Clinical protocol for the care of ophidiotoxicosis in canines in Colombia

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ABSTRACT

Every year, according to the World Health Organization, nearly 5,000,000 million accidents due to snake bites are reported worldwide, of which it is estimated that 33.3% to 50% of cases present as poisoning. Ophidic accidents that include ophidiotoxicosis have care protocols of therapy with antivenom serums, which vary according to the genus and species of the snake. Although in Colombia there are protocols for the care of ophidiotoxicosis in humans described by health entities, the canine clinic lacks this information. The aim of this systematic review is to build a medical protocol for ophidiotoxicosis in canines based on information reported in Colombia or tropical countries with which similar venomous snakes are shared. For this action, the PRISMA protocol was used; in total, 57 articles and 10 official documents on protocols for the care of ophidic accidents in humans were reviewed, which allowed the possible to classify snakebite accidents in group 1 (Bothrops, Lachesis and Crotalus accidents) and group 2 (Micrurus accident), also establish a medical protocol for ophidiotoxicosis in each of the groups indicated in canines, depending on the severity of the clinical and paraclinical condition. In conclusion, the clinical and paraclinical signs of the canine, vasculotoxic or neurotoxic, allow us to identify the group to which the aggressor snake belongs (group 1 or group 2, respectively), and their severity guides the selection and dosage of antivenom therapy specific for the clinical management of ophidiotoxicosis in canines.

Keywords: Antivenoms; emergencies; ophidian accidents; snake venoms; toxinology (Source: DeCS).

RESUMEN

Cada año según la Organización Mundial de la Salud se reporta a nivel mundial cerca de 5’000.000 millones de accidentes por mordeduras de serpientes, de los cuales se estima que del 33.3% al 50% de los casos se presentan como envenenamiento. Los accidentes ofídicos que incluyen ofidiotoxicosis tienen como protocolos de atención la terapia con sueros antiofídicos, los cuales varían de acuerdo con el género y especie de la serpiente; aunque en Colombia hay protocolos de atención de ofidiotoxicosis en humanos descritos por los entes sanitarios, en la clínica canina se adolece de esta información. El objetivo de esta revisión sistemática es construir un protocolo de atención clínica de ofidiotoxicosis en caninos a partir de información reportada en Colombia o países del trópico con los que se comparten serpientes venenosas símiles. Para esta acción se utilizó el protocolo PRISMA, en
total fueron revisados 57 artículos y 10 documentos oficiales de protocolos de atención de accidente ofídico en humanos, los cuales permitieron clasificar los accidentes ofídicos en grupo 1 (accidentes botróficos, lachésicos y crotálicos) y grupo 2 (accidente micrúrico), además establecer un protocolo de atención clínica de ophidiotoxicosis en cada uno de los grupos señalados en caninos, dependiendo de la severidad del cuadro clínico y paraclínico. En definitiva, los signos clínicos y paraclínicos del canino, vasculotóxicos o neurotóxicos, permiten identificar el grupo al que pertenece la serpiente agresora (grupo 1 o grupo 2, respectivamente), además la severidad de estos, guía en selección y dosificación de la terapia antiveveno específica para el manejo clínico de la ophidiotoxicosis en caninos.

**Palabras clave:** Accidentes ofídicos; antivenenos; toxinología; urgencias médicas; venenos de serpientes (Fuente: DeCS).

**INTRODUCTION**

In the world, Colombia occupies the third place with more species of reptiles (1), among these are different genus of poisonous snakes: *Bothrops*, *Lachesis*, *Crotalus* and *Micrurus* (1,2,3). Every year according to the World Health Organization (WHO) about 5 billion are reported worldwide of accidents due to snake bites, of which it is estimated that from 33.3 to 50% of cases are presented as poisoning (ophidiotoxicosis) (4,5). In Colombia, according to the National Institute of Health (INS) approximately 5,000 cases of ophidiotoxicosis are recorded in humans per year. In the Orinoquia region, 75% of cases of ophidiotoxicosis in humans it is caused by snakes from the *Bothrops* group (6).

