Original Article

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Retrospective study of suspected canine poisoning cases at the Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta, Nigeria (2009-2019)

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Abstract: Cases of canine poisoning pose a great challenge to pet owners and veterinarians due to incomplete patient history, late/delayed presentation of pets and the large array of poisonous agents. A ten-year retrospective study on canine poisoning cases presented to the Veterinary Teaching Hospital, Abeokuta, Nigeria was conducted. Descriptive statistics were used to characterize animal signalment, mode, month and year of exposure, severity, treatment and outcome. Associations between explanatory demographic characteristics of patients (age, sex and breed) with poison type and route of exposure were

determined using a binary logistic regression model. Fifty-two case records with poisoning history and complete data were reviewed. The study population consisted of twenty males and thirty-two females between two months and five years of age. Poisonous agents that were identified included insecticides/acaricides (83%), cleaning products (2%), rodenticides (4%) and snake venom (6%). Poisoning occurred more in Alsatians, especially during the rainy season. No association between the dog demographics with type of poisoning and route of exposure was observed ($p>0.05$). There were 4 fatalities and 48 recoveries. This study highlights the heterogeneity of poisonous agents, associated clinical signs, treatment and outcome, and the challenges involved in poison control. Standardized approaches for the collection, assessment, integration of poisoning data and risk management is needed.

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1 Introduction

Cases of poisoning in pet dogs are frequent and constitute a serious veterinary problem [1]. In our experience, owners find their dogs in an advanced stage of poisoning and are incapable of identifying the poisonous source or agent. Hence the dogs are presented as an emergency to small animal clinics and hospitals. Poisonous agents include toxic plants, medications, household cleaning products, insecticides, acaricides, herbicides, fungicides, rodenticides and molluscicides [2]. In addition, several foods such as chocolates, onions, garlic, macadamia nuts, grapes, raisins and alcohol, while safe for humans, pose serious health hazards to dogs [3].

In many developing countries, such as Nigeria, there are inadequate or no national and/or regional poisoning control centres for notification of accidental or malicious poisoning events as seen in the developed world. Data are usually not properly kept and where available, are fragmented, limited or unorganized. The unavailability of poisoning control centres causes a gross underestimation of the prevalence, sources and routes of exposure, as well as potential risk factors associated with poisoning in various animal species. A broader knowledge of the causes and types of poisoning in pet dogs may help in the diagnosis, treatment, prevention and control of poisoning events globally [4].

Pet dogs are recognized as the most common sentinel animal for outdoor exposure to environmental toxicants and respond to most poisoning agents similarly to humans [5]. Veterinary clinics/hospitals may, therefore, serve as valuable sources of information for epidemiological studies to improve public health awareness of emerging toxicological risks [6].

The aim of this study is to describe the major causative agents involved in canine poisoning; the sources and routes of exposure, the severity of clinical signs, treatment and outcomes of patients treated at the Veterinary Teaching Hospital, Alabata, Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State, Southwest Nigeria, in the last ten years. We also evaluated the relationship between poisoning and the phenotypic characteristics of patients, social status of owners and season of the year. To the best of our knowledge, this is the first study designed to identify the prevalence of canine poisoning in this region of Nigeria.

2 Materials and methods

2.1 Study site

The Veterinary Teaching Hospital (VTH), FUNAAB, Ogun State, Southwest Nigeria, lies within Latitude $7^{\circ} 11' 07''$ N and Longitude $3^{\circ} 26' 15''$ E (Figure 1). The hospital serves as a referral centre from private veterinary clinics throughout the State and neighboring States of Lagos, Oyo, Osun, Ondo, Ekiti and Kwara.

Ethical approval: The research related to animals use has been complied with all the relevant national regulations and institutional policies for the care and use of animals.

