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Research Article

Health Defense Actions to Assurance Success of Control and Prevention Programs for Bovine Viral Diarrhea

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Abstract

The production chain of cattle farming, whether for beef or dairy purposes, is subject to constant infectious challenges that circulate within the agribusiness sector, among which Bovine Viral Diarrhea (BVD) stands out, with its main impact being on animal reproduction. Given the importance of this disease to the economy, this work highlights the need to reflect on the effectiveness of sanitary defense actions against this illness, with a view to raising awareness of the already recommended actions and developing new preventive proposals to reduce its incidence. The general objective of this work was to research, describe, and analyze the actions of sanitary defense directed towards DVB, covering its transmission chain, as well as to evaluate the effectiveness of these actions in promoting animal health and reducing economic impacts. The study was conducted based on an exploratory bibliographic research using scientific databases. The inclusion and exclusion criteria were defined based on the proposal guiding the research, the identification of relevant studies through different sources, the composition of the explanatory content based on the search and inclusion/exclusion criteria, and the extraction of data related to the research question, including general information about the study. Based on the research, it was possible to observe that there is no specific national program developed for the prevention, control, or eradication of DVB. The general prophylactic measures developed and adopted for sanitary defense are the responsibility of animal health professionals, who establish strategies to prevent the introduction of the DVB virus on farms. Furthermore, knowledge of general prophylactic measures allows the entire production chain to enhance and direct its surveillance efforts towards DVB.

Keywords: Abortions; Animals PI; Serology; Prophylaxis; Vaccination; Traffic Control

Introduction

Bovine Viral Diarrhea (BVD), along with Infectious Bovine Rhinotracheitis and Leptospirosis, is among the main infectious diseases in the reproductive sphere that negatively impact the development of cattle farming both globally and nationally [1]. In Brazil, the Bovine Viral Diarrhea Virus (BVDV) is considered enzootic, and its presence in herds is confirmed through serological evidence estimated at around 60% to 80% of seropositive animals [22].

In the context of reproductive diseases in cattle, Pasqualotto., *et al.* [20] point out that the signs of the presence of infectious diseases on rural properties often go unnoticed, and effective diagnosis is

only established when the pathogens have already spread among the herds, resulting in considerable economic losses, as they affect reproduction in both beef and dairy cattle, as is the case with DVB.

VDVB is one of the most important pathogens in cattle farming, primarily because it triggers clinical manifestations related to reproduction. As a consequence, reproductive failures occur, such as embryonic losses, abortions, stillbirths, teratogenic effects, and the birth of weak or non-viable animals. It is important to consider that calves born with malformations die within a few hours after birth. Another impact caused by the virus is the possibility of the birth of persistently infected (PI) animals with Pestivirus, which, due to being asymptomatic, stand out as the main sources of virus elimination in the herd.

The PI calves play a fundamental role in the epidemiology of VDVB because, in addition to being the main spreaders of the virus, they are characterized by the impossibility of being identified through clinical and serological tests, as they are immunotolerant, seronegative, and do not exhibit clinical disease. Furthermore, they can develop a fatal disease known as Mucosal Disease, which occurs when an immunotolerant PI animal to the non-cytopathic strain of BVDV is superinfected by the cytopathic strain of the virus [2]. Longitudinal serological studies estimate that the average global prevalence of antibodies in persistently infected animals was assessed to be between 1 and 2% of the global cattle herd [14].

In this way, Moreira., *et al.* [17] emphasize the need to understand the pathogenesis of VDVB with a view to developing diagnostic techniques and vaccines, which are essential prophylactic measures to combat the disease, since the damages caused by DVB are multifactorial; that is, the disease presents various manifestations that can vary according to the developmental stage of the animal, nutritional status, local sanitary defense measures, and the circulating infecting strain in the field, as also corroborated by [18].

Being considered one of the most important infectious diseases for cattle, DVB has been the subject of ongoing research involving its pathogenesis and prophylaxis. In this way, according to its economic and sanitary importance in livestock, this work points to the need to reflect on the effectiveness of the actions taken by sanitary defense against this disease, with a view to reinforcing the actions already recommended and established by preventive veterinary medicine and the development of new epidemiological proposals to reduce its incidence, promoting the protection of animals in challenging areas. In light of the above, the general objective of this work was to research, describe, and analyze the actions of sanitary defense aimed at Bovine Viral Diarrhea, traversing its epidemiological chain. The specific objectives were to evaluate the effectiveness of the aforementioned actions in promoting animal health and reducing economic impacts.

