Porcine Circovirus - What Do We Know and What Can We Do?*

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PCVAD Web Resources

• ISU VDPAM
• The Pig Site: PMWS and PCVD
  – http://www.thepigsite.com/pmws/
• Control of Porcine Circovirus Associated Diseases (PCVDs):
  – http://www.pcvd.org/
• American Association of Swine Veterinarians
  – http://www.aasp.org/
• National Pork Board
  – http://www.pork.org/
Circoviruses

- Circoviridae
  - Circovirus, Gyrovirus (plants), TT viruses
  - Beak and Feather Disease: 1920
  - Pigeon, Duck.....circovirus
  - Porcine circovirus type 1: 1975
    - Tissue culture contaminant
    - Avirulent for swine
  - Porcine circovirus type 2: 1995
    - PCV2a
    - PCV2b

Characteristics

- Circular single stranded DNA
- Very hardy: think parvovirus/FMD
  - Disinfectants:
- Infection has affinity for lymphoid system
- Vaccines are efficacious in poultry & now pigs - IF given prior to infection

PCV2 Associated Disease (PCVAD): History

- First identified in Canada 1991
- Reported in 1996/97/98 – US and Canada
- France and Spain in 1997
- Until 2006 No clear case definition in the US
  - Diagnosis was based on pathology reports
  - Recently the AASV developed a specific case description

PCV2 → PCVAD

Clinical presentation

- Wasting pigs
  - Fever
  - Anemic pigs
  - Jaundice
- Respiratory symptoms
  - Ulcers
  - Lymphadenopathy
  - Some PDNS
- HIGH (doubling) of MORTALITY
PCVAD

• PCV-2 virus has been declared the Primary agent by almost all investigators – global
• Canada and the US have reported significant outbreaks beginning 2004/05 continuing today
  - Vaccine has shut this down in most cases but not all
The European Experience with PCV2
- Sow vaccinations appear to be successful in France
- Spain, Netherlands, and Great Britain declining epidemics without vaccine
- Only PCV2 is clearly associated with the European experience
- The disease continues to expand its range
  - Recently Poland, Croatia, Asia, & South America, China, Viet Nam
  - All pig rearing areas around the world

US & CANADIAN EXPERIENCE
- Why this sudden change?
  - The virus has been in most pigs for many years (>100?)
  - New more virulent strains? PCV2b
  - A new more elusive agent?
  - Changes in genetics?
  - Changes in management?
  - Changes in the PCV2 virulence factors?

New PCV2 or New Pathogenicity?
- There is significant circumstantial evidence that another yet unknown factor is involved
- Two studies that indicate no difference in pathogenicity between PCV2a and PCV2b

PCVAD Finisher Mortality
- No clear indication of other agents
  - PRRSv most frequent co-agent
- No FAD’s
- Pigs often do not respond to antimicrobial treatment – Most bacterial agents are unlikely co-factors
- Injecting pens or barns increases mortality?
Current Observations

PCVAD

Diarrhea similar to ileitis

Mesocolonic edema was a significant finding in grow-finish pigs in early outbreaks

Interlobular edema was frequently reported in grow-finish pigs in early outbreaks

Porcine Dermatitis and Nephropathy Syndrome (PDNS): A Significant Finding in Early Outbreaks

PDNS Field Case Courtesy of Dr. Mike Yaeger ISU VDL
The US Experience

• In the field mostly endemic/mild or misdiagnosed until 2005
  – Occasional pigs with PMWS/PDNS
  – Usually nursery pigs associated with Hps, PRRS, & Flu

• Epidemics spread like “wildfire”
  – To all pig producing states

The Recent US Experience

• High Mortality
  – Often affected and unaffected in same pens and barns
  – Affected die – Unaffected perform well
  – > 50% barn mortality was common before vaccine
  – Outbreaks last 4-6 weeks
  – Usually start 2nd to 3rd week post placement
  – Deaths rates high by 3rd week
  – Taper off to destroyed by week 6/7

Genomic Analysis of PCV2 at the ISU VDL

– Currently doing sequencing of ORF2
  • Only a few sequenced in 2005
    – 6 of 7 were genotype “2a”, the other was “2b”
  • 2006
    – 131 cases were “2b” (aka, European genotype)
    – 78 cases were “2a” (aka, North American genotype)
    – 79 cases could not be sequenced mainly due to low amount of virus

– Sequencing for RFLP prediction of the virus is under validation

Dendogram based on entire PCV2 sequencing and comparison of PCV2 sequences available from the GenBank.
**Porcine Diagnosis by System Affected**

**ISU VDL in 2007**

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<th>Diagnosis</th>
<th>Number</th>
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<td>Anemia</td>
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**PCV2 Systemic Cases**

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**Potential Co-agents in a High Mortality Field Case**

- Six months diagnostics
- Submissions for a PCVAD Investigation

**Diagnosis of PCVAD**

- Clinical Signs and Gross lesions
- Microscopic lesions
  - Hallmark lymphoid lesions
- Immunohistochemistry
  - Main confirmatory test
- Serology
  - ELISA, IFA
  - PCR: Quantitative, nested, multiplex
- Virus isolation
- Sequencing
- Antigen capture ELISA

**Submission for a PCVAD Investigation**

- Liver
- Colon
- Lung
- Ileum
- Heart
- Kidney
- ADD lymph nodes and tonsil
Bottom-line Knowledge

- PCV2 isolates that are genetically close may differ in virulence – study and field supported?
- Immune stimulation is associated with PCVAD
- There appears to be Individual/line genetic susceptibility
- Most high mortality cases have European like isolates
- Commercial Vaccine is very effective

Bottom-line Knowledge

- Virus is very stable and resistant to heat and disinfection (248°F) – steam is better than dry heat
- Easily tracked across continents?
- PCV2 is in semen of recently infected boars – does not appear to be infectious
- Fecal-Oral most likely route of transmission
- Other opportunities of transmission? i.e. airborne

Transport is a likely source of PCV2

Control Diseases

- Maximize colostrum intake/neonatal husbandry
- Vaccinate Pigs with commercial vaccine early but based on maternal antibody levels
- Use of anti-inflammatory drugs is reported to be marginally beneficial – Salicil Mix™ (Acetylsalicylic Acid)
- Pulsing the group with spray dried plasma protein is reported to be beneficial
- Additional Vit. E?

CONTROL

Vaccination and immune stimulation:
- Role of other vaccines as cofactors?
  - Literature – Immune stimulation appears necessary for PCVAD
  - Field experience – Yes – No - Unknown
- Oil adjuvant vaccines – ‘milky’
- Timing of all vaccinations are important
  - At least 3 weeks prior to PCV2 infection/field exposure
  - After maternal antibodies disappear

Commercial Vaccine
CONTROL

• “Homemade” tissue homogenate vaccines were popular before commercial vaccine
  – Due to commercial shortage
  – Marginally effective?
  – Inexpensive to make <$25
  – May not be killed
  – Pig hemolytic anemia
  – Highly controversial – adulterant
  – May be illegal?
  – Has become an Ethics? Food safety? Issue

IgM Antibody Response

ISU IgG ELISA

PRRS ELISA

Serum PCR Results

Conclusions

1. Positive Control – positive at day 7
2. Vaccine F
   • Two pigs positive by day 7
3. Vaccine C
   • One of two positive at day 7

Two of four vaccines were infectious

• Multi-factorial & PCV2b
• Still many mysteries
  – Risk factors and agents?
• Science is still incomplete?
• Commercial Vaccine is Effective
  – Availability is no longer an issue
  – Vaccine failures are becoming more common?
  – Vaccine effectiveness is falling?