2.2 Data collection

All case records of dogs presented to the VTH in the last ten years (1 January 2009–31 December 2019) were investigated,

LGA – local government area; FUNAAB - Federal University of Agriculture, Abeokuta

Figure 1 Spatial representation of the Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta, Ogun State, Southwest Nigeria

and cases with a history of poisoning were reviewed. Inclusion criteria were 1) history of exposure to poisonous agent and/or 2) clinical signs and features of poisoning. The information retrieved from the records were animal signalment (breed, sex, age), location, clinical history, type and route of exposure, season of the year, clinical signs, differential diagnosis, tentative diagnosis, suspected causative poisoning agent, confirmatory diagnosis (if identified), treatment and the outcome at the time of discharge from the hospital. Case severity was assessed using the Poisoning Severity Score (PSS) [7] which grades severity of poisoning into five levels: (0) no symptoms, (1) minor, (2) moderate, (3) severe, and (4) fatal.

2.3 Data analysis

Data obtained from the records were collated and entered into Microsoft Excel® spreadsheets, 2013 (Microsoft Corporation, Redmond, WA, USA). Descriptive statistics were calculated for all variables in the forms of frequencies and proportions using Microsoft Excel® (2013). A normality

test was conducted on continuous variables present in the data set using Kolmogorov-Smirnov (> 0.05). All variables - age, sex, breed, type of poison and the routes of exposures were recoded into binary outcomes for further analysis. The type of poison and routes of exposure were recategorized as chemical/nonchemical and topical/non-topical respectively. The relationships between dog demographics with the type of poison and route of exposure were determined using binary logistic regression analysis (SPSS® 21 analysis software package IBM, Inc.). A $p < 0.05$ was considered statistically significant and crude odds ratios were computed to determine strength of associations at 95% confidence intervals (CIs).

3 Results

A total of 52 (20 intact males and 32 intact females) canine poisoning cases presented to the VTH, FUNAAB, Abeokuta, Ogun State, Nigeria had complete data to be evaluated. About 56% were Alsations, 15% were Rottweilers, Doberman Pinchers and Boerboels were 10% each, Mongrels were 6% while Lhasa Apsos were 4%. Dogs within the ages of 7 months to 5 years were mostly affected (68%) (Figure 2). The median patient age was 10.5 months (1 month - 5 years).

The causes of poisoning are presented in Table 1. Insecticide/acaricide toxicity was the most reported (83%), snake envenomation was 6%, rodenticide poisoning was 4%, while phenol-based disinfectant poisoning accounted for 2%. Approximately 5% of cases reported showing signs of poisoning were from unidentified sources. Dichlorvos (2,2-dichlorovinyl dimethyl phosphate, DDVP), an organophosphate, cypermethrin (synthetic pyrethroid) and amitraz (formamidine) were the insecticides/acaricides used and anticoagulant rodenticides also accounted for toxicity.

Figure 2 The age distribution of dogs presented to the Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta, Ogun State, Southwest Nigeria with suspected cases of canine poisoning

The routes of exposure were topical (48%), oral (38%) and intraocular (2%). The routes of exposure were not stated for 12% of the cases (Figure 3). Most cases of insecticidal/acaricidal poisoning were presented between the months of April to October (spikes in August), while fewer cases were presented in November. Cases of snake bites were presented in August, November and January. Rodenticide poisoning cases were presented in October while the phenol-based disinfectant compounds poisoning was between February and April (Figure 4).

Most of the cases of insecticide/acaricide toxicity were caused by owner's misuse of commercial formulations on pet dogs. These formulations are available in forms of powders, neck tags, liquids for chemical bath, spot-ons or sprays. Many owners either used over the counter (OTC) formulations meant for agricultural use or did not adhere to manufacturers' instructions on dilution ratio. Snake bites (snakes were unidentified) occurred in pets kept in bushy environments while rodenticide and phenol-based disinfectant poisoning cases were due to accidental acute ingestion by non-target species as there apparently were no cases of intentional/malicious poisoning. The owners of these dogs were average to high income earners and educated.

