28th Conference of the OIE Regional Commission for Asia, the Far East and Oceania

PRRS control in the Region

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Outline of presentation

- Introduction
- Characteristics of the HP-PRRS
- HP-PRRS in the region
- The factors influencing HP-PRRS spread
- Control and prevention of PRRS
- Conclusion
Introduction of PRRS

- An economically important swine disease worldwide, characterised by reproductive failure in pregnant sows or respiratory tract distress particularly in suckling pigs
- First recognised in the USA in the mid 1980’s, subsequently found in Europe, and identified in Asia in the early 1990s;
- In 2006 in China, “Porcine high fever syndrome (PHFS)” emerged and spread throughout the country causing very severe disease in pigs
- The disease caused by this new variant strain is now called highly pathogenic PRRS
Characteristics of the HP-PRRS

- PRRS is an RNA virus of the order Nidovirales, family Arteriviridae, genus Arterivirus
- There are two related but antigenically and genetically distinguishable strains: genotype I (LV) and genotype II (VR2332)
- Genetic sequence homology of 2 genotypes less than 70%
First report that said **Porcine High Fever Syndrome** is caused/triggered by **atypical PRRS virus**.
HP-PRRS virus is a variant that belongs to North American genotype.

(Source: Report of Ministry of Agriculture, China)
Deletion in NSP2 region = Marker for HP-PRRS virus

- This deletion has been consistent with PRRS virus detected from PHFS/HP-PRRS, and is used as the marker to differentiate from classic PRRS viruses.
- This marker is still valid for HP-PRRS viruses till 2010

Classic PRRS NA type (89-VR2332, USA)
Origin of Highly Pathogenic Porcine Reproductive and Respiratory Syndrome Virus, China

(Emerging Infectious Disease Vol. 16, No. 2 • February 2010)

Appendix Figure. Phylogenetic relationships of 67 porcine reproductive and respiratory syndrome viruses (PRRSVs) based on their whole-genome sequences. The unrooted phylogenetic tree was generated by the neighbor-joining method using Molecular Evolutionary Genetics Analysis 4 (5). Bootstrap values were calculated on 1,000 replicates. The 53 isolates from China were classified into 4 subgroups (circled). Four commercially available attenuated live vaccine viruses are marked with asterisks. MLV, modified live vaccine; NVSL, National Veterinary Services Laboratories; CH, China; SP, Singapore; HN, Henan; BJ, Beijing; HB, Hebei; WUH, Wuhan; JX, Jiangxi; GD, Guangdong; LN, Liaoning; NM, Neimenggu; JS, Jiangsu; SH, Shanghai; TJ, Tianjin; SX, Shanxi; HUB, Hubei; YN, Yunnan; NX, Ningxia, GS, Gansu.
<table>
<thead>
<tr>
<th>Done by</th>
<th>Inoculums</th>
<th>Animals (age)</th>
<th>Clinical outcome</th>
<th>Reference</th>
</tr>
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<tbody>
<tr>
<td>China</td>
<td>Isolated virus (Chinese virus)</td>
<td>SPF (5wks) SPF (11wks)</td>
<td>Yes</td>
<td>100% (5wks) 57% (11wks) Plos One 2007a (2) e526- EID 13(9), 1434-1436, 2007</td>
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<tr>
<td></td>
<td>Infectious clone</td>
<td>PRRS-free (5wks)</td>
<td>Yes</td>
<td>100% JGV 89, 2075-2079, 2008</td>
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<td>USDA</td>
<td>Isolated virus (Vietnam 2007)</td>
<td>SPF (4-6wks)</td>
<td>Yes</td>
<td>0% Transboundary and Emerging Diseases, 57(5), 315-329, 2010</td>
</tr>
<tr>
<td></td>
<td>Tissue homogenate</td>
<td>SPF (4-6wks)</td>
<td>Yes</td>
<td>100% (3/3)</td>
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<tr>
<td>Vietnam</td>
<td>Isolated virus (Vietnam 2007)</td>
<td>PRRS-free (8wks)</td>
<td>Yes</td>
<td>0% (0/5)</td>
</tr>
<tr>
<td>Japan</td>
<td>Isolated virus (Vietnam 2007&amp;2010)</td>
<td>SPF (4wks)</td>
<td>Yes</td>
<td>2007; 0% (0/9) 2010; 11% (1/9)</td>
</tr>
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</table>

The 30-amino-acid deletion in the Nsp2 of highly pathogenic porcine reproductive and respiratory syndrome virus emerging in China is not related to its virulence.

Key Laboratory of Zoonosis of Ministry of Agriculture, College of Veterinary Medicine, China Agricultural University, Beijing 100193, People's Republic of China.

