Serological survey of serum antibodies against porcine circovirus type 2 (PCV2) in swine, chicken, duck, goat and cattle from Zhejiang province, China

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SUMMARY

Porcine circovirus type 2 (PCV2) is a causal agent of post-weaning multisystemic syndrome (PMWS) in piglets. Anti-PCV2 antibodies were detected by indirect immunofluorescent assay (IFA) in serum samples collected from 2003 to 2005 including 2255 pig sera from 57 pig farms, 227 duck sera, 204 chicken sera, 493 cattle sera and 38 goat sera from Zhejiang province. The PCV2 seroprevalence was 90.2% in pigs and significantly varied according to the age; whereas unweaned pigs were moderately affected (40.7%), the PCV2 infection was dramatically spread out in post-weaning piglets as well as in adults from the 4 different regions (Huzhou, Taizhou, Quzhou and Ningbo) of the Zhejiang province. Moreover, the PCV2 seroprevalence was strongly correlated with PRRSV (porcine reproduction and respiratory syndrome virus) infection rates (r=0.793, p<0.01). By contrast, no serum anti-PCV2 antibody was detected in the other species (chicken, duck, goat or cow). These results show that PCV2 infection is specific of pigs and widely frequent in this species. Because of associated economic losses, medical and sanitary prophylactic measures would be urgently applied.

Keywords : Porcine circovirus type 2, Seroprevalence, Swine, China.

Introduction

Porcine circovirus (PCV), a member of the Circovirus genus Circoviridae family, is a non enveloped, single-stranded, circular-genome DNA virus with a diameter of 17 nm [32]. Two types of PCV, porcine circovirus type 1 (PCV1) and porcine circovirus type 2 (PCV2), have been identified. PCV1, as a persistent contaminant of the continuous porcine kidney cell line PK-15, did not cause clinical disease in pigs after experimental infection [4, 33, 34]. PCV2 can cause post-weaning multisystemic wasting syndrome (PMWS) in swine herd. PMWS was found in a swine herd in western Canada in 1991, and then it was reported continuously in several countries in North America, Europe and Asia [1, 11]. Weight loss, dyspnoea, enlarged lymph nodes, diarrhoea, pallor and jaundice appeared in pigs suffering from PMWS. The morbidity of PMWS ranges from 5 to 50% in infected herds, and the mortality approaches 100% [21]. Serological studies indicated that PCV1 and PCV2 infection were common and widespread in swine herds [7, 10, 33]. Retrospective studies showed that infection of PCV2 existed in the samples in 1969 and 1986 [25, 26, 29]. However, there was a few serological investigation of PCV2 in pig herds in recent years. To get changes of PCV2 infection in pig herds, it is important to control the disease.

Pigs inoculated with PCV2 developed the typical microscopic lesions of PMWS but only a mild form of the clinical disease [3, 9, 16, 19, 20]. These results had revealed that other, concomitant factors may be needed for the development of clinical PMWS. Severe disease had been reproduced in a proportion of pigs co-infected with PCV2 and porcine reproductive and respiratory syndrome virus (PRRSV) [5, 13]. Natural co-infection with PCV2 and PRRSV had been reported in proportions of pigs affected with PMWS [2, 30]. PRRSV infection was widespread in many countries of the
Materials and Methods

VIRUS, CONTROL SERA AND CELL LINE

PCV2 strain HZ0201, PCV1 (China), PCV2-positive serum, PCV2-negative serum and PCV-free PK-15 cells were kept in our laboratory [35].

ANIMAL HERDS AND STUDY DESIGN

The investigated population in this analysis was set at 5% of the animal herds. All pig serum samples were collected from 2003 to 2004, whereas chicken, duck, goat and dairy cattle serum samples were obtained in 2005. All animals were randomly selected. A total of 2255 pig serum samples were collected from 57 pig farms distributed in 4 regions (Huzhou, Taizhou, Quzhou, and Ningbo) from the Zhejiang province of China. The selected pigs included 27 unweaned pigs (0 to 30 days old), 1726 post-weaning pigs (30 to 180 days old), 49 gilts (< 1 year old), 434 sows (1 to 3 years old) and 19 boars (≥ 1 year). A total of 227 duck serum samples (from 30 to 180 days old from the Jinhua region), 404 chicken serum samples (from 30 to 180 days old from the Jinhua region), 38 goat serum samples (goats were 180 days old) and 493 cattle serum samples (180 days to 3 years old from the Hangzhou region) were obtained in the Zhejiang province. Blood samples were collected from ear vein of pig, jugular vein of cattle and sheep, and wing vein of chicken and duck, and left 1 hour at 37°C and at 4°C overnight. Serum was centrifuged at 4000 g for 20 minutes at 4°C, placed in 1.5 ml vials, and stored at -20°C until tested.