No statistical relationship was found between the dog demographics i.e. sex, age and breed and the type of poisoning and route of exposure. However, the odds of chemical poisoning (COR: 3.00, $p = 0.40$) and topical exposure (COR: 1.30, $p = 0.70$) were found to increase in the male dogs more than the female. On the other hand, the odds of topical exposure was more reduced in young dogs (≤ 10 and half months) than older ones (COR: 0.58, $p = 0.45$) while chemical poisoning reduced with local breeds (Mongrel) rather than exotic ones (COR: 0.08, $p = 0.12$) (Table 2).

The most reported clinical signs for insecticide/acaricide poisoning are presented in Table 3. The patients with rodenticide poisoning were reported to show signs of weakness, lethargy and bloody urine after the use of rodenticides in the environment. Patients with phenol-based disinfectant poisoning showed clinical signs after a house cleaning, characterizing the poisoning origin. Diagnosis of snake envenomation was made based on history, presence of fang marks on the skin and/or ocular irritation in affected dogs.

Management mainly involved administration of atropine, an anticholinergic agent, which helps in reactivation of acetylcholinesterase, fluid therapy to maintain haemostasis, sedatives such as diazepam to help with the neurologic signs seen, anti-emetics such as metoclopramide to help increase gastric emptying and hence prevent vomiting and smooth muscle relaxants such

Table 1 The causes of poisoning in different dog breeds presented to the Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria with suspected cases of poisoning

Breed	Acaricide/Insecticide			Snake venom	Rodenticide	Disinfectant	Unidentified	Total
	Dichlorvos	Synthetic Pyrethroids	Amitraz					
Alsatian	14	6	4	3	2	0	0	29
Boerboel	2	0	2	0	0	0	1	5
Doberman	2	3	0	0	0	0	0	5
Lhasa Apso	1	1	0	0	0	0	0	2
Mongrel	1	0	0	0	0	1	1	3
Rottweiler	6	0	1	0	0	0	1	8

Figure 3 The common routes of exposure in suspected cases of canine poisoning presented to the Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta, Ogun State, Southwest Nigeria

Figure 4 The graphical pattern of poisoning throughout the years in different dog breeds presented to the Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta, Ogun State, Southwest with suspected cases of poisoning

as hyoscine (Table 4). Cases presented were scored between 2-4. Fatalities (4) due to insecticide/acaricide poisoning were recorded in 13% of the cases, 65% of patients were discharged by the third day of admission (2; moderate) while 22% had an extended hospital stay (3; severe).

4 Discussion

Cases of poisoning pose a great challenge to the small animal practitioner as there are many potentially toxic substances in and around the home. Diseases with similar gastrointestinal or neurological clinical signs may also be confused with poisoning [8, 9]. It has been widely reported that dogs are the most common species involved in animal poisonings [2]. High prevalence of poisoning in dogs has been reported in several European countries and Brazil [2, 10]. This study identifies the prevalence of canine poisoning in Nigeria. Within the last decade, a number of publications from countries such as Belgium, the Czech Republic, Europe, Italy, Switzerland, Germany and the United States of America have provided country-specific overviews of the occurrence of animal poisonings [11-20].

In this study, the Alsatis (German Shepherd Dogs) were the most presented breeds of dogs for suspected cases of poisoning. Means and Wismer [21] reported that the Labrador was the most affected in United States of America. Alsatis are the most commonly raised dog breed in Nigeria. An upsurge in acquisition and use of this breed for security and breeding might be responsible [22, 23]. These data do not suggest that Alsatis are at increased risk to poisoning due, for instance, to differences in how they metabolize poisons, but instead because they constitute a larger share of dogs in the society.

