic effects are potentially life threatening more so than the local effects. The systemic effects include things like coagulopathy (affects the way the blood clots), neurotoxicity (affects the brain), acute kidney injury, and myotoxicity (toxic to skeletal muscles). Neurotoxicity mainly results from elapid bites and is strongly correlated with the paralysis often

associated with snake envenomation, this includes paralysis of the facial, bulbar, respiratory and limb muscles that can lead to respiratory failure and death (2). The local effects being at the snake bite site, while not as severe are still very serious and definitely need medical attention. Local tissue damage is caused by a range of myotoxins and cytotoxins which can lead to extensive tissue death and potentially require amputation (4)!

Some of the most obvious symptoms include:

- Swelling and redness around the wound
- Difficulty breathing
- Vomiting and nausea
- Blurred vision
- Sweating and salivating
- Numbness in the face and limb

How do I perform first aid on a snake bite?

The first aid procedure for a snake bite in Australia is called **Pressure Immobilisation (PIM)**. This is basically applying constrictive pressures to treat snake envenomation. It is very simple. Pressure immobilisation simply involves wrapping a bandage around the envenomed site from as far down as the limb as possible to as far up the limb as possible. Done very similarly to applying bandage to a sprained wrist or injured knee, with the only exception of ensuring a splint is applied to confirm immobilisation (3).

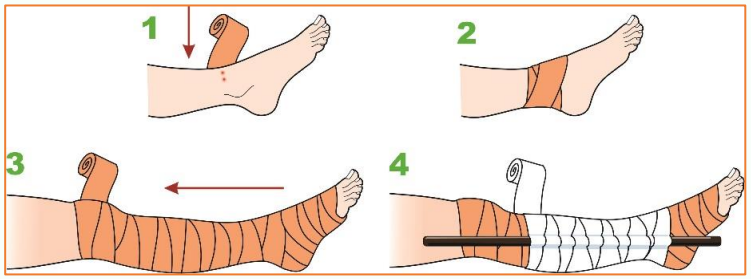

Figure 2: Demonstration of pressure immobilisation technique being performed on a snake bite on the lower limb, ensuring being bandaged all the way to the top and bottom of leg.

Pressure immobilisation is advantageous over any previous first aid methods and is now clinically acceptable in Australia due to it being very successful. It is simple, non-invasive, and cheap and is effective for a broad range of envenomations (3). Just remember to 1. Always apply this first aid procedure to a snake bite immediately 2. Do not move the bite site and 3. Always seek help. Even a few minutes of waiting around or incorrectly moving the limb can be crucial when it comes down to minimising the spread of the venom and risking your chances of survival.

Did you know: Using pressure immobilisation as a first aid approach is only effective in Australia! This is because snake species overseas contain cytotoxins and snakes in Australia do not → if a snake bite containing cytotoxins is pressure immobilised it will increase the concentration of the venom in that area and make the situation much more dangerous ☹

You have completed first aid. Now what? Will I survive?

Well you are half way there…sort of. The very last step to ensure your snake bite is treated correctly is to administer an antivenom. Not by yourself of course!

What is an antivenom? An antivenom is actually made up of antibody fragments from horses. Impressive I know! We know an antibody is a very important protein in our body that kills unwanted bacteria and viruses. So do you see where this is going? Professionals inject toxic venom into horses and when those horses develop an antibody to the venom it is extracted and prepared into an antivenom to treat us humans. The antivenom in humans binds to and neutralises free venom which prevents further toxic effects on the body (4), (1).

Sounds too good to be true right? Well there are always some negatives. Antivenom can commonly cause allergic reactions such as severe anaphylaxis as it is produced from horse serum, which can complicate the current medical situation (5). They are quite expensive, especially when the snake has not been identified. A polyvalent (treats many venoms) antivenom is then required which is much more expensive than a monovalent (treats specific venom) antivenom. Five monovalent antivenoms are now available for all major venomous snakes in Australia. A polyvalent antivenom which covers all types can cost up to $1000 and there is no way to determine how much antivenom will be needed because it is dependent on the size, species, and yield of venom (3). Once the antivenom is administered you will recover shortly and can be deemed officially treated, thanks to the use of first aid and the effective antivenoms used in Australia.

In summary, it is easy to understand the importance of adequate first aid and early intervention when assessing a snake bite. Being able to recognise the symptoms of a snake bite and to comprehend the actions that are required to treat it, such as pressure immobilisation and administering an antivenom will save your life and assist in reducing snake bite related fatalities (6).

It can be difficult to distinguish between a venomous and non-venomous snake bite. Take home message: ALWAYS treat a snake bite as if it's venomous.

References

1) Chugh, K.S. 1989, "Snake-bite-induced acute renal failure in India", *Kidney international,* vol. 35, no. 3, pp. 891-907.
2) Kharat, R., Chaudhari, V., Sonawane, S., Sabale, P. & Mohite, S. 2013, "Early Detection of Snake Bite - A Case Report", *Medico - Legal Update,* vol. 13, no. 1, pp. 85-88
3) KNOX, I. (2009). Snake bite. *Emergency Medicine*, 3(4), pp.268-274.
4) Sanhajariya, S., Duffull, S. and Isbister, G. (2018). Pharmacokinetics of Snake Venom. *Toxins*, 10(2), p.73.
5) Stewart, C. (2003). Snake bite in Australia: first aid and envenomation management. *Accident and Emergency Nursing*, 11(2), pp.106-111.
6) Zornig, B. 2015, "Acute kidney injury secondary to Eastern Brown snake (Pseudonaja textilis) bite: a case study", *Renal Society of Australasia Journal,* vol. 11, no. 2, pp. 56-61.