We recorded the information of age and region of pigs. No pig herds were vaccinated against PCV and PRRSV. Serum samples were randomly selected to detect antibodies against PRRSV.

Results

PCV2 SEROPREVALENCE

As shown in table 1, a total of 2255 pig serum samples were tested for the anti-PCV2 antibodies and 2033 (90.2%) were positive; 40.7% (11/27) of unweaned piglets, 91.3% (1576/1726) of post-weaning pigs, 98.0% (48/49) of gilts, 88.5% (384/434) of sows, and 73.7% (14/19) of boars. Anti-PCV2 antibodies were detected in all investigated herds (100%). Unweaned piglets had the lowest anti-PCV2 seroprevalence among the different age classes (p < 0.01). A positive correlation between PCV2 infection and age groups in unweaned and post-weaning pigs was evidenced (r = 0.808, p < 0.05). PCV2 seroprevalences in 2003 and 2004 were 90.3% and 90.1%, respectively. In case of sows and post-weaning pigs, all the 4 regions showed a high seroprevalence of PCV2 ranging from 75.0 to 94.4%, but no significant difference of the seroprevalence rates was found between the 4 regions (table 2).

No anti-PCV2 antibody was detected in sera from ducks (n = 227), chickens (n = 204), goats (n = 38), and cows (n = 493).
Serum anti-PRRSV antibodies were also tested by ELISA in post-weaning pigs (table 3) and in sows (table 4) in 50 pig herds for which PCV2 seroprevalences were ranged from 40% to 100%. The PCV2 infection rates were 83.16 ± 16.92% and 89.64 ± 12.84% in post-weaning piglets (25 herds) and in sows (25 herds) respectively. The PRRSV seroprevalence were 69.04 ± 23.01% (extreme values: 14% to 100%) in post-weaning pigs and was higher in sows (91.20 ± 13.31% - extreme values: 43% to 100%). The highest PRRSV infection rates (> 80%) were obtained in piglets from herds in which PCV2 seroprevalence was above 91%, whereas piglet herds where PCV2 seroprevalence was lower (< 80%) exhibited in majority moderate PRRSV infection rates (31 to 60%) (table 3). In the same way, a high PRRSV seroprevalence (> 90%) was obtained in 100% of sow herds (13 / 13) where PCV2 seroprevalence was also dramatically high (> 90%). By contrast, low PRRSV infection rates (< 81%) were only evidenced in sow herds characterized by a lower PCV2 seroprevalence (< 81%) (table 4). Moreover, prevalence of the 2 infections significantly correlated in piglets and sows (r = 0.793, p < 0.01). However, a stronger positive correlation was found in sows (r = 0.949, p < 0.01, figure 2) than in post-weaning piglets (r = 0.764, p < 0.01, figure 1).

**Regions and Number of farms***

<table>
<thead>
<tr>
<th>Regions and Number of farms</th>
<th>PCV2 seroprevalences</th>
<th>Post-weaning piglets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huzhou (n=10)*</td>
<td>75.0 (21 / 28)</td>
<td>100.0 (5 / 5)</td>
</tr>
<tr>
<td>Taizhou n = 12</td>
<td>94.4 (118 / 125)</td>
<td>100.0 (6 / 6)</td>
</tr>
<tr>
<td>Quzhou n = 20</td>
<td>83.8 (124 / 148)</td>
<td>92.6 (314 / 339)</td>
</tr>
<tr>
<td>Ningbo n = 15</td>
<td>91.0 (121 / 133)</td>
<td>89.5 (608 / 679)</td>
</tr>
<tr>
<td>Total n = 57</td>
<td>88.5 (384 / 434)</td>
<td>91.3 (1576 / 1726)</td>
</tr>
</tbody>
</table>

**TABLE 2:** PCV2 seroprevalence in pig herds from 4 different regions of Zhejiang province, China, from 2003 to 2004 (n = 2255).

