Field study on swine influenza virus (SIV) infection in weaner pigs and sows

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Key words
Influenza, nasal swab, vaccination, PCV2, risk factors, reproductive disorders

Summary
Objective: The aim of this field study was to explore the occurrence of and factors associated with the detection of swine influenza virus (SIV) by RTqPCR in weaner pigs and sows from herds with a history of respiratory or reproductive disorders. Material and methods: The sample set was based on nasal swabs from 823 sows (123 submissions) and 562 weaner pigs (80 submissions). Nasal swab samples were taken and submitted by 51 veterinary practices from all over Germany. Corresponding to the pig density most of the submissions originated from the north-western part of Germany. The nasal swabs were used to detect SIV RNA by real-time RT-PCR (RTqPCR). Subtyping of SIV RNA by conventional RT-PCR and sequencing was attempted directly from clinical samples or from isolates when available. The herd characteristics, management and housing conditions of the pig herd as well as the course of the disease were collected by a telephone questionnaire with the herd attending veterinarian. Results: SIV was detected by RTqPCR in 53.8% of the submissions from weaner pigs with a history of respiratory disease. Moreover SIV was detected in 10.6% of the submissions from sows. The predominant endemic subtype found in nasal swabs from sows and weaner pigs was H1N1 (60.5%) whereas subtypes H1N2 (14.0%) and H3N2 (14.0%) were detected less frequently. In addition, human pandemic H1N1 virus or reassortants thereof were found in 11.5%. Conclusion and clinical relevance: The results underline the significance of a SIV infection in young pigs. A significant lower detection of SIV in weaner pigs was associated with the vaccination of piglets against porcine circovirus type 2 (PCV2), possibly indicating an interaction of SIV and PCV2. Most of the positive samples from sows originated from gilts, whereas only two originated from sows. An association between reproductive disorders and the detection of SIV could not be confirmed.

Schlüsselwörter
Influenza, Nasentupfer, Impfung, PCV2, Risikofaktoren, Reproduktionsstörungen

Zusammenfassung

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Introduction

The infection with swine influenza virus (SIV) is a significant cause of respiratory disease in pigs. Besides its role in swine health, it has a considerable impact on the economy in affected herds (29). In Europe, traditionally three SIV lineages of subtypes H1N1, H1N2 and H3N2 cocirculate endemically at different prevalences in domestic swine populations (4). Since 2010, a fourth subtype, derived from the human pandemic H1N1 virus that emerged in 2009, has gained access to swine populations and tends to spread (28).

From late summer of 2010 on, veterinarians in Germany observed a marked increase of reproductive disorders within sow herds. The symptoms assumed to be associated with an SIV infection. Besides the typical clinical manifestation of an influenza infection such as coughing, dyspnoea, reduced feed intake and lethargy, an increased number of sows returning to oestrus, abortions throughout all stages of gestation and litters consisting of an augmented number of stillborn and weak born piglets were reported. Clinical signs were observed independent of the season and age of the sows. The infection and disease dynamics seemed to be insidious over several months, whereas historically outbreaks of influenza in regions with a temperate climate occurred during the cold periods of the year, mainly in the autumn or early winter (6, 21, 22, 29). However, it has been demonstrated in several studies that SIV is able to circulate all year round (11, 21).

Few data have been published on the putative association of SIV infection with reproductive disorders in breeding sows. In some cases producers and veterinarians reported a reduced reproductive performance after an acute outbreak of influenza (29). It has been suggested that a SIV infection may cause reproductive disorders, such as abortion and increased rates of stillborn piglets as a cause of febrile periods of the infected sows (26). The clinical impact of the transmission of the human pandemic influenza virus (H1N1pdm) into the naïve Norwegian pig population was evaluated in a case-control study in 2009 (9). Several farmers of the clinically affected herds reported a slightly increased number of reproductive disorders, but still, the role of SIV remains unclear. Hence, the infection of the fetuses via transplacental transmission of SIV is reported only in a very few publications (6, 7). Nevertheless, the discussion aroused suspicions that the SIV infection could be responsible for reproductive disorders and a field study was initiated to clarify the relevance of SIV infection to the described clinical signs.

