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Snake Bites in Pediatric Patients, a Current View

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1. Introduction

It has been estimated that worldwide about 5 million people (adults and children) are bitten by snakes every year (Kalantri et al., 2006), and 50,000 die according to data from the World Health Organization (Schaper, de Haro, Desel, Ebbecke, & Langer, 2004). However, it is well known that events related to snake bites are under-reported, especially in the author's country possibly because snakebites are not a very relevant cause of mortality. Nevertheless, they are a serious cause of morbidity, especially in children. Under-reporting of this important health issue can be blamed on the fact that the population is not well informed about snake classification causing them to not provide accurate information to healthcare personnel when a patient is taken for medical care after a snake attack. Children do not react to snake bites in the same way as adults. In children, this event is always more severe since they are exposed to a larger amount of venom per m² of body surface (De la O Cavazos 2006). A small child is more vulnerable to a given volume of venom than a larger individual (Hodge III & Tecklenburg, 2006) Also, there will be different presentations including neurotoxicity, myotoxicity, renal failure, edema, bleeding due to activation of clotting proteins, and intravascular hemolysis, because different kinds of snakes have different types of venom that cause different symptomatology. (Jeng & Glader, 2004).

On the other hand, there is very little information for primary care physicians and pediatricians and most of the time it is outdated. Hence, the need for a reliable source of information in the event of a snake bite in pediatric patients that is updated, easy to find and well-structured in a way physicians find it easy to read and to easily and rapidly translate it into clinical practice to assure a fact-based, accurate treatment and prompt recovery with the least possible amount of sequels.

2. Epidemiology

Snakebites are seriously under-reported all over the world. We currently do not have trustworthy studies or statistics to asses this problem. What we do have is information that can guide us and inform us about the most affected areas and the most common presentation. For example, studies such as the one by Ruiz Molina and cols. show not only a

higher incidence in men (2.5:1) but also a reasonably high incidence in pediatric population between the ages of 11 and 16 (39.3%), followed closely by even younger children ages of 6-10 (32.1%). This may be related to the fact that in several under-developed tropical countries where snakebites represent a major health issue children take part in agricultural activities or are attacked due to their innate curiosity, which in turn, makes them victims more easily than adults. Snake bites remain a public health problem in most countries. This is especially true in countries where agricultural activities are predominant, since this is one of the occupations more often affected by snakebites (Chippaux, 1998). Once we get hold of he few statistics we have, we face a new problem: the disparity in the epidemiological data. This reflects different grades of reporting. The more industrialized the country, the more reliable the statistics are. Sadly, snake bites are a problem related to low-income countries that have frail health systems and a lower rate of reporting. Also, morbidity and mortality have low rates and are well documented in first-world countries, probably because of the health facilities and availability of newer and better treatments. This is yet another argument to sustain that snake envenoming is a disease of the underdeveloped countries. In the few studies we can relate to, a negative association between snakebite deaths and government expenditure on health services has been found. Because of this, mortality is highest in these countries, since the population has no access to proper and adequate treatment and the government is not able to provide it because they are just not capable of dealing with the financial burden of snakebites (Harrison, Hargreaves, Wagstaff, Faragher, & Lalloo, 2009).

In México, an average of 20 deaths per year are reported. However, very few accidents are reported in communities most at risk. These communities also have little access to health services. In fact, about 27 000 cases of snake envenomation and more than 100 deaths per year occur in México. Between 1994 and 1996, the Mexican Social Security Institute (IMSS) reported 1 961 venomous snake bites; thirty percent of patients were children. In the IMSS report, the age group most affected was 15 to 44 years, with 51.4% of cases. The immense majority of poisonings occurred between June and October and 70-90% of these bites were located in the legs.

Area of the Body Involved	Frequency (%)
Foot and Ankle	72
Thigh	14
Hand	13
Head	10

Table 1. Areas most commonly involved in snakebites.

For years, it has been accepted that snake attacks occur in the field and men are the most affected, but in the study by Sotelo-Cruz it was found that there is no predominance in gender and while it is true that most of the children attacked were from rural areas, these attacks occured nearby their living places in some cases even within their home. The seasons of the year when more attacks were reported were summer and autumn. This is because the summer season in these countries lasts nearly six months. The time of day when most of the attacks happened ranges from 2:00 and 7:00 p.m., although 12.7% of the attacks happened during the night, the injury site was located in the legs in 78.1% of cases (Sotelo 2004).

