Highlights of the Importance and Epidemiology of Bovine Viral Diarrhea Virus Infections in Pigs

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Abstract

Pestivirus infection in pigs are responsible for raising sanitary barriers between countries. Infection caused by Bovine Viral Diarrhea Virus (BVDV) in pigs have been reported in countries such as China and the Netherlands, which brings concern about the existence of accurate diagnosis tests, questions about the risk factors involved, and the clinical form that BVDV infection may entail. Despite the importance of the Classical Swine Fever Virus (CSFV), which affects swine, triggers serious animal health problems and raises trade restrictions. Therefore, this review focused on gathering information regarding to the infection of pigs by BVDV and foster scientific community about a recent problem that has been worrying many countries.

Keywords: Pestivirus, swine, BVDV, epidemiology, classical swine fever.
Introduction

Bovine Viral Diarrhea (BVD) is an important disease of cattle, other ruminants and swine (Samara et al., 2003). BVD is found worldwide mainly in territories with high number of susceptible animal, and as a viral disease, it is spreads very easily with high morbidity rates (Scherer et al., 2002). Despite pigs are an atypical host of the Bovine Viral Diarrhea Virus (BVDV), infections occur and affect those animals making them natural carriers of the virus. Studies show that the virus is transported through the air, which turns the proximity with cattle farms into a risk factor for the swine’s herds once the virus would be able to reach long distances (Walz et al., 2004).

Several studies have shown that different viruses of Pestivirus genus are antigenically related. It is believed that all came from a common ancestor virus (Becher et al., 2003). Serological cross-reactions between Pestiviruses may occur, either in vivo or in diagnostics tests (Loeffen et al., 2009). Paredes et al., (1999), reported that BVDV and Border Disease Virus (BDV) could infect pigs and cause many different clinical manifestations however, often the infection occur asymptotically. Preventive actions and Clasical Swine Fever eradication programs are complicated by BVDV infection in pigs, because most of the clinical signs are similar to the mild form of CSF (Passler and Walz, 2010).

Epidemiology Research of BVDV in Pigs

The first serological surveys were done in the 60s, in Australia and France (1968) where were suspicions of pigs infected by BVDV, however it was only later that this type of infection was proven, with the isolation of a BVDV strain that occurred naturally in swines (Fernelius et al., 1973).

In recent years, the prevalence of BVDV infection in pigs varied among different regions. In 11 provinces of China, country with the world's largest swine herd, the prevalence among those with any reproductive disorder, ranged from 20% to 30%, the BVDV-1 serotype was the most commonly diagnosed (Deng et al., 2012). In the Netherlands, the estimated prevalence was 0.42% in finishing piglets and 2.5% in sows of reproductive age, with a prevalence of 11% at herd level (Loeffen et al., 2009).

In Austria and Germany, serological surveys showed rates that ranged from 3% to 40%, and 15% to 20% in Holland (Moenning and Liess, 1990. O'Connor et al., 1991; Terpstra and Wensvoort, 1991). In Norway and Ireland the seroprevalence of BVDV (strain NADL) was 2.2% and 3.2% respectively (Loken et al., 1991, Graham et al., 2001). Older data show that in countries declared free of CSF, the prevalence of BVDV infection in pigs had a range of 1.6% to 43.5% (Holm Jensen, 1985), which could cause problems, since Darbyshire (1961) confirmed antigenical cross-reactivity between BVDV and CSFV.

According to Song et al., (2008), the predominant genotype found in China was BVDV-1 as well as Deng et al., (2012) also reported that the BVDV-1b and BVDV-1m subgenotypes were the most frequent in Chinese swine herds. Thus there was a report, in the year of 1994, of the bovine BVDV type 2, strain that was first described in swine samples in Europe in 1979 (Ridpath, 2005). In conclusion, three genomic sequences of noncytopathic BVDV-1 strains isolated from pigs were recognized, ZM - 95 (Xu et al., 2006), SD0806 (Deng et al., 2012), and SH - 28, do BVDV-2 (Tao et al., 2012) in China.

Taking into account the importance of these diseases, later studies confirmed BVDV infection in pigs from other parts of the world (Roehe, 1998; Ridpath, 2010; Carbrey et al., 1976; Darbyshire, 1961; Fernelius et al., 1973; Liess and Moenning, 1990; Stewart et al., 1971; Terpstra and Wensvoort, 1988).

Characteristics of the Etiological Agent

The Pestivirus genus of the Flaviviridae family comprises four virus species of major epidemiological importance: CSFV, the BVDV (serotypes 1 and 2) and BDV (Fauquet, 2005). However, new viral species of the genus have been suggested: D32/00-'HoBi ', Th/04_KhonKaen and CHKaHo/cont (Liu et al., 2009), despite only one natural infection related case with a strain 'HoBi'.
like, similar to Th / 04_KhonKaen, isolated from bovine serum in Thailand has been reported (Stahl et al., 2007). Pestivirus have the ability to infect hosts of other differente species than usual ones (Moennig, 1990). Recently, BVDV infection in swines has been the focus of great discussions inside the scientific community, due to similarity of clinical signs to the CSF in infected animals (Moennig and Liess, 1990). BVDV is an enveloped virus with a single-stranded RNA genome of positive sense (Maurer et al., 2004). The viral structural proteins are encoded by the first third of the genome, while the non-structural proteins are encoded by the last two thirds. The structural protein E2 of surface glycoproteins is the main recognized epitope for virus-neutralizing antibodies (Coetzer and Tustin, 2004).