Material and methods

Study design and data collection

The project was presented to approximately 150 veterinary practitioners in a meeting in March 2011 in order to clarify the inclusion criteria. The study focussed on herds in which ≥ 100 sows showed acute clinical symptoms associated with influenza (fever and respiratory ailments) combined with reproductive disorders like abortions or an increased number of stillborn and weak born piglets.

The veterinarians were asked to collect samples from herds fulfilling the inclusion criteria. From each of the participating farms nasal swabs should be collected from a maximum of

- 15 sows with clinical signs (≥ 40 °C rectal temperature, reduced feed intake)
- 15 neighbouring sows even if they did not show clinical signs of an SIV infection
- 20 weaner pigs regardless of the presence and/or absence of clinical symptoms

The samples were collected on polyester swabs (Dacron®), which were immediately immersed in a suitable transport medium (Virokult, MWE). The swabs and all shipment material were provided to all participants for free. After sampling, the swabs were directly sent to the Friedrich Loeffler Institute (FLI). On a sample submission form, the veterinarians indicated the identification of the samples (eartag number and age of the pig), the address of the practice and the farm. Moreover, they were asked to participate in a telephone interview with a research assistant from the University of Veterinary Medicine Hannover, Field Station for Epidemiology.

Detection of SIV

RNA was extracted from nasal swab sample supernatant and subjected to RNA isolation using the Qiagen Viral RNA kit. Real-time RT-PCR (RT-qPCR) targeting the SIV matrix (M) gene was employed to detected SIV RNA (10). Positive samples were further subjected to molecular subtyping using short fragments of the hemagglutinin (HA) and neuraminidase genes (NA) according to previously published protocols (7, 10). Samples showing higher viral loads (i.e. M-gene specific RT-qPCR Cq values < 30) were used for virus isolation in Madin-Darby canine kidney (MDCK) cell culture as outlined by Starick et al. (24). Isolates were confirmed as SIV and molecularly subtyped as described above.

Data analysis

The FLI sent the submission forms along with the results of the sampling back to the Field Station for Epidemiology. Veterinarians who consented to participate in the telephone questionnaire and those who did not precisely express any interest in doing so were contacted by the research assistant. For the telephone interview a standardised questionnaire that had been validated in a pilot study was used.

The data recorded from the telephone interview were digitalised using Infopath® and summarised in Microsoft Excel®. The data were analysed on the basis of descriptive statistics, i.e. percentage frequencies, arithmetical mean, median value, range, Chi Square and Fisher’s exact test. The statistical unit was the single
submission. The submissions were classified in SIV-positive and SIV-negative, respectively.

The collection of the nasal swabs differed from the original sampling scheme, because most of the participating veterinarians collected the samples either only from sows or only from weaner pigs. Thus the data were analysed separately for the submissions originating from sows or weaner pigs. Submissions with samples from sows and weaners (n = 15) were included in both data analysis.

Results

A total of 293 sample submission forms were sent from the FLI to the Field Station for Epidemiology. Twenty-nine of the questionnaires were not considered in the analysis because the attending veterinarians refused to be interviewed. Moreover, 19 submissions were not included due to repeated failure to reach the veterinarians by phone and 57 submissions were excluded because the samples were only taken from fattening pigs.

For final analysis 188 submissions from 165 farms and 51 attending veterinary practitioners were included. A total of 123 submissions included nasal swabs collected from sows and 80 submissions included nasal swabs from weaner pigs. Only 15 submissions were collected according to the original sampling scheme and included samples from both groups.

Detection of SIV in sows

SIV was detected by RT-qPCR in 48 (5.8%) nasal swabs collected from sows (n = 823). These positive samples originated from 13 (10.6%) submissions from 13 farms, which were attended by ten different veterinarians.

The subtyping of SIV revealed the prevalent occurrence of endemic subtype H1N1 isolates (Table 1).

The analysis of the identification and origin of the samples, which were collected from sows, revealed, that seven of the 13 positive samples were taken from gilts. Four submissions included samples from gilts and sows without specifying the corresponding age group for the single sample. Two samples were clearly identified as being collected from sows. Thus, the detection of SIV in samples from sows was proved (n = 2) or possible (n = 4) in 0.8% (6 out of 823) and in 4.9% (6 out of 123) of the submissions.