3. Snake identification

In the world there are over 2,500 snake species described, of these, only about 350 are considered poisonous and dangerous for humans. These 2,500 snake species are divided into 15 families and the following have enough species to be relevant or dangerous (Government of Canada, n.d.): Colubridae, Boidae, Viperidae, and Elapidae or Hydrophiidae. Just as we have countries where venemous snakes are a major health issue because of the large number of species they harbor, we also have countries where venemous snakes are virtually non-existent (except for imported snakes), such as New Zealand, Cuba, Haiti, Jamaica, Puerto Rico, Ireland, Polynesia, Hawaii and the polar regions.

In this chapter, we are going to be focusing on the snakes most commonly found in the Americas, more specifically in North America (the United States and Northern México), These snakes are from the Elapidae and the Viperidae families such as the pit viper, the rattlesnake, the water moccasin, and the copperhead, since they are responsible for about 99% of the cases reported. The coral snake, which can also be found in North America, is responsible for only 1% of the cases, along with the exotic imported species.

Fig. 1. Diagram that shows the fifteen families of snakes in the world. The families marked in red contain the most important and dangerous snakes in America.

A very important part of the process of providing the best medical care available resides in the identification of the snake. Important as this is, it is recommended not to go after the snake to try to identify it or kill it. We need to remember that most snakes only attack when they feel menaced in the first place, thus, going after a snake after it has already attacked would put us in more danger, risking a second bite or a first bite in a different person. If we are in an advantageous situation (adequate lighting, such as broad sunlight, regular, flat

surface with minimal plant growth, etc.) there are several bits of information we should recall if we clearly see the snake:

3.1 Pit viper

These snakes have pits, one in each side of the face, located between the eye and the nostril. These pits, not found in the non-venomous species, contain heat-sensing organs, very important for these venomous snakes, since they have a very poor vision. If we have a good view of the snake, we can observe its pupils, which are different from non-poisonous snakes. Pupils in the pit viper are elliptical and vertically oriented. The fangs in venomous snakes are only superior, two in number and hollow. These are usually 5 to 20 mm long. These fangs are folded posteriorly in the palate and are shown only when the snake attacks. Regarding the head, in most poisonous snakes it is more triangular than in non-poisonous snakes. Last, if the snake is captured or killed, we can examine the anal plate. In poisonous snakes the scales are in a single row after the anal plate. In non-harmful snakes the anal plate ends in a cleft or a double row of scales. These snakes produce an hemotoxic venom.

3.1.1 Rattlesnakes

There are four kinds of rattlesnakes (Crotalus) in North America, this is the reason why this species is very heterogeneous regarding its colors and length. We have: the Eastern Diamondback, the Western Diamondback, the Mojave Rattlesnake and the Tropical Rattlesnake. The Eastern Diamondback is the most common. We can find it in the Southeast Coastal area of the United States (North Carolina, South Carolina, Louisiana and Florida). This snake can be up to two meters long and has a characteristic pattern of bright lines that form a symmetric diamond pattern. The Western Diamondback lives in the Southeast of the United States, mainly southeast California, Oklahoma, Arizona, New Mexico and Texas. It is a little shorter than the Eastern Diamondback measuring only up to 1.5 meters. The Mojave Rattlesnake can be found in the Southwestern United States, principally in the Mojave Desert in California, Nevada, Southeast Arizona, Texas and the north portion of Mexico. It prefers rocky desert areas and this species is only about 75 cm. Last, we have the Tropical Rattlesnake, which lives in crops and sandy areas in the Southern of Mexico, Central America and South America (except Chile). These can measure up to two meters long, even though it usually is 1.5 meters long. These snakes are responsible for approximately 60% of all pit viper attacks and for this reason emergency staff need to be familiar with the general characteristics of these snakes and always take into consideration the possibility of a rattlesnake attack when treating a patient that has been bitten by an unidentified snake in the United States and Northern Mexico (Hodge III & Tecklenburg, 2006). Rattlesnakes attract children because of the sound the rattle makes when the snake is ready to attack.

