RESEARCH ABSTRACT

SWINE HEALTH

Title: Attempts to broaden cross-protective immunity against swine influenza viruses – **(#19-215 IPPA)**

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Scientific Abstract:

Swine influenza is an economic burden to pig producers due to decreased feed consumption, weight loss and increased death loss that often occurs from secondary bacterial infections. In addition, influenza A virus - swine (IAV-S), also known as swine influenza virus (SIV), is a zoonotic pathogen. Therefore, the disease is a health and economic threat to both humans and swine worldwide. Although strict biosecurity, proper pig flow in a production system, and preventing transmission of human IAV to pigs have been important control measures for IAV on swine farms, vaccinations for the virus are the most common and necessary methods to control swine influenza. Current inactivated virus vaccines, however, fail to cross-protect against the massive number of antigenically diverse strains circulating in swine. Since vaccination still remains one of the most important methods to control IAV in swine, it is imperative the swine industry supports research and development of new vaccine platforms, immunogens, or alternative vaccination protocols.

Based on recent observations in our laboratories with a HA stem-based immunogen concerning universal 'flu' vaccines, an HA_{STEM}-based immunogen was constructed and produced based on consensus sequence of H3 strains of IAV ($H3HA_{STEM}$). Then a pig study was conducted to evaluate the efficacy of the immunogen against H1 and H3 IAV-S as a proof-of-concept for universal IAV vaccine. The immunogen was given intramuscularly to pigs with one of the 3 different adjuvants (Alum, Zn-chitosan, Emulsigen), 3 times at 2-week intervals. A group of pigs were kept unvaccinated as control (NV group). Two weeks after the last immunization, all pigs were challenged with a mix of H1 and H3 IAV-S. All pigs were bled at 0 and 35 days after the first immunization and at 5 days post inoculation (dpi) for antibody tests (ELISA, VN, HI). Pigs were weighed on days of challenge and at 5 dpi to calculate ADG. Oral fluids and nasal swabs were collected to assess viral shedding by qPCR at 1, 3 and 5 dpi. All pigs were necropsied at 5 dpi and lungs and trachea were collected for gross and microscopic evaluation of lesions and also tested by IHC and qPCR.

Pigs developed antibodies specific for the immunogen but no VN or HI antibodies. After challenge, no febrile response (>104 ºF) was observed in vaccinated pigs except some of the pigs received the immunogen with Zn-chitosan adjuvant (for one day). Yet, the immunized pigs had a lower ADG than the NV pigs. All pigs had both H1 and H3 IAV-S in lung and BALF samples collected at 5 dpi. Viral load in the lung was lower in pigs received the immunogen with Zn-chitosan than the NV group, while the other immunized group had a higher viral load. Likewise, pigs received the immunogen with Zn-chitosan developed gross lung lesion scores similar to the NV group but lower than any other vaccinated pigs. The same group shed significantly less virus in nasal secretion when compared to the NV group.

Overall, the study demonstrated that the H3 HA_{STEM}-based antigen was immunogenic to pigs, even though the vaccine-induced antibodies did not neutralize the virus. No subtype bias was observed in antiviral impact against H1 versus H3. While no sterile immunity could be conferred by this immunogen, the immunization appears to induce some degree of protective immunity based on lack of fever, lower lung scores, lower lung viral load, and lower viral shedding in nasal secretions after challenge particularly when the immunogen was given with Zn-chitosan adjuvant,. Therefore, the immunogen used in the study may provide a design concept toward a universal IAV vaccine even though further optimization and evaluation is necessary.