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Research Article

Contributions of Health Defense Against Animal Rabies to Promote Veterinary Public Health

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Abstract

Rabies is an important zoonosis characterized by aggressiveness by compromising the central nervous system. *In view of the importance of this disease for public and animal health, the present study points to the importance of reflecting on the effectiveness of health defense actions against this disease, with a view to reinforcing the actions already recommended and to develop new prophylactic proposals to reduce its incidence in Brazil. The* general objective of this study was to research, describe and analyze the actions of the sanitary defense directed to animal rabies, passing through the chain of transmission to the human population, in addition to evaluating the effectiveness of these actions to promote veterinary public health. The study was carried out based on an exploratory bibliographic research in scientific databases. Over the years, it has been possible to observe a reduction in the incidence of rabies cases in dogs and cats in the urban cycle. The success in the sanitary defense against rabies is related to the development of diagnostic methods, such as direct immunofluorescence and flow cytometry, in addition to active and passive surveillance actions. In Brazil, through the application of general prophylaxis measures, it was possible to point out a considerable reduction in the number of cases of rabies in dogs in recent decades. In addition, efforts should be concentrated on the control and prevention of the disease, implementing existing actions and rethinking new strategies for prophylaxis throughout the national territory, since in recent years, there has been a change in the epidemiological profile of the disease, in which the epidemiological role of dogs, as urban reservoirs and main transmitters, has been resignified.

Keywords: *Lyssavirus*; Epidemiological Surveillance; *Desmodus rotundus*; Reservoirs

Introduction

Rabies is one of the oldest diseases recognized by humanity, being classified as a notifiable disease by the World Health Organization [18] and as a zoonosis by the Sanitary and Epidemiological Surveillance [2]. In this way, the development of informative and educational actions has grown vertiginously for the sanitary defense of this infectious disease. On the other hand, there are still gaps regarding the biological understanding of the rabies virus of the genus *Lyssavirus*, as well as its replication and adaptive mechanisms to the hosts [1].

Characterized as a viral disease that compromises the central nervous system in an insidious, progressive and lethal way, rabies is treated as a zoonosis of great importance in public health. Its transmission occurs mainly through direct contact with the saliva of infected animals, such as dogs, cats, cattle and horses, as well as infected bats. The dynamics of transmissibility include viral elimination in secretions and excretions from the source of infection and direct or indirect contact of intact mucous membranes or injured epithelial tissue of susceptible individuals with viruses. The incubation period depends on the form of exposure to the virus and, most of the time, clinical disease follows after a period of 30 to 45 days [16].

The chain of transmission of rabies is very broad and, therefore, its epidemiological cycle is analytically and didactically divided into urban, rural, aerial and sylvatic cycles, all of which are responsible for maintaining circulation and viral transmission among susceptible individuals. The urban cycle is maintained by transmission between dogs, which are still described as the main transmitters to humans, generating major problems for public health. On the other hand, the air cycle involves viral transmission between bats, which can extend to the human population. The rural cycle encompasses the transmission of rabies to herbivores by the bat *Desmodus rotundus* mainly, which belongs to the aerial cycle [10].

In Brazil, *Lyssavirus* has already been isolated in thirty-one of the approximately one hundred and forty of the bat species described. The presence of bats potentially infected with rabies virus in synanthropic areas symbolizes a worrisome epidemiological obstacle, especially for pets and humans, constituting a potential source of infection, particularly due to the possibility of posing as an asymptomatic patient [16].

According to the Pan American Health Organization (PAHO), the rabies virus is present on all continents, affecting more than 150 countries. Worldwide, this disease is responsible for about 60,000 human deaths annually and, in most cases, dogs are the main source of infection in developing countries. Classified as endemic in several countries and with a lethality of approximately 100%, children under 15 years of age correspond to the most prevalent cases, with 40% of reported cases. In Europe and North America, rabies is a major concern for health authorities and the urban cycle is controlled or eradicated. On the other hand, in the countries of Latin America, Asia and Africa, the disease is responsible for thousands of deaths every year, most of them children [13].

In Brazil, the rabies virus is systematically analyzed through epidemiological and pathogenic analyses of viral antigenic and genotypic variants, focusing on evolutionary information on infections involving the different reservoirs of the virus [1]. Through the phylogenetic monitoring of the virus circulating in Brazil, several viral variants have been recorded originating in various reservoirs of the disease. Between 2010 and 2021, of forty human cases affected by the rabies virus, twenty originated through bat bites and nine originated from canids. The surplus of cases originated from reservoirs identified as cats, monkeys and foxes, which are also responsible for the transmission of the rabies virus [16].

With regard to health protection, the surveillance actions developed by the Ministries of Health and Agriculture, Livestock and Food Supply contribute to the organization of operations to control and reduce the incidence of rabies cases in animals, aiming at the prevention of human cases and, if necessary, vaccine blockade to hinder the spread of the virus among the different species affected by the rabies virus. Decision-making and the execution of defense actions are ratified by data records referring to cases detected in animals of interest to public health, such as dogs, cats, and wild animals, including hematophagous or non-hematophagous bats, as well as production animals such as cattle, horses, and others [6].