3.1.2 Copperheads

The copperhead (Agkistrodon contortrix) is a common poisonous snake that lives in the Southeast United States (from Florida to Massachusetts) and much of the Northeast (Oklahoma, Illinois, Kansas, Ohio) but it can reach westward to states such as Texas and Nebraska. This reptile accounts for approximately 30% of venomous snake bites but, luckily,

it is seldom a serious threat to life or limb. Copperheads are usually 60 cm to 1 m in length and have a light pink to red–brown body with darker brown crossbands shaped like hourglasses. The head has a coppery tinge (Hodge III & Tecklenburg, 2006).

3.1.3 Water moccasin

The water moccasin, also known as the cottonmouth (Agkistrodon piscivorus), is a semiaquatic pit viper found in the Southeastern of the United States, including Southeast Virginia, West and Central Alabama, South Georgia, Illinois, East and central Kentucky, South and Central Oklahoma, Texas, North Carolina, South Carolina and Florida. These are larger and more belligerent snakes, often traveling with their heads in an aggressive 45-degree angle from the horizontal. Their body is olive brown to black, with darker markings on the sides that often fade over the dorsum. The ventral surface is lighter in color. The oral mucosa is distinctively white, hence the name cottonmouth. Like the copperhead, bites from this species are, in general, less serious than Crotalus species (Hodge III & Tecklenburg, 2006). The cottonmouth may alert the future victim of the imminent attack by mouth gaping and tail vibrations (Glaudas & Winne, 2007).

3.2 Coral snake

Coral snakes belong to the Elapidae family. This is a relatively shy and passive snake. It can be found in Southeast United States as far as west Texas, as well as in countries from Central and South America. Unlike the pit viper, coral snakes have round pupils, not so triangular heads and do not have pits with heat sensing organs between the eye and the nostril. They can measure approximately 60 cm. and are described as a brightly colored snake. They can attract young children, who end up being victims of this venomous snake. It can be easily confused with non-poisonous snakes because of their bright colors. If the snake is presented in a safe way we can observe red and black bands that alternate with narrow yellow rings. Whenever we see yellow rings next to red bands we should think of a coral snake. Non-poisonous similar snakes have yellow rings directly in touch with black (and not red) bands.

3.3 Snakes outside america

In Europe, Africa and Oceania, we have an enormous number of species as dangerous as the ones living in America. In Europe, the Common adder is distributed widely across the continent, even reaching the northern part of Morocco. Has a variable color, ranging from completely black specimens to different dark zigzag patterns, measuring around 45 centimeters. Inoculates hemotoxic venom, its victims usually are campers, hikers and field workers. Another hemotoxic venom inoculating snake in Europe, although not as common (found only in Italy, Yugoslavia, northern Albania, and Romania) is the Long-nosed adder, which is gray, brown, or reddish with a dark brown or black zigzag pattern running the length of its back. A dark stripe is usually found behind each eye. In the southeast Europe area we can find the Pallas' viper with hemotoxic venom that is rarely fatal.

Regarding Africa, the Boomslang a 60-centimeter green or brown snake with hemotoxic venom inhabits the sub-Saharan Africa. Through most of the African territory particularly Angola, Cameroon, Uganda, Kenya, and the Congo we can find the Bush viper, often called

leaf viper because of its color and because it uses its prehensile tail to secure itself to branches. Its venom is hemotoxic and healthy adults rarely die from its bite. The feared Asiatic cobra is distributed from southeast to southwest Asia, including Indonesia. Its venom is highly neurotoxic, causing respiratory paralysis with some tissue damage. With even stronger neurotoxic venom and wider distribution (From southeast to southwest Asia, including Indonesia) we have the Egyptian cobra