Methodology

The present study was conducted based on an exploratory bibliographic research on the sanitary defense against Bovine Viral Diarrhea, utilizing scientific databases such as the Scientific Electronic Library Online (SciELO), Google Scholar, Medline, and the Latin American and Caribbean Literature in Health Sciences. (Lilacs). For the search, a temporal cut of publication between the years 2002 and 2020 was made, using the following keywords: Pestivirus, impacts, reproduction, diagnosis, serology, prophylaxis, vaccination, and traffic control.

The study included articles that addressed the effectiveness of the strategies applied by sanitary defense against this disease, with the aim of revisiting the actions already recommended by control and prevention programs, totaling 16 articles selected for obtaining results and developing discussion. The inclusion and exclusion criteria were defined based on the proposal guiding the research, the identification of relevant studies through different sources, the composition of the explanatory content based on the search and inclusion/exclusion criteria, and the extraction of data related to the research question, including general information about the study. Based on the collected material, a qualitative analysis of the selected articles was conducted, aiming to highlight and point out the effects of general prophylactic measures in combating DVB.

Results and Discussion

Since the first viral isolation conducted in Brazil, tests have been carried out on cattle herds and have confirmed the widespread dissemination of the Bovine Viral Diarrhea Virus. (VDVB). However, the prevalence rates vary by region, which have shown an average ranging from 60 to 85% of seropositive animals in the herds over the years [8,22].

Flores., *et al*. [10] demonstrated that in the state of Goiás there was an increase of approximately 38.3% in seroprevalence in the years 1999 and 2000, considering that, throughout the longitudinal study, the analyzed samples were similar in quantity and the diagnostic tests were applied using the ELISA method, as shown in Table 1. According to these authors, in populations of 493 and 425 bulls used in semen collection centers in the state of São Paulo, 40.8% and 53.8% of the males tested by Seroneutralization had antibodies against VDVB in the years 1998 and 2003, respectively, suggesting an increase in cases over the years.

State	Year	Animals Tested	Positive Animals	Average Increase/ Year	Total Increase
Goiás	1999	184	15,80%	38,30%	38,30%
Goiás	2000	207	54,10%		
São Paulo	1998	493	40,80%	3,25%	13,00%
São Paulo	2003	425	53,80%		
The tests conducted in the state of Goiás were performed using the ELISA technique. The tests conducted in the state of São Paulo were performed using the Seroneutralization technique.					

Table 1: Serology of infection by Bovine Viral Diarrhea Virus conducted in the states of Goiás and São Paulo in the years 1999, 2000, 1998, and 2003.

Source: Adapted from Flores., *et al*. [10].

According to the natural cycle of diseases, infections caused by Bovine Viral Diarrhea (BVD) naturally affect bovine and buffalo herds, and the pathogen can also infect other different species of animals, such as sheep, goats, pigs, and rabbits, although cattle are more sensitive to viral infection and the clinical presentation of the disease. On the other hand, studies conducted by Moreira., *et al*. [17] found antibodies naturally in pigs and other ungulate animals and warn that the multiplicity of hosts complicates the control and eradication of the virus.

Regarding sanitary defense against DVB, there is no specific national program developed by animal defense agencies for prevention, control, or eradication. The general prophylactic measures developed and adopted for sanitary defense are the responsibility of animal health professionals, who establish strategies to prevent the introduction of VDVB on properties [19].

These strategies encompass a series of measures related to productive and reproductive management, such as hygienic care during artificial insemination, use of semen with certified microbiological quality, adoption of periodic serodiagnosis in herds, acquisition of certified breeding animals, application of quarantine for newly purchased animals, quarantine applied to these animals, and, most importantly, the adoption of vaccination schedules, which should be followed and carried out according to the guidance of a veterinarian. Furthermore, it is recommended to eliminate all animals from the herd diagnosed as seropositive, as they can serve as a constant source of the agent's elimination in the environment [20].