Hence, the average sample size of positive evaluated submissions from sows (n = 13) was 5.6 samples and the average sample size of negative evaluated submissions (n = 110) was 6.1 samples. An influence of the sample size on the classification of a submission could not be demonstrated (Table 2).

Detection of SIV in weaner pigs

The 562 nasal swabs from weaner pigs were sent in 80 submissions. The detection of SIV via RT-qPCR succeeded in 43 submissions (53.8%) and 181 samples (32.2%). The predominant subtype was endemic H1N1 (Table 1). Two different SIV subtypes within one submission could be detected in two of the submissions with samples from weaner pigs.

The age of the weaner pigs which were sampled was documented in several submissions and, therefore, the data were analysed for a possible association of the pigs’ age with the SIV detection rate. A peak in the detection rate (45.6%) was found in weaner pigs at the age of 7–8 weeks (Fig. 1). Nevertheless, it has to be

<table>
<thead>
<tr>
<th>Subtype</th>
<th>Positive submissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sows</td>
<td>Weaner pigs</td>
</tr>
<tr>
<td>H1N1</td>
<td>7</td>
</tr>
<tr>
<td>H1N1pdm</td>
<td>1</td>
</tr>
<tr>
<td>H1N2</td>
<td>1</td>
</tr>
<tr>
<td>H3N2</td>
<td>1</td>
</tr>
<tr>
<td>H1N1 + H1N2</td>
<td>–</td>
</tr>
<tr>
<td>H1N1 + H3N2</td>
<td>–</td>
</tr>
<tr>
<td>HxN1</td>
<td>2</td>
</tr>
<tr>
<td>HxN2</td>
<td>–</td>
</tr>
<tr>
<td>RNA concentration under the threshold for subtyping</td>
<td>1</td>
</tr>
<tr>
<td>pdm = pandemic; Hx = haemagglutinin; – = non-determinable subtype</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 SIV subtype identification of positive submissions from sows and weaner pigs.

<table>
<thead>
<tr>
<th>Sample size (n)</th>
<th>Submissions (n)</th>
<th>Submission (n) classified as positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sows</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2–5</td>
<td>73</td>
<td>9 (12.3%)</td>
</tr>
<tr>
<td>6–10</td>
<td>36</td>
<td>4 (11.1%)</td>
</tr>
<tr>
<td>11–15</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>16–30</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Weaner pigs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2–5</td>
<td>22</td>
<td>2 (9.1%)</td>
</tr>
<tr>
<td>6–10</td>
<td>34</td>
<td>19 (55.9%)</td>
</tr>
<tr>
<td>11–15</td>
<td>14</td>
<td>13 (92.9%)</td>
</tr>
<tr>
<td>16–20</td>
<td>10</td>
<td>9 (90.0%)</td>
</tr>
</tbody>
</table>

Table 2 Sample size and classification of the submissions from sows and weaner pigs.
taken into consideration that in 219 out of 562 samples from weaner pigs the age was not specified.

The average sample size of positive submissions was 7.4 and the average sample size of negative evaluated submissions 6.6. The analysis of the sample size and the corresponding SIV detection rates revealed that in submissions of five or less samples collected from weaner pigs the chance of detecting SIV was lower than in submissions of six or more samples. In submissions with 11 or more samples, 90% of the submissions were classified positive (Table 2).

**Origin of the submitted samples**

The 188 submissions originated from 165 farms in Germany. These were attended by 51 different veterinary practices. The number of submissions per practice varied between one and 14. The spatial distribution of the farms of origin was analysed by considering the first two digits of the postal code. The majority of the samples came from the north and north-western part of Germany, the region with the highest pig density in Germany (27). The analysis of the spatial distribution of the submissions revealed, that the more submissions per region were analysed the chance of detecting SIV was considerably enhanced (Table 3).

