A synthetic consensus anti-Spike protein DNA vaccine induces protective immunity against Middle East Respiratory Syndrome Coronavirus in non-human primates


1 Perelman School of Medicine at the University of Pennsylvania, Philadelphia, USA
2 University of Saskatchewan, Saskatoon, Canada
3 Inovio Pharmaceuticals Inc, Plymouth Meeting, USA
4 University of South Florida Morsani College of Medicine, Tampa, USA
5 GeneOne Life Science, Seoul, Korea, Republic of
6 Special Pathogens, National Microbiology Laboratory, Winnipeg, MB, Canada
7 National Institute of Allergy and Infectious Diseases, National Institutes of Health, Hamilton, USA
8 University of Pennsylvania School of Medicine, Philadelphia, PA, USA

**Background:** First identified in 2012, Middle East respiratory syndrome (MERS) is caused by an emerging human coronavirus, which is distinct from SARS-CoV, and represents a novel member of lineage C betacoronaviruses. Since its identification, MERS-CoV has been linked to over 964 infections manifesting with severe morbidity and often mortality (i.e. approximately 400+ deaths) in the Arabian Peninsula, Europe, in the US and in Korea. Human-to-human transmission has been documented with nosocomial transmission appearing to be an important route of infection. The significant recent increase in cases of MERS in the Middle East, coupled with the lack of effective antiviral therapies or vaccines to treat or prevent this infection are significant causes for concern.

**Methods & Materials:** A synthetic DNA plasmid based vaccine containing a full-length consensus MERS-S protein sequence was constructed and the cellular and humoral immunogenicity of MERS-vaccine was evaluated in mice, macaques, and camels. Following immunization, NHPs were challenged with infectious MERS-CoV (EMC/2012) and monitored for signs of infection by clinical scoring and examinations. Viral load was measured by qRT-PCR and tissue sections were stained with H&E.

**Results:** An optimized DNA vaccine encoding the MERS spike protein induced potent cellular immunity and antigen specific neutralizing antibodies in mice, macaques and camels. Vaccinated rhesus macaque monkeys seroconverted rapidly and exhibited high levels of virus-neutralizing activity. Upon MERS viral challenge all of the monkeys in the control–vaccinated group developed characteristic disease, including pneumonia. Vaccinated macaques were protected and failed to demonstrate any clinical or radiographic signs of pneumonia.

**Conclusion:** A consensus DNA MERS–vaccine was able to generate both a strong T cell and neutralizing antibody response in multiple animal models, including camels, a natural host for MERS-CoV and a probable source of human infection. MERS-vaccine was also able to protect NHPs from an infectious MERS-CoV challenge. These results demonstrate the promise of this consensus DNA MERS-vaccine as a candidate for vaccine modality against this emerging pathogen.

http://dx.doi.org/10.1016/j.ijid.2016.02.083

**Type:** Oral Presentation