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EPIDEMIOLOGICAL ASPECTS, CONTROL AND PROPHYLAXIS OF THE RABIES VIRUS: A LITERATURE REVIEW

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Abstract: Rabies is a serious acute infectious disease with 100% lethality, it is caused by the Lyssavirus genus virus, belonging to the Rabhdoviridae family, which affects mammals, and in man, it is responsible for causing progressive and acute encephalitis, seen as a disease considered of extremely important for public health. Given this context, this work aimed to describe, according to the scientific literature, the main implications for the rabies virus today, the forms of contagion, epidemiology and prophylaxis. Therefore, this is a cross-sectional, descriptive and exploratory literature review, with a quati-qualitative approach, where the following guiding question was formulated: "What are the approaches and implications of the theme from the perspective of scientific literature?" In this study, the PubMed (National Library of Medicine) and VHL (Virtual Health Library) portals were consulted, using the indexed descriptors: "Rabies Virus", "Epidemiological Profile" and "Health Surveillance" with the inclusion criteria: studies available in a time frame from 2012 to 2022, in Portuguese, English and Spanish. Thus, six articles were selected for this study. In addition, it is understood that the rabies virus has not been eradicated, it is that there are sporadic and accidental contamination rates, where exposure to humans can be lethal, which makes it important for public health and relevant within the perspective addressed in this study due to the few works listing this theme within the current scenario.
Keywords: Rabies Virus; Epidemiological Profile; Health Surveillance.

INTRODUCTION

The first known case of rabies disease appeared in the Eshunna code, in Mesopotamia, dating from the 10th century BC. This document reports a kind of law or rule in cases of accidents with animals - if a

dog is mad and its owner does not arrest it, leaving it free, and it attacks a man and causes his death, the owner of the dog it would have to pay two thirds of mine of silver -. After a period of studies, the Greeks named this disease as Lyssa, whose meaning is "madness" (PEDROSA; GAGLIANI; CASEIRO, 2018).

Rabies is a disease of viral etiology that presents a severe progressive neurological condition that can be lethal if left untreated. It is present in more than 150 countries and approximately 59,000 people affected by this infectious disease die each year, all over the world, mainly in Asia and Africa. It is a zoonosis because it is transmitted by animals, being of great importance for Public Health, despite being a disease of compulsory notification, it is often not diagnosed, causing underreporting of the disease, impairing epidemiological data., 2011).

In 2009, the Pan American Health Organization (PAHO) was tasked with supporting the countries of South America and the Caribbean in the elimination of neglected diseases related to poverty, with rabies transmitted by dogs selected as one of its priorities. In Brazil, in the decade from 1990 to 2017, 594 cases were registered, predominantly in urban environments. In the period from 2000 to 2009, there was an increase in cases of human rabies whose transmitting animals were bats, mainly in the rural environment (VARGAS; ROMANO; MERCHÁN-HAMANN, 2019).

Between 2013 and 2016, dog-transmitted rabies was reported in Bolivia, Brazil, Dominican Republic, Guatemala, Haiti, Honduras, Peru, and Venezuela, but in reduced numbers. This reduction at the continental level is due to large dog vaccination campaigns, greater technical cooperation between the Ministries of Health and Agriculture, in addition to improvements in both the protocol and access to pre- and post-exposure prophylaxis (LÉON et al., 2021).

The National Program for the Prophylaxis of Human Rabies, established in Brazil in 1973, promoted the reduction of cases of human and canine rabies, due to canine vaccination. However, cases of human rabies transmitted by animals in the sylvatic cycle, such as bats, crabs, foxes and non-human primates stand out, showing a change in the epidemiological profile of the infection (VARGAS; ROMANO; MERCHÁN-HAMANN, 2019).

On the other hand, the maintenance of rabies cases in dogs reveals the difficulties and challenges for successful health programs, where effective canine rabies vaccine coverage and timely and complete post-exposure prophylaxis are extremely important. From this perspective, it is noticeable that rabies is associated with poverty in developing countries and there is a need for new studies and technologies around this topic, since developed countries do not have significant incidences that justify investigations that can contribute to the eradication of this disease.

Thus, this article aims to describe, according to the scientific literature, the main implications for the rabies virus today, the forms of contagion and prophylaxis.