4. Pathophysiology

In the pathophysiology of envenomation we can consider different factors that can be divided into human factors, which include the size of the victim, general health and wound characteristics, such as depth of fang penetration and location of the wound and snake factors which include the size of the snake, the amount of venom injected, and the strength of the particular species venom. Healthy, angered and hungry snakes unload more venom than a recently satiated and surprised snake (Hodge III and Tecklenburg 2006). Snake venom is a complex mixture of proteolytic enzymes, peptidases, proteinases, phospholipases and neurotoxins that are able to cause serious damage to the musculoskeletal, blood clotting, cardiopulmonary, renal and central nervous systems. Due to the venom, there is cell function degeneration and the final outcome depends on the type of venom injected. Generally, envenomation increases capillary permeability that results in blood and plasma loss from the intravascular to the extracellular space, creating edema, which, in case of being sufficiently important, may cause circulatory compromise and hypovolemic shock. Also, snake venom has citolytic properties, which cause local necrosis and secondary infection, which could result in sepsis and death (De la O Cavazos 2006). Venoms with neurotoxic activity produce paralysis and respiratory distress by binding the nicotinic acetylcholine receptors, and preventing the depolarizing action of acetylcholine. Hemotoxic effects induce hemolysis, fibrinogen proteolysis, and thrombocytopenia, which, along with activation of plasminogen, can lead to a bleeding diathesis in severe envenomation (Hodge III & Tecklenburg, 2006). Cardiotoxic effects lead to heart failure as well as myotoxicity and nephrotoxicity. Some are known poisons and it is important to know their mechanism of action for diagnosing anding accidents caused by these reptiles. It is also helped to unveil a number of physiological distrurbances caused by these venoms regarding neurotransmission, coagulation processes and mechanisms of inflammation. The most important effect of neurotoxins is to prevent the transmission of nerve impulses in cholinergic synapses. ALFA neurotoxins interfere with neurotransmitter release and cause muscle paralysis, respiratory failure and death by asphyxiation. Phospholipase A2 catalyzes the hydrolysis of phosphoglycerides creating phospholipids, which have detergent properties with a highly polar hydrophilic head and a hydrophobic tail and therefore they are capable of damaging cell membranes by breaking the continuity of its bilayer lipid . They have an important action in the phenomena of hemolysis, myonecrosis, neurotoxicity and anticoagulantion. The myotoxin-type crotalin protein acts through activation of sarcolemmal channels, inhibiting the activity of sarcoplasmic reticulum ATPase with significant depolarization and changes in the osmolarity of muscle fibers with vacuolization and lysis of myocytes and, local necrosis of skeletal muscle. The coagulants and anticoagulants such as the crotaline venoms cause a syndrome similar to disseminated intravascular coagulation (DIC) through an enzyme protein similar to thrombin, which

prompts the formation of fibrin monomers, generating an abnormal mesh of fibrin, upon which the factor XIII can not act being lysed by the mechanisms of fibrinolysis as degradation products of fibrin D-dimer. It also contains inhibitors of factor X activation of prothrombin and thrombin and fibrinogenases.

5. Clinical manifestations

We can have diverse clinical manifestations when it comes to snakebites. The inapparent bites occur mainly when dealing with non-venomous snakes or when we have a bite by a venemous snake which did not cause symptoms. Due to the low frequency of poisoning by snake bites, it has been suggested that snakes who bite as a defensive move against humans do not inject enough venom to cause systemic symptoms, these are called dry bites.

Generally, local events occur in the time span of the first 10 to 30 minutes. Local pain is perceived along with the presence of edema, exudate and presence of bullae, accompanied by numbness of the tongue, jaw and scalp. There may be numbness around the bite with bleeding or a purpuric rash and/or necrosis or gangrene. As for the systemic manifestations, they start with the onset of fear and impending death feeling, which accelerates absorption of the venom. Other symptoms depend on the pathophysiological changes of the venom of certain species; neurotoxic venoms manifest as neuromuscular blockade resulting in flaccid paralysis, ptosis, and difficulty breathing; cardiotoxic venoms manifest as tachycardia, hypotension and ECG abnormalities, there may be fluctuations in heart rate, blood pressure and even heart failure in severe cases. There may be muscle necrosis resulting in myoglobinuria.

Different poisons trigger different clinical manifestations and it is important for healthcare staff to learn to recognize the general characteristics of every single of them or at least the more common, depending on their geographical localization.

5.1 Pit vipers

Pit viper snakes (rattlesnakes, copperheads, and water moccasins) produce hemotoxic venom. Local pain is typically intense, and a sensation of burning occurs within five to ten minutes. The pain is greater with ensuing edema and presumably increases with a larger inoculation of venom. Only in rare occasions the venom will sediment in the muscle compartment, in which cases the amount of edema will be minimal. In Diamondback rattlesnake bites, the limb may swell completely in just one hour. There can be local echymmosis and vesicles in the first hours. Lymphadenitis and some adenomegalies may become apparent. Victims of a significant rattlesnake bite often complain within minutes of perioral numbness, extending to the scalp and periphery. This parenthesis may be accompanied by a metallic taste in the mouth.

