

PCV2 vaccination and reproductive improvement in sows

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Post-weaning multisystemic wasting syndrome (PMWS), an emergent global pig disease first described in Canada and Europe in 1995/1996, is one of a number of disease syndromes associated with porcine circovirus type 2 (PCV2) that are collectively called porcine circovirus type 2 disease (PCVD). Besides PMWS, PCV2 has also been implicated as a cause of reproductive failure. The objective of this article is to briefly review the available data on the topic and the published results obtained with the use of sow vaccination with Circovac, an inactivated PCV2 vaccine.

Reproductive disorders

The first report of an outbreak of reproductive failure on a farm came from Western Canada, in 1999,

Table 1. Comparison of reproduction parameters before and after vaccination with Circovac in 277 German herds.

Index		Mean	±std	Delta (p)
Farrowing rate (%) (n=181)	Before	81.1	8.11	+ 2.04 (0.022)
	After	83.2	8.67	
Return to heat (%) (n=256)	Before	14.4	8.09	-2.91 (<0.001)
	After	11.5	7.18	
Abortions (%) (n=204)	Before	1.95	1.99	-0.57 (0.004)
	After	1.38	1.96	
Total born/litter (n=241)	Before	11.8	1.90	+0.46 (0.011)
	After	12.3	2.05	
Live born/litter (n=252)	Before	10.9	1.79	+0.50 (0.002)
	After	11.4	1.8	
Dead born/litter (n=235)	Before	1.39	2.20	-0.10 (0.630)
	After	1.29	2.30	
At weaning/litter (n=252)	Before	9.4	0.94	+0.47 (<0.001)
	After	9.9	0.71	
Weaned/sow/year (n=253)	Before	21.2	2.61	+1.13 (<0.0001)
	After	22.4	2.41	

where PCV2 was isolated from a litter of aborted piglets in a farm experiencing late-term abortions and stillbirths in which concurrent infections with porcine parvo virus (PPV), porcine reproductive and respiratory syndrome virus (PRRSV), encephalo-myocarditis virus (EMCV) and enterovirus were ruled out.

Early experimental studies showed that direct inoculation of the virus into foetuses at different stages of pregnancy in PCV2 seropositive sows resulted in farrowings of still-born, mummified, weak and live born piglets depending upon the stage of pregnancy at the time of infection.

Such studies showed that the virus is able to replicate highly in foetal tissues, particularly in the heart. Since then, many other studies have identified PCV2 as a major etiological agent in foetal death associated with non-suppurative myocarditis with high virus load in heart tissues with lesions or PCV2 antibodies in sera of stillborn and mummified foetuses.

Experimental intranasal infections of pregnant sows have resulted in abortions, premature farrowings and

Start of vaccination	Country average	Herd 1 540 sows		Herd 2 150 sows		Herd 3 460 sows	
Return to oestrus (%)	7.4	4.5	2.0**	5.4	4.0	4.6	1.3*
Liveborn piglets per/litter	13.5	12.1	12.5*	12.9	14.0**	13.9	14.0
*p<0.05 **p<0.01 ***p<0.001							

Table 2. Productivity results in three herds, before and after PCV2 vaccination in May 2007.

stillbirths. Whether the virus is able to cross the placenta still remains controversial.

In some studies, abortions followed elevation of temperature but PCV2 was not found in the foetal tissues. In other trials, detection of viral protein and DNA in tissues of both stillborn and live born piglets suggested that PCV2 may be capable of crossing the placenta, replicating in foetal tissues and causing reproductive failure.

Few experimental infections of sows via the intra-uterine route have been published although an increasing number of reports identify PCV2 in boar semen.

In a PCV2-negative SPF model, shortly after the sows were inseminated normally, PCV2, in different infectious titres, was inoculated through the AI catheter. All the sows became seropositive and while most sows showed no clinical disease, some had a transitory hyperthermia.

Two sows aborted, regardless of the infectious titre of the inoculum. Liveborn piglets were found either virus-positive and/or seronegative, or neither virus nor seropositive.

It was concluded that sows and foetuses could be infected via semen; sows seroconvert without symptoms other than a transient hyperthermia that may result in abortions.

Some dose effect has been shown but PCV2 was neither detected in embryos nor in mummified foetuses below 12cm despite sow PCV2 immunological response. PCV2 may remain dormant, in foetuses or in the uterus, during the first part of pregnancy.

More recent experiments have

confirmed these findings using PCV2 spiked semen.

Taken together, these results indicate that PCV2 can be considered as an important pathogen involved in reproductive failures. Disorders may occur any time in the course of gestation. Young embryos freed from the zona pelucida are sensitive to PCV2 infection and can be infected and die early in gestation leading to return to oestrus.

On the other hand, PCV2 is a tedious virus and its slow replication may last several weeks before the detrimental effects can be seen. Late abortion due to PCV2 are usually evidenced by histopathological lesions of non-suppurative myocarditis associated with high load of virus in the tissues.

