Farrowing results following a PRRS virus challenge in pregnant sows immunized with a live virus and multivalent PRRSV protein vaccine

M. Wagner*[1] B.K. Kim[2] and H.S. Joo[3] [1]Fairmont Veterinary Clinic, Fairmont, MN.
[2]MJ Biologics, Mankato, MN, [3]College of Vet Medicine, University of Minnesota, St. Paul, MN.

Introduction

Pregnancy in sows with PRRS virus infection was reported to be protected against homologous strain,[1] while the protection has been incomplete against heterologous strains.[2] In commercial farms, the use of vaccine and/or exposure of naïve replacement gilts to farm specific PRRS virus has been commonly practised for its control. However, there have still been clinical outbreaks in the farms following commercial vaccines or live virus exposure. At present, there is no marker for protection against PRRS virus although serum neutralizing (SN) antibody has been shown to be effective in protecting from infection.[3] The purpose of this study was to investigate and evaluate how anti-PRRSV envelope proteins (EP) antibodies play roles in the ability of protection against a heterologous PRRS virus in pregnant sows.

Materials and Methods

Six 84-day pregnant sows at parity 6 were purchased from a commercial farm and divided into 3 groups based on the antibody quantity; **h**igh, **m**edium and **l**ow groups by Western immunoblot (WB) analysis to EP of the vaccine strains. In the source farm, each replacement gilt had been exposed with a farm-specific PRRS virus during their acclimatization. No new field viruses other than the virus used for acclimation had been identified during the past five years. Then each sow was inoculated at least twice with multivalent PRRSV protein vaccines (MJ Biologics, Inc., Mankato, MN). The last vaccine was given at 34 days of gestation. All sows at 30 days before their due dates were inoculated with serum that was collected during acute PRRS outbreak in a different farm. All sows were allowed to farrow, and farrowing results were compared between high (sow H1 & H2), medium (sow M1 & M2) and low (sow L1 & L2) groups. Blood samples were collected from the sows and their piglets at interval to examine the presence of antibodies and virus. Antibody titers were tested by ELISA, SN and WB. The WB was tested using a pool of GP5 from the MJ PRRS™ vaccine antigen, and the results were expressed by mean color density of the GP5 proteins and antibody reaction (Gel Logic 1500 Imaging System & software v4.1, Kodak). The SN test was carried out against PRRS virus used for acclimation.

Dendogram Analysis

- Challenge virus (CV) was 14% different to the farm acclimation virus (FV).
- CV ranged from 1.8 to 16.8% different to the MJ- PRRS™ vaccine isolates.
- FV ranged from 11.3 to 16.0% different to the MJ-PRRS™ vaccine isolates.

Percent Identity

	1	2	3	4	5	6	7	8	9	
1		92.7	85.6	82.1	82.1	93.9	83.1	91.0	90.4	1
2	3.0		88.1	84.1	82.9	95.9	84.6	95.4	94.5	2
3	10.4	12.6		82.9	84.7	88.9	84.7	88.6	86.9	3
4	14.1	16.1	17.8		88.9	84.4	88.7	84.4	81.8	4
5	14.1	18.2	15.6	12.1		83.7	88.2	83.3	83.3	5
6	1.8	4.1	11.6	16.1	16.8		86.2	94.9	93.7	6
7	13.1	16.0	15.2	11.3	11.5	14.0		83.7	83.6	7
8	4.5	4.9	12.2	16.5	17.2	5.2	17.1		93.7	8
9	5.1	5.4	13.4	19.0	17.4	6.5	17.5	6.5		9
	1	2	3	4	5	6	7	8	9	

D06-14697 → 2007 MJPRRS™
D06-34677(37-41) → 2006 MJPRRS™
D05-7398-11 → 2007 MJPRRS™
D05-29212(1-5) → 2007 MJPRRS™
D05-34229 → Challenge virus
D06-67089-1 → 2006 MJPRRS™
D07-112(6-10) → Farm Acclimation Virus
D06-16912.seq → 2006 MJPRRS™
D05-37859(19-23).seq → 2006 MJPRRS™

Results

Antibody titers of 6 sows measured by WB, ELISA and SN test are summarized in Table 1. By the WB, there was minor difference in the color density between the sow groups. Similarly there was difference in antibody titers between the sow groups by ELISA and SN test. After challenge, antibody titers were increased by all 3 methods but the antibody rise was most evident by SN test. Farrowing results of each sow were shown in Table 2. Two sows each of high, medium and low EP antibody groups farrowed 20, 16 and 9 live-born pigs, respectively. Two sows each of high, medium and low EP antibody farrowed 5, 8 and 18 born-dead pigs, respectively. PRRS virus detection from the piglets at birth was summarized in Table 3. PRRS virus was not detected in 11 of 11 piglet pools of the 4 sows with high and medium EP antibody but PRRSV PCR was positive for 2 of 3 pools of the 2 sows with low EP antibody. Results of PRRS virus detection from the piglets at 3 and 14 days of age were similar to those at birth.