These patients also may have nausea, vomiting, weakness, chills, sweating, syncope, and other more ominous symptoms of systemic venom absorption. A copperhead envenomation produces less local symptoms, and systemic consequences are often minimal or nonexistent unless a small child, multiple bites, or a larger than average snake is involved. The water moccasin's effects are more variable.

5.2 Coral snakes

In Coral Snake bites, the inoculation of venom is neurotoxic. Clinical manifestations from a coral snake envenomation are mild pain (against intense pain from a pit viper snakebite), swelling, erythema and paresthesis in the area of the wound. The wound is represented by puncture marks, abrasions or scratches (D. L. Morgan, Borys, Stanford, Kjar, & Tobleman, 2007). Most snake bites do not leave important local signs other than one or two punctures and sometimes small teeth marks. Systemic effects appearing after several hours include nausea, vomiting, dizziness, malaise, slurred speech, muscle weakness, respiratory depression, or seizures (Hodge III & Tecklenburg, 2006).

6. Laboratory

The laboratory tests are of little importance to diagnose a snakebite, with the exception of the ELISA test, which is available to identify the species involved, based on venom antigens. These studies are expensive and are not fully available and are of no value except for epidemiological studies. In a hospital setting , laboratory studies are important to monitor poisoning victims, as well as when determining stages of treatment.

Changes in the blood include anemia, leukocytosis and thrombocytopenia, the blood smear may show evidence of hemolysis. Also, prolonged clotting times and decreased fibrinogen may be present. Among the metabolic changes we can find hypokalemia and respiratory acidosis if neuroparalysis occurs.

Urinalysis may reveal hematuria, proteinuria and hemoglobinuria. Electrocardiographic changes are usually nonspecific and may include rhythm disturbances, mainly bradycardia, AV block with ST segment elevation or depression. Cholesterol lowering has been documented and can be explained by transcapillary lipoprotein loss. There have been reports of changes in the electroencephalogram in up to 96% of patients with snake bites, but none showed clinical changes or encephalopathy. In 62% of the patients, the electroencephalogram showed grade I changes, 31% showed grade II changes. (Avila-Aguero: ML199).

7. Management and treatment

Science has made enormous advances regarding the pharmacologic treatment of children and adults who have been victims of snake bites. Successful treatment will always depend on the rapidness with which management begins, even at the scene of the attack, and, of course, once the patient arrives for appropriate management to a hospital.

7.1 Prehospital care

As we mentioned before, efforts should not be made to catch the snake, since this might result in wasted time and further bites. The basis in prehospital care is to limit the spread of venom throughout the body. Compressive bandages might be of help. These can be done with elastic bandages, if available, or torn clothing after removing clothes and jewelry. The extremity should be kept below the level of the heart. The bandage should be tight enough to help delay systemic absorption of the venom. Please be aware that incisions and suction

are not indicated and could actually promote the development of further infections (D. L. Morgan et al., 2007). Remember that all bite wound are already considered contaminated wounds and that these invasive measures might actually worsen the problem unless performed in the first 30 minutes after the attack has taken place and in a sterile environment (Robert L Norris & Adler, 2011). Tourniquets that completely occlude vascular irrigation have created more problems than those solved, therefore, they are not recommended for their prehospitalary care.

7.2 Emergency room care

As soon as the patient reaches the hospital it is important to asses the CAB (circulation, airway and breathing) before starting any kind of treatment, this includes appropriate management of any active bleeding and of the airway to avoid respiratory failure or aspiration. Monitoring of vital signs can be useful to forecast complications and most of the times this can be done in the emergency room without sending the patient to the ICU. After these measures have been taken care of, hydration is next, since one of the effects of snake venoms is to mobilize intravascular fluid to the interstitial space, leaving the patient dehydrated. For this, normal saline or Ringer´s lactate is used. Laboratory tests that are useful in these settings are CBC, PT/PTT, serum electrolytes, CPK, urinalysis, BUN and creatinine and a cross-match for blood.

