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Zootoxins as a Health Problem in Animals and People

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Abstract

Poisons are mixtures of enzymes with useful functions for the evolution and survival of each of the species that produce them. Among the poisons produced by the same family, cross antigenic reactions can occur, among various species of animals such as scorpions, toads, snakes, etc. [1,2]. The effect of zootoxins in animals and people the symptoms are similar: local pain, erythema, itching, edema, burning pain, redness, with whitish area in the center, change of color to purple, hemorrhage in the area, formation of vesicles, formation of vesicles, formation of pustules, necrotic scab, deep ulceration [3-5]. In Mexico, bites by Arthropods represent a serious problem, including scorpions of the Centruroides genus and spiders of the genera Loxosceles and Latrodectus, [6-8] and their severity. is represented by the cases reported in 2018, Poison intoxication of animals 2,680 men and 2,486 women in 2017 and 22, 166 men and 23, 446 women give a cumulative in 2017 of 50 518. Regarding intoxication of Scorpion poisoning, added 22 166 men and 23 446 women with an accumulated in 2018 of 50 518 cases [9].

Introduction

The poisonous animals are those that possess a poison gland and inoculate it by means of structures adapted to inoculate such as bite, sting or contact that lacerate the skin and tissues and are frequent worldwide since they are important in the health sector of great impact [5,10]. Toxic or poison any substance external to the body, that affects the vital phenomena when it comes into contact with the organic surface or when it enters the body through an appropriate route, aided by the chemical properties of the substance. Tay & Louis [11,12]. Toxin poisons produced by living beings, plants (phytotoxins), animals (zootoxins), bacteria (exotoxins and endotoxins), fungi (mycotoxins) [7,13].

There are two toxic, the so-called general or systemic effect whose action is on a system an example is to be blocked oxygen, all cells of organisms are affected; there are also toxins that act on a specific organ, and are called (white organs) or tissues (white tissues) [6,7], white organ to the hematopoietic system. Vemon "poison of the animals that introduce it by means of a specialized apparatus (example: poison of bees, wasps, scorpions [13-15]. Poisons are a mixture of biologically and pharmacologically specialized compound enzymes: proteins and polypeptides with toxic and enzymatic activity; they can be proteolytic, coagulant, hemolytic and neurotoxic, with useful functions for the evolution and survival of each of the species that produce those [16]. But when being deposited in other organisms their results are fatal, an example is the Betatoxina present in the scorpions, responsible for altering the permeability of the ion channels, with greater effect in the potassium when acting on the membranes of neural, muscular and ganglion cells, releasing chemical mediators, such as acetyl choline and adrenaline, causing continuous depolarization [17,18]. Among the poisons produced by the same family, cross-antigenic reactions can occur, as well as among different species of animals such as scorpions, toads, snakes, etc. [19].

Epidemiology of Poisonous Animals

Between 1979 and 1994 a total of 11,272 deaths occurred in children under 15 years of age in the Mexican Republic. 6,300 were due to poisoning and toxic reactions caused by poisonous plants and animals. From these 73% were scorpion stings. Pérez G. in 2018 mentioned that an average of 350 thousand cases of poisoning by animals of poison are registered per year, so that alacrism and loxoscelism become a health problem. The SINAVE / DGE / Salud, recorded intoxications by poison of animals; 2,680 men and 2,486 women in 2017 and 22, 166 men and 23, 446 women give an accumulated in 2017 of 50 518. With regard to poisoning by scorpion sting, they added 22 166 men and 23 446 women with a cumulative in 2018 of 50 518 cases.

Geographic and Age Distribution

In the Mexican Republic, the highest incidence of cases of

poisoned animals occurs in the Northeast and Northwest, with the number increasing during the summer. 25% occurs in adolescents (11 to 20 years) with a predominance of males (greater than 66%), 70% of cases occur in the lower limbs, below the knee [16]. The environment in which the life of the animal species unfolds is abundant in toxic substances or potentially poisonous substances that can cause poisoning when the appropriate circumstances exist [15]. It must be demonstrated that there has been exposure to the substance to support the diagnosis [12,20].

Effect of Poisonous Secretions

The main effect is neurotoxic because it acts on the calcium channels of the neurons, causing incomplete activation of the same, presenting repetitive discharges in the axons. Exposure to zootoxins occurs through five routes, such as:

a. Digestive tract: dogs and cats play and consume rodenticide dead rodents, toads, wasps, scorpions, etc.

b. Pulmonary route: If the toxic substances are in gaseous, solid or liquid state, exposure occurs by inhalation, passes to the lungs and to the blood circulation.

c. Skin: When the skin is inflamed it is vulnerable to the action of toxic agents.

d. Transcutaneous route: Exposure in this way is through bites, bites: insects or animals, when injecting their poison directly.

e. Parenteral route: allergic reactions of each animal [12,20].

