



## Control of Circovirus

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### Introduction

Porcine circovirus type 2 (PCV2) is an ever-present virus within swine producing countries with most regions having evidence of infection. Minimizing exposure and controlling disease associated infection (Porcine Circovirus Associated Disease; PCVAD) can be accomplished through multiple or different strategies. There are six main (reported) approaches in the control of PCVAD: vaccination, minimizing simultaneous diseases that may aggregate PCVAD expression, management and nutritional changes, genetics, serotherapy, and depopulation and repopulation.

### Vaccines

Since the advent of PCV2 vaccines, PCVAD has greatly diminished in vaccinated herds. Most veterinarians would agree that PCV2 vaccines have been the most influential development in the swine industry in the past 5 years. Currently, best estimates would indicate that 90-95% of the growing swine population is vaccinated for PCV2.

At present, there are multiple commercially available PCV2 vaccines in most countries. All vaccines, at this time, are derived from the PCV2a genotype and are labeled for the prevention of PCVAD in growing pigs (3 vaccines) or for the use in sows (1 vaccine) to increase maternal immunity to piglets via colostral uptake. Commercially available vaccines are labeled for one-dose, two-dose, or flex dosing administration with all showing effectiveness to PCVAD.<sup>20</sup>

PCV2 vaccine has been extensively studied in recent years; the common conclusion solidifies that vaccination is the best method for controlling PCVAD within a herd or population of pigs. Below is a short summary of PCV2 vaccine research:

- PCV2 vaccine has been demonstrated to produce an effective antibody (IgM, IgG, and serum neutralizing) response 2-4 weeks post administration. Furthermore, PCV2 can be delivered intramuscularly with a needle and syringe or intradermally with a pneumatic device resulting in similar antibody development.<sup>19</sup>
- PCV2 vaccination is effective against both PCV2a and PCV2b genotypes and significantly reduces PCV2 viremia and shedding (nasal and fecal) post infection.<sup>6</sup> Vaccine also significantly reduces microscopic lesions in lymphoid tissues that are associated with disease.<sup>19</sup>
- In growing pigs (nursery and finishing), PCV2 vaccination has proven efficacy in drastically reducing mortality associated with PCVAD, and increased growth performance as measured by

average daily gain (ADG) and feed efficiency (FE).<sup>4,11,29</sup>

- Multiple studies in Europe have reported on PCV2 vaccination using CIRCOVAC® (Merial, Lyon, France) in dams. Reported results show that dam vaccination, when given pre-farrow (2-4 weeks), has improved reproductive performance measured by increased live-born piglets, total born pigs, and litters/sow/year while decreasing sow mortality, stillborn fetuses, and dam non-productive days in multiple herds.<sup>1,12,28</sup>
- Other commercial vaccines have been used in dams with proven safety and provide increased antibodies in colostrum and reduce vertical transmission of PCV2 from dam to piglets.<sup>15</sup> However, it has been noted that high maternal antibodies can interfere with piglet vaccination.<sup>7</sup> At present, laboratory data suggests that piglets with passive IFA titers of  $\geq 1:320$  are not as well suited for vaccination as there may be antibody interference. In herds where there is a perceived vaccine or vaccination failure, piglet IFA titers may be a way to determine if vaccination timing is correct in that particular herd scenario.
- Considerable thought needs to be given whether to vaccinate dams only, dams and piglets, or just piglets. Each farm scenario is slightly different, and a veterinarian should be involved in the decision process. Limited research is available in regards to vaccination practices; however, it has been shown that dam vaccination can help diminish early piglet infection and that piglet vaccination will reduce PCVAD in the late nursery/finishing phases.<sup>25</sup> In addition, both dam and piglet vaccination can be done and provide good protection from developing PCVAD. Dam vaccination only was the least beneficial protocol for protecting pigs in the finishing phase of production.<sup>21,25</sup>
- PCV2 vaccination of boars under experimental conditions was evaluated in a PCV2 and *Mycoplasma hyopneumoniae* coinfection model. Semen and serum samples were collected weekly for 5 weeks following PCV2 inoculation and tested for PCV2. Results indicate non-vaccinated boars shed significantly higher amounts of PCV2 in semen than vaccinated boars.<sup>17</sup>

## Control of other Pathogens/Diseases

PCV2 infection is required for the manifestation of PCVAD; however, coinfection with other viruses or bacteria can trigger clinical PCVAD within a herd or increase the number of pigs affected. Multiple pathogens have been recognized which enhance the propensity and progress of disease and include: porcine reproductive and respiratory syndrome virus (PRRSV), porcine parvovirus (PPV), porcine torquus virus (TTV), swine influenza virus (SIV), and *Mycoplasma hyopneumoniae* along with many others. Of contributing coinfection, PRRS appears to be the most common and influential for the development of PCVAD.<sup>26</sup>

Managing coinfections is an essential method for controlling PCV2. This can be accomplished by antimicrobial programs for bacteria pathogens, vaccination strategies, and strict biosecurity protocols. Of note, however, is that vaccination of other pathogens during active PCV2 infection can enhance or trigger PCVAD in certain scenarios. The most notable of these is *Mycoplasma hyopneumoniae* vaccination.<sup>23</sup> Considerable care should be taken on timing and administration of vaccines to pig populations, along with consultation from a veterinarian.