**Analysis of SIV-classification in relation to herd characteristics**

The data collected via telephone questionnaire were analysed separately for the submissions from sows and weaner pigs. For each of these groups submissions classified SIV-positive (SIV detected in ≥ 1 nasal swab) were compared to those classified SIV-negative (SIV not detected). In ten out of 15 submissions, which included samples from sows and weaner pigs, SIV was not detected. Hence, these submissions were consistently classified negative. In one of the submissions SIV was detected in samples from sows and weaner pigs. Therefore, this submission was consistently classified positive. In four submissions SIV was detected in samples from weaner pigs but not in the samples from sows. Consequently, the data were allocated to the class of SIV-positives in the analysis of weaner pigs but allocated to the group of SIV-negatives in the analysis of sows.

**Analysis of submissions from sows**

The herd size and the defined categories (positive for the detection of influenza virus and negative for absence of influenza virus in the sample) did not reveal any correlations or differences (Table 4). The univariate analysis of the mostly dichotomously distributed parameters by Fisher’s exact test suggests a correlation of SIV infection in sows and some of the production parameters. SIV was significantly (p < 0.05) more frequently detected when runting and diseased piglets were housed in a separate pen in the nursery unit.

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Table 3  Spatial distribution of the submissions demonstrated by first two postal code digits.

<table>
<thead>
<tr>
<th>Region (first two postal code digits)</th>
<th>Submissions (n)</th>
<th>Farms (n)</th>
<th>SIV-positive submissions (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>25</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>26</td>
<td>19</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>27</td>
<td>8</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>29</td>
<td>6</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>31</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>32</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>33</td>
<td>7</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>37</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>38</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>46</td>
<td>14</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>47</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>48</td>
<td>28</td>
<td>25</td>
<td>9</td>
</tr>
<tr>
<td>49</td>
<td>66</td>
<td>59</td>
<td>18</td>
</tr>
<tr>
<td>57</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>59</td>
<td>15</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>88</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>89</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

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1 Distribution of herd characteristics, management and housing conditions in herds classified SIV-positive or -negative based on submissions from sows are presented in an additional table (Table 6) which is available on the journal’s website (www.tieraerztliche-praxis.de, see contents of issue 6/14).
Table 4
Herd size of farms classified SIV-positive or -negative based on submissions from sows.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SIV-positive (n = 13)</th>
<th>SIV-negative (n = 109)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Arithmetic mean</td>
<td>Median</td>
</tr>
<tr>
<td>sows (n)</td>
<td>440</td>
<td>300</td>
</tr>
<tr>
<td>weaner pig places (n)</td>
<td>1095</td>
<td>900</td>
</tr>
<tr>
<td>fattening pig places (n)²</td>
<td>1925</td>
<td>1900</td>
</tr>
</tbody>
</table>

¹ In this group a herd with 32 sows, 45 weaner pigs and 35 fatteners was excluded from the calculation of the average herd size.
² Only if a fattening unit was present.

Table 5
Herd size of farms classified SIV-positive or -negative based on submissions from weaner pigs.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SIV-positive (n = 43)</th>
<th>SIV-negative (n = 36)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Arithmetic mean</td>
<td>Median</td>
</tr>
<tr>
<td>sows (n)</td>
<td>367</td>
<td>300</td>
</tr>
<tr>
<td>weaner pig places (n)</td>
<td>1307</td>
<td>1200</td>
</tr>
<tr>
<td>fattening pig places (n)²</td>
<td>1798</td>
<td>1350</td>
</tr>
</tbody>
</table>

¹ In this group a herd with 32 sows, 45 weaner pigs and 35 fatteners was excluded from the calculation of the average herd size.
² Only if a fattening unit was present.

and in herds with group housing of gestating sows. The vaccination of sows as well as the vaccination of suckling pigs against PRRSV was significantly correlated with lower SIV detection rates in sows. Vaccination of the sow herd against SIV tended to show a protective effect (p = 0.11). The vaccination of the entire sow herd at the same time tended to show an advantage over the reproduction stage oriented vaccination which included only a part of the sow herd at a time (p = 0.059).

Moreover, the detection of SIV in sows was correlated with an outbreak of an influenza-like disease 1–3 weeks before sampling but was negatively correlated with the in-term birth of stillborn and weak born piglets.

