

Bovine Viral Diarrhea Virus (BVDV)

1. BVDV symptoms

The outcome of the clinical symptoms of a BVDV infection depends on the presence of antibodies against the virus. When an animal will become infected with the BVD virus for the first time, it exhibits clinical signs and the foetus can become infected. The infected animal will start to develop antibodies against BVDV 10 days after infection. Infected animals will develop (probably) their whole live antibodies against the virus. A reinfection will often stay unnoticed: animals with antibodies show no symptoms and do not abort foetuses.

2. Cause

Bovine Virus Diarrhea is a very common infection in cattle worldwide. The BVD virus that causes the infection belongs to the pestiviruses, along with the Border Disease Virus (BDV) and Classical Swine Fever Virus (CSF). Transmission of the BVD virus between pigs, sheep and cattle is possible.

Studies in the Netherlands showed that in 71.5% of non BVD-free certified farms, antibodies against BVDV can be detected in the bulk (tank) milk. Based on the results from the Dutch national monitoring program on animal health it turns out that BVD virus circulation was present on 13.6% of the dairy farms and on 19.0% of the other cattle farms (study performed in 2013).

Fifty to eighty percent of the born BVDV-carriers die within a year. Ninety percent of the BVDV-carriers die before their second year of live.

3. Infection route and BVDV-carriers

BVD virus carriers are the main source of BVD-virus spreading within the cattle population, as they constantly excrete virus. All bovine animals that get into contact with a BVDV-carrier will become BVD infected.

In general, when a bovine animal is infected with BVD for the first time, it will develop antibodies lifelong. In case the animal will become re-infected later on, the BVDV antibodies will neutralise the virus quickly and the animal will not get sick.

4. Damage and costs of a BVDV infection

The economic damage on farms, due to BVDV, is mainly caused by carriers: mortality, poor growth, immunosuppression and thus more frequently illness is observed. A smaller proportion of the economic damage is caused by acute BVDV infections: decrease in production, abortions, reduced fertility, growth retardation, mortality and high treatment costs.

Carriers also cause damage by spreading the virus to other animals within the herd. The direct damage due to BVDV infections varies from 19 to 129 euros per average dairy cow present on the farm.

5. BVD virus types

The BVD viruses consist of two different types. In the Netherlands, most infections are caused by BVDV type 1 (BVDV-1).

5.1 BVDV1

An infection of (pregnant) animals with BVDV type 1 can result in the following clinical signs:

- Inflammation of the mucous membranes, causing diarrhea, fever, salivation, decreased appetite and / or dehydration
- Death and rejection of the foetus. This often occurs when the mother becomes infected during the first two months of gestation. The death of the foetus can also be followed by e.g. mummification. However, abortion due to BVDV can occur throughout the pregnancy period
- The birth of a BVDV-carrier **calv** (a persistently BVD virus infected **calv**). This occurs mainly when the foetus becomes infected between day 0 and day 120 of gestation.

Because the infection occurs at the time that the immune apparatus of the calf is not yet developed, the BVD virus will not be recognized, and the calf will not produce antibodies against the BVD virus

- Birth of calves with observable deviations, such as eye, fur and brain abnormalities. These deviations are recorded both in carriers and non-carriers
- Respiratory problems in calves and young cattle. BVDV does not affect the lung directly, but the immunosuppressive properties of the virus can result in more severe other infections
- Decrease in production
- Diarrhea during rearing time
- Mortality.

5.2 BVDV-2

Infections with BVD type 2 occur in the Netherlands too. Infections with this type of BVDV often result in more severe clinical signs, and sometimes also with bleeding, especially with black or bloody diarrhea and bleeding of mucous membranes. Infected animals usually die within 48 hours after infection.

6. BVD diagnosis

There are many test systems and test methods to diagnose BVDV infections. There are e.g. four test methods to demonstrate BVD infections. These test methods are used for different purposes.

6.1 The BVDV PCR on bulk milk and serum samples

This highly sensitive test method can detect the virus in (bulk) tank milk samples (up to 300 milking cows per bulk milk sample). This test can also be used to examine pooled serum samples on the presence of BVD virus (up to 20 samples per pole).

The BVDV PCR is the basis of the BVDV program in the Netherlands, and the tank milk BVD-PCR is one of the three BVD-testing methods within the "QuickScan BVD".

The bulked-PCR is available to every farm. The PCR on pooled serum samples is recommended only for BVD-free certification and Heifers BVDV-carrier Check.

6.2 The BVDV antigen-ELISA.

This test detects the virus in blood, ear tag samples (biopsy samples) and organs. This test is used for individual investigations (individual animals within the BVD-free certification status) and screening of BVDV carrier calves.

6.3 The BVDV antibody ELISA.

This assay demonstrates BVDV antibodies in blood or bulk milk. The blood test can be performed on two different times in case of a suspicion of a BVD infection. Serum samples can be titrated to examine an increase in the amount of antibodies (titration).

6.4 The virus culture.

This test is used to isolate strains of BVD virus from blood or organs. The test is not routinely used in all veterinary diagnostic labs.

6.5 Investigations at abortion

In case of abortion, the aborted calf and the mother cow can be examined for BVD virus and antibodies against the virus. The results of the blood test of the mother cow should be evaluated as follows:

- If no antibodies are demonstrated, BVD as probably not the cause of the rejection. However, in case the mother cow is a BVD virus carrier, the mother cow can be negative for BVDV antibodies but this is rare.

- In case antibodies are detected, it is difficult to interpret whether BVDV was the cause of abortion, since the time of the development of the antibodies is unknown.