This virus has two biotypes: a non-cytopathogenic (ncp) and cytopathogenic (cp). Ncp BVDV are more commonly found in nature and do not affect the integrity of the cell culture in vitro (Murphy et al., 1999). However, this biotype is more important for being able to cross the placenta and persistently infect (PI) the fetus what makes the task of controlling this disease spread harder (Deregt and Loewen, 1995).

Clinical Signs Caused by BVDV Infection in Pigs

In cattle, the clinical manifestations of BVDV infection vary according to several factors such as viral strain, immune and reproductive status of the host (Ridpath, 2010). In herds where the disease is endemic the main clinical sign, and often the only ones observed, are reproductive failures, since the disease can occur in subclinical forms in adult animals that are not pregnant (Flores et al., 2005).

Usually BVDV infection in pigs also have no notifiable clinical signs, some clinical manifestations were reported in adult animals such as reproductive disorders, birth of weak piglets, mummification and abortion (Vannier and Albina, 1999). Anemia, growth retardation, animal waste, rough coat, polyarthritis, congenital tremors, petechiae on the skin, diarrhea, conjunctivitis and cyanosis of the extremities were also reported clinical signs (Terpstra and Wensvoort, 1988).

In pregnant infected sows, clinical manifestations vary from abortions, stillbirths, birth of weak piglets, malformations and even birth of persistently infected piglets (PI) due to transplacental infection (Paton and Done, 1994; Becher et al., 2003). Tao et al., (2013) also reported the occurrence of internecine cramps and hyperthermia in adult animals affected in addition, Moennig and Liess, (1990) described syndromes characterized by growth delay and weight loss. Cases of BVDV infection, which induced large amount of pathological lesions, are likely to be caused by viral strains more adapted to swine species.

CSF infection has clinical manifestation defined as fever, loss of appetite, lethargy, constipation, diarrhea, generalized rash, cyanosis of the extremities and a table of vasculitis occur in the central nervous system (Krzyaniak et al., 2002). Still, post-natal pigs BVDV infection are practically harmless, unlike CSFV infections which affects herds with high mortality (Moennig, 1990).

BVDV Transmission

Epidemiological data place bovine as main natural host of BVDV, and consequently the main source of infection for pigs and other ruminants (Vannier and Albina, 1999; Ridpath, 2010). Direct contact with cattle in the same farm is considered the main cause of BVDV infections in pigs (Vannier and Albina, 1999; Liess and Moennig, 1990). Transmission can also happens due to the use of milk from infected cattle and other derivatives to feed pigs (Terpstra and Wensvoort, 1988). In contrast to what was believed previously, the pig-to-pig transmission is possible but in a very limited extent (Wieringa-Jelsma et al., 2006).

Other way of BVDV transmission were also identified, such as the use of virus-contaminated vaccines against CSF (Terpstra and Wensvoort, 1988) and by fomites (Carbrey et al., 1976). However, even after identified those forms of transmission, Deng et al., (2012b) stated that the prevalence of BVDV in swine herds is closely linked with the prevalence of the disease in cattle. This data agrees with the findings of Loeffen et al., (2009) and O’Sullivan et al., (2011), who attribute the low prevalence of swine BVDV infection in
their respective regions, the high specialization of agriculture that restricts the number of producing properties with more than one animal species, a fact that contributes to reduce contact between cattle and swine.

**The Presence of BVDV Can Affect the Control of CSF**

In properties with more than one animal species, ruminants and pigs are considered susceptible hosts to BVDV infection, either by direct or indirect contact (Paton et al., 1992), however Wieringa-Jelsma et al., (2006) describes limited transmission among pigs. The relationship between Pestivirus, especially among BVDV and the CSFV, and the possibility of pigs’ infection by BVDV, raises the question whether the laboratory methods used to control the CSFV are enough to differentiate infection caused by these two etiological agents. The serological cross-reaction between BVDV and the CSFV can be an obstacle to the correct diagnosis of both diseases. Consequently, information about the occurrence and prevalence of BVDV infection in pigs in many countries are lacking. In other countries, the prevalence data are conflicting; however, research indicates that animals with a history of reproductive problems appear to be most affected ones by the virus.

A recent study showed that pigs with antibodies anti-BVDV had a certain clinical resistance to infection and impaired transmission of CSFV to other animals (Wieringa-Jelsma et al., 2006). All these information confirmed that an outbreak of low intensity and self-limited is possible to happen, also, clinical signs may go unnoticed and later on transmit to other susceptible flocks. Taking into account the importance of CSF, the detection and control of CSFV is impaired by the cross reactivity between these two *pestiviruses*.

**Final Considerations**

BVDV infection is known worldwide for its economic importance in livestock, causing losses mainly because of reproductive disorders caused by the infection of pregnant animals. It is already being considered the most important bovine viral pathogen besides Foot and Mouth Disease.

It is a confirmed fact that the diversity of BVDV hosts makes the task of understanding the pathogen-host relationship hard, an information required to create and develop programs to control and eradicate. The occurrence of swine infections with clinical signs similar to CSFV, once this fact could complicate and interfere into CSF eradication and control programs, since the serological cross-reactivity can embarrass the swine herd screening procedure of those programs. Meanwhile the ease of contaminating cell cultures and biological products used in the production of vaccines is an emerging concern. It is vital that the vaccine manufacturing processes must undergo rigorous sanitary measures to avoid this kind of contamination. More information about BVDV infection in swines is of utter importance to elaborate control/eradication strategies and to develop technique to combat the spread of this disease as well.

**References**


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