METHODOLOGY

This is a cross-sectional, descriptive and exploratory literature review study, with a quati-qualitative approach. This methodology is used as a tool for evaluating and exposing the results of scientific studies, presenting a summary of the data in a didactic way (GONÇALVES, 2019). In the structural development, the "PICo" method was applied, being a complementary mechanism used in the production of the guiding question, where the following problematization was elaborated: What are the approaches and implications of the theme in the perspective

of the scientific literature?

The PICo method is an auxiliary technique that was used in the production of this review, where it corresponds to an acronym for Population or problem (P), Interest (I), and Context (Co). To select the studies that answered the research question, the following descriptors were used: Rabies Virus, Epidemiological Profile, and Health Surveillance. Where these descriptors are indexed in the Health Sciences Descriptors (DeCS) (Table 1).

The collection and selection of studies was carried out through an electronic search in the period of March 2022 in the Virtual Health Library - BVS and National Library of medicine - PubMed, using the Boolean methodology with the use of the operators "AND" and "OR ". The inclusion criteria defined were: complete studies available in full, published from 2012 to 2022, in Portuguese, English and Spanish. Studies were excluded: Book chapters, abstracts, doctoral theses, master's dissertations, monographs, and other studies that did not respond to the research objective.

RESULTS AND DISCUSSION

According to the data collected and exposed, 06 articles were selected, where it is presented in the table below, we can observe a predominance of descriptive studies, with a quantitative approach, where the main language was English.

The rabies virus continues to be one of the main public health problems worldwide, in which it stands out mainly in Latin American and Asian countries. In addition, it is known that its reservoirs are quite varied, where wild and domestic canines and vampire bats stand out. Furthermore, variations in the epidemiological profile of rabies have been observed, in which the hematophagous bat species Desmodus rotundus is the main transmitting species. Therefore, several studies have investigated its ecological, behavioral aspects and the natural history of rabies, which resulted in the development of population control methods, and rabies prevention and diagnostic tools (SCHEFFER et al., 2014).

Since the year 1900, the transmission of the rabies virus by hematophagous bats (Desmodus rotundus) was already known, which over the years, there was a geographic expansion to different species in the environment. It is noteworthy that even though it is a disease of global public importance, there is still a great underreporting of cases, as well as scientific works that evaluate the effectiveness of control measures (BENAVIDES et al., 2020).

In accordance with the data presented, in the study by Lan et al. (2017), when comparing the rabies viral strains in Southeast Asia, it is possible to show that they have a large temporal variation in the origin of both strains, where it is highlighted that the rabies viral strains from Southeast Asia originated earlier, in the 1870s, than strains found in Mainland China (1987). Where the evolution of this virus may have occurred due to illegal imports of wild animals from other countries where rabies is endemic.

In the studies by ZHANG et al. (2020), in which when performing the profile of Filovirus seroreactive in Chinese bats, an extensive infection of several viruses was evidenced. Furthermore, it is worth noting that southern China is the origin of several emerging infectious diseases, with bats being the main natural reservoirs of these zoonoses. Thus, a diversity of divergent Filoviruses (FiVs) was observed, thus constituting a potential risk to public health.

This zoonosis disproportionately affects the poorest populations, and with a shortage of resources to survive, they become more vulnerable to contagion. In

Elements		DECS	MESH
P	"Population or Problem"	Rabies virus	*Rabies virus*
I	"Interest"	Epidemiological Profile	*Health Profile*
Co	"Context"	Health Surveillance	*Public Health Surveillance*

Table 1. Elements of the PICo methodology, and used descriptors.

Source: Researchers, 2022.