1. In this study, we generated four full-length infectious cDNA clones: a clone of the highly virulent PRRSV strain JXwn06 (pWSK-JXwn), a clone of the low-virulence PRRSV strain HB-1/3.9 (pWSK-HB-1/3.9), a chimeric clone in which the Nsp2 region containing the 30-amino-acid deletion was replaced by the corresponding region of the low-virulence PRRSV strain HB-1/3.9 (pWSK-JXwn-HB1nsp2), and a mutated HB-1/3.9 clone with the same deletion in Nsp2 as JXwn06 (pWSK-HB1-ND30).

2. We also investigated the pathogenicities of the rescued viruses (designated RvJXwn, RvJXwn-HB1nsp2, RvHB-1/3.9, and RvHB1-ND30, respectively) in specific-pathogen-free piglets in order to determine the role of the 30-amino-acid deletion in the virulence of the highly pathogenic PRRSV. All the rescued viruses could replicate stably in MARC-145 cells.

3. Our findings indicated that RvJXwn-HB1nsp2 retained high virulence for piglets, like RvJXwn and the parental virus JXwn06, although the survival time of piglets infected with RvJXwn-HB1nsp2 was obviously prolonged. RvHB1-ND30 exhibited low virulence for piglets, like RvHB-1/3.9 and the parental virus HB-1/3.9.

4. Therefore, we conclude that the 30-amino-acid deletion is not related to the virulence of the highly pathogenic PRRSV emerging in China.
The cause of swine deaths in Vietnam is a multifactorial syndrome with PRRS virus as a major factor.
Findings about the HP-PRRSV

- The deletions on NSP2 gene is not responsible for the increased virulence of HP-PRRS virus.
- The level of pathogenicity of HP-PRRS may vary depending on the strains.
- PHFS is the multifactorial syndrome triggered by HP-PRRS virus as a major factor followed by secondary infections with various agents.
Clinical signs of HP-PRRS

- Respiratory signs and some abortions
- High fever (40-42°C)
- Varied mortality
- Affecting all age groups
- Pathological lesions in lung and lymph nodes
- Quick spread (highly infectious)
HP-PRRS in the region
HP-PRRS in China

- The emergence of HP-PRRS was detected in June 2006
- Two million pigs affected, of which 400,000 in 16 provinces had died
- Provinces along the Yangtze River have been the most affected
- The disease continued in 2007, and extended to 26 provinces by the end of 2007
- A compulsory PRRS vaccination policy has been implemented in high-risk areas and in high-value herds
HP-PRRS in China
HP-PRRS in China
HP-PRRS in South-East Asia

- In Vietnam
  - In March 2007, HP-PRRS was found in Hai Duong province in the northern part of Vietnam.
  - Clinical and pathological findings similar to outbreaks in China in 2006
  - HP-PRRS has become endemic in Vietnam
  - However, there seems to be a seasonal pattern in the occurrence of HP-PRRS in Vietnam: winter to spring in the north, and summer to autumn in the south.
HP-PRRS in Vietnam
HP-PRRS in Vietnam
HP-PRRS in South-East Asia

- **In Laos:**
  - In June 2010, HP-PRRS outbreaks capital city of Vientiane
  - In August 2010, 31 pig farms in 7 districts had reported the disease.
  - The mortality: 28% in sows, 48% in finishing pigs, 91% in piglets and 6% in boars. (average 25%)

- **In Thailand**
  - The first case was detected in Phitsanulok in early 2010.
  - In total, 660/2,970 pigs from 90 small pigholders in the province were affected
HP-PRRS in South-East Asia

- **In Myanmar:**
  - In February 2011, when 210 out of 559 pigs died at a farm in Naypyidaw district, Mandalay province.
  - HP-PRRS subsequently spread to the other districts (Aungmyetharsan, Chanayetharsan, Mahaungmye, Chanmyatharsi, Pyigyitagun, Amarapura and Madaya) in the Mandalay region,

- **In Cambodia**
  - HP-PRRS emerged in 3 provinces (Battambang, Kampong Cham, and Kampot) in August 2010
  - The disease quickly spread to 5 other provinces: Kampong Chhnang, Prey Veng, Svay Rieng, Takeo and Kandal

- **In Philippines:**
  - HP-PRRS was detected in Tabuk province in August 2010
Spread of HP-PRRS in Southeast Asia 2006-11

- 2006: China
- 2007: China + Vietnam
- 2008: China + Philippines
- 2010: China + Laos + Cambodia + Thailand
- 2011: + Myanmar