Clinical Case

Symptoms are related to quantity, power (younger snakes are more aggressive, and their venom is more concentrated) and the nature of the venom and snake species [21]. Clinical severity is related to the site of inoculation: face or trunk; if the deposit is in the blood vessel; the size of the snake involved because the larger ones inoculate more poison and the age of the affected person (child or elderly) [22,23]. The clinical case ranges from local pain, erythema, pruritus, edema, burning pain, redness, with whitish area in the center, color change to purple, hemorrhage in the area, formation of vesicles, formation of pustules, formation of pustules, eschar necrotic, deep ulceration [24]; Poisonous arthropods in Mexico, such as scorpions of the genus Centruroides and spiders of the genera Loxosceles and Latrodectus, are a major public health problem. Cases of more than 200,000 accidents per year have been reported due to scorpion stings and 3,000 to 5,000 per sting of spider [25,26].

Toads

They possess two voluminous glands called "parotid" located on both sides of the neck in a post orbital position [27,28]. The whole body of the toads presents ovoid glands, produces a watery and whitish venom irritating to predators, accumulates in a central cavity, and is excreted through a duct by the action of surrounding muscle fibers that when compressed is expelled [29]. The glands of Bufo paracnemis are called, paracnemis, located in the posterior area of the tibia [29]. They have a neutral fraction constituted by the derivatives of perhidrociclopentanofenantreno to the free state (cholesterol and buraginas) and conjugates with the suberilargina (bufotoxinas), that are responsible of the cardiotonic action of the poisons of toads; 2) A basic traction formed by substances of strong vasopressor action (adrenalin) and by a homogeneous group of triptamine derivatives (bufetenin, bufotanidina, dehidrobufotenina, bufothionina, to a less degree [24,30].

The poison contains budienols, bufotenins, bufotoxins, catecholamines: adrenaline and noradrenaline; and non-cardiac sterols [31]. Bufodienoles-bufofagins: are cardioactive steroids synthesized by the parotid gland from cholesterol, with action similar to digitalis, cardiac glycosides, possess a steroid nucleus, with a lactone ring on its carbon 17, selective activity on the heart, at a of carbon 3 produces glycosidic bonds with physical properties of solubility and liposolubility. The potency and union with plasmatic proteins, elimination and duration of the effect. Bufotoxin: is a component that is formed as a result of the union of bufofagins with an arginine molecule. Its action is observed enzymatically by inhibiting the ATPase of the Na + -k + pump of the cardiac muscle fiber, blocking the activity in the Na channels, raising the intracellular Ca ++ concentration, causing an increase in the contraction of the heart and a reduction in heart rate [29,32].

Signs

The toxicity of toad venom of the genus Bufo varies according to the species, some are more poisonous than others, eg. B. marinus is more poisonous than B. vulgaris [33]. The signs range from mild: irritation oral mucosa salivation; moderate: irritation oral mucosa, salivation depression and weakness, ataxia (walking in a circle), irregular heartbeat, defecation and urination [34] Severe: irritation oral mucosa salivation, abdominal pain, depression and position in sternal decubitus, seizure irregularity heart rate, pulmonary edema, cyanosis, dyspnea and death. The cats that lick or bite the skin of the toads present tialismo, convulsions, blindness and death, in addition all the toads have bad flavor, and the signs depend on the absorbed quantity. The companion intoxicated animals by this poison must be taken care of immediately.

Treatment

Wash the mouth with water for 5-10 minutes to reduce the greatest amount of poison, preventing it from crossing the mucous membrane of the mouth and induce vomiting if the animal is conscious. If you have hyperthermia, it is advisable to take a bath with cold water. Check the heart rate and make an electrocardiogram when being in treatment to check that the treatment is working. In case of suffering extreme pain, provide anesthetics to reduce the severity of symptoms. If it is necessary to

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give artificial respiration. Patients may remain with the signs for 2 or 3 days: with dizziness, temporary blindness due to the effect of atropine. Dexamethasone, fluid therapy with 5% dextrose with B complex and 2cc ascorbic acid can be administered of each, in the serum (even after 12 hours) to protect the liver and improve diuresis to excrete the toxic. Control Mix activated charcoal with water (5grams per 20cc), giving one teaspoon per kilogram of body weight orally taking care not to give more than the patient is able to swallow, because it can cause broncho aspiration. Thirty minutes later, give sodium sulfate (glauber salt, Mangxiao), one teaspoon per 5 kg of body weight, or milk of magnesia, one teaspoon per 2.5Kgs orally.

