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Prevention of zoonoses with the use of vaccines: Challenges for single health

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ABSTRACT

Zoonoses are diseases transmissible from animals to humans, 60% of which are zoonotic pathogens. Increased coexistence between animals and humans, changes in infectious agents and hosts, and globalization all contribute to this scenario. Vaccination is fundamental in the control of infectious diseases, with significant technological advances in veterinary immunization, exemplified by the eradication of rinderpest. Vaccines not only protect animals, but also help to control zoonoses such as leishmaniasis, leptospirosis and rabies, which still have high case and mortality rates every year, highlighting the importance of One Health in promoting public health.

Keywords: Leishmaniasis, Leptospirosis, Rabies, Vaccination, Zoonotic.

INTRODUCTION

Diseases that are transmitted from animals to humans through contact or ingestion of contaminated water and food are defined as zoonosis, according to the World Health Organization (WHO). In this sense, 60% of the agents that are pathogenic to humans are zoonotic, such data can be explained by the increase of animals in the social environment and in the products of animal origin produced by man, such as microorganisms associated with wildlife entering intensive agricultural systems based on livestock, increase in the frequency and speed of travel, changes in the infecting agents themselves or intrinsic characteristics of the hosts, (SCHLUNDT, 2004).

Vaccination is the most effective and low-cost method for the control of infectious diseases in public health and veterinary health. Immunization technology follows a rapid advance through the use of modern molecular techniques and the greater understanding of immunological mechanisms and ways to optimize immune responses to achieve maximum protection. As an example, veterinary immunization has enabled the eradication of rinderpest, as declared in 2011, jointly by the World Organization for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO) (WHO, 2024).

The immunization of animals serves many different purposes, such as controlling infections and infestations, thereby improving animal welfare, and as a secondary benefit promoting the control of

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anthropozoonoses (diseases of humans transmitted to animals), and thus protecting public health (PAUL-PIERRE, 2009).

Zoonotic diseases that have vaccines (leishmaniasis, leptospirosis and rabies), there is a high rate of confirmed cases annually, in which 52,645 are registered for leishmania annually. In addition, 50 thousand people die per year from leptospirosis and rabies, respectively, 60 thousand people (approximately 100%), according to the WHO (2024), therefore, it is necessary to know, debate and disseminate the knowledge of such zoonotic diseases in order to reduce the prevalence and lethality rate of these from the use of vaccines, and thus, promote the control of public health and animal health in the "*One Health*" context.

MATERIALS AND METHODS

The work was carried out with the aim of presenting some zoonoses that have vaccines available, and demonstrating their importance in prevention for One Health. To this end, articles and papers were consulted in databases such as PubMed, Scielo, Science Direct and Google Schoolar. In addition to the search and analysis of data present in the websites of SINAN and the Federal Government Portal, Boolean operators were used as a search strategy in the definition between the terms.

RESULTS

Dogs are the main reservoir hosts for the zoonotic cycle of leishmania and act as the main source of infection for humans (DANTAS, 2024). In this sense, canine visceral leishmaniasis (CVL) has a great diversity of clinicopathological manifestations, clinical signs vary according to the parasite load, and target organs (skin, bone marrow, spleen, liver, and lymph nodes). In summary, biochemical/hematological and histological changes are observed (TORRECILHA et al., 2016). In addition, the presence of signs such as alopecia, dry exfoliative dermatitis, lesions on the tip of the ear, onychogryphosis, weight loss, and splenomegaly occur in at least 50% of infected dogs (SILVA et al., 2018).

However, in humans, visceral leishmaniasis has undergone important changes in recent years, occurring in large urban centers and in the peri-urban region. It is believed that some factors, such as the process of urbanization, deforestation, migration, environmental changes, absent or inadequate basic sanitation, deficiencies in the control of vectors and the canine population, contributed to this expansion and incidence of visceral leishmaniasis, therefore there is a need for means that can help in the fight against this zoonosis (SILVA 2021).