Diagnosis is rather easy for late disorders but determining the cause of reproductive failure that occurs in the first trimester of pregnancy is more elusive.

Vaccination of sows

Few reports are available today about vaccination of the sows with piglet vaccines and its consequences.

In 2007, extensive data collected in the United States, showed that PCV2 vaccination in 18,000 sows with a PCV2 vaccine designed for piglet active protection did not result in improvement of sow reproductive performance as evaluated by the PigCHAMP software system.

In a recent study to determine whether vaccination using a PCV2 vaccine designed for piglets or previous PCV2 infection of seropositive PCV2-negative sows could prevent

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PCV2 infection of the foetuses, semen spiked with PCV2 was used for insemination. No abortions occurred and the pregnancies were carried to full term. However, after insemination, viraemia was detected in one of three vaccinated dams and in two of three dams with previous PCV2 exposure.

In litters of the vaccinated dams, a significant number of stillborn or live-born piglets were found PCV2 positive at birth. In conclusion, vaccination with the piglet vaccine was not found to protect against PCV2 contamination of the foetuses.

Vaccination with Circovac

Although experimental studies have proved that PCV2 is capable of causing reproductive failure, the extent of the losses due to PCV2 was and is still probably largely unknown.

Within the five year experience in sow vaccination all over the world, there is a large consensus that although Circovac vaccination has been always implemented to solve PCVD in the pig flow up to the slaughter age, the first visible benefits are very often seen in the reproduction performance.

A large scale field study conducted in Germany has assessed this effect over 277 sow farms including 64,062 sows that had been using Circovac for at least six months. Except for the number of stillborn per litter, all reproductive parameters were significantly improved (Table 1).

On average, the number of piglets weaned per sow per year, a parameter that summarises the reproduction performance, increased by 1.13.

Similar data, obtained from pig farming organisations in around

	Before	After
Dead sows per week	1.4	0.6
Live born	11.6	12.8
Stillborn	2.3	1.8
Total born piglets	13.9	14.6
Litter/sow/year	2.07	2.46
Non-productive days per sow per litter	37.1	9.4

Table 3. Reproduction parameters recorded before and after vaccination in a high health status SPF multiplying farm in Denmark (K.Oestergaard, Jysk Svineraedgivning).

1,500 farms as control over the same period, did not show an improvement of performances in the German swine industry.

The impact of PCV2 vaccination on productivity in 34 PMWS-positive Danish herds has been assessed through farm record analysis in a study that included a total of 14,510 sows.

The number of piglets weaned/sow/year significantly increased by +1.23 and the weaning to conception interval reduced by more than two days. Reproductive parameters of the vaccinated herds returned to national levels.

A particularly interesting study in France reviewed the evolution of reproduction parameters after vaccination of the breeding stock with Circovac using the 'GTTT', the French nationwide standardised data

recording system focused on reproduction parameters.

Although the number of herds was rather limited and the range of the parameter values widely stretched, a significant increase of the live born piglets per litter and weaned/litter was observed in the 27 vaccinated farms (+0.5) as well as the number of weaned piglets/litter (+0.3).

Comparison of GTTT results in a control population of 21 non-vaccinated farms over the same period did not show any significant improvement over the same period of time.

Many individual farm cases have also been investigated in depth. A few examples are shown here.

● In Brittany in a farm with apparently regular reproduction performance, vaccination of the sows with Circovac was implemented to solve

Table 4. Comparison of reproductive parameters before and after Circovac vaccination.

	Before	After
Repeat services	23.7	11.75*
Service within seven days (%)	86.9	92.7
Average non productive sow days	67.0	51.0*
Pigs born per litter	10.15	10.45*
Pigs born alive per litter	9.45	9.63*
Pigs weaned per sow per year	16.0	17.6*
Pre weaning mortality (%)	13.38	5.18*

* Statistically significant values (p<0.05)

poor piglet performance associated with some clinical signs evocative of PCVD. Surprisingly, the number of weaned piglets per litter jumped by 0.9 (10.6 to 11.5) after sow vaccination, with a dramatic reduction of the monthly variation and independently from any seasonal effect.

● A Danish study (Table 2), reported side benefits from vaccination of sows with Circovac that partially succeeded to solve mortality, growth retardation and over use of antibiotic treatments due to PMWS in the pig flow up to slaughter.

● A case study was conducted in Denmark in a high health status SPF sow-multiplier herd with reliable records of disease events. Historical results are shown in Table 3.

● In Malaysia, vaccination of the sows with Circovac was implemented in a 650 sow farrow-to-finish farm experiencing PCVD in the pig flow. There was a significant improvement in almost all of the reproductive parameters measured as analysed with the PigCHAMP programme (Table 4).

Conclusion

A large body of evidence, resulting from both field reports and experimental inoculation of gilts and sows support a causative role of PCV2 in reproductive failure in sows.

The large number of data collected from field trials and case investigations have confirmed in a more objective way, previous almost universal consensus and anecdotal testimonials regarding the improvement of reproductive performance following vaccination of sows with Circovac. ■

References available upon request
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