Likewise, in the Orinoquia region, there is an important incidence on these genus of poisonous snakes, substantially in the departments of Meta, Vichada and Arauca (2,6). In the Meta, two species are highlighted: *Bothrops atrox* and *Crotalus durissus* (commonly known in the region as mapaná and rattlesnake, respectively) highlighted by the INS in the program national for the conservation of snakes (1,2).

For the year 2020, the departments of Antioquia, Bolívar, Norte de Santander and Meta were the most affected; and the Viperidae family was the cause of 88.3% of the reported cases; highlighting the genus *Bothrops* for being the biggest cause with 66.8%. Highlighting the species *Bothrops atrox*, *Bothrops asper*, *Portidium nasatum*, *Bothriechis schlegelii* (called the Bothrops group) (6,7). According to the Public Health Surveillance System (SIVIGILA), by the year 2020, about 2.9% of the accidents were caused by snakes of the genus *Crotalus*, followed by *Micrurus* with 1.1% and *Lachesis* with 0.3% (7).

It should be noted that in 18% of cases the recognition of the aggressor snake is not achieved. As mentioned by the INS in 2018 in its official accident event report, the mortality figures for ophidiotoxicosis reported in the Meta department, were 0.4%, recently 257 cases of human ophidiotoxicosis were reported, making the department one of the most affected (6,7).

Ophidiotoxicosis is generally associated with proteolytic, coagulant and hemorrhagic actions, main causes of clinical manifestations that include pain, edema and bleeding that can transcend the formation of abscesses and tissue necrosis (8). Crotalus poison (ophidic accident associated with the genus *Crotalus*) produces neurotoxicity with flaccid neuromuscular paralysis (which can be fatal) and myotoxicity leading to rhabdomyolysis and consequently myoglobinemia, hyperkalemia and acute renal failure (AKI) (9).

On the other hand, in Colombia, cases of ophidiotoxicosis in humans and canines have been underreported, due to the fact that only until October 2004 the Ministry of Health established that it was an event useful in public health (2,6,7). In the world, mortality rates due to ophidiotoxicosis in canines that range from 5% (10) to 30% (11), being alarming data when compared with the mortality in humans from ophidiotoxicosis reported in Colombia, which can be between 1.7 and 10% (12,13). This high mortality in cases of ophidiotoxicosis in canines could be influenced by the area of the bite that is often on the head, the ophidic accident being called serious (14).

The aim of this systematic review is to build a clinical care protocol for ophidiotoxicosis in canines in Colombia based on information reported in Colombia or other tropical countries with which similar poisonous snakes are shared, taking clinical and paraclinical data of cases in...
canines or extrapolating actions from the clinical protocols for the care of ophidiic accidents in humans.

Approximation to scientific and state information of ophidiotoxicosis care protocols

This systematic review was based on the PRISMA protocol (15). The research survey was based on sources of information available on scientific platforms such as NCBI (PubMed: https://pubmed.ncbi.nlm.nih.gov/), Elsevier Group (ScienceDirect: http://www.sciencedirect.com/), Scientific Electronic Library Online (SciELO: https://scielo.org/es/), Scholar Google (Scholar Google: https://scholar.google.com/), Dialnet (https://dialnet.unirioja.es/), ResearchGate (https://www.researchgate.net/)

And government platforms: National Institute of Health (INS: https://www.ins.gov.co/Paginas/Inicio.aspx) and Ministry of Health and Social Protection (Minsalud: https://www.minsalud.gov.co/Portada2021/index.html). The following DeCS terms in spanish and english were included in the search strategy: ophidic accidents, anti-poisons, dogs, clinical protocol, snake poisons.

Subsequently, these eligibility criteria were taken into account: A. Clinical protocols for the management of ophidiic accidents in humans officially published in the National Institute of Health (INS) and in the Ministry of Health and Social Protection (Minsalud). B. Reports of clinical cases in dogs bitten by snakes from Central and South America are similar to Colombia. C. Unified protocols of multipurpose therapies of antiophidic serums, notifying the commercial reserves of biologicals with the permission of the Colombian Agricultural Institute (ICA) or the National Institute of Drug and Food Surveillance (INVIMA) in Colombia.