Analysis of submissions from weaner pigs

The analysis of the submissions with samples from weaner pigs was processed in the same way as the submission of samples from sows. The comparison of herd size did not reveal differences between SIV-positive and -negative classified herds (Table 5).

The analysis of the different parameters characterising the herd as well as the management and housing conditions revealed a negative correlation of SIV in weaner pigs when farrowing and nursery units were placed in the same barn (p = 0.019) and when the suckling period was equal or longer than 28 days (p = 0.011). A moderate cross-fostering (5–10% of the piglets) was also correlated with SIV-negative weaner pigs. The placement of runting and diseased weaner pigs in the farrowing unit was positively correlated with the detection of SIV (p = 0.007). A positive correlation was also shown for herds with group housing of gestating sows (p = 0.031) while the housing in gestating crates tended to show a slightly protective effect (p = 0.073). The vaccination of piglets against PCV2 was significantly correlated with SIV-negative samples from weaner pigs (p = 0.001). The vaccination of gilts against SIV was negatively correlated with the detection of SIV in weaner pigs (p = 0.014) but this effect was not confirmed for the vaccination of the sow herd. The symptom “feed refusal” tended to be correlated with the detection of SIV in weaner pigs (p = 0.052).

Discussion

When evaluating the results of this study it is crucial to consider that all the samples originated from herds with a history of respira-

Distribution of herd characteristics, management and housing conditions in herds classified SIV-positive or -negative based on submissions from weaner pigs are presented in an additional table (Table 7) which is available on the journal’s website (www.tieraerztliche-praxis.de, see contents of issue 6/14).
tory and/or reproductive disorders and that particularly clinically affected pigs were selected for sampling. Therefore, the frequencies of clinical signs are not equivalent to the prevalence of SIV in the population but give valuable information about the role SIV might play in respiratory or reproductive diseases of pigs, respectively. Furthermore, it needs to be considered that the observed clinical signs do not result merely from an SIV infection but may also have been modulated by other concurring infections (e.g. PRRSV, PCV2) (18). The statistical analysis of the data was limited to descriptive statistics due to the fact that the study only included herds with a history of disease.

Another point that needs to be considered is the potentially underestimated frequency of SIV infections in this study. For interpretation of data from weaner pigs it should be noted that submissions classified negative on average contained a lower sample size than those classified positive (Table 2). Thus, it could not be ruled out that some submissions were wrongly classified negative due to an inappropriate sample size. This effect of the sample size can be excluded from the classification of submissions of samples collected from sows as submissions from sows classified negative tended to have a larger sample size than those classified positive (Table 2). In sows the detection rate might have been underestimated due to a limited virus shedding. This phenomenon of a reduced and timely limited virus shedding is well known from PRRSV infection in adult and partially immune sows (30) and might also be valid for SIV infections.

SIV was detected via PCR in 53.8% of the submissions and 32.2% of the single nasal swabs collected from weaner pigs with a history of respiratory disease. The high detection rate of a virus that is shed only for a few days (13) emphasises again the importance of SIV for clinical relevant respiratory diseases in weaner pigs as already described by others (25). Even though this study did not rule out the involvement of other pathogens in the disease, the results demonstrate the necessity to differentiate the role of SIV in respiratory disease in weaner pigs (12). The analysis of the detection rate of SIV in relation to the age of the sampled pigs illustrate a slight "peak" (45%) in the weaner pigs at an age of 7–8 weeks as well as a constant detection rate of over 20% in every age group tested (3–12 weeks).