NOTE: If these agents are not available, protect the intestinal mucosa by orally supplying milk, egg whites, vegetable oil mixing well, and put an enema of warm water 10 to 15ml.

Frogs

Poisonous frogs (arrow or dart) are distributed in tropical America, are diurnal and mainly of terrestrial habits [35,36] located in the superfamily Dendrobatoidea, which is subdivided into the families Aromobatidae and Dendrobatidae [37].

Litoria phyllochroa

They present two types of glands: mucous and poisonous. The mucous glands secrete a colorless and liquid mucus and its function is to prevent drying of your skin and maintain ionic balance. Poisonous glands produce irritating or poisonous substances [38].

Composition of the Poison

The skin of amphibians is made up of two layers called epidermis and dermis. They have two types of mucosa glands and granular, serous or poisonous glands. The frogs Epipedobates and Phyllobates secrete a poison formed by alkaloids and toxic compounds similar to nicotine, morphine and cocaine [39,40]. There are also similar effects to those produced by steroids. The poison is given by its food, among which are simple biogenic amines, peptides, steroids and alkaloids, having similarity with the ant venoms [38,41]. The urine is used as a defense, and a drop is enough to blind the attacker, and even to kill.

Signs

When the predator comes into contact with the frogs, for example if dogs and cats or children play with frogs, the contact with their skin starts the intoxication with a progressive paralysis until it affects the diaphragmatic motor capacity; enters through the pores of the skin, passes into the circulation: vasoconstriction, with effect on the Central Nervous System (CNS) altering the transmission of nerve impulses, modifying the regulation of cation exchange, such as Na, K and Ca. there is a sustained contraction [42]. When there is a contact with the mucous membrane of the mouth, the signs are: irritation, numbness of the oral mucosa, sialorrhea, later, respiratory depression, dyspnea, ataxia, arrhythmia, intense headache, ascending numbness, defecation and involuntary urination, abdominal pain, convulsion, edema pulmonary, cyanosis and death in a matter of seconds [43] (Figure 1).

Figure 1: Destruction of muscle cells and the consequent release of intracellular content into the bloodstream.

To prevent fibrillation that leads to death, cardiac activity should be monitored using vasoconstrictors and antihistamines intravenously, plus the use of activated charcoal in the first 30 minutes, to absorb the toxin accompanied by water. Magnesia milk (adults 30ml, children 15ml) one hour after administering the activated charcoal Field. The supply of cholinergic agents is also recommended: neostigmine at an adult dose of .5mg IM and at pediatric doses of .02mg/kg / IV or .04mg/kg. IM.

Prevention

Do not play, do not touch frogs with bright colors, because the toxins they secrete are more toxic [44]. Avoid direct contact with the frogs of the family Dendrobatidae

Centipede

The feet of centipedes are long, and those of millipedes are short. Diplopods and Pauropoda: With jaws; first pair of fused maxillae originating a gnatoquilario; they do not present the second pair of maxillae. Symphyla: The jaws, first pair of separate maxillae and second pair of maxillae fused to form a lip [45]. In the segments of its body, they have two legs in each, they also have a pleural membrane on the sides, responsible for the exchange of gases, except for Scutigeromorpha presents in the dorsal area. In the terminal segment, they have a pair of legs, which they use to defend themselves and to attract the opposite sex. In this segment, the sexual organs are also located externally in Scutigeromorpha, Lithobiomorpha and some Geophilomorpha, so that it is very easy to distinguish males from females [46]. The Scolopendromorpha does not possess external sex organs, and the difference of sexes is through its size, since females are longer and wider than males [47]. Although the word “centipedes” means “a hundred legs” and the word “millipedes” means “a thousand legs”, the centipedes

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have at least 30 legs, only very few have more than a hundred legs. There is not a type of millipede with more than 400 legs [47].