On the other hand, those articles were excluded where studies were carried out in species other than canine and human, no limitations were established on the articles by the language and date of publication; in addition, documents that were not related to the aim of the study were not taken into account. Likewise, two researchers in the search for the articles emphasized in the titles and in the use of the keywords, strategically used to make a quick reading that allowed to optimize the investigation in the previously selected databases. Gathered the information was organized taking into account source of collection and pages of importance, facilitating the analysis in accordance with the eligibility criteria. Duplicate records were discarded.

When carrying out the aforementioned activities, 158 items were collected with the help of the search system. After the election by summary and title, 120 articles were chosen for their complete evaluation. Discarding 63 articles by maintaining no link with the objectives of the study, finally obtaining 41 articles. In addition, 10 reports were rescued from the platforms integrated in this article: 1 report to the SiB Colombia platform on Colombian biodiversity, 8 reports from the National Institute of Health of ophidiic events in Colombia and 1 guide for the management of toxicological emergencies (Figure 1).

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Organized information is presented through the generalities of the toxicodynamics of ophidiotoxicosis, action that allows to establish the classifications of ophidic accidents in two large groups, group 1: Bothrops, Lachesis and Crotalus accidents; and group 2: Micrurus accident. In the same way, the classification of the clinical severity of ophidiotoxicosis and the therapeutic plan to be established in each clinical picture according to the severity and type of ophidic accident according to its group; thus constituting the clinical protocol for the management of ophidiotoxicosis in canines.

**Toxicodynamic generalities of ophidiotoxicosis**

In canines, ophidic accidents with high probability are in the head and happen in peri-urban and rural areas. Canines have a constant olfactory exploratory behavior of the places they inhabit and transit, this act being a potential risk factor against severe ophidiotoxicosis, by allowing the inoculation of poisons directly on the head (14).

The venom of snakes is secreted by their salivary glands, allowing them to feed themselves by immobilizing their prey and defending themselves against natural predators or dangerous situations (16), thanks to the effect they cause, which can be vasculotoxic, proteolytic, coagulant, nephrotoxic, vagal, myotoxic, neurotoxic or nephrotoxic; about its victim depending on the gender of the snake; likewise, the clinical effect caused will be directly related to factors such as the age and size of the snake, dose of injected poison, wound expansion and bite area (17).

The poison secreted by snakes of group 1 is generally characterized by being hemocytotoxic (18), the genera Bothrops (including those of the Bothrops group), Lachesis and Crotalus have in common the vasculotoxic actions (16,17). In particular, snakes of the Bothrops group cause proteolytic, coagulant and nephrotoxic actions. Snakes of the genus Lachesis have proteolytic, coagulant and vagal actions; and snakes of the genus Crotalus have coagulant, neurotoxic and nephrotoxic myotoxic actions (Figure 2). The pathophysiological actions caused by snakes of group 2 are characterized by being neurotoxic (17), due to the main components of its poison consisting of neurotoxins, β and α-neurotoxins (Figure 3) (19).
The pathophysiological actions caused by snakes of the family Viperidae are essentially due to some of their protein components of their poison: serine proteases, phospholipases A2 (PLA2) and metalloproteases (18). Serine proteases cause the degradation of fibrinogen leading to the formation of fibrin and simultaneously activates coagulation factors V, X and XIII, prothrombin and platelets; together, this sequence of events favors the stimulation of the coagulation cascade by causing the massive use of factors, reflected in disseminated intravascular coagulation (16,20). PLA2 and metalloproteases increase vascular permeability by degrading type IV collagen and laminin in the basal lamina of the microvascular structure, destroying the endothelial barrier (21); metalloproteases, specifically, hemorrhagins are responsible for damage to endothelial cells and local or systemic bleeding, by injuring the capillary wall and endothelium, for this reason, the hemorrhages cause myonecrosis due to the lack of oxygen, exacerbating this action the myotoxic PLA2 by binding to the muscle fibers mainly at the site of inoculation of the poison (20). O₂: Oxygen.