The frequent detection of SIV in weaner pigs of all age groups reveals the endemic course the SIV infection obviously takes in many pig herds (3). In the 1970s until the 1980s the course of SIV infection usually showed an epidemic course which was characterised by a sudden onset of clinical signs in all age groups, a quite rapid spread in the individual herd but with a short duration of disease (6). The epidemic course of the infection typically occurred in herds immunologically naïve for SIV. When the population had developed an immunity against the pathogen, which resulted in a life-long or at least temporary protection of the animals, SIV was not able to find a susceptible host and the infection faded out (15). A re-emergence of the pathogen in the herd at a later point in time when most of the animals were not immune...
The last 20 years the course of SIV infection in pig herds has changed from epidemic to endemic (3, 14, 23). Nevertheless, an epidemic course of disease is still observed in exclusively fattening farms, which often only have one or a limited number of different age groups on one site. The parameters that might have supported the change from the epidemic to the frequently seen endemic course of influenza have not been evaluated in detail. The focus is on parameters such as the increasing herd size, which, especially in piglet producing farms, has probably led to a constant replenishment of susceptible individuals as hosts for SIV (8, 19). Nonetheless, an effect of the herd size on the detection rate of SIV was not demonstrated in this study. This could be due to the fact that the study was conducted in an area with intensive livestock operations. Farms with less than 100 sows, which are not typical for the present herd sizes in pig production (27), were excluded from the study. Therefore, it cannot be excluded that a comparison to farms with small herd sizes, typical for the 1970s and 1980s, would have shown an effect of herd size. The analysed farms had on average 350–400 sows (Table 5).

It can be assumed that herds, which are endemicy infected with SIV, most of the piglets receive maternal antibodies from their dams that protect the piglets from clinical disease during the suckling period (1, 16). Maternal antibodies against SIV can be detected up to 16 weeks of age in pigs (5) but a long-lasting immunity cannot be expected for all piglets born to the sows of a farrowing group. There is a rather significant variability of the immune status of the piglets mediated by colostrum intake and availability and quality of colostrum (20). These variations derive from different immune statuses of the dam (sows, in which the infection occurred a long period of time ago, transfer a smaller quantity of colostral antibodies), disorders in passing sufficient amounts of colostral antibodies (suckling behaviour, milk production, post-partum dysgalactia syndrome) and disorders affecting the colostrum intake (large litters, low birth weight, neonatal diseases). The variety of the parameters, which can influence the piglets' immunity against SIV, leads to a constant increase in the number of susceptible animals within an age group over a period of several weeks. This constant increase in the number of susceptible pigs allows SIV to take an endemic course and to circulate in a herd over time.

Besides the aforementioned parameters, which may affect the course of SIV infection in weaner pigs, further factors were identified in this study3. Among the parameters which were correlated with the more frequent detection of SIV in weaner pigs were the transfer of running or diseased weaner pigs into a hospital pen in the nursery unit with the unaffected pigs of the same age group (p = 0.007) and the group housing of breeding sows (p = 0.073). Other parameters seemed to have provided the weaner pigs with a certain amount of protection against SIV: a suckling period of ≥ 28 days (p = 0.011), a moderate cross-fostering limited to 5–10% of the piglets (p = 0.042), keeping the sows in a gestation crate (p = 0.031), the implementation of a vaccination against SIV on the level of the entire sow herd (p = 0.013), the vaccination of the piglets against PCV2 (p = 0.001) and the vaccination of gilts against influenza during the acclimatisation period (p = 0.014). It is remarkable that there are parameters which have an impact on the direct/indirect contact of the animals to each other (group housing of gestating sows, integrated hospital pens in the nursery unit, long sucking period), as well as parameters, which directly influence the SIV infection (vaccination of gilts against influenza) or have possible effects on co-infections (vaccination of piglets against PCV2). According to the applicable law the group housing of gestating sows has been compulsory from the beginning of 2013 (2). Nonetheless, the identification of this parameter is evidence of how changes in the contact intensity may affect the course of SIV infection in pig herds.

Detection of SIV was only possible in 10.6% of the submissions and 5.8% of the samples collected from sow herds. Most of the positive samples originated from pregnant gilts or those suckling their first litter. A verified positive result in samples of older sows (≥ 2 litters) was only realised in two out of 823 samples (0.2%) and two out of 123 herds (1.6%), respectively. In comparison to the weaner pigs, the detection rate in sows was already assumed to be lower due to the fact that in endemic infected herds the sows were frequently exposed to SIV and had therefore developed a certain degree of immunity against SIV (17). According to this, the total number of sows in a herd susceptible to SIV infection might be reduced. Moreover, it needs to be considered that in partially immune sows the duration and the amount of virus shedding might be limited. This effect was previously described for the PRRSV infection of sows, which possessed a partial immunity against this pathogen (30). A limited time of shedding low amounts of virus is likely to reduce the chance of detecting SIV from nasal swabs (13). Beyond that, it has to be considered that most of the reproductive disorders probably occurred days (abortion) or even weeks (return to oestrus) after a possible infection with SIV. According to this, SIV was more frequently detected in sows when the samples were collected within 3 weeks after the onset of the disease (p = 0.014). Even though SIV was only detected in very few sows with a history of reproductive disorders, the aforementioned limits for detecting SIV do not allow ruling out the contribution of SIV.

