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EPIDEMIOLOGY OF RABIES IN DOGS IN BRAZIL: CHALLENGES IN CONTROL AND PREVENTION

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ABSTRACT

Objective: To analyze the epidemiology of rabies in dogs in Brazil, identifying the challenges in the control and prevention of the disease, with emphasis on changes in the epidemiological profile, the interaction between the urban and wild cycles, and the effectiveness of vaccination and epidemiological surveillance strategies. Rabies is a highly lethal viral zoonosis, caused by the genus Lyssavirus, and is historically associated with transmission by domestic dogs. With the progress of vaccination campaigns, rabies cases in the urban cycle have decreased considerably, while the role of the wild cycle, particularly of hematophagous bats and wild canids, has been gaining

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greater importance. Immunization against rabies is still the main control strategy, however, obstacles such as low vaccination coverage, growth in the number of stray dogs, and failures in case notification complicate the elimination of the disease. The interaction between domestic dogs and wild animals constitutes a danger for the reintroduction of rabies in the urban environment, requiring joint measures of population control, education and new strategies, such as the application of oral vaccines in wild reservoirs. It is essential to reinforce public policies, such as intensifying vaccination campaigns to prevent and eradicate rabies in Brazil.

Keywords: Epidemiology. Canine rabies. Public health. Rabies Vaccination. Zoonoses.

INTRODUCTION

Rabies is an infectious disease caused by a virus, which manifests itself as a progressive and fatal encephalomyelitis, caused by the *Lyssavirus* of the *Rhabdoviridae family* (Silva *et al*., 2022). It is a highly lethal zoonosis that can affect all mammals, including humans, and is seen as a disease of great relevance to global public health (Brasil, 2021). The virus, present in the saliva of infected animals, is transmitted through bites, scratches or licks on mucous membranes or open wounds (Kotait *et al*., 2009).

Historically, rabies has always been associated with the urban environment, where dogs and cats acted as the main carriers of the virus, representing a considerable risk for the spread of the disease in humans (Favoretto *et al*., 2013). However, it is noted that the epidemiological profile of rabies in Brazil has been changing, due to the decrease in cases of canine rabies as a result of large-scale immunization campaigns and the reinforcement of epidemiological surveillance (Brasil, 2022). On the other hand, wild rabies has been gaining prominence, due to the growth of cases associated with the spread by hematophagous bats of the species *Desmodus rotundus*, known as the "common vampire bat" (Geoffroy, 1810), in wild canids. (Vieira, 2023).

In Brazil, the implementation of the National Rabies Prophylaxis Program, which began in the 1970s, resulted in a significant decrease in human cases transmitted by the urban cycle. However, the disease still persists in certain areas, especially in those with low immunization, presence of wild animals, and proximity to forest regions (Brasil, 2019). According to the Pan American Health Organization (PAHO), from 2010 to 2021, 40 cases of human rabies were reported in the country, 22.5% of which occurred through dogs and 50% through bats (PAHO, 2021).

Despite advances in the eradication of urban rabies, some challenges still persist, such as the lack of continuity in vaccination campaigns in some regions, the difficulty in controlling the population of stray dogs and cats, and viral circulation among wild species that can act as secondary reservoirs (Alves *et al*., 2020). In addition, environmental elements, such as deforestation and uncontrolled urbanization, favor the interaction between humans and wild animals, increasing the possibilities of interspecific transmission (Massote, 2021).

In this context, this study aims to analyze the epidemiology of rabies in dogs in Brazil, highlighting the challenges in controlling and preventing the disease. To this end,

aspects related to transmission, changes in the epidemiological profile and mitigation strategies applied in the country will be addressed.

METHODOLOGY

This study is a narrative literature review on the epidemiology of canine rabies in Brazil, highlighting the obstacles in the control and prevention of the disease. Scientific publications, official documents and guidelines from national and international bodies on the subject were analyzed, including articles indexed in academic databases, government reports and institutional regulations.

The study was conducted through the critical analysis of scientific articles. For the inclusion criterion of the selected studies, a discussion on the epidemiology of rabies in Brazil, the effect of immunization on dogs, the function of wild reservoirs and changes in the epidemiological profile of recent years was taken into account. Materials published in the period from 2000 to 2024, available on the internet, were researched, ensuring that the information is updated.

For the evaluation of the materials obtained, pertinent to the prevalence of the disease in dogs, vaccination coverage, notifications of human cases and variants of the virus present in Brazil, the methodology of descriptive and qualitative analysis was used. The collected data are categorized into themes to enable the detection of epidemiological patterns and possible failures in disease mitigation strategies.

RESULTS AND DISCUSSIONS

CHANGES IN THE EPIDEMIOLOGICAL PROFILE OF RABIES IN DOGS IN BRAZIL

Historically, the urban rabies cycle, with dogs as the main transmitters, represented the main concern of public health in Brazil. However, since the beginning of the National Rabies Prevention Program in 1970, there has been a notable decrease in cases of canine rabies and, consequently, in cases of human rabies transmitted by dogs (Brasil, 2019).

According to information from the Ministry of Health, from 2010 to 2021, Brazil recorded 40 cases of human rabies, of which 9 (22.5%) were transmitted directly by dogs and 20 (50%) by bats (Brasil, 2021). This data highlights the change in the epidemiological profile of the disease, with a notable decrease in the spread through dogs and an increase in the contribution of the air cycle, particularly through the

hematophagous bat *Desmodus rotundus* (Favoretto *et al*., 2013; PAHO, 2021).