Interpretation of the virus-examination of the aborted calf with an antigen-ELISA is as follows:

- Virus detected: This indicates infection of the foetus in the uterus
- No virus detected: BVDV probably played no role.
- The foetus (calf) has overcome the BVDV infection and eliminated the virus. In this case, the calf has developed antibodies due to an active infection in the last part of the gestation period (usually an aborted foetus / **calve** is unsuitable for the research on antibodies)
- Virus cannot be detected due to e.g. rotting of the aborted foetus / calf, or the amount of BVD virus is too low to detect (amount of BVDV virus is below the detection limit).

6.6 Investigation and collection of ear biopsies

Collection of an ear biopsy is a relatively simple handling. It can be done together with applying an ear tag. Below, some points are described that are important to collect the biopsy correctly, and to send the ear biopsy to the lab.

Be careful, as the metal tube that contains the biopsy needle has sharp edges and can induce injuries when opening the envelope. It is advised to seal the metal tube with the corresponding plastic tube carefully and correctly.

A biopsy from a BVD-carrier contains a lot of virus, so avoid contamination of other samples. Put the tube in the attached plastic bag and close the return envelope well.

If by accident, you have hit a blood vessel during collection and blood joined the biopsy, the investigation is less reliable (due to the presence of antibodies). In that case it is advised to collect an extra blood samples from the calf when it has reached the age of one month.

6.6.1 Collection of an ear biopsy in six steps:

Order from your dealer special **tongs** and special ear tags. The calves that will not stay on your premises (will be sold for example), you can use regular ear tags.

- Place the two halves of the ear tag in the **rod**
- Apply the ear tags in the regular way
- The biopsy is now visible in the biopsy needle.
- Push the biopsy - without touching with your hands - into the tube.
- Close the tube well.
- Send the tube to the lab.

You can store the biopsies in the refrigerator for up to a maximum of two weeks. Use the supplied packages and shipping materials for sending the biopsies to the lab.

7. Introduction and transmission of BVD virus

The BVD virus can be introduced on a farm by:

- Purchase or contact with virus carriers
- Contact with acutely infected animals
- Persistently infected unborn calves
- Cattle in neighbouring pastures, shared used of pastures
- Exhibitions, markets and auctions
- Transmission by ruminants other than cattle (e.g. sheep, swine)
- Infected bulls
- The continued circulation of the virus in a herd, even after the removal of the BVD-carrier(s) (only occasionally)

Having a closed farm operation structure can largely prevent all these introductions of BVD virus.

7.1 Hygienic rules

The infection can be introduced in cattle farms by materials, equipment and professional visitors having dust on their clothes, such as vet, inseminator, etc.

7.2 Other risk factors may include:

- Infected semen. An infection can occur after insemination with infected (foreign) semen
- Infected embryos. Embryos (for example, obtained from BVD-carriers) can also be positive for the BVD virus even after the prescribed washings.

7.3 Farm structure

The virus can be transmitted between farms via the wind. The location of the farm, in relation to other farms, plays a role.

8. Possible BVDV actions on the farm

8.1 Checklist BVD prevention

With the checklist “BVD Prevention”, the farmers can examine whether the current farm management rules prevent introduction and spread of new BVD infections. By completing the checklist you will get a risk profile for BVD on the farm, with opinions on how to further reduce the risk of introduction and spread of BVDV. The checklist is a valuable tool in determining the best approach to prevent a BVD introduction on the farm.

8.2 Doing nothing

BVD is introduced into a herd / farm. Depending on the number of susceptible animals (animals without antibodies) within a herd, the virus will spread in the presence of a carrier until more than 80% of the animals has antibodies. Thereafter, the chance that the virus will infect new animals without BVDV antibodies is decreasing and the spreading of the viral infection may stop. This process may last in some cases at least two years, but this mainly depends up on the amount of animal contacts within the herd. During this period, new young pregnant animals can still become infected, with the chance of new BVD virus carriers that are born. These BVDV-carriers can induce a renewed virus spreading.

8.3 participate in BVD control programs

Veterinary diagnostic labs may offer several options for participation in BVD control programs. Examples are:

- QuickScan BVD,
- Bulk (Tank) milk BVD,
- Program BVD virus free,
- BVD Antibodies Heifers Monitor and
- Heifers BVDV-carrier screening.

A variation in the approach to control BVD is needed and this depends on the farm (farm structure, level of farm management, etc), as the course of a BVD infection can be different between farms. We advise farmers to check with their veterinarian which approach is the best for their farm.

9. Economic considerations to participate BVD control programs

The BVD control program is profitable. To gain more insight into the economic impact of BVDV infections at farm level, the Department of Farm Management at Wageningen University and Research Centre (WUR, the Netherlands) have performed “model calculations”.

The amount of damage due to a BVD infection depends on:

- The housing of calves and older animals:
 - separated or
 - under one roof
- The amount of animals which already has antibodies at the time of the infection
- In which part of the herd, the BVDV-carrier is housing

The “model calculations” show that participation in the BVD virus-free Program is profitable. The payback time is depending on the conditions on the farm, between two and three years. In some situations, the payback is even between one and two years. Even when a reinfection occurs at a BVDV-free farm, it remains profitable to participate in the program. The re-infection will be detected fairly on time.

9.1 Cost issues to consider

Research costs, veterinary costs and monitoring costs of BVD-free certification shall be paid by the farmer. The costs of BVD-free certification will reduce sharply when the PCR bulk milk test is used. This bulk milk test saves on many farms the costs of blood collection and the investigation of lactating animals (no need for individual testing).

The costs will become higher in case the bulk milk test indicates that there is a carrier present within the group of lactating cows. In that case, individual tests are needed to identify the carrier from the animals that have contributed to the bulk milk sample. It is also possible to check by means of examination of ear biopsies of new-born calves at birth on BVD virus carriers. The ear biopsy is taken simultaneously with the application of an ear tag, and this can easily be done by the farmer.