B-neurotoxins cause a presynaptic effect by altering the release of the neurotransmitter acetylcholine, and α-neurotoxins or also known as three-finger toxins (3FTx), cause a postsynaptic effect by preventing the neurotransmitter acetylcholine from binding to the nicotinic receptor in the muscle cell (22). Therefore, the neurotoxins in question have the ability to make the venom of the snakes of the Elapidae family even in minimal doses is lethal, due to the flaccid paralysis that can be caused in muscles such as the diaphragm leading to respiratory failure (19).

Clinical and paraclinical classification of ophidiotoxicosis in canines

From the knowledge of the authors, there is no clinical classification or measurable paraclinical parameters that allows addressing and classifying the ophidic accident in canines caused by the genera of snakes: Bothrops, Lachesis, Crotalus (group 1) and Micrurus (group 2), for this reason, based on protocols designed for the control of the ophidic accident in humans and clinical cases reported in canines, this classification was hypothetically established in order to focus adequate medical treatment (Table 1 and 2; Figure 4) in the construction of the clinical protocol of ophidiotoxicosis.
Herrera-Dalel et al. - Canine ophidiotoxicosis in Colombia

### Table 1. Classification of the severity of the ophidic accident in canines caused by snakes of group 1, according to clinical signs and paraclinical tests.

<table>
<thead>
<tr>
<th>Severity</th>
<th>Clinical signs</th>
<th>Paraclinical tests</th>
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<tbody>
<tr>
<td>Mild</td>
<td>Allodynia, edematous tissue with increased thickness, with or without increased clotting time, no systemic involvement (13, 16, 17, 23, 24, 25).</td>
<td>PLT &gt;50.000/μL, HCT 30-37%, TP &lt;3 sec = 0, CRE &lt;1.6 mg/dL, SDMA &gt;14 μg/dL, TCA 60 - 110 sec, Dímero-D &gt;10 μg/mL, CK 0 - 2.000 UI/L (24-27).</td>
</tr>
<tr>
<td>Moderate</td>
<td>Allodynia, edematous tissue with generalized thickening in the limb involved by the venom injection, increased clotting time or incoagulable, neurotoxic facies, systemic or localized hemorrhages at the site of venom injection, altered state of consciousness (stupor, semi comatose and comatose) (13, 16, 17, 23, 24, 28).</td>
<td>PLT 10.000 - 50.000/μL, HCT 20 - 29%, TP 3 - 6 sec = 1, CRE 1.7 - 5.0 mg/dL, SDMA 18 - 35 μg/dL, CK 2.000 - 20.000 UI/L (25, 26).</td>
</tr>
<tr>
<td>Severe</td>
<td>Allodynia, edematous tissue with increased thickness in the limb involved by the injection of the venom, phlyctenas, neurotoxic facies, altered state of consciousness (stupor, semi comatose and comatose), increased clotting time or incoagulable (local and systemic hemorrhage), ischemia and necrosis of involved tissue, acute renal failure, arterial hypotension, hypovolemic shock, hypovolemic shock (13, 16, 23, 24, 28).</td>
<td>PLT ≤ 10.000 μL, HCT ≤ 13 - 19%, TP &gt; 6 sec = 2, CRE 5.1 - 10.0 mg/dL, SDMA 36 - 54 μg/dL, CK &gt;20.000 UI/L (25, 29).</td>
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* The ophidic accident caused by snakes of the genus *Lachesis* spp. it is considered by several authors to be serious because of the significant amount of poison it inoculates (16, 17).