7 countries affected
The factors influencing HP-PRRS spread

- Large proportion of animals are still kept in traditional small-scale and backyard settings (up to 70%)
- Low level of knowledge and understanding among livestock producers regarding the benefits of disease control
- Not knowledgeable about the requirements for a cooperative national disease monitoring programme
- Medium- and small-scale pig farmers generally have the traditional farrow-to-finish systems, often with very close mixing of age groups.
- Replacement stock often comes from a variety of sources and of unknown health status with no adequate quarantine before entry
The factors influencing HP-PRRS spread

- Hygiene application is usually very poor or does not exist with respect to the contact between farm workers and pigs outside their farms, or between outsiders and pigs housed within the farms.
- Increased consumption of pork leads to an increase in commercial pig production.
- Live pig (piglets, fatteners and finishers) movement from higher density (high risk or infected) to consumption location.
- The movement of pigs infected with HP-PRRS, even dead pigs, could also be responsible for the disease spreading between neighbouring countries.
- Biosecurity failures have occurred, including failure to control animal movements and trading among neighbouring countries at borders.
Summary of pattern of spread

- Disease is following the intensification path of pig production
- Absence of disease surveillance at community level, weakness of the Veterinary Services in dealing with outbreaks in a timely manner, lack of biosecurity in value chains and the absence of regulations and incentives to control pig diseases
- The role of small-scale holdings for virus persistence in areas with a high density of pigs (in lower density areas PRRS infection usually dies out) will require special attention.
The keys to controlling PRRS

(1) Design and strictly apply biosecurity measures to prevent the entry or re-entry of PRRSV

(2) Stop circulation of the virus among, or the spread of infection to, sows in breeding herds

The measures currently used to control PRRS include management (e.g. whole-herd depopulation/repopulation and herd closure), biosecurity, test and removal, and vaccination.
# Prevention by vaccines

<table>
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<th>No</th>
<th>Vaccine name</th>
<th>Manufacturer</th>
<th>Type</th>
<th>Genotype</th>
<th>Strain</th>
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<tbody>
<tr>
<td>1</td>
<td>Porcilis® PRRS</td>
<td>MSD Animal Health (Merck)</td>
<td>Live</td>
<td>European</td>
<td>European strain DV</td>
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<td>2</td>
<td>Ingelvac PRRS® MLV</td>
<td>Boehringer Ingelheim Vetmedica, Inc.</td>
<td>Live</td>
<td>North American</td>
<td>VR 2332</td>
</tr>
<tr>
<td>3</td>
<td>BSL-PS 100</td>
<td>Bestar Laboratories Ltd.</td>
<td>Live</td>
<td>North American</td>
<td>JKL 100</td>
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<td>4</td>
<td>PRRS Live Vaccine</td>
<td>Chengdu TECBOND Biological Products Co., Ltd</td>
<td>Live</td>
<td>North American</td>
<td>CH-1R</td>
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<td>5</td>
<td>Highly Pathogenic PRRS Live Vaccine</td>
<td>Dahanong, Chengdu Medical E&amp;P</td>
<td>Live</td>
<td>North American</td>
<td>JXA1-R</td>
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<td>6</td>
<td>Highly Pathogenic PRRS Live Vaccine</td>
<td>Harbin Veterinary Research Institute</td>
<td>Live</td>
<td>North American</td>
<td>HuN4-F112</td>
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<td>7</td>
<td>PRRS Inactivated Vaccine</td>
<td>Chengdu Medical E&amp;P</td>
<td>Killed</td>
<td>North American</td>
<td>NVDC-JXA1</td>
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<td>8</td>
<td>AMERVAC® PRRS</td>
<td>Hipra</td>
<td>Live</td>
<td>European</td>
<td>VP046 BIS</td>
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</table>
Difficulty in vaccine development

- The lack of knowledge of:
  1. The virus strategies to suppress and evade innate and adaptive host immune responses;
  2. The virus epitope(s) responsible for such immune suppression and evasion;
  3. Virus epitope(s) that are common to both NA and EU PRRSV and can confer broad protection; and
  4. The role of PRRSV non-structural proteins and structural proteins in virus replication, virulence, immunity and protection.
Prevention of PRRS

- Prevention of introduction into a herd
  - Biosecurity
  - Application of filtration systems
- Prevention of introduction into a country
  - Control of pig movement
Conclusion

- The prevention and control of HP-PRRS is currently the highest priority issue for pig producers and animal health authorities in the region.
- More research is needed to understand the virus and the disease especially in virus pathogenesis, persistence, transmission, and vaccine development.
- Need to monitor the disease status and the virus evolution in each country and the region, and to share those information among all the stakeholders.
- Develop regional strategy for the control of HP-PRRS.
Thank you