## Management and Nutritional Changes

As for most other diseases the quality of management can help to prevent or reduce the negative impact of PCVAD. A French scientist, Dr. François Madec, has proposed a list of 20 rules which, when followed, have reduced the severity of losses in a number of herds.<sup>14</sup>

### Farrowing Room

- Apply all-in/all-out procedures with emptying of pits, cleaning, and disinfection of rooms; wash sows and treat for parasites; adoptions: limit cross fostering to what is strictly necessary and only within 24 hours of farrowing; observe parity rank; conformity of vaccination plans

## Nursery

- Use small nursery pens, solid partitions; empty pit, clean, wash and disinfect between groups; lower stocking density (3 pigs/m<sup>2</sup>); increased feeder space (7 cm/pig); perfect ventilation; perfect temperature; no mixing of batches (1 batch per room)

## Finishing

- Use small pens with solid partitions in finishing; empty pit, wash and disinfect between groups; 0.75 m<sup>2</sup>/pig (8.1 sq feet/pig); temperature, good ventilation; no mixing of pens; no mixing of batches

## Other Measures

- Respect flow of air and animals within buildings; strict hygiene (tail and teeth clipping, castration, injections...); early removal of sick pigs to hospital pens

Many of the measures proposed above are basically applying good husbandry practices, while others would be difficult to implement in many of the North American systems (e.g. multi-site systems). Nevertheless, it is believed in France that as more of these rules are applied, losses associated with PCVAD will be reduced.

In addition, numerous other management and nutritional strategies have been suggested by different authors to help control PCVAD and are summarized in a recent PCV2 review.<sup>8</sup> Factors include variations of Madec's principles in addition to others and include:

- Have good on-farm biosecurity protocols including shower in/out capabilities and downtime from previous pig contact
- Use disinfectants (e.g., mixture of peroxymonosulfate (Virkon<sup>®</sup>) and sodium chloride (bleach) that have good activity against PCV2
- Breed using artificial insemination with semen from boar facilities
- Batch farrowing every 2, 3, 4 or even 5 weeks if possible
- Good colostrum management with minimal cross-fostering insuring all piglets suckle their natural mothers for the first 24 hours
- Weaning older pigs (> 21 days)
- Avoid mixing or reduce the number of weaned or feeder pig from different sources
- Sorting by sex in the nursery facilities
- Minimize the number of hospital pens with appropriate euthanasia of sick pigs
- All-in/all-out for nursery and finishing facilities
- Use of spray-dried plasma in early nursery diet
- Addition of anti-oxidants (vitamin E and Selenium) in feed with ground feed being of larger particle size
- Minimize coinfections through antimicrobial and vaccination protocols, bearing in mind the timing of administration on the immune system

The list is extensive, and not all procedures are even possible in some scenarios. In general terms, there are many risk factors that can contribute to disease progression, but by avoiding, minimizing, or changing certain aspects of pig production one can potentially reduce the economic losses associated with PCV2 infection.

## Genetic Changes

PCVAD is a multifactorial disease that can be triggered by various factors. In addition to management problems or coinfecting pathogens, there is proven research that confirms that certain genetic lines are predisposed to developing PCVAD or can be more severely affected. The following are examples:

- Opriessnig et al (2006) experimentally infected Duroc (23), Landrace (19) and Large White (21) pigs with PCV2 at 5-7 weeks of age. One Landrace pig developed PCVAD and two others had characteristic gross and microscopic lesions of the condition. No pigs of the other two breeds showed clinical signs or gross lesions of PCVAD.<sup>18</sup> The authors concluded their results suggested

that the Landrace pigs were predisposed to PCV2-associated lymphoid depletion and PCVAD.