### Table 2. Classification of the severity of the ophidic accident in canines caused by snakes of group 2, according to clinical signs and para-clinical tests

<table>
<thead>
<tr>
<th>Severity</th>
<th>Clinical signs</th>
<th>Paraclinical tests</th>
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<tbody>
<tr>
<td>Mild</td>
<td>Minimal injury with hypoalgesia at the poison injection site, emesis, no neurotoxic facies during the first 30 to 60 minutes after the accident. (30, 31).</td>
<td>PLT &gt;50.000/μL, HCT 30-37%, TP &lt;3 sec = 0, CRE &lt;1.6 mg/dL, SDMA &gt;14 μg/dL, TCA 60 - 110 sec, Dímero-D &gt;10 μg/mL, CK 0 - 2.000 UI/L (25, 24, 27-28).</td>
</tr>
<tr>
<td>Moderate</td>
<td>Hypoalgesia at the venom injection site and intense allodynia reflected throughout the affected limb; emesis, asthenia, neurotoxic facies, dyspnea, dyspnea (30, 31).</td>
<td>PLT 10.000 - 50.000/μL, HCT del 20 - 29%, TP 3 - 6 sec = 1, CRE 1.7 - 5.0 mg/dL, SDMA 36 - 54 μg/dL, CK 2.000 - 20.000 UI/L (25, 26, 28).</td>
</tr>
<tr>
<td>Severe</td>
<td>Sialorrhea, generalized flaccid motor paralysis, osteotendinous hyporeflexia, sphincter relaxation, neurotoxic facies, dyspnea or respiratory paralysis, comatose state, death. (30, 31).</td>
<td>PLT ≤ 10.000 μL, HCT ≤ 13 - 19%, TP &gt; 6 sec = 2, CRE 5.1 - 10.0 mg/dL, SDMA 36 - 54 μg/dL, CK &gt;20.000 UI/L (25, 26, 28).</td>
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</table>


* The ophidic accident caused by snakes of the genus *Micrurus* spp. it is considered serious due to the danger of acute respiratory failure resulting from muscle paralysis (32).

### Therapy of ophidiotoxicosis in canines

Due to the fact that rural areas may be the main focus of presentation of the ophididic accident according to the technical sheet for hyperimmune serums of the national institute of health (INS), it is initially recommended that the canine’s guardian consider: disinfecting the extension of the snake bite with soap and water, avoid sudden movements of the affected area, delimit the edge of the lesion site with an indelible marker to evaluate its progress, go to a veterinary clinical center in the shortest possible time. Likewise, it is not recommended to make turnstiles or compressions on the affected limb or area, make cuts or suck the snake venom (17, 33).

Based on the medical treatments indicated in humans and the few reports of clinical cases of ophidiotoxicosis in canines in Colombia, hypothetically, a therapy is proposed based on the administration of: antiophidic serum (specific therapy), fluid therapy (support therapy) and analgesics (paliative therapy); with the aim of reducing the toxicodynamics (action and effect) of snake venom in the body, accelerate the
elimination of this (excretion) and manage the patient’s pain.

**Administration of antiophidic serum**

The choice of the type of antiophidic serum to be used in canine ophidiotoxicosis, it will depend on the genus of the causal snake. In order to determine whether it is necessary to administer polyvalent antiophidic serum (group 1) or polyvalent anticoral serum (group 2) (Table 3) (6,7,34).

The distribution of antiophidic serums with permission to manufacture or market in Colombia depends on two national laboratories: the National Institute of Health (INS) and Probiol© laboratories; and two foreign laboratories: the Bioclon© Institute and the Clodomiro Picado Institute (ICP), of Mexico and Costa Rica, respectively (Figures 5 and 6) (7,34).

Likewise, the aforementioned laboratories produce the polyvalent anti-coral antivenom that neutralizes the venom of snakes of the genus *Micrurus* (*M.*) of the Elapidae family, making it necessary for all cases of ophidiotoxicosis caused by this genus to receive the anticoral serum before the first 2 hours to prevent or decrease the intensity of the paralysis (7,23). The *Micrurus* antivenom produced by Laboratorios Probiol© (https://www.probiol.com/linea-humana.html) and the Bioclon© Institute (https://bioclon.com.mx/investigacion-clinica/), have the capacity to neutralize the venom of snakes of the genus *Micrurus* spp., according to their data sheet.

