Bovine Viral Diarrhea (BVD)

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Take Home Message

Bovine viral diarrhea virus (BVDV) is an economically important pathogen of cattle and it occurs worldwide. The biology of this virus is complex because it is associated with many diverse clinical manifestations, ranging from mild acute infections to fatal mucosal disease. BVDV can infect cattle at all ages including the fetus (1-3). Serological evidence shows that BVDV is a common infectious agent in beef cattle herds and feedlots (4). Major economic losses lately in Saskatchewan have been mucosal disease and calf mortality of persistently infected animals (5, 6). Furthermore, BVDV probably plays together with other infectious agents a role in calf pneumonia (‘shipping fever’; 1, 2, 7). Thus it is important to control and prevent BVDV infections by vaccination and by identification and elimination of persistently infected cattle, which are the major source of infection.

Introduction

Based on cell culture analysis, BVD viruses can be distinguished into cytopathogenic (CP) and noncytopathogenic (NCP) biotypes. The NCP biotype is more widespread in cattle and the cause of fetal infection. Currently, BVD viruses have been divided into two types, and each type contains many strains. Clinical manifestations, which may occur in cattle infected with this virus include fetal infections, abortions, persistently infected calves, mild and severe acute infections, and mucosal disease (1-3).

BVDV infections can be divided in prenatal infections (infections of the unborn calf) and postnatal infections (acute infections after birth) (Table 1). Infection of the fetus occurs when noncytopathic (NCP) virus from a pregnant dam passes the placenta and infects the fetus resulting in abortion, birth of an abnormal calf, a BVDV carrier calf, or a normal calf dependent on the developmental stage of the fetus at the time of infection. Carrier calves are animals in which BVDV persists, meaning that the virus continuously replicates in these animals, and they shed virus for life in their body fluids. They are a major source of transmission of the virus to other calves.
There is no cure for this disease, and the fate of many of these calves is development of mucosal disease and death. The frequency of persistent BVDV of infection in cattle is estimated at 1% (4, 7, 8), although higher percentages in individual herds have been described (5, 6). Fatal mucosal disease can develop in persistently infected cattle as a consequence of a mutation of a NCP BVDV into a CP virus or as a superinfection with a CP virus.

Acute BVDV infections are very common in cattle. Data from serological surveys in adult animals show the presence of antibodies to BVDV in at least 90% of them, indicating that at least 90% has been infected with this virus (4). Usually acute BVDV infections result in mild disease of short duration characterized by fever, increased respiratory rate, diarrhea and a reduction in white blood cells (1-3). In general, this is followed by the appearance of antibodies that neutralize the virus and by a rapid recovery. However, the effect of BVDV on the immune cells reduces the host’s resistance to disease and as such BVDV may be an important pathogen for stressed cattle entering a feedlot operation and play a role in ‘shipping fever’ (7, 9-11).

Some BVDV isolates can cause acute infections in herds with sickness and death that resemble mucosal disease. These virulent NCP BVDV isolates, now classified as type 2 BVD viruses, were the cause of severe outbreaks in Ontario and Quebec in 1993, and in the last decade in the USA (12, 13). This severe form of acute BVDV, characterized by high fever, hemorrhaging, diarrhea, reduction of white blood cells and platelets, has occurred in dairy calves and cows as well as veal calves.

Table 1. Diseases caused by BVDV infections in cattle.

<table>
<thead>
<tr>
<th>Prenatal infections</th>
<th>Postnatal infections</th>
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<tbody>
<tr>
<td>Type 1 and 2 BVDV</td>
<td>Type 1 BVDV</td>
</tr>
<tr>
<td>Resorption of the embryo</td>
<td>Mild acute infection</td>
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<tr>
<td></td>
<td>in dairy and beef cattle</td>
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<tr>
<td>Abortion</td>
<td>Might lower resistance to</td>
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<td></td>
<td>other diseases</td>
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<td>Stillbirth</td>
<td>Might increase risk of</td>
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<td></td>
<td>respiratory disease</td>
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<td>Birth of abnormal calves</td>
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<tr>
<td>Persistently infected calves</td>
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<td>with high probability of</td>
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<tr>
<td>mucosal disease</td>
<td></td>
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<tr>
<td>Abortion</td>
<td>High mortality and high</td>
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<td></td>
<td>rate of abortions in</td>
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<tr>
<td></td>
<td>pregnant dairy cows</td>
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</tbody>
</table>

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Impact of BVDV on Feedlot Cattle

Persistently infected calves are estimated to make up 1% of beef cattle. These animals are in general ‘poor doers,’ less resistant to diseases, and they may develop fatal mucosal disease (5, 6). Since there is no cure for these animals and they should be culled upon detection. Moreover, the transmission of BVDV is from animal to animal and the major source of transmission consists of persistently infected calves who shed large quantities of virus for life.