Another strategy for sanitary defense is the control of animal movement between livestock properties, which must be conditioned on negative serology for VDVB, especially concerning the introduction of new animals into the herd. Serological monitoring on farms should be carried out consistently and cyclically, through laboratory tests that allow for the indirect demonstration of the presence or absence of viral circulation. In addition to serology by ELISA or by virus neutralization, other diagnostic methods, such as viral isolation through cell culture and polymerase chain reaction, can be directly applied for the detection of VDVB from samples of nasal secretions, blood, feces, lymph nodes, and intestinal fragments [13].

The control and prevention of BVD in cattle herds involve, in addition to appropriate management practices, providing good nutritional conditions for the animals, which must meet their immunological requirements, such as the development of humoral and cellular immune responses capable of combating infections and

maintaining the health status of the herd. Therefore, it is important to point out that the induction of neutralizing antibody production, both through vaccinations and field challenges, is linked to meeting the nutritional requirements of each animal.

In this way, immunoprophylaxis becomes an important strategic tool against VDVB, which should include both males and females from 3 months of age, as well as adult animals and pregnant cows. It should also take into account the need for a booster vaccination 30 days after the first dose, in addition to semi-annual or annual revaccination [6]. Flores [9] also recommends vaccinating breeding cattle at least one month before the breeding season or artificial insemination. Additionally, the practice of vaccination is also recommended in farms with high animal turnover, in feedlots, and in the finishing of steers, where animals from different origins are commonly gathered, as well as in situations where there is a constant acquisition of animals, such as in dairy herds.

Classically, vaccination is a prophylactic measure with greater efficacy in the control and prevention of BVD, and it should be strategically implemented as a way to protect animals against the clinical manifestation of the disease and to reduce the circulation of the virus in herds, in order to try to prevent transplacental transmission and, consequently, the occurrence of permanently infected calves. (PI). In this way, it is recommended to vaccinate females two or three weeks before the breeding season to stimulate maternal immunity, prevent the formation of PI animals, and provide protection to the calf, especially during the first two trimesters of life [12].

It should also be considered that the effectiveness of vaccination as a health defense against DVB is still linked to the antigenic composition of the vaccine. The inactivated vaccines used for the prevention and control of DVB are made up of cytopathogenic and non-cytopathogenic strains of VDVB [21]. Due to the genetic diversity of the virus, it is recommended to use multivalent vaccines, composed of at least two antigenically different strains, as vaccines produced with type 1 strains, although they provide cross-protection against non-cytopathic strains of types 1 and 2 of VDVB, generally induce only partial or incomplete protection against type 2 strains.

Furthermore, the immune competence of hosts is directly related to the replication and virulence of the virus in animals, with animals of all ages being susceptible to infection by VDVB. In animals with good immune condition, the production of antibodies occurs two to three weeks after infection, being capable of neutralizing the infectious agent. Meanwhile, some factors such as population density and biosafety protocols influence the health-disease process [18]. In this way, Kelling [15] advocates that for each cattle production system, the selection of the vaccine to be used should consider the type and duration of the immune response, cross-reactivity between antigens, immunosuppression, reversion of virulence, fetal protection, the effect of maternal antibodies on the immune response, and the degree of purity of the vaccine.

According to Brock [3], vaccination is a prophylactic strategy to be applied to the susceptible, capable of protecting against disease and recommended for herds with high animal turnover, positive serology, a history of clinical or reproductive disease, and confirmed viral isolation. However, vaccine failure can occur due to the presence of different antigenic strains that are unable to provide adequate immunity, as the phylogenetic relationship between the strains suggests that vaccines should be produced with standardized material. In this regard, the sanitary defense against the DVB should encompass the production of vaccines whose composition includes all types and subtypes of the virus, being capable of protecting the herd.

Conclusion

Bovine Viral Diarrhea is a disease of economic and sanitary relevance, primarily causing reproductive losses on farms. Although it is not a zoonosis, the disease is subject to mandatory reporting and should not be neglected by veterinary professionals. By identifying the actions of sanitary defense, this work contributed to raising awareness about the sanitary defense agenda and to a better understanding of the execution of these actions, enabling a reduction in the transmission of DVB and the incidence of cases. The knowledge of general prophylactic measures allows livestock companies, technicians, and other professionals involved in the cattle production chain to expand and direct their surveillance efforts towards the prevention and control of BVD. It was possible to outline pathways for the early diagnosis of persistently infected animals, an essential management strategy for controlling the disease, in addition to indicating that the culling of seropositive animals and vaccination are feasible and practical methods for the control and eradication of BVDV, aimed at alleviating economic losses.

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