Poison Composition

Centipede zootoxins compete with those of spiders to be the most toxic because their bite can paralyze prey up to 15 times larger than them. When the toxin enters the body, if the dose is high (spooky toxin) they close the movement of the potassium ions through the cell membrane and this is different in other poisonous animals, because they simultaneously block the muscles, the respiratory system, the cardiovascular and the nervous. The blood flow stops and the heart suffers a stoppage at the same time that the rest of the muscles are paralyzed, which shows that it is a very toxic toxin [48]. The poison is a limpid liquid (pure), homogeneous, transparent and acid pH with enzymes such as endopeptidase, exopeptidase (carboxypeptidase, an extra and isoenzymes of acidic and alkaline phosphatases [49,50]. With electrophoretic analysis of toxic fraction, two toxic components of 32.6 and 23 kDa were found with 11 amino acids on the amino terminal side of each of the components containing two acid toxins [49]. Its flattened head hides the three buccal pieces behind and ventrally in the chilopoda is the first pair of legs, thick and transformed for predation in a pair of forceps called forcicles that contain the poisonous glands, which are used to inject the venom during the bite.

Symptom

The centipede attacks with a pair of fangs that is behind the head, on its first pair of legs. Within each tusk there is a gland that secretes a potent neurotoxin. When the centipede bites, its fangs penetrate the body of the prey, the muscles surrounding the glands contract and the venom is expelled through a channel that ends near the tip of the tusk [51]. The prey is quickly paralyzed, it does not escape anymore. The toxin is not deadly, but the bite is painful, and the poison can redden and numb the affected area [52-55]. Pain in the area of the bite, inflammation, redness in the area of the bite, inflammation of the lymph nodes, although it is rare, numbness at the site of the bite. There may be pain in the body and in the area of the bite, inflammation with the possibility of spreading to the lymph nodes [56].

On the skin of the zone involved redness in the area of the sting and numbness. People who are allergic to centipede venom may have respiratory distress, tachycardia, throat inflammation [57,58]. There are few fatal accidents by centipede´s bite, the symptoms can be varied and range from light, local from intense pain due to serotonin and burning sensation to inflammation and subcutaneous hemorrhages, with superficial necrosis and can last between 1 to 3 weeks.

Serious symptoms include generalized alterations: anxiety, headache, dizzy, nausea, vomiting, cardiac and respiratory dysrhythmias, lymphangitis, stupor, paralysis, contractures and in extreme cases death [59,60]. Rhabdomyolysis (destruction of muscle cells and the consequent release of intracellular content into the bloodstream) and acute renal failure as a result of a giant centipede bite have been described. Gomez have identified a toxin called protein S, 60 kDa acid and thermolabile and with cardiotoxic effect, the components of the non-protein venom are biogenic amines serotonins with vasoconstrictor effect and histamine, vasodilator), polysaccharides and lipids (Phospholipids, cholesterol, free fatty acids, triglycerides, esters of cholesterol and squalene, three lipoproteins. Solopendra´s venom has effects on blood coagulation by intensively activating the fibrinolysis system [61-65].

Clinical case / Treatment

Clinical case: Mrs. Josefina Alvarez A., patient of 60 years of age, was asleep in her bed, at two o'clock in the morning, she felt a bite on the back of her left hand, at the base of the index finger, as it passed. the time the pain became more and more intense, to the degree of being unbearable, she cried out in pain, went to the emergency room of the nearest hospital, she was given a buscapan®, ice alternated with hot water compresses in the area of the bite, and pain did not decrease, ended up applying morphine, naproxen and local xylocaine to 10%, was hospitalized for 4 days with the application of tranquilizers and analgesics, after this period the hospital discharged her, but without recovery of mobility and strength of the affected arm, when the effect passed of the analgesic the pain appeared again. After 2 years of this encounter with the centipede, she did not regain the function of her hand, she did not have the strength to raise a cup with that hand and sporadically reappeared the pain [66-68].

It is important to consider: Age, weight and condition of the patient, identification of the centipede if possible, time of the bite. It is advisable to collect the centipede carefully and take it if you must go to the hospital. It is not advisable to use alcohol when washing the bitten area, use plenty of water and soap. In case of entering the toxin into the eyes wash with enough water, apply ice wrapped with a cloth in the place of the bite with intervals of ten minutes, repeating the process. If there are circulatory problems, decrease the time of application of the ice to prevent possible damage to the skin and monitor the patient for 48 hours. Treatment at home: Place ice (wrapped in a cloth) at the site of the bite for 10 minutes and then remove it for another 10 minutes, as many times as necessary. But if the patient presents circulatory problems, decrease the time of application of ice to prevent possible skin cell death.

Prevention

Avoid contact with the aggressor, do not lift stones with your hands or feet, use a mosquito net if you sleep in the field and if you rest on top of us do not reject it with your hands but with some object.

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