Persistence of Porcine Reproductive and Respiratory Syndrome in Pigs

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1. INTRODUCTION

First reported in the United States in 1987 and in Europe in 1990, porcine reproductive and respiratory syndrome has rapidly become the most important infectious disease problem in the North American swine industry. The etiological agent, porcine reproductive and respiratory syndrome virus (PRRSV), is a member of the family *Arterivirdae* in the order *Nidovirales*. PRRSV is a single-stranded, enveloped, positive-sense RNA virus with a genome of approximately 15 kb in length containing 8 open reading frames (ORFs) which are expressed as subgenomic mRNA. At present, PRRSV is present in at least 60 percent of North American swine herds (USDA:APHIS:VS, 1997)

Clinical signs exhibited by pigs infected with PRRSV are age dependent. Newborn and nursing pigs (one to 21 days old) are at risk of increased pre-weaning mortality with accompanying clinical signs of fever and lethargy. Infected growing pigs (4 to 12 weeks old) exhibit respiratory signs typically resulting from PRRSV in combination with secondary bacterial or viral infections. "Falling-back," i.e., failure to thrive, is another problem associated with PRRSV infection in growers. In breeding stock, PRRSV infection causes late-term abortions, an increase in the rate of stillborn piglets, and poor conception rates. Unless the degree of secondary involvement is severe, animals eventually recover clinically, but they still

The Nidoviruses (Coronaviruses and Arteriviruses).
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harbor infectious virus. These clinically normal, but persistently infected animals are "chronic carriers."

2. PERSISTENT INFECTION OF PRRSV

Persistent PRRSV infection is well documented. Wills et al. (1997) isolated PRRSV from oropharyngeal scrapings collected 157 days post inoculation. Albina et al. (1994) reported that, at 22 weeks of age, animals originally infected with PRRSV *in utero* transmitted PRRSV to susceptible animals through direct contact. Similarly, Benfield et al. (1997) reported detection of PRRSV RNA by PCR in serum 210 days after farrowing following transplacental exposure

Although persistence of PRRSV in individual animals has been clearly established, the dynamics of PRRSV persistence in populations has not been investigated. With that in mind, we conducted an animal trial to characterize the carrier state of PRRSV infected animals over time. The experiment consisted of 180 3-to 4-week-old pigs in 2 treatment groups: infected (N=90) and uninfected (N=90). Animals in the infected group were inoculated with PRRSV VR-2332, the North American prototype, via intranasal exposure. After inoculation, animals from each group were periodically euthanized and examined for the presence of infectious PRRSV in serum and tissues using virus isolation and swine bioassays. We found that 100% of animals experimentally inoculated with PRRSV harbored infectious virus at day 63 post inoculation (PI). The proportion of persistently infected animals decreased over time, but 90% of the animals were still carrying infectious virus 105 days PI.

3. DISCUSSION OF CARRIER STATE

PRRSV carriers pose a serious problem for the prevention and control of the disease. Carrier animals play a major role in the epidemiology of PRRSV. Transmission from chronic carriers to susceptible animals perpetuates PRRSV in endemically infected herds. Transport of infected animals is widely recognized as an important means of moving virus between herds and even continents (Dewey et al., 2000).

In our study, identifying carrier animals economically and reliably appeared to be difficult using the diagnostic technology currently available. Probably as a direct result of the low level of PRRSV in persistently infected individuals, an RT-nPCR assay was not sufficiently sensitive to detect all animals known to be carrying infectious virus on the basis of virus isolation or bioassay results. Nor was it possible to discriminate between carriers and

inoculated animals that cleared PRRSV on the basis of quantitative results produced by a commercial PRRS ELISA.

The existence of chronic carriers raises serious questions about the virology and immunology of PRRSV. PRRSV persists even in the face of an active immune response, both humoral and cell-mediated. Antibody production against PRRSV starts by 7 days PI (Yoon, et. al. 1996). Neutralizing antibodies are detectable as early as day 10 PI at low levels and peak between day 35-50 PI (Yoon, et. al. 1996). PRRSV-specific lymphocyte blastogenesis is detected by 28 days PI (Bautista, et. al. 1994). PRRSV-specific interferon gamma producing T-cells can be detected beginning about day 65 PI and rise slowly until day 200 (Zuckerman, et. al. 1999). Despite this immune response, PRRSV still persists in carrier animals, although the mechanisms by which the virus is able to persist are not clear.

4. CONCLUSION

PRRSV infection results in persistent infections. Carriers appear to be the norm, rather than the exception. Approximately 98% of animals harbor infectious virus at day 60 PI, and approximately 90% are still carriers at day 105 PI. These carrier animals are difficult to detect using current diagnostic technology. Further work needs to be done to extend these estimates beyond day 105 PI and to determine the mechanisms of persistence.

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