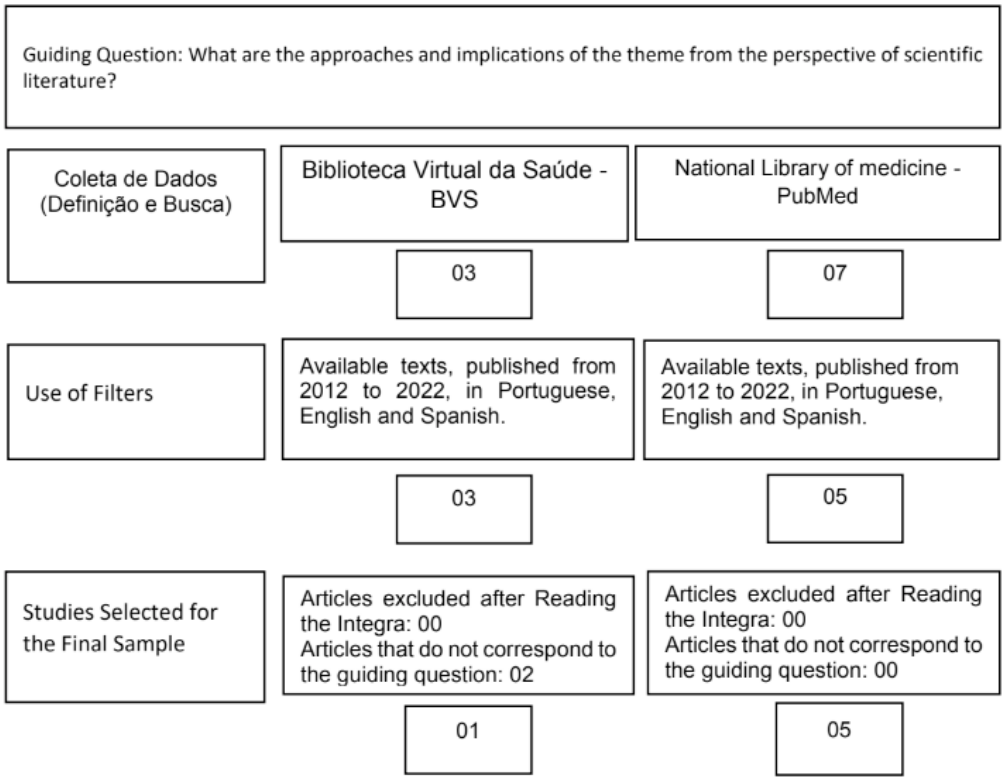

Figure 01. Selection process of studies for literature review.

Source: Researchers, 2022.

DATABASE NUMBER	ARTICLE TITLE	TYPE OF STUDY	GOAL	NEWSPAPER	AUTHOR/ YEAR
01 PubMed	Hematophagous bats as reservoirs of rabies	Descriptive	To present the most relevant questions about the role of vampire bats as reservoirs and transmitters of the rabies virus.	Revista peruana de medicina experimental y salud pública	SCHEFFER *et al*., 2014
02 PubMed	Seroreactive Profiling of Filoviruses in Chinese Bats Reveals Extensive Infection of Diverse Viruses	Experimental, Descriptive, Exploratory	Investigate the serology of FiVs in bats, reveal the antigenic relationships between FiVs and two other mononegaviruses, Tuhoko pararubulavirus (TUHV) and rabies virus (RABV), and the extensive infection of Chinese bat populations with various filoviruses.	Journal of Virology	ZHANG *et al*., 2020

03 PubMed	Indigenous Wildlife Rabies in Taiwan: Ferret Badgers, a Long Term Terrestrial Reservoir	Experimental, Descriptive, Exploratory.	Identify the possible origin of the rabies outbreak using glycoprotein sequences from 10 viral strains and nucleoprotein sequences from 8 viral strains isolated from badgers and ferrets in Taiwan.	Biomed Research International	LAN *et al*., 2017
04 PubMed	Ecological and Epidemiological Findings Associated with Zoonotic Rabies Outbreaks and Control in Moshi, Tanzania, 2017–2018	Experimental, Descriptive, Exploratory	Understand dog owners' perceptions, knowledge of host susceptibility, transmission and rabies control measures; determine the seroprevalence of rabies infection and estimate risk factors for rabies seropositivity in dogs in Moshi.	International journal of environmental research and public health	MTUI-MALAMSHA *et al.*, 2019
05 PubMed	Environmental distribution of certain modified live-virus vaccines with a high safety profile presents a low-risk, high-reward to control zoonotic diseases	Experimental, Descriptive, Exploratory.	To assess safety differences in vaccine types and target populations by comparing model-simulated results of SAD-B19 in fox populations with SAD-B19 in stray dog populations and with SPBN GASGAS in stray dog populations.	Scientific Reports	HEAD *et al.*, 2019
06 BVS	Human rabies in Brazil: a descriptive study, 2000-2017	Observational, descriptive, retrospective	To describe the epidemiological profile of human rabies in Brazil, from 2000 to 2017.	Epidemiologia e Serviços de Saúde	Vargas, Romano, Merchán-Hamann, 2019

Table 02. Synthesis of data from selected articles: Database, Title, Study type, objective, Journal, Author and Year.