The diversity of rabies virus reservoirs has allowed the National Rabies Control Program coordinated by the Ministry of Health to take a new look at the demands arising from animal rabies, particularly those related to non-hematophagous canids and bats in urban and transitional areas, so that the systematic epidemiological surveillance of rabies in dogs is not discarded. which is unevenly deployed in the different regions of the country. Despite the intense anti-rabies campaign, coordinated by the Ministry of Agriculture, through the National Rabies Control Program, new cases are registered every year in the country [9]. Through the approach presented by the program, some references helped in the organization of actions to monitor and mitigate rabies cases in animals, seeking the prevention of human cases and vaccine blockade to inhibit the spread of the virus to different species [5].

According to the importance of rabies for public and animal health, this study points to the importance of reflecting on the effectiveness of the actions applied by the sanitary defense of this disease with a view to reinforcing the actions already recommended by the national control programs and the elaboration of new epidemiological proposals to reduce the incidence of this disease. promoting the protection of humans and animals in endemic areas. It is also important to point out that since 2007, there has been an intensification of epidemiological research on viral variants to assist in the design of public health actions in order to monitor the reservoirs that act on the transmissibility of this disease [16].

In view of the above, the general objective of this study was to research, describe and analyze the actions of the sanitary defense directed to animal rabies, going through the chain of transmission to humans. The specific objectives were to evaluate the effectiveness of these actions in the promotion of public and animal health, in view of the lethality of this disease.

Methodology

The present study was carried out based on an exploratory bibliographic research in the scientific databases Scientific Electronic Library Online (SciELO), Latin American and Caribbean Health Sciences Literature (LILACS), International Health Sciences Literature (MEDLINE), the Pan American Health Organization Library Collection (PAHO), the World Health Organization Library Information System (WHOLIS), in addition to thesis and dissertation portals and Google Scholar.

The databases of the Ministries of Health and Agriculture, Livestock and Supply were also used, detailing the actions of sanitary defense against rabies. For the search, an exploratory research was carried out with a time frame of publications between the years 2007 and 2023, using the following keywords: *Lyssavirus*, surveillance, prophylaxis, epidemiology, *Desmodus rotundus*, reservoirs, transmission chain, transmissibility.

From the collected material, a qualitative analysis of the selected articles and normative instructions was carried out, seeking to highlight the actions of sanitary defense against Rabies and its effects on control and prevention in endemic areas in Brazil.

Results and Discussion

Although the current epidemiological scenario is characterized by a decrease in the prevalence and incidence of rabies in dogs and cats, it is still essential to monitor the circulation of the virus, especially in view of the incidence of this disease in these species, it is necessary to identify the viral variants involved, allowing decision-making and general prophylaxis measures for mitigation in each incident case [4].

The high adaptability of the rabies virus in different host species allows its wide distribution in nature. Therefore, the epidemiology of rabies has been studied in several ecological niches of tropical and underdeveloped countries, due to the recognition of seropositive animals in several species, including mongooses, hematophagous bats, raccoons, opossums, foxes, hyenas, jackals, wild and domestic dogs. Thus, it is necessary to concentrate efforts on the control and prevention of the disease, in which health defense strategies for general prophylaxis of the disease should be considered throughout the national territory, especially in endemic areas involving reservoirs. In addition, for the elaboration of plans and actions, it is important to analyze that the epidemiological chain has always had the dog as an urban reservoir being the main transmitter, but according to epidemiological records, it is noted that there is a change in the epidemiological profile of the disease [14].

The immunogenic capacity of rabies vaccines, diagnostic and serological tests have been frequently used to prove the interaction of unvaccinated animal populations with the virus, showing that the virus can harbor in hosts without necessarily causing immediate death; either by provoking infections with a long term of incubation, establishing a condition of carrier status in the prodromal phase, or by establishing asymptomatic infections, which can transmit the infection to third parties, which is still a subject of debate among researchers [1].

The epidemiological surveillance of rabies is an important prophylaxis tool, and virological diagnosis is performed in brain tissue samples of suspected animals. In horses, in addition to the brain, it is recommended to send parts of the medulla to the laboratory, and portions of the cerebellum, cortex and hippocampal convolutions should be included, especially in the horns of Amun. Small animals such as bats, skunks, and marmosets should be

sent to the laboratory in one piece. If it is not possible to open the braincase safely, the animal's head can also be sent to the laboratory [1].

The first rapid laboratory test proposed for the diagnosis of rabies was the detection of Negri corpuscles, a method described by Adelchi Negri more than a century ago. In 1958, the direct immunofluorescence (DIF) technique was developed and became the elective technique for rapid diagnosis, being widely used due to its high sensitivity and specificity. DIF is based on the detection of the virus in tissue smears with specific antibodies bound to a fluorescent substance, such as fluorescein isothiocyanate, achieving sensitivity and specificity close to 100%. As a result, DIF continues to be the elective technique for the rapid diagnosis of rabies [17]. Recently, flow cytometry has been developed and used in the detection of viral antigens in infected cells. However, its application is still limited due to the unavailability of the equipment in most diagnostic laboratories [11].