However, the existence of stray and semi-domiciled dogs continues to be an obstacle to the management of the disease. It is believed that approximately 30 million dogs and cats are in conditions of abandonment in Brazil, which can favor the spread of the virus and complicate large-scale immunization strategies (Portal Correio, 2022).

The identification of genetic variants of the rabies virus (AgV) is another important point. In Brazil, AgV1 and AgV2 are linked to the urban cycle, like dogs and cats. AgV3, AgV4, AgV6 and AgVCN are found in bats. AgV2* and AgVCN are found in wild canids and non-human primates, respectively (Kotait *et al.,* 2009). The sporadic detection of rabies cases in dogs with variants of wild origin raises concern about the possible reintroduction of the urban cycle through transmission between domestic and wild dogs (Vieira, 2020).

CHALLENGES IN RABIES CONTROL AND PREVENTION

Immunization against rabies in dogs and cats is one of the most effective tactics for controlling the disease. According to the World Health Organization (WHO), to stop the spread of rabies in the urban cycle, it is essential to immunize at least 70% of dogs (WHO, 2018). In Brazil, the Ministry of Health has set a goal of 80% vaccination coverage (Brasil, 2021). However, some areas do not achieve this goal, mainly because of logistical challenges and the absence of constant campaigns in certain regions (Brasil, 2022).

States such as Paraná, Santa Catarina and Rio Grande do Sul, considered free of the canine variant of rabies for more than 10 years, do not carry out annual vaccination campaigns, focusing only on passive surveillance actions (Brasil, 2019). However, the states of the Northeast and North have irregular vaccination coverage, which increases the danger of occasional outbreaks of the disease (Alves *et al*., 2020).

Interaction between the urban cycle and the sylvatic cycle

The proximity of wild animals to urban centers has been a growing risk factor for rabies transmission. Uncontrolled urbanization, deforestation, and the fragmentation of natural habitats have facilitated the interaction between domestic dogs and wild animals, such as wild dogs (*Cerdocyon thous*), foxes (*Lycalopex vetulus*), and marmosets (*Callithrix jacchus*), which serve as reservoirs of the virus in the wild cycle

(Oliveira & Gomes, 2019; Massote, 2021).

An alarming case of this interaction occurred in Maranhão in 2021, where a child died after being bitten by a contaminated fox (Brasil, 2021). Additionally, in Brazil, between 2020 and 2021, there were two cases of human rabies caused by fox attacks, highlighting the relevance of intersectoral measures to control the disease (Brasil, 2021).

Challenges in epidemiological surveillance

Compulsory rabies reporting is essential for monitoring the disease, but underreporting is still a problem in Brazil. According to Normative Instruction No. 50/2013 of the Ministry of Agriculture, Livestock and Supply (MAPA), all suspected cases must be immediately reported to the Official Veterinary Service (SVO) (Brasil, 2013). However, problems in collecting information and challenges in laboratory diagnosis hinder the effectiveness of control measures (Feijó, 2010).

Brazil has a network of laboratories specializing in the diagnosis of rabies, with the Pasteur Institute standing out as the main reference center for the analysis of human samples. With regard to cases involving animals, responsibility is shared between federal and state laboratories for agricultural defense (Brasil, 2008). The Direct Immunofluorescence (DIF) technique is seen as the gold standard for the diagnosis of rabies, but its sensitivity can be restricted in low-quality samples. Molecular techniques, such as RT-PCR, have been recommended by the WHO for their greater diagnostic accuracy, but still face implementation challenges in Brazil due to the high cost and need for imported inputs (Chierato & Mori, 2021).

MITIGATION AND CONTROL STRATEGIES

Immunization against rabies in dogs and cats is the main method of preventing the disease in Brazil. The Plan for the Elimination of Dog-Borne Rabies in the Americas, suggested by PAHO and implemented by the Ministry of Health, emphasizes the importance of constant campaigns and tactics to reach homeless animal populations (Brazil, 2020). In addition to immunization, it is necessary to intensify the population management of stray dogs and cats through neutering programs, responsible adoption, and raising awareness among the population about responsible animal ownership (Vieira, 2023).

In addition to immunization, it is also necessary to intensify the population management of stray dogs and cats through castration programs, responsible adoption, and raising awareness among the population about responsible animal ownership (Vieira, 2023).

In another context, the distribution of baits with oral vaccines to animals such as foxes and wild dogs is an efficient tactic in European, Canadian and North American countries for the control of wild rabies (Rocha, 2014). In Brazil, this strategy is still being investigated, but it may be a viable option to reduce the spread of the virus among wild and urban populations (WHO, 2013).

Finally, educating the population about rabies and its risks is essential to ensure adherence to vaccination campaigns and avoid contact with suspicious animals. Some methods, such as the training of community health agents and the execution of educational programs in school institutions, can help reduce cases of exposure to the virus and improve the effectiveness of control measures (Brasil, 2021).

FINAL CONSIDERATIONS

Changes in the epidemiological profile of rabies in Brazil demonstrate progress in rabies control in the urban cycle, due to the decrease in transmission by dogs and cats. However, emerging challenges, such as the increased contribution of the wild cycle to the spread of the virus, as well as the constant immunization of dogs and cats, efficient epidemiological surveillance and public awareness are essential to prevent the reintroduction of rabies in cities and consequently minimize the dangers to public health. In addition, innovative tactics, such as the application of oral vaccines to wild animals, may be viable options to reduce transmission between the various epidemiological cycles. The implementation of these intersectoral public policies is essential to ensure the eradication of rabies in Brazil.

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