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Vaccine for tick-borne disease SFTS protects against lethal infection

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A KAIST research team reported the development of a DNA vaccine for Severe Fever with Thrombocytopenia Syndrome Virus (SFTSV) which completely protects against lethal infection in ferrets. The team confirmed that ferrets immunized with DNA vaccines encoding all SFTSV proteins showed 100% survival rate without detectable viremia and did not develop any clinical symptoms. This study was published in *Nature Communications* on August 23.

Severe Fever with Thrombocytopenia Syndrome (SFTS) is a newly emerging tick-borne infectious disease. The disease causes fever, severe thrombocytopenia, leukocytopenia as well as vomiting and diarrhea. Severe cases end up with organ system failure often accompanied by hemorrhages, and its mortality rate stands at 10–20%.

The viral disease has been endemic to East Asia but the spread of the tick vector to North America increases the likelihood of potential outbreak beyond the Far East Asia. The World Health Organization (WHO) has also put SFTSV into the priority pathogen requiring urgent attention category. Currently, no vaccine has been available to prevent SFTS.

The research team led by Professor Su-Hyung Park noted that DNA vaccines induce broader immunity to multiple antigens than traditional ones. Moreover, DNA vaccines stimulate both T cell and antibody immunity, which make them suitable for vaccine development.

They constructed DNA vaccines that encode full-length Gn, Gc, N, NS, and RNA polymerase genes based on common sequences of 31 SFTSV strains isolated from patients. Their vaccine candidates induced both neutralizing antibody response and multifunctional SFTSV-specific T cell response in mice and ferrets.

To investigate the vaccine's efficacy in vivo, the research team applied a recently developed ferret model that recapitulates fatal clinical symptoms in SFTSV infection in humans. Vaccinated ferrets were completely protected from lethal SFTSV challenge without SFTSV detection in their blood, whereas all control ferrets died within 10 days' post-infection.

The KAIST team found that anti-envelope antibodies play an important role in protective immunity, suggesting that envelope glycoproteins of SFTSV may be the most effective antigens for inducing protective immunity. Moreover, the study revealed that T cell responses specific to non-envelope proteins of SFTSV also can contribute to protection against SFTSV infection.

Professor Park said, "This is the first study demonstrating complete protection against lethal SFTSV challenge using an immunocompetent, middle-sized animal model with clinical manifestations of SFTSV infection. We believe this study provides valuable insights into designing preventive vaccines for SFTSV."

More information: Jeong-Eun Kwak et al. Development of a SFTSV DNA vaccine that confers complete protection against lethal infection in ferrets, *Nature Communications* (2019). DOI: 10.1038/s41467-019-11815-4