Source: Researchers, 2022.

these circumstances, it is directly linked to factors such as: the lack of public policies, and strategies created to control this disease, in addition, the lack of reliable data for the burden and causes of risks in these places for the population (SALOMÃO et al, 2017).

Furthermore, it is important to highlight the informative aspects about this virus, in which according to Mtui-Malamsha et al. (2019), 94.4% of people know about rabies and 89.8% understand that rabies affects animals, but only 43.9% understand that the disease affects other animals of different species (dogs, cats, cattle, goats), swine and humans). In a more detailed investigation, the study revealed that 55.8% of the interviewees were able to clearly indicate the signs of rabies in domestic animals, being the changes in behavior: aggressiveness, altered barking, hydrophobia, fever, convulsions, paralysis, dropped jaw, and inability to eat, in addition, only 62% of these had their animals' vaccination records up to date as a form of prophylaxis.

Among the main methods of control is the vaccination of reservoir animals of this disease. For this, a collaboration between vaccinologists is necessary, which, associating with the progress of Molecular Biology and Immunology, can thus develop specific vaccines (LUTTICKEN et al., 2007). Vaccination of animals is the most effective way to reduce cases of rabies in humans. As a striking example are the oral rabies vaccines (ORV) that began in Switzerland, with the use of baits for foxes containing attenuated virus and is currently used by many European countries (STECK et al., 1982).

Oral vaccination is undoubtedly the simplest and most effective method to combat rabies in stray dogs, but these live oral vaccines for wild animals have residual pathogenicity for certain rodents (ARTOIS et al., 1992). And it was because of this potential for residual pathogenicity that more attenuated strains and recombinant vaccines were developed for use in wild populations (ANDREAS; HILDEGUND, 2002). However, there is still a need to create a standardized methodology to compare the simulated risks to humans arising from the use of oral vaccines in animal populations.

In this sense Head et al. (2019) in their study developed and applied a new method to compare the risk of various oral vaccines, these methods can be used to assist in the planning of vaccination campaigns for populations of wild or domestic animals, proving useful to carry out risk assessments. prior to delivery of oral/bait vaccines into the environment, or to explore the after-effects of vaccine changes.

The baiting method is flexible enough to be applied to other oral rabies vaccines using different formulations, such as adenovirus or vaccinia virus. In addition, the study highlights the importance that campaign planners must have in relation to public education not to touch baits if they are found in the environment, as a way of preventing serious adverse events for the population and domestic animals (HEAD et al., 2019).

Regarding the epidemiological profile of rabies cases in Brazil, Vargas et al. (2019) published an article on the epidemiological analysis of the 188 reported cases of rabies between the years 2000 and 2017. In this approach, 66.5% of the cases were male and the most prevalent age group corresponds to those under 15 years of age. age with 49.6%. The rural area has 126 cases. In this time frame, biting is highlighted as the most common transmission route with 81.9%. Added to this, the most emblematic notification region was the Northeast region, in which the state of Maranhão obtained the record of notifications (N=55).

In addition, the use of rabies prophylaxis was successful in most cases, however, 132 cases did not undergo prophylactic treatment

and 2 cases in 2017 died. The most common signs and symptoms in these cases were fever, agitation and paresthesia. As for the incubation period detected by calculating the median, it was 50 days, and cases of dog bites showed their symptoms after 57 days, while bat bites showed up after 39 days. On the other hand, there was a decrease in the incidence of rabies cases in Brazil and almost half of the notifications were associated with wild animals (VARGAS; ROMANO; MERCHÁN-HAMANN, 2019).

CONCLUSION

Based on the above, it is possible to perceive that even though rabies is a disease with great negative impacts on human health, it still has many factors that make its treatment, risk mapping and control of future cases difficult. In addition, it is known that such problems are mainly linked to the lack of campaigns aimed at educating the population in risk areas.

Among the main reservoirs of the disease in recent years, bats stand out, as they have been expanding the areas of contagion, especially in Asian countries, which further highlights this risk to public health that must be treated as a priority.

Therefore, the main weapon against this disease are public policies and strategies to control this disease, as well as reliable data on risk causes, vaccination strategies for reservoir animals and updated information on the epidemiological profile of rabies cases.

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