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Selection and use of laboratory diagnostic assays in BVD control programmes

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Abstract

Since bovine virus diarrhoea (BVD) was recognised as a unique disease complex, many different diagnostic methods have been used to detect the BVD virus (BVDV) itself, or immunity to BVDV. Of those that have evolved along with the current demands for accurate diagnostic tests, two categories are of interest for BVD control programmes. As reference assays, virus isolation and detection of virus neutralising antibodies are both carried out using cell cultures, which are time, resource and skill demanding. Enzyme immuno-assays are better suited for screening of large series of samples, and several variants of these have been developed for detection of both antibodies and viral antigens. Of other methods adapted for rapid diagnostic use are immunohistochemistry, flow cytometry and the reverse transcription-polymerase chain reaction. Basic properties of these and other methods are reviewed, with emphasis on the need for diagnostic assays in control programmes for BVD.

Keywords: Bovine viral diarrhoea virus; Diagnostic tests; Control programme

1. Introduction

Bovine viral diarrhoea (BVD) is caused by infection of cattle with BVD virus (BVDV), a small, enveloped RNA virus in the Flaviviridae family, genus *Pestivirus*. BVD is endemic in most populations of intensely reared dairy and beef cattle. The biology of the virus, clinical and epidemiological aspects of the infection have been described elsewhere (Radostits et al., 2000), and only key elements of the infection will be summarised here.

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Clinically, BVD is a very diverse condition, ranging from most often asymptomatic or mild and transient signs of upper respiratory infection to severe acute disease with signs from the enteric, haematopoietic, reproductive or respiratory organ systems, often acerbated by superinfection with other pathogens. A key element for persistence of the infection is the ability of the virus to cross the placenta in non-immune animals and infect the foetus. It is important to distinguish between two different categories of infected animals. Persistently infected (PI) animals were infected in early foetal life, before onset of immunological competence. They may remain healthy and live to a mature age, but the specific immunotolerance to the persisting virus allows it to replicate to high titres. Thus, PI animals constantly excrete large amounts of infectious virus, and are the principal source of infection of susceptible animals. As a general rule, PI animals remain BVDV-antibody negative. They may succumb to mucosal disease, which is a fatal condition resulting from superinfection with an antigenical similar but genetically rearranged BVDV, showing a cytopathogenic biotype. Animals infected after the onset of immunological competence will undergo a transient viraemia, during which they shed BVDV, but significantly less efficient than PI animals. Such acutely infected animals seroconvert after approximately three weeks, whereafter the antibody levels rise slowly, until a plateau is reached 10–12 weeks after infection. The immunity after natural infection provides life-long protection of both adult animals and their foetuses against antigenically similar BVDVs, and can easily be measured by serological tests.

During the last decade, the impact of BVD on bovine health has gradually become more apparent, and control programmes aiming at eradicating BVD have consequently attracted increasing interest, compared to the BVD management by vaccination (Brock, 2003). So far, the only control programmes with a proven reduction of the prevalence of BVD are based on removal of PI animals – ‘‘test and cull’’ (TC). In practice, this control approach depends on accurate diagnostic tests, applied to locate herds with ongoing infection and to identify the PI animals (Lindberg and Alenius, 1999). In this paper, the basic properties of such assays will be reviewed, along with how they may be used in organised TC control programmes.

2. Diagnostic approaches

Although BVD can be suspected from clinical signs, the wide range in both diversity and severity makes them at best unreliable for diagnostic investigations. Laboratory tests are mandatory, and should furthermore be used in a planned way to give useful information. This applies both to investigation of suspected individual cases of BVD and organised control efforts applied on regional or national levels.

For BVD control programmes, two major diagnostic levels can be defined; one being surveillance, which aims at monitoring the prevalence, and assessing the effect of ongoing control efforts at both the herd and population level. Secondly, focusing primarily on the individual animal level, interventive investigations aim at identifying PI animals in an organised way, for subsequent removal. In addition, specific applied diagnostic tasks can be certification of non-infectious status of individual animals for e.g. trade purposes, or to document freedom from BVDV contamination of semen (Voges et al., 1998), embryos or