It should be noted that in September 2023, INVIMA issued alert No. 292-2023, prohibiting the commercialization of Probiol© laboratories’ antiophidic serums, as they do not have good manufacturing practices certification for medicines, therefore, it would not be allowed to produce these biologics in the country (35).

On the other hand, the polyvalent antiophidic serum for the treatment of *Micrurus* accidents of the INS (https://www.ins.gov.co/Direcciones/Produccion/Paginas/Suero-antiofidico-polivalente.aspx) neutralizes the venom of *M. dumerilii*, *M. mipartitus*, *M. isozonus*, *M. surinamensis* and by cross-reaction the venom of *M. medemi*, *M. spixi*, *M. lemniscatus*; and the ICP (https://kerwa.ucr.ac.cr/handle/10669/866), which neutralizes that of *M. nigrocinctus*, *M. fulvius* and *M. d. carinicaudus* species but does not effectively neutralize the venom of *M. mipartitus* and *M. multifasciatus* (Figure 6).

The polyvalent antiophidic serum elaborated by INS has the competence to neutralize the venom of snakes of the *Bothrops* group and *Crotalus* spp. genus, in addition, by cross-reaction it neutralizes the venom of *Lachesis* (*L.*) *muda* and *L. acrochorda* (https://www.ins.gov.co/Direcciones/Produccion/Paginas/Suero-antiofidico-polivalente.aspx); the one produced by Probiol© laboratories neutralizes the venom of the *Bothrops* group, genus *Crotalus* spp. and *Lachesis* spp. (https://www.probiol.com/linea-veterinaria.html); the one produced by the Bioclon Institute© neutralizes the venom of *Bothrops* spp. and *Crotalus* spp. (https://bioclon.com.mx/investigacion-clinica/); and that produced by the ICP neutralizes the venom of *Bothrops asper*, *Crotalus simus* and *Lachesis stenophys* (https://www.icp.ucr.ac.cr/es/productos/polivet-icp), but it is not suggested for use in Colombia in cases of crotalic poisoning since it does not effectively neutralize the venom of South American *Crotalus* spp. snakes (Figure 5) (7,34).
**Table 3.** Dosage of polyvalent antiophidic serum (group 1) and polyvalent anticoral serum (group 2) according to the severity of canine ophidiotoxicosis and availability in Colombia (7,34).

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<tbody>
<tr>
<td>Severity</td>
<td>Distributors in Colombia</td>
<td>Route of administration</td>
<td>Distributors in Colombia</td>
<td>Route of administration</td>
</tr>
<tr>
<td>Mild</td>
<td>INS 2 vials, Probiol 4 vials, Bioclon 8 vials, ICP 12 vials</td>
<td>IV</td>
<td>INS 6 vials, Probiol 6 - 10 vials, Bioclon 12 vials, ICP 20 vials</td>
<td>IV</td>
</tr>
<tr>
<td>Moderate</td>
<td>INS 4 vials, Probiol 8 vials, Bioclon 12 vials, ICP 20 vials</td>
<td>IV</td>
<td>INS 10 - 15 vials, Probiol 12 vials, Bioclon 20 vials, ICP 20 vials</td>
<td>IV</td>
</tr>
<tr>
<td>Severe</td>
<td>INS 6 vials, Probiol 12 vials, Bioclon 20 vials, ICP 20 vials</td>
<td>IV</td>
<td>INS 20 - 30 vials, Probiol 20 vials, Bioclon 20 vials, ICP 20 vials</td>
<td>IV</td>
</tr>
</tbody>
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Group 1: Polyvalent antiphidic serum; Group 2: Polyvalent anticoral serum.

* 5 vials if it is a coral accident in the Andean, Caribbean and Pacific regions; 10 vials if it is a coral accident in the Orinoco or Amazon region (7).