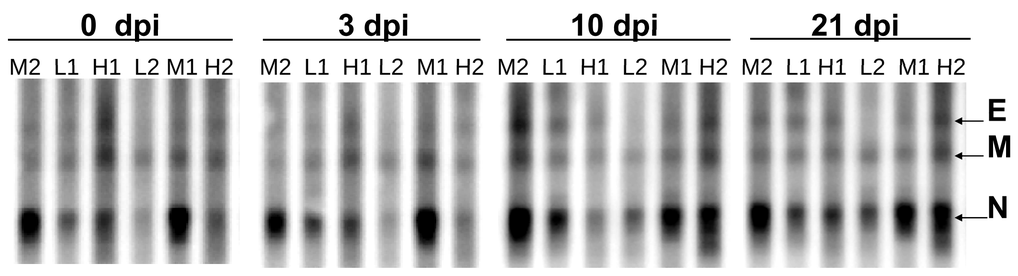
Discussion

Present results showed that farrowing results were near normal and transplacental infection did not occur in 4 sows with medium to high EP antibody. At the time of challenge, antibody titers of the 4 sows were WB color density of ≥319, ELISA OD of ≥1.07, or SN titers of ≥1:4. In summary, pregnant sows showed different response to the virus challenge depending on EP-Ab levels at the time of challenge; (1) high EP-Ab (color density 348-419) sow showed good protection, (2) medium EP-Ab (density 319-335) sows showed reasonable protection, and (3) low EP-Ab (density 263-308) sow showed no protection. These results suggest that EP antibody levels measured by WB along with SN titers may be a useful indicator for the protection when challenged with a heterologous PRRS virus. However, repeated experiment with more animals are needed to conclude these findings.

Table 1. Antibody titers measured by Western blot analysis, ELISA and SN test of the sows before and after challenge

Sow No.	Days post challenge			
	0	3	10	21
H1	419 / 2.49 / 32*	346 / 2.59 / 32	372 / 2.55 / 64	434 / 2.88 / 128
H2	348 / 1.07 / 16	283 / 1.03 / 16	539 / 2.69 / 256	527 /2.53 / 256
M1	335 / 1.72 / 8	337 / 1.89 / 16	427 / 2.69 / 256	394 / 2.65 / 128
M2	319 / 1.14 / 4	263 / 1.14 / 4	610 / 2.83 / 256	447 / 2.55 / 128
L1	308 / 0.26 / 4	270 / 0.50 / 8	446 / 2.53 / 256	409 /2.27 / 256
L2	263 / 0.94 / 2	232 / 1.04 / 4	297 / 2.16 / 128	317 / 2.38 / 128

* Antibody titers by Western blot / ELISA / SN test



Note; color density of EP for each sow in WB analysis

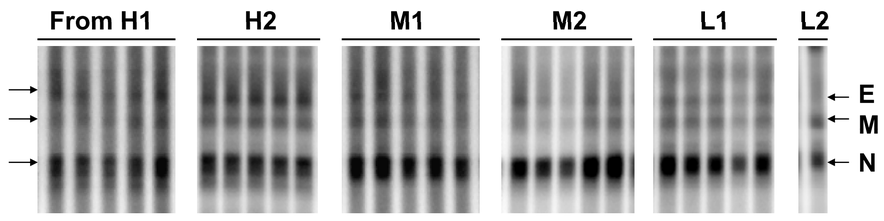
Table 2. Farrowing results following PRRS virus challenge

Sow No.	Farrowing day*	Live-Born	SB	M	Total	LB / T (%)
H1	+3*	7	2	1	10	70
H2	0	13	1	1	15	87
M1	-1	11	2	3	16	69
M2	0	5	2	1	8	63
L1	-1	5	4	1	10	50
L2	-2	4	8	5	17	24

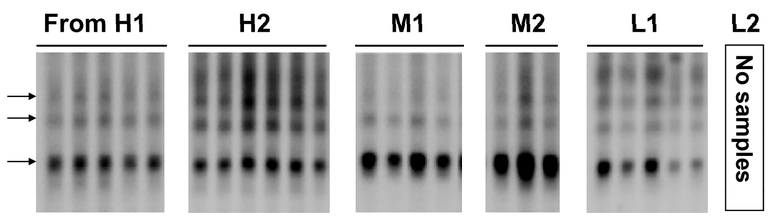
* Days early or late from due date; SB = stillborn; M=mummified

Western blots of Piglet Sera;

- **At 3 Days of Age**



- **At 25 Days of Age**



Note; Maternal antibody - color density of EP for piglets from each sow in WB

Table 3. Detection of PRRSV from piglets at different age by PCR

Sow no.	24 h of age	3 days of age	14 days of age
H1	2 of 2 pools → −	2 of 2 pools → −	2 of 2 pools → −
H2	4 of 4 pools → −	4 of 4 pools → −	4 of 4 pools → −
M1	2 of 2 pools → −	2 of 2 pools → −	2 of 2 pools → −
M2	3 of 3 pools → −	3 of 3 pools → −	3 of 3 pools → −
L1	1 of 2 pools → +	1 of 2 pools → +	1 of 2 pools → +
L2	1 of 1 pool → +	1 of 1 pool → +	All pigs died

References

1. Larger et al. 1999. Am J Vet Res 60: 1022-1027
2. Hesse et al 1996. Proc AASP p. 107-110
3. Osorio et al. 2002. Virology 302:9-20