The median age of dogs presented with suspected cases of poisoning was 10.5 months. This agrees with previous studies in which young animals were more affected [24]. Although there were no associations between dog phenotypic characteristics and the route of exposure, the odds of topical exposure were found to increase 1.3 times in male dogs than females. This supports findings by Shima et al. [22] who reported

Table 2 Binary logistic regression analysis outcome for potential factors associated with route of exposure and poison type in dogs presented to the Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria with suspected cases of poisoning

Variable	Route of exposure				Poison type			
	Frequency (%)	COR	(95% CI)	P value	Frequency (%)	COR	(95% CI)	P value
Age (Months)								
≤ 10 and half	20 (54.0)	0.586	0.157 -2.183	0.426	19 (54.3)	1.036	0.107 -9.993	0.976
>10 and half	17 (46.0)				16 (45.7)			
Sex								
Female	22 (59.5)	1.305	0.344 -4.954	0.696	20 (57.1)	3.024	0.220 -41.618	0.408
Male	15 (40.5)				15 (42.9)			
Breed								
Exotic	35 (94.6)	1.056	0.058 -19.389	0.970	33 (94.3)	0.082	0.003 -2.008	0.125
Local	2 (5.4)				2 (5.7)			

COR = Crude Odds Ratio

Table 3 Clinical signs seen in dogs presented to the Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria with suspected cases of poisoning

Clinical signs	Number of dogs (Frequency)	Percentage (%)
Anorexia	6	7
Ataxia	4	5
Behavioural change	8	10
Brachycardia	1	1
Diarrhoea	10	12
Darkened tongue	2	2
Lethargy	11	13
Ocular irritation	5	6
Punctured wound/fang marks	1	1
Salivation	17	20
Seizures	3	4
Shaking	2	2
Swollen limbs	1	1
Tachycardia	1	1
Tachypnea	2	2
Tremor	4	5
Vomiting	5	6
Total	83	100

Table 4 Some drugs administered to dogs presented to the Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria with suspected cases of poisoning

Drugs	Number of dogs (Frequency)	Percentage (%)
Dextrose saline infusion	20	13
Normal saline infusion	4	3
Lactated ringer infusion	16	10
Atropine	36	23
Mineral oil	4	3

Drugs	Number of dogs (Frequency)	Percentage (%)
Vitamin B complex	13	8
Metoclopramide	2	1
Acetaminophen	12	8
Dexamethasone	3	2
Folic acid	2	1
Chlorpromazine	1	1
Getamicin eye drop	2	1
Oxytetracycline injection (5%)	5	3
Hyoscine	6	4
Cimetidine	1	1
Phenobarbital	1	1
Kaolin	3	2
Metronidazole	2	1
Diazepam	4	3
Calcium gluconate	2	1
Neurovitamins	1	1
Furosemide	2	1
Prednisolone	1	1
Etamsylate	5	3
Vitamin K	2	1
Enrofloxacin	1	1
Hydrocortisone	2	1
Chloramphenicol eye drop	1	1
Chlorphenamine	2	1
Vitamin C	1	1
Total	157	100

a higher incidence of poisoning in male dogs than females. However, limited cases of sex differences being associated with poisons in animals were reported by Tiwari and Sinha [25].

The most reported toxicants responsible for poisoning revealed in this study were insecticides/acaricides, used in the management of ectoparasitism (tick, flea, lice and mange infestation). The organophosphates, organochlorines, carbamates and pyrethroids are of concern due to their low biodegradability and potential toxicity to humans, animals and the environment [26]. The organophosphate dichlorvos was the most reported, which could be due to its uncontrolled availability and sale as an OTC drug to both medical personnel and untrained individuals. Sniper® (active ingredient-dichlorvos), though banned in Nigeria due to its use for suicidal attempts in humans, is still used to control ectoparasitism in dogs and most cases lead to poisoning [27]. Arnot et al. [28] and Razwiedani and Rautenbach [29], earlier associated the increase in organophosphate poisoning among humans and animals alike to sales to non-professionals, poor handling and abuse, which corroborates results from this study. In this retrospective study, there were apparently no instances in which concomitant human poisoning was identified.