Dosage of antiophidic serum is based on the severity of canine ophidiotoxicosis and not by the patient’s weight. After establishing the patient’s dose, the quantity of total vials of the corresponding antiophidic serum should be diluted in 100 - 250 mL of 0.9% saline solution (NaCl 0.9%) and administered within 1 hour intravenously (IV) under permanent medical supervision (7,34), starting with a slow drip factor to rule out the occurrence of possible adverse reactions such as type I hypersensitivity reactions (36); to determine the volume of 0.9% NaCl to be used to dilute the calculated dose, the fluid dosing guidelines should be taken into account assuming that any dehydration deficit would be corrected by implementing the resuscitation phase (10 mL/kg/15 min up to 3 boluses) (37); that is to say, for a patient of 10 kg body weight, a maximum of 100 to 300 mL of antiophidic serum dilution may be administered and NaCl 0.9%; in theory the recommendation would be to use the minimum range of NaCl 0.9% (e.g. 100 mL, without exceeding 300 mL) for dilution of the vials and vehicleization of the antiophidic serum. In addition, a possible type I hypersensitivity reaction or other adverse reactions should be ruled out; in case of severe anaphylaxis treat with epinephrine in dilution 1:1,000 (1 mg/mL) at 0.01 mg/kg intramuscularly (IM) (maximum dose 0.3 mg in patients < 40 kg and 0.5 mg in patients > 40 kg). Followed by (5 minutes) constant rate infusion at 0.05 µg/min/kg IV (38, 39).

**Fluid therapy.** IV fluid therapy is essential in cases of canine ophidiotoxicosis, since it contributes to the restoration of circulatory volume and provides renal support. Although each patient should be evaluated and treated on an individual basis, the proceedings of the congress of the World Association of Small Animal Veterinarians (WSAVA-World Small Animal Veterinary Association 2018) recommend crystalloid solutions as the basis of fluid therapy at doses of 10 - 20 mL/kg bolus in cases of ophidiotoxicosis (40).

It is necessary that, for the management of the fluid therapy, systolic blood pressure (SBP) and urine output are continuously assessed, verifying that the patient is normotensive (SBP <140 mmHg) and produce normal urine volumes (1-2 mL/kg/h of urine) (16, 37).

**Pain management (analgesia).** Pain from the typical snakebite has not been extensively characterized in animals, however, pain management is suggested. The use of potent analgesics such as Dipyrone at 30 mg/kg IV, every 6-8 hours is recommended; supplemented with regional...
anesthesia with lidocaine (41). The use of morphine is not recommended for pain management in these cases because it causes respiratory depression due to the release of histamine derived from its administration, which can be confused with an anaphylactic reaction (42).

**Final considerations**

It is highly probable that snakes of the *Bothrops* group are the most frequently associated with ophidiotoxicosis in canines, extrapolating epidemiological information from the human ophidian accident; likewise, the severity of the ophidian accident is classified as serious, due to the fact that the head and neck are the areas most prone to be inoculated with these poisons in canines, given their natural behavior of continuous olfactory exploration of the environments they inhabit or visit.

The venom secreted by snakes *Bothrops* spp. Group, *Lachesis* spp. and *Crotalus* spp., have in common vasculotoxic actions (inflammatory and alterations of hemostasis), and can therefore be grouped in the same group (referred to in this manuscript as group 1) and treated with the polyvalent antiphidic serum that combines the respective antivenoms of these genus; on the other hand, the venom secreted by snakes of the genus *Micrurus* spp. have in common neurotoxic actions (hemostatic alterations are neither important nor evident), so they can be grouped in a different group (referred to in this manuscript as group 2) and treated with the polyvalent anticoral serum.

The diagnosis of the ophidian accident is immediately certain (group 1 or group 2), the clinical and paraclinical classification of ophidiotoxicosis (mild, moderate or severe for group 1, in case of group 2 they are always classified as severe); specific therapy should be instituted with the correct dosage of polyvalent antiphidic serum (group 1) or polyvalent anticoral serum (group 2). Whereas the total amount of vials should be diluted between 100-250 ml of 0.9% NaCl and be administered during one hour, taking into account the maximum infusion rate in canines 80-90 ml/kg/hour.

**Conflict of interest**

The authors declare that they have no conflicts of interest.

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**REFERENCIAS**