The wound should be inspected, if fang marks are found, the distance between them needs to be measured in order to get an idea of the size of the snake. The distance between fang punctures smaller than 8 mm suggests a small snake, between 8 and 12 mm a medium snake and a distance greater than 12 mm suggests a large snake. In the case of the patient being bitten by a rattlesnake, the fang punctures could be hidden by hemorrhagic blebs and edema. If no puncture wounds can be found, we need to consider the fact that scratches and abrasions could be envenomed wounds until we demonstrate otherwise. When a snake attacks and bites 10 % to 20% of the time it does not inject any venom (dry bite) and if we are dealing with a non-venomous snake we could observe a row of tiny teeth without fang punctures. As a precaution, the circumference of the limb should be measured every thirty minutes for 6 hours and every 4 hours until 24 hours have passed with the aim of preventing the development of complications related to important edema. If no systemic symptoms are evident, the wound should be cleansed, dressed and slightly elevated.

In the setting of not only the subject being bitten, but also suffering from envenomation, the use of antivenins is required. In the case of pit viper attacks, there are two antivenins, the Polyvalent Crotalic Antivenin (PCAV), which is the oldest, derived from horse's serum and highly antigenic, which is the reason for it to be discontinued from the United States market. In 2000, the FDA approved the Crotalic Polyvalent Fab Immune (FabAV) to manage patients with mild to moderate envenomations by American crotalus and since the Polyvalent Crotalic Antivenin is no longer marketed, the Fab Immune represents the only treatment option available in the United States, regardless of the severity of the envenomation. This alternative is derived from sheep's serum, a property that makes it less antigenic that its predecessor. FabAV appears to be effective in the management of severe crotaline snake envenomation (Lavonas, Schaeffer, Kokko, Mlynarchek, & Bogdan, 2009). It is available as a powder that needs to be reconstituted with normal saline. Regarding the use of PCAV, the

dosing should be greater in children than in adults; for FabAV, since it can be eliminated before the venom emerges from tissues, therefore, a fixed dosing schedule is used. When using PCAV, a crash cart (including instruments to ensure airway patency, IV adrenaline, antihistaminics, steroids, etc) should be readily available because of the antivenin's elevated immunogenicity and risk of anaphylactic reactions. Skin testing should be performed and is done by injecting 0.02 ml of 1:10 diluted antivenin. Skin testing is not necessary for use of FabAV. Even though the use of antivenin is the only treatment for envenomations, its use is not free from adverse reactions, some of which could be life-threatening such as anaphylaxis. Some authors recommend the use of 0.25 ml of 1:1000 subcutaneous adrenaline to reduce the risk of acute adverse reactions to the serum (Premawardhena, C. E. de Silva, Fonseka, Gunatilake, & H. J. de Silva, 1999). If no adverse reactions appear, the full dosage should be administered (one vial with 10 ml saline solution) diluted in normal saline 1:4 as a slow infusion (1 or 2 ml per hour). Even after negative skin tests, one should be aware of the signs or symptoms of anaphylaxis within the first 10-20 minutes. If data suggestive of an anaphylactic reaction are not observed, the remaining volume should be passed on within two hours. The initial dose should be repeated until the swelling has stopped. There are reports in children of up to 75 bottles being used. In case of anaphylactic reaction, the infusion must be stopped and diphenhydramine administered (1 or 2 mg / kg IV). The infusion can be restarted at a slower rate, but a close watch should be kept and if symptoms of anaphylactic reaction reoccur treatment with antivenom should be discontinued.
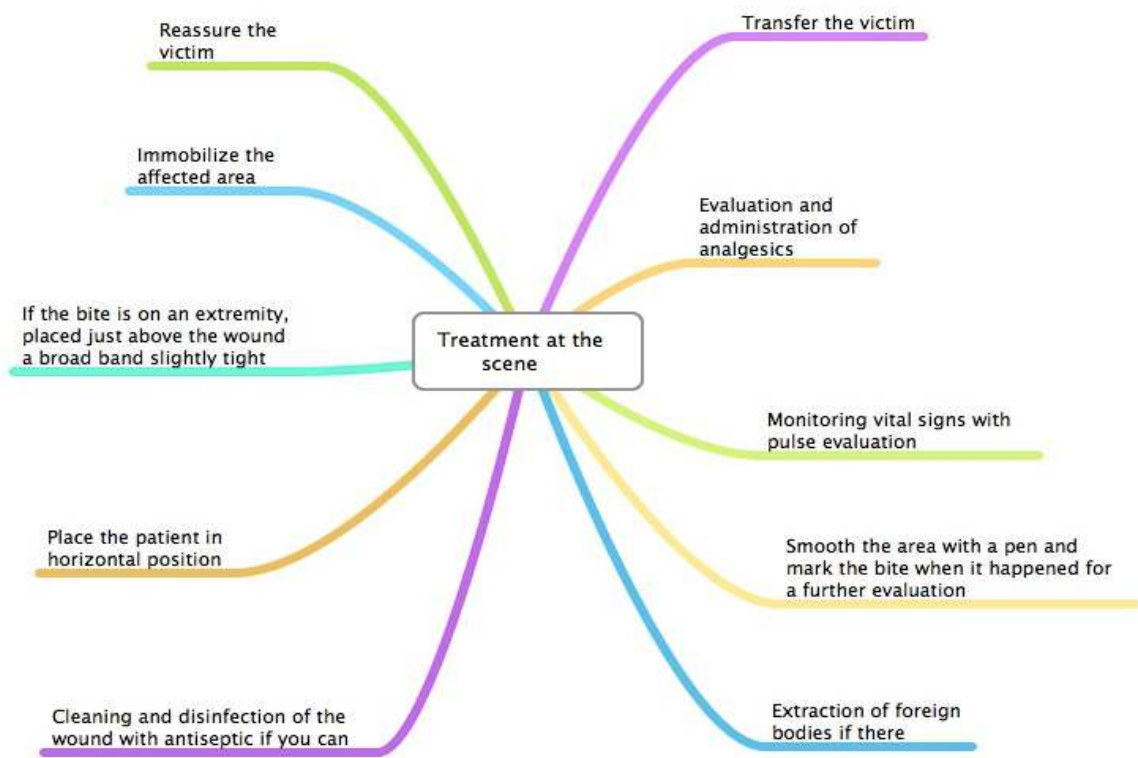