The analysis of factors that might have an influence on the detection of SIV in sows did not show an effect of the herd size. This also applies to the detection rate in weaner pigs (Table 4).

The analysis of other parameters showed that in herds with positively classified submissions, the sows were kept in groups more frequently (p = 0.025) and that diseased weaner pigs were separated in hospital pens in the farrowing unit (p = 0.007). Parameters indicating a close contact between sows or sows and

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3 Distribution of herd characteristics, management and housing conditions in herds classified SIV-positive or -negative based on submissions from weaner pigs are presented in an additional table (Table 7) which is available on the journal's website (www.tieraerztliche-praxis.de, see contents of issue 6/14).
piglets were also identified as being correlated with the detection of SIV in weaner pigs. Herds in which sows were vaccinated against SIV tended to be protected (p = 0.11) especially when the entire herd was regularly vaccinated at the same point of time (p = 0.059). The vaccination of the sow herds against PRRSV even had a more obvious positive effect (p = 0.002). A positive effect on the SIV detection in sows was also shown in herds where the piglets were vaccinated against PRRSV (p = 0.024). The effect of a vaccination against PRRSV on the detection of SIV might be further evidence of an interaction between these agents as was previously described (25).

Conclusion

The detection of SIV in weaner pigs with respiratory disorders was extraordinarily frequent. The subtype H1N1 was more frequently detected than the subtypes H1N1pdm, H1N2 and H3N2. SIV obviously spread easily within the different production lines in the herds, indicating that susceptible pigs are always present in common management systems. The influence of close animal contacts (group housing of sows, management of runting weaner pigs) on SIV transmission was confirmed in this study. As a consequence the control of the disease needs to be improved particularly regarding internal biosecurity. Besides the demonstrated positive effects of SIV vaccination in sows and the vaccination against possible co-infections such as PRRSV and PCV2, the development of a vaccine against SIV, which induces a protection for weaner pigs, would signify an important step towards improving respiratory health in pigs of this age group.

As previously mentioned the hypothesis of an association of SIV infection in sows and hereinafter reproductive disorders could not be verified in this study. It remains unclear whether there is any association or whether the detection of the virus failed due to the potentially lower and timely limited virus shedding in older sows.

Conflict of interest

The authors declare that they do not have any conflict of interest.

References


Clinical relevance

The frequent detection of SIV in weaner pigs confirmed the relevance of this agent for the occurrence of respiratory diseases in pigs of this age group. However, the supposed association between SIV infection and reproductive disorders could not be confirmed with the sampling strategy performed in this study.
Meldung

Ferkelgruppen: Weniger Aggressionen durch Ablenkung


Die Ergebnisse sind bisher erfolgversprechend. Das Verhalten der am 35. Tag abgesetzten Ferkel in neu zusammengesetzten Gruppen zu jeweils zwölf Tieren konnte positiv beeinflusst werden. 84% aller zwischen zwei zuvor trainierten Ferkeln ausgelösten Aggressionen wurden unterbrochen, sobald der Futterautomat inklusive Ton aktiviert wurde. Das Ablenkungsmanöver beendete die aggressiven Verhaltensweisen zwischen den Ferkeln vorzeitig.

Diese im Saugferkelalter erlernte Verhaltensreaktion könnte genutzt werden, um zu späteren Zeitpunkten Aggressionen zwischen den Gruppenmitgliedern zu minimieren und Stress für die Tiere zu verringern. Ob eine solche Methode unter Praxisbedingungen funktionieren kann, muss weiter untersucht werden.

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