

Geographic distribution and genetic diversity of porcine circovirus type 3 from clinical samples in US swine farms

Zhen Yang, Todd Knutson, Fangzhou Chen, Douglas Marthaler, Albert Rovira

Key points:

- PCV3 is widespread in the U.S.
- Abortion cases in study had a high rate of PCV3 positivity
- PCV3 found in association with lesions in an abortion case suggesting causality

Background and Objectives:

PCV3 was first reported in 2017 in the U.S. However, the frequency of PCV3 infection in U.S. swine is unknown. The objective of this study was to investigate the geographic distribution, frequency, ages of infection, viral co-infection, clinical signs and genetic diversity of PCV3 in cases submitted to the MN VDL, U.S.

Materials and Methods:

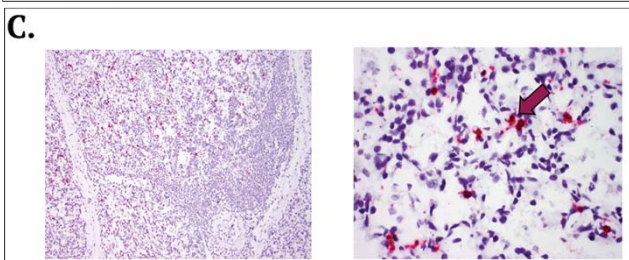
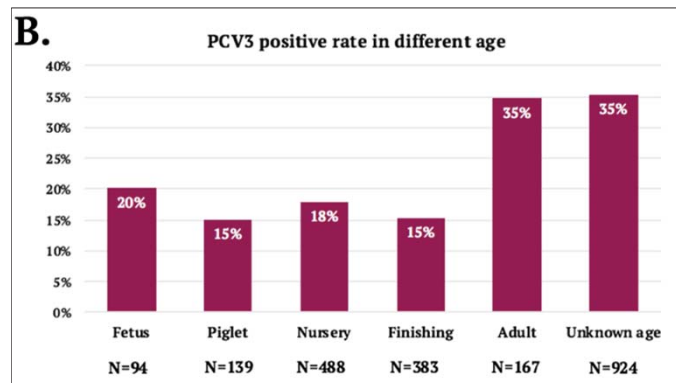
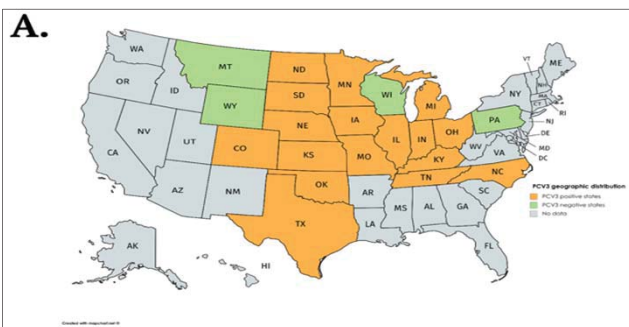
The study used seven hundred and thirty cases containing 2177 samples with a PCV3 test from the MN VDL database. Cases were received between Feb 2016 and Jan 2018. The original test used was the in-house PCV3 qPCR. After November 14, 2017 we switched to QIAGEN virotype PCV2/3. Descriptive statistics, including geographic distribution, ages of infection, clinical signs, and the rates of PCV3 positive samples, cases and sites were analyzed by Excel. Sixteen tissue homogenates were selected for Next Generation Sequencing using paired-end, 300bp reads on the Illumina MiSeq, and another fifteen samples were selected for Sanger sequencing. Alignments of the whole PCV3 genomes were created using global sequences.

Results:

- 27% samples were PCV3 positive. Each case had a variable sample size; the case positive rate was 35%. Cases came from 474 swine sites, 38% of them were positive. Out of 22 states, 18 states were PCV3 positive. In four states there were no positive samples found. However, very limited numbers of samples were available from these states.
- PCV3 was detected in pigs from all ages. The positive rate among fetus, piglets, nursery and finishing pigs ranged from 15%-20%. The PCV3 rate in adults was 35%.
- PCV3/PCV2 co-infection rate was 5.2%, and PCV3/PRRSV co-infection rate was 7.6%.
- In our data, we had 67 abortion cases, and 40% of them were PCV3 positive. Also, we had data of other viruses that can cause abortion. 7% abortion cases were PRRSV positive, 6% for PCV2 and 13% for PPV1 or 2.
- In one abortion case investigation, histological lesions were observed in lung tissue of aborted fetus and PCV3 in-situ hybridization showed presence of PCV3 in the lesion.
- Seven PCV3 whole genome sequences were obtained. Current PCV3 genomes in the U.S shared over 98% nucleotide identities. U.S strains did not cluster together and were grouped with PCV3 sequences obtained in other countries.

Conclusions and implications:

PCV3 is widespread in the U.S.; It is common to find co-infection with PCV2 and PRRSV in PCV3 positive samples. PCV3 can infect pigs of any age, from fetus to adults. Abortion cases had a high rate of PCV3 positivity (40%). Also, we identified the first case of PCV3-associated histological lesions in an aborted fetus. PCV3 complete genomes from the US showed a degree of variability comparable to that found in the rest of the world. All this information taken together suggest that PCV3 is an endemic virus in the US that has most likely been circulating within the U.S. swine populations for years.



A. PCV3 geographic distribution in U.S. Yellow states were positive, green states were negative, and no data in grey states.

B. PCV3 positivity in samples of different ages.

C. PCV3 in-situ hybridization (red spots) in the lung lesion of an aborted fetus.