



Horse Care

New Vaccine Technology: Naked DNA Vaccines

by HEATHER SMITH THOMAS

Exciting new developments in immunology are creating better vaccines for horses. One of these new technologies is DNA vaccine. Kevin Hankins DVM, MBA (Field Veterinary Consultant, Fort Dodge Animal Health) says the FDAH has a new naked DNA West Nile Virus vaccine. It has now gone through all its field trials and has been approved by the USDA. "Right now the scientists are tweaking it a little to make it more effective than any other vaccine out there, and we're looking at cost effectiveness. It will be on the market very soon (this spring). This vaccine uses CDC (Center for Disease Control) technology and is the first and only true DNA vaccine on the market, both in human and veterinary medicine. It's labeled for use in horses, but is a platform that will be used in many future vaccines for both animals and humans," he says.

"Instead of the recombinant technology (as used in Merial's new West Nile Virus vaccine), this is a naked DNA vaccine—not recombined with anything. It's just the DNA and an adjuvant. There's a lot of advantage to that; there's no antigen for the horse to react to, so this is basically a reaction-free type of vaccine. It also gives very rapid protection."

DNA from the virus itself is used, and will be the technology in many future vaccines. "If a new disease hits, we

can more rapidly develop a vaccine just by getting DNA from the virus and growing it in culture. It goes through a washing process to purify it, an adjuvant is added, and that's the vaccine," says Hankins.

The DNA goes directly to the body cells and starts replicating in the vaccinated animal, and this is what gives the rapid immune response and quick protection against the disease. "The minute it starts entering the cells, it starts replicating, so the protection is much more rapid than with traditional vaccines. This will still require an initial series of two shots, and an annual booster."

When vaccinating foals, there has always been a problem with maternal antibodies (from colostrum) interfering with the foal's ability to mount immune response to vaccine. "With DNA vaccine, however, there's no worry about maternal antibody influence, so you can vaccinate foals at a younger age," says Hankins.

"This is the basis for many human vaccines being developed now, too, such as an HIV vaccine using naked DNA. It's an exciting new step in vaccine production; it's the cutting edge and has gone beyond anything we've done before," he says. 🐾

DNA Vaccines

Fort Dodge's new DNA vaccine for West Nile Virus (WNV) is the first commercially available DNA vaccine for any species. Steve Chu DVM, PhD (Global Research and Development, Fort Dodge Animal Health) explains that when the DNA of a virus is given to an animal in a vaccine, it is taken up by body cells, to be processed into RNA. The RNA is then translated into proteins which stimulate antibodies and white blood cell immune response, protecting the vaccinated animal from that particular disease.

A DNA vaccine relies on a ring of nucleic acid to encode an antigen. When taken up by the body's immune system, the antigen triggers an immune response that is strong enough to protect the animal. In early experiments it was shown that rodents injected with foreign genes (such as DNA from a virus) produced antibodies and gained a long-lasting immune response against diseases like hepatitis B, herpes virus and HIV.

DNA vaccines are a very new concept, first presented in 1992. The FDA approved the first DNA vaccines for use in human trials in 1995, but none have been approved yet for commercial use. Fort Dodge's WNV equine vaccine is an important milestone. Gary Nabel, director of U.S. National Institutes of Health (NIH) says several DNA vaccines in their Vaccine Research Center are in clinical trials right now, including a human WNV vaccine with the same gene insert as the equine vaccine.

DNA vaccines are being developed to aid cancer immunotherapy, such as for injection into melanoma tumors, activating the body's immune system so it can recognize self-tumor cells. The immune response creates tumor-killing T-cells that can spread to other tumors in the body; injection into a single tumor can thus treat

multiple tumors. Another DNA vaccine is being developed to fight lymphoma. These vaccines target certain tumors with much more specificity than traditional killed tumor cell vaccines, and are also much cheaper to produce.

Use of "naked" DNA has an advantage over using the virus itself in creating a vaccine, since the DNA is more stable. DNA vaccines may not require refrigeration, and have a very good safety record (rarely producing adverse reactions). Because of this, a DNA West Nile Virus vaccine was used experimentally to protect endangered California condors at the Los Angeles Zoo—birds who would be at high risk for this disease. The vaccine protected them and gave long-lasting immunity. A year after vaccination, those birds still showed high antibody titers against WNV.

DNA vaccines can be created quickly once a new virus is isolated, which is very beneficial when faced with a new disease outbreak or epidemic. For instance, in both the WNV outbreak in North America and SARS (Severe Acquired Respiratory Syndrome) outbreak in China, DNA components for use in clinical testing became available just four to six months after antigen gene sequences were discovered. By contrast, clinical grade traditional vaccines usually take two to three years to safely develop.

The WNV equine vaccine is given intra-muscularly in two initial doses three to four weeks apart, with annual booster thereafter. A human WNV vaccine will probably be approved in the next few years. DNA vaccine's ability to protect primates exposed to Ebola and HIV, and to protect horses from WNV, gives promise that this technology may soon be used to protect humans from diseases like malaria, HIV and SARS. Fort Dodge's new equine vaccine is helping open the door for an exciting new era in immunology. 🐾