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Evaluation of a needle-free injection system (AcuShot™) for reduction of hematogenous transmission of PRRS virus

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Introduction

Needle-free injection devices (NFID) deliver vaccine directly through the skin or trans-dermally. The NFID forces the vaccine out of the device at such a high velocity (> 100m/sec) that it creates a small hole in the skin. There has been a renewed interest in this technology because it offers some advantages over conventional vaccine or medicine delivery methods: elimination of broken needles, consistent vaccine delivery, elimination of accidental worker needle sticks, elimination of needle disposal, and less pain and stress on animals.¹ Since it has been demonstrated that hematogenous transmission of porcine reproductive and respiratory syndrome virus (PRRSv) can occur from infected pigs to susceptible pigs via repeated use of the same needle,² another potential advantage of needle-free technology is the reduction of hematogenous transmission of PRRSv. The objective of this study was to evaluate the ability of the AcuShot™ NFID (AcuShot, Inc., Winnipeg, CA) to reduce or eliminate the hematogenous transmission of PRRSv.

Materials and methods

A total of 88, four-week-old gilts were purchased from a farm that was PRRSv-negative. The pigs were divided into four replicates of 5 groups. Group #1 (PRRSv source population) consisted of 10 pigs which were intramuscularly inoculated on day 0 with 2 ml of the MN-184 PRRSv isolate at a concentration of 10^4 TCID₅₀/ml. Group #2 AcuShot, Group #3 conventional needle or positive control, Group #4 sham-inoculated, and Group #5 negative control, each consisted of three pigs. All pigs in Group 4 (the sham-inoculated) were intramuscularly inoculated with 2 ml of virus-free media. On days 5, 6 and 7 post-inoculation (PI) of Group #1, pigs from Groups #1, #2 and #3 were vaccinated with a killed *Mycoplasma hyopneumoniae* (*M hyo*) bacterin (Ingelvac MycoFLEX®, Boehringer Ingelheim Vetmedica, Inc., St. Joseph, MO). The same AcuShot device and needle/syringe used to initially *M hyo*-vaccinate the PRRSv source pigs (Group #1) on opposite sides of the neck were used to subsequently *M hyo*-vaccinate pigs in Groups #2 and #3, respectively. Serum samples were

collected from all pigs on days 0, 2, 5, 7, 12, 19 and 22 PI for PRRS PCR, and PRRS ELISA at days 0 and 22. The statistical analysis was run with Minitab® software, applying Fisher's exact test

Results

The results are demonstrated in Table 1. At arrival (day 0), all pigs tested negative by PRRS ELISA and PCR. All Group 1 pigs tested PRRS PCR positive at days 2 and 5 PI. All 12 pigs (4 reps of 3 pigs) injected with the conventional needle/syringe became PRRS PCR-positive at days 12 and 19 PI, while 3 out of 12 pigs (1 rep) injected by AcuShot tested PRRS PCR-positive by day 19 PI. The proportion of PRRS PCR-positive animals was significantly lower in the AcuShot group compared with the needle/syringe group ($P \leq 0.05$, Table 1). On day 22 PI, the final day of the study, all PRRSv source pigs tested PRRS ELISA-positive, as did the 12 animals injected with conventional needle/syringe. Three of 12 animals treated using AcuShot and none of the negative controls or sham-inoculated pigs tested ELISA positive on day 22 PI.

Table 1: Proportion of PRRS PCR-positive pigs per treatment by testing day

Groups		Day 7	Day 12	Day 19	Day 22
Group #3 Needle & Syringe	Pigs	9/12 ^b	12/12 ^b	12/12 ^b	NT
	Replicates	4/4	4/4	4/4	NT
Group #2 AcuShot	Pigs	0/12 ^a	2/12 ^a	3/12 ^a	3/12 ^a
	Replicates	0/4	1/4	1/4	1/4
Group #4 Sham Inoc.	Pigs	NT	NT	NT	0/12 ^a
Group #5 Neg. control	Pigs	NT	NT	NT	0/12 ^a

NT=No samples taken.

Different superscripts within columns indicate significant differences at $P \leq 0.05$.

Discussion

The results of this study indicate that hematogenous transmission of PRRSv occurs from infected pigs to susceptible pigs via repeated use of the same needle and that needle-free systems reduce, but do not eliminate, the hematogenous transmission of PRRSv. Further research is needed to identify the mechanisms of PRRSv transmission by needle-free devices. Further evaluation of needleless devices under field conditions is warranted to ensure their suitability for use in swine production.

References

1. Chase C.L., Daniels C.S., Garcia R., Milward F., Nation T. (2008). Needle-free injection technology in swine: Progress toward vaccine efficacy and pork quality. *J Swine Health Prod.*16, 254–26.
2. Otake S., Dee S.A., Rossow K.D., Joo H.S., Deen J., Molitor T.W., Pijoan C. (2002). Transmission of porcine reproductive and respiratory syndrome virus by needles. *Vet Rec.*150(4),114–115.



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References

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