Fig. 2. Diagram that shows actions that should be taken care of when helping a snakebite victim.

In patients who receive FabAV, the starting dose consists of four to six bottles in a period of one hour. Each vial is reconstituted with 10 ml of sterile water mixed in a total dose in 250

ml of saline. The infusion is started slowly to see if there is a reaction to medication, if not, the rest of the load is administered in one hour. The initial dose is fixed, regardless of the degree of poisoning. Subsequent doses are administered depending on the progression of the clinical evolution.

Modified scale that correlates of clinical signs, edema and dose of antivenom in children					
(Christopher-Rodning)		Loading dose			Subsequent doses
Grade	Signs and symptoms	Direct (intra-venous) 1ml/min Normal saline	First hour 100 ml dilute solution (glucose-normal saline 2:1)	Following three hours in 250 ml mixed solution	Maintenance (value)
0	Evidence of bite without poisoning (probably dry bite)	0	0	0	
1	Mild poisoning, pain and edema less than 10 cm from the lesion.	2-3	4	Rate 4 bottles	Assess clinical status
2	Moderate poisoning: pain, edema greater than 15 cm from the lesion site, changes in skin, lymph regional.	5	10	6-8 bottles	Assess clinical status
3	Severe poisoning, swelling around the affected limb, vomiting, dizziness, fever, most notable changes in skin (ecchymosis, bullae, petechiae, numbness, oliguria)	5	20	6-8 bottles	4-5 bottles every 4 hours
4	Severe poisoning, bleeding bite marks, bruising and petechiae extensive data of disseminated intravascular coagulation, acute renal failure, respiratory distress, multiple organ failure.	25	25	10 bottles	4-5 bottles every 4 hours

Table 2. Modified scale correlation of clinical signs, edema and dose of antivenom in children.

When facing bites by Coral Snakes, the FDA extended the expiration date on the only product available in the United States to treat these envenomations. Wyeth's *Micrurus fulvius* Antivenin is no longer in production and there has been a need to obtain antivenoms produced in other countries (eg, Brazil, Costa Rica) for non-North American coral snakes. Mexico shares snake distribution with the United States. This country produces antivenom that is likely effective for coral snake bites in the United States. In the absence of such antivenom care must be entirely supportive. (R. L Norris, n.d.). Wound care should include irrigation, cleansing and dressings. Is convenient to consider tetanus prophylaxis and analgesia in case of need.

