A polyvalent influenza A DNA vaccine induces heterologous immunity and protects pigs against pandemic A(H1N1)pdm09 virus infection

The composition of current influenza protein vaccines has to be reconsidered every season to match the circulating influenza viruses, continuously changing antigenicity. Thus, influenza vaccines inducing a broad cross-reactive immune response would be a great advantage for protection against both seasonal and emerging influenza viruses. We have developed an alternative influenza vaccine based on DNA expressing selected influenza proteins of pandemic and seasonal origin. In the current study, we investigated the protection of a polyvalent influenza DNA vaccine approach in pigs. We immunised pigs intradermally with a combination of influenza DNA vaccine components based on the pandemic 1918 H1N1 (M and NP genes), pandemic 2009 H1N1pdm09 (HA and NA genes) and seasonal 2005 H3N2 genes (HA and NA genes) and investigated the protection against infection with virus both homologous and heterologous to the DNA vaccine components. We found that pigs challenged with a virus homologous to the HA and NA DNA vaccine components were well protected from infection. In addition, heterologous challenge virus was cleared rapidly compared to the unvaccinated control pigs. Immunisation by electroporation induced HI antibodies >40 HAU/ml seven days after second vaccination. Heterologous virus challenge as long as ten weeks after last immunisation was able to trigger a vaccine antibody HI response 26 times higher than in the control pigs. The H3N2 DNA vaccine HA and NA genes also triggered an effective vaccine response with protective antibody titres towards heterologous H3N2 virus. The described influenza DNA vaccine is able to induce broadly protective immune responses even in a larger animal, like the pig, against both heterologous and homologous virus challenges despite relatively low HI titres after vaccination. The ability of this DNA vaccine to limit virus shedding may have an impact on virus spread among pigs which could possibly extend to humans as well, thereby diminishing the risk for epidemics and pandemics to evolve.

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