The frequency of the poisoning route (48% topical and 38% oral) agrees with that reported by Berny et al. [30]. The monthly distribution of the poisoning cases revealed that the number of cases increased gradually and spiked in February, April, August and December. There were no case reports in January. Seasons in Nigeria are divided into a) Late dry: January to March, b) Early rain: April to June, c) Late rain: July to September, and d) Early dry: October to December. Most reports of poisoning were reported during the rainy season (April-October). This period is characterized by high rainfall and increased relative humidity, creating a conducive environment for the survival and reproduction of ectoparasites, hence the increase in the rate of use of ectoparasiticides. Our study agrees with Asoke and Charles [31], who reported that acaricides are used more during the rainy seasons in Trinidad and Tobago.

For this study, the determination of causative agents of canine poisoning was based on history and patients' clinical signs. This agrees with reports from several authors where the diagnosis of canine poisoning was based on clinical signs and history [32, 33, 10]. Most cases of poisoning documented in this study were caused by the owner after bathing pet dogs with commercially available insecticide/acaricide formulations. Pet owners' involvement in poisoning cases in this study was higher than previously reported by Zang et al. [10]. The propensity for self-medication (being educated), poor knowledge of their use, handling and disposal by pet owners may have been key reasons for dogs exposure to poisoning rather

than malicious and mischievous exposures as previously reported by some studies [13, 22]. Campaigns at regional and national levels should be done to improve public health awareness of these emerging toxicological risks. The goal should be the phasing out of the WHO Class I and II pesticides (such as dichlorvos) and replacing them with safer alternatives [34]. In addition, the purchase of such products should be through reliable sources.

A presumptive diagnosis was made for many of the cases of poisoning in this study, a common practice in many veterinary clinics and hospitals in the developing world. This is because specific laboratory investigations are expensive, elaborate, time consuming, require expensive instrumentation and high technical skill [33]. It is very likely, that cases of poisoning at the VTH are underreported and many cases presented with gastrointestinal or nervous symptoms may have been misdiagnosed. In addition, many cases of food and plant poisonings may have been treated as haemorrhagic enteritis and not reported as poisoning. In general, poisoning episodes through foods result from a lack of public knowledge on the hazards that some foods may constitute to pet dog health. As dogs are indiscriminate in their eating habits, they will readily ingest potentially harmful foodstuffs available at home [3].

The management of poisonings, depending on the cause, can be specific (antidotal) or symptomatic. The most common clinical signs recorded in this study were neurological (70%), followed by gastrointestinal (30%). This does not agree with another study where many canine patients poisoned showed severe gastrointestinal signs [10]. In this study, management was mainly symptomatic. Treatment protocol was influenced by factors such as the severity of clinical signs, the owner's financial status, and the clinical and ethical perspective of both the owner and attending veterinarian.

Though a major advantage of data collection on case poisonings from veterinary clinics is the potential to provide detailed case information (including outcome), allowing for a more thorough assessment of cases, this study had its limitations. As data typically exist as separate records, it was difficult to collate and time-consuming. The limitations in comparison due to differences in documentation practices, investigative and treatment protocols, as well as the coding of cases among clinicians has been reported [35]. Results from the VTH in this study may not be assumed to represent the situation for all veterinary clinics throughout the different states of Nigeria. However, it could serve as a pointer to poisoning patterns in Nigeria, as in many regions of the developing world. Since cases were retrospectively collected, all poisoning

cases may not have been captured. Also, cases of poisoning in stray dogs that have a significant population in rural areas are also not reported. The use of harmonized and standardized documentation and assessment methods, improved interdisciplinary collaborations (one health strategic approach), and the promotion or development of practical and sustainable options for data exchange within and between the animal and human health sectors is necessary [36].

5 Conclusion

This study shows the heterogeneity of the causative agents of poisoning and their associated symptomatology, which highlights the need for further studies in this area. The need for standardized approaches for the collection, assessment, and integration of poisoning data as well as risk management was identified. This could contribute to the prediction, prevention, and control of poisonings in animals and humans.

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Authors' contributions: OAA was involved in data collection and drafted the first manuscript; OOA and JAO were also involved in data collection; OOA did the statistical analysis; OTA did the conception and design of the project, revised the manuscript critically for important intellectual content; JOO was also involved in the revision of the manuscript. All authors read and approved the final version of the manuscript.

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