- Lopez-Soria et al (2004) reported the results of a comparison between the progeny of three different boar genetics (Pietrain, Large White (50%)/Pietrain (50%), and Large White (25%)/Duroc (75%) from 2 large 5000 sow Spanish herds. The sows were of the same genetic background for all three genetics of boars used. In pigs from the two sow farms, the total mortality rate and the mortality rate specifically associated with PCVAD were, for the three different boar genetics, respectively 1.8 and 1.1%, 5.4 and 2.7%, and 16.3 and 12.4%.<sup>13</sup>
- Opriessnig et al (2009) further investigated the difference between purebred Landrace pigs (26) and purebred Pietrain pigs (26) under experimental condition. Pigs were obtained from the same sow farm and were of similar age, yet post infection with PCV2, significant difference were seen between the genetic lines with Landrace pigs having more severe microscopic lesions associated with PCV2 infection.<sup>22</sup>
- McIntosh et al (2006) previously evaluated PCV2 shedding in semen from a single boar center in Canada. The center contained Duroc, Large White (maternal and paternal lines), Landrace, Hamline, and Meishan-synthetic lines. The evaluation was not block by genetic background or the number of boars within each line. However, positive semen samples were only detected in Duroc and Landrace breeds.<sup>16</sup> This suggests that these breeds may have a predisposition to shed higher amounts of virus.
- Not all information on the Pietrain breed shows positive results in regards to a relative PCVAD resistance. In a study conducted by Rose et al (2004) in four French farms, no beneficial effect of the Pietrain boars against PCVAD could be detected in their progeny.<sup>27</sup>
- In the Netherlands, an epidemiological study involving herds with and without PCVAD and PDNS found an association between PCVAD/PDNS and the historical use of breeding stock from an Anglo-Saxon origin.<sup>3</sup>
- Bergström et al (2006) reported that purebred animals from different herds were raised in a Swedish progeny testing station. PCVAD became a problem and the proportion of animals that were found to be thin or wasted was 2.8% for the Hampshire, 8.8% for the Yorkshire, 11.3% for the Landrace and 11.7% for the SPF-Yorkshire animals.<sup>2</sup> The authors concluded that under the conditions of their study, Hampshire pigs were less likely to become thin or wasted. Information from UK also suggests that some genetic lines of the Hampshire breed may offer some resistance against the disease.

The previous examples are to point out specific differences that have been observed and reported. By no means are the above examples all-inclusive as there is anecdotal evidence from different swine regions or companies that would indicate other differences, both within specific breeds or specific lines within a breed. The take home point of mentioning genetic susceptibility is to reveal that there is, to some extent, genetic factors that can play a role in the development or progression of PCVAD.

## Serotherapy

Another approach employed to control PCVAD in growing pigs prior to vaccine was the use of serotherapy; a method by which serum from clinically healthy market weight animals was injected into younger pigs as a source of antibodies to help fend off severe infection. Ferreira et al (2001) were the first to propose serotherapy as an alternative to prevent losses contributable to PCVAD. Piglets that were about 33 days of age were injected subcutaneously with 20 mL of serum from market age pigs that had gone through the problem and had recovered. The results obtained in three trials were excellent (15.2% vs. 4.9%; 18.5% vs. 2.7%; 17.9% vs. 2.8% mortality).<sup>5</sup> Different variations of this strategy, in most cases using lower volumes of serum, have been used successfully in other countries like Spain, UK, the Czech Republic and Canada.

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However, a more recent report in an experimental setting compared control pigs to those administered serotherapy or PCV2 vaccine. No differences were apparent between control pigs and those receiving serotherapy. The vaccinated pigs, however, did show significant differences as they had reduce microscopic lesions associated with infection and less circulating virus.<sup>30</sup>

Overall, the results obtained through the use of serotherapy do not outweighed the risks in most situations. At minimum, serotherapy is not easily applied and represents a significant biosecurity risk. At the very least, producers considering this procedure should consult a veterinarian.

## Depopulation and Repopulation

Successful control of PCVAD or the complete elimination of PCV2 has been obtained in the past through depopulation/repopulation. The risk and expenses associated with this method are high and chances of remaining PCV2 free for extended periods is low. Caution should be exercised when deciding whether depopulation and repopulation is the most advantageous method for control, especially since the advent of successful vaccine development.

This approach is rather expensive, but multiple reports indicate successful elimination. Hassing et al (2004) reported that of six Danish herds that were depopulated, cleaned, disinfected and left emptied for 3-4 weeks, then repopulated with animals from herds without PCVAD, five got rid of PCVAD. In the sixth herd it reappeared about three months after the repopulation program, but in that case the supplier of pigs was the same as before the depopulation/repopulation.<sup>10</sup> Gresham et al (2003) also reported that PCVAD had not recurred in three farms after complete depopulation and re-stocking with pigs from unaffected farms.<sup>9</sup> In a more recent report, an extensive cleaning process (involving removal of expendable materials, multiple disinfection steps, painting and sealing surfaces, and a downtime of 63 days without pigs on the premises), was able to completely remove PCV2 from the environment from a small research farrowing facility with multiple buildings. At this time, the facility has maintained a PCV2 free status for over 1.5 years with strict testing and excellent biosecurity measures.<sup>24</sup>

## Summary

PCVAD has produced severe losses for pig producers in many areas of the world. Different control alternatives have been discussed in this report to aid in the prevention of PCVAD. Depending on the circumstances, the value of these alternatives will vary. The best and most proven method for control is vaccination.

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