Cattle entering a feedlot are exposed to several factors that may increase the incidence of disease and economic losses caused by disease. These factors include lower disease resistance caused by stress and increased risk of disease transmission of infectious agents caused by commingling calves. Furthermore, 4 to 6 month old calves often have a lower resistance to infectious diseases because passive immunity, level of BVDV antibodies obtained from suckling colostrum, has declined. In these cases calves active immunity, development of defence against the virus by the calf itself, is not yet established. The effect of BVDV on healthy calves without the impact of these other factors is probably economically not very significant. However, in combination with other factors BVDV may have an impact on diseases in feedlots, mostly caused by the effect of this virus on the host’s immune system. Infections by BVDV, as measured by an increase in antibody titre during the first month in the feedlot, have been correlated with increased risk of respiratory treatment (14, 15).

It is very difficult to determine the production losses caused by BVDV infections since the diseases it can be associated with are multifactorial.

BVDV Type 1 and 2 Infections

Despite the devastating outbreaks caused by emerging type 2 BVDV in dairy and veal cattle, not much is known about acute type 2 BVDV infections in beef cattle. In recent years, type 2 BVDV has been isolated from beef cattle with mucosal disease, and serological studies have demonstrated the appearance of antibodies to type 1 and type 2 viruses in feedlot cattle (J. van den Hurk, unpublished data). The impact of acute type 2 BVDV infections on beef cattle seems to be much lower than on dairy cattle.
Persistently infected or carrier animals are the major source of virus transmission and therefore should be eliminated from herds whenever possible, especially in breeding herds. This may not be practical in large open breeding herds and feedlots. Identification of carrier animals is carried out on blood samples taken at dates two weeks apart \((16, 17)\). Reliable tests for type 2 BVD viruses and for differentiation between the two BVDV types are still under development.

The many commercially available BVDV vaccines can be divided in modified live and killed vaccines. Modified live vaccines should be used cautiously and should not be used in pregnant dams, herd mates of pregnant dams, and breeding bulls, because there is a risk that infectious virus may induce abortions or malformations of the fetus. Furthermore, modified live BVDV vaccines might have a negative effect on the immune system and so effect immune responses to other components in combination vaccines \((18)\). In general, modified live virus vaccines have the advantage that they induce a faster immune response and usually require one immunization. Killed or inactivated vaccines are safer but they are usually more expensive and require two immunizations.

The degree of cross-protection of type 1 vaccines for the range of type 1 field viruses seems reasonable but is not well established. Even less is known about the cross-protection between type 1 vaccines and type 2 viruses. Type 2 BVDV vaccines are currently under development.

An ideal vaccine for BVDV should induce a fast immune response to a broad spectrum of BVDV field isolates after one immunization without risks of side effects and induce protection in non-breeding and breeding animals.

All breeding cows and heifers should be vaccinated for BVDV to decrease the occurrence of fetal infection and birth of persistently infected calves. Killed vaccines should be given twice 3 to 4 weeks apart starting at 7 to 8 weeks before breeding, and modified live vaccines should be given once 3 to 4 weeks before breeding.

Currently, there have been no clear data on the effectiveness and cost-efficiency of vaccination of feedlot cattle against BVDV to prevent respiratory disease. An increase in antibody titre to BVDV during the first month in the feedlot was found to be related to increased risk of respiratory disease, whereas antibody titres to BVDV at arrival in the feedlot appeared to decrease the risk of respiratory treatment \((14, 15)\). Based on these data, the best recommendation for feedlot vaccination, if
the producer decides to vaccinate, is to precondition the calves before entering the feedlot. The animals should be vaccinated 3 to 4 weeks before entering the feedlot and their second dose should be given when they enter the feedlot in case a killed vaccine is used. In addition, it is recommended that farmers should monitor the immune status of their herds and check their vaccinated animals for appearance of seroconversion.

Summary

BVDV is associated with a number of diseases in cattle including fetal infections, abortions, BVDV carrier state, mild and severe acute infections, respiratory disease, and mucosal disease. Fetal infection is a cause of economic loss for cattle breeders. In feedlots losses are caused by persistently infected calves and by the effect of BVDV on the host’s immune system which may result in an increased occurrence and severity of other infectious diseases, such as respiratory disease. For prevention and control of BVDV infections, elimination of BVDV carrier animals and vaccination of breeding cattle is recommended. The efficacy of preconditioning calves by pre-entry vaccination to the feedlot is unknown.

References