8. Complications

Compartmental syndrome is a limb threatening complication and it is considered a medical emergency that should be managed with fasciotomies. Fasciotomies are indicated in patients with signs and symptoms related to the syndrome, such as, pain to passive mobilization, hipostesia, weakness and elevated compartmental pressure, measured every hour with more than 30 mmHg regardless of elevation of the extremity and the administration of the antivenin. (Walter, Bilden, & Gibly, 1999)

9. Prevention

Snake bites are considered occupational accidents involving farmers, workers in plantations, sheepherders and fishermen (Alirol, Sharma, Bawaskar, Kuch, & François Chappuis, 2010). The Statistical Yearbook of the Méxican Ministry of Health (SSA) in the chapter on accidents and poisoning in the section of hospital morbidity does not appear to report cases of snakebites in the years 1995 to 2000. Clearly there is an underreporting of such injuries. This assertion is based on the IMSS 1994-1998 reported 2 620 cases with 23 deaths (0.8%). (Madrazo-Navarro M, Zarate-Aguilar A, 1998). Although in normal conditions victims are adults, we must take into account that children perform these activities in many third world countries. In performing these activities, people should wear appropriate clothing (heavy pants, rubber boots) and it could be helpful to limit activities that involve staying in areas with tall grass to hours with sunlight. Most of the times this is impossible, and in these cases is important to educate the population about the appropriate pre-hospital management in case of a snake bite. They should know the fastest routes to reach the nearest hospital and take into account that children engaged in these activities are at greater risk of bites by snakes and that the severity of these lesions is greater, even if they are exposed to the same amount of venom as an adult.

Open rooms with no windows or doors and some habits, such as sleeping on the ground exposes people to night snake attack (Alirol et al., 2010) and these practices must be eradicated whenever it is possible. Since the snake bites are more common in the legs, feet, to be more precise, the mere fact of having children wear shoes dramatically reduces the incidence of such bites, as well as keeping children away from sites where snakes may hide, especially in the evenings and early hours of the morning in summer and autumn seasons. (Hon, Kwok, & Leung, 2004)

There is very vague knowledge about the procedures to be followed when someone is attacked by a snake, below we present some guidelines that contrary to popular belief and misinformation should not be performed:

- No incisions in places where the bite is located, as excesive bleeding and the risk of infection are favored.
- Do not use tourniquets since they hinder blood flow and therefore cause more tissue damage.
- Do not apply ice, it worsens local lesions caused by poison.
- Do not administer electric shocks of any kind.
- Do not use any chemicals or extracts of plants or animals of any kind, so far none have been proven scientifically effective as treatment.
- Do not give alcoholic beverages.
- Do not suction with the mouth, this favors infections on the bite site and can be dangerous if you have a cavity or open lesion in your mouth. In addition there is no guarantee of how much venom you can withdraw with this method.

10. Conclusion

Snakebites are not an infectious disease, they do not have an epidemic potential and snakes themselves are not vectors that carry important diseases throughout the world. Nonetheless, the mortality caused by these attacks is greater than the mortality attributed to other diseases such as dengue hemorrhagic fever, cholera and Chaga's disease. At least 100 000 people die as a result of snake bites each year, and around three times as many amputations and other permanent disabilities are caused by snakebites annually and agricultural workers and children are the most affected (World Health Organization, n.d.). It is important to be familiar with first aid procedures as well as proper treatment in a hospital environment in order to decrease deaths and prevent complications and sequels derived from this very important health issue.

Science has made tremendous progress with regard to drug treatment for children and adults who have been bitten by snakes. Successful treatment will always depend on the speed with which you begin handling the victim from the outpatient level, as well as the availability of the drugs for proper treatment once the patient enters the hospital. Keep in mind that treatment recommendations published in 1999 could represent insufficient dosages and it is necessary an accurate clinical assessment to provide an effective therapy.

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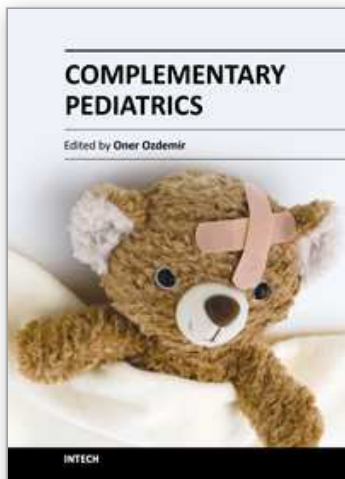
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