Vaccines focus on the immunization of animals that act as a reservoir of the protozoan and that are close to humans, that is, the vast majority of dogs. In this logic, the known immunizations for

leishmaniasis are divided into three groups, the first, second and third generations. First-generation vaccines use killed parasites, fractionated antigens or live attenuated pathogens, have advantages because they have a low cost and stimulate innate immunity in dogs, on the other hand, they did not reach test standard III and were not approved for human use. The second-generation ones use recombinant proteins through modified cells and the third-generation ones use simian adenovirus (ChAd63) (MOAFI, 2019).

Leptospirosis is a zoonosis caused by the bacterium *Leptospira spp.* which has negative impacts on farm animals and companion animals. It is a systemic disease that has clinical signs such as fever, renal failure, miscarriage, infertility, pulmonary manifestations and hemorrhages (ELLIS WA, 2015), cases that progress to death represent 5 to 10% of diagnoses (COSTA et al., 2015). In Brazil, there were 42,168 confirmed cases and 4,344 deaths, according to the epidemiological bulletin (SINAN, 2023).

In humans, severe leptospirosis is most often associated with the *Icterohaemorrhagiae serogroup*, in particular with the Copenhageni serovar (BHARTI et al., 2003). The immunological protocol for leptospirosis is based on bacterins and developed using deactivated leptospira structures. However, the outer envelope immunization and others because they are inactivated acellular have not obtained widespread support, with the main reasons being the lack of efficacy, the lack of consistency and the high production costs (KLASSEN, 2015).

In 1958, China began the process of manufacturing a leptospirosis vaccine in humans by manipulating monovalent or polyvalent inactivated leptospire cells and applied it to populations in epidemic regions. In the last 80 years, the vaccine has undergone adaptation processes with the advancement of technology and better immunological understanding, however, clinical studies developed in the country have shown that the vaccine can cause hypersensitivity and toxicity reactions (XU, 2018).

Rabies is caused by the *Lyssavirus* virus that infects neurons and generates neural dysfunction. The microorganism uses the proteins of the host cells to take control of cellular functions and cause irreversible damage that leads to the death of the host (FATEMEH, 2021). The importance of this zoonosis is due to the high lethality rate, because in the history of rabies in Brazil, only two cases have evolved to cure, according to the Technical Group on Rabies of the Technical Unit for Zoonoses Surveillance, of the Ministry of Health in an epidemiological bulletin published in 2023, covering data collected between the years 1986 and 2023 (MINISTRY OF HEALTH, 2023).

The Centers for Disease Control (CDC) (2010), in Atlanta, Georgia, USA, defines rabies as a disease that can be prevented with the use of vaccines. In principle, this is a disease maintained and perpetuated in nature, mainly by carnivorous mammals and bats with different feeding habits, known as vector reservoirs or amplifying hosts (VAN DER MERWE, 1982; FIELD et al., 2001). Prevention, of dogs and cats, occurs through the use of rabies vaccine, which is produced from the inactivated virus and

immunization occurs through the production of neutralizing antibodies and activation of helper T cells to protect against the rabies virus (ASTRAY, 2017).

In contrast to other zoonoses analyzed, the rabies vaccine is efficient in controlling dogs and humans, according to the Health Surveillance Secretariat, in Brazil 60% of dogs are vaccinated (SINAN, 2023). Humans who have been exposed to the virus receive anti-rabies serum, with the exception of at-risk professionals, such as biologists and veterinarians who receive the protocol before exposure to the virus (MINISTRY OF HEALTH, 2022).

FINAL THOUGHTS

It can be concluded from the data and information presented that zoonoses play an important role for both humans and animals. However, the use of vaccines can help control these diseases. It is important to note that some zoonoses do not have vaccines with efficacy accepted by the WHO, such as the vaccine for leishmania, however, research in search of these more efficient options continues as biomolecular technology advances. In addition, for the control of zoonotic diseases that have an effective vaccine, for example, rabies and leptospirosis, it is essential to understand the population about the consequences of this disease and respect the vaccination schedule, in order to protect human and animal health.

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