<table>
<thead>
<tr>
<th>PCV2 seroprevalences*</th>
<th>0 - 30%</th>
<th>PRRSV seroprevalences</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 - 80% (n=9)*</td>
<td>1</td>
<td>31 - 60%</td>
</tr>
<tr>
<td>81 - 90% (n = 5)</td>
<td>1</td>
<td>61 - 80%</td>
</tr>
<tr>
<td>91 - 100% (n = 11)</td>
<td>0</td>
<td>81 - 100%</td>
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**TABLE 3: Distribution of PRRSV seroprevalences in 25 herds of post-weaning piglets according to the PCV2 seroprevalences.**

<table>
<thead>
<tr>
<th>PCV2 seroprevalences*</th>
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<th>PRRSV seroprevalences</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 - 80% (n=5)*</td>
<td>0</td>
<td>31 - 60%</td>
</tr>
<tr>
<td>81 - 90% (n = 7)</td>
<td>0</td>
<td>61 - 80%</td>
</tr>
<tr>
<td>91 - 100% (n = 13)</td>
<td>0</td>
<td>81 - 100%</td>
</tr>
</tbody>
</table>

**TABLE 4: Distribution of PRRSV seroprevalences in 25 herds of sows according to the PCV2 seroprevalences.**

*n: number of farms; **d: day; ***y: year

*Regions and number of farms: Table 2: PCV2 seroprevalence in pig herds in Zhejiang province, China, according to their age and according to the year of blood collection (2003 to 2004) (n = 2255).
Discussion

In the recent years, PCV2 has been causally associated with the development of PMWS in pigs. There are conflicting data concerning the ability of this virus to infect and cause disease in other animal species [6, 8, 12, 14, 15, 17, 18, 22, 23, 31, 32]. In the study, we conducted the serological investigation of PCV2 in swine, cattle, chicken, duck and goat in Zhejiang province of China from 2003 to 2005. No anti-PCV2 antibody was detected in goat, chicken, duck, and cattle, indicating that PCV2 infection in these species was a rare event. These results were in agreement with a previous study [6].

PCV2 seroprevalence was 90.2% in the pig population from 2003 to 2004. Following a previous sero-survey [35], monitoring the evolution of seroprevalence in Zhejiang province for 5 years (2000-2004), the PCV2 seroprevalence in the pig herds from 2003 to 2004 was remarkably higher than that from 2000 to 2002 (p < 0.01). Consequently, prevention of PCV2 is an urgent task in the development of swine industry in China. The marked increase of PCV2 infection in pigs during 2003-2004 would be related to the selection criteria of pig herds. Indeed, only non PRRSV vaccinated herds were retained in the present study. But, ROVIRA et al. [27] reported that PRRSV infection enhanced PCV2 replications. In agreement with these findings, a strong positive correlation was evidenced between the 2 infections in post-weaning piglets as well in sows, indicating that PCV2 infection promotes PRRSV infection or vice versa. Likely, the PRRSV infection would favour the development of PCV2 infection.

On the other hand, PCV2 infection rates were similar in the 4 different regions of Zhejiang province, indicating that the infection extent was uniform in this province. Post-weaning pigs and gilts were significantly more sensitive to the infection than non weaned piglets, the significant increase of PCV2 seroprevalence being probably related to the drop of maternal antibodies during weaning. Low level of anti-PCV2 specific antibodies from mother and the weaning-induced stress would favour PMWS emergency.

In front of the great expression of PCV2 infection, three methods would be applied to prevent the disease. Firstly, vaccination methods can be developed to induce immunity in piglets before the decline of maternal antibody titres to levels of cut-off during weaning. Secondly, weaning was a huge stimulus to piglets, and reduction of stimulus to piglets after weaning was important to prevent occurrence of the disease. Finally, when weaning piglets transferred from nursery rooms to growing rooms, effective disinfection of environment was necessary to prevent horizontal transmission of virus.

In conclusion, there are no serological evidence of PCV2 infection in cattle, goat, chicken and duck, whereas this infection is markedly frequent (sero-prevalence: 90.2%) in farm pigs of Zhejiang province. Because post-weaning piglet and adult are particularly affected, it is urgent to prevent and control this disease by vaccination program associated to sanitary measures.

Acknowledgements

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References