Serological diagnosis is not routinely used for the diagnosis of suspected cases of rabies in animals. In these cases, *post-mortem* examination by means of histopathology of the nervous tissue in search of viral antigens is absolutely recommended and effective. In relation to human rabies, in which *antemortem* diagnosis is relevant and access to the brain is not easily available, the evaluation of antibodies plays an important role in establishing the diagnosis. In cases involving humans, elevated antibody titers in the cerebrospinal fluid is considered confirmatory for suspected cases [12].

In Brazil, the sanitary defense of rabies has as its prophylactic axis the vaccination of susceptible people and the control of reservoirs. In the urban cycle, the essential measures of rabies prophylaxis have been the systematic vaccination of canines and felines, as well as the capture and elimination of stray dogs. With the adoption of these measures, it can be seen that the number of cases of canine rabies in the country has decreased considerably, which increases the relevance of the application of epidemiological surveillance actions aimed at preventing outbreaks of the disease. Thus, the control of outbreaks with the adoption of mass vaccination with inactivated vaccines is the main measure proposed by the health defense in the focal and perifocal areas [9].

For the effective control of the spread of this zoonosis, epidemiological and sanitary data are indispensable, in addition to constant active and passive surveillance. Thus, the integration between the different classes of health professionals in this process is of paramount importance, in addition to being essential for the execution of rabies control actions. In this context, the health defense of rabies aims to assess risk areas, control the disease in order to reduce cases of human rabies, carry out animal rabies vaccination campaigns, investigate all suspected cases and establish their origin, perform focus blocks in the face of suspicion, ensure the help and performance of the prophylactic scheme in humans, standardize the conducts of anti-rabies care, supply the Unified Health System network with immunobiologicals and specific drugs for the treatment of human beings; and to present and continuously analyze prevention and control measures [3].

At the federal level, the Ministry of Agriculture, Livestock and Food Supply develops the National Program for the Control of Rabies in Herbivores (PNCRH) through the application of public policies for the prevention, control and eradication of the disease. At the state level, the implementation and execution of the PNCRH aims to strengthen the health defense against the disease. In the state of São Paulo, for example, the epidemiological surveillance against rabies aims to ensure compliance with the normative instructions for health protection and to preserve livestock farms of economic and strategic interest to the state, in addition to promoting the improvement of the quality of products, services and inputs; and also the obtaining and maintenance of areas free of the disease in animals [7].

In addition to inspection actions on the rabies transmission chain, the PNCRH regulates health continuing education work for communities, which consists of lectures for rural producers, riverside populations and health professionals, as an essential prophylactic measure for the preservation of human and animal health. Synergistically, the Minas Gerais Institute of Agriculture has promoted actions to capture the hematophagous bat *Desmodus rotundus in* endemic areas of the state of Minas Gerais, with the objective of carrying out population control of the main reservoir and transmitter of the disease in the rural cycle, preserving the health of people and production animals, mitigating possible losses, such as the spread of the disease [8].

Another example of health defense implemented in the federative units of Brazil against rabies are activities planned and executed in the Federal District, which consist of mapping endemic areas and identifying the presence of *Desmodus rotundus in* these areas. Following the condition of epidemiological surveillance, the defense agencies carry out other actions pertinent to the fight against the rabies virus, such as vaccination of herbivores, clinical care for sick and suspicious animals, collection and sampling of stray animals, monitoring of various herds in order to monitor possible bat bites and sanitary activities with regional populations [15].

According to the Secretariat of Agricultural Defense, responsible for the regulation, implementation and execution of various control systems, the objective of these epidemiological actions is, in addition to researching the incidence and prevalence of rabies cases, to generate guarantees that health security is adequate throughout the national territory, which directly and indirectly reflects on the health of the population [6].

Final Considerations

Health education for the rural and urban population regarding general prophylaxis measures against rabies is important for the prevention and control of this endemic disease in the national territory. Health defense actions, such as active immunoprophylaxis, aimed at production and companion animals, in addition to the measures to be taken with the appearance of new cases are challenging guidelines for veterinary public health in Brazil. Therefore, considering the endemic form of rabies in the country, it should be emphasized that notifications to regional surveillance agencies represent a significant prophylaxis for taking measures in relation to the sources of infection, avoiding the risk to those susceptible to the disease.

In addition, efforts should be concentrated on the control and prevention of the disease, implementing existing actions and rethinking new strategies for prophylaxis throughout the national territory, since in recent years, there has been a change in the epidemiological profile of the disease, in which the role of dogs, as urban reservoirs and main transmitters, has been resignified. Thus, it is extremely important to continuously notify and register outbreaks to active and passive epidemiological surveillance agencies to ensure the control and prevention of this endemic disease in Brazil.

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